Language Reference

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.*

Arduino programs can be divided in three main parts: *structure*, *values* (variables and constants), and *functions*. The Arduino language is based on C/C++.

Structure

An Arduino program run in two parts:

- void setup()
- void loop()

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinModes, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

- Variable Declaration
- Function Declaration
  - void

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)

Arithmetic Operators

- + (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Comparison Operators

Functions

Digital I/O

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Analog I/O

- int analogRead(pin)
- analogWrite(pin, value) - *PWM*

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Math

- min(x, y)
- max(x, y)
- abs(x)
- constrain(x, a, b)
- map(value, fromLow, fromHigh, toLow, toHigh)
- pow(base, exponent)
- sqrt(x)

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Random Numbers

- randomSeed(seed)
- long random(max)
- long random(min, max)

Serial Communication

Used for communication between the Arduino board and a

- == (equal to)
- != (not equal to)
- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Boolean Operators

- && (and)
- || (or)
- ! (not)

Compound Operators

- ++ (increment)
- -- (decrement)
- += (compound addition)
- -= (compound subtraction)
- *= (compound multiplication)
- /= (compound division)

Variables

Variables are expressions that you can use in programs to store values, such as a sensor reading from an analog pin.

Constants

Constants are particular values with specific meanings.

- HIGH | LOW
- INPUT | OUTPUT
- true | false

- Integer Constants

Data Types

Variables can have various types, which are described below.

- boolean
- char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double
- string
- array

Reference

- ASCII chart

computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, *you cannot also use pins 0 and 1 for digital i/o.*

- Serial.begin(speed)
- int Serial.available()
- int Serial.read()
- Serial.flush()
- Serial.print(data)
- Serial.println(data)

Didn't find something? Check the extended reference or the libraries.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino Reference (extended)

The Arduino language is based on C/C++ and supports all standard C constructs and some C++ features. It links against AVR Libc and allows the use of any of its functions; see its user manual for details.

Structure

In Arduino, the standard program entry point (main) is defined in the core and calls into two functions in a sketch. **setup()** is called once, then **loop()** is called repeatedly (until you reset your board).

- void setup()
- void loop()

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define
- #include

Arithmetic Operators

- + (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Comparison Operators

- == (equal to)
- != (not equal to)
- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Functions

Digital I/O

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Analog I/O

- analogReference(type)
- int analogRead(pin)
- analogWrite(pin, value) - *PWM*

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Math

- min(x, y)
- max(x, y)
- abs(x)
- constrain(x, a, b)
- map(value, fromLow, fromHigh, toLow, toHigh)
- pow(base, exponent)
- sqrt(x)

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Random Numbers

- randomSeed(seed)
- long random(max)
- long random(min, max)

External Interrupts

- attachInterrupt(interrupt, function, mode)
- detachInterrupt(interrupt)

Boolean Operators

- && (and)
- || (or)
- ! (not)

Pointer Access Operators

- * dereference operator
- & reference operator

Bitwise Operators

- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
- ~ (bitwise not)
- << (bitshift left)
- >> (bitshift right)

- Port Manipulation

Compound Operators

- ++ (increment)
- -- (decrement)
- += (compound addition)
- -= (compound subtraction)
- *= (compound multiplication)
- /= (compound division)

- &= (compound bitwise and)
- |= (compound bitwise or)

Variables

Constants

- HIGH | LOW
- INPUT | OUTPUT
- true | false
- integer constants
- floating point constants

Data Types

- void keyword
- boolean
- char
- unsigned char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double
- string
- array

Variable Scope & Qualifiers

- static
- volatile
- const
- PROGMEM

Interrupts

- interrupts()
- noInterrupts()

Serial Communication

- Serial.begin(speed)
- int Serial.available()
- int Serial.read()
- Serial.flush()
- Serial.print(data)
- Serial.println(data)

Utilities

- cast (cast operator)
- sizeof() (sizeof operator)

Reference

- keywords
- ASCII chart
- Atmega168 pin mapping

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Libraries

To use an existing library in a sketch, go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert one or more **#include** statements at the top of the sketch and allow it to use the library.

Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

Official Libraries

These are the "official" libraries that are included in the Arduino distribution.

- EEPROM - reading and writing to "permanent" storage
- SoftwareSerial - for serial communication on any digital pins
- Stepper - for controlling stepper motors
- Wire - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors.

These libraries are compatible Wiring versions, and the links below point to the (excellent) Wiring documentation.

- Matrix - Basic LED Matrix display manipulation library
- Sprite - Basic image sprite manipulation library for use in animations with an LED matrix

Contributed Libraries

Libraries written by members of the Arduino community.

- DateTime - a library for keeping track of the current date and time in software.
- Firmata - for communicating with applications on the computer using a standard serial protocol.
- GLCD - graphics routines for LCD based on the KS0108 or equivalent chipset.
- LCD - control LCDs (using 8 data lines)
- LCD 4 Bit - control LCDs (using 4 data lines)
- LedControl - for controlling LED matrices or seven-segment displays with a MAX7221 or MAX7219.
- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.
- TextString - handle strings
- Metro - help you time actions at regular intervals
- MsTimer2 - uses the timer 2 interrupt to trigger an action every N milliseconds.
- OneWire - control devices (from Dallas Semiconductor) that use the One Wire protocol.
- PS2Keyboard - read characters from a PS2 keyboard.
- Servo - provides software support for Servo motors on any pins.
- Servotimer1 - provides hardware support for Servo motors on pins 9 and 10
- Simple Message System - send messages between Arduino and the computer
- SSerial2Mobile - send text messages or emails using a cell phone (via AT commands over software serial)
- X10 - Sending X10 signals over AC power lines

To install, unzip the library to a sub-directory of the **hardware/libraries** sub-directory of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

For a guide to writing your own libraries, see this tutorial.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino/Processing Language Comparison

The Arduino language (based on Wiring) is implemented in C/C++, and therefore has some differences from the Processing language, which is based on Java.

Arrays

Arduino	*Processing*

int bar[8];
bar[0] = 1;
	int[] bar = new int[8];
	bar[0] = 1;

int foo[] = { 0, 1, 2 };	int foo[] = { 0, 1, 2 };
	or
	int[] foo = { 0, 1, 2 };

Loops

Arduino	*Processing*

int i;
for (i = 0; i < 5; i++) { ... }
	for (int i = 0; i < 5; i++) { ... }

Printing

Arduino	*Processing*
Serial.println("hello world");	println("hello world");

int i = 5;
Serial.println(i);
	int i = 5;
	println(i);

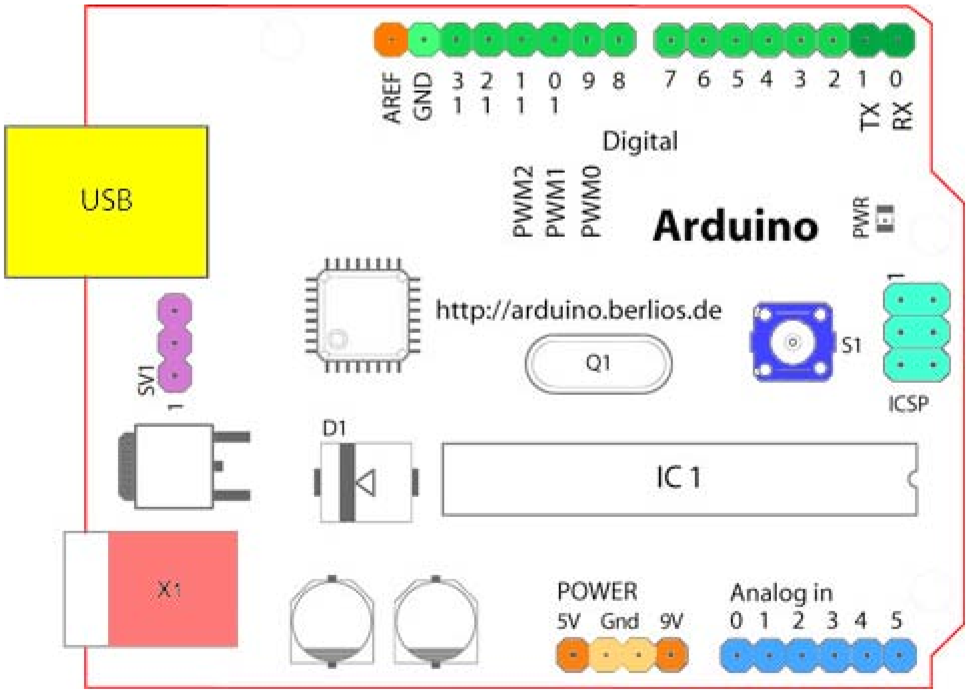
int i = 5;
Serial.print("i = ");
Serial.print(i);
Serial.println();
	int i = 5;
	println("i = " + i);

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Introduction to the Arduino Board

Looking at the board from the top down, this is an outline of what you will see (parts of the board you might interact with in the course of normal use are highlighted):



Starting clockwise from the top center:

- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - *These pins cannot be used for digital i/o (**digitalRead** and **digitalWrite**) if you are also using serial communication (e.g. **Serial.begin**).*
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog In Pins 0-5 (light blue)
- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply In (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow)

Microcontrollers

ATmega168 (used on most Arduino boards)

Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6 (DIP) or 8 (SMD)
DC Current per I/O Pin	40 mA

ATmega8 (used on some older board)

Digital I/O Pins	14 (of which 3 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA

Flash Memory	16 KB
SRAM	1 KB
EEPROM	512 bytes

(datasheet)

Flash Memory	8 KB
SRAM	1 KB
EEPROM	512 bytes

(datasheet)

Digital Pins

In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pinMode(), digitalRead(), and digitalWrite() commands. Each pin has an internal pull-up resistor which can be turned on and off using digitalWrite() (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40 mA.

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Diecimila, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11 Bluetooth module. On the Arduino Mini and LilyPad Arduino, they are intended for use with an external TTL serial module (e.g. the Mini-USB Adapter).
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.
- **BT Reset: 7.** (Arduino BT-only) Connected to the reset line of the bluetooth module.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED: 13.** On the Diecimila and LilyPad, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

Analog Pins

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analogRead() function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

- **I^{2}C: 4 (SDA) and 5 (SCL).** Support I^{2}C (TWI) communication using the Wire library (documentation on the Wiring website).

Power Pins

- **VIN** (sometimes labelled "9V"). The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. Note that different boards accept different input voltages ranges, please see the documentation for your board. Also note that the LilyPad has no VIN pin and accepts only a regulated input.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3V3.** (Diecimila-only) A 3.3 volt supply generated by the on-board FTDI chip.
- **GND.** Ground pins.

Other Pins

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().
- **Reset.** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

setup()

The setup() function is called when your program starts. Use it to initialize your variables, pin modes, start using libraries, etc. The setup function will only run once, after each powerup or reset of the Arduino board.

Example

```
int buttonPin = 3;

void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

void loop()
{
  // ...
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

loop()

After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.

Example

```
int buttonPin = 3;

// setup initializes serial and the button pin
void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

// loop checks the button pin each time,
// and will send serial if it is pressed
void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

pinMode(pin, mode)

Description

Configures the specified pin to behave either as an input or an output. See the reference page below.

Parameters

pin: the number of the pin whose mode you wish to set. (*int*)

mode: either INPUT or OUTPUT.

Returns

None

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

Note

The analog input pins can be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- constants
- digitalWrite
- digitalRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Variables

A variable is a way of naming and storing a value for later use by the program, such as data from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

```
int inputVariable = 0;         // declares the variable; this only needs to be done once
inputVariable = analogRead(2); // set the variable to the input of analog pin #2
```

inputVariable is the variable itself. The first line declares that it will contain an int (short for integer.) The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code.

Once a variable has been set (or re-set), you can test its value to see if it meets certain conditions, or you can use it's value directly. For instance, the following code tests whether the inputVariable is less than 100, then sets a delay based on inputVariable which is a minimum of 100:

```
if (inputVariable < 100)
{
  inputVariable = 100;
}

delay(inputVariable);
```

This example shows all three useful operations with variables. It tests the variable (`if (inputVariable < 100)`), it sets the variable if it passes the test (`inputVariable = 100`), and it uses the value of the variable as an input to the delay() function (`delay(inputVariable)`)

Style Note: You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value**, on the other hand, do little to make your code readable.

You can name a variable any word that is not already one of the keywords in Arduino. Avoid beginning variable names with numeral characters.

Variable Declaration

All variables have to be declared before they are used. Declaring a variable means defining its type, and optionally, setting an initial value (initializing the variable). In the above example, the statement

int inputVariable = 0;

declares that inputVariable is an int, and that its initial value is zero.

Possible types for variables are:

- char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double

Reference Home

Functions

Segmenting code into functions allows a programmer to create modular pieces of code that perform a defined task and then return to the area of code from which the function was "called". The typical case for creating a function is when one needs to perform the same action multiple times in a program.

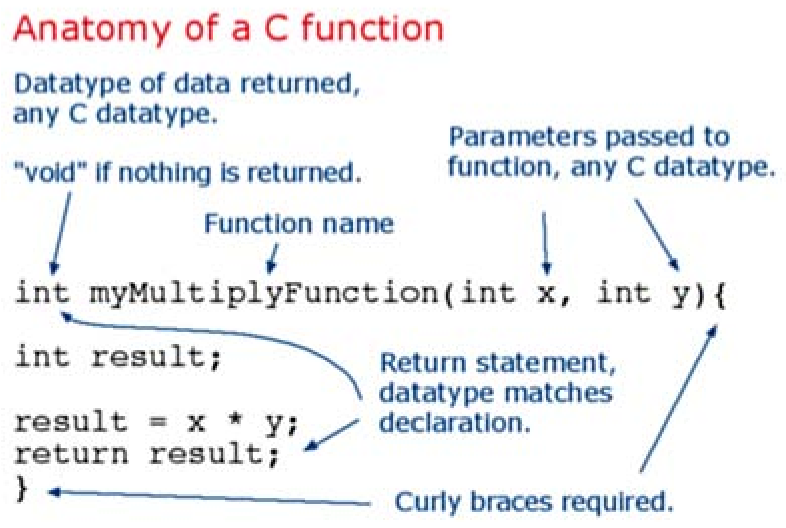
For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB in BASIC).

Standardizing code fragments into functions has several advantages:

- Functions help the programmer stay organized. Often this helps to conceptualize the program.
- Functions codify one action in one place so that the function only has to be thought out and debugged once.
- This also reduces chances for errors in modification, if the code needs to be changed.
- Functions make the whole sketch smaller and more compact because sections of code are reused many times.
- They make it easier to reuse code in other programs by making it more modular, and as a nice side effect, using functions also often makes the code more readable.

There are two required functions in an Arduino sketch, setup() and loop(). Other functions must be created outside the brackets of those two functions. As an example, we will create a simple function to multiply two numbers.

Example


Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any C datatype.
Return statement, datatype matches declaration.
Curly braces required.

```
int myMultiplyFunction(int x, int y){
int result;

result = x * y;
return result;
}
```

To "call" our simple multiply function, we pass it parameters of the datatype that it is expecting:

```
void loop{
int i = 2;
int j = 3;
int k;

k = myMultiplyFunction(i, j); // k now contains 6
}
```

Our function needs to be *declared* outside any other function, so "myMultiplyFunction()" can go either above or below the "loop()" function.

The entire sketch would then look like this:

```
void setup(){
  Serial.begin(9600);
}

void loop{
  int i = 2;
  int j = 3;
  int k;

  k = myMultiplyFunction(i, j); // k now contains 6
  Serial.println(k);
  delay(500);
}

int myMultiplyFunction(int x, int y){
  int result;
  result = x * y;
  return result;
}
```

Another example

This function will read a sensor five times with analogRead() and calculate the average of five readings. It then scales the data to 8 bits (0-255), and inverts it, returning the inverted result.

```
int ReadSens_and_Condition(){
  int i;
  int sval;

  for (i = 0; i < 5; i++){
    sval = sval + analogRead(0);    // sensor on analog pin 0
  }

  sval = sval / 5;    // average
  sval = sval / 4;    // scale to 8 bits (0 - 255)
  sval = 255 - sval;  // invert output
  return sval;
}
```

To call our function we just assign it to a variable.

```
int sens;

sens = ReadSens_and_Condition();
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

void

The void keyword is used only in function declarations. It indicates that the function is expected to return no information to the function from which it was called.

Example:

```
// actions are performed in the functions "setup" and "loop"
// but  no information is reported to the larger program

void setup()
{
  // ...
}

void loop()
{
  // ...
}
```

See also

function declaration

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

if

if tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

```
if (someVariable > 50)
{
  // do something here
}
```

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in parentheses is true, the statements inside the brackets are run. If not, the program skips over the code.

The brackets may be omitted after an *if* statement. If this is done, the next line (defined by the semicolon) becomes the only conditional statement.

```
if (x > 120)  digitalWrite(LEDpin, HIGH);

if (x > 120)
digitalWrite(LEDpin, HIGH);

if (x > 120) {digitalWrite(LEDpin, HIGH);}   // all are correct
```

The statements being evaluated inside the parentheses require the use of one or more operators:

Operators:

```
 x == y (x is equal to y)
 x != y (x is not equal to y)
 x <  y (x is less than y)
 x >  y (x is greater than y)
 x <= y (x is less than or equal to y)
 x >= y (x is greater than or equal to y)
```

Warning:

Beware of accidentally using the single equal sign (e.g. `if (x = 10)`). The single equal sign is the assignment operator, and sets x to 10. Instead use the double equal sign (e.g. `if (x == 10)`), which is the comparison operator, and tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

This is because C evaluates the statement `if (x=10)` as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, `if (x = 10)` will always evaluate to TRUE, which is not the desired result when using an 'if' statement. Additionally, the variable x will be set to 10, which is also not a desired action.

if can also be part of a branching control structure using the if...else] construction.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

if/else

if/else allows greater control over the flow of code than the basic **if** statement, by allowing multiple tests to be grouped together. For example, an analog input could be tested and one action taken if the input was less than 500, and another action taken if the input was 500 or greater. The code would look like this:

```
if (pinFiveInput < 500)
{
  // action A
}
else
{
  // action B
}
```

else can proceed another **if** test, so that multiple, mutually exclusive tests can be run at the same time:

```
if (pinFiveInput < 500)
{
  // do Thing A
}
else if (pinFiveInput >= 1000)
{
  // do Thing B
}
else
{
  // do Thing C
}
```

You can have an unlimited nuber of such branches. (Another way to express branching, mutually exclusive tests is with the switch case statement.

Coding Note: If you are using if/else, and you want to make sure that some default action is always taken, it is a good idea to end your tests with an else statement set to your desired default behavior.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

for statements

Desciption

The **for** statement is used to repeat a block of statements enclosed in curly braces. An increment counter is usually used to increment and terminate the loop. The **for** statement is useful for any repetitive operation, and is often used in combination with arrays to operate on collections of data/pins.

There are three parts to the **for** loop header:

```
for (initialization; condition; increment) {

//statement(s);

}
```

The **initialization** happens first and exactly once. Each time through the loop, the **condition** is tested; if it's true, the statement block, and the **increment** is executed, then the **condition** is tested again. When the **condition** becomes false, the loop ends.

Example

```
// Dim an LED using a PWM pin
int PWMpin = 10; // LED in series with 1k resistor on pin 10

void setup()
{
  // no setup needed
}

void loop()
{
   for (int i=0; i <= 255; i++){
      analogWrite(PWMpin, i);
      delay(10);
   }
}
```

Coding Tip

The C **for** loop is much more flexible than **for** loops found in some other computer languages, including BASIC. Any or all of the three header elements may be omitted, although the semicolons are required. Also the statements for initialization, condition, and increment can be any valid C statements with unrelated variables. These types of unusual **for** statements may provide solutions to some rare programming problems.

See also

- while

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

switch / case statements

Just like If statements, switch case statements help the control and flow of the programs. Switch/case allows you to make a list of "cases" inside a switch curly bracket. The program checks each case for a match with the test variable, and runs the code if if a match is found.

Parameters

- var - variable you wish to match with case statements
- default - if no other conditions are met, default will run
- break - **important**, without break, the switch statement will continue checking through the statement for any other possibile matches. If one is found, it will run that as well, which may not be your intent. Break tells the switch statement to stop looking for matches, and exit the switch statement.

Example

```
switch (var) {
  case 1:
    //do something when var == 1
    break;
    // break is optional
  case 2:
    //do something when var == 2
    break;
  default:
    // if nothing else matches, do the default
    // default is optional
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

while loops

Description

while loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

Syntax

```
while(expression){
  // statement(s)
}
```

Parameters

expression - a (boolean) C statement that evaluates to true or false

Example

```
var = 0;
while(var < 200){
  // do something repetitive 200 times
  var++;
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

do - while

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested at the end of the loop, so the **do** loop will *always* run at least once.

```
do
{
    // statement block
} while (test condition);
```

Example

```
do
{
  delay(50);          // wait for sensors to stabilize
  x = readSensors();  // check the sensors

} while (x < 100);
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

break

break is used to exit from a **do**, **for**, or **while** loop, bypassing the normal loop condition. It is also used to exit from a **switch** statement.

Example

```
for (x = 0; x < 255; x ++)
{
    digitalWrite(PWMpin, x);
    sens = analogRead(sensorPin);
    if (sens > threshold){      // bail out on sensor detect
       x = 0;
       break;
    }
    delay(50);
}
```

Corrections, suggestions, and new documentation should be posted to the Forum.

continue

continue is used to bypass portions of code in a *do*, *for*, or *while* loop. It forces the conditional expression to be evaluated, without terminating the loop.

Example

```
for (x = 0; x < 255; x ++)
{
    if (x > 40 && x < 120){      // create jump in values
        continue;
    }

    digitalWrite(PWMpin, x);
    delay(50);
}
```

Corrections, suggestions, and new documentation should be posted to the Forum.

return

Terminate a function and return a value from a function to the calling function, if desired.

Syntax:

return;

return value; // both forms are valid

Parameters

value: any variable or constant type

Examples:

A function to compare a sensor input to a threshold

```
 int checkSensor(){
    if (analogRead(0) > 400) {
        return 1;
    else{
        return 0;
    }
}
```

The return keyword is handy to test a section of code without having to "comment out" large sections of possibly buggy code.

```
void loop(){

// brilliant code idea to test here

return;

// the rest of a dysfunctional sketch here
// this code will never be executed
}
```

See also

comments

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

; semicolon

Used to end a statement.

Example

```
int a = 13;
```

Tip

Forgetting to end a line in a semicolon will result in a compiler error. The error text may be obvious, and refer to a missing semicolon, or it may not. If an impenetrable or seemingly illogical compiler error comes up, one of the first things to check is a missing semicolon, in the immediate vicinity, preceding the line at which the compiler complained.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

{} Curly Braces

Curly braces (also referred to as just "braces" or as "curly brackets") are a major part of the C programming language. They are used in several different constructs, outlined below, and this can sometimes be confusing for beginners.

An opening curly brace "{" must always be followed by a closing curly brace "}". This is a condition that is often referred to as the braces being balanced. The Arduino IDE (integrated development environment) includes a convenient feature to check the balance of curly braces. Just select a brace, or even click the insertion point immediately following a brace, and its logical companion will be highlighted.

At present this feature is slightly buggy as the IDE will often find (incorrectly) a brace in text that has been "commented out."

Beginning programmers, and programmers coming to C from the BASIC language often find using braces confusing or daunting. After all, the same curly braces replace the RETURN statement in a subroutine (function), the ENDIF statement in a conditional and the NEXT statement in a FOR loop.

Because the use of the curly brace is so varied, it is good programming practice to type the closing brace immediately after typing the opening brace when inserting a construct which requires curly braces. Then insert some carriage returns between your braces and begin inserting statements. Your braces, and your attitude, will never become unbalanced.

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages, braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

The main uses of curly braces

Functions

```
void myfunction(datatype argument){
  statements(s)
}
```

Loops

```
while (boolean expression)
{
   statement(s)
}

do
{
   statement(s)
} while (boolean expression);

for (initialisation; termination condition; incrementing expr)
{
   statement(s)
}
```

Conditional statements

```
if (boolean expression)
{
   statement(s)
}
```

```
else if (boolean expression)
{
   statement(s)
}
else
{
   statement(s)
}
```

Reference Home Reference Home

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Comments

Comments are lines in the program that are used to inform yourself or others about the way the program works. They are ignored by the compiler, and not exported to the processor, so they don't take up any space on the Atmega chip.

Comments only purpose are to help you understand (or remember) how your program works or to inform others how your program works. There are two different ways of marking a line as a comment:

Example

```
 x = 5;  // This is a single line comment. Anything after the slashes is a comment
        // to the end of the line

/* this is multiline comment - use it to comment out whole blocks of code

if (gwb == 0){   // single line comment is OK inside of multiline comment
x = 3;           /* but not another multiline comment - this is invalid */
}
// don't forget the "closing" comment - they have to be balanced!
*/
```

Tip
When experimenting with code, "commenting out" parts of your program is a convenient way to remove lines that may be buggy. This leaves the lines in the code, but turns them into comments, so the compiler just ignores them. This can be especially useful when trying to locate a problem, or when a program refuses to compile and the compiler error is cryptic or unhelpful.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Addition, Subtraction, Multiplication, & Division

Description

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type (e.g. adding 1 to an int with the value 32,767 gives -32,768). If the operands are of different types, the "larger" type is used for the calculation.

If one of the numbers (operands) are of the type **float** or of type **double**, floating point math will be used for the calculation.

Examples

```
y = y + 3;
x = x - 7;
i = j * 6;
r = r / 5;
```

Syntax

```
result = value1 + value2;
result = value1 - value2;
result = value1 * value2;
result = value1 / value2;
```

Parameters:

value1: any variable or constant

value2: any variable or constant

Programming Tips:

- Know that integer constants default to int, so some constant calculations may overflow (e.g. 60 * 1000 will yield a negative result).
- Choose variable sizes that are large enough to hold the largest results from your calculations
- Know at what point your variable will "roll over" and also what happens in the other direction e.g. (0 - 1) OR (0 - - 32768)
- For math that requires fractions, use float variables, but be aware of their drawbacks: large size, slow computation speeds
- Use the cast operator e.g. (int)myFloat to convert one variable type to another on the fly.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

% (modulo)

Description

Returns the remainder from an integer division

Syntax

result = value1 % value2

Parameters

value1: a byte, char, int, or long

value2: a byte, char, int, or long

Returns

The remainder from an integer division.

Examples

```
x = 7 % 5;   // x now contains 2
x = 9 % 5;   // x now contains 4
x = 5 % 5;   // x now contains 0
x = 4 % 5;   // x now contains 4
```

The modulo operator is useful for tasks such as making an event occur at regular periods or making a memory array roll over

Example Code

```
// check a sensor every 10 times through a loop
void loop(){
i++;
if ((i % 10) == 0){          // read sensor every ten times through loop
   x = analogRead(sensPin);
   }
/ ...
}

// setup a buffer that averages the last five samples of a sensor

int senVal[5];  // create an array for sensor data
int i, j;       // counter variables
long average;   // variable to store average
...

void loop(){
// input sensor data into oldest memory slot
sensVal[(i++) % 5] = analogRead(sensPin);
average = 0;
for (j=0; j<5; j++){
average += sensVal[j];   // add up the samples
}
```

```
average = average / 5;  // divide by total
```

The modulo operator can also be used to strip off the high bits of a variable. The example below is from the Firmata library.

```
    // send the analog input information (0 - 1023)
     Serial.print(value % 128, BYTE); // send lowest 7 bits
     Serial.print(value >> 7, BYTE);  // send highest three bits
```

Tip

the modulo operator will not work on floats

See also

division

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

digitalWrite(pin, value)

Description

Sets a pin configured as OUTPUT to either a HIGH or a LOW state at the specified pin.

The digitalWrite() function is also used to set pullup resistors when a pin is configured as an INPUT.

Parameters

pin: the pin number
value: HIGH or LOW

Returns

none

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

Sets pin 13 to HIGH, makes a one-second-long delay, and sets the pin back to LOW.

Note

The analog input pins can also be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- pinMode
- digitalRead

Corrections, suggestions, and new documentation should be posted to the Forum.

digitalRead(pin)

What it does

Reads the value from a specified pin, it will be either HIGH or LOW.

Parameters

pin: the number of the digital pin you want to read.

Returns

Either HIGH or LOW

Example

```
int ledPin = 13; // LED connected to digital pin 13
int inPin = 7;   // pushbutton connected to digital pin 7
int val = 0;     // variable to store the read value

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin 13 as output
  pinMode(inPin, INPUT);      // sets the digital pin 7 as input
}

void loop()
{
  val = digitalRead(inPin);   // read the input pin
  digitalWrite(ledPin, val);    // sets the LED to the button's value
}
```

Sets pin 13 to the same value as the pin 7, which is an input.

Note

If the pin isn't connected to anything, digitalRead() can return either HIGH or LOW (and this can change randomly).

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- pinMode
- digitalWrite

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

int analogRead(pin)

Description

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the Mini and Nano), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit.

It takes about 100 us (0.0001 s) to read an analog input, so the maximum reading rate is about 10,000 times a second.

Parameters

pin: the number of the analog input pin to read from (0 to 5 on most boards, 0 to 7 on the Mini and Nano)

Returns

An integer value in the range of 0 to 1023.

Note

If the analog input pin is not connected to anything, the value returned by analogRead() will fluctuate based on a number of factors (e.g. the values of the other analog inputs, how close your hand is to the board, etc.).

Example

```
int analogPin = 3;     // potentiometer wiper (middle terminal) connected to analog pin 3
                      // outside leads to ground and +5V
int val = 0;           // variable to store the value read

void setup()
{
  Serial.begin(9600);          //  setup serial
}

void loop()
{
  val = analogRead(analogPin);    // read the input pin
  Serial.println(val);             // debug value
}
```

See also

- Description of the analog input pins
- analogWrite

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

analogWrite(pin, value)

Description

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin). The frequency of the PWM signal is approximately 490 Hz.

On newer Arduino boards (including the Mini and BT) with the ATmega168 chip, this function works on pins 3, 5, 6, 9, 10, and 11. Older USB and serial Arduino boards with an ATmega8 only support analogWrite() on pins 9, 10, and 11.

Parameters

pin: the pin to write to.

value: the duty cycle: between 0 (always off) and 255 (always on).

Returns

nothing

Notes and Known Issues

You do not need to call pinMode() to set the pin as an output before calling analogWrite().

The PWM outputs generated on pins 5 and 6 will have higher-than-expected duty cycles. This is because of interactions with the millis() and delay() functions, which share the same internal timer used to generate those PWM outputs.

Example

Sets the output to the LED proportional to the value read from the potentiometer.

```
int ledPin = 9;      // LED connected to digital pin 9
int analogPin = 3;   // potentiometer connected to analog pin 3
int val = 0;         // variable to store the read value

void setup()
{
  pinMode(ledPin, OUTPUT);   // sets the pin as output
}

void loop()
{
  val = analogRead(analogPin);   // read the input pin
  analogWrite(ledPin, val / 4);  // analogRead values go from 0 to 1023, analogWrite values from 0 to 255
}
```

See also

- Explanation of PWM
- pinMode
- digitalWrite
- analogRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

shiftOut(dataPin, clockPin, bitOrder, value)

Description

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to the dataPin, after which the clockPin is toggled to indicate that the bit is available.

This is known as synchronous serial protocol and is a common way that microcontrollers communicate with sensors, and with other microcontrollers. The two devices always stay synchronized, and communicate at close to maximum speeds, since they both share the same clock line. Often referred to as SPI (synchronous protocol interface) in hardware documentation.

Parameters

dataPin: the pin on which to output each bit (*int*)

clockPin: the pin to toggle once the **dataPin** has been set to the correct value (*int*)

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.
(Most Significant Bit First, or, Least Significant Bit First)

value: the data to shift out. (*byte*)

Returns

None

Note

The **dataPin** and **clockPin** must already be configured as outputs by a call to pinMode.

Common Programming Errors

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so outputting an int with shiftout requires a two-step operation:

Example:

```
int data;
int clock;
int cs;
...

digitalWrite(cs, LOW);
data = 500;
shiftOut(data, clock, MSBFIRST, data)
digitalWrite(cs, HIGH);

// this will actually only output 244 because
// 500 % 256 = 244
// since only the low 8 bits are output

// Instead do this for MSBFIRST serial
data = 500;
// shift out highbyte
// " >> " is bitshift operator - moves top 8 bits (high byte) into low byte
```

```
shiftOut(data, clock, MSBFIRST, (data >> 8));

// shift out lowbyte
shiftOut(data, clock, MSBFIRST, data);



// And do this for LSBFIRST serial
data = 500;
// shift out lowbyte
shiftOut(data, clock, LSBFIRST, data);

// shift out highbyte
shiftOut(data, clock, LSBFIRST, (data >> 8));
```

Example

For accompanying circuit, see the tutorial on controlling a 74HC595 shift register.

```
//**************************************************************//
//  Name    : shiftOutCode, Hello World                         //
//  Author  : Carlyn Maw,Tom Igoe                               //
//  Date    : 25 Oct, 2006                                      //
//  Version : 1.0                                               //
//  Notes   : Code for using a 74HC595 Shift Register           //
//          : to count from 0 to 255                            //
//****************************************************************

//Pin connected to ST_CP of 74HC595
int latchPin = 8;
//Pin connected to SH_CP of 74HC595
int clockPin = 12;
////Pin connected to DS of 74HC595
int dataPin = 11;

void setup() {
  //set pins to output because they are addressed in the main loop
  pinMode(latchPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
}

void loop() {
  //count up routine
  for (int j = 0; j < 256; j++) {
    //ground latchPin and hold low for as long as you are transmitting
    digitalWrite(latchPin, LOW);
    shiftOut(dataPin, clockPin, LSBFIRST, j);
    //return the latch pin high to signal chip that it
    //no longer needs to listen for information
    digitalWrite(latchPin, HIGH);
    delay(1000);
  }
}
```

Reference Home Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

unsigned long pulseIn(pin, value)

unsigned long pulseIn(pin, value, timeout)

Description

Reads a pulse (either HIGH or LOW) on a pin. For example, if **value** is **HIGH**, **pulseIn()** waits for the pin to go **HIGH**, starts timing, then waits for the pin to go **LOW** and stops timing. Returns the length of the pulse in microseconds. Gives up and returns 0 if no pulse starts within a specified time out.

The timing of this function has been determined empirically and will probably show errors in longer pulses. Works on pulses from 10 microseconds to 3 minutes in length.

Parameters

pin: the number of the pin on which you want to read the pulse. (*int*)

value: type type of pulse to read: either HIGH or LOW. (*int*)

timeout (optional): the number of microseconds to wait for the pulse to start; default is one second (*unsigned long*)

Returns

the length of the pulse (in microseconds) or 0 if no pulse started before the timeout

Example

```
int pin = 7;
unsigned long duration;

void setup()
{
  pinMode(pin, INPUT);
}

void loop()
{
  duration = pulseIn(pin, HIGH);
}
```

See also

- pinMode

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

unsigned long millis()

Description

Returns the number of milliseconds since the Arduino board began running the current program.

Parameters

None

Returns

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 9 hours and 32 minutes.

Examples

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

```
/* Frequency Test
*  Paul Badger 2007
*  Program to empirically determine the time delay to generate the
*  proper frequency for a an  Infrared (IR) Remote Control Receiver module
*  These modules typically require 36 - 52 khz communication frequency
*  depending on specific device.
*/

int tdelay;
unsigned long i, hz;
unsigned long time;
int outPin = 11;

void setup(){
  pinMode(outPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  for (tdelay = 1; tdelay < 12; tdelay++){      // scan across a range of time delays to find the right
frequency
    time = millis();               // get start time of inner loop
    for (i = 0; i < 100000; i++){  // time 100,000 cycles through the loop
      digitalWrite(outPin, HIGH);
      delayMicroseconds(tdelay);
      digitalWrite(outPin, LOW);
      delayMicroseconds(tdelay);
    }
    time = millis() - time;      // compute time through inner loop in milliseconds
    hz = (1 /((float)time / 100000000.0));   // divide by 100,000 cycles and 1000 milliseconds per second
    // to determine period, then take inverse to convert to hertz
    Serial.print(tdelay, DEC);
    Serial.print("   ");
    Serial.println(hz, DEC);
  }
}
```

Warning:

Note that the parameter for millis is an unsigned long, errors may be generated if a programmer, tries to do math with other datatypes such as *ints*.

Example:

```
int startTime;             // should be "unsigned long startTime;"

// ...

startTime = millis();     // datatype not large enough to hold data, will generate errors
```

See also

- delay
- delayMicroseconds
- cast

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

delay(ms)

Description

Pauses your program for the amount of time (in miliseconds) specified as parameter.

Parameters

unsigned long ms - the number of milliseconds to pause (there are 1000 milliseconds in a second)

Returns

nothing

Warning:

The parameter for delay is an unsigned long. When using an integer constant larger than about 32767 as a parameter for delay, append an "UL" suffix to the end. e.g. **`delay(60000UL);`** Similarly, casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

configures pin number 13 to work as an output pin. It sets the pin to HIGH, waits for 1000 miliseconds (1 second), sets it back to LOW and waits for 1000 miliseconds.

See also

- millis
- delayMicroseconds
- integer constants

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

delayMicroseconds(us)

Description

Pauses the program for the amount of time (in microseconds) specified as parameter. For delays longer than a few thousand microseconds, you should use delay() instead.

Currently, the largest value that will produce an accurate delay is 16383. This could change in future Arduino releases.

Parameters

us: the number of microseconds to pause. (There are a thousand microseconds in a millisecond, and a million microseconds in a second.)

Returns

None

Example

```
int outPin = 8;                 // digital pin 8

void setup()
{
  pinMode(outPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(outPin, HIGH);   // sets the pin on
  delayMicroseconds(50);        // pauses for 50 microseconds
  digitalWrite(outPin, LOW);    // sets the pin off
  delayMicroseconds(50);        // pauses for 50 microseconds
}
```

configures pin number 8 to work as an output pin. It sends a train of pulses with 100 microseconds period.

Caveats and Known Issues

This function works very accurately in the range 3 microseconds and up. We cannot assure that delayMicroseconds will perform precisely for smaller delay-times.

To ensure more accurate delays, this functions disables interrupts during its operation, meaning that some things (like receiving serial data, or incrementing the value returned by millis()) will not happen during the delay. Thus, you should only use this function for short delays, and use delay() for longer ones.

delayMicroseconds(0) will generate a much longer delay than expected (~1020 us) as will negative numbers.

See also

- millis
- delay

Corrections, suggestions, and new documentation should be posted to the Forum.

min(x, y)

Description

Calculates the minimum of two numbers.

Parameters

x: the first number, any data type

y: the second number, any data type

Returns

The smaller of the two numbers.

Examples

```
sensVal = min(sensVal, 100); // assigns sensVal to the smaller of sensVal or 100
                             // ensuring that it never gets above 100.
```

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

See also

- max()
- constrain()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

max(x, y)

Description

Calculates the maximum of two numbers.

Parameters

x: the first number, any data type

y: the second number, any data type

Returns

The larger of the two parameter values.

Example

```
sensVal = max(senVal, 20); // assigns sensVal to the larger of sensVal or 20
                           // (effectively ensuring that it is at least 20)
```

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

See also

- min()
- constrain()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

abs(x)

Description

Computes the absolute value of a number.

Parameters

x: the number

Returns

x: if **x** is greater than or equal to 0.

-x: if **x** is less than 0.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

constrain(x, a, b)

Description

Constrains a number to be within a range.

Parameters

x: the number to constrain, all data types

a: the lower end of the range, all data types

b: the upper end of the range, all data types

Returns

x: if **x** is between **a** and **b**

a: if **x** is less than **a**

b: if **x** is greater than **b**

Example

```
sensVal = constrain(sensVal, 10, 150);
// limits range of sensor values to between 10 and 150
```

See also

- min()
- max()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

map(value, fromLow, fromHigh, toLow, toHigh)

Description

Re-maps a number from one range to another. That is, a **value** of **fromLow** would get mapped to **toLow**, a value of **fromHigh** to **toHigh**, values in-between to values in-between, etc.

Does not constrain values to within the range, because out-of-range values are sometimes intended and useful.

Parameters

value: the number to map

fromLow: the lower bound of the value's current range

fromHigh: the upper bound of the value's current range

toLow: the lower bound of the value's target range

toHigh: the upper bound of the value's target range

Returns

The mapped value.

Example

```
void setup() {}

void loop()
{
  int val = analogRead(0);
  val = map(val, 0, 1023, 0, 255);
  analogWrite(9, val);
}
```

See Also

- constrain()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

pow(base, exponent)

Description

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values or curves.

Parameters

base: the number (*float*)

exponent: the power to which the base is raised (*float*)

Returns

The result of the exponentiation (*double*)

Example

See the fscale function in the code library.

See also

- sqrt()
- float
- double

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

sqrt(x)

Description

Calculates the square root of a number.

Parameters

x: the number, any data type

Returns

double, the number's square root.

See also

- pow()
- float
- double

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

sin(rad)

Description

Calculates the sine of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

the sine of the angle (*double*)

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- cos()
- tan()
- float
- double

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

cos(rad)

Description

Calculates the cos of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

The cos of the angle ("double")

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- tan()
- float
- double

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

tan(rad)

Description

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.

Parameters

rad: the angle in radians (*float*)

Returns

The tangent of the angle (*double*)

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- cos()
- float
- double

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

randomSeed(seed)

Description

randomSeed() initializes the pseudo-random number generator, causing it to start at an arbitrary point in its random sequence. This sequence, while very long, and random, is always the same.

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Parameters

long, int - pass a number to generate the seed.

Returns

no returns

Example

```
long randNumber;

void setup(){
  Serial.begin(9600);
  randomSeed(analogRead(0));
}

void loop(){
  randNumber = random(300);
  Serial.println(randNumber);

  delay(50);
}
```

See also

- random

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

long random(max)
long random(min, max)

Description

The random function generates pseudo-random numbers.

Parameters

min - lower bound of the random value, inclusive *(optional parameter)*

max - upper bound of the random value, exclusive

Returns

long - a random number between min and max - 1

Note:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Example

```
long randNumber;

void setup(){
  Serial.begin(9600);

  // if analog input pin 0 is unconnected, random analog
  // noise will cause the call to randomSeed() to generate
  // different seed numbers each time the sketch runs.
  // randomSeed() will then shuffle the random function.
  randomSeed(analogRead(0));
}

void loop() {
  // print a random number from 0 to 299
  randNumber = random(300);
  Serial.println(randNumber);

  // print a random number from 10 to 19
  randNumber = random(10, 20);
  Serial.println(randNumber);

  delay(50);
}
```

See also

- randomSeed

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Boolean Operators

These can be used inside the condition of an if statement.

&& (logical and)

True only if both operands are true, e.g.

```
if (digitalRead(2) == 1  && digitalRead(3) == 1) { // read two switches
  // ...
}
```

is true only if x is 1, 2, 3, or 4.

|| (logical or)

True if either operand is true, e.g.

```
if (x > 0 || y > 0) {
  // ...
}
```

is true if either x or y is greater than 0.

! (not)

True if the operand is false, e.g.

```
if (!x) {
  // ...
}
```

is true if x is false (i.e. if x equals 0).

Warning

Make sure you don't mistake the boolean AND operator, && (double ampersand) for the bitwise AND operator & (single ampersand). They are entirely different beasts.

Similarly, do not confuse the boolean || (double pipe) operator with the bitwise OR operator | (single pipe).

The bitwise not ~ (tilde) looks much different than the boolean not ! (exclamation point or "bang" as the programmers say) but you still have to be sure which one you want where.

Examples

```
if (a >= 10 && a <= 20){}   // true if a is between 10 and 20
```

See also

- & (bitwise AND)
- | (bitwise OR)
- ~ (bitwise NOT
- if

++ (increment) / -- (decrement)

Description

Increment or decrement a variable

Syntax

```
x++;  // increment x by one and returns the old value of x
++x;  // increment x by one and returns the new value of x

x-- ;   // decrement x by one and returns the old value of x
--x ;   // decrement x by one and returns the new value of x
```

Parameters

x: an integer or long (possibly unsigned)

Returns

The original or newly incremented / decremented value of the variable.

Examples

```
x = 2;
y = ++x;      // x now contains 3, y contains 3
y = x--;      // x contains 2 again, y still contains 3
```

See also

+=
-=

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

+= , -= , *= , /=

Description

Perform a mathematical operation on a variable with another constant or variable. The += (et al) operators are just a convenient shorthand for the expanded syntax, listed below.

Syntax

```
x += y;   // equivalent to the expression x = x + y;
x -= y;   // equivalent to the expression x = x - y;
x *= y;   // equivalent to the expression x = x * y;
x /= y;   // equivalent to the expression x = x / y;
```

Parameters

x: any variable type

y: any variable type or constant

Examples

```
x = 2;
x += 4;      // x now contains 6
x -= 3;      // x now contains 3
x *= 10;     // x now contains 30
x /= 2;      // x now contains 15
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

constants

Constants are predefined variables in the Arduino language. They are used to make the programs easier to read. We classify constants in groups.

Defining Logical Levels, true and false (Boolean Constants)

There are two constants used to represent truth and falsity in the Arduino language: **true**, and **false**.

false

false is the easier of the two to define. false is defined as 0 (zero).

true

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is *non-zero* is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

Note that the *true* and *false* constants are typed in lowercase unlike HIGH, LOW, INPUT, & OUTPUT.

Defining Pin Levels, HIGH and LOW

When reading or writing to a digital pin there are only two possible values a pin can take/be-set-to: **HIGH** and **LOW**.

HIGH

The meaning of HIGH (in reference to a pin) is somewhat different depending on whether a pin is set to an INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report HIGH if a voltage of 3 volts or more is present at the pin.

When a pin is configured to OUTPUT with pinMode, and set to HIGH with digitalWrite, the pin is at 5 volts. In this state it can *source* current, e.g. light an LED that is connected through a series resistor to ground, or to another pin configured as an output, and set to LOW.

LOW

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW if a voltage of 2 volts or less is present at the pin.

When a pin is configured to OUTPUT with pinMode, and set to LOW with digitalWrite, the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to, +5 volts, or to another pin configured as an output, and set to HIGH.

Defining Digital Pins, INPUT and OUTPUT

Digital pins can be used either as **INPUT** or **OUTPUT**. Changing a pin from INPUT TO OUTPUT with pinMode() drastically changes the electrical behavior of the pin.

Pins Configured as Inputs

Arduino (Atmega) pins configured as **INPUT** with pinMode() are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Pins Configured as Outputs

Pins configured as **OUTPUT** with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for reading sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. The amount of current provided by an Atmega pin is also not enough to power most relays or motors, and some interface circuitry will be required.

See also

- pinMode()
- Integer Constants
- boolean variables

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Integer Constants

Integer constants are numbers used directly in a sketch, like 123. By default, these numbers are treated as int's but you can change this with the U and L modifiers (see below).

Normally, integer constants are treated as base 10 (decimal) integers, but special notation (formatters) may be used to enter numbers in other bases.

Base	Example	Formatter	Comment
10 (decimal)	123	none	
2 (binary)	B1111011	capital 'B'	only works with 8 bit values characters 0-1 valid
8 (octal)	0173	leading zero	characters 0-7 valid
16 (hexadecimal)	0x7B	leading 0x	characters 0-9, A-F, a-f valid

Decimal is base 10, this is the common-sense math with which you are aquainted.

Example: `101 == 101 decimal ((1 * 10^2) + (0 * 10^1) + 1)`

Binary is base two. Only characters 0 and 1 are valid.

```
Example: B101 == 5 decimal ((1 * 2^2) + (0 * 2^1) + 1)
```

The binary formatter only works on bytes (8 bits) between 0 (B0) and 255 (B11111111). If it's convenient to input an int (16 bits) in binary form you can do it a two-step procedure such as this:

```
myInt = (B11001100 * 256) + B10101010; // B11001100 is the high byte
```

Octal is base eight. Only characters 0 through 7 are valid.

```
Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)
```

Warning

You can generate a hard-to-find bug by (unintentionally) including a leading zero before a constant and having the compiler unintentionally interpret your constant as octal

Hexadecimal (or hex) is base sixteen. Valid characters are 0 through 9 and letters A through F; A has the value 10, B is 11, up to F, which is 15.

Example: `0x101 == 257 decimal ((1 * 16^2) + (0 * 16^1) + 1)`

U & L formatters

By default, an integer constant is treated as an int with the attendant limitations in values. To specify an integer constant with another data type, follow it with:

- a 'u' or 'U' to force the constant into an unsigned data format. Example: 33u

- a 'l' or 'L' to force the constant into a long data format. Example: 100000L
- a 'ul' or 'UL' to force the constant into an unsigned long constant. Example: 32767ul

See also

- constants
- #define
- byte
- int
- unsigned int
- long
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

boolean variables

boolean variables are hold one of two values, true and false.

Example

```
int LEDpin = 5;       // LED on pin 5
int switchPin = 13;   // momentary switch on 13, other side connected to ground

boolean running = false;

void setup()
{
  pinMode(LEDpin, OUTPUT);
  pinMode(switchPin, INPUT);
  digitalWrite(switchPin, HIGH);      // turn on pullup resistor
}

void loop()
{
  if (digitalRead(switchPin) == LOW)
  {  // switch is pressed - pullup keeps pin high normally
    delay(100);                        // delay to debounce switch
    running = !running;                // toggle running variable
    digitalWrite(LEDpin, running)      // indicate via LED
  }
}
```

See also

- constants
- boolean operators

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

char

Description

A data type that takes up 1 byte of memory that stores a character value. Character literals are written in single quotes, like this: 'A' (for multiple characters - strings - use double quotes: "ABC").

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. This means that it is possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println reference for more on how characters are translated to numbers.

The char datatype is a signed type, meaning that it encodes numbers from -128 to 127. For an unsigned, one-byte (8 bit) data type, use the *byte* data type.

Example

```
char myChar = 'A';
```

See also

- byte
- int
- array
- Serial.println

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

byte

Description

Bytes store an 8-bit number, from 0 to 255. *byte* is an unsigned data type, meaning that it does not store negative numbers.

Example

```
byte b = B10010;  // "B" is the binary formatter (18 decimal)
```

See also

- int
- unsigned int
- long
- unsigned long
- integer constants

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

int

Description

Integers are your primary datatype for number storage, and store a 2 byte value. This yields a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1).

Int's store negative numbers with a technique called 2's complement math. The highest bit, sometimes refered to as the "sign" bit, flags the number as a negative number. The rest of the bits are inverted and 1 is added.

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work transparently in the expected manner. There can be an unexpected complication in dealing with the bitshift right operator (>>) however.

Example

```
int ledPin = 13;
```

Syntax

```
int var = val;
```

- var - your int variable name
- val - the value you assign to that variable

Coding Tip

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions.

```
int x
x = -32,768;
x = x - 1;       // x now contains 32,767 - rolls over in neg. direction

x = 32,767;
x = x + 1;       // x now contains -32,768 - rolls over
```

See Also

- byte
- unsigned int
- long
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

unsigned int

Description

Unsigned ints (unsigned integers) are the same as ints in that they store a 2 byte value. Instead of storing negative numbers however they only store positive values, yielding a useful range of 0 to 65,535 (2^16) - 1).

The difference between unsigned ints and (signed) ints, lies in the way the highest bit, sometimes refered to as the "sign" bit, is interpreted. In the Arduino int type (which is signed), if the high bit is a "1", the number is interpreted as a negative number, and the other 15 bits are interpreted with 2's complement math.

Example

```
    unsigned int ledPin = 13;
```

Syntax

```
     unsigned int var = val;
```

- var - your unsigned int variable name
- val - the value you assign to that variable

Coding Tip

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions

```
   unsigned int x
   x = 0;
   x = x - 1;       // x now contains 65535 - rolls over in neg direction
   x = x + 1;       // x now contains 0 - rolls over
```

See Also

- byte
- int
- long
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

long

Description

Long variables are extended size variables for number storage, and store 32 bits (4 bytes), from -2,147,483,648 to 2,147,483,647.

Example

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Syntax

```
long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

See Also

- byte
- int
- unsigned int
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

unsigned long

Description

Unsigned long variables are extended size variables for number storage, and store 32 bits (4 bytes). Unlike standard longs unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32 - 1).

Example

```
unsigned long time;

void setup()
{
  Serial.begin(9600);
}

void loop()
{
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Syntax

```
    unsigned long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

See Also

- byte
- int
- unsigned int
- long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

float

Description

Datatype for floating-point numbers, a number that has a decimal point. Floating-point numbers are often used to approximate analog and continuous values because they have greater resolution than integers. Floating-point numbers can be as large as 3.4028235E+38 and as low as -3.4028235E+38. They are stored as 32 bits (4 bytes) of information.

Floating point numbers are not exact, and may yield strange results when compared. For example `6.0 / 3.0` may not equal `2.0`. You should instead check that the absolute value of the difference between the numbers is less than some small number.

Floating point math is also much slower than integer math in performing calculations, so should be avoided if, for example, a loop has to run at top speed for a critical timing function. Programmers often go to some lengths to convert floating point calculations to integer math to increase speed.

That being said, floating point math is useful for a wide range of physical computing tasks, and is one of the things missing from many beginning microcontroller systems.

Examples

```
float myfloat;
float sensorCalbrate = 1.117;
```

Syntax

```
float var = val;
```

- var - your float variable name
- val - the value you assign to that variable

Example Code

```
int x;
int y;
float z;

x = 1;
y = x / 2;            // y now contains 0, ints can't hold fractions
z = (float)x / 2.0;   // z now contains .5 (you have to use 2.0, not 2)
```

Programming Tip

Serial.println() truncates floats (throws away the fractions) into integers when sending serial. Multiply by power of ten to preserve resolution.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

double

Desciption

Double precision floating point number. Occupies 4 bytes.

See:

- Float

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

string

Description

Strings are represented as arrays of type char and are null-terminated.

Examples

All of the following are valid declarations for strings.

```
  char Str1[15];
  char Str2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char Str3[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o', '\0'};
  char Str4[ ] = "arduino";
  char Str5[8] = "arduino";
  char Str6[15] = "arduino";
```

Possibilities for declaring strings

- Declare an array of chars without initializing it as in Str1
- Declare an array of chars (with one extra char) and the compiler will add the required null character, as in Str2
- Explicitly add the null character, Str3
- Initialize with a string constant in quotation marks; the compiler will size the array to fit the string constant and a terminating null character, Str4
- Initialize the array with an explicit size and string constant, Str5
- Initialize the array, leaving extra space for a larger string, Str6

Null termination

Generally, strings are terminated with a null character (ASCII code 0). This allows functions (like Serial.print()) to tell where the end of a string is. Otherwise, they would continue reading subsequent bytes of memory that aren't actually part of the string.

This means that your string needs to have space for one more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled with a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

Note that it's possible to have a string without a final null character (e.g. if you had specified the length of Str2 as seven instead of eight). This will break most functions that use strings, so you shouldn't do it intentionally. If you notice something behaving strangely (operating on characters not in the string), however, this could be the problem.

Single quotes or double quotes?

Strings are always defined inside double quotes ("Abc") and characters are always defined inside single quotes('A').

Wrapping long strings

You can wrap long strings like this:

```
char myString[] = "This is the first line"
" this is the second line"
" etcetera";
```

Arrays of strings

It is often convenient, when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

In the code below, the asterisk after the datatype char "char*" indicates that this is an array of "pointers". All array names are actually pointers, so this is required to make an array of arrays. Pointers are one of the more esoteric parts of C for beginners to understand, but it isn't necessary to understand pointers in detail to use them effectively here.

Example

```
char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",
"This is string 4", "This is string 5","This is string 6"};

void setup(){
Serial.begin(9600);
}

void loop(){
for (int i = 0; i < 6; i++){
   Serial.println(myStrings[i]);
   delay(500);
   }
}
```

See Also

- array
- PROGMEM

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arrays

An array is a collection of variables that are accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but using simple arrays is relatively straightforward.

Creating (Declaring) an Array

All of the methods below are valid ways to create (declare) an array.

```
  int myInts[6];
  int myPins[] = {2, 4, 8, 3, 6};
  int mySensVals[6] = {2, 4, -8, 3, 2};
  char message[6] = "hello";
```

You can declare an array without initializing it as in myInts.

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and creates an array of the appropriate size.

Finally you can both initialize and size your array, as in mySensVals. Note that when declaring an array of type char, one more element than your initialization is required, to hold the required null character.

Accessing an Array

Arrays are **zero indexed**, that is, referring to the array initialization above, the first element of the array is at index 0, hence

`mySensVals[0] == 2, mySensVals[1] == 4,` and so forth.

It also means that in an array with ten elements, index nine is the last element. Hence:

```
int myArray[10]={9,3,2,4,3,2,7,8,9,11};
     // myArray[9]    contains 11
     // myArray[10]   is invalid and contains random information (other memory address)
```

For this reason you should be careful in accessing arrays. Accessing past the end of an array (using an index number greater than your declared array size - 1) is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Unlike in some versions of BASIC, the C compiler does no checking to see if array access is within legal bounds of the array size that you have declared.

To assign a value to an array:

```
mySensVals[0] = 10;
```

To retrieve a value from an array:

```
x = mySensVals[4];
```

Arrays and FOR Loops

Arrays are often manipulated inside **for** loops, where the loop counter is used as the index for each array element. For example, to print the elements of an array over the serial port, you could do something like this:

```
int i;
for (i = 0; i < 5; i = i + 1) {
  Serial.println(myPins[i]);
}
```

Example

For a complete program that demonstrates the use of arrays, see the Knight Rider example from the Tutorials.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

ASCII chart

The ASCII (American Standard Code for Information Interchange) encoding dates to the 1960's. It is the standard way that text is encoded numerically.

Note that the first 32 characters (0-31) are non-printing characters, often called control characters. The more useful characters have been labeled.

DEC Value	Character	DEC Value	Character	DEC Value	Character	DEC Value	Character
0	null	32	space	64	@	96	`
1		33	!	65	A	97	a
2		34	"	66	B	98	b
3		35	#	67	C	99	c
4		36	$	68	D	100	d
5		37	%	69	E	101	e
6		38	&	70	F	102	f
7		39	'	71	G	103	g
8		40	(	72	H	104	h
9	tab	41	)	73	I	105	i
10	line feed	42	*	74	J	106	j
11		43	+	75	K	107	k
12		44	,	76	L	108	l
13	carriage	45	-	77	M	109	m
return		46	.	78	N	110	n
14		47	/	79	O	111	o
15		48	0	80	P	112	p
16		49	1	81	Q	113	q
17		50	2	82	R	114	r
18		51	3	83	S	115	s
19		52	4	84	T	116	t
20		53	5	85	U	117	u
21		54	6	86	V	118	v
22		55	7	87	W	119	w
23		56	8	88	X	120	x
24		57	9	89	Y	121	y
25		58	:	90	Z	122	z
26		59	;	91	[	123	{
27		60	<	92	\	124	|
28		61	=	93	]	125	}
29		62	>	94	^	126	~
30		63	?	95	_	127	
31							

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

search

Login to Arduino

Username:	
Password:	
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Reference.HomePage History

Hide minor edits - Show changes to markup

July 02, 2008, at 03:11 PM by David A. Mellis -
Changed lines 2-3 from:

Arduino Reference

to:

Language Reference

Restore
May 07, 2008, at 02:40 PM by David A. Mellis -
Changed line 41 from:

- plus (addition)

to:

- + (addition)

Restore
April 29, 2008, at 10:33 AM by David A. Mellis -
Changed lines 4-5 from:

''See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.*

Restore
April 29, 2008, at 10:33 AM by David A. Mellis -
Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The **foundations page** has extended descriptions of some hardware and software features.*

to:

''See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.

Restore
April 23, 2008, at 10:30 PM by David A. Mellis -
Changed line 8 from:

(:table width=90% border=0 cellpadding=5 cellspacing=0:)

to:

(:table width=100% border=0 cellpadding=5 cellspacing=0:)

Restore
March 31, 2008, at 06:24 AM by Paul Badger -
Restore

March 29, 2008, at 11:39 AM by David A. Mellis -
Changed lines 128-135 from:
to:

- pow(base, exponent)
- sqrt(x)

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Restore
March 29, 2008, at 09:18 AM by David A. Mellis -
Changed lines 127-128 from:
to:

- map(value, fromLow, fromHigh, toLow, toHigh)

Restore
March 07, 2008, at 10:05 PM by Paul Badger -
Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The **Foundations page** has extended descriptions of some hardware and software features.*

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The **foundations page** has extended descriptions of some hardware and software features.*

Restore
March 07, 2008, at 10:04 PM by Paul Badger -
Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The* Foundations page *has extended descriptions of hardware and software features.*

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The **Foundations page** has extended descriptions of some hardware and software features.*

Restore
March 07, 2008, at 10:03 PM by Paul Badger -
Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The [[Tutorial/Foundations|Foundations page has extended descriptions of hardware and software features.*

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The* Foundations page *has extended descriptions of hardware and software features.*

Restore
March 07, 2008, at 10:03 PM by Paul Badger -
Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.*

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware. The [[Tutorial/Foundations|Foundations page has extended descriptions of hardware and software features.*

Restore
March 06, 2008, at 09:01 AM by David A. Mellis -

Changed lines 4-5 from:

*See the **extended reference** for more advanced features of the Arduino languages.*

to:

*See the **extended reference** for more advanced features of the Arduino languages and the **libraries page** for interfacing with particular types of hardware.*

Changed lines 147-148 from:

Didn't find something? Check the extended reference.

to:

Didn't find something? Check the extended reference or the libraries.

Restore
February 28, 2008, at 09:49 AM by David A. Mellis -
Changed lines 77-78 from:
to:

- true | false

Restore
November 24, 2007, at 12:42 AM by Paul Badger -
Changed line 14 from:

- void setup().

to:

- void setup()

Restore
November 24, 2007, at 12:39 AM by Paul Badger - test the summary feature
Changed line 14 from:

- void setup()

to:

- void setup().

Restore
November 05, 2007, at 03:44 AM by David A. Mellis -
Deleted line 108:

- analog pins

Restore
November 03, 2007, at 10:53 PM by Paul Badger -
Added line 109:

- analog pins

Deleted line 110:

- analog pins

Restore
November 03, 2007, at 10:01 PM by Paul Badger -
Changed line 110 from:

- configuring analog pins

to:

- analog pins

Restore
November 03, 2007, at 09:58 PM by Paul Badger -
Restore
November 03, 2007, at 09:58 PM by Paul Badger -

Changed lines 109-110 from:

- int analogRead(pin)

to:

- int analogRead(pin)
- configuring analog pins

Restore
August 31, 2007, at 11:05 PM by David A. Mellis -
Changed lines 2-3 from:

Arduino Reference (standard)

to:

Arduino Reference

Restore
August 31, 2007, at 10:46 PM by David A. Mellis -
Changed lines 6-7 from:

Arduino programs can be divided in three main parts: **structure**, **values** (variables and constants), and **functions**. The Arduino language is based on C/C++.

to:

Arduino programs can be divided in three main parts: *structure*, *values* (variables and constants), and *functions*. The Arduino language is based on C/C++.

Restore
August 31, 2007, at 10:46 PM by David A. Mellis -
Changed lines 4-5 from:

See the **extended reference** *for more advanced features of the Arduino languages.*

to:

*See the **extended reference** for more advanced features of the Arduino languages.*

Restore
August 31, 2007, at 10:45 PM by David A. Mellis -
Changed lines 4-5 from:

See the **extended reference** for more advanced features of the Arduino languages.

to:

See the **extended reference** *for more advanced features of the Arduino languages.*

Restore
August 31, 2007, at 10:45 PM by David A. Mellis -
Changed lines 4-5 from:

The extended reference covers more advanced features of the Arduino language.

to:

See the **extended reference** for more advanced features of the Arduino languages.

Restore
August 31, 2007, at 10:44 PM by David A. Mellis -
Changed lines 39-41 from:

- #define
- #include

to:
Restore
August 31, 2007, at 10:43 PM by David A. Mellis -
Added lines 146-147:

Restore
August 31, 2007, at 10:43 PM by David A. Mellis -
Added lines 146-147:

Didn't find something? Check the extended reference.

Restore
August 31, 2007, at 10:40 PM by David A. Mellis - removing things that only belong in the extended reference.
Deleted lines 61-68:

Bitwise Operators

- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
- ~ (bitwise not)
- << (bitshift left)
- >> (bitshift right)

Deleted lines 69-71:

- &= (compound bitwise and)
- |= (compound bitwise or)

Deleted lines 97-109:

Variable Scope & Qualifiers

- variable scope
- static
- volatile
- const

Utilities

- cast (cast operator)

Deleted line 99:

- keywords

Deleted lines 134-140:

External Interrupts

These functions allow you to trigger a function when the input to a pin changes value.

- attachInterrupt(interrupt, function, mode)
- detachInterrupt(interrupt)

Restore
August 31, 2007, at 10:26 PM by David A. Mellis -
Changed lines 121-122 from:

- sizeof() (sizeof operator)

to:
Changed lines 177-178 from:

Extended

to:
Restore
August 31, 2007, at 10:25 PM by David A. Mellis -
Changed lines 2-3 from:

Arduino Reference (basic)

to:

Arduino Reference (standard)

Restore
August 31, 2007, at 10:24 PM by David A. Mellis -
Changed lines 4-6 from:

The extended reference covers more advanced features of the Arduino language.

to:

The extended reference covers more advanced features of the Arduino language.

Restore
August 31, 2007, at 10:24 PM by David A. Mellis -
Changed lines 4-6 from:

The extended reference covers more advanced features of the Arduino language.

to:

The extended reference covers more advanced features of the Arduino language.

Restore
August 31, 2007, at 10:24 PM by David A. Mellis -
Changed lines 4-6 from:

The extended reference covers more advanced features of the Arduino language.

to:

The extended reference covers more advanced features of the Arduino language.

Restore
August 31, 2007, at 10:23 PM by David A. Mellis -
Changed lines 6-7 from:

to:
Restore
August 31, 2007, at 10:23 PM by David A. Mellis -
Added lines 6-7:

Restore
August 31, 2007, at 10:23 PM by David A. Mellis -
Changed lines 4-5 from:

For more advanced features of the Arduino language, see the extended reference.

to:

The extended reference covers more advanced features of the Arduino language.

Restore
August 31, 2007, at 10:22 PM by David A. Mellis -
Changed lines 2-3 from:

Arduino Reference

to:

Arduino Reference (basic)

For more advanced features of the Arduino language, see the extended reference.

Restore
August 31, 2007, at 10:19 PM by David A. Mellis -
Changed lines 84-85 from:

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

to:

Constants are particular values with specific meanings.

Restore
August 31, 2007, at 10:18 PM by David A. Mellis -
Changed lines 81-82 from:

Variables are expressions that you can use in programs to store values, such as a sensor reading from an analog pin. They can have various types, which are described below.

to:

Variables are expressions that you can use in programs to store values, such as a sensor reading from an analog pin.

Constants

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

- HIGH | LOW
- INPUT | OUTPUT

- Integer Constants

Added lines 93-94:

Variables can have various types, which are described below.

Changed lines 115-122 from:

Constants

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

- HIGH | LOW
- INPUT | OUTPUT

- IntegerConstants

to:
Restore
August 31, 2007, at 09:46 PM by David A. Mellis - removing PROGMEM (doesn't belong in the basic reference)
Changed lines 104-105 from:

- PROGMEM

to:
Restore
August 31, 2007, at 09:45 PM by David A. Mellis -
Changed lines 10-11 from:

In Arduino, the standard program entry point (main) is defined in the core and calls into two functions in a sketch. **setup()** is called once, then **loop()** is called repeatedly (until you reset your board).

to:

An Arduino program run in two parts:

Added lines 15-16:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinModes, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Restore
August 31, 2007, at 09:44 PM by David A. Mellis -
Changed lines 10-11 from:

An Arduino program run in two parts:

to:

In Arduino, the standard program entry point (main) is defined in the core and calls into two functions in a sketch. **setup()** is called once, then **loop()** is called repeatedly (until you reset your board).

Deleted lines 14-15:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinModes, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Restore
August 23, 2007, at 02:24 PM by Paul Badger -
Changed lines 15-16 from:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

to:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinModes, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Restore
August 23, 2007, at 02:19 PM by Paul Badger -
Changed lines 81-82 from:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

to:

Variables are expressions that you can use in programs to store values, such as a sensor reading from an analog pin. They can have various types, which are described below.

Restore
July 17, 2007, at 11:10 AM by Paul Badger -
Changed lines 19-20 from:

- void keyword

to:

- void

Restore
July 17, 2007, at 10:27 AM by Paul Badger -
Restore
July 17, 2007, at 10:27 AM by Paul Badger -
Changed lines 174-175 from:
to:

Extended

Restore
July 17, 2007, at 06:36 AM by Paul Badger -
Restore
July 17, 2007, at 06:35 AM by Paul Badger -
Changed lines 19-20 from:
to:

- void keyword

Restore
July 16, 2007, at 11:47 PM by Paul Badger -
Added lines 31-38:

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define
- #include

Deleted lines 77-85:

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define
- #include

Restore
July 16, 2007, at 11:05 PM by Paul Badger -
Changed lines 29-30 from:
to:

- return

Restore
July 16, 2007, at 09:42 PM by Paul Badger -
Changed lines 173-174 from:

Alpha

to:
Restore
July 16, 2007, at 09:41 PM by Paul Badger -
Restore
July 16, 2007, at 09:41 PM by Paul Badger -
Restore
July 16, 2007, at 09:40 PM by Paul Badger -
Changed lines 173-174 from:
to:

Alpha

Restore
July 16, 2007, at 05:56 AM by Paul Badger -
Changed lines 31-36 from:

- plus(addition)
- -(subtraction)
- *(multiplication)
- /(division)
- %(modulo)

to:

- plus (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Restore
July 16, 2007, at 05:55 AM by Paul Badger -
Changed lines 63-69 from:

- += (compound multiplication)
- -= (compound division)

- &= (bitwise and)

- |= (bitwise or)

to:

- *= (compound multiplication)
- /= (compound division)

- &= (compound bitwise and)
- |= (compound bitwise or)

Restore
July 16, 2007, at 05:54 AM by Paul Badger -
Changed lines 61-62 from:

- += (compound increment)
- -= (compound decrement)

to:

- += (compound addition)
- -= (compound subtraction)
- += (compound multiplication)
- -= (compound division)

Restore
July 16, 2007, at 05:12 AM by Paul Badger -
Changed lines 60-62 from:

- --? (decrement)

to:

- -- (decrement)
- += (compound increment)
- -= (compound decrement)

Restore
July 16, 2007, at 04:48 AM by Paul Badger -
Changed lines 60-64 from:

- |? (decrement)
- (bitwise and)
- (bitwise or)

to:

- --? (decrement)
- &= (bitwise and)
- |= (bitwise or)

Restore
July 16, 2007, at 04:46 AM by Paul Badger -
Added lines 58-64:

Compound Operators

- ++ (increment)
- |? (decrement)
- (bitwise and)
- (bitwise or)

Restore
June 11, 2007, at 06:57 PM by Paul Badger -
Changed lines 91-92 from:
to:

- PROGMEM

Restore
May 29, 2007, at 02:34 PM by Paul Badger -
Changed lines 85-86 from:

Variable Scope

to:

Variable Scope & Qualifiers

Changed lines 90-91 from:
to:

- const

Restore
May 28, 2007, at 01:50 PM by Paul Badger -
Added line 72:

- boolean

Restore
May 26, 2007, at 07:41 PM by Paul Badger -
Changed lines 106-107 from:

- ASCII chart?

to:

- ASCII chart

Restore
May 26, 2007, at 07:41 PM by Paul Badger -
Changed lines 106-107 from:
to:

- ASCII chart?

Restore
May 26, 2007, at 07:08 AM by Paul Badger -
Changed line 26 from:

- do... while

to:

- do... while

Restore
May 26, 2007, at 07:07 AM by Paul Badger -
Added line 26:

- do... while

Restore
May 26, 2007, at 06:36 AM by Paul Badger -
Changed lines 26-28 from:
to:

- break
- continue

Restore
May 17, 2007, at 10:36 PM by Paul Badger -
Changed lines 85-86 from:
to:

- volatile

Restore
May 17, 2007, at 11:51 AM by David A. Mellis -
Changed lines 4-5 from:

Arduino programs can be divided in three main parts: **structure**, **values** (variables and constants), and **functions**.

to:

Arduino programs can be divided in three main parts: **structure**, **values** (variables and constants), and **functions**. The Arduino language is based on C/C++.

Restore
May 17, 2007, at 11:09 AM by Paul Badger -
Changed lines 110-111 from:

- pullup resistors?

to:
Restore
May 17, 2007, at 11:08 AM by Paul Badger -
Changed lines 110-111 from:

- pullup resistors

to:

- pullup resistors?

Restore
May 17, 2007, at 11:08 AM by Paul Badger -
Changed lines 110-111 from:
to:

- pullup resistors

Restore
May 04, 2007, at 06:01 AM by Paul Badger -
Changed lines 83-85 from:

- Variable scope
- Static

to:

- variable scope
- static

Restore
May 04, 2007, at 06:00 AM by Paul Badger -
Added lines 80-85:

Variable Scope

- Variable scope
- Static

Restore
April 29, 2007, at 05:06 AM by David A. Mellis - math.h isn't supported, so don't document it here.
Changed lines 123-124 from:

- math.h(trig,sqrt,pow etc.)

to:
Restore
April 29, 2007, at 05:03 AM by David A. Mellis - API changes (including exposing internal registers) should be discussed on the developers list
Changed lines 54-55 from:

- port manipulation

to:
Changed lines 96-98 from:

- Atmega8 hardware
- Atmega168 hardware

to:
Restore
April 27, 2007, at 10:18 PM by Paul Badger -

Changed lines 126-127 from:

- math.h(math.h - trig,sqrt,pow etc.)

to:

- math.h(trig,sqrt,pow etc.)

Restore
April 27, 2007, at 10:18 PM by Paul Badger -
Changed lines 126-127 from:

- math?(math.h - trig,sqrt,pow etc.)

to:

- math.h(math.h - trig,sqrt,pow etc.)

Restore
April 27, 2007, at 10:17 PM by Paul Badger -
Changed lines 126-127 from:

- mathHeader(trig,sqrt,pow etc.)

to:

- math?(math.h - trig,sqrt,pow etc.)

Restore
April 27, 2007, at 10:08 PM by Paul Badger -
Added line 77:

- double

Restore
April 27, 2007, at 10:06 PM by Paul Badger -
Changed lines 125-126 from:

- math.h(trig,sqrt,pow etc.)

to:

- mathHeader(trig,sqrt,pow etc.)

Restore
April 27, 2007, at 09:25 PM by Paul Badger -
Changed lines 125-126 from:
to:

- math.h(trig,sqrt,pow etc.)

Restore
April 25, 2007, at 09:34 PM by Paul Badger -
Changed lines 86-87 from:

- Constants

to:

- IntegerConstants

Restore
April 25, 2007, at 09:31 PM by Paul Badger -
Changed lines 86-87 from:

- Integer Constants

to:

- Constants

Changed line 90 from:

- cast(cast operator)

to:

- cast (cast operator)

Restore
April 25, 2007, at 09:24 PM by Paul Badger -
Changed lines 62-63 from:

- #include

to:

- #include

Restore
April 25, 2007, at 08:58 PM by Paul Badger -
Changed lines 62-63 from:
to:

- #include

Restore
April 24, 2007, at 10:32 AM by Paul Badger -
Changed lines 54-55 from:
to:

- port manipulation

Changed lines 97-98 from:

- port manipulation

to:
Restore
April 24, 2007, at 12:58 AM by Paul Badger -
Changed lines 96-97 from:

- Port Manipulation

to:

- port manipulation

Restore
April 24, 2007, at 12:57 AM by Paul Badger -
Changed lines 91-92 from:

Reference

to:

Reference

Restore
April 24, 2007, at 12:29 AM by Paul Badger -
Changed lines 96-97 from:
to:

- Port Manipulation

Restore
April 23, 2007, at 10:29 PM by Paul Badger -
Changed lines 94-96 from:
to:

- Atmega8 hardware
- Atmega168 hardware

Restore
April 18, 2007, at 08:49 AM by Paul Badger -
Changed line 50 from:

- ^ (bitwise xor)

to:

- ^ (bitwise xor)

Restore
April 17, 2007, at 11:22 PM by Paul Badger -
Changed lines 93-94 from:

- keywords)

to:

- keywords

Restore
April 17, 2007, at 11:21 PM by Paul Badger -
Changed lines 93-94 from:

- keywords(keywords)

to:

- keywords)

Restore
April 17, 2007, at 11:11 PM by Paul Badger -
Changed lines 91-94 from:
to:

Reference

- keywords(keywords)

Restore
April 17, 2007, at 09:08 PM by Paul Badger -
Changed line 50 from:

- ^ (bitwise xor)

to:

- ^ (bitwise xor)

Restore
April 17, 2007, at 08:49 PM by Paul Badger -
Changed line 51 from:

- ~ (bitwise not)

to:

- ~ (bitwise not)

Restore
April 17, 2007, at 08:31 PM by Paul Badger -
Changed lines 48-49 from:

- & (bitwise and)
- | (bitwise or)

to:

- & (bitwise and)
- | (bitwise or)

Restore
April 16, 2007, at 11:15 AM by Paul Badger -
Added line 71:

- unsigned int

Added line 73:

- unsigned long

Restore
April 16, 2007, at 11:02 AM by Paul Badger -
Changed lines 2-3 from:

Arduino Reference

to:

Arduino Reference

Restore
April 16, 2007, at 02:02 AM by David A. Mellis -
Added lines 66-67:

Data Types

Changed lines 75-77 from:

- cast(cast operator)
- sizeof() (sizeof operator)

to:
Changed lines 84-85 from:
to:

Utilities

- cast(cast operator)
- sizeof() (sizeof operator)

Restore
April 16, 2007, at 01:56 AM by Paul Badger -
Changed line 28 from:

- Arithmetic(addition)

to:

- plus(addition)

Restore
April 16, 2007, at 01:55 AM by David A. Mellis -
Changed line 28 from:

- plus(addition)

to:

- Arithmetic(addition)

Changed lines 48-51 from:

- & (and)
- | (or)
- ^ (xor)
- ~ (not)

to:

- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
- ~ (bitwise not)

Restore
April 16, 2007, at 12:22 AM by Paul Badger -
Changed lines 52-54 from:

to:

- << (bitshift left)
- >> (bitshift right)

Restore
April 16, 2007, at 12:19 AM by Paul Badger -
Restore
April 15, 2007, at 11:47 PM by Paul Badger -
Changed lines 51-52 from:

- ! (not)

to:

- ~ (not)

Restore
April 15, 2007, at 11:35 PM by Paul Badger -
Changed line 42 from:

Boolean Operations

to:

Boolean Operators

Changed line 47 from:

Bitwise Operations

to:

Bitwise Operators

Restore
April 15, 2007, at 11:34 PM by Paul Badger -
Added lines 47-52:

Bitwise Operations

- & (and)
- | (or)
- ^ (xor)
- ! (not)

Restore
April 15, 2007, at 11:31 PM by Paul Badger -
Changed lines 66-67 from:

- sizeof(sizeof operator)

to:

- sizeof() (sizeof operator)

Restore
April 15, 2007, at 04:40 PM by Paul Badger -
Changed lines 66-67 from:
to:

- sizeof(sizeof operator)

Restore
April 15, 2007, at 04:17 PM by Paul Badger -
Changed lines 65-66 from:
to:

- cast(cast operator)

Restore

April 15, 2007, at 03:05 PM by Paul Badger -
Changed lines 28-31 from:

- Addition?(addition)
- -?(subtraction)
- *?(multiplication)
- /?(division)

to:

- plus(addition)
- -(subtraction)
- *(multiplication)
- /(division)

Restore
April 15, 2007, at 02:58 PM by Paul Badger -
Restore
April 15, 2007, at 02:55 PM by Paul Badger -
Restore
April 15, 2007, at 02:49 PM by Paul Badger -
Changed lines 28-31 from:

- Addition?(modulo)
- -?(modulo)
- *?(modulo)
- /?(modulo)

to:

- Addition?(addition)
- -?(subtraction)
- *?(multiplication)
- /?(division)

Restore
April 15, 2007, at 02:47 PM by Paul Badger -
Restore
April 15, 2007, at 02:47 PM by Paul Badger -
Added lines 28-31:

- Addition?(modulo)
- -?(modulo)
- *?(modulo)
- /?(modulo)

Restore
April 13, 2007, at 11:27 PM by David A. Mellis -
Changed lines 28-29 from:

- %(modulo)

to:

- %(modulo)

Restore
April 13, 2007, at 11:20 PM by Paul Badger -
Restore
April 13, 2007, at 11:18 PM by Paul Badger -
Restore
April 13, 2007, at 11:17 PM by Paul Badger -
Restore
April 13, 2007, at 10:53 PM by David A. Mellis - moving % (modulo) the left column under "arithmetic operators"; keeping the right col. for functions
Changed lines 15-16 from:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you woiuld set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

to:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Added lines 27-29:

Arithmetic Operators

- %(modulo)

Deleted line 93:

- %(modulo)

Restore
April 13, 2007, at 10:50 PM by Paul Badger -
Changed line 91 from:

- %

to:

- %(modulo)

Restore
April 13, 2007, at 10:00 PM by Paul Badger -
Changed line 91 from:

- % (modulo)

to:

- %

Restore
April 13, 2007, at 09:49 PM by Paul Badger -
Changed line 91 from:
to:

- % (modulo)

Restore
December 25, 2006, at 06:25 PM by David A. Mellis -
Changed lines 4-6 from:

Arduino provides a library of functions on top of the standard AVR C/C++ routines. The main file of your sketch is compiled as C++, but you can add straight C files as well.

Arduino programs can be divided in three main parts: **program structure**, **values** (variables and constants), and **functions**.

to:

Arduino programs can be divided in three main parts: **structure**, **values** (variables and constants), and **functions**.

Changed lines 8-11 from:

Program Structure

Getting Started

to:

Structure

Added line 52:

- byte

Changed lines 65-66 from:
to:

- Integer Constants

Changed lines 75-77 from:

- int digitalRead(pin)
- unsigned long pulseIn(pin, value)

to:

- int digitalRead(pin)

Changed lines 81-85 from:

Handling Time

to:

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

Changed lines 90-93 from:

Random number generation

New in Arduino 0005.

to:

Math

- min(x, y)
- max(x, y)
- abs(x)
- constrain(x, a, b)

Random Numbers

Added lines 103-109:

External Interrupts

These functions allow you to trigger a function when the input to a pin changes value.

- attachInterrupt(interrupt, function, mode)
- detachInterrupt(interrupt)

Changed lines 115-116 from:

- Serial.available()
- Serial.read()

to:

- int Serial.available()
- int Serial.read()
- Serial.flush()

Deleted lines 120-137:

Old serial library (deprecated).

- beginSerial(speed)
- serialWrite(c)
- int serialAvailable()
- int serialRead()
- printMode(mode)
- printByte(c)
- printString(str)
- printInteger(num)
- printHex(num)

- printOctal(num)
- printBinary(num)
- printNewline()

Expert / Internal Functions

- avr-libc is the standard library of C functions that Arduino builds on. To use these, you may need to add the corresponding **#include** statement to the top of your sketch.

Restore
November 12, 2006, at 11:51 AM by David A. Mellis - removing bit about floats not being supported
Changed lines 52-53 from:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below. *Floating point variables and operations are not currently supported.*

to:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

Added line 57:

- float

Restore
November 04, 2006, at 01:19 PM by David A. Mellis -
Deleted lines 5-6:

If you're used to Processing or Java, please check out the Arduino/Processing language comparison.

Restore
November 04, 2006, at 01:18 PM by David A. Mellis -
Deleted lines 123-137:

Libraries

These are the "official" libraries that are included in the Arduino distribution. They are compatible with the Wiring versions, and the links below point to the (excellent) Wiring documentation.

- Matrix - Basic LED Matrix display manipulation library
- Sprite - Basic image sprite manipulation library for use in animations with an LED matrix
- Wire - Two Wire Interface for sending and receiving data over a net of devices or sensors.

These are not (yet) included with the Arduino distribution and may change.

- Simple Message System
- LCD Library
- TextString Library
- Metro

Restore
October 21, 2006, at 03:32 PM by David A. Mellis - adding link to metro library
Added lines 137-138:

- Metro

Restore
October 21, 2006, at 03:07 PM by David A. Mellis - adding libraries included in the distribution
Added lines 126-131:

These are the "official" libraries that are included in the Arduino distribution. They are compatible with the Wiring versions, and the links below point to the (excellent) Wiring documentation.

- Matrix - Basic LED Matrix display manipulation library
- Sprite - Basic image sprite manipulation library for use in animations with an LED matrix
- Wire - Two Wire Interface for sending and receiving data over a net of devices or sensors.

Restore
October 20, 2006, at 11:57 AM by Tom Igoe -
Added line 130:

- TextString Library

Restore
October 01, 2006, at 03:55 PM by David A. Mellis - adding libraries
Added lines 123-129:

Libraries

These are not (yet) included with the Arduino distribution and may change.

- Simple Message System
- LCD Library

Restore
September 05, 2006, at 08:58 AM by David A. Mellis -
Changed lines 4-5 from:

These are the basics about the Arduino language, which implemented in C. If you're used to Processing or Java, please check out the Arduino/Processing language comparison.

to:

Arduino provides a library of functions on top of the standard AVR C/C++ routines. The main file of your sketch is compiled as C++, but you can add straight C files as well.

If you're used to Processing or Java, please check out the Arduino/Processing language comparison.

Restore
August 27, 2006, at 10:58 AM by David A. Mellis -
Added lines 81-93:

Handling Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Random number generation

New in Arduino 0005.

- randomSeed(seed)
- long random(max)
- long random(min, max)

Changed lines 118-122 from:

Handling Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

to:
Restore
August 26, 2006, at 04:07 PM by David A. Mellis -
Changed line 1 from:

(:title API Reference:)

to:

(:title Reference:)

Restore
August 26, 2006, at 04:07 PM by David A. Mellis -
Changed lines 1-2 from:

(:title Arduino API Reference:) !!Arduino Reference

to:

(:title API Reference:)

Arduino Reference

Restore
August 26, 2006, at 04:07 PM by David A. Mellis -
Changed lines 1-2 from:

Arduino Reference

to:

(:title Arduino API Reference:) !!Arduino Reference

Restore
August 01, 2006, at 12:55 PM by David A. Mellis - Adding string and array.
Changed lines 56-58 from:
to:

- string
- array

Restore
August 01, 2006, at 07:18 AM by David A. Mellis -
Added lines 30-31:

- == (equal to)
- != (not equal to)

Restore
August 01, 2006, at 07:17 AM by David A. Mellis -
Changed lines 30-34 from:

- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

to:

- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Restore
August 01, 2006, at 07:04 AM by David A. Mellis - adding comparison and boolean operators
Added lines 29-39:

Comparison Operators

- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Boolean Operations

- && (and)
- || (or)
- ! (not)

Restore
July 09, 2006, at 07:47 AM by David A. Mellis - adding link to avr-libc
Added lines 93-95:

Expert/Internal Functions

- avr-libc is the standard library of C functions that Arduino builds on. To use these, you may need to add the corresponding **#include** statement to the top of your sketch.

Restore

May 28, 2006, at 05:03 PM by David A. Mellis -
Changed lines 38-39 from:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below. **Warning**: floating point variables and operations are not currently supported.

to:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below. *Floating point variables and operations are not currently supported.*

Changed lines 67-68 from:

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, you cannot also use pins 0 and 1 for digital i/o.

to:

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, *you cannot also use pins 0 and 1 for digital i/o.*

Restore
May 28, 2006, at 05:01 PM by David A. Mellis - clarifying serial communication
Changed lines 67-68 from:

Used for communication between the Arduino board and the computer, via the USB or serial connection. This communication happens on digital pins 0 (RX) and 1 (TX). This means that these functions can be used to communicate with a serial device on those pins, but also that any digital i/o on pins 0 and 1 will interfere with this communication.

to:

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, you cannot also use pins 0 and 1 for digital i/o.

Restore
May 28, 2006, at 04:55 PM by David A. Mellis -
Changed lines 67-68 from:

Used for communication between the Arduino board and the computer, via the USB or serial connection. Or used for serial communication on digital pins 0 (RX) and 1 (TX). *Note: if you are using these functions, you cannot also use pins 0 and 1 for digital i/o.*

to:

Used for communication between the Arduino board and the computer, via the USB or serial connection. This communication happens on digital pins 0 (RX) and 1 (TX). This means that these functions can be used to communicate with a serial device on those pins, but also that any digital i/o on pins 0 and 1 will interfere with this communication.

Restore
May 28, 2006, at 04:52 PM by David A. Mellis - serial notes
Changed lines 67-68 from:

Used for communication between the Arduino board and the computer, via the USB or serial connection (both appear as serial ports to software on the computer). Or used for serial communication on digital pins 0 (RX) and 1 (TX).

to:

Used for communication between the Arduino board and the computer, via the USB or serial connection. Or used for serial communication on digital pins 0 (RX) and 1 (TX). *Note: if you are using these functions, you cannot also use pins 0 and 1 for digital i/o.*

- Serial.begin(speed)
- Serial.available()
- Serial.read()
- Serial.print(data)
- Serial.println(data)

Old serial library (deprecated).

Deleted lines 88-96:

Serial Library as of version 0004

- Serial.begin(speed)
- Serial.available()
- Serial.read()
- Serial.print(data)
- Serial.println(data)

Restore
April 19, 2006, at 06:45 AM by David A. Mellis - Clarifying serial communication (USB or serial)
Added lines 66-68:

Used for communication between the Arduino board and the computer, via the USB or serial connection (both appear as serial ports to software on the computer). Or used for serial communication on digital pins 0 (RX) and 1 (TX).

Restore
April 17, 2006, at 06:47 AM by Massimo Banzi -
Restore
April 14, 2006, at 07:49 AM by David A. Mellis - Adding pulseIn()
Changed lines 59-60 from:
to:

- unsigned long pulseIn(pin, value)

Restore
March 31, 2006, at 06:19 AM by Clay Shirky -
Changed line 5 from:

Arduino programs can be divided in three main parts: program structure, values (variables and constants), and functions.

to:

Arduino programs can be divided in three main parts: **program structure**, **values** (variables and constants), and **functions**.

Changed lines 17-18 from:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you initialize variables?, set pinMode, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

to:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you woiuld set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Restore
March 31, 2006, at 05:02 AM by Clay Shirky -
Added lines 11-13:

An Arduino program run in two parts:

Added lines 16-18:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you initialize variables?, set pinMode, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Changed lines 21-22 from:

Further Syntax

to:

Control Structures

Added lines 28-29:

Further Syntax

Restore

March 31, 2006, at 04:48 AM by Clay Shirky -
Changed line 5 from:

Arduino programs can be divided in three main parts:

to:

Arduino programs can be divided in three main parts: program structure, values (variables and constants), and functions.

Restore
March 31, 2006, at 03:39 AM by David A. Mellis - Clarifying analogWrite == pwm
Changed line 46 from:

Digital Pins

to:

Digital I/O

Changed line 51 from:

Analog Pins

to:

Analog I/O

Changed lines 53-54 from:

- analogWrite(pin, value)

to:

- analogWrite(pin, value) - *PWM*

Restore
March 30, 2006, at 08:02 PM by Tom Igoe -
Changed line 17 from:

- else?

to:

- if...else

Restore
March 30, 2006, at 08:01 PM by Tom Igoe -
Added line 17:

- else?

Restore
March 28, 2006, at 03:19 AM by David A. Mellis - Changed "Define" to "#define"
Changed lines 24-25 from:

- Define

to:

- #define

Restore
March 27, 2006, at 01:10 PM by Tom Igoe -
Changed lines 24-25 from:
to:

- Define

Changed lines 35-36 from:

Another form of variables are constants, which are preset variables that you do not need to define or initialize.

to:

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

Changed lines 40-53 from:

Finally, defines are a useful C component that allow you to specify something before it is compiled.

Defines

You can define numbers in arduino that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

```
#define constantName value
```

Note that the # is necessary. For example:

```
#define ledPin 3
```

The compiler will replace any mentions of ledPin with the value 3 at compile time.

to:
Restore
March 27, 2006, at 12:56 PM by Tom Igoe -
Restore
March 27, 2006, at 12:28 PM by Tom Igoe -
Changed lines 83-87 from:
to:

- Serial.print(data)
- Serial.println(data)

Restore
March 27, 2006, at 12:23 PM by Tom Igoe -
Changed lines 82-83 from:
to:

- Serial.read()

Restore
March 27, 2006, at 12:19 PM by Tom Igoe -
Changed lines 81-82 from:
to:

- Serial.available()

Restore
March 27, 2006, at 12:14 PM by Tom Igoe -
Added lines 79-81:

Serial Library as of version 0004

- Serial.begin(speed)

Restore
March 26, 2006, at 02:21 PM by Jeff Gray -
Changed line 18 from:

- select case?

to:

- switch case

Restore
March 26, 2006, at 02:21 PM by Jeff Gray -
Added line 18:

- select case?

Restore
March 26, 2006, at 11:29 AM by Jeff Gray -
Deleted line 5:
Restore

March 25, 2006, at 02:21 PM by Jeff Gray -
Changed lines 9-10 from:

Program Structure

to:

Program Structure

Changed lines 25-26 from:

Variables

to:

Variables

Changed lines 54-55 from:

Functions

to:

Functions

Restore
March 25, 2006, at 02:20 PM by Jeff Gray -
Changed lines 7-8 from:

(:table border=0 cellpadding=5 cellspacing=0:) (:cell:)

to:

(:table width=90% border=0 cellpadding=5 cellspacing=0:) (:cell width=50%:)

Changed line 53 from:

(:cell:)

to:

(:cell width=50%:)

Restore
March 25, 2006, at 02:19 PM by Jeff Gray -
Changed lines 7-8 from:
to:

(:table border=0 cellpadding=5 cellspacing=0:) (:cell:)

Changed line 53 from:
to:

(:cell:)

Changed line 83 from:
to:

(:tableend:)

Restore
March 25, 2006, at 02:17 PM by Jeff Gray -
Added lines 7-8:
Added line 53:
Added line 83:
Restore
March 25, 2006, at 12:20 AM by Jeff Gray -
Restore
March 24, 2006, at 05:46 PM by Jeff Gray -
Changed lines 41-42 from:

You can define constants in arduino, that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

to:

You can define numbers in arduino that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

Restore
March 24, 2006, at 05:45 PM by Jeff Gray -
Added line 31:

Constants

Changed lines 39-40 from:

Defines

to:

Defines

Restore
March 24, 2006, at 05:44 PM by Jeff Gray -
Added lines 36-49:

Finally, defines are a useful C component that allow you to specify something before it is compiled.

Defines

You can define constants in arduino, that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

```
#define constantName value
```

Note that the # is necessary. For example:

```
#define ledPin 3
```

The compiler will replace any mentions of ledPin with the value 3 at compile time.

Deleted lines 78-91:

Creating New Functions

Defines

You can define constants in arduino, that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

```
#define constantName value
```

Note that the # is necessary. For example:

```
#define ledPin 3
```

The compiler will replace any mentions of ledPin with the value 3 at compile time.

Restore
March 24, 2006, at 05:42 PM by Jeff Gray -
Added lines 31-35:

Another form of variables are constants, which are preset variables that you do not need to define or initialize.

- HIGH | LOW
- INPUT | OUTPUT

Deleted lines 65-69:

Constants

- HIGH | LOW
- INPUT | OUTPUT

Restore
March 24, 2006, at 04:46 PM by Jeff Gray -
Added lines 5-6:

Arduino programs can be divided in three main parts:

Changed lines 9-11 from:

Arduino programs can be divided in three main parts:

- Variable Declaration

to:

Getting Started

Added lines 12-14:

- Variable Declaration
- Function Declaration

Further Syntax

Restore
February 09, 2006, at 08:25 AM by 85.18.81.162 -
Changed lines 22-23 from:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

to:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below. **Warning**: floating point variables and operations are not currently supported.

Restore
January 20, 2006, at 10:44 AM by 85.18.81.162 -
Changed lines 3-6 from:

These are the basics about the arduino language.

to:

These are the basics about the Arduino language, which implemented in C. If you're used to Processing or Java, please check out the Arduino/Processing language comparison.

Restore
January 08, 2006, at 12:46 PM by 82.186.237.10 -
Changed lines 53-54 from:
to:

- printNewline()

Restore
January 03, 2006, at 03:35 AM by 82.186.237.10 -
Deleted lines 65-79:

Writing Comments

Comments are parts in the program that are used to inform about the way the program works. They are not going to be compiled, nor will be exported to the processor. They are useful for you to understand what a certain program you downloaded is doing or to inform to your colleagues about what one of its lines is. There are two different ways of marking a line as a comment:

- you could use a double-slash in the beginning of a line: ***//***
- you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments: ***/* blabla */***

Tip When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

Restore

December 30, 2005, at 05:41 AM by 82.186.237.10 -
Deleted lines 6-9:

Variables

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin.

Added lines 22-29:

Variables

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

- char
- int
- long

Restore
December 29, 2005, at 08:08 AM by 82.186.237.10 -
Changed lines 18-25 from:
to:

- if
- for
- while
- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)

Restore
December 28, 2005, at 03:59 PM by 82.186.237.10 -
Changed lines 22-25 from:

- void pinMode(int pin, int mode)
- void digitalWrite(int pin, int val)
- int digitalRead(int pin)

to:

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Changed lines 27-29 from:

- int analogRead(int pin)
- void analogWrite(int pin, int val)

to:

- int analogRead(pin)
- analogWrite(pin, value)

Changed lines 31-32 from:

- void beginSerial(int baud)
- void serialWrite(unsigned char c)

to:

- beginSerial(speed)
- serialWrite(c)

Changed lines 35-42 from:

- void printMode(int mode)
- void printByte(unsigned char c)
- void printString(unsigned char *s)
- void printInteger(int n)
- void printHex(unsigned int n)

- void printOctal(unsigned int n)
- void printBinary(unsigned int n)

to:

- printMode(mode)
- printByte(c)
- printString(str)
- printInteger(num)
- printHex(num)
- printOctal(num)
- printBinary(num)

Changed lines 44-47 from:

- unsigned long millis?()
- void delay(unsigned long ms)
- void delayMicroseconds(unsigned long us)

to:

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Restore
December 16, 2005, at 02:58 PM by 85.18.81.162 -
Added lines 67-80:

Defines

You can define constants in arduino, that don't take up any program memory space on the chip. Arduino defines have the same syntax as C defines:

```
#define constantName value
```

Note that the # is necessary. For example:

```
#define ledPin 3
```

The compiler will replace any mentions of ledPin with the value 3 at compile time.

Restore
December 09, 2005, at 11:39 AM by 195.178.229.25 -
Changed lines 4-6 from:

These are the functions available in the arduino language

to:

These are the basics about the arduino language.

Changed line 15 from:

- variable declaration

to:

- Variable Declaration

Restore
December 03, 2005, at 02:02 PM by 213.140.6.103 -
Changed lines 50-52 from:

- HIGH | LOW
- INPUT | OUTPUT

to:

- HIGH | LOW
- INPUT | OUTPUT

Restore

December 03, 2005, at 01:41 PM by 213.140.6.103 -
Changed line 21 from:

Digital Pins

to:

Digital Pins

Changed line 26 from:

Analog Pins

to:

Analog Pins

Changed line 30 from:

Serial Communication

to:

Serial Communication

Changed line 43 from:

Handling Time

to:

Handling Time

Restore
December 03, 2005, at 01:40 PM by 213.140.6.103 -
Added lines 20-21:

Digital Pins

Added lines 25-26:

Analog Pins

Added lines 29-30:

Serial Communication

Added lines 42-43:

Handling Time

Restore
December 03, 2005, at 12:48 PM by 213.140.6.103 -
Added lines 40-44:

Constants

- HIGH | LOW
- INPUT | OUTPUT

Restore
December 03, 2005, at 12:37 PM by 213.140.6.103 -
Added lines 40-43:

Creating New Functions

Restore
December 03, 2005, at 10:53 AM by 213.140.6.103 -
Changed lines 9-10 from:
to:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin.

Added lines 12-15:

Arduino programs can be divided in three main parts:

- variable declaration

Changed lines 38-49 from:

- void delayMicroseconds(unsigned long us)

to:

- void delayMicroseconds(unsigned long us)

Writing Comments

Comments are parts in the program that are used to inform about the way the program works. They are not going to be compiled, nor will be exported to the processor. They are useful for you to understand what a certain program you downloaded is doing or to inform to your colleagues about what one of its lines is. There are two different ways of marking a line as a comment:

- you could use a double-slash in the beginning of a line: ***//***
- you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments: ***/* blabla */***

Tip When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

Restore
November 27, 2005, at 10:42 AM by 81.154.199.248 -
Changed lines 12-13 from:

- voide loop()

to:

- void loop()

Restore
November 27, 2005, at 10:17 AM by 81.154.199.248 -
Changed lines 24-33 from:

- void printMode(int mode)
- void printByte(unsigned char c)
- void printString(unsigned char *s)
- void printInteger(int n)
- void printHex(unsigned int n)
- void printOctal(unsigned int n)
- void printBinary(unsigned int n)
- unsigned long millis()
- void delay(unsigned long ms)
- void delayMicroseconds(unsigned long us)

to:

- void printMode(int mode)
- void printByte(unsigned char c)
- void printString(unsigned char *s)
- void printInteger(int n)
- void printHex(unsigned int n)
- void printOctal(unsigned int n)
- void printBinary(unsigned int n)
- unsigned long millis?()
- void delay(unsigned long ms)
- void delayMicroseconds(unsigned long us)

Restore
November 27, 2005, at 10:15 AM by 81.154.199.248 -
Changed lines 16-23 from:

void digitalWrite(int pin, int val)
- int digitalRead(int pin)
- int analogRead(int pin)
- void analogWrite(int pin, int val)
- void beginSerial(int baud)
- void serialWrite(unsigned char c)
- int serialAvailable()
- int serialRead()

to:

- void digitalWrite(int pin, int val)
- int digitalRead(int pin)
- int analogRead(int pin)
- void analogWrite(int pin, int val)
- void beginSerial(int baud)
- void serialWrite(unsigned char c)
- int serialAvailable()
- int serialRead()

Restore
November 27, 2005, at 09:58 AM by 81.154.199.248 -
Changed lines 11-13 from:

- void setup
- voide loop

to:

- void setup()
- voide loop()

Restore
November 27, 2005, at 09:58 AM by 81.154.199.248 -
Added lines 9-13:

Program Structure

- void setup
- voide loop

Restore
November 27, 2005, at 09:56 AM by 81.154.199.248 -
Added lines 6-9:

Variables

Functions

Restore
November 27, 2005, at 09:49 AM by 81.154.199.248 -
Added lines 1-24:

Arduino Reference

These are the functions available in the arduino language

- void pinMode(int pin, int mode)
- void digitalWrite(int pin, int val)
- int digitalRead(int pin)
- int analogRead(int pin)
- void analogWrite(int pin, int val)
- void beginSerial(int baud)
- void serialWrite(unsigned char c)
- int serialAvailable()
- int serialRead()
- void printMode(int mode)
- void printByte(unsigned char c)
- void printString(unsigned char *s)

- void printInteger(int n)
- void printHex(unsigned int n)
- void printOctal(unsigned int n)
- void printBinary(unsigned int n)
- unsigned long millis()
- void delay(unsigned long ms)
- void delayMicroseconds(unsigned long us)

Restore

Language Reference

See the extended reference for more advanced features of the Arduino languages and the libraries page for interfacing with particular types of hardware.

Arduino programs can be divided in three main parts: *structure*, *values* (variables and constants), and *functions*. The Arduino language is based on C/C++.

Structure

An Arduino program run in two parts:

- void setup()
- void loop()

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinModes, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

- Variable Declaration
- Function Declaration
  - void

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)

Arithmetic Operators

- + (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Functions

Digital I/O

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Analog I/O

- int analogRead(pin)
- analogWrite(pin, value) - *PWM*

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Math

- min(x, y)
- max(x, y)
- abs(x)
- constrain(x, a, b)
- map(value, fromLow, fromHigh, toLow, toHigh)
- pow(base, exponent)
- sqrt(x)

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Random Numbers

- randomSeed(seed)
- long random(max)
- long random(min, max)

Serial Communication

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB

Comparison Operators

- == (equal to)
- != (not equal to)
- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Boolean Operators

- && (and)
- || (or)
- ! (not)

Compound Operators

- ++ (increment)
- -- (decrement)
- += (compound addition)
- -= (compound subtraction)
- *= (compound multiplication)
- /= (compound division)

Variables

Variables are expressions that you can use in programs to store values, such as a sensor reading from an analog pin.

Constants

Constants are particular values with specific meanings.

- HIGH | LOW
- INPUT | OUTPUT
- true | false

- Integer Constants

Data Types

Variables can have various types, which are described below.

- boolean
- char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double
- string
- array

Reference

connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, *you cannot also use pins 0 and 1 for digital i/o.*

- Serial.begin(speed)
- int Serial.available()
- int Serial.read()
- Serial.flush()
- Serial.print(data)
- Serial.println(data)

Didn't find something? Check the extended reference or the libraries.

- ASCII chart

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Define

#define is a useful C component that allows you to give a name to a constant value before the program is compiled. Defined constants in arduino don't take up any program memory space on the chip. The compiler will replace references to these constants with the defined value at compile time.

Arduino defines have the same syntax as C defines:

Syntax

```
#define constantName value
```

Note that the # is necessary.

Example

```
#define ledPin 3
//The compiler will replace any mention of ledPin with the value 3 at compile time.
```

Tip

There is no semicolon after the #define statement. If you include one, the compiler will throw cryptic errors further down the page.

See

- Constants

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

#include

#include is used to include outside libraries in your sketch. This gives the programmer access to a large group of standard C libraries (groups of pre-made functions), and also libraries written especially for Arduino.

The main reference page for AVR C libraries (AVR is a reference to the Atmel chips on which the Arduino is based) is here.

Note that **#include**, similar to **#define**, has no semicolon terminator, and the compiler will yield cryptic error messages if you add one.

Example

This example includes a library that is used to put data into the program space *flash* instead of *ram*. This saves the ram space for dynamic memory needs and makes large lookup tables more practical.

```
#include <avr/pgmspace.h>

prog_uint16_t myConstants[] PROGMEM = {0, 21140, 702  , 9128,  0, 25764, 8456,
0,0,0,0,0,0,0,0,29810,8968,29762,29762,4500};
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

analogReference(type)

Description

Configures the reference voltage used for analog input. The analogRead() function will return 1023 for an input equal to the reference voltage. The options are:

- DEFAULT: the default analog reference of 5 volts.
- INTERNAL: an built-in reference, equal to 1.1 volts on the ATmega168 and 2.56 volts on the ATmega8.
- EXTERNAL: the voltage applied to the AREF pin is used as the reference.

Parameters

type: which type of reference to use (DEFAULT, INTERNAL, or EXTERNAL).

Returns

None.

Warning

It is a good idea to connect external voltages to the AREF pin through a 5K resistor. This will prevent possible internal damage to the Atmega chip if analogReference() software settings are incompatible with the current hardware setup. Connecting external voltages through a resistor also make it possible to switch the AREF voltage on the fly, say from the 5 volt DEFAULT setting, to a 3.3 volt EXTERNAL setting (and applied voltage), without the hardware setup affecting either ADC configuration.

Use of the AREF pin

The voltage applied to the AREF pin directly governs the ADC and sets the voltage at which the ADC will report its highest reading, 1023. Lower voltages applied to ADC (analog) pins will be scaled proportionally, so at the DEFAULT setting (5 volt internal connection), 2.5 volts on an analog pin will report approximately 512.

The default configuration on all Arduino implementations is to have nothing connected externally to the AREF pin (Atmega pin 21). In this case the DEFAULT analogReference software setting connects the AVCC voltage, internally, to the AREF pin. This appears to be a low impedance connection (high current) and voltages, other than AVCC, applied (erroneously) to the AREF pin in the DEFAULT setting could damage the ATMEGA chip. For this reason, connecting external voltages to the AREF pin through a 5K resistor is a good idea.

The AREF pin may also be connected internally to an (internal) 1.1 volt source with analogReference(INTERNAL). With this setting voltages applied to the ADC (analog) pins that are 1.1 volts (or higher) will report 1023, when read with analogRead. Lower voltages will report proportional values, so .55 volts will report about 512.

The connection between the 1.1 volt source and the AREF pin is a very high impedance (low current) connection, so that reading the 1.1 (internally supplied) voltage at the AREF pin may only be done with a more expensive, high-impedance multimeter. An external voltage applied (erroneously) to AREF pin while using the INTERNAL setting will not damage the chip, but will totally override the 1.1 volt source, and ADC readings will be governed by the external voltage. It is still desirable to connect any external voltage to the AREF pin however, through a 5K resistor to avoid the problem cited above.

The correct software setting for using the AREF pin with an external voltage is analogReference(EXTERNAL). This disconnects both of the internal references and the voltage applied externally to the AREF pin sets the reference voltage for the ADC.

See also

- Description of the analog input pins

analogRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

attachInterrupt(interrupt, function, mode)

Description

Specifies a function to call when external interrupt 0 or 1 occurs, on digital pin 2 or 3, respectively.

Note: *Inside the attached function, delay() won't work and the value returned by millis() will not increment. Serial data received while in the function may be lost. You should declare as volatile any variables that you modify within the attached function.*

Parameters

interrupt:: the number of the interrupt (*int*): 0 or 1.

function:: the function to call when the interrupt occurs; this function must take no parameters and return nothing. This function is sometimes referred to as an *interrupt service routine.*

mode: defines when the interrupt should be triggered. Four contstants are predefined as valid values:

- **LOW** to trigger the interrupt whenever the pin is low,
- **CHANGE** to trigger the interrupt whenever the pin changes value
- **RISING** to trigger when the pin goes from low to high,
- **FALLING** for when the pin goes from high to low.

Returns

none

Using Interrupts

Interrupts are useful for making things happen automatically in microcontroller programs, and can help solve timing problems. A good task for using an interrupt might be reading a rotary encoder, monitoring user input.

If you wanted to insure that a program always caught the pulses from a rotary encoder, never missing a pulse, it would make it very tricky to write a program to do anything else, because the program would need to constantly poll the sensor lines for the encoder, in order to catch pulses when they occurred. Other sensors have a similar interface dynamic too, such as trying to read a sound sensor that is trying to catch a click, or an infrared slot sensor (photo-interrupter) trying to catch a coin drop. In all of these situations, using an interrupt can free the microcontroller to get some other work done while not missing the doorbell.

Example

```
int pin = 13;
volatile int state = LOW;

void setup()
{
  pinMode(pin, OUTPUT);
  attachInterrupt(0, blink, CHANGE);
}

void loop()
{
  digitalWrite(pin, state);
}
```

```
void blink()
{
  state = !state;
}
```

See also

- detachInterrupt

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

detachInterrupt(interrupt)

Description

Turns off the given interrupt.

Parameters

interrupt: the number of interrupt to disable (0 or 1).

See also

- attachInterrupt()

Corrections, suggestions, and new documentation should be posted to the Forum.

The pointer operators

& (reference) and * (dereference)

Pointers are one of the more complicated subjects for beginners in learning C, and it is possible to write the vast majority of Arduino sketches without ever encountering pointers. However for manipulating certain data structures, the use of pointers can simplify the code, and and knowledge of manipulating pointers is handy to have in one's toolkit.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Bitwise AND (&), Bitwise OR (|), Bitwise XOR (^)

Bitwise AND (&)

The bitwise operators perform their calculations at the bit level of variables. They help solve a wide range of common programming problems. Much of the material below is from an excellent tutorial on bitwise math wihch may be found here.

Description and Syntax

Below are descriptions and syntax for all of the operators. Further details may be found in the referenced tutorial.

Bitwise AND (&)

The bitwise AND operator in C++ is a single ampersand, &, used between two other integer expressions. Bitwise AND operates on each bit position of the surrounding expressions independently, according to this rule: if both input bits are 1, the resulting output is 1, otherwise the output is 0. Another way of expressing this is:

```
    0  0  1  1    operand1
    0  1  0  1    operand2
    ----------
    0  0  0  1    (operand1 & operand2) - returned result
```

In Arduino, the type int is a 16-bit value, so using & between two int expressions causes 16 simultaneous AND operations to occur. In a code fragment like:

```
    int a =  92;    // in binary: 0000000001011100
    int b = 101;    // in binary: 0000000001100101
    int c = a & b;  // result:    0000000001000100, or 68 in decimal.
```

Each of the 16 bits in a and b are processed by using the bitwise AND, and all 16 resulting bits are stored in c, resulting in the value 01000100 in binary, which is 68 in decimal.

One of the most common uses of bitwise AND is to select a particular bit (or bits) from an integer value, often called masking. See below for an example

Bitwise OR (|)

The bitwise OR operator in C++ is the vertical bar symbol, |. Like the & operator, | operates independently each bit in its two surrounding integer expressions, but what it does is different (of course). The bitwise OR of two bits is 1 if either or both of the input bits is 1, otherwise it is 0. In other words:

```
    0  0  1  1    operand1
    0  1  0  1    operand2
    ----------
    0  1  1  1    (operand1 | operand2) - returned result
```

Here is an example of the bitwise OR used in a snippet of C++ code:

```
    int a =  92;    // in binary: 0000000001011100
    int b = 101;    // in binary: 0000000001100101
    int c = a | b;  // result:    0000000001111101, or 125 in decimal.
```

Example Program

A common job for the bitwise AND and OR operators is what programmers call Read-Modify-Write on a port. On microcontrollers, a port is an 8 bit number that represents something about the condition of the pins. Writing to a port controls all of the pins at once.

PORTD is a built-in constant that refers to the output states of digital pins 0,1,2,3,4,5,6,7. If there is 1 in an bit position, then that pin is HIGH. (The pins already need to be set to outputs with the pinMode() command.) So if we write `PORTD = B00110001;` we have made pins 2,3 & 7 HIGH. One slight hitch here is that we *may* also have changeed the state of Pins 0 & 1, which are used by the Arduino for serial communications so we may have interfered with serial communication.

```
     Our algorithm for the program is:
```

- Get PORTD and clear out only the bits corresponding to the pins we wish to control (with bitwise AND).
- Combine the modified PORTD value with the new value for the pins under control (with biwise OR).

```
int i;     // counter variable
int j;

void setup(){
DDRD = DDRD | B11111100; // set direction bits for pins 2 to 7, leave 0 and 1 untouched (xx | 00 == xx)
// same as pinMode(pin, OUTPUT) for pins 2 to 7
Serial.begin(9600);
}

void loop(){
for (i=0; i<64; i++){

PORTD = PORTD & B00000011;  // clear out bits 2 - 7, leave pins 0 and 1 untouched (xx & 11 == xx)
j = (i << 2);               // shift variable up to pins 2 - 7 - to avoid pins 0 and 1
PORTD = PORTD | j;          // combine the port information with the new information for LED pins
Serial.println(PORTD, BIN); // debug to show masking
delay(100);
   }
}
```

Bitwise XOR (^)

There is a somewhat unusual operator in C++ called bitwise EXCLUSIVE OR, also known as bitwise XOR. (In English this is usually pronounced "eks-or".) The bitwise XOR operator is written using the caret symbol ^. This operator is very similar to the bitwise OR operator |, only it evaluates to 0 for a given bit position when both of the input bits for that position are 1:

```
    0  0  1  1    operand1
    0  1  0  1    operand2
    ----------
    0  1  1  0    (operand1 ^ operand2) - returned result
```

Another way to look at bitwise XOR is that each bit in the result is a 1 if the input bits are different, or 0 if they are the same.

Here is a simple code example:

```
    int x = 12;     // binary: 1100
    int y = 10;     // binary: 1010
    int z = x ^ y;  // binary: 0110, or decimal 6
```

The ^ operator is often used to toggle (i.e. change from 0 to 1, or 1 to 0) some of the bits in an integer expression. In a bitwise OR operation if there is a 1 in the mask bit, that bit is inverted; if there is a 0, the bit is not inverted and stays the same. Below is a program to blink digital pin 5.

```
// Blink_Pin_5
// demo for Exclusive OR
void setup(){
DDRD = DDRD | B00100000; // set digital pin five as OUTPUT
Serial.begin(9600);
}

void loop(){
PORTD = PORTD ^ B00100000;  // invert bit 5 (digital pin 5), leave others untouched
delay(100);
}
```

See Also

- &&(Boolean AND)
- ||(Boolean OR)

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Bitwise NOT (~)

The bitwise NOT operator in C++ is the tilde character ~. Unlike & and |, the bitwise NOT operator is applied to a single operand to its right. Bitwise NOT changes each bit to its opposite: 0 becomes 1, and 1 becomes 0. For example:

```
    0  1    operand1

   ----------
    1  0   ~ operand1

    int a = 103;    // binary:  0000000001100111
    int b = ~a;     // binary:  1111111110011000 = -104
```

You might be surprised to see a negative number like -104 as the result of this operation. This is because the highest bit in an int variable is the so-called sign bit. If the highest bit is 1, the number is interpreted as negative. This encoding of positive and negative numbers is referred to as two's complement. For more information, see the Wikipedia article on two's complement.

As an aside, it is interesting to note that for any integer x, ~x is the same as -x-1.

At times, the sign bit in a signed integer expression can cause some unwanted surprises.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

bitshift left (<<), bitshift right (>>)

Description

From *The Bitmath Tutorial* in The Playground

There are two bit shift operators in C++: the left shift operator << and the right shift operator >>. These operators cause the bits in the left operand to be shifted left or right by the number of positions specified by the right operand.

More on bitwise math may be found here.

Syntax

variable << number_of_bits

variable >> number_of_bits

Parameters

variable - (byte, int, long) number_of_bits integer <= 32

Example:

```
int a = 5;        // binary: 0000000000000101
int b = a << 3;   // binary: 0000000000101000, or 40 in decimal
int c = b >> 3;   // binary: 0000000000000101, or back to 5 like we started with
```

When you shift a value x by y bits (x << y), the leftmost y bits in x are lost, literally shifted out of existence:

```
int a = 5;        // binary: 0000000000000101
int b = a << 14;  // binary: 0100000000000000 - the first 1 in 101 was discarded
```

If you are certain that none of the ones in a value are being shifted into oblivion, a simple way to think of the left-shift operator is that it multiplies the left operand by 2 raised to the right operand power. For example, to generate powers of 2, the following expressions can be employed:

```
1 <<  0  ==    1
1 <<  1  ==    2
1 <<  2  ==    4
1 <<  3  ==    8
...
1 <<  8  ==  256
1 <<  9  ==  512
1 << 10  == 1024
...
```

When you shift x right by y bits (x >> y), and the highest bit in x is a 1, the behavior depends on the exact data type of x. If x is of type int, the highest bit is the sign bit, determining whether x is negative or not, as we have discussed above. In that case, the sign bit is copied into lower bits, for esoteric historical reasons:

```
int x = -16;     // binary: 1111111111110000
int y = x >> 3;  // binary: 1111111111111110
```

This behavior, called sign extension, is often not the behavior you want. Instead, you may wish zeros to be shifted in from the left. It turns out that the right shift rules are different for unsigned int expressions, so you can use a typecast to suppress ones being copied from the left:

```
    int x = -16;                   // binary: 1111111111110000
    int y = (unsigned int)x >> 3;  // binary: 0001111111111110
```

If you are careful to avoid sign extension, you can use the right-shift operator >> as a way to divide by powers of 2. For example:

```
    int x = 1000;
    int y = x >> 3;   // integer division of 1000 by 8, causing y = 125.
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Port Registers

Port registers allow for lower-level and faster manipulation of the i/o pins of the microcontroller on an Arduino board. The chips used on the Arduino board (the ATmega8 and ATmega168) have three ports:

- B (digital pin 8 to 13)
- C (analog input pins)
- D (digital pins 0 to 7)

Each port is controlled by three registers, which are also defined variables in the arduino language. The DDR register, determines whether the pin is an INPUT or OUTPUT. The PORT register controls whether the pin is HIGH or LOW, and the PIN register reads the state of INPUT pins set to input with pinMode(). The maps of the ATmega8 and ATmega168 chips show the ports.

DDR and PORT registers may be both written to, and read. PIN registers correspond to the state of inputs and may only be read.

PORTD maps to Arduino digital pins 0 to 7

DDRD – The Port D Data Direction Register
PORTD – The Port D Data Register
PIND – The Port D Input Pins Register - read only

PORTB maps to Arduino digital pins 8 to 13 The two high bits (6 & 7) map to the crystal pins and are not usable

DDRB – The Port B Data Direction Register
PORTB – The Port B Data Register
PINB – The Port B Input Pins Register - read only

PORTC maps to Arduino analog pins 0 to 5. Pins 6 & 7 are only accessible on the Arduino Mini

DDRC – The Port C Data Direction Register
PORTC – The Port C Data Register
PINC – The Port C Input Pins Register

Each bit of these registers corresponds to a single pin; e.g. the low bit of DDRB, PORTB, and PINB refers to pin PB0 (digital pin 8). For a complete mapping of Arduino pin numbers to ports and bits, see the diagram for your chip: ATmega8, ATmega168. (Note that some bits of a port may be used for things other than i/o; be careful not to change the values of the register bits corresponding to them.)

Examples

Referring to the pin map above, the PortD registers control Arduino digital pins 0 – 7.

You should note, however, that pins 0 & 1 are used for serial communications for programming and debugging the Arduino, so changing these pins should usually be avoided unless needed for serial input or output functions. Be aware that this can interfere with program download or debugging.

DDRD is the direction register for Port D (Arduino digital pins 0-7). The bits in this register control whether the pins in PORTD are configured as inputs or outputs so, for example:

```
DDRD = B11111110;  // sets Arduino pins 1 – 7 as outputs, pin 0 as input
DDRD = DDRD | B11111100;  // this is safer – it sets pins 2 to 7 as outputs
                          // without changing the value of pins 0 & 1, which are RX & TX
```

`//See the bitwise operators reference pages and` The Bitmath Tutorial in the Playground

PORTB is the register for the state of the outputs. For example;

```
PORTD = B10101000; // sets digital pins 7,5,3 HIGH
```

You will only see 5 volts on these pins however if the pins have been set as outputs using the DDRD register or with pinMode().

PINB is the input register variable – it will read all of the digital input pins at the same time.

Why use port manipulation?

From The Bitmath Tutorial

Generally speaking, doing this sort of thing is **not** a good idea. Why not? Here are a few reasons:

- The code is much more difficult for you to debug and maintain, and is a lot harder for other people to understand. It only takes a few microseconds for the processor to execute code, but it might take hours for you to figure out why it isn't working right and fix it! Your time is valuable, right? But the computer's time is very cheap, measured in the cost of the electricity you feed it. Usually it is much better to write code the most obvious way.
- The code is less portable. If you use digitalRead() and digitalWrite(), it is much easier to write code that will run on all of the Atmel microcontrollers, whereas the control and port registers can be different on each kind of microcontroller.
- It is a lot easier to cause unintentional malfunctions with direct port access. Notice how the line DDRD = B11111110; above mentions that it must leave pin 0 as an input pin. Pin 0 is the receive line (RX) on the serial port. It would be very easy to accidentally cause your serial port to stop working by changing pin 0 into an output pin! Now that would be very confusing when you suddenly are unable to receive serial data, wouldn't it?

So you might be saying to yourself, great, why would I ever want to use this stuff then? Here are some of the positive aspects of direct port access:

- If you are running low on program memory, you can use these tricks to make your code smaller. It requires a lot fewer bytes of compiled code to simultaneously write a bunch of hardware pins simultaneously via the port registers than it would using a for loop to set each pin separately. In some cases, this might make the difference between your program fitting in flash memory or not!
- Sometimes you might need to set multiple output pins at exactly the same time. Calling digitalWrite(10,HIGH); followed by digitalWrite(11,HIGH); will cause pin 10 to go HIGH several microseconds before pin 11, which may confuse certain time-sensitive external digital circuits you have hooked up. Alternatively, you could set both pins high at exactly the same moment in time using PORTB |= B1100;
- You may need to be able to turn pins on and off very quickly, meaning within fractions of a microsecond. If you look at the source code in lib/targets/arduino/wiring.c, you will see that digitalRead() and digitalWrite() are each about a dozen or so lines of code, which get compiled into quite a few machine instructions. Each machine instruction requires one clock cycle at 16MHz, which can add up in time-sensitive applications. Direct port access can do the same job in a lot fewer clock cycles.

Corrections, suggestions, and new documentation should be posted to the Forum.

compound bitwise AND (&=), compound bitwise OR (|=)

The compound bitwise operators perform their calculations at the bit level of variables. They are often used to clear and set specific bits of a variable.

See the bitwise AND (&) and bitwise OR (|) operators for the details of their operation, and also the Bitmath Tutorial for more information on bitwise operators.

compound bitwise AND (&=)

Description

The compound bitwise AND operator (&=) is often used with a variable and a constant to force particular bits in a variable to the LOW state (to 0). This is often referred to in programming guides as "clearing" or "resetting" bits.

Syntax:

```
x &= y;   // equivalent to x = x & y;
```

Parameters

x: a char, int or long variable
y: an integer constant or char, int, or long

Example:

First, a review of the Bitwise AND (&) operator

```
   0  0  1  1    operand1
   0  1  0  1    operand2
   ----------
   0  0  0  1    (operand1 & operand2) - returned result
```

Bits that are "bitwise ANDed" with 0 are cleared to 0 so, if myByte is a byte variable,
`myByte & B00000000 = 0;`

Bits that are "bitwise ANDed" with 1 are unchanged so,
`myByte & B11111111 = myByte;`

Note: because we are dealing with bits in a bitwise operator - it is convenient to use the binary formatter with constants. The numbers are still the same value in other representations, they are just not as easy to understand. Also, B00000000 is shown for clarity, but zero in any number format is zero (hmmm something philosophical there?)

Consequently - to clear (set to zero) bits 0 & 1 of a variable, while leaving the rest of the variable unchanged, use the compound bitwise AND operator (&=) with the constant B11111100

```
   1  0  1  0  1  0  1  0    variable
   1  1  1  1  1  1  0  0    mask
   ----------------------
   1  0  1  0  1  0  0  0

 variable unchanged
                     bits cleared
```

Here is the same representation with the variable's bits replaced with the symbol x

```
   x  x  x  x  x  x  x  x    variable
   1  1  1  1  1  1  0  0    mask
   ----------------------
   x  x  x  x  x  x  0  0

 variable unchanged
                     bits cleared
```

So if:

```
myByte =  10101010;

myByte &= B1111100 == B10101000;
```

compound bitwise OR (|=)

Description

The compound bitwise OR operator (|=) is often used with a variable and a constant to "set" (set to 1) particular bits in a variable.

Syntax:

```
x |= y;   // equivalent to x = x | y;
```

Parameters

x: a char, int or long variable
y: an integer constant or char, int, or long

Example:

First, a review of the Bitwise OR (|) operator

```
   0  0  1  1    operand1
   0  1  0  1    operand2
   ----------
   0  1  1  1    (operand1 | operand2) - returned result
```

Bits that are "bitwise ORed" with 0 are unchanged, so if myByte is a byte variable,
myByte | B00000000 = myByte;

Bits that are "bitwise ORed" with 1 are set to 1 so:
myByte & B11111111 = B11111111;

Consequently - to set bits 0 & 1 of a variable, while leaving the rest of the variable unchanged, use the compound bitwise AND operator (&=) with the constant B00000011

```
   1  0  1  0  1  0  1  0    variable
   0  0  0  0  0  0  1  1    mask
   ----------------------
   1  0  1  0  1  0  1  1

 variable unchanged
                     bits set
```

Here is the same representation with the variables bits replaced with the symbol x

```
   x  x  x  x  x  x  x  x    variable
   0  0  0  0  0  0  1  1    mask
   ----------------------
   x  x  x  x  x  x  1  1
```

```
 variable unchanged
                    bits set
```

So if:

```
myByte =  B10101010;

myByte |= B00000011 == B10101011;
```

See Also

- & (bitwise AND)
- | (bitwise OR)
- && (Boolean AND)
- || (Boolean OR)

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

floating point constants

Similar to integer constants, floating point constants are used to make code more readable. Floating point constants are swapped at compile time for the value to which the expression evaluates.

Examples:

```
n = .005;
```

Floating point constants can also be expressed in a variety of scientific notation. 'E' and 'e' are both accepted as valid exponent indicators.

```
floating-point   evaluates to:      also evaluates to:
  constant

   10.0              10
  2.34E5          2.34 x 105             234000
  67e-12        67.0 x 10-12         .000000000067
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

unsigned char

Description

An unsigned data type that occupies 1 byte of memory. Same as the byte datatype.

The unsigned char datatype encodes numbers from 0 to 255.

For consistency of Arduino programming style, the *byte* data type is to be preferred.

Example

```
unsigned char myChar = 240;
```

See also

- byte
- int
- array
- Serial.println

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Static

The static keyword is used to create variables that are visible to only one function. However unlike local variables that get created and destroyed every time a function is called, static variables persist beyond the function call, preserving their data between function calls.

Variables declared as static will only be created and initialized the first time a function is called.

Example

```
/* RandomWalk
 Paul Badger 2007
 RandomWalk wanders up and down randomly between two
endpoints. The maximum move in one loop is governed by
the parameter "stepsize".
 A static variable is moved up and down a random amount.
This technique is also known as "pink noise" and "drunken walk".
 */

#define randomWalkLowRange -20
#define randomWalkHighRange 20
int stepsize;

int thisTime;
int total;

void setup()
{
  Serial.begin(9600);
}

void loop()
{        //  tetst randomWalk function
  stepsize = 5;
  thisTime = randomWalk(stepsize);
  Serial.println(thisTime);
   delay(10);
}

int randomWalk(int moveSize){
  static int  place;     // variable to store value in random walk - declared static so that it stores
                         // values in between function calls, but no other functions can change its value

  place = place + (random(-moveSize, moveSize + 1));

  if (place < randomWalkLowRange){                    // check lower and upper limits
    place = place + (randomWalkLowRange - place);     // reflect number back in positive direction
  }
  else if(place > randomWalkHighRange){
    place = place - (place - randomWalkHighRange);     // reflect number back in negative direction
  }
  return place;
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

volatile keyword

volatile is a keyword known as a variable *qualifier*, it is usually used before the datatype of a variable, to modify the way in which the compiler and subsequent program treats the variable.

Declaring a variable volatile is a directive to the compiler. The compiler is software which translates your C/C++ code into the machine code, which are the real instructions for the Atmega chip in the Arduino.

Specifically, it directs the compiler to load the variable from RAM and not from a storage register, which is a temporary memory location where program variables are stored and manipulated. Under certain conditions, the value for a variable stored in registers can be inaccurate.

A variable should be declared volatile whenever its value can be changed by something beyond the control of the code section in which it appears, such as a concurrently executing thread. In the Arduino, the only place that this is likely to occur is in sections of code associated with interrupts, called an interrupt service routine.

Example

```
// toggles LED when interrupt pin changes state

int pin = 13;
volatile int state = LOW;

void setup()
{
  pinMode(pin, OUTPUT);
  attachInterrupt(0, blink, CHANGE);
}

void loop()
{
  digitalWrite(pin, state);
}

void blink()
{
  state = !state;
}
```

See also

- AttachInterrupt

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

const keyword

The **const** keyword stands for constant. It is a variable *qualifier* that modifies the behavior of the variable.

const makes a variable "*read-only*". This means that the variable can be used just as any other variable of its type, but its value cannot be changed. You will get a compiler error if you try to assign a value to a **const** variable.

Example

```
const float pi = 3.14;
float x;

// ....

x = pi * 2;    // it's fine to use const's in math

pi = 7;        // illegal - you can't write to (modify) a constant
```

#define or const

You can use either **const** or **#define** for creating numeric or string constants. For arrays, you will need to use **const**.

See also:

- #define
- volatile

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

PROGMEM

Store data in flash (program) memory instead of SRAM. There's a description of the various types of memory available on an Arduino board.

The PROGMEM keyword is a variable modifier, it should be used only with the datatypes defined in pgmspace.h. It tells the compiler "put this information into flash memory", instead of into SRAM, where it would normally go.

PROGMEM is part of the pgmspace.h library. So you first need to include the library at the top your sketch, like this:

```
#include <avr/pgmspace.h>
```

Syntax

```
dataType variableName[] PROGMEM = {dataInt0, dataInt1, dataInt3...};
```

- program memory dataType - any program memory variable type (see below)
- variableName - the name for your array of data

Note that because PROGMEM is a variable modifier, there is no hard and fast rule about where it should go, so the Arduino compiler accepts all of the definitions below, which are also synonymous.

```
dataType variableName[] PROGMEM = {};
dataType PROGMEM variableName[] = {};
PROGMEM dataType variableName[] = {};
```

Common programming styles favor one of the first two however.

While PROGMEM could be used on a single variable, it is really only worth the fuss if you have a larger block of data that needs to be stored, which is usually easiest in an array, (or another C data structure beyond our present discussion).

Using PROGMEM is also a two-step procedure. After getting the data into Flash memory, it requires special methods (functions), also defined in the pgmspace.h library, to read the data from program memory back into SRAM, so we can do something useful with it.

As mentioned above, it is important to use the datatypes outlined in pgmspace.h. Some cryptic bugs are generated by using ordinary datatypes for program memory calls. Below is a list of variable types to use. Floating point numbers in program memory do not appear to be supported.

```
 prog_char      - a signed char (1 byte) -127 to 128
 prog_uchar     - an unsigned char (1 byte) 0 to 255
 prog_int16_t   - a signed int (2 bytes) -32,767 to 32,768
 prog_uint16_t  - an unsigned int (2 bytes) 0 to 65,535
 prog_int32_t   - a signed long (4 bytes) -2,147,483,648 to * 2,147,483,647.
 prog_uint32_t  - an unsigned long (4 bytes) 0 to 4,294,967,295
```

Example

The following code fragments illustrate how to read and write unsigned chars (bytes) and ints (2 bytes) to PROGMEM.

```
#include <avr/pgmspace.h>


// save some unsigned ints
PROGMEM  prog_uint16_t charSet[]  = { 65000, 32796, 16843, 10, 11234};
```

```
// save some chars
prog_uchar signMessage[] PROGMEM  = {"I AM PREDATOR,  UNSEEN COMBATANT. CREATED BY THE UNITED STATES
DEPART"};

unsigned int displayInt;
int k;    // counter variable
char myChar;

// read back a 2-byte int
 displayInt = pgm_read_word_near(charSet + k)

// read back a char
myChar =  pgm_read_byte_near(signMessage + k);
```

Arrays of strings

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

These tend to be large structures so putting them into program memory is often desirable. The code below illustrates the idea.

```
/*
 PROGMEM string demo
 How to store a table of strings in program memory (flash),
 and retrieve them.

 Information summarized from:
 http://www.nongnu.org/avr-libc/user-manual/pgmspace.html

 Setting up a table (array) of strings in program memory is slightly complicated, but
 here is a good template to follow.

 Setting up the strings is a two-step process. First define the strings.

*/

#include <avr/pgmspace.h>
prog_char string_0[] PROGMEM = "String 0";   // "String 0" etc are strings to store - change to suit.
prog_char string_1[] PROGMEM = "String 1";
prog_char string_2[] PROGMEM = "String 2";
prog_char string_3[] PROGMEM = "String 3";
prog_char string_4[] PROGMEM = "String 4";
prog_char string_5[] PROGMEM = "String 5";


// Then set up a table to refer to your strings.

PGM_P PROGMEM string_table[] =     // change "string_table" name to suit
{
  string_0,
  string_1,
  string_2,
  string_3,
  string_4,
  string_5 };

char buffer[30];    // make sure this is large enough for the largest string it must hold

void setup()
{
  Serial.begin(9600);
}
```

```
void loop()
{
  /* Using the string table in program memory requires the use of special functions to retrieve the data.
     The strcpy_P function copies a string from program space to a string in RAM ("buffer").
     Make sure your receiving string in RAM  is large enough to hold whatever
     you are retrieving from program space. */


  for (int i = 0; i < 6; i++)
  {
    strcpy_P(buffer, (char*)pgm_read_word(&(string_table[i]))); // Necessary casts and dereferencing, just
copy.
    Serial.println( buffer );
    delay( 500 );
  }
}
```

See also

- Types of memory available on an Arduino board
- array
- string

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

interrupts()

Description

Re-enables interrupts (after they've been disabled by noInterrupts()). Interrupts allow certain important tasks to happen in the background and are enabled by default. Some functions will not work while interrupts are disabled, and incoming communication may be ignored. Interrupts can slightly disrupt the timing of code, however, and may be disabled for particularly critical sections of code.

Parameters

None.

Returns

None.

Example

```
void setup() {}

void loop()
{
  noInterrupts();
  // critical, time-sensitive code here
  interrupts();
  // other code here
}
```

See Also

- noInterrupts()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

noInterrupts()

Description

Disables interrupts (you can re-enable them with interrupts()). Interrupts allow certain important tasks to happen in the background and are enabled by default. Some functions will not work while interrupts are disabled, and incoming communication may be ignored. Interrupts can slightly disrupt the timing of code, however, and may be disabled for particularly critical sections of code.

Parameters

None.

Returns

None.

Example

```
void setup() {}

void loop()
{
  noInterrupts();
  // critical, time-sensitive code here
  interrupts();
  // other code here
}
```

See Also

- interrupts()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Cast

Description

The cast operator translates one variable type into another and forces calculations to be performed in the cast type.

Syntax

(type)variable

Parameters:

type: any variable type (e.g. int, float, byte)

variable: any variable or constant

Example

```
int i;
float f;

f = 3.6;
i = (int) f; // now i is 3
```

Note

When casting from a float to an int, the value is truncated not rounded. So both `(int) 3.2` and `(int) 3.7` are 3.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

sizeof

Description

The sizeof operator returns the number of bytes in a variable type, or the number of bytes occupied by an array.

Syntax

sizeof(variable)

Parameters

variable: any variable type or array (e.g. int, float, byte)

Example code

The sizeof operator is useful for dealing with arrays (such as strings) where it is convenient to be able to change the size of the array without breaking other parts of the program.

This program prints out a text string one character at a time. Try changing the text phrase.

```
char myStr[] = "this is a test";
int i;

void setup(){
  Serial.begin(9600);
}

void loop() {
  for (i = 0; i < sizeof(myStr) - 1; i++){
    Serial.print(i, DEC);
    Serial.print(" = ");
    Serial.println(myStr[i], BYTE);
  }
}
```

Note that sizeof returns the total number of bytes. So for larger variable types such as ints, the for loop would look something like this.

```
for (i = 0; i < (sizeof(myInts)/sizeof(int)) - 1; i++) {
  // do something with myInts[i]
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Keywords

Keywords are constants, variables and function names that are defined as part of the Arduino language. Avoid using keywords for variable names.

```
# Constants                      private
                                 protected                        loop
HIGH                             public                           max
LOW                              return                           millis
INPUT                            short                            min
OUTPUT                           signed                           -
SERIAL                           static                           %
DISPLAY                          switch                           /*
PI                               throw                            *
HALF_PI                          try                              new
TWO_PI                           unsigned                         null
LSBFIRST                         void                             ()
MSBFIRST                                                          PI
CHANGE                           # Other                          return
FALLING                                                           >>
RISING                           abs                              ;
false                            acos                             Serial
true                             +=                               Setup
null                             +                                sin
                                 []                               sq
# Port Variables & Constants     asin                             sqrt
                                 =                                -=
DDRB                             atan                             switch
PINB                             atan2                            tan
PORTB                            &                                this
PB0                              |                                true
PB1                              boolean                          TWO_PI
PB2                              byte                             void
PB3                              case                             while
PB4                              ceil                             Serial
PB5                              char                             begin
PB6                              char                             read
PB7                              class                            print
                                 ,                                write
DDRC                             //                               println
PINC                             ?:                               available
PORTC                            constrain                        digitalWrite
PC0                              cos                              digitalRead
PC1                              {}                               pinMode
PC2                              --                               analogRead
PC3                              default                          analogWrite
PC4                              delay                            attachInterrupts
PC5                              delayMicroseconds                detachInterrupts
PC6                              /                                beginSerial
PC7                              /**                              serialWrite
                                 .                                serialRead
DDRD                             else                             serialAvailable
```

```
PIND
PORTD
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7

# Datatypes

boolean
byte
char
class
default
do
double
int
long
```

```
==
exp
false
float
float
floor
for
<
<=
HALF_PI
if
++
!=
int
<<
<
<=
log
&&
!
||
```

```
printString
printInteger
printByte
printHex
printOctal
printBinary
printNewline
pulseIn
shiftOut
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Extended History

Hide minor edits - Show changes to markup

May 07, 2008, at 02:44 PM by David A. Mellis -
Changed line 35 from:

- plus (addition)

to:

- + (addition)

Restore
April 30, 2008, at 08:49 AM by David A. Mellis -
Deleted lines 3-4:

*The **foundations page** has extended descriptions of some hardware and software features.*

Restore
April 23, 2008, at 10:30 PM by David A. Mellis -
Changed line 8 from:

(:table width=90% border=0 cellpadding=5 cellspacing=0:)

to:

(:table width=100% border=0 cellpadding=5 cellspacing=0:)

Restore
March 31, 2008, at 06:26 AM by Paul Badger -
Changed lines 4-5 from:

foundations page has extended descriptions of some hardware and software features.''

to:

*The **foundations page** has extended descriptions of some hardware and software features.*

Restore
March 31, 2008, at 06:26 AM by Paul Badger -
Added lines 4-5:

foundations page has extended descriptions of some hardware and software features.''

Restore
March 29, 2008, at 11:30 AM by David A. Mellis -
Added lines 173-177:

Interrupts

- interrupts()
- noInterrupts()

Restore
March 29, 2008, at 09:19 AM by David A. Mellis -
Added line 153:

- map(value, fromLow, fromHigh, toLow, toHigh)

Restore

March 28, 2008, at 06:14 PM by David A. Mellis -
Added line 135:

- analogReference(type)

Restore
February 28, 2008, at 09:49 AM by David A. Mellis -
Added line 85:

- true | false

Restore
January 17, 2008, at 10:02 AM by David A. Mellis - because hardware information doesn't belong in the programming language / api reference
Deleted line 133:

- analog pins

Restore
January 16, 2008, at 10:40 AM by Paul Badger - people want to know where to find this info - why not here?
Added line 134:

- analog pins

Restore
January 11, 2008, at 12:05 PM by David A. Mellis - moving the analog pin description to the hardware tutorials on the playground.
Deleted line 133:

- analog pins

Restore
January 11, 2008, at 11:29 AM by David A. Mellis - moving variable scope to the code tutorials section (in the playground)
Deleted line 107:

- variable scope

Restore
November 23, 2007, at 06:13 PM by David A. Mellis - we're documenting the Arduino language here, not AVR LIBC.
Changed lines 155-156 from:

- math.h

to:
Restore
November 23, 2007, at 05:02 PM by Paul Badger -
Changed lines 86-88 from:

- floating point contstants

to:

- floating point constants

Restore
November 23, 2007, at 05:02 PM by Paul Badger -
Changed line 85 from:

- Integer Constants

to:

- integer constants

Restore
November 23, 2007, at 05:01 PM by Paul Badger -
Added line 85:

- Integer Constants

Changed lines 88-89 from:

- Integer Constants

to:
Restore
November 23, 2007, at 04:46 PM by Paul Badger -
Restore
November 23, 2007, at 04:45 PM by Paul Badger -
Changed lines 85-86 from:
to:

- floating point contstants

Restore
November 23, 2007, at 04:11 PM by Paul Badger -
Changed lines 154-155 from:
to:

- math.h

Restore
November 21, 2007, at 02:11 PM by Paul Badger -
Deleted lines 118-119:

(:cell width=50%:)

Changed lines 124-125 from:
to:

(:cell width=50%:)

Restore
November 21, 2007, at 02:10 PM by Paul Badger -
Added lines 119-120:

(:cell width=50%:)

Changed lines 126-127 from:

(:cell width=50%:)

to:
Restore
November 21, 2007, at 09:33 AM by David A. Mellis - adding sqrt
Changed lines 153-154 from:
to:

- sqrt(x)

Restore
November 21, 2007, at 09:27 AM by David A. Mellis -
Changed lines 152-153 from:

- pow(x, n)

to:

- pow(base, exponent)

Restore
November 21, 2007, at 09:24 AM by David A. Mellis -
Changed lines 152-153 from:
to:

- pow(x, n)

Restore
November 21, 2007, at 09:22 AM by David A. Mellis -
Deleted lines 147-149:

- sin(rad)
- cos(rad)
- tan(rad)

Added lines 153-157:

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Restore
November 21, 2007, at 09:17 AM by David A. Mellis - adding trig functions (instead of general math.h page)
Changed lines 148-150 from:

- AVR math.h library

to:

- sin(rad)
- cos(rad)
- tan(rad)

Restore
November 17, 2007, at 10:56 PM by Paul Badger -
Changed lines 55-57 from:

- * dereference operator?
- & reference operator?

to:

- * dereference operator
- & reference operator

Restore
November 17, 2007, at 10:55 PM by Paul Badger -
Changed lines 55-57 from:

- * dereference operator?
- & indirection operator?

to:

- * dereference operator?
- & reference operator?

Restore
November 17, 2007, at 10:46 PM by Paul Badger -
Changed lines 55-57 from:

- *dereference operator?
- &indirection operator?

to:

- * dereference operator?
- & indirection operator?

Restore
November 17, 2007, at 10:45 PM by Paul Badger -
Added lines 54-57:

Pointer Access Operators

- *dereference operator?
- &indirection operator?

Restore
November 13, 2007, at 08:49 PM by Paul Badger -
Changed line 119 from:

- Atmega168 pin mapping chart

to:

- Atmega168 pin mapping

Restore
November 13, 2007, at 08:48 PM by Paul Badger -
Changed line 119 from:
to:

- Atmega168 pin mapping chart

Restore
November 06, 2007, at 03:34 PM by Paul Badger -
Changed line 130 from:

- int analog pins

to:

- analog pins

Restore
November 06, 2007, at 03:33 PM by Paul Badger -
Added line 130:

- int analog pins

Restore
October 15, 2007, at 04:55 AM by Paul Badger -
Changed lines 61-62 from:

- port manipulation

to:

- Port Manipulation

Restore
September 08, 2007, at 09:23 AM by Paul Badger -
Added line 88:

- unsigned char

Restore
August 31, 2007, at 10:17 PM by David A. Mellis -
Added lines 76-82:

Constants

- HIGH | LOW
- INPUT | OUTPUT

- Integer Constants

Changed lines 107-113 from:

Constants

- HIGH | LOW
- INPUT | OUTPUT

- IntegerConstants

to:
Restore
August 31, 2007, at 10:16 PM by David A. Mellis - moved discussion of AVR libraries to the introduction of this page.
Changed lines 166-172 from:

AVR Libraries

- Using AVR libraries
- Main Library page

to:

Restore
August 31, 2007, at 10:14 PM by David A. Mellis -
Deleted lines 14-15:

        - void keyword

Added lines 76-78:

Data Types

- void keyword

Restore
August 31, 2007, at 10:14 PM by David A. Mellis - don't need a tutorial on functions and variables here.
Changed lines 14-15 from:

- Variable Declaration
- Function Declaration

to:
Restore
August 31, 2007, at 10:13 PM by David A. Mellis - moving reference to bottom of first column
Deleted lines 111-112:

(:cell width=50%:)

Added lines 117-118:

(:cell width=50%:)

Restore
August 31, 2007, at 10:13 PM by David A. Mellis - AREF pin doesn't belong here; instead we should have a function to put it in use.
Deleted lines 118-121:

Hardware

- Analog Reference Pin (AREF)

Restore
August 31, 2007, at 10:11 PM by David A. Mellis - removing the pin mappings; there are links from the port manipulation reference instead.
Deleted line 120:

- Atmega168 pin mapping

Restore
August 31, 2007, at 09:45 PM by David A. Mellis -
Changed line 1 from:

(:title Reference:)

to:

(:title Extended Reference:)

Restore
August 31, 2007, at 09:45 PM by David A. Mellis -
Changed lines 10-11 from:

An Arduino program run in two parts:

to:

In Arduino, the standard program entry point (main) is defined in the core and calls into two functions in a sketch. **setup()** is called once, then **loop()** is called repeatedly (until you reset your board).

Restore
August 31, 2007, at 09:37 PM by David A. Mellis -
Changed lines 2-7 from:

Arduino Reference

Extended Version

The Arduino language is based on C/C++.

to:

Arduino Reference (extended)

The Arduino language is based on C/C++ and supports all standard C constructs and some C++ features. It links against AVR Libc and allows the use of any of its functions; see its user manual for details.

Restore
August 11, 2007, at 08:46 AM by Paul Badger -
Added lines 114-115:

(:cell width=50%:)

Added lines 120-122:

Hardware

Changed lines 124-125 from:

(:cell width=50%:)

to:

- Analog Reference Pin (AREF)

Restore
July 17, 2007, at 11:03 AM by Paul Badger -
Changed lines 66-67 from:
to:

- port manipulation

Restore
July 17, 2007, at 10:58 AM by Paul Badger -
Changed lines 117-118 from:
to:

- Atmega168 pin mapping

Restore
July 17, 2007, at 10:55 AM by Paul Badger -
Restore
July 17, 2007, at 10:47 AM by Paul Badger -
Changed lines 168-169 from:

Arduino 0008 contains headers for the following libraries:

to:

- Using AVR libraries

Restore
July 17, 2007, at 10:45 AM by Paul Badger -
Changed lines 166-173 from:
to:

AVR Libraries

Arduino 0008 contains headers for the following libraries:

- Main Library page

Restore
July 17, 2007, at 10:36 AM by Paul Badger -
Deleted lines 79-82:

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

Data Types

Restore
July 17, 2007, at 10:35 AM by Paul Badger -
Changed lines 106-107 from:

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

to:
Deleted lines 157-158:

These functions allow you to trigger a function when the input to a pin changes value.

Deleted lines 162-163:

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, *you cannot also use pins 0 and 1 for digital i/o.*

Restore
July 17, 2007, at 10:33 AM by Paul Badger -
Added line 145:

- AVR math.h library

Restore
July 17, 2007, at 10:30 AM by Paul Badger -
Deleted lines 15-17:

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

Restore
July 17, 2007, at 10:29 AM by Paul Badger -
Added lines 1-178:

(:title Reference:)

Arduino Reference

Extended Version

The Arduino language is based on C/C++.

(:table width=90% border=0 cellpadding=5 cellspacing=0:) (:cell width=50%:)

Structure

An Arduino program run in two parts:

- void setup()
- void loop()

setup() is preparation, and loop() is execution. In the setup section, always at the top of your program, you would set pinMode, initialize serial communication, etc. The loop section is the code to be executed -- reading inputs, triggering outputs, etc.

- Variable Declaration
- Function Declaration
    - void keyword

Control Structures

- if
- if...else
- for

- switch case
- while
- do... while
- break
- continue
- return

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define
- #include

Arithmetic Operators

- plus (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Comparison Operators

- == (equal to)
- != (not equal to)
- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Boolean Operators

- && (and)
- || (or)
- ! (not)

Bitwise Operators

- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
- ~ (bitwise not)
- << (bitshift left)
- >> (bitshift right)

Compound Operators

- ++ (increment)
- -- (decrement)
- += (compound addition)
- -= (compound subtraction)
- *= (compound multiplication)
- /= (compound division)

- &= (compound bitwise and)
- |= (compound bitwise or)

Variables

Variables are expressions that you can use in programs to store values, like e.g. sensor reading from an analog pin. They can have various types, which are described below.

Data Types

- boolean
- char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double
- string
- array

Variable Scope & Qualifiers

- variable scope
- static
- volatile
- const
- PROGMEM

Constants

Constants are labels for certain values which are preset in the Arduino compiler. You do not need to define or initialize constants. Arduino includes the following pre-defined constants.

- HIGH | LOW
- INPUT | OUTPUT

- IntegerConstants

Utilities

- cast (cast operator)
- sizeof() (sizeof operator)

Reference

- keywords
- ASCII chart

(:cell width=50%:)

Functions

Digital I/O

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Analog I/O

- int analogRead(pin)
- analogWrite(pin, value) - *PWM*

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Math

- min(x, y)
- max(x, y)

- abs(x)
- constrain(x, a, b)

Random Numbers

- randomSeed(seed)
- long random(max)
- long random(min, max)

External Interrupts

These functions allow you to trigger a function when the input to a pin changes value.

- attachInterrupt(interrupt, function, mode)
- detachInterrupt(interrupt)

Serial Communication

Used for communication between the Arduino board and a computer or other devices. This communication happens via the Arduino board's serial or USB connection and on digital pins 0 (RX) and 1 (TX). Thus, if you use these functions, *you cannot also use pins 0 and 1 for digital i/o.*

- Serial.begin(speed)
- int Serial.available()
- int Serial.read()
- Serial.flush()
- Serial.print(data)
- Serial.println(data)

(:tableend:)

Restore

Arduino Reference (extended)

The Arduino language is based on C/C++ and supports all standard C constructs and some C++ features. It links against AVR Libc and allows the use of any of its functions; see its user manual for details.

Structure

In Arduino, the standard program entry point (main) is defined in the core and calls into two functions in a sketch. **setup()** is called once, then **loop()** is called repeatedly (until you reset your board).

- void setup()
- void loop()

Control Structures

- if
- if...else
- for
- switch case
- while
- do... while
- break
- continue
- return

Further Syntax

- ; (semicolon)
- {} (curly braces)
- // (single line comment)
- /* */ (multi-line comment)
- #define
- #include

Arithmetic Operators

- + (addition)
- - (subtraction)
- * (multiplication)
- / (division)
- % (modulo)

Comparison Operators

- == (equal to)
- != (not equal to)
- < (less than)
- > (greater than)
- <= (less than or equal to)
- >= (greater than or equal to)

Functions

Digital I/O

- pinMode(pin, mode)
- digitalWrite(pin, value)
- int digitalRead(pin)

Analog I/O

- analogReference(type)
- int analogRead(pin)
- analogWrite(pin, value) - *PWM*

Advanced I/O

- shiftOut(dataPin, clockPin, bitOrder, value)
- unsigned long pulseIn(pin, value)

Time

- unsigned long millis()
- delay(ms)
- delayMicroseconds(us)

Math

- min(x, y)
- max(x, y)
- abs(x)
- constrain(x, a, b)
- map(value, fromLow, fromHigh, toLow, toHigh)
- pow(base, exponent)
- sqrt(x)

Trigonometry

- sin(rad)
- cos(rad)
- tan(rad)

Random Numbers

- randomSeed(seed)
- long random(max)
- long random(min, max)

External Interrupts

- attachInterrupt(interrupt, function, mode)
- detachInterrupt(interrupt)

Interrupts

Boolean Operators

- && (and)
- || (or)
- ! (not)

Pointer Access Operators

- * dereference operator
- & reference operator

Bitwise Operators

- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
- ~ (bitwise not)
- << (bitshift left)
- >> (bitshift right)

- Port Manipulation

Compound Operators

- ++ (increment)
- -- (decrement)
- += (compound addition)
- -= (compound subtraction)
- *= (compound multiplication)
- /= (compound division)

- &= (compound bitwise and)
- |= (compound bitwise or)

Variables

Constants

- HIGH | LOW
- INPUT | OUTPUT
- true | false
- integer constants
- floating point constants

Data Types

- void keyword
- boolean
- char
- unsigned char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double

- interrupts()
- noInterrupts()

Serial Communication

- Serial.begin(speed)
- int Serial.available()
- int Serial.read()
- Serial.flush()
- Serial.print(data)
- Serial.println(data)

- string
- array

Variable Scope & Qualifiers

- static
- volatile
- const
- PROGMEM

Utilities

- cast (cast operator)
- sizeof() (sizeof operator)

Reference

- keywords
- ASCII chart
- Atmega168 pin mapping

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

EEPROM Library

The microcontroller on the Arduino board has 512 bytes of EEPROM: memory whose values are kept when the board is turned off (like a tiny hard drive). This library enables you to read and write those bytes.

Functions

- byte EEPROM.read(address)
- EEPROM.write(address, value)

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

SoftwareSerial Library

The Arduino hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the Atmega chip to receive serial communication even while working on other tasks, as long as there room in the 64 byte serial buffer.

The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial").

Limitations

Because it's not supported by hardware, the library has a few limitations:

- Only speeds up to 9600 baud work
- Serial.available() doesn't work
- Serial.read() will wait until data arrives
- Only data received while Serial.read() is being called will be received. Data received at other times will be lost, since the chip is not "listening".

SoftwareSerial appears to have some timing issues and/or software issues. Check this forum thread for discussion. Software Serial Discussion. In particular, if you are having problems using SoftwareSerial with an Atmega168 chip delete SoftwareSerial.o in your Arduino directory.

Example

`SoftwareSerialExample`

Functions

- SoftwareSerial()
- begin()
- read()
- print()
- println()

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Stepper Library

This library allows you to control unipolar or bipolar stepper motors. To use it you will need a stepper motor, and the appropriate hardware to control it. For more on that, see Tom Igoe's notes on steppers.

Circuits

- Unipolar Steppers
- Bipolar Steppers

Functions

- Stepper(steps, pin1, pin2)
- Stepper(steps, pin1, pin2, pin3, pin4)
- setSpeed(rpm)
- step(steps)

Example

- Motor Knob

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Wire Library

This library allows you to communicate with I2C / TWI devices. On the Arduino, SDA (data line) is on analog input pin 4, and SCL (clock line) is on analog input pin 5.

Functions

- begin()
- begin(address)
- requestFrom(address, count)
- beginTransmission(address)
- endTransmission()
- send()
- byte available()
- byte receive()
- onReceive(handler)
- onRequest(handler)

Note

There are both 7- and 8-bit versions of I2C addresses. 7 bits identify the device, and the eighth bit determines if it's being written to or read from. The Wire library uses 7 bit addresses throughout. If you have a datasheet or sample code that uses 8 bit address, you'll want to drop the low bit, yielding an address between 0 and 127.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.Libraries History

Hide minor edits - Show changes to markup

July 09, 2008, at 04:10 PM by David A. Mellis -
Changed line 40 from:

- [[http://code.google.com/p/sserial2mobile/ | SSerial2Mobile] - send text messages or emails using a cell phone (via AT commands over software serial)

to:

- SSerial2Mobile - send text messages or emails using a cell phone (via AT commands over software serial)

Restore
July 09, 2008, at 04:10 PM by David A. Mellis - adding sserial2mobile
Added line 40:

- [[http://code.google.com/p/sserial2mobile/ | SSerial2Mobile] - send text messages or emails using a cell phone (via AT commands over software serial)

Restore
July 03, 2008, at 11:10 PM by David A. Mellis -
Added line 25:

- DateTime - a library for keeping track of the current date and time in software.

Restore
July 02, 2008, at 10:58 AM by David A. Mellis - pointing Wire link to local documentation
Added line 11:

- EEPROM - reading and writing to "permanent" storage

Changed lines 14-15 from:

- EEPROM - reading and writing to "permanent" storage

to:

- Wire - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors.

Changed lines 20-21 from:

- Wire - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors. On the Arduino, SDA is on analog input pin 4, and SCL on analog input pin 5.

to:
Restore
May 16, 2008, at 10:49 PM by David A. Mellis -
Added line 35:

- PS2Keyboard - read characters from a PS2 keyboard.

Restore
May 10, 2008, at 12:46 PM by David A. Mellis -
Added line 33:

- MsTimer2 - uses the timer 2 interrupt to trigger an action every N milliseconds.

Restore
May 10, 2008, at 12:40 PM by David A. Mellis - adding link to the glcd library.

Changed lines 21-24 from:

Unofficial Libraries

These are not (yet) included with the Arduino distribution and may change.

to:

Contributed Libraries

Libraries written by members of the Arduino community.

Added line 26:

- GLCD - graphics routines for LCD based on the KS0108 or equivalent chipset.

Restore
April 09, 2008, at 06:39 PM by David A. Mellis -
Changed lines 25-26 from:

- Simple Message System - send messages between Arduino and the computer
- OneWire - control devices (from Dallas Semiconductor) that use the One Wire protocol.

to:

- Firmata - for communicating with applications on the computer using a standard serial protocol.

Added line 29:

- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

Added line 32:

- OneWire - control devices (from Dallas Semiconductor) that use the One Wire protocol.

Added line 35:

- Simple Message System - send messages between Arduino and the computer

Changed lines 37-38 from:

- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

to:
Restore
January 20, 2008, at 11:14 AM by David A. Mellis - adding link to the one wire library
Added line 26:

- OneWire - control devices (from Dallas Semiconductor) that use the One Wire protocol.

Restore
December 05, 2007, at 08:42 AM by David A. Mellis - adding LedControl library link.
Added line 28:

- LedControl - for controlling LED matrices or seven-segment displays with a MAX7221 or MAX7219.

Restore
November 02, 2007, at 04:20 PM by David A. Mellis -
Changed lines 37-39 from:

For a guide to writing your own libraries, see this tutorial.

to:

For a guide to writing your own libraries, see this tutorial.

Restore
November 02, 2007, at 04:19 PM by David A. Mellis -
Changed lines 35-37 from:

To install, unzip the library to a sub-directory of the **hardware/libraries** sub-directory of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

to:

To install, unzip the library to a sub-directory of the **hardware/libraries** sub-directory of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

For a guide to writing your own libraries, see this tutorial.

Restore
November 02, 2007, at 02:16 PM by David A. Mellis -
Changed line 35 from:

To install, unzip the library to a sub-directory of the **hardware/libraries** of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

to:

To install, unzip the library to a sub-directory of the **hardware/libraries** sub-directory of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

Restore
November 02, 2007, at 02:16 PM by David A. Mellis - cleaning up the instructions
Changed lines 3-6 from:

To use an existing library in a sketch simply go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert an **#include** statement at the top of the sketch for each header (.h) file in the library's folder and make the library's functions and constants available to your sketch.

Because libraries are uploaded to the board with your sketch, they increase the amount of space used by the ATmega8 on the board. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

to:

To use an existing library in a sketch, go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert one or more **#include** statements at the top of the sketch and allow it to use the library.

Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

Changed lines 33-35 from:

- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

to:

- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

To install, unzip the library to a sub-directory of the **hardware/libraries** of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

Restore
June 20, 2007, at 05:11 PM by David A. Mellis -
Changed line 33 from:

- [[http://www.wayoda.org/arduino/ledcontrol/index.html | LedControl] - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

to:

- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

Restore
June 20, 2007, at 05:11 PM by David A. Mellis -
Changed lines 32-33 from:

- X10 - Sending X10 signals over AC power lines

to:

- X10 - Sending X10 signals over AC power lines
- [[http://www.wayoda.org/arduino/ledcontrol/index.html | LedControl] - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.

Restore
June 20, 2007, at 10:30 AM by Tom Igoe -
Changed line 32 from:

- * X10 - Sending X10 signals over AC power lines

to:

- X10 - Sending X10 signals over AC power lines

Restore
June 20, 2007, at 10:29 AM by Tom Igoe -
Changed line 32 from:

- * X10? - Sending X10 signals over AC power lines

to:

- * X10 - Sending X10 signals over AC power lines

Restore
June 20, 2007, at 10:29 AM by Tom Igoe -
Changed lines 31-32 from:

- Servotimer1 - provides hardware support for Servo motors on pins 9 and 10

to:

- Servotimer1 - provides hardware support for Servo motors on pins 9 and 10
- * X10? - Sending X10 signals over AC power lines

Restore
June 13, 2007, at 01:25 PM by David A. Mellis - adding LCD 4 bit link
Changed lines 26-27 from:

- LCD Library - control LCD displays
- TextString Library - handle strings

to:

- LCD - control LCDs (using 8 data lines)
- LCD 4 Bit - control LCDs (using 4 data lines)
- TextString - handle strings

Restore
June 13, 2007, at 01:20 PM by David A. Mellis - adding links to the servo libraries
Changed lines 29-30 from:

- Stepper - Allows you to control a unipolar or bipolar stepper motor

to:

- Servo - provides software support for Servo motors on any pins.
- Servotimer1 - provides hardware support for Servo motors on pins 9 and 10

Restore
June 09, 2007, at 06:53 PM by David A. Mellis -
Changed lines 11-12 from:

- SoftwareSerial Software Serial - a few examples for 0007

to:

- SoftwareSerial - for serial communication on any digital pins
- Stepper - for controlling stepper motors
- EEPROM - reading and writing to "permanent" storage

Restore
March 11, 2007, at 05:18 PM by Tom Igoe -
Added line 27:

- Stepper - Allows you to control a unipolar or bipolar stepper motor

Restore
January 13, 2007, at 03:17 AM by David A. Mellis - describing the unofficial libraries.
Changed lines 23-26 from:

- Simple Message System
- LCD Library
- TextString Library
- Metro

to:

- Simple Message System - send messages between Arduino and the computer
- LCD Library - control LCD displays
- TextString Library - handle strings
- Metro - help you time actions at regular intervals

Restore
January 08, 2007, at 07:36 AM by David A. Mellis -
Changed lines 9-10 from:

These are the "official" libraries that are included in the Arduino distribution. They are compatible with the Wiring versions, and the links below point to the (excellent) Wiring documentation.

to:

These are the "official" libraries that are included in the Arduino distribution.

- SoftwareSerial Software Serial - a few examples for 0007

These libraries are compatible Wiring versions, and the links below point to the (excellent) Wiring documentation.

Changed lines 18-21 from:

(:if loggedin true:) SoftwareSerial Software Serial - a few examples for 0007 (:if:)

to:
Restore
January 06, 2007, at 11:05 AM by Tom Igoe -
Changed line 15 from:

hi there

to:

SoftwareSerial Software Serial - a few examples for 0007

Restore
January 06, 2007, at 11:04 AM by Tom Igoe -
Changed line 14 from:

(:if auth admin:)

to:

(:if loggedin true:)

Restore
January 06, 2007, at 11:04 AM by Tom Igoe -
Changed line 14 from:

(:if auth=admin:)

to:

(:if auth admin:)

Restore
January 06, 2007, at 11:03 AM by Tom Igoe -
Changed line 14 from:

(:if auth edit:)

to:

(:if auth=admin:)

Restore
January 06, 2007, at 11:02 AM by Tom Igoe -

Changed line 14 from:

(:if auth=edit:)

to:

(:if auth edit:)

Restore
January 06, 2007, at 11:02 AM by Tom Igoe -
Changed line 14 from:

(:if auth edit:)

to:

(:if auth=edit:)

Restore
January 06, 2007, at 11:01 AM by Tom Igoe -
Changed lines 14-17 from:
to:

(:if auth edit:) hi there (:if:)

Restore
November 07, 2006, at 09:20 AM by David A. Mellis - adding twi/i2c pins
Changed lines 13-14 from:

- Wire - Two Wire Interface for sending and receiving data over a net of devices or sensors.

to:

- Wire - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors. On the Arduino, SDA is on analog input pin 4, and SCL on analog input pin 5.

Restore
November 04, 2006, at 12:48 PM by David A. Mellis -
Added lines 3-8:

To use an existing library in a sketch simply go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert an **#include** statement at the top of the sketch for each header (.h) file in the library's folder and make the library's functions and constants available to your sketch.

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Official Libraries

Added lines 15-16:

Unofficial Libraries

Restore
November 04, 2006, at 12:46 PM by David A. Mellis -
Added lines 1-14:

Libraries

These are the "official" libraries that are included in the Arduino distribution. They are compatible with the Wiring versions, and the links below point to the (excellent) Wiring documentation.

- Matrix - Basic LED Matrix display manipulation library
- Sprite - Basic image sprite manipulation library for use in animations with an LED matrix
- Wire - Two Wire Interface for sending and receiving data over a net of devices or sensors.

These are not (yet) included with the Arduino distribution and may change.

- Simple Message System
- LCD Library
- TextString Library
- Metro

Libraries

To use an existing library in a sketch, go to the Sketch menu, choose "Import Library", and pick from the libraries available. This will insert one or more **#include** statements at the top of the sketch and allow it to use the library.

Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its **#include** statements from the top of your code.

Official Libraries

These are the "official" libraries that are included in the Arduino distribution.

- EEPROM - reading and writing to "permanent" storage
- SoftwareSerial - for serial communication on any digital pins
- Stepper - for controlling stepper motors
- Wire - Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors.

These libraries are compatible Wiring versions, and the links below point to the (excellent) Wiring documentation.

- Matrix - Basic LED Matrix display manipulation library
- Sprite - Basic image sprite manipulation library for use in animations with an LED matrix

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Libraries written by members of the Arduino community.

- DateTime - a library for keeping track of the current date and time in software.
- Firmata - for communicating with applications on the computer using a standard serial protocol.
- GLCD - graphics routines for LCD based on the KS0108 or equivalent chipset.
- LCD - control LCDs (using 8 data lines)
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- LedControl - for controlling LED matrices or seven-segment displays with a MAX7221 or MAX7219.
- LedControl - an alternative to the Matrix library for driving multiple LEDs with Maxim chips.
- TextString - handle strings
- Metro - help you time actions at regular intervals
- MsTimer2 - uses the timer 2 interrupt to trigger an action every N milliseconds.
- OneWire - control devices (from Dallas Semiconductor) that use the One Wire protocol.
- PS2Keyboard - read characters from a PS2 keyboard.
- Servo - provides software support for Servo motors on any pins.
- Servotimer1 - provides hardware support for Servo motors on pins 9 and 10
- Simple Message System - send messages between Arduino and the computer
- SSerial2Mobile - send text messages or emails using a cell phone (via AT commands over software serial)
- X10 - Sending X10 signals over AC power lines

To install, unzip the library to a sub-directory of the **hardware/libraries** sub-directory of the Arduino application directory. Then launch the Arduino environment; you should see the library in the **Import Library** menu.

For a guide to writing your own libraries, see this tutorial.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.Comparison History

Hide minor edits - Show changes to markup

June 15, 2007, at 05:38 PM by David A. Mellis -
Changed lines 3-4 from:

The Arduino language (based on Wiring) is implemented in C, and therefore has some differences from the Processing language, which is based on Java.

to:

The Arduino language (based on Wiring) is implemented in C/C++, and therefore has some differences from the Processing language, which is based on Java.

Restore
June 15, 2007, at 05:38 PM by David A. Mellis - updating serial examples to current api
Changed line 30 from:

(:cellnr:) printString("hello world");
printNewline();

to:

(:cellnr:) Serial.println("hello world");

Changed line 32 from:

(:cellnr bgcolor=#999999:) int i = 5;
printInteger(i);
printNewline();

to:

(:cellnr bgcolor=#999999:) int i = 5;
Serial.println(i);

Changed line 34 from:

(:cellnr:) int i = 5;
printString("i = ");
printInteger(i);
printNewline();

to:

(:cellnr:) int i = 5;
Serial.print("i = ");
Serial.print(i);
Serial.println();

Restore
November 04, 2006, at 12:45 PM by David A. Mellis -
Added lines 1-37:

Arduino/Processing Language Comparison

The Arduino language (based on Wiring) is implemented in C, and therefore has some differences from the Processing language, which is based on Java.

Arrays

(:table width=75% cellspacing=0 cellpadding=5:) (:cellnr width=50% bgcolor=#999999:) *Arduino* (:cell width=50% bgcolor=#CCCCCC:) *Processing* (:cellnr:) int bar[8];
bar[0] = 1; (:cell:) int[] bar = new int[8];
bar[0] = 1; (:cellnr bgcolor=#999999:) int foo[] = { 0, 1, 2 }; (:cell bgcolor=#CCCCCC:) int foo[] = { 0, 1, 2 };
or
int[] foo = { 0, 1, 2 }; (:tableend:)

Loops

(:table width=75% cellspacing=0 cellpadding=5:) (:cellnr width=50% bgcolor=#999999:) *Arduino* (:cell width=50% bgcolor=#CCCCCC:) *Processing* (:cellnr:) int i;
for (i = 0; i < 5; i++) { ... } (:cell:) for (int i = 0; i < 5; i++) { ... } (:tableend:)

Printing

(:table width=75% cellspacing=0 cellpadding=5:) (:cellnr width=50% bgcolor=#999999:) *Arduino* (:cell width=50% bgcolor=#CCCCCC:) *Processing* (:cellnr:) printString("hello world");
printNewline(); (:cell:) println("hello world"); (:cellnr bgcolor=#999999:) int i = 5;
printInteger(i);
printNewline(); (:cell bgcolor=#CCCCCC:) int i = 5;
println(i); (:cellnr:) int i = 5;
printString("i = ");
printInteger(i);
printNewline(); (:cell:) int i = 5;
println("i = " + i); (:tableend:)

Restore

Arduino/Processing Language Comparison

The Arduino language (based on Wiring) is implemented in C/C++, and therefore has some differences from the Processing language, which is based on Java.

Arrays

Arduino	*Processing*

int bar[8];
bar[0] = 1;
	int[] bar = new int[8];
	bar[0] = 1;

int foo[] = { 0, 1, 2 };	int foo[] = { 0, 1, 2 };
	or
	int[] foo = { 0, 1, 2 };

Loops

Arduino	*Processing*

int i;
for (i = 0; i < 5; i++) { ... }
	for (int i = 0; i < 5; i++) { ... }

Printing

Arduino	*Processing*
Serial.println("hello world");	println("hello world");

int i = 5;
Serial.println(i);
	int i = 5;
	println(i);

int i = 5;
Serial.print("i = ");
Serial.print(i);
Serial.println();
	int i = 5;
	println("i = " + i);

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Board History

Hide minor edits - Show changes to markup

April 23, 2008, at 10:30 PM by David A. Mellis -
Changed line 23 from:

(:table width=95% border=0 cellpadding=5 cellspacing=0:)

to:

(:table width=100% border=0 cellpadding=5 cellspacing=0:)

Restore
April 18, 2008, at 08:54 PM by David A. Mellis -
Changed lines 88-89 from:

- **AREF.** Reference voltage for the analog inputs. Not currently supported by the Arduino software.

to:

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().

Restore
March 09, 2008, at 08:32 PM by David A. Mellis -
Changed line 32 from:

Flash Memory	16 KB (of which 2 KB used by bootloader)

to:

Flash Memory	16 KB

Changed line 46 from:

Flash Memory	8 KB (of which 1 KB used by bootloader)

to:

Flash Memory	8 KB

Restore
March 09, 2008, at 08:31 PM by David A. Mellis -
Added lines 21-53:

Microcontrollers

(:table width=95% border=0 cellpadding=5 cellspacing=0:) (:cell width=50%:)

ATmega168 (used on most Arduino boards)

Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6 (DIP) or 8 (SMD)
DC Current per I/O Pin	40 mA
Flash Memory	16 KB (of which 2 KB used by bootloader)
SRAM	1 KB
EEPROM	512 bytes

(datasheet)

(:cell width=50%:)

ATmega8 (used on some older board)

Digital I/O Pins	14 (of which 3 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
Flash Memory	8 KB (of which 1 KB used by bootloader)
SRAM	1 KB
EEPROM	512 bytes

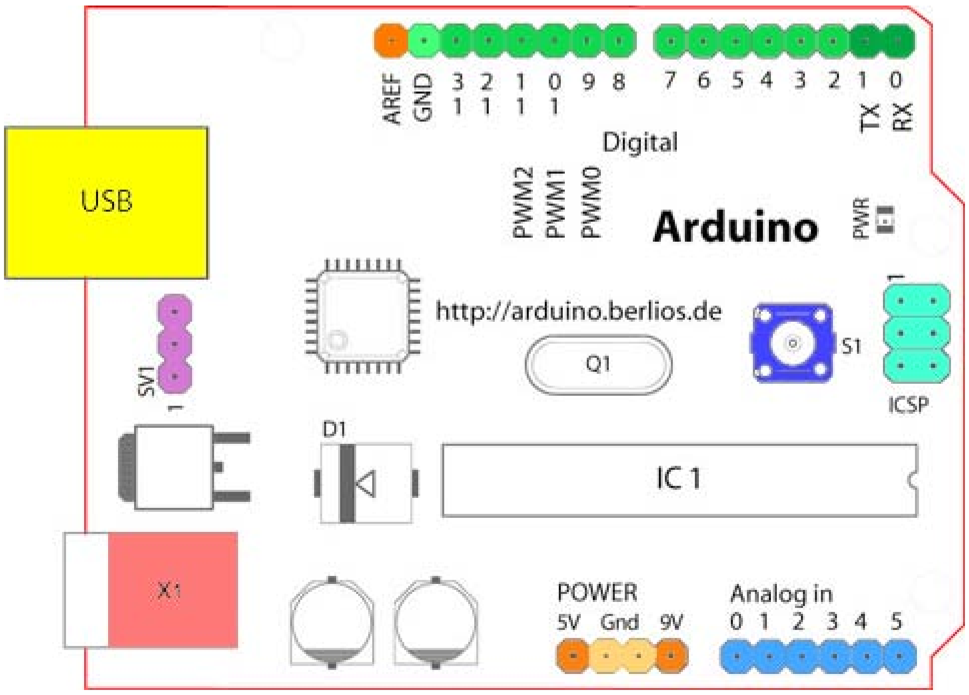
(datasheet)

(:tableend:)

Restore
February 13, 2008, at 09:16 PM by David A. Mellis - moving the board page here from the guide, since it's not really about "getting started"
Added lines 1-57:

Introduction to the Arduino Board

Looking at the board from the top down, this is an outline of what you will see (parts of the board you might interact with in the course of normal use are highlighted):



Starting clockwise from the top center:

- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - *These pins cannot be used for digital i/o (**digitalRead** and **digitalWrite**) if you are also using serial communication (e.g. **Serial.begin**).*
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog In Pins 0-5 (light blue)
- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply In (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow)

Digital Pins

In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pinMode(), digitalRead(), and digitalWrite() commands. Each pin has an internal pull-up resistor which can be turned on and off using digitalWrite() (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input.

The maximum current per pin is 40 mA.

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Diecimila, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11 Bluetooth module. On the Arduino Mini and LilyPad Arduino, they are intended for use with an external TTL serial module (e.g. the Mini-USB Adapter).

- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.

- **BT Reset: 7.** (Arduino BT-only) Connected to the reset line of the bluetooth module.

- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

- **LED: 13.** On the Diecimila and LilyPad, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

Analog Pins

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analogRead() function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

- **I^{2}C: 4 (SDA) and 5 (SCL).** Support I^{2}C (TWI) communication using the Wire library (documentation on the Wiring website).

Power Pins

- **VIN** (sometimes labelled "9V"). The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. Note that different boards accept different input voltages ranges, please see the documentation for your board. Also note that the LilyPad has no VIN pin and accepts only a regulated input.

- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

- **3V3.** (Diecimila-only) A 3.3 volt supply generated by the on-board FTDI chip.

- **GND.** Ground pins.

Other Pins

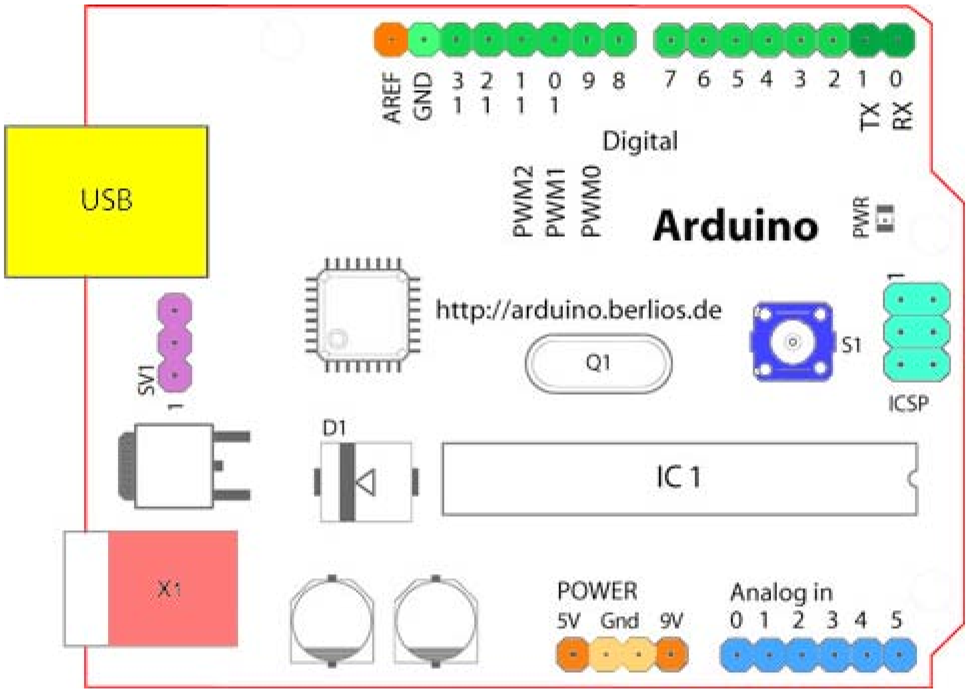
- **AREF.** Reference voltage for the analog inputs. Not currently supported by the Arduino software.

- **Reset.** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Restore

Introduction to the Arduino Board

Looking at the board from the top down, this is an outline of what you will see (parts of the board you might interact with in the course of normal use are highlighted):



Starting clockwise from the top center:

- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - *These pins cannot be used for digital i/o (**digitalRead** and **digitalWrite**) if you are also using serial communication (e.g. **Serial.begin**).*
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- Analog In Pins 0-5 (light blue)
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Microcontrollers

ATmega168 (used on most Arduino boards)		*ATmega8* (used on some older board)	
Digital I/O Pins	14 (of which 6 provide PWM output)	Digital I/O Pins	14 (of which 3 provide PWM output)
Analog Input Pins	6 (DIP) or 8 (SMD)	Analog Input Pins	6
DC Current per I/O Pin	40 mA	DC Current per I/O Pin	40 mA

Flash Memory	16 KB
SRAM	1 KB
EEPROM	512 bytes

(datasheet)

Flash Memory	8 KB
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EEPROM	512 bytes

(datasheet)

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- **Reset.** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Setup History

Hide minor edits - Show changes to markup

January 02, 2008, at 10:24 PM by Paul Badger -
Changed lines 3-4 from:

The setup() function is called when your program starts. Use it to initialize your variables, pin modes, start using libraries, etc.

to:

The setup() function is called when your program starts. Use it to initialize your variables, pin modes, start using libraries, etc. The setup function will only run once, after each powerup or reset of the Arduino board.

Restore
August 31, 2007, at 10:15 PM by David A. Mellis -
Changed lines 17-22 from:

```
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
```

to:

```
  // ...
```

Restore
April 16, 2007, at 09:18 AM by Paul Badger -
Changed lines 1-2 from:

setup()

to:

setup()

Restore
April 16, 2007, at 09:17 AM by Paul Badger -
Deleted lines 25-26:

Reference Home

Restore
March 24, 2006, at 04:36 PM by Jeff Gray -
Changed lines 1-2 from:

Setup

to:

setup()

Restore
March 24, 2006, at 04:35 PM by Jeff Gray -
Changed lines 1-2 from:

setup

to:

Setup

Restore
March 24, 2006, at 04:30 PM by Jeff Gray -
Deleted line 5:
Deleted line 6:
Restore
March 24, 2006, at 01:37 PM by Jeff Gray -
Restore
January 12, 2006, at 05:34 PM by 82.186.237.10 -
Added lines 28-29:

Reference Home

Restore
December 16, 2005, at 03:13 PM by 85.18.81.162 -
Changed lines 1-3 from:

Setup

to:

setup

The setup() function is called when your program starts. Use it to initialize your variables, pin modes, start using libraries, etc.

Example

```
int buttonPin = 3;

void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
}
```

Restore
November 27, 2005, at 09:58 AM by 81.154.199.248 -
Added lines 1-3:

Setup

Restore

setup()

The setup() function is called when your program starts. Use it to initialize your variables, pin modes, start using libraries, etc. The setup function will only run once, after each powerup or reset of the Arduino board.

Example

```
int buttonPin = 3;

void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

void loop()
{
  // ...
}
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Loop History

Hide minor edits - Show changes to markup

April 16, 2007, at 09:19 AM by Paul Badger -
Deleted lines 29-30:

Reference Home

Restore
March 24, 2006, at 04:35 PM by Jeff Gray -
Changed lines 1-2 from:

loop()

to:

loop()

Restore
March 24, 2006, at 01:42 PM by Jeff Gray -
Deleted line 7:
Restore
March 24, 2006, at 01:42 PM by Jeff Gray -
Added lines 1-32:

loop()

After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.

Example

```
int buttonPin = 3;

// setup initializes serial and the button pin
void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

// loop checks the button pin each time,
// and will send serial if it is pressed
void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
}
```

loop()

After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.

Example

```
int buttonPin = 3;

// setup initializes serial and the button pin
void setup()
{
  beginSerial(9600);
  pinMode(buttonPin, INPUT);
}

// loop checks the button pin each time,
// and will send serial if it is pressed
void loop()
{
  if (digitalRead(buttonPin) == HIGH)
    serialWrite('H');
  else
    serialWrite('L');

  delay(1000);
}
```

Reference Home

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Arduino

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Reference.PinMode History

Hide minor edits - Show changes to markup

February 13, 2008, at 09:28 PM by David A. Mellis -
Changed line 38 from:

- Description of the pins on an Arduino board?

to:

- Description of the pins on an Arduino board

Restore
February 13, 2008, at 09:28 PM by David A. Mellis -
Changed lines 38-39 from:

- Description of the pins on an Arduino board
- analog pins

to:

- Description of the pins on an Arduino board?

Restore
January 19, 2008, at 09:39 AM by David A. Mellis - changing analog pins link to playground.
Changed line 39 from:

- analog pins

to:

- analog pins

Restore
January 18, 2008, at 12:32 PM by Paul Badger -
Changed lines 35-36 from:

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

to:

The analog input pins can be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 18, 2008, at 09:14 AM by David A. Mellis -
Deleted lines 8-9:

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite and pinMode commands.

Added lines 33-36:

Note

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 17, 2008, at 11:23 PM by Paul Badger -
Changed lines 4-5 from:

Configures the specified pin to behave either as an input or an output.

to:

Configures the specified pin to behave either as an input or an output. See the reference page below.

Changed lines 7-8 from:

pin: the number of the pin whose mode you want to set. (*int*)

to:

pin: the number of the pin whose mode you wish to set. (*int*)

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite and pinMode commands.

Added line 37:

- analog pins

Restore
January 11, 2008, at 11:40 AM by David A. Mellis -
Deleted line 5:
Changed lines 9-10 from:

mode: either INPUT or OUTPUT. (*int*)

to:

mode: either INPUT or OUTPUT.

Deleted lines 32-53:

Pins Configured as INPUT

Arduino (Atmega) pins default to inputs, so they don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a capacitive touch sensor.

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown resistor (resistor to ground) on the input, with 10K being a common value.

There are also convenient 20K pullup resistors built into the Atmega chip that can be accessed from software. These built-in pullup resistors are accessed in the following manner.

```
pinMode(pin, INPUT);           // set pin to input
digitalWrite(pin, HIGH);       // turn on pullup resistors
```

Note that the pullup resistors provide enough current to dimmly light an LED connected to a pin that has been configured as an input. If LED's in a project seem to be working, but very dimmly, this is likely what is going on, and you have forgotten to use pinMode to change the pins to outputs.

Pins Configured as OUTPUT

Pins configured as OUTPUT with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately. For this reason it is a good idea to connect OUTPUT pins to other devices with 470O or 1k resistors.

Added line 34:

- Description of the pins on an Arduino board

Deleted line 37:

- delay

Restore
December 02, 2007, at 09:52 PM by Paul Badger -
Restore
December 02, 2007, at 09:50 PM by Paul Badger -
Restore
December 02, 2007, at 09:49 PM by Paul Badger -
Changed lines 47-49 from:
to:

Note that the pullup resistors provide enough current to dimmly light an LED connected to a pin that has been configured as an input. If LED's in a project seem to be working, but very dimmly, this is likely what is going on, and you have forgotten to use pinMode to change the pins to outputs.

Restore
November 18, 2007, at 01:01 PM by Paul Badger -
Changed lines 38-39 from:

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown resistor(resistor to ground) to the input, with 10K being a common value.

to:

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown resistor (resistor to ground) on the input, with 10K being a common value.

Changed lines 50-51 from:

Pins configured as OUTPUT with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

to:

Pins configured as OUTPUT with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

Restore
November 03, 2007, at 09:55 PM by Paul Badger -
Changed lines 38-39 from:

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

to:

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown resistor(resistor to ground) to the input, with 10K being a common value.

Restore
June 09, 2007, at 08:39 PM by Paul Badger -
Changed line 55 from:

- Constants

to:

- constants

Restore
June 09, 2007, at 08:39 PM by Paul Badger -
Changed line 55 from:

- Constants

to:

- Constants

Restore
June 09, 2007, at 08:39 PM by Paul Badger -
Added line 55:

- Constants

Restore
June 09, 2007, at 08:37 PM by Paul Badger -
Changed lines 34-35 from:

Pins Configured as Inputs

to:

Pins Configured as INPUT

Changed lines 48-53 from:

Pins Configured as Outputs

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately. For this reason it is a good idea to connect output pins with 470O or 1k resistors.

to:

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Pins configured as OUTPUT with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

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Restore
June 09, 2007, at 08:34 PM by Paul Badger -
Changed lines 52-53 from:

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately.

to:

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately. For this reason it is a good idea to connect output pins with 470O or 1k resistors.

Restore
May 21, 2007, at 09:04 PM by Paul Badger -
Changed lines 36-37 from:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a capacitive touch sensor.

to:

Arduino (Atmega) pins default to inputs, so they don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a capacitive touch sensor.

Restore
May 17, 2007, at 12:36 PM by Paul Badger -
Added line 56:

- digitalRead

Restore
May 17, 2007, at 12:34 PM by Paul Badger -
Deleted lines 56-58:

Reference Home

Restore
May 17, 2007, at 12:33 PM by Paul Badger -
Changed lines 50-51 from:

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids or motors.

to:

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.

Restore
May 17, 2007, at 12:30 PM by Paul Badger -
Changed lines 50-51 from:

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can provide up to 40 mA (milliamps) to other devices. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids or motors.

to:

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids or motors.

Restore
May 17, 2007, at 12:28 PM by Paul Badger -
Changed lines 38-39 from:

Often it is useful however to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC) or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

to:

Often it is useful however, to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC), or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

Restore

May 17, 2007, at 12:27 PM by Paul Badger -
Changed lines 36-37 from:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a touch sensor.

to:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a capacitive touch sensor.

Restore
May 17, 2007, at 12:26 PM by Paul Badger -
Changed lines 36-40 from:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs have an extremely high input impedance (~100 Megohm). This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a touch sensor.

Often it is useful however to steer an input pin to a known state, if no input is present. This can be done by adding a pullup (resistor to VCC) or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

to:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a touch sensor.

Often it is useful however to steer an input pin to a known state if no input is present. This can be done by adding a pullup (resistor to VCC) or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

Restore
May 17, 2007, at 11:50 AM by Paul Badger -
Changed lines 53-54 from:

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, either/or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately.

to:

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately.

Restore
May 17, 2007, at 11:49 AM by Paul Badger -
Changed lines 44-45 from:

pinMode (pin, INPUT); // set pin to input digitalWrite (pin, HIGH); // turn on pullup resistors

to:

pinMode(pin, INPUT); // set pin to input digitalWrite(pin, HIGH); // turn on pullup resistors

Added lines 49-54:

Pins Configured as Outputs

Pins configured as outputs with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can provide up to 40 mA (milliamps) to other devices. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids or motors.

Short circuits on Arduino pins, or attempting to run high current devices from them, can damage or destroy the output transistors in the pin, either/or damage the entire Atmega chip. Often this will result in a "dead" pin in the microcontroller but the remaining chip will still function adequately.

Restore
May 17, 2007, at 11:39 AM by Paul Badger -
Changed lines 36-37 from:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs have an extremely high input impedance (~100 Megohm). This means that it takes very little current to move the input pin from one state to another and can make the pins useful for such tasks as capacitive sensing.

to:

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs have an extremely high input impedance (~100 Megohm). This means that it takes very little current to move the input pin from one state to another, and can make the pins useful for such tasks as implementing a touch sensor.

Restore
May 17, 2007, at 11:38 AM by Paul Badger -
Changed lines 16-17 from:

```
 [@
```

to:

```
[@
```

Changed lines 34-36 from:

configures pin number 13 to work as an output pin.

to:

Pins Configured as Inputs

Arduino (Atmega) pins default to inputs, so don't need to be explicitly declared as inputs with pinMode(). Pins configured as inputs have an extremely high input impedance (~100 Megohm). This means that it takes very little current to move the input pin from one state to another and can make the pins useful for such tasks as capacitive sensing.

Often it is useful however to steer an input pin to a known state, if no input is present. This can be done by adding a pullup (resistor to VCC) or pulldown (resistor to ground) resistor to the input, with 10K being a common value.

There are also convenient 20K pullup resistors built into the Atmega chip that can be accessed from software. These built-in pullup resistors are accessed in the following manner.

```
pinMode (pin, INPUT);           // set pin to input
digitalWrite (pin, HIGH);       // turn on pullup resistors
```

Restore
January 12, 2006, at 05:36 PM by 82.186.237.10 -
Added lines 40-42:

Reference Home

Restore
December 28, 2005, at 03:45 PM by 82.186.237.10 -
Changed lines 8-11 from:

pin (*int*): the number of the pin whose mode you want to set.

mode (*int*): either INPUT or OUTPUT

to:

pin: the number of the pin whose mode you want to set. (*int*)

mode: either INPUT or OUTPUT. (*int*)

Restore
December 28, 2005, at 03:44 PM by 82.186.237.10 -

Changed lines 1-6 from:

pinMode

`pinMode(int pin, int mode)`

to:

pinMode(pin, mode)

Changed lines 8-11 from:

pin: the number of the pin whose mode you want to set

mode: either INPUT or OUTPUT

to:

pin (*int*): the number of the pin whose mode you want to set.

mode (*int*): either INPUT or OUTPUT

Restore
December 28, 2005, at 03:42 PM by 82.186.237.10 -
Added line 21:
Restore
December 28, 2005, at 03:42 PM by 82.186.237.10 -
Changed line 7 from:

What it does

to:

Description

Changed lines 11-17 from:

What parametres does it take

you need to specify the number of the pin you want to configure followed by the word INPUT or OUTPUT.

This function returns

nothing

to:

Parameters

pin: the number of the pin whose mode you want to set

mode: either INPUT or OUTPUT

Returns

None

Restore
December 10, 2005, at 10:33 AM by 62.255.32.10 -
Changed lines 3-6 from:
to:

`pinMode(int pin, int mode)`

Changed lines 14-17 from:

```
pinMode(ledPin, OUTPUT);      // sets the digital pin as output
```

to:
Restore
December 10, 2005, at 10:31 AM by 62.255.32.10 -

Added line 11:

[@

Changed lines 13-14 from:
to:

@]

Restore
December 10, 2005, at 10:30 AM by 62.255.32.10 -
Added lines 11-12:

pinMode(ledPin, OUTPUT); // sets the digital pin as output

Restore
December 10, 2005, at 10:28 AM by 62.255.32.10 -
Changed lines 9-11 from:

you need to specify the number of the pin y ou want to configure followed by the word INPUT or OUTPUT.

to:

you need to specify the number of the pin you want to configure followed by the word INPUT or OUTPUT.

Restore
December 10, 2005, at 10:26 AM by 62.255.32.10 -
Changed lines 5-7 from:

Configures the specified pin to behave like an input or an output.

to:

Configures the specified pin to behave either as an input or an output.

Restore
December 03, 2005, at 01:13 PM by 213.140.6.103 -
Changed lines 10-11 from:

ou want to configure followed by the word INPUT or OUTPUT.

to:

ou want to configure followed by the word INPUT or OUTPUT.

Restore
December 03, 2005, at 01:13 PM by 213.140.6.103 -
Changed lines 16-17 from:

```
 [@int ledPin = 13;                 // LED connected to digital pin 13
```

to:

```
 [@
```

int ledPin = 13; // LED connected to digital pin 13

Restore
December 03, 2005, at 01:12 PM by 213.140.6.103 -
Changed lines 16-17 from:

```
int ledPin = 13; // LED connected to digital pin 13
```

to:

```
 [@int ledPin = 13;                 // LED connected to digital pin 13
```

Changed lines 29-30 from:

}

to:

} @]

Restore
December 03, 2005, at 01:12 PM by 213.140.6.103 -
Changed line 36 from:

- digitalRead

to:

- delay

Restore
November 27, 2005, at 10:41 AM by 81.154.199.248 -
Changed lines 16-17 from:

@@int ledPin = 13; // LED connected to digital pin 13

to:

```
int ledPin = 13; // LED connected to digital pin 13
```

Restore
November 27, 2005, at 10:41 AM by 81.154.199.248 -
Changed lines 29-30 from:

}@@

to:

}

Restore
November 27, 2005, at 10:40 AM by 81.154.199.248 -
Deleted line 17:
Deleted line 18:
Deleted line 19:
Deleted line 20:
Deleted line 23:
Restore
November 27, 2005, at 10:40 AM by 81.154.199.248 -
Changed lines 16-18 from:

[@int ledPin = 13; // LED connected to digital pin 13

to:

@@int ledPin = 13; // LED connected to digital pin 13

Changed lines 34-35 from:

}@]

to:

}@@

Restore
November 27, 2005, at 10:26 AM by 81.154.199.248 -
Added line 18:
Added line 20:
Added line 22:
Added line 24:
Added line 28:
Restore
November 27, 2005, at 10:26 AM by 81.154.199.248 -
Changed lines 16-19 from:

[@

int ledPin = 13; // LED connected to digital pin 13

to:

[@int ledPin = 13; // LED connected to digital pin 13

Changed lines 29-31 from:

} @]

to:

}@]

Restore
November 27, 2005, at 10:17 AM by 81.154.199.248 -
Changed lines 5-7 from:

Configures the speficied pin to behave like an input or an output.

to:

Configures the specified pin to behave like an input or an output.

Restore
November 27, 2005, at 10:17 AM by 81.154.199.248 -
Changed lines 16-17 from:

[=

to:

[@

Changed lines 32-33 from:

=]

to:

@]

Restore
November 27, 2005, at 10:13 AM by 81.154.199.248 -
Changed lines 16-17 from:

@@int ledPin = 13; // LED connected to digital pin 13

to:

[= int ledPin = 13; // LED connected to digital pin 13

Changed lines 30-31 from:

}@@

to:

} =]

Restore
November 27, 2005, at 10:10 AM by 81.154.199.248 -
Changed lines 16-17 from:

[@int ledPin = 13; // LED connected to digital pin 13

to:

@@int ledPin = 13; // LED connected to digital pin 13

Changed lines 29-30 from:

}@]

to:

}@@

Restore
November 27, 2005, at 10:05 AM by 81.154.199.248 -

Changed lines 16-18 from:

[@ int ledPin = 13; // LED connected to digital pin 13

to:

[@int ledPin = 13; // LED connected to digital pin 13

Changed lines 29-32 from:

}

@]

to:

}@]

Restore
November 27, 2005, at 10:03 AM by 81.154.199.248 -
Changed lines 16-17 from:

pinMode(13,OUTPUT)

to:

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

Restore
November 27, 2005, at 09:55 AM by 81.154.199.248 -
Changed line 22 from:

- [[digitalWrite]

to:

- digitalWrite

Restore
November 27, 2005, at 09:55 AM by 81.154.199.248 -
Changed line 4 from:

What it does

to:

What it does

Changed line 8 from:

What parametres does it take

to:

What parametres does it take

Changed line 12 from:

This function returns

to:

This function returns

Changed line 15 from:

Example

to:

Example

Changed lines 21-23 from:

See also

- {{digitalWrite}}
- {{digitalRead}}

to:

See also

- [[digitalWrite]
- digitalRead

Restore
November 27, 2005, at 09:54 AM by 81.154.199.248 -
Added lines 1-23:

pinMode

What it does

Configures the speficied pin to behave like an input or an output.

What parametres does it take

you need to specify the number of the pin y ou want to configure followed by the word INPUT or OUTPUT.

This function returns

nothing

Example

pinMode(13,OUTPUT)

configures pin number 13 to work as an output pin.

See also

- {{digitalWrite}}
- {{digitalRead}}

Restore

pinMode(pin, mode)

Description

Configures the specified pin to behave either as an input or an output. See the reference page below.

Parameters

pin: the number of the pin whose mode you wish to set. (*int*)

mode: either INPUT or OUTPUT.

Returns

None

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

Note

The analog input pins can be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- constants
- digitalWrite
- digitalRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.VariableDeclaration History

Hide minor edits - Show changes to markup

July 16, 2007, at 11:44 PM by Paul Badger -
Changed lines 27-28 from:

You can name a variable any word that is not already one of the keywords in Arduino.

to:

You can name a variable any word that is not already one of the keywords in Arduino. Avoid beginning variable names with numeral characters.

Added line 42:

- byte

Restore
July 16, 2007, at 11:42 PM by Paul Badger -
Changed lines 31-32 from:

All variables have to be declared before they are used. Declaring a variable means defining its type, and setting an initial value. In the above example, the statement

to:

All variables have to be declared before they are used. Declaring a variable means defining its type, and optionally, setting an initial value (initializing the variable). In the above example, the statement

Restore
June 22, 2007, at 07:20 AM by Paul Badger -
Changed line 18 from:

```
  inputVariable = 100
```

to:

```
  inputVariable = 100;
```

Changed lines 21-22 from:

delay(inputVariable)@]

to:

delay(inputVariable);@]

Restore
May 26, 2007, at 07:38 PM by Paul Badger -
Changed line 43 from:

- unsigned int?

to:

- unsigned int

Changed line 45 from:

- unsigned long

to:

- unsigned long

Restore
May 26, 2007, at 07:37 PM by Paul Badger -
Added line 43:

- unsigned int?

Added lines 45-47:

- unsigned long
- float
- double

Restore
May 26, 2007, at 07:35 PM by Paul Badger -
Changed lines 8-10 from:

int inputVariable = 0; # Declares the variable; this only needs to be done once inputVariable = analogRead(2); # Set the variable to the input of analog pin #2@]

to:

int inputVariable = 0; // declares the variable; this only needs to be done once inputVariable = analogRead(2); // set the variable to the input of analog pin #2@]

Restore
April 16, 2007, at 09:22 AM by Paul Badger -
Changed lines 1-2 from:

Variables

to:

Variables

Deleted lines 43-44:

Reference Home

Restore
March 30, 2006, at 08:00 PM by Tom Igoe -
Changed lines 13-14 from:

Once a variable has been set (or re-set), you can test it's value to see if it meets certain conditions, or you can use it's value directly. For instance, the following code tests whether the inputVariable (from analog pin #2) is less than 100, then sets a delay based on inputVariable which is a minimum of 100:

to:

Once a variable has been set (or re-set), you can test its value to see if it meets certain conditions, or you can use it's value directly. For instance, the following code tests whether the inputVariable is less than 100, then sets a delay based on inputVariable which is a minimum of 100:

Restore
March 30, 2006, at 08:00 PM by Tom Igoe -
Changed lines 9-10 from:

inputVariable = analogRead(2); # Set the variable@]

to:

inputVariable = analogRead(2); # Set the variable to the input of analog pin #2@]

Restore
March 30, 2006, at 07:59 PM by Tom Igoe -
Changed lines 3-4 from:

A variable is a way of naming and storing a value for later use by the program. An example of , like data from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

to:

A variable is a way of naming and storing a value for later use by the program, such as data from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

Restore
March 30, 2006, at 07:58 PM by Tom Igoe -
Changed lines 11-12 from:

inputVariable is the variable itself. The first line declares that it will contain an int (short for integer.) The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value at analog pin #2 is greater than 0:

to:

inputVariable is the variable itself. The first line declares that it will contain an int (short for integer.) The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code.

Once a variable has been set (or re-set), you can test it's value to see if it meets certain conditions, or you can use it's value directly. For instance, the following code tests whether the inputVariable (from analog pin #2) is less than 100, then sets a delay based on inputVariable which is a minimum of 100:

Changed line 16 from:

if (inputVariable > 0)

to:

if (inputVariable < 100)

Changed lines 18-22 from:

```
  # do something here
```

}@]

You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value**, on the other hand, do little to make your code readable.

to:

```
  inputVariable = 100
```

}

delay(inputVariable)@]

This example shows all three useful operations with variables. It tests the variable (`if (inputVariable < 100)`), it sets the variable if it passes the test (`inputVariable = 100`), and it uses the value of the variable as an input to the delay() function (`delay(inputVariable)`)

Style Note: You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value**, on the other hand, do little to make your code readable.

Restore
March 30, 2006, at 07:49 PM by Tom Igoe -
Changed lines 8-10 from:

int inputVariable = 0; # This declares the variable, declaration only needs to be done once inputVariable = analogRead(2); # This sets the variable@]

to:

int inputVariable = 0; # Declares the variable; this only needs to be done once inputVariable = analogRead(2); # Set the variable@]

Restore
March 30, 2006, at 07:48 PM by Tom Igoe -
Changed lines 5-6 from:

```
 You set a variable by making it equal to the value you want to store. The following code declares a
```

variable **inputVariable**, and then sets it equal to the value at analog pin #2:

to:

You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

Restore
March 30, 2006, at 07:48 PM by Tom Igoe -
Changed lines 3-6 from:

Variables are expressions that store values, like sensor reading and storing input from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

to:

A variable is a way of naming and storing a value for later use by the program. An example of , like data from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

Changed lines 8-10 from:

int inputVariable = 0; inputVariable = analogRead(2);@]

to:

int inputVariable = 0; # This declares the variable, declaration only needs to be done once inputVariable = analogRead(2); # This sets the variable@]

Restore
March 30, 2006, at 06:45 PM by Tom Igoe -
Changed lines 11-12 from:

inputVariable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value at analog pin #2 is greater than 0:

to:

inputVariable is the variable itself. The first line declares that it will contain an int (short for integer.) The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value at analog pin #2 is greater than 0:

Changed lines 25-26 from:

All variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

to:

All variables have to be declared before they are used. Declaring a variable means defining its type, and setting an initial value. In the above example, the statement

Changed line 28 from:

int val = 0;

to:

int inputVariable = 0;

Changed lines 31-32 from:

The previous statement informs that the variable **val** is of the type **int** and that its initial value is zero.

to:

declares that inputVariable is an int, and that its initial value is zero.

Added line 35:

- char

Deleted line 36:

- char

Restore
March 30, 2006, at 02:24 PM by Tom Igoe -
Changed lines 19-20 from:

You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value** do little to make your code readable.

to:

You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value**, on the other hand, do little to make your code readable.

Restore
March 30, 2006, at 02:11 PM by Tom Igoe -
Changed lines 37-38 from:
to:

- long

Restore
March 30, 2006, at 02:11 PM by Tom Igoe -
Restore
March 30, 2006, at 02:11 PM by Tom Igoe -
Changed lines 11-12 from:

inputVariable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of inputVariable is greater than 0:

to:

inputVariable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value at analog pin #2 is greater than 0:

Restore
March 30, 2006, at 02:00 PM by Tom Igoe -
Changed lines 9-11 from:

inputVariable = analogRead(2); @]

to:

inputVariable = analogRead(2);@]

Changed lines 17-18 from:

} @]

to:

}@]

Restore
March 30, 2006, at 01:59 PM by Tom Igoe -
Changed lines 20-22 from:

You give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value** do little to make your code readable.

to:

You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value** do little to make your code readable.

Restore
March 30, 2006, at 01:59 PM by Tom Igoe -
Changed lines 5-6 from:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **inputVariable** equal to the value at analog pin #2:

to:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

Changed line 8 from:

int inputVariable;

to:

int inputVariable = 0;

Changed lines 12-13 from:

input_variable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of inputVariable is greater than 0:

to:

inputVariable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of inputVariable is greater than 0:

Changed lines 23-26 from:

You can choose any word that is not already existing in the language. The pre-defined words in the language are also called **keywords**. Examples of keywords are: **digitalRead**, **pinMode**, or **setup**.

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended. Use variable names that describe what you're using them for, like **sensorValue** or **switchState**.

to:

You can name a variable any word that is not already one of the keywords in Arduino.

Changed lines 27-28 from:

Variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

to:

All variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

Restore
March 30, 2006, at 01:52 PM by Tom Igoe -
Changed line 7 from:

[=

to:

[@

Changed lines 10-11 from:

=]

to:

@]

Changed line 14 from:

[=

to:

[@

Changed lines 19-20 from:

=]

to:

@]

Restore
March 30, 2006, at 01:52 PM by Tom Igoe -
Changed line 8 from:

int inputVariable;\\

to:

int inputVariable;

Changed lines 15-17 from:

if (inputVariable > 0)
{
# do something here\\

to:

if (inputVariable > 0) {

```
  # do something here
```

Restore
March 30, 2006, at 01:52 PM by Tom Igoe -
Changed line 8 from:

int inputVariable;

to:

int inputVariable;\\

Changed lines 15-17 from:

if (inputVariable > 0) {

```
  # do something here
```

to:

if (inputVariable > 0)
{
# do something here\\

Restore
March 30, 2006, at 01:51 PM by Tom Igoe -
Changed lines 5-6 from:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **input_variable** equal to the value at analog pin #2:

to:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **inputVariable** equal to the value at analog pin #2:

Changed lines 8-9 from:

input_variable = analogRead(2);

to:

int inputVariable; inputVariable = analogRead(2);

Changed lines 12-21 from:

input_variable is the variable itself; it makes the value at analog pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of input_variable is The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

You can choose any word that is not already existing in the language. The pre-defined words in the language are also called **keywords**. Examples of keywords are: **digitalRead**, **pinMode**, or **setup**.

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended. Use variable names that describe what you're using them for, like **sensorValue** or **switchState**.

Variable Declaration

Variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

to:

input_variable is the variable itself. The first line declares that it will contain an int, which is to say a whole number. The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of inputVariable is greater than 0:

Changed lines 15-18 from:

int val = 0;

to:

```
if (inputVariable > 0) {

  # do something here

}
```

Added lines 21-34:

You give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value** do little to make your code readable.

You can choose any word that is not already existing in the language. The pre-defined words in the language are also called **keywords**. Examples of keywords are: **digitalRead**, **pinMode**, or **setup**.

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended. Use variable names that describe what you're using them for, like **sensorValue** or **switchState**.

Variable Declaration

Variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

int val = 0;

Restore
March 30, 2006, at 01:37 PM by Tom Igoe -
Changed lines 5-6 from:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **input_variable** equal to the value at analog pin #2.:

to:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **input_variable** equal to the value at analog pin #2:

Changed lines 11-12 from:

input_variable is what's called a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

to:

input_variable is the variable itself; it makes the value at analog pin #2 accessible elsewhere in the code. For instance, the following code tests whether the value of input_variable is The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

Restore
March 30, 2006, at 01:35 PM by Tom Igoe -
Added lines 5-6:

A variable is a way of giving a name to the stored value. You set a variable by making it equal to the value you want to store. The following code sets **input_variable** equal to the value at analog pin #2.:

Changed line 8 from:

val = analogRead(2);

to:

input_variable = analogRead(2);

Changed lines 11-12 from:

val is what's called a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

to:

input_variable is what's called a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

Restore
March 30, 2006, at 01:32 PM by Tom Igoe -
Changed lines 3-4 from:

Variables are expressions that can be used in programs to store values, like e.g. sensor reading from an analog pin.

to:

Variables are expressions that store values, like sensor reading and storing input from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

Restore
March 25, 2006, at 12:18 AM by Jeff Gray -
Changed lines 1-2 from:

Variables

to:

Variables

Restore
March 24, 2006, at 11:32 PM by Tom Igoe -
Changed lines 9-10 from:

val is what we call a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

to:

val is what's called a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

Changed lines 13-14 from:

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended.

to:

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended. Use variable names that describe what you're using them for, like **sensorValue** or **switchState**.

Restore
January 12, 2006, at 05:34 PM by 82.186.237.10 -
Changed lines 23-24 from:

The previous statement informs that the variable **val** is of the type **Integer** and that its initial value is zero.

to:

The previous statement informs that the variable **val** is of the type **int** and that its initial value is zero.

Changed lines 27-29 from:

- Integer?

- Char?

to:

- int
- char

Reference Home

Restore
December 09, 2005, at 11:58 AM by 195.178.229.25 -
Added lines 1-29:

Variables

Variables are expressions that can be used in programs to store values, like e.g. sensor reading from an analog pin.

val = analogRead(2);

val is what we call a variable. It is a container for data inside the memory of Arduino. The name of the variable is **val** in this case, but we could have chosen anything else like e.g. **inputPin** or **sensorA**.

You can choose any word that is not already existing in the language. The pre-defined words in the language are also called **keywords**. Examples of keywords are: **digitalRead**, **pinMode**, or **setup**.

Again it is possible to choose completely random names like **tomato** or **I_love_Sushi** but this will make much more complicated for other people to read your code and it is not recommended.

Variable Declaration

Variables have to be declared before they are used. To declare a variable implies to define its type, and an initial value.

int val = 0;

The previous statement informs that the variable **val** is of the type **Integer** and that its initial value is zero.

Possible types for variables are:

- Integer?

- Char?

Restore

Variables

A variable is a way of naming and storing a value for later use by the program, such as data from a analog pin set to input. (See pinMode for more on setting pins to input or output.)

You set a variable by making it equal to the value you want to store. The following code declares a variable **inputVariable**, and then sets it equal to the value at analog pin #2:

```
int inputVariable = 0;         // declares the variable; this only needs to be done once
inputVariable = analogRead(2); // set the variable to the input of analog pin #2
```

inputVariable is the variable itself. The first line declares that it will contain an int (short for integer.) The second line sets inputVariable to the value at analog pin #2. This makes the value of pin #2 accessible elsewhere in the code.

Once a variable has been set (or re-set), you can test its value to see if it meets certain conditions, or you can use it's value directly. For instance, the following code tests whether the inputVariable is less than 100, then sets a delay based on inputVariable which is a minimum of 100:

```
if (inputVariable < 100)
{
  inputVariable = 100;
}

delay(inputVariable);
```

This example shows all three useful operations with variables. It tests the variable (`if (inputVariable < 100)`), it sets the variable if it passes the test (`inputVariable = 100`), and it uses the value of the variable as an input to the delay() function (`delay(inputVariable)`)

Style Note: You should give your variables descriptive names, so as to make your code more readable. Variable names like **tiltSensor** or **pushButton** help you (and anyone else reading your code) understand what the variable represents. Variable names like **var** or **value**, on the other hand, do little to make your code readable.

You can name a variable any word that is not already one of the keywords in Arduino. Avoid beginning variable names with numeral characters.

Variable Declaration

All variables have to be declared before they are used. Declaring a variable means defining its type, and optionally, setting an initial value (initializing the variable). In the above example, the statement

int inputVariable = 0;

declares that inputVariable is an int, and that its initial value is zero.

Possible types for variables are:

- char
- byte
- int
- unsigned int
- long
- unsigned long
- float
- double

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.FunctionDeclaration History

Hide minor edits - Show changes to markup

February 14, 2008, at 12:08 AM by Paul Badger -
Changed lines 3-6 from:

Functions allow a programmer to create modular pieces of code that performs a defined task and then returns to the area of code from which the function was "called". The typical case for creating a function is when one needs to perform the same action multiple times in a program.

For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB in BASIC).

to:

Segmenting code into functions allows a programmer to create modular pieces of code that perform a defined task and then return to the area of code from which the function was "called". The typical case for creating a function is when one needs to perform the same action multiple times in a program.

For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB in BASIC).

Restore
December 02, 2007, at 09:59 PM by Paul Badger -
Added line 34:

}

Changed lines 36-37 from:

Our function needs to be *declared* outside any other function, so "myMultiplyFunction()" can go above or below the "loop()" function.

to:

Our function needs to be *declared* outside any other function, so "myMultiplyFunction()" can go either above or below the "loop()" function.

Restore
November 28, 2007, at 11:11 PM by Paul Badger -
Restore
November 28, 2007, at 11:07 PM by Paul Badger -
Changed lines 60-61 from:

This function will read a sensor five time with analogRead() and calculate the average of five readings. It then scales the data to 8 bits (0-255), and inverts it, returning the inverted result.

to:

This function will read a sensor five times with analogRead() and calculate the average of five readings. It then scales the data to 8 bits (0-255), and inverts it, returning the inverted result.

Restore
November 05, 2007, at 05:00 PM by Paul Badger -
Changed lines 60-61 from:

The function will read a sensor five time with analogRead() then calculate the average of five readings. It then scales the data to 8 bits (0-255) and inverts it.

to:

This function will read a sensor five time with analogRead() and calculate the average of five readings. It then scales the data to 8 bits (0-255), and inverts it, returning the inverted result.

Restore
November 05, 2007, at 04:58 PM by Paul Badger -
Changed lines 58-59 from:

A more complex example

to:

Another example

Restore
November 05, 2007, at 04:53 PM by Paul Badger -
Changed lines 64-65 from:
to:

```
  int sval;
```

Changed line 67 from:

```
    i = i + analogRead(0);    // sensor on analog pin 0
```

to:

```
    sval = sval + analogRead(0);    // sensor on analog pin 0
```

Changed lines 70-73 from:

```
  i = i / 5;    // average
  i = i / 4;    // scale to 8 bits (0 - 255)
  i = 255 - i;  // invert output
  return i;
```

to:

```
  sval = sval / 5;    // average
  sval = sval / 4;    // scale to 8 bits (0 - 255)
  sval = 255 - sval;  // invert output
  return sval;
```

Restore
November 05, 2007, at 04:50 PM by Paul Badger -
Changed lines 69-70 from:

```
  i = i / 5;  // average
  i = i / 4;  // scale to 8 bits (0 - 255)
```

to:

```
  i = i / 5;    // average
  i = i / 4;    // scale to 8 bits (0 - 255)
```

Restore
November 05, 2007, at 04:49 PM by Paul Badger -
Changed line 66 from:

```
    i = i +  analogRead(0);
```

to:

```
    i = i + analogRead(0);    // sensor on analog pin 0
```

Deleted lines 82-83:

@]

Restore
November 05, 2007, at 04:48 PM by Paul Badger -

Changed lines 62-78 from:

[@ int ReadSens_and_Condition(){ int i;

for (i = 0; i < 5; i++){

```
   i = i +  analogRead(0);
```

}

```
 i = i / 5;  // average
 i = i / 4;  // scale to 8 bits (0 - 255)
 i = 255 - i;  // invert output
 return i;
```

}

to:

```
int ReadSens_and_Condition(){
  int i;

  for (i = 0; i < 5; i++){
    i = i +  analogRead(0);
  }

  i = i / 5;  // average
  i = i / 4;  // scale to 8 bits (0 - 255)
  i = 255 - i;  // invert output
  return i;
}
```

To call our function we just assign it to a variable.

[@int sens;

sens = ReadSens_and_Condition();

Added lines 81-84:

@]

Restore
November 05, 2007, at 04:45 PM by Paul Badger -
Changed lines 5-6 from:

For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB).

to:

For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB in BASIC).

Changed lines 25-26 from:

To "call" our simple multiply function we pass it the datatypes it is expecting:

to:

To "call" our simple multiply function, we pass it parameters of the datatype that it is expecting:

Changed lines 60-68 from:

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

[@ if (student_age > x) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

to:

The function will read a sensor five time with analogRead() then calculate the average of five readings. It then scales the data to 8 bits (0-255) and inverts it.

[@ int ReadSens_and_Condition(){ int i;

for (i = 0; i < 5; i++){

```
   i = i +  analogRead(0);
```

Changed lines 68-71 from:

if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

to:

```
 i = i / 5;  // average
 i = i / 4;  // scale to 8 bits (0 - 255)
 i = 255 - i;  // invert output
 return i;
```

Added lines 74-78:

Deleted lines 79-100:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

```
// tell us the type of data the function expects
void tuitionTest(int tuition_balance) {
  if (tuition_balance < 100) {
    student_grade++;
  }
}
```

And our code looks like this:

```
if (student_age > x) {
  tuitionTest(tuition_balance);
}
if (test_score > y) {
  tuitionTest(tuition_balance);
}
```

Restore
November 05, 2007, at 04:21 PM by Paul Badger -
Restore
November 05, 2007, at 04:20 PM by Paul Badger -
Deleted line 21:
Deleted lines 24-25:
Changed lines 38-40 from:

[@

void setup(){

to:

[@void setup(){

Restore
November 05, 2007, at 04:17 PM by Paul Badger -
Changed line 44 from:

Serial.begin(9600);

to:

```
  Serial.begin(9600);
```

Changed lines 48-54 from:

int i = 2; int j = 3; int k;

k = myMultiplyFunction(i, j); // k now contains 6 Serial.println(k); delay(500);

to:

```
  int i = 2;
  int j = 3;
  int k;

  k = myMultiplyFunction(i, j); // k now contains 6
  Serial.println(k);
  delay(500);
```

Changed lines 58-60 from:

int result; result = x * y; return result;

to:

```
  int result;
  result = x * y;
  return result;
```

Restore
November 05, 2007, at 04:16 PM by Paul Badger -
Deleted line 36:
Deleted lines 37-38:
Changed line 40 from:

The entire sketch would look like this:

to:

The entire sketch would then look like this:

Changed lines 60-69 from:

}

@]

to:

return result; }@]

Restore
November 05, 2007, at 04:13 PM by Paul Badger -
Changed lines 7-8 from:

Standardizing code fragments into functions has severaladvantages:

to:

Standardizing code fragments into functions has several advantages:

Changed lines 11-12 from:

- They codify one action in one place so that the function only has to be thought out and debugged once.

to:

- Functions codify one action in one place so that the function only has to be thought out and debugged once.

Added lines 20-22:

There are two required functions in an Arduino sketch, setup() and loop(). Other functions must be created outside the brackets of those two functions. As an example, we will create a simple function to multiply two numbers.

Restore
November 05, 2007, at 04:07 PM by Paul Badger -
Changed line 57 from:

int myMultiplyFunction(int i, int j){

to:

int myMultiplyFunction(int x, int y){

Changed lines 59-65 from:

result =

to:

result = x * y; }

Restore
November 05, 2007, at 03:58 PM by Paul Badger -
Changed lines 58-64 from:

to:

int result; result =

Restore
November 05, 2007, at 03:57 PM by Paul Badger -
Added lines 23-24:
Changed lines 29-32 from:

int: i = 2; int: j = 3; int: k;

to:

int i = 2; int j = 3; int k;

Changed lines 38-44 from:

A more complex example

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

to:

Our function needs to be *declared* outside any other function, so "myMultiplyFunction()" can go above or below the "loop()" function.

The entire sketch would look like this:

Changed lines 42-45 from:

if (student_age > x) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

to:

void setup(){ Serial.begin(9600);

Changed lines 46-49 from:

if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

to:

void loop{ int i = 2; int j = 3; int k;

k = myMultiplyFunction(i, j); // k now contains 6 Serial.println(k); delay(500);

Added lines 56-64:

int myMultiplyFunction(int i, int j){

Changed lines 66-70 from:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

to:

A more complex example

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

Changed lines 75-77 from:

// tell us the type of data the function expects void tuitionTest(int tuition_balance) {

```
  if (tuition_balance < 100) {
```

to:

if (student_age > x) {

```
  if (tuition == "paid") {
```

Added lines 80-84:

if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

}

Changed lines 86-90 from:

And our code looks like this:

to:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

Changed lines 92-93 from:

if (student_age > x) {

```
  tuitionTest(tuition_balance);
```

to:

// tell us the type of data the function expects void tuitionTest(int tuition_balance) {

```
  if (tuition_balance < 100) {
    student_grade++;
  }
```

Deleted lines 97-99:

if (test_score > y) {

```
  tuitionTest(tuition_balance);
```

}

Added lines 99-107:

And our code looks like this:

```
if (student_age > x) {
  tuitionTest(tuition_balance);
}
if (test_score > y) {
  tuitionTest(tuition_balance);
}
```

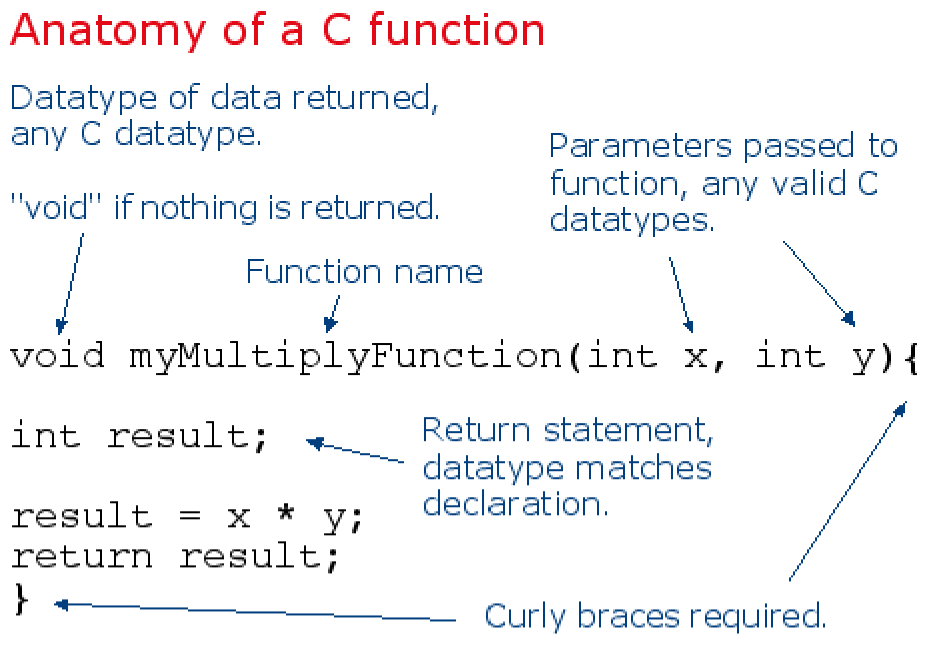
Restore
October 15, 2007, at 07:48 AM by Paul Badger -
Changed lines 23-24 from:

To "call" our simple multiply function we pass it the datatypes is it expecting:

to:

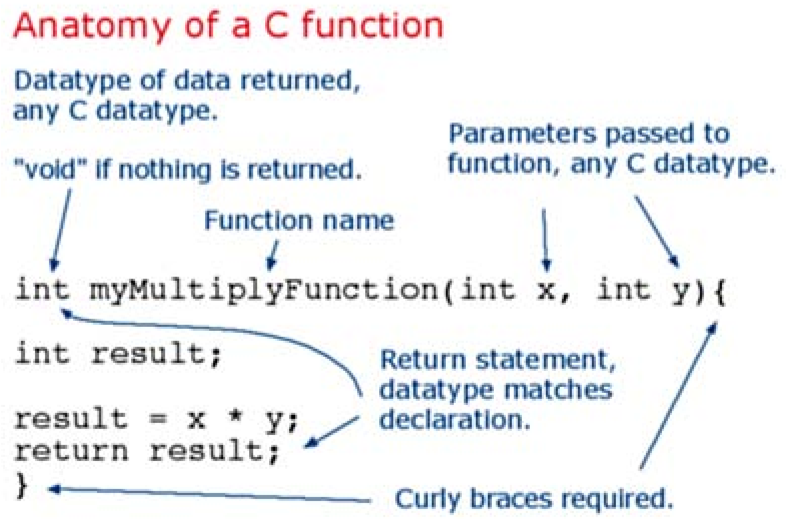
To "call" our simple multiply function we pass it the datatypes it is expecting:

Restore
October 15, 2007, at 07:45 AM by Paul Badger -
Changed lines 21-22 from:


Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any valid C datatypes.
Return statement, datatype matches declaration.
Curly braces required.

```
void myMultiplyFunction(int x, int y){
int result;
result = x * y;
return result;
}
```

to:


Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any C datatype.
Return statement, datatype matches declaration.
Curly braces required.

```
int myMultiplyFunction(int x, int y){
int result;

result = x * y;
return result;
}
```

Restore
October 15, 2007, at 06:04 AM by Paul Badger -
Changed lines 23-25 from:

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

to:

To "call" our simple multiply function we pass it the datatypes is it expecting:

Changed lines 26-35 from:

if (student_age > x) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

} if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

}

to:

void loop{ int: i = 2; int: j = 3; int: k;

k = myMultiplyFunction(i, j); // k now contains 6

Changed lines 34-38 from:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

to:

A more complex example

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

Changed lines 44-46 from:

// tell us the type of data the function expects void tuitionTest(int tuition_balance) {

```
  if (tuition_balance < 100) {
```

to:

if (student_age > x) {

```
  if (tuition == "paid") {
```

Added lines 49-53:

if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

}

Changed lines 55-59 from:

And our code looks like this:

to:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

Changed lines 61-62 from:

if (student_age > x) {

```
  tuitionTest(tuition_balance);
```

to:

// tell us the type of data the function expects void tuitionTest(int tuition_balance) {

```
  if (tuition_balance < 100) {
    student_grade++;
  }
```

Deleted lines 66-68:

if (test_score > y) {

```
  tuitionTest(tuition_balance);
```

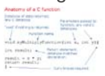
}

Added lines 68-76:

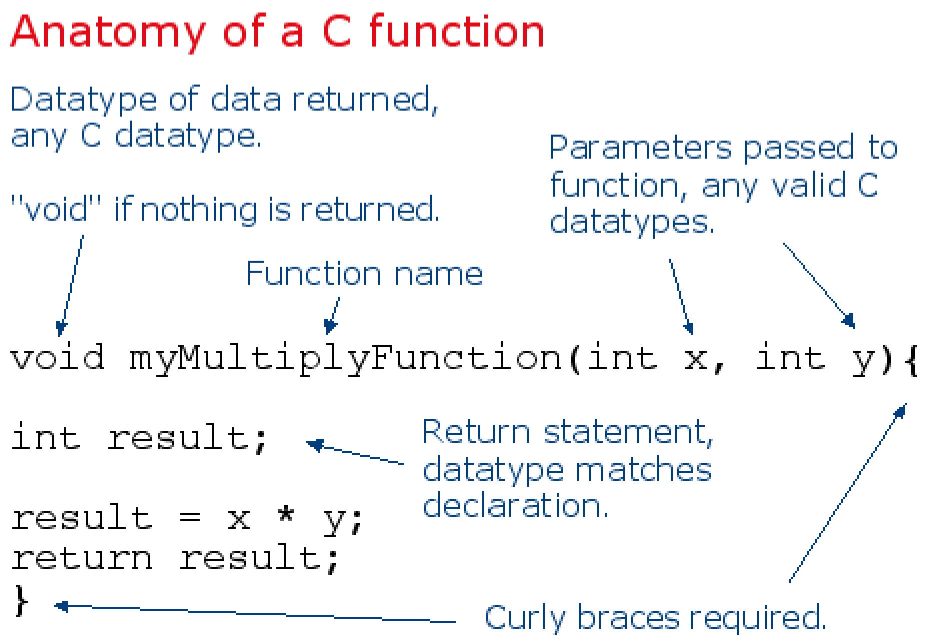
And our code looks like this:

```
if (student_age > x) {
  tuitionTest(tuition_balance);
}
if (test_score > y) {
  tuitionTest(tuition_balance);
}
```

Restore
October 15, 2007, at 05:57 AM by Paul Badger -
Changed lines 21-23 from:



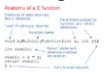
to:



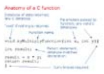
Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any valid C datatypes.
Return statement, datatype matches declaration.
Curly braces required.

```
void myMultiplyFunction(int x, int y){

int result;

result = x * y;
return result;
}
```

Restore
October 15, 2007, at 05:57 AM by Paul Badger -
Changed lines 21-23 from:



to:



Restore
October 15, 2007, at 05:57 AM by Paul Badger -
Changed lines 7-10 from:

Standardizing code fragments into functions has several advantages:

- Functions help the programmer stay organized. Often this helps to concpetualize the program.

to:

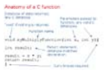
Standardizing code fragments into functions has severaladvantages:

- Functions help the programmer stay organized. Often this helps to conceptualize the program.

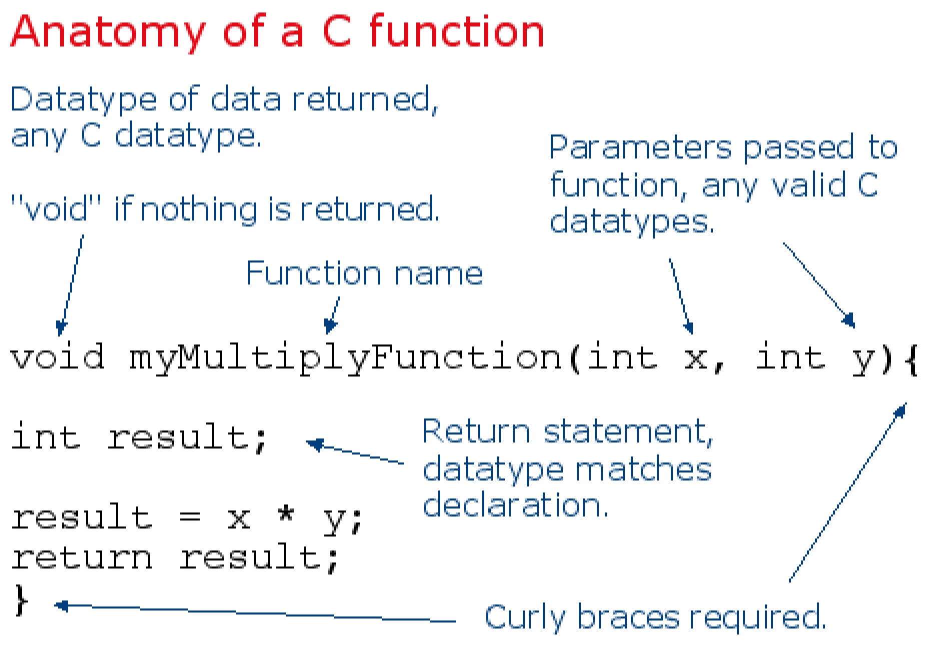
Changed lines 21-25 from:

%width=50pxAttach:FunctionAnatom.gif

to:



Restore
October 15, 2007, at 05:51 AM by Paul Badger -
Changed lines 22-25 from:


Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any valid C datatypes.
Return statement, datatype matches declaration.
Curly braces required.

```
void myMultiplyFunction(int x, int y){

int result;

result = x * y;
return result;
}
```

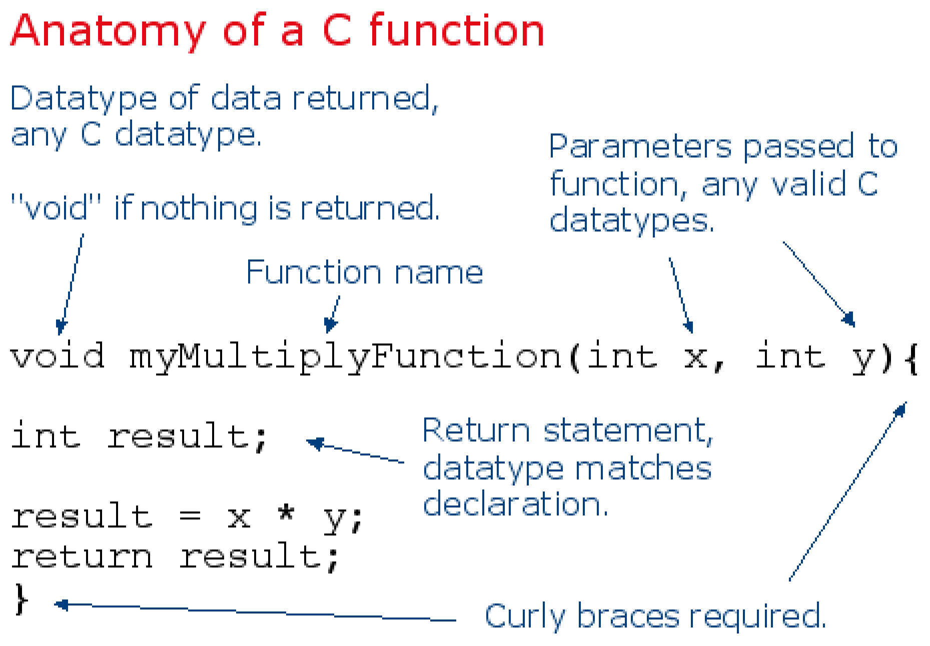
to:

%width=50pxAttach:FunctionAnatom.gif

Restore
October 15, 2007, at 05:48 AM by Paul Badger -
Changed lines 22-25 from:

Anatomy of a function?

to:



Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any valid C datatypes.
Return statement, datatype matches declaration.
Curly braces required.

```
void myMultiplyFunction(int x, int y){

int result;

result = x * y;
return result;
}
```

Restore
October 15, 2007, at 05:46 AM by Paul Badger -
Changed lines 23-25 from:

[[FunctionAnatom.gif | Anatomy of a function]

to:

Anatomy of a function?

Restore

October 15, 2007, at 05:46 AM by Paul Badger -
Added line 22:
Added line 25:
Restore
October 15, 2007, at 05:46 AM by Paul Badger -
Changed lines 22-23 from:

Attach:image.jpeg Δ

to:

[[FunctionAnatom.gif | Anatomy of a function]

Restore
October 15, 2007, at 05:44 AM by Paul Badger -
Added lines 22-23:

Attach:image.jpeg Δ

Restore
July 17, 2007, at 01:28 PM by David A. Mellis - removing prototyping note... i hope no one is still using arduino 0003 or earlier
Deleted lines 57-67:

Prototyping, prior to 0004

If you are using a version of Arduino prior to 0004, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration, with a semicolon at the end.

```
void displayNumber(int incomingValue);
```

This tells Arduino what kind of function you are calling and what arguments it will pass.

Restore
July 17, 2007, at 01:27 PM by David A. Mellis -
Changed lines 5-6 from:

For programmers accustomed to using BASIC, functions in C provide (and extend) the utility of using subroutines (GOSUB).

to:

For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB).

Restore
July 17, 2007, at 06:30 AM by Paul Badger -
Changed lines 3-4 from:

Functions allow you to create modular pieces of code that perform a defined task and then return you to the area of code from which the function was "called". The typical case for creating a function is when you need to perform the same action multiple times in one program.

to:

Functions allow a programmer to create modular pieces of code that performs a defined task and then returns to the area of code from which the function was "called". The typical case for creating a function is when one needs to perform the same action multiple times in a program.

For programmers accustomed to using BASIC, functions in C provide (and extend) the utility of using subroutines (GOSUB).

Restore
July 17, 2007, at 06:25 AM by Paul Badger -
Changed lines 11-12 from:

- This reduces chances for errors in debugging and modification, if the code needs to be changed.

to:

- This also reduces chances for errors in modification, if the code needs to be changed.

Restore
July 16, 2007, at 11:02 PM by Paul Badger -
Changed lines 15-17 from:

- They make it easier to reuse code in other programs. Funcitons make programs more modular and flexible.

to:

- They make it easier to reuse code in other programs by making it more modular, and as a nice side effect, using functions also often makes the code more readable.

Restore
July 16, 2007, at 10:51 PM by Paul Badger -
Changed lines 3-6 from:

Functions allow you to create modular pieces of code that perform certain tasks and then return you to the area of code it was executed from. The typical case for creating a function is when you need to perform the same action.

For instance, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

to:

Functions allow you to create modular pieces of code that perform a defined task and then return you to the area of code from which the function was "called". The typical case for creating a function is when you need to perform the same action multiple times in one program.

Standardizing code fragments into functions has several advantages:

- Functions help the programmer stay organized. Often this helps to concpetualize the program.
- They codify one action in one place so that the function only has to be thought out and debugged once.
- This reduces chances for errors in debugging and modification, if the code needs to be changed.
- Functions make the whole sketch smaller and more compact because sections of code are reused many times.
- They make it easier to reuse code in other programs. Funcitons make programs more modular and flexible.

Example

In a program to keep track of school records, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

Restore
April 16, 2007, at 09:30 AM by Paul Badger -
Restore
April 16, 2007, at 09:25 AM by Paul Badger -
Added line 51:
Restore
April 16, 2007, at 09:24 AM by Paul Badger -
Changed lines 1-2 from:

Functions

to:

Functions

Deleted lines 50-51:

Reference Home

Restore
October 01, 2006, at 05:54 AM by Clay Shirky -
Deleted line 18:
Changed line 24 from:
to:

[@

Changed line 31 from:

to:

@]

Deleted line 32:
Restore
October 01, 2006, at 05:53 AM by Clay Shirky - Updated example and prototyping note
Changed lines 3-4 from:

Functions allow you to create modular pieces of code that perform certain tasks and then return you to the area of code it was executed from. Below is an example of a function being called:

to:

Functions allow you to create modular pieces of code that perform certain tasks and then return you to the area of code it was executed from. The typical case for creating a function is when you need to perform the same action.

For instance, we move a student up a grade if they are old enough, or if they have passed a test, but only if they have paid their tuition.

Changed lines 8-17 from:

displayNumber(value);

to:

if (student_age > x) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

} if (test_score > y) {

```
  if (tuition == "paid") {
    student_grade++;
  }
```

}

Changed lines 20-21 from:

When Arduino executes this line, it looks for this function's declaration somewhere in the code, passes the "value" variable put inside the () as an "argument" to the function. Below is an example of what the function declaration could look like:

to:

However, if we later want to change tuition to a numerical test showing that they owe us less than a hundred dollars -- tuition < 100; -- we have to change the code in two places, greatly increasing the risk of bugs if we change it one place and forget to change it in the other.

A function helps by giving a block of code a name, then letting you call the entire block with that name. As a result, when you need to changed the named code, you only have to change it in one place.

Our function looks like this:

// tell us the type of data the function expects void tuitionTest(int tuition_balance) {

```
  if (tuition_balance < 100) {
    student_grade++;
  }
```

}

And our code looks like this:

Changed lines 36-39 from:

void displayNumber(int incomingValue){

```
  printInteger(incomingValue);
  // other code in the function
```

}

to:

if (student_age > x) {

```
  tuitionTest(tuition_balance);
```

} if (test_score > y) {

```
  tuitionTest(tuition_balance);
```

}

Changed lines 43-47 from:

Important (Prototyping)

In C, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration, with a semicolon at the end.

to:

Prototyping, prior to 0004

If you are using a version of Arduino prior to 0004, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration, with a semicolon at the end.

Changed lines 52-53 from:

This prepares C to know what kind of function you are calling and what arguments it will pass.

to:

This tells Arduino what kind of function you are calling and what arguments it will pass.

Restore
March 26, 2006, at 10:11 AM by David A. Mellis - Added "void" to function as C++ (in release 0004) will require it.
Changed line 12 from:

displayNumber(int incomingValue){

to:

void displayNumber(int incomingValue){

Changed line 23 from:

displayNumber(int incomingValue);

to:

void displayNumber(int incomingValue);

Restore
March 25, 2006, at 05:41 AM by David A. Mellis - Prototypes end with semicolons.
Changed lines 20-21 from:

In C, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration.

to:

In C, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration, with a semicolon at the end.

Changed line 23 from:

displayNumber(int incomingValue)

to:

displayNumber(int incomingValue);

Restore
March 24, 2006, at 05:27 PM by Jeff Gray -
Changed line 5 from:

[=

to:

[@

Changed lines 7-8 from:

=]

to:

@]

Changed line 22 from:

[=

to:

[@

Changed lines 24-25 from:

=]

to:

@]

Restore
March 24, 2006, at 05:27 PM by Jeff Gray -
Changed lines 16-17 from:
to:

@]

Restore
March 24, 2006, at 05:26 PM by Jeff Gray -
Changed lines 1-2 from:

Functions

to:

Functions

Restore
March 24, 2006, at 05:26 PM by Jeff Gray -
Added lines 1-27:

Functions

Functions allow you to create modular pieces of code that perform certain tasks and then return you to the area of code it was executed from. Below is an example of a function being called:

displayNumber(value);

When Arduino executes this line, it looks for this function's declaration somewhere in the code, passes the "value" variable put inside the () as an "argument" to the function. Below is an example of what the function declaration could look like:

[@ displayNumber(int incomingValue){

```
  printInteger(incomingValue);
  // other code in the function
```

}

Important (Prototyping)

In C, any function you create yourself the in the body of your code needs a function prototype at the beginning of your code, before the setup() code block. This is similar to the declaration of a variable, and essentially is just the first line of your function declaration.

displayNumber(int incomingValue)

This prepares C to know what kind of function you are calling and what arguments it will pass.

Reference Home

Restore

Functions

Segmenting code into functions allows a programmer to create modular pieces of code that perform a defined task and then return to the area of code from which the function was "called". The typical case for creating a function is when one needs to perform the same action multiple times in a program.

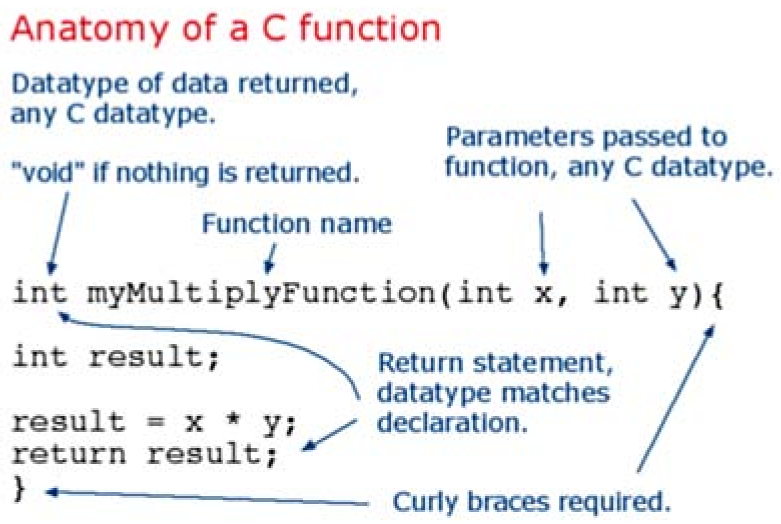
For programmers accustomed to using BASIC, functions in Arduino provide (and extend) the utility of using subroutines (GOSUB in BASIC).

Standardizing code fragments into functions has several advantages:

- Functions help the programmer stay organized. Often this helps to conceptualize the program.
- Functions codify one action in one place so that the function only has to be thought out and debugged once.
- This also reduces chances for errors in modification, if the code needs to be changed.
- Functions make the whole sketch smaller and more compact because sections of code are reused many times.
- They make it easier to reuse code in other programs by making it more modular, and as a nice side effect, using functions also often makes the code more readable.

There are two required functions in an Arduino sketch, setup() and loop(). Other functions must be created outside the brackets of those two functions. As an example, we will create a simple function to multiply two numbers.

Example


Anatomy of a C function
Datatype of data returned, any C datatype.
"void" if nothing is returned.
Function name
Parameters passed to function, any C datatype.
Return statement, datatype matches declaration.
Curly braces required.

```
int myMultiplyFunction(int x, int y){
int result;
result = x * y;
return result;
}
```

To "call" our simple multiply function, we pass it parameters of the datatype that it is expecting:

```
void loop{
int i = 2;
int j = 3;
int k;

k = myMultiplyFunction(i, j); // k now contains 6
}
```

Our function needs to be *declared* outside any other function, so "myMultiplyFunction()" can go either above or below the "loop()" function.

The entire sketch would then look like this:
```
void setup(){
  Serial.begin(9600);
}

void loop{
  int i = 2;
  int j = 3;
  int k;

  k = myMultiplyFunction(i, j); // k now contains 6
  Serial.println(k);
  delay(500);
}

int myMultiplyFunction(int x, int y){
  int result;
  result = x * y;
  return result;
}
```

Another example

This function will read a sensor five times with analogRead() and calculate the average of five readings. It then scales the data to 8 bits (0-255), and inverts it, returning the inverted result.

```
int ReadSens_and_Condition(){
  int i;
  int sval;

  for (i = 0; i < 5; i++){
    sval = sval + analogRead(0);    // sensor on analog pin 0
  }

  sval = sval / 5;    // average
  sval = sval / 4;    // scale to 8 bits (0 - 255)
  sval = 255 - sval;  // invert output
  return sval;
}
```

To call our function we just assign it to a variable.

```
int sens;

sens = ReadSens_and_Condition();
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.Void History

Hide minor edits - Show changes to markup

July 17, 2007, at 01:15 PM by David A. Mellis -
Changed lines 8-18 from:

// actions are performed in the function "setup" but // no information is reported to the larger program

void setup(){

serial.begin(9600);

}@]

to:

// actions are performed in the functions "setup" and "loop" // but no information is reported to the larger program

void setup() {

  // ...

}

void loop() {

  // ...

} @]

Restore
July 17, 2007, at 11:07 AM by Paul Badger -
Changed lines 3-5 from:

The void keyword is used only in function declarations. It indicates that the function is expected to return no information, to the function from which it was called.

to:

The void keyword is used only in function declarations. It indicates that the function is expected to return no information to the function from which it was called.

Restore
July 17, 2007, at 06:41 AM by Paul Badger -
Changed lines 17-19 from:

} @]

to:

}@]

Restore
July 17, 2007, at 06:41 AM by Paul Badger -
Added lines 23-24:
Restore
July 17, 2007, at 06:41 AM by Paul Badger -
Changed line 22 from:
to:

function declaration

Restore
July 17, 2007, at 06:40 AM by Paul Badger -
Added lines 1-22:

void

The void keyword is used only in function declarations. It indicates that the function is expected to return no information, to the function from which it was called.

Example:

```
// actions are performed in the function "setup" but
// no information is reported to the larger program


void setup(){

serial.begin(9600);

}
```

See also

Restore

void

The void keyword is used only in function declarations. It indicates that the function is expected to return no information to the function from which it was called.

Example:

```
// actions are performed in the functions "setup" and "loop"
// but  no information is reported to the larger program

void setup()
{
  // ...
}

void loop()
{
  // ...
}
```

See also

function declaration

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.If History

Hide minor edits - Show changes to markup

April 08, 2008, at 06:32 PM by Paul Badger -
Changed lines 37-38 from:

This is because C evaluates `if (x=10)` is as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, `if (x = 10)` will always evaluate to TRUE, which is not the desired result when using an 'if' statement.

to:

This is because C evaluates the statement `if (x=10)` as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, `if (x = 10)` will always evaluate to TRUE, which is not the desired result when using an 'if' statement. Additionally, the variable x will be set to 10, which is also not a desired action.

Restore
September 23, 2007, at 07:57 AM by Paul Badger -
Changed lines 35-36 from:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, and sets x to 10. Instead use the double equal sign, == (e.g. `if (x == 10)`), which is the comparison operator, and tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

to:

Beware of accidentally using the single equal sign (e.g. `if (x = 10)`). The single equal sign is the assignment operator, and sets x to 10. Instead use the double equal sign (e.g. `if (x == 10)`), which is the comparison operator, and tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

Restore
September 23, 2007, at 07:54 AM by Paul Badger -
Changed lines 35-38 from:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, setting x to 10. Instead use the double equal sign, == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

This is because C evaluates `if (x=10)` is as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, if (x = 10) will always evaluate to TRUE, which is not the desired result when using an 'if' statement.

to:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, and sets x to 10. Instead use the double equal sign, == (e.g. `if (x == 10)`), which is the comparison operator, and tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

This is because C evaluates `if (x=10)` is as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, `if (x = 10)` will always evaluate to TRUE, which is not the desired result when using an 'if' statement.

Restore
September 23, 2007, at 07:52 AM by Paul Badger -
Changed lines 34-36 from:

Coding Warning:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

to:

Warning:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, setting x to 10. Instead use the double equal sign, == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

This is because C evaluates `if (x=10)` is as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, if (x = 10) will always evaluate to TRUE, which is not the desired result when using an 'if' statement.

Restore
September 23, 2007, at 07:47 AM by Paul Badger -
Changed lines 35-36 from:

Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

to:

Beware of accidentally using the single equal sign '='(e.g. `if (x = 10)`), which is the assignment operator, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

Restore
September 23, 2007, at 07:44 AM by Paul Badger -
Changed line 13 from:

The brackets may be omitted after an *if* statement. If this is done the next line (defined by the semicolon) becomes the only conditional statement.

to:

The brackets may be omitted after an *if* statement. If this is done, the next line (defined by the semicolon) becomes the only conditional statement.

Restore
September 23, 2007, at 07:43 AM by Paul Badger -
Changed lines 16-17 from:

if (x > 120) digitalWrite(LEDpin, HIGH); if (x > 120) {digitalWrite(LEDpin, HIGH);} // both are correct

to:

if (x > 120) digitalWrite(LEDpin, HIGH);

if (x > 120) digitalWrite(LEDpin, HIGH);

if (x > 120) {digitalWrite(LEDpin, HIGH);} // all are correct

Restore
September 23, 2007, at 07:41 AM by Paul Badger -
Changed line 13 from:

It is often convenient to use a single line for a compact conditional test, and reaction to the test. In this case, the brackets may be ommited although they may add clarity for beginning programmers:

to:

The brackets may be omitted after an *if* statement. If this is done the next line (defined by the semicolon) becomes the only conditional statement.

Restore
June 11, 2007, at 11:49 PM by Paul Badger -
Changed lines 35-38 from:

See also

If ... Else

to:
Restore
June 11, 2007, at 11:48 PM by Paul Badger -
Changed lines 35-38 from:
to:

See also

If ... Else

Restore
June 11, 2007, at 11:44 PM by Paul Badger -
Changed lines 30-31 from:

Coding Warning: Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

to:

Coding Warning:

Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

Restore
May 26, 2007, at 07:36 AM by Paul Badger -
Added lines 11-12:

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in parentheses is true, the statements inside the brackets are run. If not, the program skips over the code.

Changed line 16 from:

if (x > 120) digitalWrite(LEDpin, HIGH); // both are correct

to:

if (x > 120) digitalWrite(LEDpin, HIGH);

Deleted lines 19-20:

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in parentheses is true, the statements inside the brackets are run. If not, the program skips over the code.

Restore
May 26, 2007, at 07:33 AM by Paul Badger -
Changed lines 16-17 from:
to:

@]

Restore
May 26, 2007, at 07:33 AM by Paul Badger -
Added lines 10-16:

It is often convenient to use a single line for a compact conditional test, and reaction to the test. In this case, the brackets may be ommited although they may add clarity for beginning programmers: [@

if (x > 120) digitalWrite(LEDpin, HIGH); // both are correct if (x > 120) {digitalWrite(LEDpin, HIGH);} // both are correct

Restore
April 16, 2007, at 05:02 PM by David A. Mellis -
Changed line 7 from:

```
  # do something here
```

to:

```
  // do something here
```

Restore
April 16, 2007, at 10:52 AM by Paul Badger -
Changed lines 22-23 from:

Coding Warning: Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

to:

Coding Warning: Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable, as a (probably unwanted) side-effect.

Restore
April 16, 2007, at 10:51 AM by Paul Badger -
Changed lines 1-2 from:

if

to:

if

Restore
April 16, 2007, at 09:14 AM by Paul Badger -
Changed lines 26-29 from:

Reference Home

to:
Restore
March 30, 2006, at 08:58 PM by Tom Igoe -
Changed lines 22-23 from:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

to:

Coding Warning: Beware of accidently using = (e.g. `if (x = 10)`), which sets a variable, instead of using == (e.g. `if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

Restore
March 30, 2006, at 08:55 PM by Tom Igoe -
Changed lines 22-23 from:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is set if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

to:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is true if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

Restore
March 30, 2006, at 08:38 PM by Tom Igoe -
Changed line 18 from:

```
 x > y (x is greater than y)
```

to:

```
 x >  y (x is greater than y)
```

Restore
March 30, 2006, at 08:38 PM by Tom Igoe -
Changed lines 15-21 from:

- **x == y** (x is equal to y)
- **x != y** (x is not equal to y)
- **x < y** (x is less than y)
- **x > y** (x is greater than y)
- **x <= y** (x is less than or equal to y)
- **x >= y** (x is greater than or equal to y)

to:

```
 x == y (x is equal to y)
 x != y (x is not equal to y)
 x <  y (x is less than y)
 x > y (x is greater than y)
 x <= y (x is less than or equal to y)
 x >= y (x is greater than or equal to y)
```

Restore
March 30, 2006, at 08:37 PM by Tom Igoe -
Changed lines 22-26 from:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not.

The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is set if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

to:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is set if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

if can also be part of a branching control structure using the if...else] construction.

Restore
March 30, 2006, at 08:36 PM by Tom Igoe -
Changed lines 15-21 from:

- x == y(x is equal to y)
- x != y (x is not equal to y)
- x < y (x is less than y)
- x > y (x is greater than y)
- x <= y (x is less than or equal to y)
- x >= y (x is greater than or equal to y)

to:

- **x == y** (x is equal to y)
- **x != y** (x is not equal to y)
- **x < y** (x is less than y)
- **x > y** (x is greater than y)
- **x <= y** (x is less than or equal to y)
- **x >= y** (x is greater than or equal to y)

Restore
March 30, 2006, at 08:35 PM by Tom Igoe -
Changed lines 15-21 from:

- == (equals to)
- != (not equals)
- < (less than)
- > (grater than)
- <= (less than or equals)
- >= (greater than or equals)

to:

- x == y(x is equal to y)
- x != y (x is not equal to y)
- x < y (x is less than y)
- x > y (x is greater than y)
- x <= y (x is less than or equal to y)
- x >= y (x is greater than or equal to y)

Restore
March 30, 2006, at 08:33 PM by Tom Igoe -
Changed lines 10-11 from:

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in brackets is true, the statements inside the brackets are run. If not, the program skips over the code.

to:

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in parentheses is true, the statements inside the brackets are run. If not, the program skips over the code.

Restore
March 30, 2006, at 08:32 PM by Tom Igoe -
Changed lines 3-4 from:

`if` tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

to:

`if` tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

Restore
March 30, 2006, at 08:32 PM by Tom Igoe -
Changed lines 1-4 from:

if statements

if tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

to:

if

`if` tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

Restore

March 30, 2006, at 08:31 PM by Tom Igoe -
Changed lines 3-12 from:

This helps the control and flow of the programs, used to check if condition has been reached, the computer determines whether the expression (in the brackets) is true or false. If true the statements (inside the curly brackets) are executed, if not, the program skips over the code.

To test for equality is ==

A warning: Beware of using = instead of ==, such as writing accidentally

```
   if ( i = j ) .....
```

This is a perfectly LEGAL C statement (syntactically speaking) which copies the value in "j" into "i", and delivers this value, which will then be interpreted as TRUE if j is non-zero. This is called assignment by value -- a key feature of C.

to:

if tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

```
if (someVariable > 50)
{
  # do something here
}
```

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in brackets is true, the statements inside the brackets are run. If not, the program skips over the code.

The statements being evaluated inside the parentheses require the use of one or more operators:

Changed lines 22-31 from:

Example

```
if(expression)
{
   statement;
   statement;
}
```

to:

Coding Warning: Beware of accidently using =, which sets a variable (`if (x = 10)`), instead of == (`if (x == 10)`), which tests *whether* x is equal to 10 or not.

The latter statement is only true if x equals 10, but the former statement will always be true, because the value of `x = 10` is set if the assignment is successful. Mistaking = for == will result in a test that is always passed, and which resets your variable as a (probably unwanted) side-effect.

Restore
March 24, 2006, at 04:36 PM by Jeff Gray -
Changed lines 1-2 from:

if

to:

if statements

Restore
March 24, 2006, at 04:36 PM by Jeff Gray -
Changed lines 1-2 from:

setup

to:

if

Restore
March 24, 2006, at 04:35 PM by Jeff Gray -
Changed lines 1-2 from:

setup

to:

setup

Restore
March 24, 2006, at 04:34 PM by Jeff Gray -
Changed lines 1-6 from:

if(expression) {

```
   statement;
   statement;
```

}

to:

setup

Changed lines 5-7 from:

To test for equality is ==

to:

To test for equality is ==

Deleted line 8:
Deleted line 10:
Changed lines 13-19 from:

Other operators:

!= (not equals)

```
 < (less than)
 > (grater than)
```

<= (less than or equals)

>= (greater than or equals)

to:

Operators:

- == (equals to)
- != (not equals)
- < (less than)
- > (grater than)
- <= (less than or equals)
- >= (greater than or equals)

Example

```
      if(expression)
      {
         statement;
         statement;
      }
```

Reference Home

Restore
February 14, 2006, at 09:46 AM by Erica Calogero -
Changed lines 12-14 from:

A warning: Beware of using ``= *instead of* ``==, such as writing accidentally

to:

A warning: Beware of using = instead of ==, such as writing accidentally

Restore
February 14, 2006, at 09:45 AM by Erica Calogero -
Added lines 1-26:

if(expression) {

```
   statement;
   statement;
```

}

This helps the control and flow of the programs, used to check if condition has been reached, the computer determines whether the expression (in the brackets) is true or false. If true the statements (inside the curly brackets) are executed, if not, the program skips over the code.

To test for equality is ==

A warning: Beware of using ``= *instead of* ``==, such as writing accidentally

```
   if ( i = j ) .....
```

This is a perfectly LEGAL C statement (syntactically speaking) which copies the value in "j" into "i", and delivers this value, which will then be interpreted as TRUE if j is non-zero. This is called assignment by value -- a key feature of C.

Other operators:

!= (not equals)

```
 < (less than)
 > (grater than)
```

<= (less than or equals)

>= (greater than or equals)

Restore

if

if tests whether a certain condition has been reached, such as an input being above a certain number. The format for an if test is:

```
if (someVariable > 50)
{
  // do something here
}
```

The program tests to see if someVariable is greater than 50. If it is, the program takes a particular action. Put another way, if the statement in parentheses is true, the statements inside the brackets are run. If not, the program skips over the code.

The brackets may be omitted after an *if* statement. If this is done, the next line (defined by the semicolon) becomes the only conditional statement.

```
if (x > 120)  digitalWrite(LEDpin, HIGH);

if (x > 120)
digitalWrite(LEDpin, HIGH);

if (x > 120) {digitalWrite(LEDpin, HIGH);}   // all are correct
```

The statements being evaluated inside the parentheses require the use of one or more operators:

Operators:

```
 x == y (x is equal to y)
 x != y (x is not equal to y)
 x <  y (x is less than y)
 x >  y (x is greater than y)
 x <= y (x is less than or equal to y)
 x >= y (x is greater than or equal to y)
```

Warning:

Beware of accidentally using the single equal sign (e.g. `if (x = 10)`). The single equal sign is the assignment operator, and sets x to 10. Instead use the double equal sign (e.g. `if (x == 10)`), which is the comparison operator, and tests *whether* x is equal to 10 or not. The latter statement is only true if x equals 10, but the former statement will always be true.

This is because C evaluates the statement `if (x=10)` as follows: 10 is assigned to x, so x now contains 10. Then the 'if' conditional evaluates 10, which always evaluates to TRUE, since any non-zero number evaluates to TRUE. Consequently, `if (x = 10)` will always evaluate to TRUE, which is not the desired result when using an 'if' statement. Additionally, the variable x will be set to 10, which is also not a desired action.

if can also be part of a branching control structure using the if...else] construction.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Else History

Hide minor edits - Show changes to markup

September 23, 2007, at 08:10 AM by Paul Badger -
Changed lines 3-4 from:

if/else gives you greater control over the flow of your code than the basic **if** statement, by allowing you to group multiple tests together. For instance, if you wanted to test an analog input, and do one thing if the input was less than 500, and another thing if the input was 500 or greater, you would write that this way:

to:

if/else allows greater control over the flow of code than the basic **if** statement, by allowing multiple tests to be grouped together. For example, an analog input could be tested and one action taken if the input was less than 500, and another action taken if the input was 500 or greater. The code would look like this:

Changed line 7 from:

```
  // do Thing A
```

to:

```
  // action A
```

Changed line 11 from:

```
  // do Thing B
```

to:

```
  // action B
```

Restore
April 16, 2007, at 05:02 PM by David A. Mellis -
Changed line 7 from:

```
  # do Thing A
```

to:

```
  // do Thing A
```

Changed line 11 from:

```
  # do Thing B
```

to:

```
  // do Thing B
```

Changed line 18 from:

```
  # do Thing A
```

to:

```
  // do Thing A
```

Changed line 22 from:

```
  # do Thing B
```

to:

```
  // do Thing B
```

Changed line 26 from:

```
  # do thing C
```

to:

```
  // do Thing C
```

Restore
April 16, 2007, at 09:34 AM by Paul Badger -
Changed lines 1-2 from:

if/else

to:

if/else

Restore
March 31, 2006, at 02:44 PM by Jeff Gray -
Added lines 1-2:

if/else

Restore
March 30, 2006, at 08:53 PM by Tom Igoe -
Changed lines 1-2 from:

if/else gives you greater control over the flow of your code than the basic **if** statement, by allowing you to group multiple together. For instance, if you wanted to test an analog input, and do one thing if the input was less than 500, and another thing if the input was 500 or greater, you would write that this way:

to:

if/else gives you greater control over the flow of your code than the basic **if** statement, by allowing you to group multiple tests together. For instance, if you wanted to test an analog input, and do one thing if the input was less than 500, and another thing if the input was 500 or greater, you would write that this way:

Changed lines 10-30 from:

}@]

to:

}@]

else can proceed another **if** test, so that multiple, mutually exclusive tests can be run at the same time:

```
if (pinFiveInput < 500)
{
  # do Thing A
}
else if (pinFiveInput >= 1000)
{
  # do Thing B
}
else
{
  # do thing C
}
```

You can have an unlimited nuber of such branches. (Another way to express branching, mutually exclusive tests is with the switch case statement.

Coding Note: If you are using if/else, and you want to make sure that some default action is always taken, it is a good idea to end your tests with an else statement set to your desired default behavior.

Restore
March 30, 2006, at 08:43 PM by Tom Igoe -
Added lines 1-10:

if / else gives you greater control over the flow of your code than the basic **if** statement, by allowing you to group multiple together. For instance, if you wanted to test an analog input, and do one thing if the input was less than 500, and another thing if the input was 500 or greater, you would write that this way:

```
if (pinFiveInput < 500)
{
  # do Thing A
}
else
{
  # do Thing B
}
```

Restore

if / else

if / else allows greater control over the flow of code than the basic **if** statement, by allowing multiple tests to be grouped together. For example, an analog input could be tested and one action taken if the input was less than 500, and another action taken if the input was 500 or greater. The code would look like this:

```
if (pinFiveInput < 500)
{
  // action A
}
else
{
  // action B
}
```

else can proceed another **if** test, so that multiple, mutually exclusive tests can be run at the same time:

```
if (pinFiveInput < 500)
{
  // do Thing A
}
else if (pinFiveInput >= 1000)
{
  // do Thing B
}
else
{
  // do Thing C
}
```

You can have an unlimited nuber of such branches. (Another way to express branching, mutually exclusive tests is with the switch case statement.

Coding Note: If you are using if/else, and you want to make sure that some default action is always taken, it is a good idea to end your tests with an else statement set to your desired default behavior.

Reference Home

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Reference.For History

Hide minor edits - Show changes to markup

May 31, 2007, at 09:42 AM by David A. Mellis -
Changed lines 21-30 from:

1. define PWMpin 10 // LED in series with 1k resistor on pin 10

void setup(){};

void loop(){};

```
   for (int i=0; i <= 255; i++){
      analogWrite(PWMpin, i);
      delay(10);
   }
```

to:

int PWMpin = 10; // LED in series with 1k resistor on pin 10

void setup() {

```
  // no setup needed
```

Added lines 27-34:

void loop() {

```
   for (int i=0; i <= 255; i++){
      analogWrite(PWMpin, i);
      delay(10);
   }
```

}

Added line 36:
Restore
May 30, 2007, at 11:34 AM by Paul Badger -
Changed lines 21-22 from:

1. define PWMpin 10

to:

1. define PWMpin 10 // LED in series with 1k resistor on pin 10

Restore
May 30, 2007, at 11:33 AM by Paul Badger -
Changed lines 20-22 from:

for (int i=1; i <= 8; i++){

```
  // statement using the value i;
```

}

to:

// Dim an LED using a PWM pin

1. define PWMpin 10

void setup(){};

void loop(){};

```
   for (int i=0; i <= 255; i++){
      analogWrite(PWMpin, i);
      delay(10);
   }
```

}

Restore
April 16, 2007, at 05:00 PM by David A. Mellis -
Changed lines 11-12 from:

```
#statement(s)
```

to:

```
//statement(s);
```

Changed line 21 from:

```
  statement using the value i;
```

to:

```
  // statement using the value i;
```

Restore
April 16, 2007, at 10:30 AM by Paul Badger -
Changed lines 9-10 from:

```
for (initialization;;condition;; increment) {
```

to:

```
for (initialization; condition; increment) {
```

Changed lines 15-16 from:

The **initialization** happens first and exactly once. Each time through the loop, the **condition** is tested; if it's true, the statement block, and the **increment** is executed, then the **condition** is tested again. When the **condition** is false, the loop ends.

to:

The **initialization** happens first and exactly once. Each time through the loop, the **condition** is tested; if it's true, the statement block, and the **increment** is executed, then the **condition** is tested again. When the **condition** becomes false, the loop ends.

Restore
April 16, 2007, at 10:27 AM by Paul Badger -
Changed lines 15-16 from:

The **initialization** happens first and exactly once. Each time through the loop the **condition** is tested; if it's true, the **statement block**, and the **increment** is executed, then the **condition** is tested again. When the **condition** is false, the loop ends.

to:

The **initialization** happens first and exactly once. Each time through the loop, the **condition** is tested; if it's true, the statement block, and the **increment** is executed, then the **condition** is tested again. When the **condition** is false, the loop ends.

Restore
April 16, 2007, at 10:25 AM by Paul Badger -
Changed lines 15-16 from:

The **initialization** happens first and exactly once. Each time through the loop the **condition** is tested; if it's true, the **statement block**, the **increment** is executed, and the condition is tested again. When the **condition** is false, the loop ends.

to:

The **initialization** happens first and exactly once. Each time through the loop the **condition** is tested; if it's true, the **statement block**, and the **increment** is executed, then the **condition** is tested again. When the **condition** is false, the loop ends.

Restore
April 16, 2007, at 10:21 AM by Paul Badger -
Changed lines 24-26 from:

Coding Tip

to:

Coding Tip

Restore
April 16, 2007, at 10:21 AM by Paul Badger -
Changed lines 9-12 from:

`for (`**`initialization`**`; `**`condition`**`;`**`increment`**`) {`

`#statement(s)`

to:

`for` `(`**`initialization;`**`;`**`condition;`**`; `**`increment`**`) {`

`#statement(s)`

Changed lines 15-16 from:

The **initialization** happens first and exactly once. Then, the **condition** is tested; if it's true, the **body** and the **increment** are executed, and the condition is tested again. When the **condition** is false, the loop ends.

to:

The **initialization** happens first and exactly once. Each time through the loop the **condition** is tested; if it's true, the **statement block**, the **increment** is executed, and the condition is tested again. When the **condition** is false, the loop ends.

Added lines 25-28:

Coding Tip

The C **for** loop is much more flexible than **for** loops found in some other computer languages, including BASIC. Any or all of the three header elements may be omitted, although the semicolons are required. Also the statements for initialization, condition, and increment can be any valid C statements with unrelated variables. These types of unusual **for** statements may provide solutions to some rare programming problems.

Restore
April 16, 2007, at 10:03 AM by Paul Badger -
Changed lines 9-12 from:

`for (`**`initialization`**`; `**`condition`**`;`**`increment`**`) {\\ #statement(s)\\ }`

to:

`for (`**`initialization`**`; `**`condition`**`;`**`increment`**`) {`

`#statement(s)`

`}`

Restore
April 16, 2007, at 09:59 AM by Paul Badger -
Changed line 9 from:

`for (`**`initialization`**`; `**`condition`**`; `**`increment`**`) {\\`

to:

`for (`**`initialization`**`; `**`condition`**`;`**`increment`**`) {\\`

Restore
April 16, 2007, at 09:52 AM by Paul Badger -
Changed lines 3-10 from:

Loops through multiple values, from the first to the last by the increment specified. Useful when used in combination with arrays to operate on collections of data/pins.

There are many parts to the for loop:

```
for (initialization; condition; increment) {
   body
}
```

to:

Desciption

The **for** statement is used to repeat a block of statements enclosed in curly braces. An increment counter is usually used to increment and terminate the loop. The **for** statement is useful for any repetitive operation, and is often used in combination with arrays to operate on collections of data/pins.

There are three parts to the **for** loop header:

```
for (initialization; condition; increment) {\\ #statement(s)\\ }
```

Restore
April 16, 2007, at 09:36 AM by Paul Badger -
Restore
April 16, 2007, at 09:17 AM by Paul Badger -
Restore
April 16, 2007, at 09:16 AM by Paul Badger -
Changed lines 1-2 from:

for statements

to:

for statements

Restore
April 16, 2007, at 09:16 AM by Paul Badger -
Deleted lines 23-24:

Reference Home

Restore
December 02, 2006, at 09:53 AM by David A. Mellis -
Changed lines 13-14 from:

Example

to:

Example

Added lines 21-24:

See also

- while

Restore
December 02, 2006, at 09:52 AM by David A. Mellis -
Changed lines 3-6 from:

Loops through the values of i, from the first to the last by the increment specified. Useful when used in combination with arrays to operate on collections of data/pins.

Important Note: In C you don't need to initialise the local variable i. You can do it directly in the for statement itself. This is different in other, java based languages.

to:

Loops through multiple values, from the first to the last by the increment specified. Useful when used in combination with arrays to operate on collections of data/pins.

There are many parts to the for loop:

```
for (initialization; condition; increment) {
   body
}
```

The **initialization** happens first and exactly once. Then, the **condition** is tested; if it's true, the **body** and the **increment** are executed, and the condition is tested again. When the **condition** is false, the loop ends.

Deleted lines 20-27:

Restore
March 27, 2006, at 10:59 AM by Tom Igoe -
Changed lines 5-6 from:

Important Note: In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

Important Note: In C you don’t need to initialise the local variable i. You can do it directly in the for statement itself. This is different in other, java based languages.

Changed line 10 from:

for (i=1; i <= 8; i++){

to:

for (int i=1; i <= 8; i++){

Restore
March 24, 2006, at 04:37 PM by Jeff Gray -
Changed lines 1-2 from:

for()

to:

for statements

Restore
March 24, 2006, at 04:28 PM by Jeff Gray -
Changed lines 5-6 from:

Important Note: In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

Important Note: In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Restore
March 24, 2006, at 04:28 PM by Jeff Gray -
Changed lines 5-6 from:

[""Important Note:""] In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

Important Note: In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Restore
March 24, 2006, at 04:27 PM by Jeff Gray -
Changed lines 5-6 from:

"bold"Important Note:"bold" In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

[""Important Note:""] In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Restore
March 24, 2006, at 04:25 PM by Jeff Gray -
Changed lines 5-6 from:

<b>Important Note:</b> In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

"bold"Important Note:"bold" In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Restore
March 24, 2006, at 04:25 PM by Jeff Gray -
Added lines 1-2:

for()

Changed lines 5-10 from:

for (i=1; i <= 8; i++) {

```
    statement using the value i;
 }
```

N.B. In C you don’t need to initialise the local variable i. This is different in other, java based languages.

to:

<b>Important Note:</b> In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Example

```
for (i=1; i <= 8; i++){
  statement using the value i;
}
```

Reference Home

Restore
February 14, 2006, at 09:50 AM by Erica Calogero -
Added lines 1-8:

Loops through the values of i, from the first to the last by the increment specified. Useful when used in combination with arrays to operate on collections of data/pins.

for (i=1; i <= 8; i++) {

```
    statement using the value i;
 }
```

N.B. In C you don’t need to initialise the local variable i. This is different in other, java based languages.

Restore

for statements

Desciption

The **for** statement is used to repeat a block of statements enclosed in curly braces. An increment counter is usually used to increment and terminate the loop. The **for** statement is useful for any repetitive operation, and is often used in combination with arrays to operate on collections of data/pins.

There are three parts to the **for** loop header:

```
for (initialization; condition; increment) {

//statement(s);

}
```

The **initialization** happens first and exactly once. Each time through the loop, the **condition** is tested; if it's true, the statement block, and the **increment** is executed, then the **condition** is tested again. When the **condition** becomes false, the loop ends.

Example

```
// Dim an LED using a PWM pin
int PWMpin = 10; // LED in series with 1k resistor on pin 10

void setup()
{
  // no setup needed
}

void loop()
{
   for (int i=0; i <= 255; i++){
      analogWrite(PWMpin, i);
      delay(10);
   }
}
```

Coding Tip

The C **for** loop is much more flexible than **for** loops found in some other computer languages, including BASIC. Any or all of the three header elements may be omitted, although the semicolons are required. Also the statements for initialization, condition, and increment can be any valid C statements with unrelated variables. These types of unusual **for** statements may provide solutions to some rare programming problems.

See also

- while

Reference Home

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Reference.SwitchCase History

Hide minor edits - Show changes to markup

July 17, 2007, at 11:18 AM by Paul Badger -
Changed lines 1-4 from:

Switch / Case statements

Just like If statements, switch case statements help the control and flow of the programs. Switch case's allow you to make a list of "cases" inside a switch bracket in which arduino will find the most suitable and run it.

to:

switch / case statements

Just like If statements, switch case statements help the control and flow of the programs. Switch/case allows you to make a list of "cases" inside a switch curly bracket. The program checks each case for a match with the test variable, and runs the code if if a match is found.

Restore
July 17, 2007, at 11:15 AM by Paul Badger -
Changed lines 1-2 from:

Switch Case statements

to:

Switch / Case statements

Restore
July 17, 2007, at 11:15 AM by Paul Badger -
Changed lines 8-9 from:

- break - **important**, without break, the switch statement will continue checking through the statement for any other possibilities. If one is found, it will run that as well, which may not be your intent. Break tells the switch statement to stop looking for matches, and end its function.

to:

- break - **important**, without break, the switch statement will continue checking through the statement for any other possibile matches. If one is found, it will run that as well, which may not be your intent. Break tells the switch statement to stop looking for matches, and exit the switch statement.

Restore
July 17, 2007, at 11:14 AM by Paul Badger -
Changed line 16 from:

```
    // break is optional, without it, case statement goes on checking for matches
```

to:

```
    // break is optional
```

Restore
July 17, 2007, at 11:13 AM by Paul Badger -
Added line 16:

```
    // break is optional, without it, case statement goes on checking for matches
```

Added line 22:

```
      // default is optional
```

Restore
April 16, 2007, at 10:31 AM by Paul Badger -
Changed lines 1-2 from:

Switch Case statements

to:

Switch Case statements

Changed lines 25-27 from:

Reference Home

to:

Restore
March 26, 2006, at 02:30 PM by Jeff Gray -
Changed lines 8-9 from:

- break - **important**, without break, the switch statement will continue checking through the statement for any other possibilities. If one is found, it will run that as well, which may not be your intent.

to:

- break - **important**, without break, the switch statement will continue checking through the statement for any other possibilities. If one is found, it will run that as well, which may not be your intent. Break tells the switch statement to stop looking for matches, and end its function.

Restore
March 26, 2006, at 02:28 PM by Jeff Gray -
Added lines 1-11:

Switch Case statements

Just like If statements, switch case statements help the control and flow of the programs. Switch case's allow you to make a list of "cases" inside a switch bracket in which arduino will find the most suitable and run it.

Parameters

- var - variable you wish to match with case statements
- default - if no other conditions are met, default will run
- break - **important**, without break, the switch statement will continue checking through the statement for any other possibilities. If one is found, it will run that as well, which may not be your intent.

Example

[@
Changed lines 21-27 from:

```
  }
```

to:

```
  }
 @]
```

Reference Home

Restore
March 26, 2006, at 02:22 PM by Jeff Gray -
Added lines 1-10:

```
  switch (var) {
    case 1:
      //do something when var == 1
      break;
    case 2:
      //do something when var == 2
      break;
    default:
      // if nothing else matches, do the default
  }
```

Restore

switch / case statements

Just like If statements, switch case statements help the control and flow of the programs. Switch/case allows you to make a list of "cases" inside a switch curly bracket. The program checks each case for a match with the test variable, and runs the code if if a match is found.

Parameters

- var - variable you wish to match with case statements
- default - if no other conditions are met, default will run
- break - **important**, without break, the switch statement will continue checking through the statement for any other possibile matches. If one is found, it will run that as well, which may not be your intent. Break tells the switch statement to stop looking for matches, and exit the switch statement.

Example

```
switch (var) {
  case 1:
    //do something when var == 1
    break;
    // break is optional
  case 2:
    //do something when var == 2
    break;
  default:
    // if nothing else matches, do the default
    // default is optional
}
```

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Reference.While History

Hide minor edits - Show changes to markup

May 26, 2007, at 07:05 AM by Paul Badger -
Changed lines 5-6 from:

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

to:

while loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

Restore
May 26, 2007, at 07:05 AM by Paul Badger -
Changed lines 1-2 from:

While statements

to:

while loops

Restore
May 05, 2007, at 07:37 AM by Paul Badger -
Changed lines 5-6 from:

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code such as an incremented variable, or an external condition such as testing a sensor.

to:

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

Restore
May 05, 2007, at 07:36 AM by Paul Badger -
Changed lines 5-6 from:

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something inside the loop must change the tested variable, or the **while** loop will never exit.

to:

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code such as an incremented variable, or an external condition such as testing a sensor.

Restore
April 16, 2007, at 05:01 PM by David A. Mellis -
Changed line 9 from:

```
  // statement(s);
```

to:

```
  // statement(s)
```

Restore
April 16, 2007, at 05:01 PM by David A. Mellis -
Changed line 9 from:

```
  // #statement(s)
```

to:

```
  // statement(s);
```

Restore
April 16, 2007, at 05:01 PM by David A. Mellis -
Changed lines 9-11 from:

1. statement(s)

to:

```
  // #statement(s)
```

Restore
April 16, 2007, at 10:48 AM by Paul Badger -
Changed lines 3-6 from:

Loops continuously until the expression inside () are not true. Useful for creating your own loops, but make sure to keep track of some variable you can use to stop the while loop if that is your intent.

Example

to:

Description

While loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something inside the loop must change the tested variable, or the **while** loop will never exit.

Syntax

```
while(expression){

#statement(s)

}
```

Parameters

expression - a (boolean) C statement that evaluates to true or false

Example

Changed line 23 from:

```
  //do something repetitive 200 times
```

to:

```
  // do something repetitive 200 times
```

Restore
March 26, 2006, at 02:34 PM by Jeff Gray -
Added lines 1-13:

While statements

Loops continuously until the expression inside () are not true. Useful for creating your own loops, but make sure to keep track of some variable you can use to stop the while loop if that is your intent.

Example

```
var = 0;
while(var < 200){
  //do something repetitive 200 times
  var++;
}
```

Restore

while loops

Description

while loops will loop continuously, and infinitely, until the expression inside the parenthesis, () becomes false. Something must change the tested variable, or the **while** loop will never exit. This could be in your code, such as an incremented variable, or an external condition, such as testing a sensor.

Syntax

```
while(expression){
  // statement(s)
}
```

Parameters

expression - a (boolean) C statement that evaluates to true or false

Example

```
var = 0;
while(var < 200){
  // do something repetitive 200 times
  var++;
}
```

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Reference.DoWhile History

Hide minor edits - Show changes to markup

May 26, 2007, at 07:25 AM by Paul Badger -
Changed line 18 from:

```
  delay(50);         // wait for sensors to stabilize
```

to:

```
  delay(50);          // wait for sensors to stabilize
```

Restore
May 26, 2007, at 07:25 AM by Paul Badger -
Added line 5:

[@

Changed lines 10-12 from:

Example

to:

@]

Example

Restore
May 26, 2007, at 07:24 AM by Paul Badger -
Changed lines 3-4 from:

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested only after the loop has run, so the **do** loop will *always* run at least once.

to:

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested at the end of the loop, so the **do** loop will *always* run at least once.

Restore
May 26, 2007, at 07:23 AM by Paul Badger -
Added lines 1-19:

do - while

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested only after the loop has run, so the **do** loop will *always* run at least once.

do {

    // statement block

} while (test condition);

Example

```
do
{
  delay(50);         // wait for sensors to stabilize
  x = readSensors();  // check the sensors

} while (x < 100);
```

Restore

do - while

The **do** loop works in the same manner as the **while** loop, with the exception that the condition is tested at the end of the loop, so the **do** loop will *always* run at least once.

```
do
{
    // statement block
} while (test condition);
```

Example

```
do
{
  delay(50);          // wait for sensors to stabilize
  x = readSensors();  // check the sensors

} while (x < 100);
```

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Reference.Break History

Hide minor edits - Show changes to markup

August 08, 2007, at 05:42 AM by Paul Badger -
Changed lines 3-5 from:

break is used to exit from a **do**, **for**, or **while** loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

to:

break is used to exit from a **do**, **for**, or **while** loop, bypassing the normal loop condition. It is also used to exit from a **switch** statement.

Restore
May 30, 2007, at 11:37 AM by Paul Badger -
Restore
May 26, 2007, at 07:04 AM by Paul Badger -
Changed lines 3-5 from:

break is used to exit from a *do*, *for*, or *while* loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

to:

break is used to exit from a **do**, **for**, or **while** loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

Restore
May 26, 2007, at 06:48 AM by Paul Badger -
Changed lines 3-5 from:

break is used to exit from a *do*, *for*, or *while* loop, bypassing the normal loop condition. It is also used to exit from a switch statement. An example of break in a loop is shown here:

to:

break is used to exit from a *do*, *for*, or *while* loop, bypassing the normal loop condition. It is also used to exit from a switch statement.

Restore
May 26, 2007, at 06:47 AM by Paul Badger -
Changed lines 3-5 from:

break is used to exit from a do, for, or while loop, bypassing the normal loop condition. It is also used to exit from a switch statement. An example of break in a loop is shown here:

to:

break is used to exit from a *do*, *for*, or *while* loop, bypassing the normal loop condition. It is also used to exit from a switch statement. An example of break in a loop is shown here:

Changed lines 11-12 from:

```
    sens = analogRead(sensorPin);
    if (sens > threshold) break;  // bail out on sensor detect
```

to:

```
    sens = analogRead(sensorPin);
    if (sens > threshold){      // bail out on sensor detect
       x = 0;
       break;
    }
```

Restore
May 26, 2007, at 06:44 AM by Paul Badger -
Added lines 5-7:

Example

[@

Changed lines 14-16 from:

}

to:

}

@]

Restore
May 26, 2007, at 06:43 AM by Paul Badger -
Added lines 1-11:

break

break is used to exit from a do, for, or while loop, bypassing the normal loop condition. It is also used to exit from a switch statement. An example of break in a loop is shown here:

for (x = 0; x < 255; x ++) {

```
    digitalWrite(PWMpin, x);
    sens = analogRead(sensorPin);
    if (sens > threshold) break;  // bail out on sensor detect
    delay(50);
```

}

Restore

break

break is used to exit from a **do**, **for**, or **while** loop, bypassing the normal loop condition. It is also used to exit from a **switch** statement.

Example

```
for (x = 0; x < 255; x ++)
{
    digitalWrite(PWMpin, x);
    sens = analogRead(sensorPin);
    if (sens > threshold){      // bail out on sensor detect
       x = 0;
       break;
    }
    delay(50);
}
```

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Reference.Continue History

Hide minor edits - Show changes to markup

May 26, 2007, at 07:01 AM by Paul Badger -
Deleted line 9:
Changed line 11 from:

```
       continue;
```

to:

```
        continue;
```

Restore
May 26, 2007, at 07:01 AM by Paul Badger -
Added line 5:

Example

Changed lines 7-8 from:

Example

to:
Restore
May 26, 2007, at 07:00 AM by Paul Badger -
Changed lines 1-19 from:

continue

to:

continue

continue is used to bypass portions of code in a *do*, *for*, or *while* loop. It forces the conditional expression to be evaluated, without terminating the loop.

```
!!!!Example

for (x = 0; x < 255; x ++)
{

    if (x > 40 && x < 120){      // create jump in values
       continue;
    }

    digitalWrite(PWMpin, x);
    delay(50);
}
```

Restore
May 26, 2007, at 06:51 AM by Paul Badger -
Added line 1:

continue

continue

continue is used to bypass portions of code in a *do*, *for*, or *while* loop. It forces the conditional expression to be evaluated, without terminating the loop.

Example

```
for (x = 0; x < 255; x ++)
{
    if (x > 40 && x < 120){      // create jump in values
        continue;
    }

    digitalWrite(PWMpin, x);
    delay(50);
}
```

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Reference.Return History

Hide minor edits - Show changes to markup

April 03, 2008, at 01:15 PM by Paul Badger -
Changed lines 9-10 from:

return value;

to:

return value; // both forms are valid

Restore
October 08, 2007, at 10:32 PM by Paul Badger -
Changed lines 18-19 from:

[@ int checkSensor(){

to:

[@ int checkSensor(){

Restore
October 08, 2007, at 10:32 PM by Paul Badger -
Deleted line 17:
Restore
July 16, 2007, at 11:28 PM by Paul Badger -
Changed lines 5-6 from:

Syntax:

to:

Syntax:

Changed lines 11-12 from:

Parameters

to:

Parameters

Restore
July 16, 2007, at 11:28 PM by Paul Badger -
Changed lines 11-12 from:

Parameters

to:

Parameters

Restore
July 16, 2007, at 11:26 PM by Paul Badger -
Added line 31:
Restore
July 16, 2007, at 11:25 PM by Paul Badger -

Changed lines 37-39 from:

}

to:

}@]

Restore
July 16, 2007, at 11:23 PM by Paul Badger -
Changed lines 42-43 from:

comment?

to:

comments

Restore
July 16, 2007, at 11:22 PM by Paul Badger -
Changed lines 3-4 from:

Terminate a function and return a value to the calling function if desired.

to:

Terminate a function and return a value from a function to the calling function, if desired.

Changed lines 26-43 from:

}@]

to:

}@]

The return keyword is handy to test a section of code without having to "comment out" large sections of possibly buggy code.

[@void loop(){ // brilliant code idea to test here

return;

// the rest of a dysfunctional sketch here // this code will never be executed }

See also

comment?

Restore
July 16, 2007, at 11:14 PM by Paul Badger -
Added lines 1-26:

return

Terminate a function and return a value to the calling function if desired.

Syntax:

return;

return value;

Parameters

value: any variable or constant type

Examples:

A function to compare a sensor input to a threshold

```
int checkSensor(){
    if (analogRead(0) > 400) {
        return 1;
    else{
        return 0;
    }
}
```

Restore

return

Terminate a function and return a value from a function to the calling function, if desired.

Syntax:

return;

return value; // both forms are valid

Parameters

value: any variable or constant type

Examples:

A function to compare a sensor input to a threshold

```
 int checkSensor(){
    if (analogRead(0) > 400) {
        return 1;
    else{
        return 0;
    }
}
```

The return keyword is handy to test a section of code without having to "comment out" large sections of possibly buggy code.

```
void loop(){

// brilliant code idea to test here

return;

// the rest of a dysfunctional sketch here
// this code will never be executed
}
```

See also

comments

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.SemiColon History

Hide minor edits - Show changes to markup

April 29, 2007, at 05:10 AM by David A. Mellis -
Changed lines 3-4 from:

Used at the end of a statement to tell the computer when to execute an instruction.

to:

Used to end a statement.

Restore
April 25, 2007, at 11:03 PM by Paul Badger -
Changed lines 1-2 from:

; semicolon

to:

; semicolon

Changed lines 12-15 from:

Forgetting to end a line in a semicolon will result in a compiler error. The error text may be obvious, and refer to a missing semicolon, or it may not. If an impenetrable or seemingly illogical compiler error comes up, one of the first things to check is a missing semicolon in the immediate vicinity preceding the line at which the compiler complained.

Reference Home

to:

Forgetting to end a line in a semicolon will result in a compiler error. The error text may be obvious, and refer to a missing semicolon, or it may not. If an impenetrable or seemingly illogical compiler error comes up, one of the first things to check is a missing semicolon, in the immediate vicinity, preceding the line at which the compiler complained.

Restore
April 14, 2007, at 09:46 AM by Paul Badger -
Restore
April 14, 2007, at 09:46 AM by Paul Badger -
Changed lines 10-11 from:
to:

Tip

Forgetting to end a line in a semicolon will result in a compiler error. The error text may be obvious, and refer to a missing semicolon, or it may not. If an impenetrable or seemingly illogical compiler error comes up, one of the first things to check is a missing semicolon in the immediate vicinity preceding the line at which the compiler complained.

Restore
March 24, 2006, at 04:39 PM by Jeff Gray -
Changed lines 9-12 from:

@]

to:

@]

Restore
March 24, 2006, at 04:39 PM by Jeff Gray -
Changed lines 9-25 from:

@]

to:

@]

Restore
March 24, 2006, at 04:38 PM by Jeff Gray -
Changed lines 1-3 from:

```
     int a = 13;
```

Used at the end of a statement to tell the computer when to execute an instruction.

to:

; semicolon

Used at the end of a statement to tell the computer when to execute an instruction.

Example

```
int a = 13;
```

Restore
February 14, 2006, at 10:00 AM by Erica Calogero -
Added lines 1-3:

```
     int a = 13;
```

Used at the end of a statement to tell the computer when to execute an instruction.

Restore

; semicolon

Used to end a statement.

Example

```
int a = 13;
```

Tip

Forgetting to end a line in a semicolon will result in a compiler error. The error text may be obvious, and refer to a missing semicolon, or it may not. If an impenetrable or seemingly illogical compiler error comes up, one of the first things to check is a missing semicolon, in the immediate vicinity, preceding the line at which the compiler complained.

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Reference.Braces History

Hide minor edits - Show changes to markup

May 28, 2007, at 02:04 PM by Paul Badger -
Changed lines 13-14 from:

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

to:

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages, braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

Restore
April 14, 2007, at 09:47 AM by Paul Badger -
Added lines 56-58:

Reference Home

Restore
April 14, 2007, at 09:37 AM by Paul Badger -
Changed lines 9-14 from:

Beginning programmers and programmers coming to C from the BASIC language often find using braces confusing or daunting. After all, the same curly braces replace the RETURN statement in a subroutine (function), the ENDIF statement in a conditional and the NEXT statement in a FOR loop.

For this reason it is good programming practice to type the closing brace immediately after typing the opening brace when inserting a construct which requires curly braces. Then type some carriage returns between the braces and begin inserting statements, and your braces, and your attitude, will never become unbalanced.

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

to:

Beginning programmers, and programmers coming to C from the BASIC language often find using braces confusing or daunting. After all, the same curly braces replace the RETURN statement in a subroutine (function), the ENDIF statement in a conditional and the NEXT statement in a FOR loop.

Because the use of the curly brace is so varied, it is good programming practice to type the closing brace immediately after typing the opening brace when inserting a construct which requires curly braces. Then insert some carriage returns between your braces and begin inserting statements. Your braces, and your attitude, will never become unbalanced.

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

Restore
April 14, 2007, at 09:33 AM by Paul Badger -
Changed lines 15-16 from:

The main uses of curly braces

to:

The main uses of curly braces

Restore
April 14, 2007, at 09:31 AM by Paul Badger -
Added lines 15-16:

The main uses of curly braces

Changed lines 21-22 from:

```
  }
```

to:

```
  }@]
```

Restore
April 14, 2007, at 09:28 AM by Paul Badger -
Changed lines 3-4 from:

Curly braces (also referred to as just "braces" or as "curly brackets) are a major part of the C programming language. They are used in several different constructs, outlined below, and this can sometimes be confusing for beginners.

to:

Curly braces (also referred to as just "braces" or as "curly brackets") are a major part of the C programming language. They are used in several different constructs, outlined below, and this can sometimes be confusing for beginners.

Restore
April 14, 2007, at 09:27 AM by Paul Badger -
Changed lines 13-14 from:

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a

to:

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

Restore
April 14, 2007, at 09:26 AM by Paul Badger -
Changed lines 1-2 from:

{}Curly Braces

to:

{} Curly Braces

Curly braces (also referred to as just "braces" or as "curly brackets) are a major part of the C programming language. They are used in several different constructs, outlined below, and this can sometimes be confusing for beginners.

An opening curly brace "{" must always be followed by a closing curly brace "}". This is a condition that is often referred to as the braces being balanced. The Arduino IDE (integrated development environment) includes a convenient feature to check the balance of curly braces. Just select a brace, or even click the insertion point immediately following a brace, and its logical companion will be highlighted.

At present this feature is slightly buggy as the IDE will often find (incorrectly) a brace in text that has been "commented out."

Beginning programmers and programmers coming to C from the BASIC language often find using braces confusing or daunting. After all, the same curly braces replace the RETURN statement in a subroutine (function), the ENDIF statement in a conditional and the NEXT statement in a FOR loop.

For this reason it is good programming practice to type the closing brace immediately after typing the opening brace when inserting a construct which requires curly braces. Then type some carriage returns between the braces and begin inserting statements, and your braces, and your attitude, will never become unbalanced.

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages braces are also incredibly important to the syntax of a

Restore
April 14, 2007, at 08:30 AM by Paul Badger -
Changed lines 1-8 from:

{}Curly Braces

to:

{}Curly Braces

Functions

[@ void myfunction(datatype argument){

```
    statements(s)
  }
```

Changed lines 11-25 from:

```
while (boolean expression)
{
    statement(s)
}

do
{
    statement(s)
} while (boolean expression);

for (initialisation; termination condition; incrementing expr)
{
    statement(s)
}
```

to:

```
  while (boolean expression)
  {
     statement(s)
  }

  do
  {
     statement(s)
  } while (boolean expression);

  for (initialisation; termination condition; incrementing expr)
  {
     statement(s)
  }
```

Changed lines 29-41 from:

if (boolean expression) {

```
    statement(s)
```

}

if (boolean expression) {

```
    statement(s)
```

} else {

```
    statement(s)
```

}

to:

```
  if (boolean expression)
  {
     statement(s)
  }

  else if (boolean expression)
  {
     statement(s)
  }
  else
  {
     statement(s)
  }
```

Restore
April 14, 2007, at 08:10 AM by Paul Badger -
Changed line 11 from:

int ledPin = 13;while (boolean expression)

to:

[@while (boolean expression)

Changed lines 24-25 from:

}=]

to:

} @]

Restore
April 14, 2007, at 08:08 AM by Paul Badger -
Added lines 1-41:

{}Curly Braces

Loops

int ledPin = 13;while (boolean expression) {

```
    statement(s)
```

}

do {

```
    statement(s)
```

} while (boolean expression);

for (initialisation; termination condition; incrementing expr) {

```
    statement(s)
```

}=]

Conditional statements

if (boolean expression) {

```
    statement(s)
```

}

if (boolean expression) {

```
    statement(s)
```

} else {

```
    statement(s)

}
```

Restore

{ } Curly Braces

Curly braces (also referred to as just "braces" or as "curly brackets") are a major part of the C programming language. They are used in several different constructs, outlined below, and this can sometimes be confusing for beginners.

An opening curly brace "{" must always be followed by a closing curly brace "}". This is a condition that is often referred to as the braces being balanced. The Arduino IDE (integrated development environment) includes a convenient feature to check the balance of curly braces. Just select a brace, or even click the insertion point immediately following a brace, and its logical companion will be highlighted.

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Beginning programmers, and programmers coming to C from the BASIC language often find using braces confusing or daunting. After all, the same curly braces replace the RETURN statement in a subroutine (function), the ENDIF statement in a conditional and the NEXT statement in a FOR loop.

Because the use of the curly brace is so varied, it is good programming practice to type the closing brace immediately after typing the opening brace when inserting a construct which requires curly braces. Then insert some carriage returns between your braces and begin inserting statements. Your braces, and your attitude, will never become unbalanced.

Unbalanced braces can often lead to cryptic, impenetrable compiler errors that can sometimes be hard to track down in a large program. Because of their varied usages, braces are also incredibly important to the syntax of a program and moving a brace one or two lines will often dramatically affect the meaning of a program.

The main uses of curly braces

Functions

```
  void myfunction(datatype argument){
    statements(s)
  }
```

Loops

```
  while (boolean expression)
  {
     statement(s)
  }

  do
  {
     statement(s)
  } while (boolean expression);

  for (initialisation; termination condition; incrementing expr)
  {
     statement(s)
  }
```

Conditional statements

```
  if (boolean expression)
  {
     statement(s)
  }

  else if (boolean expression)
  {
     statement(s)
  }
  else
  {
     statement(s)
  }
```

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Reference.Comments History

Hide minor edits - Show changes to markup

July 16, 2007, at 11:24 PM by Paul Badger -
Changed line 21 from:

Tip

to:

Tip\\

Restore
June 03, 2007, at 09:40 PM by Paul Badger -
Changed line 15 from:

x = 3; /* but not another multiline comment - this is invalid */

to:

x = 3; /* but not another multiline comment - this is invalid */

Restore
June 03, 2007, at 09:40 PM by Paul Badger -
Changed line 14 from:

if (gwb > 0){ // single line comment is OK inside of multiline comment

to:

if (gwb == 0){ // single line comment is OK inside of multiline comment

Restore
June 03, 2007, at 09:39 PM by Paul Badger -
Changed lines 10-11 from:

```
           // to the end of the line
```

to:

```
         // to the end of the line
```

Restore
June 03, 2007, at 09:39 PM by Paul Badger -
Changed lines 10-11 from:

// to the end of the line

to:

```
           // to the end of the line
```

Restore
June 03, 2007, at 09:38 PM by Paul Badger -
Changed lines 9-10 from:

[@ x = 5; // This is a single line comment. Anything after the slashes is a comment to the end of the line

to:

[@ x = 5; // This is a single line comment. Anything after the slashes is a comment // to the end of the line

Restore
June 03, 2007, at 09:38 PM by Paul Badger -
Deleted line 19:
Changed lines 21-22 from:

When experimenting with code "commenting out" parts of your program is a convenient way to remove lines that may be buggy. This leaves the lines in the code but turns them into comments, so the compiler will ignore them. This can be especially useful when trying to locate a problem, or when a program refuses to compile and the compiler error is cryptic or unhelpful.

to:

When experimenting with code, "commenting out" parts of your program is a convenient way to remove lines that may be buggy. This leaves the lines in the code, but turns them into comments, so the compiler just ignores them. This can be especially useful when trying to locate a problem, or when a program refuses to compile and the compiler error is cryptic or unhelpful.

Restore
June 03, 2007, at 09:36 PM by Paul Badger -
Changed lines 3-5 from:

Comments are parts in the program that are used to inform yourself or others about the way the program works. Comments are ignored by the compiler, and not exported to the processor, so they don't take up any space on the Atmega chip.

They are strictly useful to help you understand (or remember) how your program works or to inform others how your program works.

to:

Comments are lines in the program that are used to inform yourself or others about the way the program works. They are ignored by the compiler, and not exported to the processor, so they don't take up any space on the Atmega chip.

Comments only purpose are to help you understand (or remember) how your program works or to inform others how your program works.

Changed lines 9-10 from:

[@ x = 5; // This is a single line comment. Anything after the slashes is a comment

to:

[@ x = 5; // This is a single line comment. Anything after the slashes is a comment to the end of the line

Changed line 16 from:
to:

// don't forget the "closing" comment - they have to be balanced!

Restore
June 03, 2007, at 09:24 PM by Paul Badger -
Changed lines 3-5 from:

Comments are parts in the program that are used to inform oneself or others about the way the program works. Comments are not compiled or exported to the processor, so they don't take up any space on the Atmega chip.

They are strictly useful for you to understand what your program is doing or to inform others how your program works.

to:

Comments are parts in the program that are used to inform yourself or others about the way the program works. Comments are ignored by the compiler, and not exported to the processor, so they don't take up any space on the Atmega chip.

They are strictly useful to help you understand (or remember) how your program works or to inform others how your program works.

Changed line 14 from:

x = 3; /* but not another multiline comment - this is invalid */

to:

x = 3; /* but not another multiline comment - this is invalid */

Restore
June 03, 2007, at 09:20 PM by Paul Badger -
Changed lines 11-13 from:

/* you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments:

x = 7;

to:

/* this is multiline comment - use it to comment out whole blocks of code

Changed lines 17-23 from:

8/

 */'''

to:

- /

Restore
June 03, 2007, at 09:17 PM by Paul Badger -
Changed lines 9-11 from:

[@ x = 5; // This is a single line comment - anything after the slashes is a comment

- you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments: **/* blabla */**

to:

[@ x = 5; // This is a single line comment. Anything after the slashes is a comment

/* you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments:

x = 7; if (gwb > 0){ // single line comment is OK inside of multiline comment x = 3; /* but not another multiline comment - this is invalid */ }

8/

 */'''

Restore
June 03, 2007, at 09:14 PM by Paul Badger -
Changed lines 12-14 from:
to:

@]

Restore
June 03, 2007, at 09:13 PM by Paul Badger -
Changed lines 8-9 from:

- you may use a double-slash in the beginning of a line: **//**

to:

Example

[@ x = 5; // This is a single line comment - anything after the slashes is a comment

Restore
June 03, 2007, at 09:12 PM by Paul Badger -
Changed lines 3-5 from:

Comments are parts in the program that are used to inform about the way the program works. They are not going to be compiled, nor will be exported to the processor. They are useful for you to understand what a certain program you downloaded is doing or to inform to your colleagues about what one of its lines is.

to:

Comments are parts in the program that are used to inform oneself or others about the way the program works. Comments are not compiled or exported to the processor, so they don't take up any space on the Atmega chip.

They are strictly useful for you to understand what your program is doing or to inform others how your program works.

Changed line 8 from:

- you could use a double-slash in the beginning of a line: ***//***

to:

- you may use a double-slash in the beginning of a line: ***//***

Added line 11:
Changed lines 13-14 from:

When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

to:

When experimenting with code "commenting out" parts of your program is a convenient way to remove lines that may be buggy. This leaves the lines in the code but turns them into comments, so the compiler will ignore them. This can be especially useful when trying to locate a problem, or when a program refuses to compile and the compiler error is cryptic or unhelpful.

Restore
April 18, 2007, at 02:09 AM by David A. Mellis -
Deleted lines 11-12:

Reference Home

Restore
January 12, 2006, at 05:35 PM by 82.186.237.10 -
Changed lines 10-13 from:

When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

to:

When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

Reference Home

Restore
January 03, 2006, at 03:35 AM by 82.186.237.10 -
Added lines 1-10:

Comments

Comments are parts in the program that are used to inform about the way the program works. They are not going to be compiled, nor will be exported to the processor. They are useful for you to understand what a certain program you downloaded is doing or to inform to your colleagues about what one of its lines is. There are two different ways of marking a line as a comment:

- you could use a double-slash in the beginning of a line: ***//***
- you could use a combination of slash-asterisk --> asterisk-slash encapsulating your comments: ***/* blabla */***

Tip When experimenting with code the ability of commenting parts of your program becomes very useful for you to "park" part of the code for a while.

Restore

Comments

Comments are lines in the program that are used to inform yourself or others about the way the program works. They are ignored by the compiler, and not exported to the processor, so they don't take up any space on the Atmega chip.

Comments only purpose are to help you understand (or remember) how your program works or to inform others how your program works. There are two different ways of marking a line as a comment:

Example

```
 x = 5;  // This is a single line comment. Anything after the slashes is a comment
         // to the end of the line

/* this is multiline comment - use it to comment out whole blocks of code

if (gwb == 0){   // single line comment is OK inside of multiline comment
x = 3;           /* but not another multiline comment - this is invalid */
}
// don't forget the "closing" comment - they have to be balanced!
*/
```

Tip
When experimenting with code, "commenting out" parts of your program is a convenient way to remove lines that may be buggy. This leaves the lines in the code, but turns them into comments, so the compiler just ignores them. This can be especially useful when trying to locate a problem, or when a program refuses to compile and the compiler error is cryptic or unhelpful.

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Reference.Arithmetic History

Hide minor edits - Show changes to markup

February 13, 2008, at 10:43 AM by David A. Mellis -
Changed lines 5-6 from:

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type. If the operands are of different types, the "larger" type is used for the calculation.

to:

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type (e.g. adding 1 to an int with the value 32,767 gives -32,768). If the operands are of different types, the "larger" type is used for the calculation.

Added lines 35-36:

- Know that integer constants default to int, so some constant calculations may overflow (e.g. 60 * 1000 will yield a negative result).

Restore
May 28, 2007, at 08:24 PM by Paul Badger -
Restore
May 28, 2007, at 08:23 PM by Paul Badger -
Changed line 7 from:

If one of the numbers (operands) are of the type **float** or of type **double**, floating point math will be used for the operation.

to:

If one of the numbers (operands) are of the type **float** or of type **double**, floating point math will be used for the calculation.

Restore
May 28, 2007, at 08:21 PM by Paul Badger -
Changed lines 5-6 from:

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type. If the operands are of different types, the "larger" type is used for the calculation.

to:

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type. If the operands are of different types, the "larger" type is used for the calculation.

If one of the numbers (operands) are of the type **float** or of type **double**, floating point math will be used for the operation.

Changed lines 33-34 from:

Tips:

to:

Programming Tips:

Changed lines 41-47 from:

- Use the cast operator e.g. (int)myfloat to convert one variable type to another on the fly.

to:

- Use the cast operator e.g. (int)myFloat to convert one variable type to another on the fly.

Restore
April 16, 2007, at 10:49 AM by Paul Badger -
Changed lines 42-45 from:

Reference Home

to:

Restore
April 15, 2007, at 10:18 PM by Paul Badger -
Changed lines 38-41 from:

- Use the cast operator eg (int)myfloat to convert one variable type to another on the fly.

to:

- Use the cast operator e.g. (int)myfloat to convert one variable type to another on the fly.

Restore
April 15, 2007, at 10:11 PM by David A. Mellis -
Changed lines 5-6 from:

The arithmetic operators work exactly as one expects with the result returned being the result of the two values and the operator

to:

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type. If the operands are of different types, the "larger" type is used for the calculation.

Changed lines 17-18 from:

result = value1 [+-*/] value2

to:

```
result = value1 + value2;
result = value1 - value2;
result = value1 * value2;
result = value1 / value2;
```

Changed lines 26-28 from:

value1: any variable type

value2: any variable type

to:

value1: any variable or constant

value2: any variable or constant

Restore
April 15, 2007, at 04:13 PM by Paul Badger -
Added lines 35-39:

Reference Home

Restore
April 15, 2007, at 04:11 PM by Paul Badger -
Changed lines 26-29 from:

A longer tutorial on computer math can eventually go in this space but for now, to benefit beginning programmers some general guidelines will be presented. These will hopefully get you started toward getting the same answer out of your Arduino that you do on your calculator.

- Choose variable sizes that you are sure are large enough to hold the largest results from your calculations

to:

- Choose variable sizes that are large enough to hold the largest results from your calculations

Changed lines 32-34 from:
to:

- Use the cast operator eg (int)myfloat to convert one variable type to another on the fly.

Restore
April 15, 2007, at 04:08 PM by Paul Badger -
Changed lines 28-30 from:

to:

- Choose variable sizes that you are sure are large enough to hold the largest results from your calculations

- Know at what point your variable will "roll over" and also what happens in the other direction e.g. (0 - 1) OR (0 - - 32768)

- For math that requires fractions, use float variables, but be aware of their drawbacks: large size, slow computation speeds

Restore
April 15, 2007, at 04:03 PM by Paul Badger -
Changed line 21 from:

value1: any variable type

to:

value1: any variable type\\\

Changed lines 26-32 from:

For beginning programmers there are several details of doing math on the computer to which one must pay attention. One is that math on computers, as opposed to algebra class, must exist in physical space. This means that the variable (which occupies a physical space on your Atmega chip) must be large enough to hold the results of your calculations.

Hence if you try something like this

```
 byte x;
x =  255;
x = x + 1;
```

to:

A longer tutorial on computer math can eventually go in this space but for now, to benefit beginning programmers some general guidelines will be presented. These will hopefully get you started toward getting the same answer out of your Arduino that you do on your calculator.

Restore
April 15, 2007, at 03:59 PM by Paul Badger -
Added lines 14-18:

Syntax

result = value1 [+-*/] value2

Restore
April 15, 2007, at 03:27 PM by Paul Badger -
Changed line 8 from:

to:

[@

Changed line 13 from:
to:

@]

Changed lines 26-27 from:

x = x + 1;

to:

x = x + 1; @]

Restore
April 15, 2007, at 03:23 PM by Paul Badger -
Added lines 1-27:

Addition, Subtraction, Multiplication, & Division

Description

The arithmetic operators work exactly as one expects with the result returned being the result of the two values and the operator

Examples

y = y + 3; x = x - 7; i = j * 6; r = r / 5;

Parameters:

value1: any variable type value2: any variable type

Tips:

For beginning programmers there are several details of doing math on the computer to which one must pay attention. One is that math on computers, as opposed to algebra class, must exist in physical space. This means that the variable (which occupies a physical space on your Atmega chip) must be large enough to hold the results of your calculations.

Hence if you try something like this [@ byte x; x = 255; x = x + 1;

Restore

Addition, Subtraction, Multiplication, & Division

Description

These operators return the sum, difference, product, or quotient (respectively) of the two operands. The operation is conducted using the data type of the operands, so, for example, `9 / 4` gives 2 since 9 and 4 are ints. This also means that the operation can overflow if the result is larger than that which can be stored in the data type (e.g. adding 1 to an int with the value 32,767 gives -32,768). If the operands are of different types, the "larger" type is used for the calculation.

If one of the numbers (operands) are of the type **float** or of type **double**, floating point math will be used for the calculation.

Examples

```
y = y + 3;
x = x - 7;
i = j * 6;
r = r / 5;
```

Syntax

```
result = value1 + value2;
result = value1 - value2;
result = value1 * value2;
result = value1 / value2;
```

Parameters:

value1: any variable or constant

value2: any variable or constant

Programming Tips:

- Know that integer constants default to int, so some constant calculations may overflow (e.g. 60 * 1000 will yield a negative result).
- Choose variable sizes that are large enough to hold the largest results from your calculations
- Know at what point your variable will "roll over" and also what happens in the other direction e.g. (0 - 1) OR (0 - - 32768)
- For math that requires fractions, use float variables, but be aware of their drawbacks: large size, slow computation speeds
- Use the cast operator e.g. (int)myFloat to convert one variable type to another on the fly.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Modulo History

Hide minor edits - Show changes to markup

March 25, 2008, at 03:13 PM by Paul Badger -
Restore
March 25, 2008, at 03:11 PM by Paul Badger -
Changed line 60 from:

[[// send the analog input information (0 - 1023)

to:

[@ // send the analog input information (0 - 1023)

Changed lines 62-68 from:

```
     Serial.print(value >> 7, BYTE);  // send highest three bits  ]]
```

to:

```
     Serial.print(value >> 7, BYTE);  // send highest three bits  @]
```

Restore
March 25, 2008, at 03:11 PM by Paul Badger -
Changed lines 59-60 from:

[[

```
     // send the analog input information (0 - 1023)
```

to:

[[// send the analog input information (0 - 1023)

Changed lines 62-68 from:

```
     Serial.print(value >> 7, BYTE);  // send highest three bits
```

]]

to:

```
     Serial.print(value >> 7, BYTE);  // send highest three bits  ]]
```

Restore
March 25, 2008, at 03:10 PM by Paul Badger -
Changed lines 57-58 from:

The modulo operator can also be used to strip off the high bytes of a variable. The example below is from the Firmata library.

to:

The modulo operator can also be used to strip off the high bits of a variable. The example below is from the Firmata library.

Changed lines 60-61 from:

// send analog input information (0 - 1023)

```
     Serial.print(value % 128, BYTE); //send lowest 7 bits
```

to:

```
     // send the analog input information (0 - 1023)
     Serial.print(value % 128, BYTE); // send lowest 7 bits
```

Restore
March 25, 2008, at 03:09 PM by Paul Badger -
Changed lines 57-58 from:
to:

The modulo operator can also be used to strip off the high bytes of a variable. The example below is from the Firmata library.

[[// send analog input information (0 - 1023)

```
     Serial.print(value % 128, BYTE); //send lowest 7 bits
     Serial.print(value >> 7, BYTE);  // send highest three bits
```

]]

Restore
July 16, 2007, at 04:55 AM by Paul Badger -
Changed line 34 from:

if ((i % 10) == 0){ // read sensor every ten times through loop

to:

if ((i % 10) == 0){ // read sensor every ten times through loop

Restore
July 16, 2007, at 04:54 AM by Paul Badger -
Changed lines 34-35 from:

if ((i % 10) == 0){

```
   x = analogRead(sensPin);   // read sensor every ten times through loop
```

to:

if ((i % 10) == 0){ // read sensor every ten times through loop

```
   x = analogRead(sensPin);
```

Restore
May 28, 2007, at 08:12 PM by Paul Badger -
Changed lines 65-66 from:

division?

to:

division

Restore
May 28, 2007, at 08:12 PM by Paul Badger -
Changed lines 65-66 from:

division?

to:

division?

Restore
May 28, 2007, at 08:11 PM by Paul Badger -
Changed lines 65-66 from:

?

to:

division?

Restore

May 28, 2007, at 08:11 PM by Paul Badger -
Changed lines 65-66 from:

/ ?

to:

?

Restore
May 05, 2007, at 07:46 AM by Paul Badger -
Deleted line 39:
Restore
May 05, 2007, at 07:45 AM by Paul Badger -
Changed lines 34-35 from:

if ((i % 10) == 0){x = analogRead(sensPin);}

to:

if ((i % 10) == 0){

```
   x = analogRead(sensPin);   // read sensor every ten times through loop
   }
```

/ ... }

Restore
May 05, 2007, at 07:43 AM by Paul Badger -
Changed lines 27-28 from:

The modulo operator is useful for tasks like making an event occur at regular periods or making a memory array roll over

to:

The modulo operator is useful for tasks such as making an event occur at regular periods or making a memory array roll over

Restore
April 16, 2007, at 10:54 AM by Paul Badger -
Added line 60:
Restore
April 16, 2007, at 10:54 AM by Paul Badger -
Deleted lines 61-62:

Reference Home

Restore
April 16, 2007, at 10:54 AM by Paul Badger -
Changed lines 27-28 from:

The modulo operator is useful for making an event occur at regular periods and tasks like making a memory array roll over

to:

The modulo operator is useful for tasks like making an event occur at regular periods or making a memory array roll over

Restore
April 15, 2007, at 03:57 PM by Paul Badger -
Changed lines 8-9 from:

x % y

to:

result = value1 % value2

Changed lines 12-15 from:

x: a byte, char, int, or long

y: a byte, char, int, or long

to:

value1: a byte, char, int, or long

value2: a byte, char, int, or long

Restore
April 15, 2007, at 02:07 PM by Paul Badger -
Deleted line 35:
Deleted lines 54-55:
Restore
April 15, 2007, at 02:06 PM by Paul Badger -
Changed line 58 from:

Common Programming Errors

to:

Tip

Restore
April 13, 2007, at 10:45 PM by Paul Badger -
Changed lines 63-65 from:

- / ?

to:

/ ?

Restore
April 13, 2007, at 10:43 PM by Paul Badger -
Changed lines 27-28 from:

The modulo operator is useful for making an event occur at regular periods, and tasks like making a memory array roll over

to:

The modulo operator is useful for making an event occur at regular periods and tasks like making a memory array roll over

Restore
April 13, 2007, at 10:42 PM by Paul Badger -
Changed lines 6-9 from:
to:

Syntax

x % y

Changed lines 12-15 from:

x: the first number, a byte, char, int, or long

y: the second number, a byte, char, int, or long

to:

x: a byte, char, int, or long

y: a byte, char, int, or long

Changed line 21 from:

[@x = 7 % 5; // x now contains 2

to:

[@x = 7 % 5; // x now contains 2

Changed lines 46-47 from:

sensVal[i++ % 5] = analogRead(sensPin);

to:

sensVal[(i++) % 5] = analogRead(sensPin); average = 0;

Changed line 49 from:

average = sensVal[j]; // add up the samples

to:

average += sensVal[j]; // add up the samples

Restore
April 13, 2007, at 10:33 PM by Paul Badger -
Changed line 18 from:

[@x = 7 % 5; // x now contains 2

to:

[@x = 7 % 5; // x now contains 2

Changed line 26 from:

Example Programs

to:

Example Code

Restore
April 13, 2007, at 10:33 PM by Paul Badger -
Changed line 18 from:

[@x = 7 % 5; // x now contains 2

to:

[@x = 7 % 5; // x now contains 2

Changed lines 24-33 from:

The modulo operator is useful for generating repeating patterns or series of numbers, such as getting a memory array to roll over

Example Program

[@// setup a buffer that averages the last five samples of a sensor

int senVal[5]; // create an array for sensor data int i, j; // counter variables long average; // variable to store average ...

to:

The modulo operator is useful for making an event occur at regular periods, and tasks like making a memory array roll over

Example Programs

[@ // check a sensor every 10 times through a loop

Added lines 30-41:

i++; if ((i % 10) == 0){x = analogRead(sensPin);}

// setup a buffer that averages the last five samples of a sensor

int senVal[5]; // create an array for sensor data int i, j; // counter variables long average; // variable to store average ...

void loop(){

Restore
April 13, 2007, at 10:25 PM by Paul Badger -
Changed line 18 from:

x = 7 % 5; // x now contains 2

to:

[@x = 7 % 5; // x now contains 2

Changed lines 22-23 from:
to:

@]

Changed lines 27-28 from:

{@// setup a buffer that averages the last five samples of a sensor

to:

[@// setup a buffer that averages the last five samples of a sensor

Restore
April 13, 2007, at 10:23 PM by Paul Badger -
Changed lines 26-33 from:

// setup a buffer that averages the last five samples of a sensor

int senVal[5]; //create an array for sensor data

to:

{@// setup a buffer that averages the last five samples of a sensor

int senVal[5]; // create an array for sensor data int i, j; // counter variables long average; // variable to store average ...

void loop(){ // input sensor data into oldest memory slot sensVal[i++ % 5] = analogRead(sensPin); for (j=0; j<5; j++){ average = sensVal[j]; // add up the samples } average = average / 5; // divide by total @]

Restore
April 13, 2007, at 10:15 PM by Paul Badger -
Added lines 1-42:

% (modulo)

Description

Returns the remainder from an integer division

Parameters

x: the first number, a byte, char, int, or long

y: the second number, a byte, char, int, or long

Returns

The remainder from an integer division.

Examples

x = 7 % 5; // x now contains 2 x = 9 % 5; // x now contains 4 x = 5 % 5; // x now contains 0 x = 4 % 5; // x now contains 4

The modulo operator is useful for generating repeating patterns or series of numbers, such as getting a memory array to roll over

Example Program

// setup a buffer that averages the last five samples of a sensor

int senVal[5]; //create an array for sensor data

Common Programming Errors

the modulo operator will not work on floats

See also

- / ?

% (modulo)

Description

Returns the remainder from an integer division

Syntax

result = value1 % value2

Parameters

value1: a byte, char, int, or long

value2: a byte, char, int, or long

Returns

The remainder from an integer division.

Examples

```
x = 7 % 5;   // x now contains 2
x = 9 % 5;   // x now contains 4
x = 5 % 5;   // x now contains 0
x = 4 % 5;   // x now contains 4
```

The modulo operator is useful for tasks such as making an event occur at regular periods or making a memory array roll over

Example Code

```
// check a sensor every 10 times through a loop
void loop(){
i++;
if ((i % 10) == 0){          // read sensor every ten times through loop
   x = analogRead(sensPin);
   }
/ ...
}

// setup a buffer that averages the last five samples of a sensor

int senVal[5];  // create an array for sensor data
int i, j;       // counter variables
long average;   // variable to store average
...

void loop(){
// input sensor data into oldest memory slot
sensVal[(i++) % 5] = analogRead(sensPin);
average = 0;
for (j=0; j<5; j++){
average += sensVal[j];   // add up the samples
}
average = average / 5;  // divide by total
```

The modulo operator can also be used to strip off the high bits of a variable. The example below is from the Firmata library.

```
    // send the analog input information (0 - 1023)
     Serial.print(value % 128, BYTE); // send lowest 7 bits
     Serial.print(value >> 7, BYTE);  // send highest three bits
```

Tip

the modulo operator will not work on floats

See also

division

Reference Home

Arduino

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Reference.DigitalWrite History

Hide minor edits - Show changes to markup

March 31, 2008, at 06:15 AM by Paul Badger -
Changed lines 5-6 from:

Ouputs either HIGH or LOW at a specified pin.

to:

Sets a pin configured as OUTPUT to either a HIGH or a LOW state at the specified pin.

The digitalWrite() function is also used to set pullup resistors when a pin is configured as an INPUT.

Restore
February 13, 2008, at 09:29 PM by David A. Mellis -
Changed line 40 from:

- Description of the pins on an Arduino board

to:

- Description of the pins on an Arduino board

Restore
February 02, 2008, at 09:05 AM by Paul Badger -
Changed lines 37-38 from:

The analog input pins can be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

to:

The analog input pins can also be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 19, 2008, at 09:40 AM by David A. Mellis - i'm not sure digitalWrite() needs to link to an explanation of ADCs, etc.
Deleted line 40:

- analog pins

Restore
January 18, 2008, at 12:30 PM by Paul Badger -
Restore
January 18, 2008, at 10:53 AM by Paul Badger -
Changed lines 37-38 from:

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

to:

The analog input pins can be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 18, 2008, at 09:14 AM by David A. Mellis -
Deleted lines 9-11:

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite and pinMode commands.

Changed lines 35-38 from:

to:

Note

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 17, 2008, at 11:17 PM by Paul Badger -
Changed lines 11-12 from:

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite, and pinMode commands.

to:

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite and pinMode commands.

Restore
January 17, 2008, at 11:16 PM by Paul Badger -
Added line 10:
Restore
January 17, 2008, at 11:16 PM by Paul Badger -
Added line 9:
Restore
January 17, 2008, at 11:15 PM by Paul Badger -
Changed lines 9-10 from:

valid pin numbers on most boards are 0 to 19, valid pin number on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite, and pinMode commands.

to:

valid pin numbers on most boards are 0 to 19, valid pin numbers on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite, and pinMode commands.

Restore
January 17, 2008, at 11:14 PM by Paul Badger -
Changed lines 8-9 from:

pin: the pin number, valid pin numbers on most boards are 0 to 19, valid pin number on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the analog pins, when using the digitalWrite command.

to:

pin: the pin number
valid pin numbers on most boards are 0 to 19, valid pin number on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the *analog* pins, when using the digitalWrite, and pinMode commands.

Added line 39:

- analog pins

Restore
January 17, 2008, at 11:11 PM by Paul Badger -
Changed lines 8-9 from:

pin: the pin number

to:

pin: the pin number, valid pin numbers on most boards are 0 to 19, valid pin number on the Mini are 0 to 21. Pins 0 to 13 refer to the *digital* pins and pins 14 to 19 refer to the analog pins, when using the digitalWrite command.

Deleted line 41:

Reference Home

Restore
January 11, 2008, at 11:40 AM by David A. Mellis -
Changed line 37 from:

- delay

to:

- Description of the pins on an Arduino board

Restore
January 12, 2006, at 05:37 PM by 82.186.237.10 -
Added lines 40-42:

Reference Home

Restore
December 28, 2005, at 03:46 PM by 82.186.237.10 -
Changed lines 1-4 from:

DigitalWrite

What it does

to:

digitalWrite(pin, value)

Description

Changed lines 7-13 from:

What parametres does it take

You need to specify the number of the pin you want to set followed by the word HIGH or LOW.

This function returns

nothing

to:

Parameters

pin: the pin number

value: HIGH or LOW

Returns

none

Restore
December 03, 2005, at 12:47 PM by 213.140.6.103 -
Changed lines 5-7 from:

Outputs a series of digital pulses that act like an analogue voltage.

to:

Ouputs either HIGH or LOW at a specified pin.

Changed lines 9-11 from:

you need to specify the number of the pin y ou want to configure followed by the word INPUT or OUTPUT.

to:

You need to specify the number of the pin you want to set followed by the word HIGH or LOW.

Changed lines 32-34 from:

configures pin number 13 to work as an output pin.

to:

Sets pin 13 to HIGH, makes a one-second-long delay, and sets the pin back to LOW.

Changed lines 36-37 from:

- **digitalWrite**

to:

- delay
- pinMode

Restore
December 03, 2005, at 12:42 PM by 213.140.6.103 -
Changed lines 16-17 from:

[@

to:

 [@

Deleted line 18:
Deleted line 19:
Deleted line 20:
Deleted line 21:
Deleted line 24:
Deleted line 25:
Deleted line 26:
Deleted line 27:
Deleted line 28:
Deleted line 29:
Restore
December 03, 2005, at 12:40 PM by 213.140.6.103 -
Added line 20:
Added line 22:
Added line 24:
Added line 26:
Added line 30:
Added line 32:
Added line 34:
Added line 36:
Added line 38:
Added line 40:
Restore
December 03, 2005, at 12:39 PM by 213.140.6.103 -
Changed lines 16-17 from:

[=

to:

[@

Changed lines 32-33 from:

=]

to:

@]

Restore
December 03, 2005, at 12:39 PM by 213.140.6.103 -
Changed lines 16-17 from:

[@

to:

[=

Changed lines 32-33 from:

@]

to:

=]

Restore
November 27, 2005, at 10:20 AM by 81.154.199.248 -
Added lines 1-39:

DigitalWrite

What it does

Outputs a series of digital pulses that act like an analogue voltage.

What parametres does it take

you need to specify the number of the pin y ou want to configure followed by the word INPUT or OUTPUT.

This function returns

nothing

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

configures pin number 13 to work as an output pin.

See also

- **digitalWrite**
- digitalRead

Restore

digitalWrite(pin, value)

Description

Sets a pin configured as OUTPUT to either a HIGH or a LOW state at the specified pin.

The digitalWrite() function is also used to set pullup resistors when a pin is configured as an INPUT.

Parameters

pin: the pin number
value: HIGH or LOW

Returns

none

Example

```
int ledPin = 13;                  // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

Sets pin 13 to HIGH, makes a one-second-long delay, and sets the pin back to LOW.

Note

The analog input pins can also be used as digital pins, referred to as numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- pinMode
- digitalRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.DigitalRead History

Hide minor edits - Show changes to markup

June 29, 2008, at 01:08 PM by David A. Mellis -
Changed lines 8-9 from:

pin: the number of the pin you want to read.

to:

pin: the number of the digital pin you want to read.

Restore
February 13, 2008, at 09:29 PM by David A. Mellis -
Changed line 40 from:

- Description of the pins on an Arduino board

to:

- Description of the pins on an Arduino board

Restore
January 18, 2008, at 09:15 AM by David A. Mellis -
Changed lines 8-9 from:

pin: the number of the pin you want to read. It has to be one of the digital pins of the board, thus it should be a number between 0 and 13. It could also be a variable representing a value in that range.

to:

pin: the number of the pin you want to read.

Changed lines 37-38 from:
to:

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

Restore
January 11, 2008, at 11:41 AM by David A. Mellis -
Changed line 39 from:

- description of the pins on an Arduino board

to:

- Description of the pins on an Arduino board

Restore
January 11, 2008, at 11:40 AM by David A. Mellis -
Added line 39:

- description of the pins on an Arduino board

Restore
August 10, 2007, at 11:01 AM by David A. Mellis - adding a note about unconnected pins
Changed lines 34-37 from:
to:

Note

If the pin isn't connected to anything, digitalRead() can return either HIGH or LOW (and this can change randomly).

Restore
December 28, 2005, at 03:48 PM by 82.186.237.10 -
Changed lines 1-2 from:

digitalRead

to:

digitalRead(pin)

Changed lines 7-10 from:

What parametres does it take

You need to specify the number of the pin you want to read. It has to be one of the digital pins of the board, thus it should be a number between 0 and 13. It could also be a variable representing one value in that range.

This function returns

to:

Parameters

pin: the number of the pin you want to read. It has to be one of the digital pins of the board, thus it should be a number between 0 and 13. It could also be a variable representing a value in that range.

Returns

Restore
December 03, 2005, at 01:11 PM by 213.140.6.103 -
Changed line 37 from:

- **digitalRead**

to:

- digitalWrite

Restore
December 03, 2005, at 12:57 PM by 213.140.6.103 -
Added lines 3-37:

What it does

Reads the value from a specified pin, it will be either HIGH or LOW.

What parametres does it take

You need to specify the number of the pin you want to read. It has to be one of the digital pins of the board, thus it should be a number between 0 and 13. It could also be a variable representing one value in that range.

This function returns

Either HIGH or LOW

Example

```
int ledPin = 13; // LED connected to digital pin 13
int inPin = 7;   // pushbutton connected to digital pin 7
int val = 0;     // variable to store the read value

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin 13 as output
  pinMode(inPin, INPUT);      // sets the digital pin 7 as input
}
```

```
void loop()
{
  val = digitalRead(inPin);   // read the input pin
  digitalWrite(ledPin, val);    // sets the LED to the button's value
}
```

Sets pin 13 to the same value as the pin 7, which is an input.

See also

- pinMode
- **digitalRead**

Restore
November 27, 2005, at 10:42 AM by 81.154.199.248 -
Added lines 1-2:

digitalRead

Restore

digitalRead(pin)

What it does

Reads the value from a specified pin, it will be either HIGH or LOW.

Parameters

pin: the number of the digital pin you want to read.

Returns

Either HIGH or LOW

Example

```
int ledPin = 13; // LED connected to digital pin 13
int inPin = 7;   // pushbutton connected to digital pin 7
int val = 0;     // variable to store the read value

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin 13 as output
  pinMode(inPin, INPUT);      // sets the digital pin 7 as input
}

void loop()
{
  val = digitalRead(inPin);   // read the input pin
  digitalWrite(ledPin, val);    // sets the LED to the button's value
}
```

Sets pin 13 to the same value as the pin 7, which is an input.

Note

If the pin isn't connected to anything, digitalRead() can return either HIGH or LOW (and this can change randomly).

The analog input pins can be used as digital pins w/ numbers 14 (analog input 0) to 19 (analog input 5).

See also

- Description of the pins on an Arduino board
- pinMode
- digitalWrite

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.AnalogRead History

Hide minor edits - Show changes to markup

June 18, 2008, at 09:41 AM by David A. Mellis -
Changed lines 5-6 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the Mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the Mini and Nano), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit.

Changed lines 11-12 from:

pin: the number of the analog input pin to read from (0 to 5 on most boards, 0 to 7 on the Mini)

to:

pin: the number of the analog input pin to read from (0 to 5 on most boards, 0 to 7 on the Mini and Nano)

Restore
February 13, 2008, at 09:29 PM by David A. Mellis -
Changed line 38 from:

- Description of the analog input pins

to:

- Description of the analog input pins

Restore
January 31, 2008, at 02:34 PM by David A. Mellis -
Added lines 13-15:

Returns

An integer value in the range of 0 to 1023.

Changed lines 17-21 from:

Analog pins default to inputs and unlike digital ones, do not need to be declared as INPUT nor OUTPUT

Returns

An integer value in the range of 0 to 1023.

to:

If the analog input pin is not connected to anything, the value returned by analogRead() will fluctuate based on a number of factors (e.g. the values of the other analog inputs, how close your hand is to the board, etc.).

Deleted line 20:

int ledPin = 13; // LED connected to digital pin 13

Changed lines 24-25 from:

int threshold = 512; // threshold

to:
Deleted line 26:

```
  pinMode(ledPin, OUTPUT);   // sets the digital pin 13 as output
```

Deleted lines 33-38:

```
  if (val >= threshold) {
    digitalWrite(ledPin, HIGH);   // sets the LED on
  } else {
    digitalWrite(ledPin, LOW);    // sets the LED off
  }
```

Deleted lines 36-38:

Sets pin 13 to HIGH or LOW depending if the input at analog pin is higher than a certain threshold.

Deleted lines 38-39:

- pinMode
- digitalWrite

Restore
January 25, 2008, at 05:09 PM by David A. Mellis - removing duplicate link
Deleted line 50:

- analogPins

Restore
January 25, 2008, at 05:09 PM by David A. Mellis -
Changed lines 5-8 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per A/D unit.

It takes about 100 us (.0001 s) to read an analog input, so the maximum reading rate is about 10000 times a second.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the Mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit.

It takes about 100 us (0.0001 s) to read an analog input, so the maximum reading rate is about 10,000 times a second.

Changed lines 11-14 from:

int pin

AnalogRead() accepts one integer specifying the number of the pin to read. Values between 0 and 5 are valid on most boards, and between 0 and 7 on the mini.

to:

pin: the number of the analog input pin to read from (0 to 5 on most boards, 0 to 7 on the Mini)

Restore
January 11, 2008, at 12:06 PM by David A. Mellis -
Added line 52:

- Description of the analog input pins

Deleted lines 57-58:

Reference Home

Restore
December 22, 2007, at 07:42 AM by Paul Badger -
Changed line 32 from:

Serial.begin(9600); // setup serial

to:

```
  Serial.begin(9600);          //  setup serial
```

Changed lines 38-39 from:

```
  Serial.begin(9600);             // debug value
```

to:

```
  Serial.println(val);             // debug value
```

Restore
December 22, 2007, at 07:41 AM by Paul Badger -
Changed lines 5-6 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per A/D unit.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per A/D unit.

Added line 32:

Serial.begin(9600); // setup serial

Added lines 38-39:

```
  Serial.begin(9600);             // debug value
```

Restore
November 03, 2007, at 11:27 PM by Paul Badger -
Changed lines 5-6 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 volts / 1024 units or .0049 volts (4.9 mV) per A/D unit.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per A/D unit.

Restore
November 03, 2007, at 11:25 PM by Paul Badger -
Changed lines 5-6 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 / 1024 or .0049 volts (4.9 mV) per A/D unit.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 volts / 1024 units or .0049 volts (4.9 mV) per A/D unit.

Restore
November 03, 2007, at 11:21 PM by Paul Badger -
Changed lines 5-6 from:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 / 1024 or .0049 volts (4.9 mV) per A/D unit.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 / 1024 or .0049 volts (4.9 mV) per A/D unit.

It takes about 100 us (.0001 s) to read an analog input, so the maximum reading rate is about 10000 times a second.

Restore
November 03, 2007, at 11:06 PM by Paul Badger -
Added line 47:

- analogPins

Restore
November 03, 2007, at 11:05 PM by Paul Badger -
Changed lines 11-12 from:

AnalogRead() accepts one int parameter specifing the number of the pin to read. Values between 0 and 5 are valid on most boards, and between 0 and 7 on the mini.

to:

AnalogRead() accepts one integer specifying the number of the pin to read. Values between 0 and 5 are valid on most boards, and between 0 and 7 on the mini.

Changed lines 21-24 from:

int ledPin = 13; // LED connected to digital pin 13 int analogPin = 3; // potentiometer wiper (middle terminal) connected to analog pin 3 // outside leads to ground and +5V int val = 0; // variable to store the read value

to:

int ledPin = 13; // LED connected to digital pin 13 int analogPin = 3; // potentiometer wiper (middle terminal) connected to analog pin 3

```
                       // outside leads to ground and +5V
```

int val = 0; // variable to store the value read

Changed line 34 from:

```
  val = analogRead(analogPin);   // read the input pin
```

to:

```
  val = analogRead(analogPin);    // read the input pin
```

Changed line 38 from:

```
    digitalWrite(ledPin, LOW);   // sets the LED off
```

to:

```
    digitalWrite(ledPin, LOW);    // sets the LED off
```

Restore
November 03, 2007, at 11:03 PM by Paul Badger -
Changed lines 4-6 from:

Reads the value from a specified analog pin, the Arduino board makes a 10-bit analog to digital conversion. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023.

to:

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the mini), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of 5 / 1024 or .0049 volts (4.9 mV) per A/D unit.

Changed lines 8-9 from:

You need to specify the number of the pin you want to read. It has to be one of the analog pins of the board, thus it should be a number between 0 and 5. It could also be a variable representing one value in that range.

to:

int pin

AnalogRead() accepts one int parameter specifing the number of the pin to read. Values between 0 and 5 are valid on most boards, and between 0 and 7 on the mini.

Changed lines 14-16 from:

Analog pins unlike digital ones, do not need to be declared as INPUT nor OUTPUT

This function returns

to:

Analog pins default to inputs and unlike digital ones, do not need to be declared as INPUT nor OUTPUT

Returns

Changed lines 22-23 from:

int analogPin = 3; // potentiometer connected to analog pin 3

to:

int analogPin = 3; // potentiometer wiper (middle terminal) connected to analog pin 3 // outside leads to ground and +5V

Restore
September 26, 2007, at 10:05 PM by David A. Mellis - changing 1024 to 1023
Changed lines 4-6 from:

Reads the value from a specified analog pin, the Arduino board makes a 10-bit analog to digital conversion. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1024.

to:

Reads the value from a specified analog pin, the Arduino board makes a 10-bit analog to digital conversion. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023.

Changed lines 14-15 from:

An integer value in the range of 0 to 1024.

to:

An integer value in the range of 0 to 1023.

Restore
July 13, 2006, at 06:32 AM by Massimo Banzi -
Changed line 34 from:

```
    digitalWrite(ledPin, LOW);   // sets the LED on
```

to:

```
    digitalWrite(ledPin, LOW);   // sets the LED off
```

Restore
January 12, 2006, at 05:38 PM by 82.186.237.10 -
Changed lines 1-3 from:

analogRead

What it does

to:

int analogRead(pin)

Description

Changed line 7 from:

What parametres does it take

to:

Parameters

Added lines 47-48:

Reference Home

Restore
December 03, 2005, at 01:58 PM by 213.140.6.103 -
Changed line 18 from:

int ledPin = 13; // LED connected to digital pin 13

to:

int ledPin = 13; // LED connected to digital pin 13

Changed line 20 from:

int val = 0; // variable to store the read value

to:

int val = 0; // variable to store the read value

Changed line 25 from:

```
  pinMode(ledPin, OUTPUT);      // sets the digital pin 13 as output
```

to:

```
  pinMode(ledPin, OUTPUT);   // sets the digital pin 13 as output
```

Changed line 32 from:

```
    digitalWrite(ledPin, HIGH);    // sets the LED on
```

to:

```
    digitalWrite(ledPin, HIGH);   // sets the LED on
```

Changed line 34 from:

```
    digitalWrite(ledPin, LOW);    // sets the LED on
```

to:

```
    digitalWrite(ledPin, LOW);   // sets the LED on
```

Restore
December 03, 2005, at 01:57 PM by 213.140.6.103 -
Added lines 3-46:

What it does

Reads the value from a specified analog pin, the Arduino board makes a 10-bit analog to digital conversion. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1024.

What parametres does it take

You need to specify the number of the pin you want to read. It has to be one of the analog pins of the board, thus it should be a number between 0 and 5. It could also be a variable representing one value in that range.

Note

Analog pins unlike digital ones, do not need to be declared as INPUT nor OUTPUT

This function returns

An integer value in the range of 0 to 1024.

Example

```
int ledPin = 13; // LED connected to digital pin 13
int analogPin = 3;   // potentiometer connected to analog pin 3
int val = 0;     // variable to store the read value
int threshold = 512;   // threshold

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin 13 as output
}

void loop()
{
  val = analogRead(analogPin);   // read the input pin
  if (val >= threshold) {
    digitalWrite(ledPin, HIGH);    // sets the LED on
  } else {
    digitalWrite(ledPin, LOW);    // sets the LED on
  }
}
```

Sets pin 13 to HIGH or LOW depending if the input at analog pin is higher than a certain threshold.

See also

- pinMode
- digitalWrite
- analogWrite

Restore
November 27, 2005, at 10:42 AM by 81.154.199.248 -
Added lines 1-2:

analogRead

Restore

Reference Language (extended) | Libraries | Comparison | Board

int analogRead(pin)

Description

Reads the value from the specified analog pin. The Arduino board contains a 6 channel (8 channels on the Mini and Nano), 10-bit analog to digital converter. This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. This yields a resolution between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit.

It takes about 100 us (0.0001 s) to read an analog input, so the maximum reading rate is about 10,000 times a second.

Parameters

pin: the number of the analog input pin to read from (0 to 5 on most boards, 0 to 7 on the Mini and Nano)

Returns

An integer value in the range of 0 to 1023.

Note

If the analog input pin is not connected to anything, the value returned by analogRead() will fluctuate based on a number of factors (e.g. the values of the other analog inputs, how close your hand is to the board, etc.).

Example

```
int analogPin = 3;     // potentiometer wiper (middle terminal) connected to analog pin 3
                       // outside leads to ground and +5V
int val = 0;           // variable to store the value read

void setup()
{
  Serial.begin(9600);          //  setup serial
}

void loop()
{
  val = analogRead(analogPin);    // read the input pin
  Serial.println(val);             // debug value
}
```

See also

- Description of the analog input pins
- analogWrite

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.AnalogWrite History

Hide minor edits - Show changes to markup

June 08, 2008, at 11:18 AM by David A. Mellis -
Changed lines 4-7 from:

Writes an analog value (PWM wave) to a pin. On newer Arduino boards (including the Mini and BT) with the ATmega168 chip, this function works on pins 3, 5, 6, 9, 10, and 11. Older USB and serial Arduino boards with an ATmega8 only support analogWrite() on pins 9, 10, and 11.

Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

to:

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin). The frequency of the PWM signal is approximately 490 Hz.

On newer Arduino boards (including the Mini and BT) with the ATmega168 chip, this function works on pins 3, 5, 6, 9, 10, and 11. Older USB and serial Arduino boards with an ATmega8 only support analogWrite() on pins 9, 10, and 11.

Changed lines 11-12 from:

value: the duty cycle: between 0 and 255. A value of 0 generates a constant 0 volts output at the specified pin; a value of 255 generates a constant 5 volts output at the specified pin. For values in between 0 and 255, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts). For example, a value of 64 will be 0 volts three-quarters of the time, and 5 volts one quarter of the time; a value of 128 will be at 0 half the time and 255 half the time; and a value of 192 will be 0 volts one quarter of the time and 5 volts three-quarters of the time.

to:

value: the duty cycle: between 0 (always off) and 255 (always on).

Deleted lines 18-19:

The frequency of the PWM signal is approximately 490 Hz.

Restore
April 10, 2008, at 09:58 AM by David A. Mellis -
Changed lines 21-22 from:

The PWM outputs generated on pins 5 and 6 will have higher-than-expected duty cycles. This is because the internal timer used to generate the PWM signals on pins 5 and 6 is also used for the millis() and delay() functions.

to:

The PWM outputs generated on pins 5 and 6 will have higher-than-expected duty cycles. This is because of interactions with the millis() and delay() functions, which share the same internal timer used to generate those PWM outputs.

Restore
April 10, 2008, at 09:56 AM by David A. Mellis -
Changed lines 21-22 from:

The millis() and delay() functions apparently interfere with the PWM signal on pins 5 and 6 causing them to report a higher-than-expected average voltage.

to:

The PWM outputs generated on pins 5 and 6 will have higher-than-expected duty cycles. This is because the internal timer used to generate the PWM signals on pins 5 and 6 is also used for the millis() and delay() functions.

Restore
April 10, 2008, at 09:54 AM by David A. Mellis -
Added line 47:

- Explanation of PWM

Restore
February 18, 2008, at 03:51 PM by Paul Badger -
Changed line 16 from:

Note

to:

Notes and Known Issues

Added lines 21-22:

The millis() and delay() functions apparently interfere with the PWM signal on pins 5 and 6 causing them to report a higher-than-expected average voltage.

Restore
July 17, 2007, at 01:09 PM by David A. Mellis - clarifying a couple of things
Changed lines 17-18 from:

Pins taking analogWrite (9-11), unlike standard digital ones (1-8, 12, 13), do not need to be declared as INPUT nor OUTPUT

to:

You do not need to call pinMode() to set the pin as an output before calling analogWrite().

Deleted lines 20-21:

analogWrite only works on pins 9, 10, and 11; on all other pins it will write a digital value of 0 or 5 volts.

Restore
July 16, 2007, at 10:32 PM by Paul Badger -
Deleted lines 49-51:

Reference Home

Restore
July 16, 2007, at 10:31 PM by Paul Badger -
Added lines 24-26:

Sets the output to the LED proportional to the value read from the potentiometer.

Changed line 28 from:

int ledPin = 9; // LED connected to digital pin 9

to:

int ledPin = 9; // LED connected to digital pin 9

Changed lines 30-31 from:

int val = 0; // variable to store the read value

to:

int val = 0; // variable to store the read value

Changed lines 44-45 from:

Sets the output to the LED proportional to the value read from the potentiometer.

to:
Restore
June 15, 2007, at 04:45 PM by David A. Mellis - updating to reflect the fact that the atmega168 (and thus 6 pwm pins) is now standard.

Changed lines 4-5 from:

Writes an analog value (PWM wave) to a pin. On normal Arduino boards (e.g. Arduino NG), this works on pins 9, 10, or 11. On the Arduino Mini, this also works on pins 3, 5, and 6.

to:

Writes an analog value (PWM wave) to a pin. On newer Arduino boards (including the Mini and BT) with the ATmega168 chip, this function works on pins 3, 5, 6, 9, 10, and 11. Older USB and serial Arduino boards with an ATmega8 only support analogWrite() on pins 9, 10, and 11.

Restore
February 26, 2007, at 04:32 PM by David A. Mellis -
Changed lines 19-20 from:

The frequency of the PWM signal is approximately 30769 Hz

to:

The frequency of the PWM signal is approximately 490 Hz.

Restore
November 11, 2006, at 02:33 AM by David A. Mellis -
Changed lines 4-5 from:

Writes an analog value (PWM wave) to pins 9, 10, or 11. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

to:

Writes an analog value (PWM wave) to a pin. On normal Arduino boards (e.g. Arduino NG), this works on pins 9, 10, or 11. On the Arduino Mini, this also works on pins 3, 5, and 6.

Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

Restore
April 13, 2006, at 11:03 AM by Clay Shirky - Updated PWM description to include pin 11
Changed lines 4-5 from:

Writes an analog value (PWM wave) to pin 9 or 10. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

to:

Writes an analog value (PWM wave) to pins 9, 10, or 11. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

Changed lines 9-10 from:

value: the duty cycle: between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

to:

value: the duty cycle: between 0 and 255. A value of 0 generates a constant 0 volts output at the specified pin; a value of 255 generates a constant 5 volts output at the specified pin. For values in between 0 and 255, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts). For example, a value of 64 will be 0 volts three-quarters of the time, and 5 volts one quarter of the time; a value of 128 will be at 0 half the time and 255 half the time; and a value of 192 will be 0 volts one quarter of the time and 5 volts three-quarters of the time.

Changed lines 15-16 from:

Analog pins unlike digital ones, do not need to be declared as INPUT nor OUTPUT

to:

Pins taking analogWrite (9-11), unlike standard digital ones (1-8, 12, 13), do not need to be declared as INPUT nor OUTPUT

Changed lines 19-20 from:

analogWrite only works on pins 9 and 10; on all other pins it will write a digital value of 0 or 5 volts.

to:

analogWrite only works on pins 9, 10, and 11; on all other pins it will write a digital value of 0 or 5 volts.

Restore
March 31, 2006, at 03:43 AM by David A. Mellis -
Changed lines 4-5 from:

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. **analogWrite only works on pins 9 and 10**; on all other pins it will write a digital value of 0 or 5 volts.

to:

Writes an analog value (PWM wave) to pin 9 or 10. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin).

Changed lines 9-10 from:

value: the value between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

to:

value: the duty cycle: between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

Added lines 19-20:

analogWrite only works on pins 9 and 10; on all other pins it will write a digital value of 0 or 5 volts.

Restore
January 19, 2006, at 05:01 AM by 85.18.81.162 -
Added lines 17-18:

The frequency of the PWM signal is approximately 30769 Hz

Restore
January 12, 2006, at 05:39 PM by 82.186.237.10 -
Changed lines 4-5 from:

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. *analogWrite only works on pins 9 and 10*; on all other pins it will write a digital value of 0 or 5 volts.

to:

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. **analogWrite only works on pins 9 and 10**; on all other pins it will write a digital value of 0 or 5 volts.

Changed line 11 from:

This function returns

to:

Returns

Added lines 42-43:

Reference Home

Restore
January 03, 2006, at 03:36 AM by 82.186.237.10 -
Changed lines 1-10 from:

analogWrite

What it does

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds.

What parameters does it take

The pin to write to. *analogWrite only works on pins 9 and 10*; on all other pins it will write a digital value of 0 or 5 volts.

The value between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

to:

analogWrite(pin, value)

Description

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. *analogWrite only works on pins 9 and 10*; on all other pins it will write a digital value of 0 or 5 volts.

Parameters

pin: the pin to write to.

value: the value between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

Restore
December 16, 2005, at 03:14 PM by 85.18.81.162 -
Added lines 11-13:

This function returns

nothing

Restore
December 16, 2005, at 03:09 PM by 85.18.81.162 -
Added lines 1-38:

analogWrite

What it does

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds.

What parameters does it take

The pin to write to. *analogWrite only works on pins 9 and 10*; on all other pins it will write a digital value of 0 or 5 volts.

The value between 0 and 255. 0 corresponds to constant low output (no voltage); 255 is a constantly on output (5 volts). For values in-between, the pin rapidly alternates between 0 and 5 volts - the higher the value, the more often the pin is high (5 volts).

Note

Analog pins unlike digital ones, do not need to be declared as INPUT nor OUTPUT

Example

```
int ledPin = 9;   // LED connected to digital pin 9
int analogPin = 3;   // potentiometer connected to analog pin 3
int val = 0;   // variable to store the read value

void setup()
```

```
{
  pinMode(ledPin, OUTPUT);   // sets the pin as output
}

void loop()
{
  val = analogRead(analogPin);   // read the input pin
  analogWrite(ledPin, val / 4);  // analogRead values go from 0 to 1023, analogWrite values from 0 to 255
}
```

Sets the output to the LED proportional to the value read from the potentiometer.

See also

- pinMode
- digitalWrite
- analogRead

Restore

analogWrite(pin, value)

Description

Writes an analog value (PWM wave) to a pin. Can be used to light a LED at varying brightnesses or drive a motor at various speeds. After a call to **analogWrite**, the pin will generate a steady wave until the next call to **analogWrite** (or a call to **digitalRead** or **digitalWrite** on the same pin). The frequency of the PWM signal is approximately 490 Hz.

On newer Arduino boards (including the Mini and BT) with the ATmega168 chip, this function works on pins 3, 5, 6, 9, 10, and 11. Older USB and serial Arduino boards with an ATmega8 only support analogWrite() on pins 9, 10, and 11.

Parameters

pin: the pin to write to.

value: the duty cycle: between 0 (always off) and 255 (always on).

Returns

nothing

Notes and Known Issues

You do not need to call pinMode() to set the pin as an output before calling analogWrite().

The PWM outputs generated on pins 5 and 6 will have higher-than-expected duty cycles. This is because of interactions with the millis() and delay() functions, which share the same internal timer used to generate those PWM outputs.

Example

Sets the output to the LED proportional to the value read from the potentiometer.

```
int ledPin = 9;      // LED connected to digital pin 9
int analogPin = 3;   // potentiometer connected to analog pin 3
int val = 0;         // variable to store the read value

void setup()
{
  pinMode(ledPin, OUTPUT);   // sets the pin as output
}

void loop()
{
  val = analogRead(analogPin);   // read the input pin
  analogWrite(ledPin, val / 4);  // analogRead values go from 0 to 1023, analogWrite values from 0
to 255
}
```

See also

- Explanation of PWM
- pinMode
- digitalWrite

- analogRead

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.ShiftOut History

Hide minor edits - Show changes to markup

December 22, 2007, at 07:47 AM by Paul Badger -
Changed lines 59-60 from:

shiftOut(data, clock, MSBFIRST, data);

to:

shiftOut(data, clock, LSBFIRST, data);

Changed line 62 from:

shiftOut(data, clock, MSBFIRST, (data >> 8));

to:

shiftOut(data, clock, LSBFIRST, (data >> 8));

Restore
December 22, 2007, at 07:46 AM by Paul Badger -
Changed line 48 from:

// " >> " is bitshift operator - moves top 8 bit (high byte) into low byte

to:

// " >> " is bitshift operator - moves top 8 bits (high byte) into low byte

Restore
December 22, 2007, at 07:45 AM by Paul Badger -
Changed lines 27-28 from:

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so if one tries to outputing an int with shiftout requires a two-step operation:

to:

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so outputting an int with shiftout requires a two-step operation:

Restore
December 05, 2007, at 12:56 PM by Paul Badger -
Changed lines 13-16 from:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.

(Most Significant Bit First, or, Least Significant Bit First)
to:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.
(Most Significant Bit First, or, Least Significant Bit First)

Restore
December 05, 2007, at 12:56 PM by Paul Badger -
Changed lines 13-14 from:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.\\

to:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.

Restore
December 05, 2007, at 12:55 PM by Paul Badger -
Changed lines 14-15 from:
(Most Significant Bit First, or, Least Significant Bit First)
to:
(Most Significant Bit First, or, Least Significant Bit First)
Restore
December 05, 2007, at 12:55 PM by Paul Badger -
Restore
December 05, 2007, at 12:53 PM by Paul Badger -
Changed lines 14-15 from:

(Most Significant Bit First, or, Least Significant Bit First)

to:
(Most Significant Bit First, or, Least Significant Bit First)
Restore
December 05, 2007, at 12:52 PM by Paul Badger -
Changed line 13 from:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.

to:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.\\

Restore
December 05, 2007, at 12:52 PM by Paul Badger -
Changed lines 13-14 from:

bitOrder: which order to shift out the bits (either **MSBFIRST** or **LSBFIRST**).

to:

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**. (Most Significant Bit First, or, Least Significant Bit First)

Restore
December 05, 2007, at 12:50 PM by Paul Badger -
Changed lines 26-27 from:

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so if one tries to do something like this:

to:

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so if one tries to outputing an int with shiftout requires a two-step operation:

Example:

Restore
November 03, 2007, at 11:35 PM by Paul Badger -
Changed lines 4-5 from:

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to a pin, after which another pin is toggled to indicate that the bit is available.

to:

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to the dataPin, after which the clockPin is toggled to indicate that the bit is available.

Restore
July 14, 2007, at 06:10 PM by Paul Badger -
Added line 47:
Added line 55:

// shift out lowbyte

Changed lines 57-58 from:

// shift out lowbyte

to:

// shift out highbyte

Changed lines 60-62 from:

// shift out highbyte @]

to:

@]

Restore
July 14, 2007, at 06:09 PM by Paul Badger -
Changed lines 45-46 from:

shiftOut(data, clock, MSBFIRST, (data >> 8)); // >> is bitshift operator - moves highbyte into lowbyte

to:

// " >> " is bitshift operator - moves top 8 bit (high byte) into low byte shiftOut(data, clock, MSBFIRST, (data >> 8));

Restore
July 14, 2007, at 06:08 PM by Paul Badger -
Deleted line 43:

shiftOut(data, clock, MSBFIRST, (data >> 8));

Added lines 45-46:

shiftOut(data, clock, MSBFIRST, (data >> 8)); // >> is bitshift operator - moves highbyte into lowbyte // shift out lowbyte

Added lines 48-53:

// And do this for LSBFIRST serial data = 500; shiftOut(data, clock, MSBFIRST, data);

Deleted lines 54-59:

// And do this for LSBFIRST serial data = 500; shiftOut(data, clock, MSBFIRST, data); // shift out lowbyte

Restore
April 13, 2007, at 11:30 PM by Paul Badger -
Changed lines 6-7 from:

This is known as synchronous serial protocol and is a common way that microcontrollers communicate with sensors, and with other microcontrollers. The two devices always stay synchronized, and communicate at close to maximum speeds, since they both share the same clock line. Often referred to in hardware documentation as SPI.

to:

This is known as synchronous serial protocol and is a common way that microcontrollers communicate with sensors, and with other microcontrollers. The two devices always stay synchronized, and communicate at close to maximum speeds, since they both share the same clock line. Often referred to as SPI (synchronous protocol interface) in hardware documentation.

Restore
April 13, 2007, at 09:44 PM by Paul Badger -
Restore
April 13, 2007, at 09:43 PM by Paul Badger -
Changed line 25 from:

Common Errors

to:

Common Programming Errors

Restore
April 13, 2007, at 09:42 PM by Paul Badger -

Changed lines 25-27 from:

Warning

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes (16 bits), so if one tries to do something like this:

to:

Common Errors

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so if one tries to do something like this:

Restore
April 13, 2007, at 09:27 PM by Paul Badger -
Changed lines 26-27 from:

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes, so if one tries to do something like this:

to:

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes (16 bits), so if one tries to do something like this:

Restore
April 13, 2007, at 09:26 PM by Paul Badger -
Changed lines 26-27 from:

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes so if one tries to do something like this:

to:

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes, so if one tries to do something like this:

Restore
April 13, 2007, at 09:25 PM by Paul Badger -
Changed lines 4-5 from:

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to a pin, after which another pin is toggled to indicate that the bit is available.

to:

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to a pin, after which another pin is toggled to indicate that the bit is available.

This is known as synchronous serial protocol and is a common way that microcontrollers communicate with sensors, and with other microcontrollers. The two devices always stay synchronized, and communicate at close to maximum speeds, since they both share the same clock line. Often referred to in hardware documentation as SPI.

Added lines 24-57:

Warning

Note also that this function, as it is currently written, only outputs 8 bits at a time. An int holds two bytes so if one tries to do something like this:

```
int data;
int clock;
int cs;
...

digitalWrite(cs, LOW);
data = 500;
shiftOut(data, clock, MSBFIRST, data)
digitalWrite(cs, HIGH);
```

```
// this will actually only output 244 because
// 500 % 256 = 244
// since only the low 8 bits are output

// Instead do this for MSBFIRST serial
data = 500;
shiftOut(data, clock, MSBFIRST, (data >> 8));
// shift out highbyte
shiftOut(data, clock, MSBFIRST, data);
// shift out lowbyte


// And do this for LSBFIRST serial
data = 500;
shiftOut(data, clock, MSBFIRST, data);
// shift out lowbyte
shiftOut(data, clock, MSBFIRST, (data >> 8));
// shift out highbyte
```

Restore
December 02, 2006, at 09:42 AM by David A. Mellis -
Changed lines 25-26 from:

```
 [@//***************************************************************//
```

to:

[@//***//

Restore
December 02, 2006, at 09:42 AM by David A. Mellis -
Changed line 25 from:

```
 [@ //***************************************************************//
```

to:

```
 [@//***************************************************************//
```

Restore
December 02, 2006, at 09:42 AM by David A. Mellis -
Changed lines 25-27 from:

```
 [@
```

//***//

to:

```
 [@ //***************************************************************//
```

Deleted lines 40-41:
Restore
December 02, 2006, at 09:41 AM by David A. Mellis -
Added lines 23-25:

For accompanying circuit, see the tutorial on controlling a 74HC595 shift register.

Changed lines 65-66 from:

For accompanying circuit, see the tutorial on controlling a 74HC595 shift register.

to:
Restore
December 02, 2006, at 09:41 AM by David A. Mellis -
Changed lines 60-62 from:

} @]

to:

} @]

Restore
December 02, 2006, at 09:41 AM by David A. Mellis -
Added lines 18-21:

Note

The **dataPin** and **clockPin** must already be configured as outputs by a call to pinMode.

Deleted line 60:
Changed lines 63-66 from:

Note

The **dataPin** and **clockPin** must already be configured as outputs by a call to pinMode.

to:

For accompanying circuit, see the tutorial on controlling a 74HC595 shift register.

Restore
December 02, 2006, at 09:39 AM by David A. Mellis -
Changed lines 21-22 from:

// Name : shiftOutCode, Hello World // // Author : Carlyn Maw,Tom Igoe //

to:

// Name : shiftOutCode, Hello World // // Author : Carlyn Maw,Tom Igoe //

Added line 57:
Restore
December 02, 2006, at 09:38 AM by David A. Mellis -
Added lines 1-63:

shiftOut(dataPin, clockPin, bitOrder, value)

Description

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to a pin, after which another pin is toggled to indicate that the bit is available.

Parameters

dataPin: the pin on which to output each bit (*int*)

clockPin: the pin to toggle once the **dataPin** has been set to the correct value (*int*)

bitOrder: which order to shift out the bits (either **MSBFIRST** or **LSBFIRST**).

value: the data to shift out. (*byte*)

Returns

None

Example

```
//**************************************************************//
//  Name    : shiftOutCode, Hello World                                //
//  Author  : Carlyn Maw,Tom Igoe                           //
//  Date    : 25 Oct, 2006                                    //
//  Version : 1.0                                             //
//  Notes   : Code for using a 74HC595 Shift Register           //
//          : to count from 0 to 255                           //
//****************************************************************

//Pin connected to ST_CP of 74HC595
int latchPin = 8;
```

```
//Pin connected to SH_CP of 74HC595
int clockPin = 12;
////Pin connected to DS of 74HC595
int dataPin = 11;



void setup() {
  //set pins to output because they are addressed in the main loop
  pinMode(latchPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
}

void loop() {
  //count up routine
  for (int j = 0; j < 256; j++) {
    //ground latchPin and hold low for as long as you are transmitting
    digitalWrite(latchPin, LOW);
    shiftOut(dataPin, clockPin, LSBFIRST, j);
    //return the latch pin high to signal chip that it
    //no longer needs to listen for information
    digitalWrite(latchPin, HIGH);
    delay(1000);
  }
}
```

Note

The **dataPin** and **clockPin** must already be configured as outputs by a call to pinMode.

Reference Home

Restore

shiftOut(dataPin, clockPin, bitOrder, value)

Description

Shifts out a byte of data one bit at a time. Starts from either the most (i.e. the leftmost) or least (rightmost) significant bit. Each bit is written in turn to the dataPin, after which the clockPin is toggled to indicate that the bit is available.

This is known as synchronous serial protocol and is a common way that microcontrollers communicate with sensors, and with other microcontrollers. The two devices always stay synchronized, and communicate at close to maximum speeds, since they both share the same clock line. Often referred to as SPI (synchronous protocol interface) in hardware documentation.

Parameters

dataPin: the pin on which to output each bit (*int*)

clockPin: the pin to toggle once the **dataPin** has been set to the correct value (*int*)

bitOrder: which order to shift out the bits; either **MSBFIRST** or **LSBFIRST**.
(Most Significant Bit First, or, Least Significant Bit First)

value: the data to shift out. (*byte*)

Returns

None

Note

The **dataPin** and **clockPin** must already be configured as outputs by a call to pinMode.

Common Programming Errors

Note also that this function, as it is currently written, is hard-wired to output 8 bits at a time. An int holds two bytes (16 bits), so outputting an int with shiftout requires a two-step operation:

Example:

```
int data;
int clock;
int cs;
...

digitalWrite(cs, LOW);
data = 500;
shiftOut(data, clock, MSBFIRST, data)
digitalWrite(cs, HIGH);

// this will actually only output 244 because
// 500 % 256 = 244
// since only the low 8 bits are output

// Instead do this for MSBFIRST serial
data = 500;
// shift out highbyte
// " >> " is bitshift operator - moves top 8 bits (high byte) into low byte
shiftOut(data, clock, MSBFIRST, (data >> 8));
```

```
// shift out lowbyte
shiftOut(data, clock, MSBFIRST, data);



// And do this for LSBFIRST serial
data = 500;
// shift out lowbyte
shiftOut(data, clock, LSBFIRST, data);

// shift out highbyte
shiftOut(data, clock, LSBFIRST, (data >> 8));
```

Example

For accompanying circuit, see the tutorial on controlling a 74HC595 shift register.

```
//**************************************************************//
//  Name    : shiftOutCode, Hello World                         //
//  Author  : Carlyn Maw,Tom Igoe                               //
//  Date    : 25 Oct, 2006                                      //
//  Version : 1.0                                               //
//  Notes   : Code for using a 74HC595 Shift Register           //
//          : to count from 0 to 255                            //
//****************************************************************

//Pin connected to ST_CP of 74HC595
int latchPin = 8;
//Pin connected to SH_CP of 74HC595
int clockPin = 12;
////Pin connected to DS of 74HC595
int dataPin = 11;

void setup() {
  //set pins to output because they are addressed in the main loop
  pinMode(latchPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
}

void loop() {
  //count up routine
  for (int j = 0; j < 256; j++) {
    //ground latchPin and hold low for as long as you are transmitting
    digitalWrite(latchPin, LOW);
    shiftOut(dataPin, clockPin, LSBFIRST, j);
    //return the latch pin high to signal chip that it
    //no longer needs to listen for information
    digitalWrite(latchPin, HIGH);
    delay(1000);
  }
}
```

Reference Home Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.PulseIn History

Hide minor edits - Show changes to markup

March 29, 2008, at 10:09 AM by David A. Mellis -
Changed lines 2-3 from:
to:

unsigned long pulseIn(pin, value, timeout)

Changed lines 5-9 from:

Reads a pulse (either HIGH or LOW) on a pin. For example, if **value** is **HIGH**, **pulseIn()** waits for the pin to go **HIGH**, starts timing, then waits for the pin to go **LOW** and stops timing. Returns the length of the pulse in microseconds.

The timing of this function has been determined empirically and will probably show errors in longer pulses. Works on pulses from 10 microseconds to 3 minutes in length. Note that this function will not return until a pulse is detected.

to:

Reads a pulse (either HIGH or LOW) on a pin. For example, if **value** is **HIGH**, **pulseIn()** waits for the pin to go **HIGH**, starts timing, then waits for the pin to go **LOW** and stops timing. Returns the length of the pulse in microseconds. Gives up and returns 0 if no pulse starts within a specified time out.

The timing of this function has been determined empirically and will probably show errors in longer pulses. Works on pulses from 10 microseconds to 3 minutes in length.

Added lines 15-16:

timeout (optional): the number of microseconds to wait for the pulse to start; default is one second (*unsigned long*)

Changed lines 18-19 from:

the length of the pulse (in microseconds)

to:

the length of the pulse (in microseconds) or 0 if no pulse started before the timeout

Changed lines 39-41 from:

- pinMode

to:

- pinMode

Restore
September 26, 2007, at 10:10 PM by David A. Mellis - describing what the function does, not what it doesn't do.
Changed lines 6-8 from:

The timing of this function has been determined empirically and will probably show errors in longer pulses.Works on pulses from 10 microseconds to 3 minutes in length. Note that this function does not have a timeout built into it, so can appear to lock the Arduino if it misses the pulse.

to:

The timing of this function has been determined empirically and will probably show errors in longer pulses. Works on pulses from 10 microseconds to 3 minutes in length. Note that this function will not return until a pulse is detected.

Restore

April 18, 2007, at 07:20 AM by Paul Badger -
Added line 38:
Restore
April 18, 2007, at 07:20 AM by Paul Badger -
Deleted lines 37-38:

Reference Home

Restore
April 18, 2007, at 07:14 AM by Paul Badger -
Changed lines 6-8 from:

Works on pulses from 10 microseconds to 3 minutes in length.

to:

The timing of this function has been determined empirically and will probably show errors in longer pulses.Works on pulses from 10 microseconds to 3 minutes in length. Note that this function does not have a timeout built into it, so can appear to lock the Arduino if it misses the pulse.

Restore
April 18, 2007, at 07:07 AM by Paul Badger -
Added lines 6-8:

Works on pulses from 10 microseconds to 3 minutes in length.

Restore
April 14, 2006, at 07:56 AM by David A. Mellis - Documented pulseIn()
Added lines 1-36:

unsigned long pulseIn(pin, value)

Description

Reads a pulse (either HIGH or LOW) on a pin. For example, if **value** is **HIGH**, **pulseIn()** waits for the pin to go **HIGH**, starts timing, then waits for the pin to go **LOW** and stops timing. Returns the length of the pulse in microseconds.

Parameters

pin: the number of the pin on which you want to read the pulse. (*int*)

value: type type of pulse to read: either HIGH or LOW. (*int*)

Returns

the length of the pulse (in microseconds)

Example

```
int pin = 7;
unsigned long duration;

void setup()
{
  pinMode(pin, INPUT);
}

void loop()
{
  duration = pulseIn(pin, HIGH);
}
```

See also

- pinMode

unsigned long pulseIn(pin, value)

unsigned long pulseIn(pin, value, timeout)

Description

Reads a pulse (either HIGH or LOW) on a pin. For example, if **value** is **HIGH**, **pulseIn()** waits for the pin to go **HIGH**, starts timing, then waits for the pin to go **LOW** and stops timing. Returns the length of the pulse in microseconds. Gives up and returns 0 if no pulse starts within a specified time out.

The timing of this function has been determined empirically and will probably show errors in longer pulses. Works on pulses from 10 microseconds to 3 minutes in length.

Parameters

pin: the number of the pin on which you want to read the pulse. (*int*)

value: type type of pulse to read: either HIGH or LOW. (*int*)

timeout (optional): the number of microseconds to wait for the pulse to start; default is one second (*unsigned long*)

Returns

the length of the pulse (in microseconds) or 0 if no pulse started before the timeout

Example

```
int pin = 7;
unsigned long duration;

void setup()
{
  pinMode(pin, INPUT);
}

void loop()
{
  duration = pulseIn(pin, HIGH);
}
```

See also

- pinMode

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Millis History

Hide minor edits - Show changes to markup

April 22, 2008, at 11:39 PM by Paul Badger -
Changed lines 10-11 from:

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 9 hours.

to:

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 9 hours and 32 minutes.

Restore
December 05, 2007, at 12:42 PM by Paul Badger -
Changed lines 71-72 from:

[@int startTime; // should be "unsigned long startTime;

to:

[@int startTime; // should be "unsigned long startTime;"

Restore
December 05, 2007, at 12:41 PM by Paul Badger -
Changed lines 71-72 from:

int startTime; // should be "unsigned long startTime;

to:

[@int startTime; // should be "unsigned long startTime;

Changed lines 75-79 from:

startTime = millis(); // datatype not large enough to hold data, will generate errors

to:

startTime = millis(); // datatype not large enough to hold data, will generate errors@]

Restore
December 05, 2007, at 12:41 PM by Paul Badger -
Changed line 65 from:

Note:

to:

Warning:

Restore
December 05, 2007, at 12:40 PM by Paul Badger -
Changed lines 65-67 from:

Note: Note that the parameter for millis is an unsigned long, errors may be generated if a programmer, tries to do math with other datatypes such as *ints*.

to:

Note:

Note that the parameter for millis is an unsigned long, errors may be generated if a programmer, tries to do math with other datatypes such as *ints*.

Changed lines 71-72 from:

int startTime; // should be "unsigned long startTime;

to:

int startTime; // should be "unsigned long startTime;

Changed lines 75-79 from:

startTime = millis();

to:

startTime = millis(); // datatype not large enough to hold data, will generate errors

Restore
December 05, 2007, at 12:38 PM by Paul Badger -
Restore
December 05, 2007, at 12:37 PM by Paul Badger -
Added lines 64-78:

Note: Note that the parameter for millis is an unsigned long, errors may be generated if a programmer, tries to do math with other datatypes such as *ints*.

Example:

int startTime; // should be "unsigned long startTime;

// ...

startTime = millis();

Changed lines 82-83 from:
to:

- cast

Restore
May 07, 2007, at 06:57 AM by Paul Badger -
Changed line 34 from:

- depending on specific part number.

to:

- depending on specific device.

Changed line 58 from:

```
    // to determine period, then take inverse to convert to hz
```

to:

```
    // to determine period, then take inverse to convert to hertz
```

Restore
May 07, 2007, at 06:56 AM by Paul Badger -
Deleted line 68:

Reference Home

Restore
April 19, 2007, at 09:48 PM by Paul Badger -
Changed line 57 from:

```
    hz = (1 /((float)time / 100000000.0));   // divide by 100,000 cycles and 10000 milliseconds per second
```

to:

```
    hz = (1 /((float)time / 100000000.0));   // divide by 100,000 cycles and 1000 milliseconds per second
```

Deleted line 61:
Restore
April 19, 2007, at 09:47 PM by Paul Badger -
Changed lines 64-65 from:

} @]

to:

}@]

Restore
April 19, 2007, at 09:47 PM by Paul Badger -
Deleted line 28:
Deleted lines 64-65:
Deleted line 65:
Restore
April 19, 2007, at 09:46 PM by Paul Badger -
Changed lines 12-13 from:

Example

to:

Examples

Added lines 28-67:

/* Frequency Test

- Paul Badger 2007
- Program to empirically determine the time delay to generate the
- proper frequency for a an Infrared (IR) Remote Control Receiver module
- These modules typically require 36 - 52 khz communication frequency
- depending on specific part number.
- /

int tdelay; unsigned long i, hz; unsigned long time; int outPin = 11;

void setup(){

```
  pinMode(outPin, OUTPUT);
  Serial.begin(9600);
```

}

void loop() {

```
  for (tdelay = 1; tdelay < 12; tdelay++){      // scan across a range of time delays to find the right
frequency
    time = millis();                // get start time of inner loop
    for (i = 0; i < 100000; i++){  // time 100,000 cycles through the loop
      digitalWrite(outPin, HIGH);
      delayMicroseconds(tdelay);
      digitalWrite(outPin, LOW);
      delayMicroseconds(tdelay);
    }
    time = millis() - time;      // compute time through inner loop in milliseconds
    hz = (1 /((float)time / 100000000.0));   // divide by 100,000 cycles and 10000 milliseconds per second
    // to determine period, then take inverse to convert to hz
    Serial.print(tdelay, DEC);
    Serial.print("   ");
    Serial.println(hz, DEC);
```

```
  }
```

```
}
```

Restore
October 04, 2006, at 01:41 AM by David A. Mellis -
Changed lines 10-11 from:

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 50 days.

to:

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 9 hours.

Restore
March 28, 2006, at 03:17 AM by David A. Mellis - added delay(1000) and changed baud rate to 9600.
Changed line 18 from:

```
  Serial.begin(19200);
```

to:

```
  Serial.begin(9600);
```

Added lines 25-26:

```
  // wait a second so as not to send massive amounts of data
  delay(1000);
```

Restore
March 27, 2006, at 06:20 PM by Jeff Gray -
Added line 23:

```
  //prints time since program started
```

Restore
March 27, 2006, at 06:13 PM by Jeff Gray -
Added lines 12-26:

Example

```
long time;

void setup(){
  Serial.begin(19200);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  Serial.println(time);
}
```

Restore
January 12, 2006, at 05:46 PM by 82.186.237.10 -
Changed lines 14-17 from:

- delayMicroseconds

to:

- delayMicroseconds

Reference Home

Restore
December 29, 2005, at 08:05 AM by 82.186.237.10 -
Added lines 1-14:

unsigned long millis()

Description

Returns the number of milliseconds since the Arduino board began running the current program.

Parameters

None

Returns

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 50 days.

See also

- delay
- delayMicroseconds

Restore

unsigned long millis()

Description

Returns the number of milliseconds since the Arduino board began running the current program.

Parameters

None

Returns

The number of milliseconds since the current program started running, as an unsigned long. This number will overflow (go back to zero), after approximately 9 hours and 32 minutes.

Examples

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

```
/* Frequency Test
*  Paul Badger 2007
*  Program to empirically determine the time delay to generate the
*  proper frequency for a an  Infrared (IR) Remote Control Receiver module
*  These modules typically require 36 - 52 khz communication frequency
*  depending on specific device.
*/

int tdelay;
unsigned long i, hz;
unsigned long time;
int outPin = 11;

void setup(){
  pinMode(outPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  for (tdelay = 1; tdelay < 12; tdelay++){      // scan across a range of time delays to find the
right frequency
    time = millis();               // get start time of inner loop
    for (i = 0; i < 100000; i++){  // time 100,000 cycles through the loop
      digitalWrite(outPin, HIGH);
      delayMicroseconds(tdelay);
      digitalWrite(outPin, LOW);
      delayMicroseconds(tdelay);
    }
    time = millis() - time;      // compute time through inner loop in milliseconds
    hz = (1 /((float)time / 100000000.0));   // divide by 100,000 cycles and 1000 milliseconds per
second
    // to determine period, then take inverse to convert to hertz
    Serial.print(tdelay, DEC);
    Serial.print("   ");
    Serial.println(hz, DEC);
  }
}
```

Warning:

Note that the parameter for millis is an unsigned long, errors may be generated if a programmer, tries to do math with other datatypes such as *ints*.

Example:

```
int startTime;              // should be "unsigned long startTime;"

// ...

startTime = millis();     // datatype not large enough to hold data, will generate errors
```

See also

- delay
- delayMicroseconds
- cast

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.Delay History

Hide minor edits - Show changes to markup

February 17, 2008, at 11:45 PM by Paul Badger -
Changed lines 15-16 from:

e.g. **`delay(60000UL);`** Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

to:

e.g. **`delay(60000UL);`** Similarly, casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

Restore
February 17, 2008, at 11:44 PM by Paul Badger -
Changed lines 15-16 from:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

to:

e.g. **`delay(60000UL);`** Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

Restore
February 17, 2008, at 11:44 PM by Paul Badger -
Changed lines 15-16 from:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. '`delay((unsigned long)tdelay * 100UL);` '

to:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. **`delay((unsigned long)tdelay * 100UL);`**

Restore
February 17, 2008, at 11:43 PM by Paul Badger -
Changed lines 15-16 from:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. *`delay((unsigned long)tdelay * 100UL);`*

to:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. '`delay((unsigned long)tdelay * 100UL);` '

Restore
February 17, 2008, at 11:43 PM by Paul Badger -
Changed lines 15-16 from:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. `delay((unsigned long)tdelay * 100UL);`

to:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. *`delay((unsigned long)tdelay * 100UL);`*

Restore
February 17, 2008, at 11:42 PM by Paul Badger -
Changed line 14 from:

When using a number larger than about 32767 as a parameter for delay, append an "UL" suffix to the end.

to:

When using an integer constant larger than about 32767 as a parameter for delay, append an "UL" suffix to the end.

Restore
February 17, 2008, at 11:42 PM by Paul Badger -
Changed lines 14-16 from:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. `delay((unsigned long)tdelay);`

to:

When using a number larger than about 32767 as a parameter for delay, append an "UL" suffix to the end. e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. `delay((unsigned long)tdelay * 100UL);`

Restore
February 17, 2008, at 11:41 PM by Paul Badger -
Changed lines 15-16 from:

e.g. `delay(60000UL);`. Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. delay((unsigned long)tdelay).

to:

e.g. `delay(60000UL);` Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. `delay((unsigned long)tdelay);`

Restore
February 17, 2008, at 11:40 PM by Paul Badger -
Changed lines 14-15 from:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. delay(60000UL). Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. delay((unsigned long)tdelay).

to:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. `delay(60000UL);`. Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. delay((unsigned long)tdelay).

Restore
February 17, 2008, at 11:39 PM by Paul Badger -
Changed line 38 from:

- integer constants?

to:
Changed line 41 from:
to:

- integer constants

Restore
February 17, 2008, at 11:38 PM by Paul Badger -
Changed lines 14-15 from:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. delay(60000UL). Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g.

delay((unsigned long)tdelay)

to:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. delay(60000UL). Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. delay((unsigned long)tdelay).

Added line 38:

- integer constants?

Restore
February 17, 2008, at 11:36 PM by Paul Badger -
Changed lines 14-15 from:

When using a number larger than about 32000 as a parameter for delay, append an UL suffix to the end. e.g. delay(60000UL)

to:

When using a number larger than about 32000 as a parameter for delay, append an "UL" suffix to the end. e.g. delay(60000UL). Similarly casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g. delay((unsigned long)tdelay)

Restore
February 17, 2008, at 11:34 PM by Paul Badger -
Changed lines 13-14 from:

When using numbers larger than about 32000 as parameters, append an UL suffix to the end. e.g. delay(60000UL)

to:

The parameter for delay is an unsigned long. When using a number larger than about 32000 as a parameter for delay, append an UL suffix to the end. e.g. delay(60000UL)

Restore
February 17, 2008, at 11:33 PM by Paul Badger -
Changed lines 12-13 from:

Warning: When using numbers larger than about 32000 as parameters, append an UL suffix to the end. e.g. delay(60000UL)

to:

Warning:

When using numbers larger than about 32000 as parameters, append an UL suffix to the end. e.g. delay(60000UL)

Restore
February 17, 2008, at 11:33 PM by Paul Badger -
Changed lines 7-8 from:

ms: the number of milliseconds to pause (there are 1000 milliseconds in a second)

to:

unsigned long ms - the number of milliseconds to pause (there are 1000 milliseconds in a second)

Added lines 12-13:

Warning: When using numbers larger than about 32000 as parameters, append an UL suffix to the end. e.g. delay(60000UL)

Restore
January 21, 2008, at 10:54 AM by David A. Mellis -
Deleted lines 36-38:

Reference Home

Restore
January 12, 2006, at 05:47 PM by 82.186.237.10 -

Changed line 9 from:

This function returns

to:

Returns

Added lines 36-39:

Reference Home

Restore
December 29, 2005, at 08:00 AM by 82.186.237.10 -
Changed lines 1-9 from:

delay

What it does

It pauses your program for the amount of time (in miliseconds) specified as parameter.

What parametres does it take

It takes one integer value as parameter. This value represents miliseconds (there are 1000 milliseconds in a second).

to:

delay(ms)

Description

Pauses your program for the amount of time (in miliseconds) specified as parameter.

Parameters

ms: the number of milliseconds to pause (there are 1000 milliseconds in a second)

Changed lines 34-35 from:

- digitalWrite
- pinMode

to:

- millis

Restore
December 16, 2005, at 03:16 PM by 85.18.81.162 -
Changed lines 8-9 from:

It takes one integer value as parameter. This value represents miliseconds.

to:

It takes one integer value as parameter. This value represents miliseconds (there are 1000 milliseconds in a second).

Restore
December 03, 2005, at 01:30 PM by 213.140.6.103 -
Added line 37:

- delayMicroseconds

Restore
December 03, 2005, at 01:28 PM by 213.140.6.103 -
Added lines 1-36:

delay

What it does

It pauses your program for the amount of time (in miliseconds) specified as parameter.

What parametres does it take

It takes one integer value as parameter. This value represents miliseconds.

This function returns

nothing

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

configures pin number 13 to work as an output pin. It sets the pin to HIGH, waits for 1000 miliseconds (1 second), sets it back to LOW and waits for 1000 miliseconds.

See also

- digitalWrite
- pinMode

Restore

delay(ms)

Description

Pauses your program for the amount of time (in miliseconds) specified as parameter.

Parameters

unsigned long ms - the number of milliseconds to pause (there are 1000 milliseconds in a second)

Returns

nothing

Warning:

The parameter for delay is an unsigned long. When using an integer constant larger than about 32767 as a parameter for delay, append an "UL" suffix to the end. e.g. **`delay(60000UL);`** Similarly, casting variables to unsigned longs will insure that they are handled correctly by the compiler. e.g.
`delay((unsigned long)tdelay * 100UL);`

Example

```
int ledPin = 13;                 // LED connected to digital pin 13

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(1000);                  // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(1000);                  // waits for a second
}
```

configures pin number 13 to work as an output pin. It sets the pin to HIGH, waits for 1000 miliseconds (1 second), sets it back to LOW and waits for 1000 miliseconds.

See also

- millis
- delayMicroseconds
- integer constants

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.DelayMicroseconds History

Hide minor edits - Show changes to markup

January 17, 2008, at 11:30 PM by Paul Badger -
Changed lines 4-5 from:

Pauses your program for the amount of time (in microseconds) specified as parameter. For delays longer than a few thousand microseconds, you should use delay() instead.

to:

Pauses the program for the amount of time (in microseconds) specified as parameter. For delays longer than a few thousand microseconds, you should use delay() instead.

Restore
October 16, 2007, at 10:00 AM by David A. Mellis - the reference is not a place for coordinating development
Changed lines 40-43 from:

Users should use care when using a variable as the parameter for delayMicroseconds. delayMicroseconds(0) will generate a much longer delay than expected (~1020 us) as will negative numbers, if passed as a parameters to delayMicroseconds.

Users desiring to patch delayMicroseconds(0) to work correctly (return immediately) should see this forum thread.

to:

delayMicroseconds(0) will generate a much longer delay than expected (~1020 us) as will negative numbers.

Restore
October 12, 2007, at 11:04 PM by Paul Badger -
Changed lines 40-41 from:

Users should use care when using a variable as the parameter of delayMicroseconds. delayMicroseconds(0) will generate a much longer delay than expected ~1020 us as will negative numbers, if passed as a parameters to delayMicroseconds.

to:

Users should use care when using a variable as the parameter for delayMicroseconds. delayMicroseconds(0) will generate a much longer delay than expected (~1020 us) as will negative numbers, if passed as a parameters to delayMicroseconds.

Restore
October 12, 2007, at 11:02 PM by Paul Badger -
Changed lines 42-43 from:

Users desiring to patch delayMicroseconds(0) to work correctly (return immediately) should see this forum thread.

to:

Users desiring to patch delayMicroseconds(0) to work correctly (return immediately) should see this forum thread.

Restore
October 12, 2007, at 11:00 PM by Paul Badger -
Changed line 35 from:

Warning

to:

Caveats and Known Issues

Added lines 40-43:

Users should use care when using a variable as the parameter of delayMicroseconds. delayMicroseconds(0) will generate a much longer delay than expected ~1020 us as will negative numbers, if passed as a parameters to delayMicroseconds.

Users desiring to patch delayMicroseconds(0) to work correctly (return immediately) should see this forum thread.

Restore
August 29, 2007, at 09:50 PM by Paul Badger -
Restore
August 29, 2007, at 09:36 PM by Paul Badger -
Changed lines 6-7 from:
to:

Currently, the largest value that will produce an accurate delay is 16383. This could change in future Arduino releases.

Restore
August 27, 2007, at 11:12 AM by David A. Mellis - don't document exact maximum as it may change, instead recommend delay() for longer delays.
Changed lines 4-6 from:

Pauses your program for the amount of time (in microseconds) specified as parameter.

to:

Pauses your program for the amount of time (in microseconds) specified as parameter. For delays longer than a few thousand microseconds, you should use delay() instead.

Changed lines 8-10 from:

us: the number of microseconds to pause. (There are a thousand microseconds in a millisecond, and a million microseconds in a second.) The largest value that will result in an accurate delay is 16383.

to:

us: the number of microseconds to pause. (There are a thousand microseconds in a millisecond, and a million microseconds in a second.)

Restore
August 27, 2007, at 08:30 AM by Paul Badger -
Changed lines 8-9 from:

us: the number of microseconds to pause. (there are a thousand microseconds in a millisecond, and a million microseconds in a second)

to:

us: the number of microseconds to pause. (There are a thousand microseconds in a millisecond, and a million microseconds in a second.) The largest value that will result in an accurate delay is 16383.

Restore
May 07, 2007, at 06:44 AM by Paul Badger -
Deleted lines 40-42:

Reference Home

Restore
September 17, 2006, at 05:08 AM by David A. Mellis -
Changed lines 34-35 from:

This function works very accurately in the range 10 microseconds and up. We cannot assure that delayMicroseconds will perform precisely for smaller delay-times.

to:

This function works very accurately in the range 3 microseconds and up. We cannot assure that delayMicroseconds will perform precisely for smaller delay-times.

To ensure more accurate delays, this functions disables interrupts during its operation, meaning that some things (like receiving serial data, or incrementing the value returned by millis()) will not happen during the delay. Thus, you should only use this function for short delays, and use delay() for longer ones.

Restore

January 12, 2006, at 05:47 PM by 82.186.237.10 -
Added lines 39-41:

Reference Home

Restore
December 29, 2005, at 08:02 AM by 82.186.237.10 -
Changed lines 1-12 from:

delayMicroseconds

What it does

It pauses your program for the amount of time (in microseconds) specified as parameter.

What parametres does it take

It takes one integer value as parameter. This value represents microseconds.

This function returns

nothing

to:

delayMicroseconds(us)

Description

Pauses your program for the amount of time (in microseconds) specified as parameter.

Parameters

us: the number of microseconds to pause. (there are a thousand microseconds in a millisecond, and a million microseconds in a second)

Returns

None

Changed line 33 from:

Note: Disclaimer

to:

Warning

Deleted line 35:
Changed lines 37-38 from:

- digitalWrite
- pinMode

to:

- millis

Restore
December 03, 2005, at 01:38 PM by 213.140.6.103 -
Added lines 1-40:

delayMicroseconds

What it does

It pauses your program for the amount of time (in microseconds) specified as parameter.

What parametres does it take

It takes one integer value as parameter. This value represents microseconds.

This function returns

nothing

Example

```
int outPin = 8;                 // digital pin 8

void setup()
{
  pinMode(outPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(outPin, HIGH);   // sets the pin on
  delayMicroseconds(50);        // pauses for 50 microseconds
  digitalWrite(outPin, LOW);    // sets the pin off
  delayMicroseconds(50);        // pauses for 50 microseconds
}
```

configures pin number 8 to work as an output pin. It sends a train of pulses with 100 microseconds period.

Note: Disclaimer

This function works very accurately in the range 10 microseconds and up. We cannot assure that delayMicroseconds will perform precisely for smaller delay-times.

See also

- digitalWrite
- pinMode
- delay

Restore

delayMicroseconds(us)

Description

Pauses the program for the amount of time (in microseconds) specified as parameter. For delays longer than a few thousand microseconds, you should use delay() instead.

Currently, the largest value that will produce an accurate delay is 16383. This could change in future Arduino releases.

Parameters

us: the number of microseconds to pause. (There are a thousand microseconds in a millisecond, and a million microseconds in a second.)

Returns

None

Example

```
int outPin = 8;                 // digital pin 8

void setup()
{
  pinMode(outPin, OUTPUT);      // sets the digital pin as output
}

void loop()
{
  digitalWrite(outPin, HIGH);   // sets the pin on
  delayMicroseconds(50);        // pauses for 50 microseconds
  digitalWrite(outPin, LOW);    // sets the pin off
  delayMicroseconds(50);        // pauses for 50 microseconds
}
```

configures pin number 8 to work as an output pin. It sends a train of pulses with 100 microseconds period.

Caveats and Known Issues

This function works very accurately in the range 3 microseconds and up. We cannot assure that delayMicroseconds will perform precisely for smaller delay-times.

To ensure more accurate delays, this functions disables interrupts during its operation, meaning that some things (like receiving serial data, or incrementing the value returned by millis()) will not happen during the delay. Thus, you should only use this function for short delays, and use delay() for longer ones.

delayMicroseconds(0) will generate a much longer delay than expected (~1020 us) as will negative numbers.

See also

- millis
- delay

Reference Home

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Reference.Min History

Hide minor edits - Show changes to markup

November 03, 2007, at 11:32 PM by Paul Badger -
Changed lines 19-20 from:

```
                              // ensuring that it never gets above 100.
```

@]

to:

```
                              // ensuring that it never gets above 100.@]
```

Restore
November 03, 2007, at 11:32 PM by Paul Badger -
Deleted line 20:
Restore
November 03, 2007, at 11:32 PM by Paul Badger -
Changed lines 18-19 from:

[@sensVal = min(sensVal, 100); // assigns sensVal to the smaller of sensVal or 100, ensuring that it never gets above 100.

to:

[@sensVal = min(sensVal, 100); // assigns sensVal to the smaller of sensVal or 100

```
                              // ensuring that it never gets above 100.
```

Added lines 22-24:

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

Restore
April 16, 2007, at 11:06 AM by Paul Badger -
Changed line 26 from:

Reference Home

to:
Restore
April 16, 2007, at 02:13 AM by David A. Mellis -
Changed line 18 from:

[@sensVal = min(senVal, 100); // limits sensor's top reading to 100 maximum

to:

[@sensVal = min(sensVal, 100); // assigns sensVal to the smaller of sensVal or 100, ensuring that it never gets above 100.

Deleted lines 20-24:

Tip

min is useful for limiting the range a variable (say reading a sensor) can move. Even though the name min would seem to suggest it should be used to limit the sensor's minimum value, its real effect is to limit the variable's highest value. This can be slightly counterintuitive.

Programmers coming to C from the BASIC language may alsoexpect min to affect a variable without assigning the returned result to anything.

Restore
April 14, 2007, at 08:43 PM by Paul Badger -
Changed line 18 from:

[@sensVal = min(senVal, 100); // limits sensor to 100 MAXIMUM

to:

[@sensVal = min(senVal, 100); // limits sensor's top reading to 100 maximum

Changed lines 21-25 from:

Common Programming Errors

Paradoxically, even though min would seem to limit the desired variable to a minimum value, it is really used to set the maximum value a variable can hold.

Programmers coming to C from the BASIC language may expect min to affect a variable without assigning the returned result to anything

to:

Tip

min is useful for limiting the range a variable (say reading a sensor) can move. Even though the name min would seem to suggest it should be used to limit the sensor's minimum value, its real effect is to limit the variable's highest value. This can be slightly counterintuitive.

Programmers coming to C from the BASIC language may alsoexpect min to affect a variable without assigning the returned result to anything.

Restore
April 14, 2007, at 12:55 AM by Paul Badger -
Changed lines 22-23 from:

Paradoxically, even though min would seem to limit the desired variable to a minimum value, it is really used to set the maximum value a variable can achieve.

to:

Paradoxically, even though min would seem to limit the desired variable to a minimum value, it is really used to set the maximum value a variable can hold.

Restore
April 14, 2007, at 12:54 AM by Paul Badger -
Changed line 18 from:

[@sensVal = min(senVal, 100); // limits sensor to 100 MAX

to:

[@sensVal = min(senVal, 100); // limits sensor to 100 MAXIMUM

Restore
April 13, 2007, at 11:13 PM by Paul Badger -
Restore
April 13, 2007, at 11:06 PM by Paul Badger -
Restore
April 13, 2007, at 11:05 PM by Paul Badger -
Changed line 18 from:

[@sensVal = min(senVal, 100); // limits sensor to 100 max

to:

[@sensVal = min(senVal, 100); // limits sensor to 100 MAX

Restore

April 13, 2007, at 11:04 PM by Paul Badger -
Changed lines 9-12 from:

x: the first number

y: the second number

to:

x: the first number, any data type

y: the second number, any data type

Added lines 17-25:

Examples

```
sensVal = min(senVal, 100); // limits sensor to 100 max
```

Common Programming Errors

Paradoxically, even though min would seem to limit the desired variable to a minimum value, it is really used to set the maximum value a variable can achieve.

Programmers coming to C from the BASIC language may expect min to affect a variable without assigning the returned result to anything

Restore
December 02, 2006, at 11:59 AM by David A. Mellis -
Changed lines 20-22 from:

- constrain()

to:

- constrain()

Reference Home

Restore
December 02, 2006, at 11:10 AM by David A. Mellis -
Added lines 1-20:

min(x, y)

Description

Calculates the minimum of two numbers.

Parameters

x: the first number

y: the second number

Returns

The smaller of the two numbers.

See also

- max()
- constrain()

Restore

min(x, y)

Description

Calculates the minimum of two numbers.

Parameters

x: the first number, any data type

y: the second number, any data type

Returns

The smaller of the two numbers.

Examples

```
sensVal = min(sensVal, 100); // assigns sensVal to the smaller of sensVal or 100
                              // ensuring that it never gets above 100.
```

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

See also

- max()
- constrain()

Reference Home

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Reference.Max History

Hide minor edits - Show changes to markup

November 03, 2007, at 11:30 PM by Paul Badger -
Changed lines 19-21 from:

```
                              // (effectively ensuring that it is at least 20)
```

@]

to:

```
                              // (effectively ensuring that it is at least 20)@]
```

Restore
November 03, 2007, at 11:30 PM by Paul Badger -
Added lines 22-25:

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

Restore
November 03, 2007, at 11:24 PM by Paul Badger -
Changed lines 15-16 from:

The larger of the two numbers.

to:

The larger of the two parameter values.

Restore
November 03, 2007, at 11:24 PM by Paul Badger -
Changed line 18 from:

[@sensVal = max(senVal, 20); // assigns sensVal to the bigger of sensVal or 20

to:

[@sensVal = max(senVal, 20); // assigns sensVal to the larger of sensVal or 20

Restore
November 03, 2007, at 11:23 PM by Paul Badger -
Changed line 19 from:

```
                                // (effectively ensuring that it is at least 20)
```

to:

```
                              // (effectively ensuring that it is at least 20)
```

Restore
November 03, 2007, at 11:23 PM by Paul Badger -
Changed lines 18-19 from:

[@sensVal = max(senVal, 20); // assigns sensVal to the bigger of sensVal or 20 (effectively ensuring that it is at least 20)

to:

[@sensVal = max(senVal, 20); // assigns sensVal to the bigger of sensVal or 20

```
                              // (effectively ensuring that it is at least 20)
```

Restore
April 16, 2007, at 11:05 AM by Paul Badger -
Changed line 26 from:

Reference Home

to:
Restore
April 16, 2007, at 02:12 AM by David A. Mellis -
Changed line 18 from:

[@sensVal = max(senVal, 20); // limits sensor value to at least 20

to:

[@sensVal = max(senVal, 20); // assigns sensVal to the bigger of sensVal or 20 (effectively ensuring that it is at least 20)

Deleted lines 20-24:

Tips

max is useful for limiting the range a variable (say reading a sensor) can move. Even though the name max would seem to suggest it should be used to limit the sensor's maximum value, its real effect is to limit the variable's lowest value. This can be slightly counterintuitive.

Programmers coming to C from the BASIC language may also expect max to affect a variable without assigning the returned result to anything.

Restore
April 14, 2007, at 08:49 PM by Paul Badger -
Changed lines 17-18 from:

Examples

[@sensVal = max(senVal, 20); // limits sensor value to 20 MINIMUM

to:

Example

[@sensVal = max(senVal, 20); // limits sensor value to at least 20

Changed lines 21-26 from:

Common Programming Errors

Paradoxically, even though max would seem to limit the desired variable to a maximum value, it is really used to set the minimum value to which a variable can descend.

Programmers coming to C from the BASIC language may expect max to affect a variable without assigning the returned result to anything

to:

Tips

max is useful for limiting the range a variable (say reading a sensor) can move. Even though the name max would seem to suggest it should be used to limit the sensor's maximum value, its real effect is to limit the variable's lowest value. This can be slightly counterintuitive.

Programmers coming to C from the BASIC language may also expect max to affect a variable without assigning the returned result to anything.

Restore
April 13, 2007, at 11:11 PM by Paul Badger -
Changed lines 9-12 from:

x: the first number

y: the second number

to:

x: the first number, any data type

y: the second number, any data type

Changed lines 15-16 from:

The bigger of the two numbers.

to:

The larger of the two numbers.

Examples

```
sensVal = max(senVal, 20); // limits sensor value to 20 MINIMUM
```

Common Programming Errors

Paradoxically, even though max would seem to limit the desired variable to a maximum value, it is really used to set the minimum value to which a variable can descend.

Programmers coming to C from the BASIC language may expect max to affect a variable without assigning the returned result to anything

Restore
December 02, 2006, at 12:00 PM by David A. Mellis -
Changed lines 20-22 from:

- constrain()

to:

- constrain()

Reference Home

Restore
December 02, 2006, at 11:10 AM by David A. Mellis -
Added lines 1-20:

max(x, y)

Description

Calculates the maximum of two numbers.

Parameters

x: the first number

y: the second number

Returns

The bigger of the two numbers.

See also

- min()
- constrain()

Restore

max(x, y)

Description

Calculates the maximum of two numbers.

Parameters

x: the first number, any data type

y: the second number, any data type

Returns

The larger of the two parameter values.

Example

```
sensVal = max(senVal, 20); // assigns sensVal to the larger of sensVal or 20
                           // (effectively ensuring that it is at least 20)
```

Note

Perhaps counter-intuitively, max() is often used to constrain the lower end of a variable's range, while min() is used to constrain the upper end of the range.

See also

- min()
- constrain()

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Reference.Abs History

Hide minor edits - Show changes to markup

April 16, 2007, at 11:07 AM by Paul Badger -
Deleted line 16:

Reference Home

Restore
December 02, 2006, at 11:59 AM by David A. Mellis -
Added lines 1-17:

abs(x)

Description

Computes the absolute value of a number.

Parameters

x: the number

Returns

x: if **x** is greater than or equal to 0.

-x: if **x** is less than 0.

Reference Home

Restore

abs(x)

Description

Computes the absolute value of a number.

Parameters

x: the number

Returns

x: if **x** is greater than or equal to 0.

-x: if **x** is less than 0.

Reference Home

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Reference.Constrain History

Hide minor edits - Show changes to markup

April 16, 2007, at 09:37 AM by Paul Badger -
Changed line 32 from:

Reference Home

to:
Restore
April 16, 2007, at 09:36 AM by Paul Badger -
Restore
April 15, 2007, at 10:15 PM by Paul Badger -
Changed lines 1-2 from:

constrain(x, a, b)

to:

constrain(x, a, b)

Restore
April 15, 2007, at 10:15 PM by Paul Badger -
Changed lines 1-2 from:

constrain(x, a, b)

to:

constrain(x, a, b)

Restore
April 15, 2007, at 10:14 PM by Paul Badger -
Changed lines 1-2 from:

constain(x, a, b)

to:

constrain(x, a, b)

Restore
April 14, 2007, at 08:54 PM by Paul Badger -
Changed lines 25-26 from:

// limits range of sensor from 10 to 150 @]

to:

// limits range of sensor values to between 10 and 150 @]

Restore
April 14, 2007, at 08:52 PM by Paul Badger -
Changed lines 9-14 from:

x: the number to constrain

a: the lower end of the range

b: the upper end of the range

to:

x: the number to constrain, all data types

a: the lower end of the range, all data types

b: the upper end of the range, all data types

Added lines 23-26:

Example

```
sensVal = constrain(sensVal, 10, 150);
// limits range of sensor from 10 to 150
```

Restore
December 02, 2006, at 12:00 PM by David A. Mellis -
Changed lines 26-28 from:

- max()

to:

- max()

Reference Home

Restore
December 02, 2006, at 11:14 AM by David A. Mellis -
Changed lines 11-14 from:

a: the minimum value

b: the maximum value

to:

a: the lower end of the range

b: the upper end of the range

Restore
December 02, 2006, at 11:13 AM by David A. Mellis -
Added lines 1-26:

constain(x, a, b)

Description

Constrains a number to be within a range.

Parameters

x: the number to constrain

a: the minimum value

b: the maximum value

Returns

x: if **x** is between **a** and **b**

a: if **x** is less than **a**

b: if **x** is greater than **b**

See also

- min()
- max()

constrain(x, a, b)

Description

Constrains a number to be within a range.

Parameters

x: the number to constrain, all data types

a: the lower end of the range, all data types

b: the upper end of the range, all data types

Returns

x: if **x** is between **a** and **b**

a: if **x** is less than **a**

b: if **x** is greater than **b**

Example

```
sensVal = constrain(sensVal, 10, 150);
// limits range of sensor values to between 10 and 150
```

See also

- min()
- max()

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Reference.Map History

Hide minor edits - Show changes to markup

April 22, 2008, at 11:44 PM by Paul Badger -
Changed lines 7-8 from:

Does not constrain values to within the range, because out-of-range values are something intended and useful.

to:

Does not constrain values to within the range, because out-of-range values are sometimes intended and useful.

Restore
March 29, 2008, at 09:31 AM by David A. Mellis -
Added lines 25-37:

Example

```
void setup() {}

void loop()
{
  int val = analogRead(0);
  val = map(val, 0, 1023, 0, 255);
  analogWrite(9, val);
}
```

Restore
March 29, 2008, at 09:15 AM by David A. Mellis -
Added lines 1-27:

map(value, fromLow, fromHigh, toLow, toHigh)

Description

Re-maps a number from one range to another. That is, a **value** of **fromLow** would get mapped to **toLow**, a value of **fromHigh** to **toHigh**, values in-between to values in-between, etc.

Does not constrain values to within the range, because out-of-range values are something intended and useful.

Parameters

value: the number to map

fromLow: the lower bound of the value's current range

fromHigh: the upper bound of the value's current range

toLow: the lower bound of the value's target range

toHigh: the upper bound of the value's target range

Returns

The mapped value.

See Also

- constrain()

Restore

map(value, fromLow, fromHigh, toLow, toHigh)

Description

Re-maps a number from one range to another. That is, a **value** of **fromLow** would get mapped to **toLow**, a value of **fromHigh** to **toHigh**, values in-between to values in-between, etc.

Does not constrain values to within the range, because out-of-range values are sometimes intended and useful.

Parameters

value: the number to map

fromLow: the lower bound of the value's current range

fromHigh: the upper bound of the value's current range

toLow: the lower bound of the value's target range

toHigh: the upper bound of the value's target range

Returns

The mapped value.

Example

```
void setup() {}

void loop()
{
  int val = analogRead(0);
  val = map(val, 0, 1023, 0, 255);
  analogWrite(9, val);
}
```

See Also

- constrain()

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Reference.Pow History

Hide minor edits - Show changes to markup

December 22, 2007, at 09:41 AM by David A. Mellis -
Changed lines 24-27 from:

- float()
- double()

to:

- float
- double

Restore
December 22, 2007, at 09:32 AM by David A. Mellis -
Changed lines 5-7 from:

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values or curves.
Pow() makes use of the avr-libc library.

to:

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values or curves.

Restore
December 22, 2007, at 08:43 AM by Paul Badger -
Changed lines 25-26 from:
to:

- float()
- double()

Restore
December 22, 2007, at 08:41 AM by Paul Badger -
Changed lines 20-21 from:

See the fscale? function in the code library.

to:

See the fscale function in the code library.

Restore
December 22, 2007, at 08:41 AM by Paul Badger -
Changed lines 20-21 from:

See the fscale? function in the code library.

to:

See the fscale? function in the code library.

Restore
December 22, 2007, at 08:40 AM by Paul Badger -
Changed lines 20-21 from:

See the fscale function in the code library.

to:

See the fscale? function in the code library.

Restore
December 22, 2007, at 08:38 AM by Paul Badger -
Added lines 18-21:

Example

See the fscale function in the code library.

Restore
December 22, 2007, at 08:37 AM by Paul Badger -
Changed line 5 from:

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values / curves.

to:

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values or curves.\\

Restore
December 22, 2007, at 08:36 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the value of a number raised to a power.

to:

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values / curves. Pow() makes use of the avr-libc library.

Changed lines 10-13 from:

base: the number

exponent: the power to raise it to

to:

base: the number (*float*)

exponent: the power to which the base is raised (*float*)

Changed lines 16-17 from:

The result of the exponentiation.

to:

The result of the exponentiation (*double*)

Restore
November 21, 2007, at 09:26 AM by David A. Mellis -
Added lines 1-21:

pow(base, exponent)

Description

Calculates the value of a number raised to a power.

Parameters

base: the number

exponent: the power to raise it to

Returns

The result of the exponentiation.

See also

- sqrt()

Restore

pow(base, exponent)

Description

Calculates the value of a number raised to a power. Pow() can be used to raise a number to a fractional power. This is useful for generating exponential mapping of values or curves.

Parameters

base: the number (*float*)

exponent: the power to which the base is raised (*float*)

Returns

The result of the exponentiation (*double*)

Example

See the fscale function in the code library.

See also

- sqrt()
- float
- double

Reference Home

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Reference.Sqrt History

Hide minor edits - Show changes to markup

December 22, 2007, at 09:32 AM by David A. Mellis -
Changed lines 5-7 from:

Calculates the square root of a number.
Sqrt() makes use of the avr-libc library.

to:

Calculates the square root of a number.

Restore
December 22, 2007, at 08:47 AM by Paul Badger -
Restore
December 22, 2007, at 08:45 AM by Paul Badger -
Changed lines 6-7 from:

Sqrt() is part of the avr-libc library.

to:

Sqrt() makes use of the avr-libc library.

Changed lines 19-20 from:
to:

- float
- double

Restore
December 22, 2007, at 08:44 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the square root of a number. sqrt() is part of the avr-libc library.

to:

Calculates the square root of a number.
Sqrt() is part of the avr-libc library.

Restore
December 22, 2007, at 08:13 AM by Paul Badger -
Restore
December 22, 2007, at 08:13 AM by Paul Badger -
Changed lines 9-10 from:

x: the number

to:

x: the number, any data type

Changed lines 13-14 from:

The number's square root.

to:

double, the number's square root.

Restore
December 22, 2007, at 07:58 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the square root of a number.

to:

Calculates the square root of a number. sqrt() is part of the avr-libc library.

Restore
November 21, 2007, at 09:33 AM by David A. Mellis -
Added lines 1-19:

sqrt(x)

Description

Calculates the square root of a number.

Parameters

x: the number

Returns

The number's square root.

See also

- pow()

Restore

sqrt(x)

Description

Calculates the square root of a number.

Parameters

x: the number, any data type

Returns

double, the number's square root.

See also

- pow()
- float
- double

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Reference.Sin History

Hide minor edits - Show changes to markup

December 22, 2007, at 09:32 AM by David A. Mellis -
Changed lines 5-7 from:

Calculates the sine of an angle (in radians). The result will be between -1 and 1.
Sin() makes use of the avr-libc library.

to:

Calculates the sine of an angle (in radians). The result will be between -1 and 1.

Restore
December 22, 2007, at 08:33 AM by Paul Badger -
Restore
December 22, 2007, at 08:32 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the sine of an angle (in radians). The result will be between -1 and 1. Sin() makes use of the avr-libc library.

to:

Calculates the sine of an angle (in radians). The result will be between -1 and 1.
Sin() makes use of the avr-libc library.

Restore
December 22, 2007, at 08:32 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the sine of an angle (in radians). The result will be between -1 and 1. sin() is part of the avr-libc library.

to:

Calculates the sine of an angle (in radians). The result will be between -1 and 1. Sin() makes use of the avr-libc library.

Restore
December 22, 2007, at 08:22 AM by Paul Badger -
Restore
December 22, 2007, at 08:21 AM by Paul Badger -
Changed lines 13-14 from:

double, the sine of the angle.

to:

the sine of the angle (*double*)

Restore
December 22, 2007, at 08:21 AM by Paul Badger -
Changed lines 13-14 from:

The sine of the angle as a double.

to:

double, the sine of the angle.

Restore
December 22, 2007, at 08:18 AM by Paul Badger -

Changed lines 13-14 from:

double, The sine of the angle in radians.

to:

The sine of the angle as a double.

Restore
December 22, 2007, at 08:16 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the sin of an angle (in radians). The result will be between -1 and 1.

to:

Calculates the sine of an angle (in radians). The result will be between -1 and 1. sin() is part of the avr-libc library.

Changed lines 13-14 from:

The sin of the angle.

to:

double, The sine of the angle in radians.

Changed lines 22-23 from:
to:

- float
- double

Restore
November 21, 2007, at 09:20 AM by David A. Mellis -
Added lines 1-23:

sin(rad)

Description

Calculates the sin of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

The sin of the angle.

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- cos()
- tan()

Restore

sin(rad)

Description

Calculates the sine of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

the sine of the angle (*double*)

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- cos()
- tan()
- float
- double

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Reference.Cos History

Hide minor edits - Show changes to markup

December 22, 2007, at 09:41 AM by David A. Mellis -
Changed lines 22-24 from:

- float()
- double()

to:

- float
- double

Restore
December 22, 2007, at 09:31 AM by David A. Mellis - people shouldn't need to know where a function is defined.
Changed lines 6-8 from:

Cos() is part of the avr-libc library.

to:
Restore
December 22, 2007, at 08:28 AM by Paul Badger -
Restore
December 22, 2007, at 08:25 AM by Paul Badger -
Changed lines 5-7 from:

Calculates the cos of an angle (in radians). The result will be between -1 and 1.\\ Cos() is part of the avr-libc library.

to:

Calculates the cos of an angle (in radians). The result will be between -1 and 1.
Cos() is part of the avr-libc library.

Restore
December 22, 2007, at 08:24 AM by Paul Badger -
Changed lines 5-7 from:

Calculates the cos of an angle (in radians). The result will be between -1 and 1. cos() is part of the avr-libc library.

to:

Calculates the cos of an angle (in radians). The result will be between -1 and 1.\\ Cos() is part of the avr-libc library.

Restore
December 22, 2007, at 08:24 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the cos of an angle (in radians). The result will be between -1 and 1.

to:

Calculates the cos of an angle (in radians). The result will be between -1 and 1. cos() is part of the avr-libc library.

Changed lines 14-15 from:

The cos of the angle.

to:

The cos of the angle ("double")

Changed lines 23-24 from:
to:

- float()
- double()

Restore
November 21, 2007, at 09:21 AM by David A. Mellis -
Added lines 1-23:

cos(rad)

Description

Calculates the cos of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

The cos of the angle.

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- tan()

Restore

cos(rad)

Description

Calculates the cos of an angle (in radians). The result will be between -1 and 1.

Parameters

rad: the angle in radians (*float*)

Returns

The cos of the angle ("double")

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- tan()
- float
- double

Reference Home

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Reference.Tan History

Hide minor edits - Show changes to markup

December 22, 2007, at 09:41 AM by David A. Mellis -
Changed lines 22-23 from:

- float()
- double()

to:

- float
- double

Restore
December 22, 2007, at 09:31 AM by David A. Mellis - don't need a link to math.h, it's included automatically.
Changed lines 5-7 from:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity. Tan() uses the avr-libc library.

to:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.

Restore
December 22, 2007, at 08:31 AM by Paul Badger -
Changed lines 14-15 from:

The tangent of the angle ("double")

to:

The tangent of the angle (*double*)

Restore
December 22, 2007, at 08:30 AM by Paul Badger -
Changed lines 5-7 from:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.
* **tan**()

to:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity. Tan() uses the avr-libc library.

Changed lines 14-15 from:

The tangent of the angle.

to:

The tangent of the angle ("double")

Changed lines 23-24 from:
to:

- float()
- double()

Restore
December 22, 2007, at 08:27 AM by Paul Badger -
Changed lines 5-6 from:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.

to:

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.
* **tan**()

Restore
November 21, 2007, at 09:21 AM by David A. Mellis -
Added lines 1-23:

tan(rad)

Description

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.

Parameters

rad: the angle in radians (*float*)

Returns

The tangent of the angle.

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- cos()

Restore

tan(rad)

Description

Calculates the tangent of an angle (in radians). The result will be between negative infinity and infinity.

Parameters

rad: the angle in radians (*float*)

Returns

The tangent of the angle (*double*)

Note

Serial.print() and Serial.println() do not currently support printing floats.

See also

- sin()
- cos()
- float
- double

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Reference.RandomSeed History

Hide minor edits - Show changes to markup

February 08, 2008, at 10:20 AM by David A. Mellis -
Deleted line 35:

- millis

Restore
September 27, 2007, at 07:56 AM by David A. Mellis - millis() isn't random if there's no human intervention.
Changed lines 6-7 from:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time by calling millis().

to:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Added line 23:

```
  randomSeed(analogRead(0));
```

Deleted line 26:

```
  randomSeed(analogRead(0));
```

Restore
September 26, 2007, at 11:08 PM by Paul Badger -
Changed lines 6-7 from:

If it is important for a sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time by calling millis().

to:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time by calling millis().

Restore
September 26, 2007, at 11:05 PM by Paul Badger -
Changed lines 4-5 from:

randomSeed initializes the pseudo-random number generator, causing it to start at an arbitrary point in its random sequence. This sequence, while very long, and random, is always the same.

to:

randomSeed() initializes the pseudo-random number generator, causing it to start at an arbitrary point in its random sequence. This sequence, while very long, and random, is always the same.

Restore
September 26, 2007, at 11:04 PM by Paul Badger -
Changed lines 6-7 from:

If it is important for sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time with millis().

to:

If it is important for a sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time by calling millis().

Restore
September 26, 2007, at 11:03 PM by Paul Badger -
Changed lines 4-5 from:

randomSeed initializes the pseudo-random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis()), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

to:

randomSeed initializes the pseudo-random number generator, causing it to start at an arbitrary point in its random sequence. This sequence, while very long, and random, is always the same.

If it is important for sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin, or read the time with millis().

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Changed line 22 from:

```
  Serial.begin(19200);
```

to:

```
  Serial.begin(9600);
```

Added lines 29-30:

```
  delay(50);
```

Restore
September 26, 2007, at 10:56 PM by Paul Badger -
Changed lines 4-5 from:

This allows you to place a variable into your random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis()), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

to:

randomSeed initializes the pseudo-random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis()), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

Restore
May 26, 2007, at 07:33 PM by Paul Badger -
Deleted lines 30-32:

Reference Home

Restore
May 08, 2007, at 12:22 PM by David A. Mellis -
Deleted line 14:

int time;

Changed lines 22-23 from:

```
  time = millis();
  randomSeed(time);
```

to:

```
  randomSeed(analogRead(0));
```

Changed line 24 from:

```
  Serial.println(r);
```

to:

```
  Serial.println(randNumber);
```

Restore
September 18, 2006, at 10:04 AM by Jeff Gray -
Changed lines 4-5 from:

This allows you to place a variable into your random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis(), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

to:

This allows you to place a variable into your random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis()), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

Restore
September 11, 2006, at 09:59 AM by Jeff Gray -
Changed lines 1-2 from:

randomSeed(long seedValue)

to:

randomSeed(seed)

Changed lines 7-8 from:

long - pass a number to generate the seed.

to:

long, int - pass a number to generate the seed.

Restore
September 11, 2006, at 09:57 AM by Jeff Gray -
Added lines 1-35:

randomSeed(long seedValue)

Description

This allows you to place a variable into your random number generator, which helps it to generate "random" numbers. There are a variety of different variables you can use in this function. Commonly used are current time values (using millis(), but you could also try something else like user intervention on a switch or antennae noise through an analog pin.

Parameters

long - pass a number to generate the seed.

Returns

no returns

Example

```
int time;
long randNumber;

void setup(){
  Serial.begin(19200);
}

void loop(){
  time = millis();
  randomSeed(time);
  randNumber = random(300);
  Serial.println(r);
}
```

See also

- random
- millis

Reference Home

Restore

randomSeed(seed)

Description

randomSeed() initializes the pseudo-random number generator, causing it to start at an arbitrary point in its random sequence. This sequence, while very long, and random, is always the same.

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Parameters

long, int - pass a number to generate the seed.

Returns

no returns

Example

```
long randNumber;

void setup(){
  Serial.begin(9600);
  randomSeed(analogRead(0));
}

void loop(){
  randNumber = random(300);
  Serial.println(randNumber);

  delay(50);
}
```

See also

- random

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Random History

Hide minor edits - Show changes to markup

September 26, 2007, at 11:06 PM by Paul Badger -
Changed lines 16-17 from:

If it is important for sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

to:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Restore
September 26, 2007, at 10:53 PM by Paul Badger -
Changed line 29 from:

```
  // noise will cause the calls to randomSeed() to generate
```

to:

```
  // noise will cause the call to randomSeed() to generate
```

Changed line 31 from:

```
  // randomSeed() then shuffles the random function
```

to:

```
  // randomSeed() will then shuffle the random function.
```

Restore
September 26, 2007, at 10:51 PM by Paul Badger -
Restore
September 26, 2007, at 10:50 PM by Paul Badger -
Changed lines 18-19 from:

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number.

to:

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Restore
September 26, 2007, at 10:49 PM by Paul Badger -
Changed lines 8-9 from:

min - lower bound of the random value, inclusive (optional parameter)

to:

min - lower bound of the random value, inclusive *(optional parameter)*

Restore
September 26, 2007, at 10:49 PM by Paul Badger -

Changed lines 8-9 from:

min - lower bound of the random value, inclusive (optional parameter)

to:

min - lower bound of the random value, inclusive (optional parameter)

Restore
September 26, 2007, at 10:48 PM by Paul Badger -
Changed lines 8-11 from:

min - lower bound on the random value, inclusive (optional)

max - upper bound on the random number, exclusive

to:

min - lower bound of the random value, inclusive (optional parameter)

max - upper bound of the random value, exclusive

Restore
September 26, 2007, at 10:46 PM by Paul Badger -
Changed lines 26-27 from:

```
  Serial.begin(19200);
```

to:

```
  Serial.begin(9600);
```

Added lines 43-44:

```
  delay(50);
```

Restore
September 26, 2007, at 10:44 PM by Paul Badger -
Deleted line 39:
Deleted line 42:
Restore
September 26, 2007, at 10:44 PM by Paul Badger -
Changed lines 29-30 from:

```
  // noise will cause the calls to random() to generate
  // different numbers each time the sketch runs.
```

to:

```
  // noise will cause the calls to randomSeed() to generate
  // different seed numbers each time the sketch runs.
  // randomSeed() then shuffles the random function
```

Deleted lines 35-38:

```
  // print a random number from 10 to 19
  randNumber = random(10, 20);
  Serial.println(randNumber);
```

Added lines 38-42:

```
  Serial.println(randNumber);

  // print a random number from 10 to 19
  randNumber = random(10, 20);
```

Added line 44:
Restore
September 26, 2007, at 10:41 PM by Paul Badger -
Changed lines 18-19 from:

Conversely, it can occasionally be useful to use sequences pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number.

to:

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number.

Changed lines 28-29 from:

```
  // if analog input pin 0 is unconnected, this
  // will cause the calls to random() to generate
```

to:

```
  // if analog input pin 0 is unconnected, random analog
  // noise will cause the calls to random() to generate
```

Restore
September 26, 2007, at 10:00 PM by David A. Mellis -
Changed lines 5-6 from:

The random function allows convenient access to pseudo-random numbers for use in sketches.

to:

The random function generates pseudo-random numbers.

Changed lines 8-21 from:

min - optional starting range (ie: from "50" - 300).

max - the largest random number returned (plus one).

In the current version of this function, the max parameter will not be returned, although the minimum will, so for example:

`random(10); // returns numbers from 0 to 9`

`random(-5, 5); // returns numbers from -5 to 4`

Consequently, enter a maximum parameter one larger than the maximum integer desired.

min and **max** are long integers so numbers between -2,147,483,648 and 2,147,483,647 are valid.

to:

min - lower bound on the random value, inclusive (optional)

max - upper bound on the random number, exclusive

Changed lines 13-14 from:

long - the random number.

to:

long - a random number between min and max - 1

Changed lines 16-19 from:

If it is important for a random number sequence to *begin* on a random number, then call the randomSeed() function using something for a parameter that is fairly random, such as millis(), or analogRead() on a pin with no electrical connection.

Conversely, it can occasionally be useful to use pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed() with the same number as a parameter.

to:

If it is important for sequence of values generated by random() to differ on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Conversely, it can occasionally be useful to use sequences pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number.

Added lines 27-31:

```
  // if analog input pin 0 is unconnected, this
  // will cause the calls to random() to generate
  // different numbers each time the sketch runs.
  randomSeed(analogRead(0));
```

Changed lines 34-42 from:

void loop(){

```
  randomSeed(analogRead(0));
  // return a random number from 50 - 300
  randNumber = random(50,301);

  // example with only a range, which would return
  // a number between 0 - 300
  // randNumber = random(301);
  Serial.println(r);
```

to:

void loop() {

```
  // print a random number from 10 to 19
  randNumber = random(10, 20);
  Serial.println(randNumber);

  // print a random number from 0 to 299
  randNumber = random(300);
  Serial.println(randNumber);
```

Changed lines 47-48 from:

- millis

to:
Restore
September 26, 2007, at 09:37 PM by Paul Badger -
Changed lines 10-11 from:

max - the largest random numbers you'd like returned.

to:

max - the largest random number returned (plus one).

Changed lines 18-19 from:

Consequently, enter a maximum parameter one larger than the maximum integer dersired.

to:

Consequently, enter a maximum parameter one larger than the maximum integer desired.

Changed lines 23-24 from:

long - returns the random number.

to:

long - the random number.

Changed lines 26-29 from:

If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something for a parameter that is fairly random, such as millis(), or analogRead() on a pin with no electrical connection.

Conversely it can occasionally be useful to use pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed with the same number.

to:

If it is important for a random number sequence to *begin* on a random number, then call the randomSeed() function using something for a parameter that is fairly random, such as millis(), or analogRead() on a pin with no electrical connection.

Conversely, it can occasionally be useful to use pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed() with the same number as a parameter.

Restore
September 26, 2007, at 09:31 PM by Paul Badger -
Changed lines 42-43 from:

```
  randNumber = random(50,300);
```

to:

```
  randNumber = random(50,301);
```

Changed line 46 from:

```
  // randNumber = random(300);
```

to:

```
  // randNumber = random(301);
```

Restore
September 26, 2007, at 09:31 PM by Paul Badger -
Changed lines 26-27 from:

If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

to:

If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something for a parameter that is fairly random, such as millis(), or analogRead() on a pin with no electrical connection.

Restore
September 26, 2007, at 09:30 PM by Paul Badger -
Changed lines 25-26 from:

Note: If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

to:

Note:

If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

Restore
September 26, 2007, at 09:29 PM by Paul Badger -
Changed lines 25-26 from:

Note: If it is important for a random number series to begin on a random number then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

to:

Note: If it is important for a random number series to *begin* on a random number, then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

Restore
September 26, 2007, at 09:29 PM by Paul Badger -
Changed lines 5-6 from:

The random function allows convenient access to pseudo-random numbers for use in an applications. NOTE: Use this after using the randomSeed() function.

to:

The random function allows convenient access to pseudo-random numbers for use in sketches.

Changed lines 12-13 from:

In the current version of this function, the max parameter will not be returned, although the minimum will so, for example:

to:

In the current version of this function, the max parameter will not be returned, although the minimum will, so for example:

```
random(10); // returns numbers from 0 to 9
```

Changed lines 18-19 from:

Consequently enter a maximum parameter one more than the meximum dersired.

to:

Consequently, enter a maximum parameter one larger than the maximum integer dersired.

Added lines 25-28:

Note: If it is important for a random number series to begin on a random number then call the randomSeed() function using something that is fairly random such as millis() or analogRead() on a pin with no electrical connection.

Conversely it can occasionally be useful to use pseudo-random numbers that repeat exactly. This can be accomplished by calling randomSeed with the same number.

Restore
September 26, 2007, at 09:17 PM by Paul Badger -
Changed lines 5-6 from:

The random function allows you to return pseudo-random numbers for use in your applications. NOTE: Use this after using the randomSeed() function.

to:

The random function allows convenient access to pseudo-random numbers for use in an applications. NOTE: Use this after using the randomSeed() function.

Changed lines 10-11 from:

max - the overall range of random numbers you'd like returned.

to:

max - the largest random numbers you'd like returned.

In the current version of this function, the max parameter will not be returned, although the minimum will so, for example:

```
random(-5, 5); // returns numbers from -5 to 4
```

Consequently enter a maximum parameter one more than the meximum dersired.

Restore
September 26, 2007, at 08:23 PM by Paul Badger -
Added lines 12-13:

min and **max** are long integers so numbers between -2,147,483,648 and 2,147,483,647 are valid.

Restore
May 26, 2007, at 07:33 PM by Paul Badger -
Restore
May 26, 2007, at 07:32 PM by Paul Badger -
Deleted lines 39-40:

Reference Home

Restore
May 08, 2007, at 12:22 PM by David A. Mellis -
Deleted line 17:

int time;

Changed lines 25-26 from:

```
  time = millis();
  randomSeed(time);
```

to:

```
  randomSeed(analogRead(0));
```

Restore
September 15, 2006, at 11:21 AM by David A. Mellis -
Changed lines 1-3 from:

long random(max)

long random(min, max)

to:

long random(max)
long random(min, max)

Restore
September 15, 2006, at 11:21 AM by David A. Mellis -
Changed lines 1-2 from:

long random([min,] max)

to:

long random(max)

long random(min, max)

Restore
September 11, 2006, at 10:15 AM by Jeff Gray -
Changed lines 1-2 from:

long random([start,] range)

to:

long random([min,] max)

Changed lines 7-10 from:

start - optional starting range (ie: from "50" - 300).

range - the overall range of random numbers you'd like returned.

to:

min - optional starting range (ie: from "50" - 300).

max - the overall range of random numbers you'd like returned.

Restore
September 11, 2006, at 10:05 AM by Jeff Gray -
Added lines 29-32:

```
  // example with only a range, which would return
  // a number between 0 - 300
  // randNumber = random(300);
```

Restore
September 11, 2006, at 10:04 AM by Jeff Gray -
Added lines 1-38:

long random([start,] range)

Description

The random function allows you to return pseudo-random numbers for use in your applications. NOTE: Use this after using the randomSeed() function.

Parameters

start - optional starting range (ie: from "50" - 300).

range - the overall range of random numbers you'd like returned.

Returns

long - returns the random number.

Example

```
int time;
long randNumber;

void setup(){
  Serial.begin(19200);
}

void loop(){
  time = millis();
  randomSeed(time);
  // return a random number from 50 - 300
  randNumber = random(50,300);
  Serial.println(r);
}
```

See also

- randomSeed
- millis

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long random(max)
long random(min, max)

Description

The random function generates pseudo-random numbers.

Parameters

min - lower bound of the random value, inclusive *(optional parameter)*

max - upper bound of the random value, exclusive

Returns

long - a random number between min and max - 1

Note:

If it is important for a sequence of values generated by random() to differ, on subsequent executions of a sketch, use randomSeed() to initialize the random number generator with a fairly random input, such as analogRead() on an unconnected pin.

Conversely, it can occasionally be useful to use pseudo-random sequences that repeat exactly. This can be accomplished by calling randomSeed() with a fixed number, before starting the random sequence.

Example

```
long randNumber;

void setup(){
  Serial.begin(9600);

  // if analog input pin 0 is unconnected, random analog
  // noise will cause the call to randomSeed() to generate
  // different seed numbers each time the sketch runs.
  // randomSeed() will then shuffle the random function.
  randomSeed(analogRead(0));
}

void loop() {
  // print a random number from 0 to 299
  randNumber = random(300);
  Serial.println(randNumber);

  // print a random number from 10 to 19
  randNumber = random(10, 20);
  Serial.println(randNumber);

  delay(50);
}
```

See also

- randomSeed

Reference Home

Arduino

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Reference.Boolean History

Hide minor edits - Show changes to markup

September 14, 2007, at 10:48 AM by Paul Badger -
Changed lines 8-9 from:

if (x > 0 && x < 5) {

to:

if (digitalRead(2) == 1 && digitalRead(3) == 1) { // read two switches

Restore
July 16, 2007, at 07:18 AM by Paul Badger -
Changed line 46 from:

- ^ (bitwise NOT

to:

- ~ (bitwise NOT

Restore
July 16, 2007, at 07:17 AM by Paul Badger -
Added line 46:

- ^ (bitwise NOT

Restore
July 16, 2007, at 07:14 AM by Paul Badger -
Added lines 44-45:

- & (bitwise AND)
- | (bitwise OR)

Restore
July 16, 2007, at 07:08 AM by Paul Badger -
Changed lines 46-49 from:

Reference Home

to:
Restore
April 15, 2007, at 10:29 AM by David A. Mellis -
Changed line 8 from:

if (x > 0 && x< 5) {

to:

if (x > 0 && x < 5) {

Changed line 22 from:

True if the operand is true, e.g.

to:

True if the operand is false, e.g.

Restore

April 15, 2007, at 10:28 AM by David A. Mellis -
Changed lines 38-39 from:

[@ if (a >= 10 && a <= 20){} // true if a is between 10 and 20

to:

[@

Restore
April 15, 2007, at 10:28 AM by David A. Mellis - matching formatting tags and removing incorrect example.
Changed lines 41-43 from:

digitalWrite(ledPin, !a); // this will turn on the LED every other time through the loop

to:

@]

Restore
April 14, 2007, at 09:15 PM by Paul Badger -
Changed lines 29-30 from:

Example

to:

Warning

Make sure you don't mistake the boolean AND operator, && (double ampersand) for the bitwise AND operator & (single ampersand). They are entirely different beasts.

Similarly, do not confuse the boolean || (double pipe) operator with the bitwise OR operator | (single pipe).

The bitwise not ~ (tilde) looks much different than the boolean not ! (exclamation point or "bang" as the programmers say) but you still have to be sure which one you want where.

Examples

[@ if (a >= 10 && a <= 20){} // true if a is between 10 and 20

if (a >= 10 && a <= 20){} // true if a is between 10 and 20

digitalWrite(ledPin, !a); // this will turn on the LED every other time through the loop

Restore
August 01, 2006, at 07:16 AM by David A. Mellis -
Changed lines 5-6 from:

&& (logical and): true only if both operands are true, e.g.

to:

&& (logical and)

True only if both operands are true, e.g.

Changed lines 13-14 from:

|| (logical or): true if either operand is true, e.g.

to:

|| (logical or)

True if either operand is true, e.g.

Changed lines 21-22 from:

! (not): true if the operand is true, e.g.

to:

! (not)

True if the operand is true, e.g.

Restore
August 01, 2006, at 07:15 AM by David A. Mellis -
Changed lines 5-10 from:

&& (logical and): true only if both operands are true, e.g. if (x > 0 && x< 5) { } is true only if x is 1, 2, 3, or 4.

|| (logical or): true if either operand is true, e.g. if (x > 0 || y > 0) { } is true if either x or y is greater than 0.

! (not): true if the operand is true, e.g. if (!x) { } is true if x is false (i.e. if x equals 0).

to:

&& (logical and): true only if both operands are true, e.g.

```
if (x > 0 && x< 5) {
  // ...
}
```

is true only if x is 1, 2, 3, or 4.

|| (logical or): true if either operand is true, e.g.

```
if (x > 0 || y > 0) {
  // ...
}
```

is true if either x or y is greater than 0.

! (not): true if the operand is true, e.g.

```
if (!x) {
  // ...
}
```

is true if x is false (i.e. if x equals 0).

Restore
August 01, 2006, at 07:13 AM by David A. Mellis -
Added lines 1-20:

Boolean Operators

These can be used inside the condition of an if statement.

&& (logical and): true only if both operands are true, e.g. if (x > 0 && x< 5) { } is true only if x is 1, 2, 3, or 4.

|| (logical or): true if either operand is true, e.g. if (x > 0 || y > 0) { } is true if either x or y is greater than 0.

! (not): true if the operand is true, e.g. if (!x) { } is true if x is false (i.e. if x equals 0).

Example

See also

- if

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Restore

Boolean Operators

These can be used inside the condition of an if statement.

&& (logical and)

True only if both operands are true, e.g.

```
if (digitalRead(2) == 1  && digitalRead(3) == 1) { // read two switches
  // ...
}
```

is true only if x is 1, 2, 3, or 4.

|| (logical or)

True if either operand is true, e.g.

```
if (x > 0 || y > 0) {
  // ...
}
```

is true if either x or y is greater than 0.

! (not)

True if the operand is false, e.g.

```
if (!x) {
  // ...
}
```

is true if x is false (i.e. if x equals 0).

Warning

Make sure you don't mistake the boolean AND operator, && (double ampersand) for the bitwise AND operator & (single ampersand). They are entirely different beasts.

Similarly, do not confuse the boolean || (double pipe) operator with the bitwise OR operator | (single pipe).

The bitwise not ~ (tilde) looks much different than the boolean not ! (exclamation point or "bang" as the programmers say) but you still have to be sure which one you want where.

Examples

```
if (a >= 10 && a <= 20){}   // true if a is between 10 and 20
```

See also

- & (bitwise AND)
- | (bitwise OR)
- ~ (bitwise NOT
- if

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Increment History

Hide minor edits - Show changes to markup

July 16, 2007, at 09:35 AM by David A. Mellis -
Added line 34:
Restore
July 16, 2007, at 09:35 AM by David A. Mellis -
Changed line 13 from:

x-- ; // decrement x by one and returns the old value of x @]

to:

x-- ; // decrement x by one and returns the old value of x

Restore
July 16, 2007, at 09:35 AM by David A. Mellis - clarifying x++ and ++x, etc.
Changed lines 10-12 from:

x++ ; // equivalent to the expression x = x + 1; x-- ; // equivalent to the expression x = x - 1; @]

to:

x++; // increment x by one and returns the old value of x ++x; // increment x by one and returns the new value of x

x-- ; // decrement x by one and returns the old value of x @] --x ; // decrement x by one and returns the new value of x @]

Changed lines 18-19 from:

x: any variable type

to:

x: an integer or long (possibly unsigned)

Changed lines 22-23 from:

Incremented or decremented variable

to:

The original or newly incremented / decremented value of the variable.

Changed lines 27-30 from:

x++; // x now contains 3 x--; // x contains 2 again@]

to:

y = ++x; // x now contains 3, y contains 3 y = x--; // x contains 2 again, y still contains 3 @]

Deleted lines 31-32:
Deleted line 33:
Restore
July 16, 2007, at 05:18 AM by Paul Badger -
Restore
July 16, 2007, at 05:17 AM by Paul Badger -
Changed line 23 from:

[@x = 2; // x now contains 2

to:

[@x = 2;

Restore
July 16, 2007, at 05:17 AM by Paul Badger -
Changed lines 24-27 from:

x++; // x now contains 3 x--; // x contains 2 again@]

to:

x++; // x now contains 3 x--; // x contains 2 again@]

Restore
July 16, 2007, at 05:16 AM by Paul Badger -
Restore
July 16, 2007, at 05:16 AM by Paul Badger -
Deleted lines 4-7:

The ++ operator is

The -- operator is equivalent to the expression x = x - 1;

Restore
July 16, 2007, at 05:14 AM by Paul Badger -
Changed lines 3-4 from:

Description

to:

Description

Restore
July 16, 2007, at 05:14 AM by Paul Badger -
Changed line 35 from:

+=

to:

+=\\

Restore
July 16, 2007, at 05:13 AM by Paul Badger -
Changed lines 35-36 from:

division

to:

+= -=

Restore
July 16, 2007, at 05:08 AM by Paul Badger -
Deleted lines 26-28:

Deleted lines 31-63:

Example Code

```
// check a sensor every 10 times through a loop
void loop(){
i++;
if ((i % 10) == 0){          // read sensor every ten times through loop
   x = analogRead(sensPin);
   }
/ ...
}
```

```
// setup a buffer that averages the last five samples of a sensor

int senVal[5];  // create an array for sensor data
int i, j;       // counter variables
long average;   // variable to store average
...

void loop(){
// input sensor data into oldest memory slot
sensVal[(i++) % 5] = analogRead(sensPin);
average = 0;
for (j=0; j<5; j++){
average += sensVal[j];   // add up the samples
}
average = average / 5;  // divide by total
```

Tip

the modulo operator will not work on floats

Restore
July 16, 2007, at 05:07 AM by Paul Badger -
Added line 13:

[@

Changed lines 15-17 from:

x-- ; // equivalent to the expression x = x - 1;

to:

x-- ; // equivalent to the expression x = x - 1; @]

Restore
July 16, 2007, at 05:06 AM by Paul Badger -
Added line 14:
Restore
July 16, 2007, at 05:06 AM by Paul Badger -
Changed lines 1-8 from:

++ (increment)

Increment a variable

Syntax

x++;

to:

++ (increment) / -- (decrement)

Description

The ++ operator is

The -- operator is equivalent to the expression x = x - 1;

Increment or decrement a variable

Syntax

x++ ; // equivalent to the expression x = x + 1; x-- ; // equivalent to the expression x = x - 1;

Parameters

x: any variable type

Returns

Incremented or decremented variable

Examples

```
x = 2;    // x now contains 2
x++;        // x now contains 3
x--;        // x contains 2 again
```

Example Code

```
// check a sensor every 10 times through a loop
void loop(){
i++;
if ((i % 10) == 0){          // read sensor every ten times through loop
   x = analogRead(sensPin);
   }
/ ...
}

// setup a buffer that averages the last five samples of a sensor

int senVal[5];  // create an array for sensor data
int i, j;       // counter variables
long average;   // variable to store average
...

void loop(){
// input sensor data into oldest memory slot
sensVal[(i++) % 5] = analogRead(sensPin);
average = 0;
for (j=0; j<5; j++){
average += sensVal[j];   // add up the samples
}
average = average / 5;  // divide by total
```

Tip

the modulo operator will not work on floats

See also

division

Restore
July 16, 2007, at 04:51 AM by Paul Badger -
Added lines 1-8:

++ (increment)

Increment a variable

Syntax

x++;

Restore

++ (increment) / -- (decrement)

Description

Increment or decrement a variable

Syntax

```
x++;  // increment x by one and returns the old value of x
++x;  // increment x by one and returns the new value of x

x-- ;   // decrement x by one and returns the old value of x
--x ;   // decrement x by one and returns the new value of x
```

Parameters

x: an integer or long (possibly unsigned)

Returns

The original or newly incremented / decremented value of the variable.

Examples

```
x = 2;
y = ++x;      // x now contains 3, y contains 3
y = x--;      // x contains 2 again, y still contains 3
```

See also

+=
-=

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.IncrementCompound History

Hide minor edits - Show changes to markup

July 16, 2007, at 05:51 AM by Paul Badger -
Deleted lines 30-36:

See also

+=
-=

Restore
July 16, 2007, at 05:50 AM by Paul Badger -
Deleted line 33:
Added lines 36-37:
Restore
July 16, 2007, at 05:50 AM by Paul Badger -
Changed line 36 from:

-=

to:

-=

Restore
July 16, 2007, at 05:48 AM by Paul Badger -
Added line 19:
Restore
July 16, 2007, at 05:47 AM by Paul Badger -
Deleted line 18:
Restore
July 16, 2007, at 05:47 AM by Paul Badger -
Deleted line 19:
Restore
July 16, 2007, at 05:47 AM by Paul Badger -
Changed lines 18-20 from:

x: any variable type \\

to:

x: any variable type

Restore
July 16, 2007, at 05:47 AM by Paul Badger -
Changed line 18 from:

x: any variable type\\

to:

x: any variable type \\

Restore
July 16, 2007, at 05:46 AM by Paul Badger -
Changed lines 18-20 from:

x: any variable type //y: any variable type or constant

to:

x: any variable type\\ y: any variable type or constant

Restore
July 16, 2007, at 05:46 AM by Paul Badger -
Changed lines 19-20 from:

\\y: any variable type or constant

to:

//y: any variable type or constant

Restore
July 16, 2007, at 05:45 AM by Paul Badger -
Changed lines 18-19 from:

x: any variable type \\y: any variable type or constant

to:

x: any variable type \\y: any variable type or constant

Restore
July 16, 2007, at 05:45 AM by Paul Badger -
Changed lines 18-20 from:

x: any variable type\\ y: any variable type or constant

to:

x: any variable type \\y: any variable type or constant

Restore
July 16, 2007, at 05:45 AM by Paul Badger -
Changed line 18 from:

x: any variable type

to:

x: any variable type\\

Restore
July 16, 2007, at 05:45 AM by Paul Badger -
Changed line 26 from:

x *= 10; // x now contains 30

to:

x *= 10; // x now contains 30

Restore
July 16, 2007, at 05:44 AM by Paul Badger -
Changed lines 5-6 from:

Perform a mathematical operation on a variable with another constant or variable. The += (et al) operators are just a convenient shorthand for the expanded syntax below.

to:

Perform a mathematical operation on a variable with another constant or variable. The += (et al) operators are just a convenient shorthand for the expanded syntax, listed below.

Changed lines 10-13 from:

x+=2; // equivalent to the expression x = x + 2; x-=2; // equivalent to the expression x = x - 1; x*=2; // equivalent to the expression x = x * 2; x/=2; // equivalent to the expression x = x / 2;

to:

x += y; // equivalent to the expression x = x + y; x -= y; // equivalent to the expression x = x - y; x *= y; // equivalent to the expression x = x * y; x /= y; // equivalent to the expression x = x / y;

Changed lines 18-19 from:

x: any variable type

to:

x: any variable type y: any variable type or constant

Changed lines 24-27 from:

x++; // x now contains 3 x--; // x contains 2 again@]

to:

x += 4; // x now contains 6 x -= 3; // x now contains 3 x *= 10; // x now contains 30 x /= 2; // x now contains 15 @]

Restore
July 16, 2007, at 05:27 AM by Paul Badger -
Added lines 1-31:

+= , -= , *= , /=

Description

Perform a mathematical operation on a variable with another constant or variable. The += (et al) operators are just a convenient shorthand for the expanded syntax below.

Syntax

```
x+=2;   // equivalent to the expression x = x + 2;
x-=2;   // equivalent to the expression x = x - 1;
x*=2;   // equivalent to the expression x = x * 2;
x/=2;   // equivalent to the expression x = x / 2;
```

Parameters

x: any variable type

Examples

```
x = 2;
x++;      // x now contains 3
x--;      // x contains 2 again
```

See also

+=
-=

Restore

+= , -= , *= , /=

Description

Perform a mathematical operation on a variable with another constant or variable. The += (et al) operators are just a convenient shorthand for the expanded syntax, listed below.

Syntax

```
x += y;   // equivalent to the expression x = x + y;
x -= y;   // equivalent to the expression x = x - y;
x *= y;   // equivalent to the expression x = x * y;
x /= y;   // equivalent to the expression x = x / y;
```

Parameters

x: any variable type

y: any variable type or constant

Examples

```
x = 2;
x += 4;      // x now contains 6
x -= 3;      // x now contains 3
x *= 10;     // x now contains 30
x /= 2;      // x now contains 15
```

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Constants History

Hide minor edits - Show changes to markup

May 09, 2008, at 11:57 PM by David A. Mellis -
Changed lines 26-27 from:

When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report HIGH (0) if a voltage of 3 volts or more is present at the pin.

to:

When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report HIGH if a voltage of 3 volts or more is present at the pin.

Changed lines 32-33 from:

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW (0) if a voltage of 2 volts or less is present at the pin.

to:

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW if a voltage of 2 volts or less is present at the pin.

Restore
March 29, 2008, at 11:43 AM by David A. Mellis -
Changed lines 6-7 from:

There are two boolean constants defined in the C language, upon which Arduino is based: TRUE and FALSE.

to:

There are two constants used to represent truth and falsity in the Arduino language: **true**, and **false**.

Restore
March 27, 2008, at 08:48 PM by Paul Badger -
Changed lines 41-42 from:

Arduino (Atmega) pins configured as **INPUT** are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

to:

Arduino (Atmega) pins configured as **INPUT** with pinMode() are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Changed lines 45-47 from:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. The amount of current provided by an Atmega pin is also not enough to power most relays or motors, and some interface circuitry will be required.

to:

Pins configured as **OUTPUT** with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for reading sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. The amount of current provided by an Atmega pin is also not enough to power most relays or motors, and some interface circuitry will be required.

Restore
March 27, 2008, at 08:45 PM by Paul Badger -
Changed lines 27-28 from:

When an output pin is configured to OUTPUT with pinMode, and set to HIGH with digitalWrite, the pin is at 5 volts. In this state it can *source* current, i.e. light an LED that is connected through a series resistor to ground, or to another pin configured as an output, and set to LOW.

to:

When a pin is configured to OUTPUT with pinMode, and set to HIGH with digitalWrite, the pin is at 5 volts. In this state it can *source* current, e.g. light an LED that is connected through a series resistor to ground, or to another pin configured as an output, and set to LOW.

Changed lines 31-33 from:

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW (0) if a voltage of 2 volts or less is present at the pin.

to:

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW (0) if a voltage of 2 volts or less is present at the pin.

Restore
March 27, 2008, at 08:43 PM by Paul Badger -
Changed line 24 from:

The meaning of HIGH has a somewhat different meaning depending on whether a pin is set to an INPUT or OUTPUT.

to:

The meaning of HIGH (in reference to a pin) is somewhat different depending on whether a pin is set to an INPUT or OUTPUT.

Restore
March 17, 2008, at 10:40 PM by Paul Badger -
Added lines 8-9:

false

Changed lines 12-13 from:

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense. Consequently *true* is often said to be defined as "non-zero".

to:

true

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is *non-zero* is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

Deleted line 18:
Restore
March 17, 2008, at 11:18 AM by Paul Badger -
Changed line 27 from:

The meaning of LOW also has a different meaning depending on whether the pin is set to INPUT or OUTPUT.

to:

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT.

Restore
March 17, 2008, at 11:16 AM by Paul Badger -
Changed lines 10-11 from:

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense. Consequently *true* is often said to be defined as *non-zero*.

to:

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense. Consequently *true* is often said to be defined as "non-zero".

Restore
March 17, 2008, at 11:16 AM by Paul Badger -
Changed lines 10-11 from:

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

to:

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense. Consequently *true* is often said to be defined as *non-zero*.

Restore
March 17, 2008, at 11:14 AM by Paul Badger -
Changed line 27 from:

The meaning of LOW has a somewhat different meaning depending on whether the pin is set to INPUT or OUTPUT.

to:

The meaning of LOW also has a different meaning depending on whether the pin is set to INPUT or OUTPUT.

Restore
March 17, 2008, at 11:12 AM by Paul Badger -
Changed lines 18-19 from:

HIGH

to:

HIGH

Changed lines 25-26 from:

LOW

to:

LOW

Restore
March 17, 2008, at 11:12 AM by Paul Badger -
Changed line 5 from:

Defining Logical Levels, TRUE and FALSE (Boolean Constants)

to:

Defining Logical Levels, true and false (Boolean Constants)

Changed lines 8-9 from:

FALSE is the easier of the two to define. FALSE is defined as 0 (zero).

to:

false is the easier of the two to define. false is defined as 0 (zero).

Changed lines 12-14 from:
to:

Note that the *true* and *false* constants are typed in lowercase unlike HIGH, LOW, INPUT, & OUTPUT.

Restore
March 17, 2008, at 11:08 AM by Paul Badger -
Changed lines 5-12 from:

Defining Logical Levels, true and false (Boolean Constants)

There are two boolean constants defined in the C language, upon which Arduino is based: true and false.

false is the easier of the two to define. false is defined as 0 (zero).

true is often said to be defined as 1, which is true, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

to:

Defining Logical Levels, TRUE and FALSE (Boolean Constants)

There are two boolean constants defined in the C language, upon which Arduino is based: TRUE and FALSE.

FALSE is the easier of the two to define. FALSE is defined as 0 (zero).

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

Changed lines 16-18 from:

HIGH represents the programming equivalent to 5 volts. When reading the value at a digital pin if there is 3 volts or more at the input pin, the microprocessor will understand it as **HIGH**. This constant is also represented by the integer number **1**.

LOW represents the programming equivalent to 0 volts. The meaning of LOW has a somewhat different meaning depending on whether the pin is set to an INPUT or OUTPUT.

to:

HIGH The meaning of HIGH has a somewhat different meaning depending on whether a pin is set to an INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report HIGH (0) if a voltage of 3 volts or more is present at the pin.

When an output pin is configured to OUTPUT with pinMode, and set to HIGH with digitalWrite, the pin is at 5 volts. In this state it can *source* current, i.e. light an LED that is connected through a series resistor to ground, or to another pin configured as an output, and set to LOW.

LOW The meaning of LOW has a somewhat different meaning depending on whether the pin is set to INPUT or OUTPUT.

Changed lines 26-27 from:

When an output pin is configured to OUTPUT with pinMode, and set to LOW with digitalWrite, the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to +5 volts, or to another pin configured as an output, and set to HIGH.

to:

When a pin is configured to OUTPUT with pinMode, and set to LOW with digitalWrite, the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to, +5 volts, or to another pin configured as an output, and set to HIGH.

Changed lines 38-40 from:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails.

to:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. The amount of current provided by an Atmega pin is also not enough to power most relays or motors, and some interface circuitry will be required.

Restore
March 17, 2008, at 10:59 AM by Paul Badger -
Changed lines 21-22 from:

Setting an output pin to low with digitalWrite, means that the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to +5 volts, or to another pin configured as an output, and set to HIGH.

to:

When an output pin is configured to OUTPUT with pinMode, and set to LOW with digitalWrite, the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to +5 volts, or to another pin configured as an output, and set to HIGH.

Restore
March 17, 2008, at 10:57 AM by Paul Badger -
Changed lines 18-20 from:

LOW represents the programming equivalent to 0 volts. The meaning of LOW has a somewhat different meaning, depending on whether the pin is set to an input or output. When reading a pin is set to an input with digitalRead, if a voltage of 2 volts or less is present at the pin, the microcontroller will report LOW (0).

to:

LOW represents the programming equivalent to 0 volts. The meaning of LOW has a somewhat different meaning depending on whether the pin is set to an INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW (0) if a voltage of 2 volts or less is present at the pin.

Restore
March 17, 2008, at 10:55 AM by Paul Badger -
Changed lines 18-19 from:

LOW is representing the programming equivalent to 0 volts. When reading the value at a digital pin, if we get 2 volts or less, the microprocessor will understand it as **LOW**. This constant if also represented by the integer number **0**.

to:

LOW represents the programming equivalent to 0 volts. The meaning of LOW has a somewhat different meaning, depending on whether the pin is set to an input or output. When reading a pin is set to an input with digitalRead, if a voltage of 2 volts or less is present at the pin, the microcontroller will report LOW (0).

Setting an output pin to low with digitalWrite, means that the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to +5 volts, or to another pin configured as an output, and set to HIGH.

Restore
March 17, 2008, at 10:45 AM by Paul Badger -
Changed line 5 from:

Defining Logical Levels, true and false (Boolean Constants)

to:

Defining Logical Levels, true and false (Boolean Constants)

Changed line 13 from:

Defining Pin Levels, HIGH and LOW

to:

Defining Pin Levels, HIGH and LOW

Changed lines 20-21 from:

Defining Digital Pins, INPUT and OUTPUT

to:

Defining Digital Pins, INPUT and OUTPUT

Changed lines 28-29 from:

Pins Configured as Outputs

to:

Pins Configured as Outputs

Restore
March 17, 2008, at 10:45 AM by Paul Badger -
Changed lines 24-25 from:

Pins Configured as Inputs

to:

Pins Configured as Inputs

Restore
March 17, 2008, at 10:44 AM by Paul Badger -
Changed lines 24-25 from:

Pins Configured as Inputs

to:

Pins Configured as Inputs

Changed lines 28-29 from:

Pins Configured as Outputs

to:

Pins Configured as Outputs

Restore
March 17, 2008, at 10:14 AM by Paul Badger -
Changed line 5 from:

Defining Logical Levels, true and false (Boolean Constants)

to:

Defining Logical Levels, true and false (Boolean Constants)

Changed line 13 from:

Defining Pin Levels, HIGH and LOW

to:

Defining Pin Levels, HIGH and LOW

Changed lines 20-21 from:

Defining Digital Pins, INPUT and OUTPUT

to:

Defining Digital Pins, INPUT and OUTPUT

Restore
January 21, 2008, at 10:57 AM by David A. Mellis -
Changed lines 16-19 from:

HIGH represents the programming equivalent to 5 volts. When reading the value at a digital pin if there is 3 volts or more at the input pin, the microprocessor will understand it as **HIGH**. This constant is also represented by the integer number **1**, and also the truth level **TRUE**.

LOW is representing the programming equivalent to 0 volts. When reading the value at a digital pin, if we get 2 volts or less, the microprocessor will understand it as **LOW**. This constant if also represented by the integer number **0**, and also the truth level **FALSE**.

to:

HIGH represents the programming equivalent to 5 volts. When reading the value at a digital pin if there is 3 volts or more at the input pin, the microprocessor will understand it as **HIGH**. This constant is also represented by the integer number **1**.

LOW is representing the programming equivalent to 0 volts. When reading the value at a digital pin, if we get 2 volts or less, the microprocessor will understand it as **LOW**. This constant if also represented by the integer number **0**.

Restore
January 21, 2008, at 10:57 AM by David A. Mellis -
Changed lines 5-12 from:

Defining Logical Levels, TRUE and FALSE (Boolean Constants)

There are two boolean constants defined in the C language, upon which Arduino is based: TRUE and FALSE.

FALSE is the easier of the two to define. FALSE is defined as 0 (zero).

TRUE is often said to be defined as 1, which is true, but TRUE has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as TRUE, too, in a Boolean sense.

to:

Defining Logical Levels, true and false (Boolean Constants)

There are two boolean constants defined in the C language, upon which Arduino is based: true and false.

false is the easier of the two to define. false is defined as 0 (zero).

true is often said to be defined as 1, which is true, but true has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

Restore
June 09, 2007, at 08:47 PM by Paul Badger -
Restore
June 09, 2007, at 08:44 PM by Paul Badger -
Changed line 5 from:

Defining Logical Levels (Boolean Constants)

to:

Defining Logical Levels, TRUE and FALSE (Boolean Constants)

Changed line 13 from:

Defining Pin Levels

to:

Defining Pin Levels, HIGH and LOW

Changed lines 20-21 from:

Defining Digital Pins

to:

Defining Digital Pins, INPUT and OUTPUT

Restore
June 09, 2007, at 08:33 PM by Paul Badger -
Changed lines 30-33 from:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. For this reason it is a good idea to connect output pins with 470O or 1k resistors.

to:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails.

Restore
June 09, 2007, at 08:32 PM by Paul Badger -
Changed lines 5-6 from:

Defining Logical levels (Boolean Constants)

to:

Defining Logical Levels (Boolean Constants)

There are two boolean constants defined in the C language, upon which Arduino is based: TRUE and FALSE.

FALSE is the easier of the two to define. FALSE is defined as 0 (zero).

TRUE is often said to be defined as 1, which is true, but TRUE has a wider definition. Any integer which is non-zero is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as TRUE, too, in a Boolean sense.

Defining Pin Levels

Changed lines 16-17 from:

HIGH is representing the programming equivalent to 5 Volts. When reading the value at a digital pin if we get 3 Volts or more the microprocessor will understad it as **HIGH**. This constant is also represented the integer number **1**, and also the truth level **TRUE**.

to:

HIGH represents the programming equivalent to 5 volts. When reading the value at a digital pin if there is 3 volts or more at the input pin, the microprocessor will understand it as **HIGH**. This constant is also represented by the integer number **1**, and also the truth level **TRUE**.

Changed lines 26-27 from:

Arduino (Atmega) pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

to:

Arduino (Atmega) pins configured as **INPUT** are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Changed lines 30-33 from:

Pins configured as OUTPUT are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors.

to:

Pins configured as **OUTPUT** are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. For this reason it is a good idea to connect output pins with 470O or 1k resistors.

Restore

May 28, 2007, at 01:24 PM by Paul Badger -
Changed lines 31-41 from:

- boolean

to:

- boolean variables

Restore
May 28, 2007, at 01:23 PM by Paul Badger -
Changed lines 15-16 from:

Digital pins can be used either as **INPUT** or **OUTPUT**. These values drastically change the electrical behavior of the pins.

to:

Digital pins can be used either as **INPUT** or **OUTPUT**. Changing a pin from INPUT TO OUTPUT with pinMode() drastically changes the electrical behavior of the pin.

Changed lines 19-20 from:

Arduino (Atmega) pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

to:

Arduino (Atmega) pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Changed lines 23-26 from:

Pins configured as outputs are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors.

to:

Pins configured as OUTPUT are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors.

Restore
May 28, 2007, at 01:20 PM by Paul Badger -
Changed lines 3-6 from:

Constants are predefined variables in the system. They are used to make the programs easier to read. We classify constants in groups.

Defining Logical levels

to:

Constants are predefined variables in the Arduino language. They are used to make the programs easier to read. We classify constants in groups.

Defining Logical levels (Boolean Constants)

Changed lines 9-12 from:

HIGH is representing the programming equivalent to 5 Volts. When reading the value at a digital pin if we get 3 Volts or more the microprocessor will understad it as **HIGH**. This constant represents the integer number **1**, and also the truth level **TRUE**.

LOW is representing the programming equivalen to 0 Volts. When reading the value at a digital pin if we get 2 Volts or less the microprocessor will understand it as **LOW**. This constant represents the integer number **0**, and also the truth level **FALSE**.

to:

HIGH is representing the programming equivalent to 5 Volts. When reading the value at a digital pin if we get 3 Volts or more the microprocessor will understad it as **HIGH**. This constant is also represented the integer number **1**, and also the truth level **TRUE**.

LOW is representing the programming equivalent to 0 volts. When reading the value at a digital pin, if we get 2 volts or less, the microprocessor will understand it as **LOW**. This constant if also represented by the integer number **0**, and also the truth level **FALSE**.

Changed lines 15-16 from:

Digital pins can be used either as **INPUT** or **OUTPUT**. These values represent precisely what their meaning stands for.

to:

Digital pins can be used either as **INPUT** or **OUTPUT**. These values drastically change the electrical behavior of the pins.

Pins Configured as Inputs

Arduino (Atmega) pins configured as inputs are said to be in a high-impedance state. One way of explaining this is that input pins make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Pins Configured as Outputs

Pins configured as outputs are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can sorce (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for connecting to sensors.

See also

- pinMode()
- Integer Constants
- boolean

Restore
May 26, 2007, at 07:43 PM by Paul Badger -
Changed lines 1-2 from:

Constants

to:

constants

Restore
April 16, 2007, at 09:33 AM by Paul Badger -
Deleted lines 16-17:

Reference Home

Restore
March 24, 2006, at 05:40 PM by Jeff Gray -
Changed lines 1-2 from:

Constants

to:

Constants

Restore
January 12, 2006, at 05:48 PM by 82.186.237.10 -
Changed lines 15-18 from:

Digital pins can be used either as **INPUT** or **OUTPUT**. These values represent precisely what their meaning stands for.

to:

Digital pins can be used either as **INPUT** or **OUTPUT**. These values represent precisely what their meaning stands for.

Restore
December 03, 2005, at 01:10 PM by 213.140.6.103 -
Added lines 1-15:

Constants

Constants are predefined variables in the system. They are used to make the programs easier to read. We classify constants in groups.

Defining Logical levels

When reading or writing to a digital pin there are only two possible values a pin can take/be-set-to: **HIGH** and **LOW**.

HIGH is representing the programming equivalent to 5 Volts. When reading the value at a digital pin if we get 3 Volts or more the microprocessor will understad it as **HIGH**. This constant represents the integer number **1**, and also the truth level **TRUE**.

LOW is representing the programming equivalen to 0 Volts. When reading the value at a digital pin if we get 2 Volts or less the microprocessor will understand it as **LOW**. This constant represents the integer number **0**, and also the truth level **FALSE**.

Defining Digital Pins

Digital pins can be used either as **INPUT** or **OUTPUT**. These values represent precisely what their meaning stands for.

Restore

constants

Constants are predefined variables in the Arduino language. They are used to make the programs easier to read. We classify constants in groups.

Defining Logical Levels, true and false (Boolean Constants)

There are two constants used to represent truth and falsity in the Arduino language: **true**, and **false**.

false

false is the easier of the two to define. false is defined as 0 (zero).

true

true is often said to be defined as 1, which is correct, but true has a wider definition. Any integer which is *non-zero* is TRUE, in a Boolean sense. So -1, 2 and -200 are all defined as true, too, in a Boolean sense.

Note that the *true* and *false* constants are typed in lowercase unlike HIGH, LOW, INPUT, & OUTPUT.

Defining Pin Levels, HIGH and LOW

When reading or writing to a digital pin there are only two possible values a pin can take/be-set-to: **HIGH** and **LOW**.

HIGH

The meaning of HIGH (in reference to a pin) is somewhat different depending on whether a pin is set to an INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report HIGH if a voltage of 3 volts or more is present at the pin.

When a pin is configured to OUTPUT with pinMode, and set to HIGH with digitalWrite, the pin is at 5 volts. In this state it can *source* current, e.g. light an LED that is connected through a series resistor to ground, or to another pin configured as an output, and set to LOW.

LOW

The meaning of LOW also has a different meaning depending on whether a pin is set to INPUT or OUTPUT. When a pin is configured as an INPUT with pinMode, and read with digitalRead, the microcontroller will report LOW if a voltage of 2 volts or less is present at the pin.

When a pin is configured to OUTPUT with pinMode, and set to LOW with digitalWrite, the pin is at 0 volts. In this state it can *sink* current, i.e. light an LED that is connected through a series resistor to, +5 volts, or to another pin configured as an output, and set to HIGH.

Defining Digital Pins, INPUT and OUTPUT

Digital pins can be used either as **INPUT** or **OUTPUT**. Changing a pin from INPUT TO OUTPUT with pinMode() drastically changes the electrical behavior of the pin.

Pins Configured as Inputs

Arduino (Atmega) pins configured as **INPUT** with pinMode() are said to be in a high-impedance state. One way of explaining this is that pins configured as INPUT make extremely small demands on the circuit that they are sampling, say equivalent to a series resistor of 100 Megohms in front of the pin. This makes them useful for reading a sensor, but not powering an LED.

Pins Configured as Outputs

Pins configured as **OUTPUT** with pinMode() are said to be in a low-impedance state. This means that they can provide a substantial amount of current to other circuits. Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This makes them useful for powering LED's but useless for reading sensors. Pins configured as outputs can also be damaged or destroyed if short circuited to either ground or 5 volt power rails. The amount of current provided by an Atmega pin is also not enough to power most relays or motors, and some interface circuitry will be required.

See also

- pinMode()
- Integer Constants
- boolean variables

Reference Home

Login to Arduino

Username:	
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Reference.IntegerConstants History

Hide minor edits - Show changes to markup

March 17, 2008, at 11:21 AM by Paul Badger -
Changed lines 52-53 from:

By default, an integer constant is treated as an int with the attendant limitations in values. To specify an integer constant with another data type, follow it with::

to:

By default, an integer constant is treated as an int with the attendant limitations in values. To specify an integer constant with another data type, follow it with:

Restore
February 13, 2008, at 10:41 AM by David A. Mellis -
Changed lines 3-5 from:

Integer constants are numbers used directly in a sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but special notation (formatters) may be used to enter numbers in other bases.

to:

Integer constants are numbers used directly in a sketch, like 123. By default, these numbers are treated as int's but you can change this with the U and L modifiers (see below).

Normally, integer constants are treated as base 10 (decimal) integers, but special notation (formatters) may be used to enter numbers in other bases.

Changed lines 52-53 from:

An integer constant may be followed by:

to:

By default, an integer constant is treated as an int with the attendant limitations in values. To specify an integer constant with another data type, follow it with::

Restore
November 23, 2007, at 05:06 PM by Paul Badger -
Changed lines 3-5 from:

Integer constants are the numbers you type directly into your sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation (formatters) to enter numbers in other bases.

to:

Integer constants are numbers used directly in a sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but special notation (formatters) may be used to enter numbers in other bases.

Restore
July 17, 2007, at 01:26 PM by David A. Mellis -
Changed lines 50-51 from:

In the C language, an integer constant may be followed by:

to:

An integer constant may be followed by:

Restore
July 17, 2007, at 01:25 PM by David A. Mellis - hex digits can be lowercase too
Changed line 16 from:

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

to:

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F, a-f valid

Restore
July 17, 2007, at 07:34 AM by Paul Badger -
Changed lines 7-8 from:

Base Example Formatter Comment

to:

Base Example Formatter Comment

Changed lines 11-16 from:

2 (binary) B1111011 capital 'B' only works with 8 bit values

```
                                             characters 0-1 valid
```

8 (octal) 0173 leading zero characters 0-7 valid

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

to:

2 (binary) B1111011 capital 'B' only works with 8 bit values

```
                                               characters 0-1 valid
```

8 (octal) 0173 leading zero characters 0-7 valid

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

Restore
July 17, 2007, at 07:33 AM by Paul Badger -
Changed lines 7-8 from:

Base Example Formatter Comment

to:

Base Example Formatter Comment

Changed lines 11-16 from:

2 (binary) B1111011 capital 'B' (only works with 8 bit values)

```
                                            characters 0-1 valid
```

8 (octal) 0173 leading zero characters 0-7 valid

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

to:

2 (binary) B1111011 capital 'B' only works with 8 bit values

```
                                             characters 0-1 valid
```

8 (octal) 0173 leading zero characters 0-7 valid

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

Restore
July 17, 2007, at 07:33 AM by Paul Badger -
Changed lines 12-13 from:
to:

```
                                            characters 0-1 valid
```

Restore
July 17, 2007, at 07:30 AM by Paul Badger -
Changed lines 51-53 from:

- a 'u' or 'U' to force the constant into an unsigned data format, like 33u
- a 'l' or 'L' to indicate a long constant, like 100000L
- a 'ul' or 'UL' to indicate an unsigned long constant, like 32767ul

to:

- a 'u' or 'U' to force the constant into an unsigned data format. Example: 33u
- a 'l' or 'L' to force the constant into a long data format. Example: 100000L
- a 'ul' or 'UL' to force the constant into an unsigned long constant. Example: 32767ul

Restore
July 17, 2007, at 07:28 AM by Paul Badger -
Changed line 51 from:

- a 'u' or 'U' to indicate an unsigned constant, like 33u

to:

- a 'u' or 'U' to force the constant into an unsigned data format, like 33u

Restore
July 17, 2007, at 07:24 AM by Paul Badger -
Changed line 38 from:

You can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler unintentionally interpret your contstant as octal

to:

You can generate a hard-to-find bug by (unintentionally) including a leading zero before a constant and having the compiler unintentionally interpret your constant as octal

Restore
July 17, 2007, at 07:23 AM by Paul Badger -
Added line 55:
Restore
July 17, 2007, at 07:23 AM by Paul Badger -
Changed line 54 from:
to:

\\

Restore
July 17, 2007, at 07:22 AM by Paul Badger -
Changed lines 54-55 from:

to:
Restore
July 17, 2007, at 07:22 AM by Paul Badger -
Changed lines 54-57 from:

to:

Restore
July 17, 2007, at 07:21 AM by Paul Badger -
Changed line 23 from:

\\\

to:

\\

Restore
June 09, 2007, at 08:09 PM by Paul Badger -
Changed line 60 from:

- #Define

to:

- #define

Restore
June 09, 2007, at 08:08 PM by Paul Badger -
Added line 60:

- #Define

Restore
May 28, 2007, at 10:19 PM by David A. Mellis - fixing typo 2 -> 10 in decimal example
Changed lines 21-22 from:

Example: `101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)`

to:

Example: `101 == 101 decimal ((1 * 10^2) + (0 * 10^1) + 1)`

Restore
May 28, 2007, at 02:01 PM by Paul Badger -
Changed line 59 from:

- Constants

to:

- constants

Restore
May 28, 2007, at 02:00 PM by Paul Badger -
Changed line 52 from:

- a 'l' or 'L' to indicate a long constant, like 100000l

to:

- a 'l' or 'L' to indicate a long constant, like 100000L

Restore
May 28, 2007, at 01:08 PM by Paul Badger -
Added line 62:

- unsigned int

Changed lines 64-65 from:
to:

- unsigned long

Restore
May 28, 2007, at 01:07 PM by Paul Badger -
Added line 52:

- a 'l' or 'L' to indicate a long constant, like 100000l

Restore
May 28, 2007, at 01:05 PM by Paul Badger -
Added lines 47-56:

U & L formatters

In the C language, an integer constant may be followed by:

- a 'u' or 'U' to indicate an unsigned constant, like 33u
- a 'ul' or 'UL' to indicate an unsigned long constant, like 32767ul

Restore
May 28, 2007, at 01:03 PM by Paul Badger -
Deleted line 23:
Restore
May 28, 2007, at 01:02 PM by Paul Badger -
Added line 22:
Restore
May 28, 2007, at 01:01 PM by Paul Badger -
Changed lines 22-23 from:
to:

Restore
May 28, 2007, at 01:01 PM by Paul Badger -
Changed lines 5-6 from:

to:
Changed lines 22-24 from:

to:
Restore
May 28, 2007, at 12:58 PM by Paul Badger -
Changed lines 8-9 from:

Base Example Formatter Comment

to:

Base Example Formatter Comment

Changed lines 12-16 from:

2 (binary) B1111011 capital 'B' (only works with 8 bit values)

8 (octal) 0173 leading zero

16 (hexadecimal) 0x7B leading 0x

to:

2 (binary) B1111011 capital 'B' (only works with 8 bit values)

8 (octal) 0173 leading zero characters 0-7 valid

16 (hexadecimal) 0x7B leading 0x characters 0-9, A-F valid

Restore
May 28, 2007, at 12:56 PM by Paul Badger -
Changed lines 8-16 from:

Base Example Comment

10 (decimal) 123

2 (binary) B1111011 (only works with 1 to 8 bit values)

8 (octal) 0173

16 (hexadecimal) 0x7B

to:

Base Example Formatter Comment

10 (decimal) 123 none

2 (binary) B1111011 capital 'B' (only works with 8 bit values)

8 (octal) 0173 leading zero

16 (hexadecimal) 0x7B leading 0x

Restore
May 28, 2007, at 12:46 PM by Paul Badger -
Changed line 40 from:

You can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler interpreting your constant unintentionally interpreted as octal

to:

You can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler unintentionally interpret your contstant as octal

Restore
May 28, 2007, at 12:45 PM by Paul Badger -
Changed lines 39-40 from:

One can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler interpreting your constant (unwantedly) as octal

to:

Warning

You can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler interpreting your constant unintentionally interpreted as octal

Restore
April 29, 2007, at 05:08 AM by David A. Mellis -
Changed lines 10-16 from:

10 (decimal) 123 default format - cannot start with 0 (zero)

2 (binary) B1111011 use capital B only (not C++ 0b), only works on bytes

8 (octal) 0173 start constant with zero (0)

16 (hexadecimal) 0x7B start with zero - x (0x)

to:

10 (decimal) 123

2 (binary) B1111011 (only works with 1 to 8 bit values)

8 (octal) 0173

16 (hexadecimal) 0x7B

Restore
April 29, 2007, at 05:07 AM by David A. Mellis - don't confuse things with extraneous information.
Deleted lines 4-6:

So why would one *want* to enter numbers in another base? Often it is convenient to enter numbers in binary form if they are being used to set port variables. This often corresponds to setting one pin HIGH and another LOW, for example.

Numbers are sometimes entered in hexidecimal to save characters in entering larger numbers. This is something that comes with practice to programmers but is often confusing to beginners.

Restore
April 25, 2007, at 10:55 PM by Paul Badger -
Restore
April 25, 2007, at 10:54 PM by Paul Badger -
Changed line 7 from:

Numbers are sometimes entered in hexidecimal to save characters in entering larger numbers. This is something that comes with practice to programmers but is often confusing to beginning programmers.

to:

Numbers are sometimes entered in hexidecimal to save characters in entering larger numbers. This is something that comes with practice to programmers but is often confusing to beginners.

Restore
April 25, 2007, at 10:52 PM by Paul Badger -
Added line 46:
Restore
April 25, 2007, at 10:51 PM by Paul Badger -
Changed lines 10-11 from:

```
 [@
```

to:

```
[@
```

Restore
April 25, 2007, at 10:50 PM by Paul Badger -
Changed lines 8-10 from:

to:

Restore
April 25, 2007, at 10:50 PM by Paul Badger -
Changed lines 3-4 from:

Integer constants are the numbers you type directly into your sketch, like `123`. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation (formatters) to enter numbers in other bases. See the following table for details.

to:

Integer constants are the numbers you type directly into your sketch, like `123`. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation (formatters) to enter numbers in other bases.

So why would one *want* to enter numbers in another base? Often it is convenient to enter numbers in binary form if they are being used to set port variables. This often corresponds to setting one pin HIGH and another LOW, for example.

Numbers are sometimes entered in hexidecimal to save characters in entering larger numbers. This is something that comes with practice to programmers but is often confusing to beginning programmers.

Restore
April 25, 2007, at 10:43 PM by Paul Badger -
Changed lines 26-27 from:

```
Example: B101 == 5 decimal. a
```

to:

```
Example: B101 == 5 decimal ((1 * 2^2) + (0 * 2^1) + 1)
```

Restore
April 25, 2007, at 10:42 PM by Paul Badger -
Changed lines 26-27 from:

Example: `B101 == 5 decimal.`

to:

Example: B101 == 5 decimal. a

Restore
April 25, 2007, at 10:41 PM by Paul Badger -
Changed lines 36-37 from:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

to:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

Restore
April 25, 2007, at 10:34 PM by Paul Badger -
Changed line 20 from:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

to:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

Restore
April 25, 2007, at 10:34 PM by Paul Badger -
Restore
April 25, 2007, at 10:29 PM by Paul Badger -
Changed line 20 from:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

to:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

Restore
April 25, 2007, at 10:27 PM by Paul Badger -
Changed line 20 from:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

to:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

Changed lines 36-37 from:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

to:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

Restore
April 25, 2007, at 10:26 PM by Paul Badger -
Changed line 20 from:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

to:

Example: 101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)

Changed lines 36-37 from:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

to:

Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)

Changed line 43 from:

Example: 0x101 == 257 decimal ((1 * 16^2) + (0 * 16^1) + 1)

to:

Example: `0x101 == 257 decimal ((1 * 16^2) + (0 * 16^1) + 1)`

Restore
April 25, 2007, at 10:25 PM by Paul Badger -
Changed line 20 from:

Example: `101 == 101 decimal`

to:

Example: `101 == 101 decimal ((1 * 2^2) + (0 * 2^1) + 1)`

Changed lines 36-37 from:

Example: `0101 == 65 decimal (1 * 8^2) + (0 * 8^1) + 1`

to:

Example: `0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)`

Added line 40:
Changed lines 43-45 from:

Example: `0x101 == 257 decimal (1 * 16^2) + (0 * 16^1) + 1`

to:

Example: `0x101 == 257 decimal ((1 * 16^2) + (0 * 16^1) + 1)`

Added line 47:

- Constants

Restore
April 25, 2007, at 10:22 PM by Paul Badger -
Added line 23:
Restore
April 25, 2007, at 10:18 PM by Paul Badger -
Changed lines 21-23 from:

to:

Changed lines 37-38 from:
to:

One can generate a hard-to-find bug by unintentionally including a leading zero before a constant and having the compiler interpreting your constant (unwantedly) as octal \\\

Changed lines 43-47 from:

To decode a two-digit hex value into decimal multiply the most significant (left-most) digit by 16 and add the right digit.

Example

to:
Restore
April 25, 2007, at 10:14 PM by Paul Badger -
Changed lines 31-33 from:

to:

Restore

April 25, 2007, at 10:13 PM by Paul Badger -
Changed lines 31-33 from:

to:

Restore
April 25, 2007, at 10:13 PM by Paul Badger -
Changed lines 31-33 from:

to:

Restore
April 25, 2007, at 10:11 PM by Paul Badger -
Changed lines 28-33 from:
to:

The binary formatter only works on bytes (8 bits) between 0 (B0) and 255 (B11111111). If it's convenient to input an int (16 bits) in binary form you can do it a two-step procedure such as this:

`myInt = (B11001100 * 256) + B10101010; // B11001100 is the high byte`

Changed lines 36-45 from:

Example: `0101 == 65 decimal`

Notice that in hexadecimal, valid characters are 0 through 9 and A through F; `A` has the value 10, `B` is 11, up to `F`, which is 15. To decode a two-digit hex value into decimal multiply the most significant (left-most) digit by 16 and add the right digit.

The binary formatter only works on bytes (8 bits) between 0 (B0) and 255 (B11111111). If it's convenient to input an int (16 bits) in binary form you can do it a two-step procedure such as this:

`myInt = (B11001100 * 256) + B10101010; // B11001100 is the high byte`

to:

Example: `0101 == 65 decimal (1 * 8^2) + (0 * 8^1) + 1`

Hexadecimal (or hex) is base sixteen. Valid characters are 0 through 9 and letters A through F; `A` has the value 10, `B` is 11, up to `F`, which is 15.

Example: `0x101 == 257 decimal (1 * 16^2) + (0 * 16^1) + 1`

To decode a two-digit hex value into decimal multiply the most significant (left-most) digit by 16 and add the right digit.

Restore
April 25, 2007, at 10:02 PM by Paul Badger -
Changed lines 18-20 from:

Decimal is base 10, this is the common-sense math with which you are aquainted. Example: `101 == 101 decimal`

to:

Decimal is base 10, this is the common-sense math with which you are aquainted.

Example: `101 == 101 decimal`

Added line 28:
Added lines 33-34:
Restore
April 25, 2007, at 10:01 PM by Paul Badger -
Changed lines 18-24 from:

Binary is base two. Only characters 0 and 1 are valid. Example: B101 == 5 decimal.

to:

Decimal is base 10, this is the common-sense math with which you are aquainted. Example: `101 == 101 decimal`

Binary is base two. Only characters 0 and 1 are valid.

Example: `B101 == 5 decimal.`

Octal is base eight. Only characters 0 through 7 are valid.

Example: `0101 == 65 decimal`

Restore
April 25, 2007, at 09:54 PM by Paul Badger -
Added lines 18-20:

Restore
April 25, 2007, at 09:54 PM by Paul Badger -
Added lines 17-21:

Binary is base two. Only characters 0 and 1 are valid. Example: B101 == 5 decimal.

Restore
April 25, 2007, at 09:51 PM by Paul Badger -
Changed lines 6-14 from:

Base Example Comment

10 (decimal) 123 default format - cannot start with 0 (zero)

2 (binary) B1111011

8 (octal) 0173

16 (hexadecimal) 0x7B

to:

Base Example Comment

10 (decimal) 123 default format - cannot start with 0 (zero)

2 (binary) B1111011 use capital B only (not C++ 0b), only works on bytes

8 (octal) 0173 start constant with zero (0)

16 (hexadecimal) 0x7B start with zero - x (0x)

Restore
April 25, 2007, at 09:48 PM by Paul Badger -
Changed lines 3-4 from:

Integer constants are the numbers you type directly into your sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation to enter numbers in other bases. See the following table for details.

to:

Integer constants are the numbers you type directly into your sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation (formatters) to enter numbers in other bases. See the following table for details.

Changed lines 6-7 from:

Base Example 10 (decimal) 123

to:

Base Example Comment

10 (decimal) 123 default format - cannot start with 0 (zero)

Added line 11:
Added line 13:

Changed lines 15-16 from:

```
 @]
```

to:

```
@]
```

Restore
April 24, 2007, at 06:19 PM by Paul Badger -
Changed lines 13-14 from:

Notice that in hexadecimal, valid characters are 0 through 9 and A through F; A has the value 10, B is 11, up to F, which is 15.

to:

Notice that in hexadecimal, valid characters are 0 through 9 and A through F; A has the value 10, B is 11, up to F, which is 15. To decode a two-digit hex value into decimal multiply the most significant (left-most) digit by 16 and add the right digit.

Deleted lines 18-20:

Deleted line 25:

Reference Home

Restore
April 24, 2007, at 06:17 PM by Paul Badger -
Changed lines 17-21 from:

@@myInt = (B11001100 * 256) + B10101010; // first constant is the high byte

to:

```
myInt = (B11001100 * 256) + B10101010; // B11001100 is the high byte
```

Restore
April 24, 2007, at 06:16 PM by Paul Badger -
Changed lines 13-16 from:

Notice that in hexadecimal, some digits can be letters; A has the value 10, B is 11, up to F, which is 15.

The binary constants only work between 0 (B0) and 255 (B11111111). The others can be negative and bigger.

to:

Notice that in hexadecimal, valid characters are 0 through 9 and A through F; A has the value 10, B is 11, up to F, which is 15.

The binary formatter only works on bytes (8 bits) between 0 (B0) and 255 (B11111111). If it's convenient to input an int (16 bits) in binary form you can do it a two-step procedure such as this:

@@myInt = (B11001100 * 256) + B10101010; // first constant is the high byte

Restore
December 02, 2006, at 09:30 AM by David A. Mellis -
Added lines 15-16:

The binary constants only work between 0 (B0) and 255 (B11111111). The others can be negative and bigger.

Restore
December 02, 2006, at 09:28 AM by David A. Mellis -
Changed lines 6-10 from:

Name Base Prefix Example Value Decimal 10 none 123 123 Binary 2 B B1111011 123 Octal 8 0 0173 123 Hexadecimal 16 0x 0x7B 123

to:

Base Example 10 (decimal) 123 2 (binary) B1111011 8 (octal) 0173 16 (hexadecimal) 0x7B

Restore
December 02, 2006, at 09:26 AM by David A. Mellis -
Added lines 1-22:

Integer Constants

Integer constants are the numbers you type directly into your sketch, like 123. Normally, these numbers are treated as base 10 (decimal) integers, but you can use special notation to enter numbers in other bases. See the following table for details.

Name	Base	Prefix	Example	Value
Decimal	10	none	123	123
Binary	2	B	B1111011	123
Octal	8	0	0173	123
Hexadecimal	16	0x	0x7B	123

Notice that in hexadecimal, some digits can be letters; A has the value 10, B is 11, up to F, which is 15.

Example

See also

- byte
- int
- long

Reference Home

Restore

Integer Constants

Integer constants are numbers used directly in a sketch, like `123`. By default, these numbers are treated as int's but you can change this with the U and L modifiers (see below).

Normally, integer constants are treated as base 10 (decimal) integers, but special notation (formatters) may be used to enter numbers in other bases.

Base	Example	Formatter	Comment
10 (decimal)	123	none	
2 (binary)	B1111011	capital 'B'	only works with 8 bit values characters 0-1 valid
8 (octal)	0173	leading zero	characters 0-7 valid
16 (hexadecimal)	0x7B	leading 0x	characters 0-9, A-F, a-f valid

Decimal is base 10, this is the common-sense math with which you are aquainted.

Example: `101 == 101 decimal ((1 * 10^2) + (0 * 10^1) + 1)`

Binary is base two. Only characters 0 and 1 are valid.

```
Example: B101 == 5 decimal ((1 * 2^2) + (0 * 2^1) + 1)
```

The binary formatter only works on bytes (8 bits) between 0 (B0) and 255 (B11111111). If it's convenient to input an int (16 bits) in binary form you can do it a two-step procedure such as this:

```
myInt = (B11001100 * 256) + B10101010; // B11001100 is the high byte
```

Octal is base eight. Only characters 0 through 7 are valid.

```
Example: 0101 == 65 decimal ((1 * 8^2) + (0 * 8^1) + 1)
```

Warning

You can generate a hard-to-find bug by (unintentionally) including a leading zero before a constant and having the compiler unintentionally interpret your constant as octal

Hexadecimal (or hex) is base sixteen. Valid characters are 0 through 9 and letters A through F; A has the value 10, B is 11, up to F, which is 15.

Example: `0x101 == 257 decimal ((1 * 16^2) + (0 * 16^1) + 1)`

U & L formatters

By default, an integer constant is treated as an int with the attendant limitations in values. To specify an integer constant with another data type, follow it with:

- a 'u' or 'U' to force the constant into an unsigned data format. Example: 33u
- a 'l' or 'L' to force the constant into a long data format. Example: 100000L

- a 'ul' or 'UL' to force the constant into an unsigned long constant. Example: 32767ul

See also

- constants
- #define
- byte
- int
- unsigned int
- long
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.BooleanVariables History

Hide minor edits - Show changes to markup

January 21, 2008, at 10:58 AM by David A. Mellis - boolean variables actually take up a full byte of memory.
Changed lines 3-4 from:

boolean variables are one-bit variables that can only hold two values, true and false.

to:

boolean variables are hold one of two values, true and false.

Restore
August 27, 2007, at 11:11 AM by David A. Mellis - should only use true and false for booleans (not 0 and 1 or HIGH and LOW)
Changed lines 3-4 from:

boolean variables are one-bit variables that can only hold two values, 1 and 0. Note that the constants HIGH and LOW are also defined as 1 and 0, as are the variables TRUE and FALSE.

to:

boolean variables are one-bit variables that can only hold two values, true and false.

Changed lines 10-11 from:

boolean running;

to:

boolean running = false;

Restore
August 23, 2007, at 02:21 PM by Paul Badger -
Changed lines 8-9 from:

int switchPin = 13; // momentary switch on 13

to:

int switchPin = 13; // momentary switch on 13, other side connected to ground

Restore
May 28, 2007, at 10:28 PM by David A. Mellis -
Changed lines 7-9 from:

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@

to:

int LEDpin = 5; // LED on pin 5 int switchPin = 13; // momentary switch on 13

Changed lines 11-12 from:

int x;

to:
Restore

May 28, 2007, at 10:28 PM by David A. Mellis - cleaning up example code
Changed lines 22-26 from:

```
  if (digitalRead(switchPin) == LOW){  // switch is pressed - pullup keeps pin high normally
  delay(100);                        // delay to debounce switch
  running = !running;                // toggle running variable
  digitalWrite(LEDpin, running)      // indicate via LED
```

// more statements

to:

```
  if (digitalRead(switchPin) == LOW)
  {  // switch is pressed - pullup keeps pin high normally
    delay(100);                        // delay to debounce switch
    running = !running;                // toggle running variable
    digitalWrite(LEDpin, running)      // indicate via LED
  }
```

Restore
May 28, 2007, at 10:27 PM by David A. Mellis - we shouldn't encourage people to assign non-boolean values to boolean variables.
Changed line 5 from:

All of the following will set the variable *running* to a TRUE condition:

to:

Example

Added lines 7-9:

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@

Deleted lines 10-23:

running = 35; // any non-zero number is TRUE running = -7; // negative numbers are non-zero (TRUE) running = HIGH; // HIGH is defined as 1 running = TRUE; // TRUE defined as 1 running = .125 // non-zero float defined as TRUE

Example

[@

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@ boolean running;

Changed lines 13-16 from:

void setup(){ pinMode(LEDpin, OUTPUT); pinMode(switchPin, INPUT); digitalWrite(switchPin, HIGH); // turn on pullup resistor

to:

void setup() {

```
  pinMode(LEDpin, OUTPUT);
  pinMode(switchPin, INPUT);
  digitalWrite(switchPin, HIGH);      // turn on pullup resistor
```

Changed lines 20-24 from:

void loop(){ if (digitalRead(switchPin) == 0){ // switch is pressed - pullup keeps pin high normally delay(100); // delay to debounce switch running = !running; // toggle running variable digitalWrite(LEDpin, running) // indicate via LED

to:

void loop() {

```
  if (digitalRead(switchPin) == LOW){  // switch is pressed - pullup keeps pin high normally
  delay(100);                         // delay to debounce switch
  running = !running;                 // toggle running variable
  digitalWrite(LEDpin, running)       // indicate via LED
```

Restore
May 28, 2007, at 01:53 PM by Paul Badger -
Changed line 10 from:

running = -7; // negative numbers are non-zero

to:

running = -7; // negative numbers are non-zero (TRUE)

Added line 12:

running = TRUE; // TRUE defined as 1

Restore
May 28, 2007, at 01:52 PM by Paul Badger -
Changed line 26 from:

digitalWrite(switchPin, HIGH); // turn on pullup resistors

to:

digitalWrite(switchPin, HIGH); // turn on pullup resistor

Changed line 30 from:

if (digitalRead(switchPin) == 0){ // switch is pressed - pullups keep pin high normally

to:

if (digitalRead(switchPin) == 0){ // switch is pressed - pullup keeps pin high normally

Restore
May 28, 2007, at 01:51 PM by Paul Badger -
Changed line 30 from:

if (digitalRead(switchPin) == 0){ // switch is pressed

to:

if (digitalRead(switchPin) == 0){ // switch is pressed - pullups keep pin high normally

Restore
May 28, 2007, at 01:50 PM by Paul Badger -
Changed line 31 from:

delay(100); // delay to debounce switch

to:

delay(100); // delay to debounce switch

Restore
May 28, 2007, at 01:49 PM by Paul Badger -
Changed line 39 from:

- Constants

to:

- constants

Restore
May 28, 2007, at 01:48 PM by Paul Badger -
Changed line 40 from:

- boolean operators?

to:

- boolean operators

Restore
May 28, 2007, at 01:47 PM by Paul Badger -
Changed lines 3-6 from:

boolean variables are one-bit variables that can only hold two values, 1 and 0. Note that the constants HIGH and LOW are also defined as 1 and 0, as are the variables TRUE and FALSE.

Example

to:

boolean variables are one-bit variables that can only hold two values, 1 and 0. Note that the constants HIGH and LOW are also defined as 1 and 0, as are the variables TRUE and FALSE.

All of the following will set the variable *running* to a TRUE condition:

Deleted lines 6-8:

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@

Changed lines 8-20 from:

boolean LEDon;

to:

running = 35; // any non-zero number is TRUE running = -7; // negative numbers are non-zero running = HIGH; // HIGH is defined as 1 running = .125 // non-zero float defined as TRUE

Example

[@

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@ boolean running;

Changed line 31 from:

delay(50); // delay to debounce switch

to:

delay(100); // delay to debounce switch

Changed line 34 from:
to:

// more statements

Changed lines 36-40 from:

@]

to:

@]

See also

- Constants
- boolean operators?

Restore
May 28, 2007, at 01:37 PM by Paul Badger -
Changed line 28 from:

-]

to:

@]

Restore
May 28, 2007, at 01:37 PM by Paul Badger -
Changed line 7 from:
to:

[@

Added line 28:

-]

Restore
May 28, 2007, at 01:36 PM by Paul Badger -
Added lines 1-27:

boolean variables

boolean variables are one-bit variables that can only hold two values, 1 and 0. Note that the constants HIGH and LOW are also defined as 1 and 0, as are the variables TRUE and FALSE.

Example

1. define LEDpin 5 // LED on pin 5
2. define switchPin 13 // momentary switch on 13

[@ boolean running; boolean LEDon; int x;

void setup(){ pinMode(LEDpin, OUTPUT); pinMode(switchPin, INPUT); digitalWrite(switchPin, HIGH); // turn on pullup resistors }

void loop(){ if (digitalRead(switchPin) == 0){ // switch is pressed delay(50); // delay to debounce switch running = !running; // toggle running variable digitalWrite(LEDpin, running) // indicate via LED

}

Restore

boolean variables

boolean variables are hold one of two values, true and false.

Example

```
int LEDpin = 5;       // LED on pin 5
int switchPin = 13;   // momentary switch on 13, other side connected to ground

boolean running = false;

void setup()
{
  pinMode(LEDpin, OUTPUT);
  pinMode(switchPin, INPUT);
  digitalWrite(switchPin, HIGH);      // turn on pullup resistor
}

void loop()
{
  if (digitalRead(switchPin) == LOW)
  {  // switch is pressed - pullup keeps pin high normally
    delay(100);                        // delay to debounce switch
    running = !running;                // toggle running variable
    digitalWrite(LEDpin, running)      // indicate via LED
  }
}
```

See also

- constants
- boolean operators

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

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Reference.Char History

Hide minor edits - Show changes to markup

September 08, 2007, at 09:22 AM by Paul Badger -
Changed lines 7-8 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println reference for more on how characters are translated to numbers.

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. This means that it is possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println reference for more on how characters are translated to numbers.

Restore
July 19, 2007, at 06:11 PM by David A. Mellis -
Changed lines 9-10 from:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the *byte* data type.

to:

The char datatype is a signed type, meaning that it encodes numbers from -128 to 127. For an unsigned, one-byte (8 bit) data type, use the *byte* data type.

Restore
July 18, 2007, at 08:12 PM by Paul Badger -
Changed lines 9-10 from:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the **byte** data type.

to:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the *byte* data type.

Restore
July 18, 2007, at 08:12 PM by Paul Badger -
Changed lines 9-10 from:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the !!!byte data type.

to:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the **byte** data type.

Restore
July 18, 2007, at 08:11 PM by Paul Badger -
Restore
July 18, 2007, at 08:09 PM by Paul Badger -
Changed lines 9-10 from:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127.

to:

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127. For an unsigned, one-byte (8 bit) data type, use the !!!byte data type.

Restore
July 18, 2007, at 08:05 PM by Paul Badger -
Changed line 20 from:

- Println?

to:

- Serial.println

Restore
July 18, 2007, at 08:04 PM by Paul Badger -
Changed lines 7-8 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println? reference for more on how characters are translated to numbers.

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println reference for more on how characters are translated to numbers.

Restore
July 18, 2007, at 08:03 PM by Paul Badger -
Changed lines 7-8 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println? reference for more on how characters are translated to numbers.

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println? reference for more on how characters are translated to numbers.

Restore
July 18, 2007, at 08:03 PM by Paul Badger -
Restore
July 18, 2007, at 08:02 PM by Paul Badger -
Changed lines 7-8 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is aslo possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See the [[Serial.println example for more on how this works.

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is also possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println? reference for more on how characters are translated to numbers.

The char datatype is a signed type, meaning that it encodes numbers from -127 to 127.

Added line 20:

- Println?

Restore
July 18, 2007, at 07:48 PM by Paul Badger -
Changed lines 7-10 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is aslo possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. myChar ='A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

See the Serial.prinln example for more on how this works.

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is aslo possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See the [[Serial.println example for more on how this works.

Restore
July 18, 2007, at 07:47 PM by Paul Badger -
Changed lines 7-8 from:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart You can also do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

to:

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. It is aslo possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. myChar ='A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

Restore
July 18, 2007, at 07:44 PM by Paul Badger -
Changed lines 5-6 from:

A data type that takes up 1 byte of memory that stores a character value. Character literals are written in single quotes, like this: 'A' (for multiple characters - strings - use double quotes: "ABC"). You can do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

to:

A data type that takes up 1 byte of memory that stores a character value. Character literals are written in single quotes, like this: 'A' (for multiple characters - strings - use double quotes: "ABC").

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart You can also do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

See the Serial.prinln example for more on how this works.

Restore
May 28, 2007, at 10:21 PM by David A. Mellis -
Deleted lines 6-8:

Synonymous with type **byte** in Arduino.

Restore
May 28, 2007, at 08:06 PM by Paul Badger -
Changed lines 7-9 from:
to:

Synonymous with type **byte** in Arduino.

Changed lines 12-26 from:

```
    char sign = ' ';
```

Parameters

```
    char var = 'x';
```

- var - your char variable name
- x - the value (single character) you assign to that variable... ie: a, 4, #, etc.

to:

```
    char myChar = 'A';
```

See also

- byte
- int
- array

Restore
May 28, 2007, at 08:03 PM by Paul Badger -
Added line 7:
Restore
April 16, 2007, at 10:57 AM by Paul Badger -
Changed lines 1-2 from:

char

to:

char

Deleted lines 21-24:

Reference Home

Restore
August 01, 2006, at 06:55 AM by David A. Mellis -
Changed lines 5-6 from:

A data type that takes up 1 byte of memory that stores a character value.

to:

A data type that takes up 1 byte of memory that stores a character value. Character literals are written in single quotes, like this: 'A' (for multiple characters - strings - use double quotes: "ABC"). You can do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65).

Changed lines 13-14 from:

```
    char var = 'val';
```

to:

```
    char var = 'x';
```

Changed lines 16-22 from:

- val - the value (single character) you assign to that variable... ie: a, 4, #, etc.

to:

- x - the value (single character) you assign to that variable... ie: a, 4, #, etc.

Restore
March 31, 2006, at 02:54 PM by Jeff Gray -
Changed lines 1-2 from:

int

to:

char

Restore
March 31, 2006, at 02:53 PM by Jeff Gray -
Changed lines 1-8 from:
to:

int

Description

A data type that takes up 1 byte of memory that stores a character value.

Example

Changed lines 11-27 from:

A data type that takes up 1 byte of memory that stores a character value.

to:

Parameters

```
char var = 'val';
```

- var - your char variable name
- val - the value (single character) you assign to that variable... ie: a, 4, #, etc.

Reference Home

Restore
February 14, 2006, at 09:54 AM by Erica Calogero -
Added lines 1-3:

```
char sign = ' ';
```

Restore
February 14, 2006, at 09:53 AM by Erica Calogero -
Added line 1:

A data type that takes up 1 byte of memory that stores a character value.

Restore

char

Description

A data type that takes up 1 byte of memory that stores a character value. Character literals are written in single quotes, like this: 'A' (for multiple characters - strings - use double quotes: "ABC").

Characters are stored as numbers however. You can see the specific encoding in the ASCII chart. This means that it is possible to do arithmetic on characters, in which the ASCII value of the character is used (e.g. 'A' + 1 has the value 66, since the ASCII value of the capital letter A is 65). See Serial.println reference for more on how characters are translated to numbers.

The char datatype is a signed type, meaning that it encodes numbers from -128 to 127. For an unsigned, one-byte (8 bit) data type, use the *byte* data type.

Example

```
    char myChar = 'A';
```

See also

- byte
- int
- array
- Serial.println

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Byte History

Hide minor edits - Show changes to markup

March 09, 2008, at 07:35 PM by David A. Mellis -
Changed lines 18-21 from:

- Serial.printIn

to:

Restore
July 18, 2007, at 08:17 PM by Paul Badger -
Changed lines 18-21 from:

- Serial.printLn?

to:

- Serial.println

Restore
July 18, 2007, at 08:16 PM by Paul Badger -
Restore
July 18, 2007, at 08:15 PM by Paul Badger -
Changed lines 5-6 from:

Bytes store an 8-bit number, from 0 to 255.

to:

Bytes store an 8-bit number, from 0 to 255. *byte* is an unsigned data type, meaning that it does not store negative numbers.

Changed lines 18-21 from:

to:

- Serial.printLn?

Restore
May 28, 2007, at 10:21 PM by David A. Mellis - bytes are actually unsigned chars, not chars (but saying so seems confusing)
Changed lines 5-6 from:

Bytes store an 8-bit number, from 0 to 255. Synonymous with type char.

to:

Bytes store an 8-bit number, from 0 to 255.

Restore
May 28, 2007, at 08:04 PM by Paul Badger -
Changed lines 5-6 from:

Bytes store an 8-bit number, from 0 to 255.

to:

Bytes store an 8-bit number, from 0 to 255. Synonymous with type char.

Restore
April 16, 2007, at 05:10 PM by David A. Mellis -
Added line 14:

- unsigned int

Added line 16:

- unsigned long

Restore
April 16, 2007, at 11:11 AM by Paul Badger -
Changed line 19 from:

Reference Home

to:
Restore
April 15, 2007, at 03:25 PM by Paul Badger -
Changed lines 9-10 from:

```
    byte b = B10010;
```

to:

```
    byte b = B10010;  // "B" is the binary formatter (18 decimal)
```

Restore
December 02, 2006, at 10:17 AM by David A. Mellis -
Changed lines 15-17 from:

to:

- integer constants

Restore
December 02, 2006, at 10:16 AM by David A. Mellis -
Changed lines 11-14 from:

to:

See also

- int
- long

Restore
December 02, 2006, at 10:16 AM by David A. Mellis -
Changed lines 5-6 from:

Bytes store an 8-bit number, from 0 to 255 (2^8 - 1).

to:

Bytes store an 8-bit number, from 0 to 255.

Restore
December 02, 2006, at 10:15 AM by David A. Mellis -
Added lines 1-15:

byte

Description

Bytes store an 8-bit number, from 0 to 255 (2^8 - 1).

Example

```
    byte b = B10010;
```

Reference Home

Restore

byte

Description

Bytes store an 8-bit number, from 0 to 255. *byte* is an unsigned data type, meaning that it does not store negative numbers.

Example

```
    byte b = B10010;  // "B" is the binary formatter (18 decimal)
```

See also

- int
- unsigned int
- long
- unsigned long
- integer constants

Reference Home

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Reference.Int History

Hide minor edits - Show changes to markup

May 26, 2007, at 08:52 PM by Paul Badger -
Changed lines 25-26 from:

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions

to:

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions.

Restore
May 26, 2007, at 08:44 PM by Paul Badger -
Changed lines 9-11 from:

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work transparently in the expected manner. There can be an unexpected complication in dealing with the bitshift right operator (>>) however.

to:

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work transparently in the expected manner. There can be an unexpected complication in dealing with the bitshift right operator (>>) however.

Restore
April 29, 2007, at 05:15 AM by David A. Mellis -
Deleted line 41:

- >>

Restore
April 24, 2007, at 06:02 PM by Paul Badger -
Changed line 42 from:

- >>?

to:

- >>

Restore
April 24, 2007, at 06:01 PM by Paul Badger -
Changed lines 7-11 from:

Int's store negative numbers with a technique called 2's complement math. The highest bit, sometimes refered to as the "sign" bit is flags the number as a negative number. The rest of the bits are inverted and 1 is added.

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work trasparently in the expected manner. There can be an additional complication in dealing with the bitshift right operator (>>) however.

to:

Int's store negative numbers with a technique called 2's complement math. The highest bit, sometimes refered to as the "sign" bit, flags the number as a negative number. The rest of the bits are inverted and 1 is added.

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work transparently in the expected manner. There can be an unexpected complication in dealing with the bitshift right operator (>>) however.

Restore
April 24, 2007, at 06:00 PM by Paul Badger -
Changed lines 9-11 from:

The Arduino takes care of dealing with negative numbers for you so arithmetic operations work in the expected manner. There can be an additional complication in dealing with the bitshift right operator (>>) however.

to:

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work trasparently in the expected manner. There can be an additional complication in dealing with the bitshift right operator (>>) however.

Restore
April 24, 2007, at 05:59 PM by Paul Badger -
Changed lines 5-6 from:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1).

to:

Integers are your primary datatype for number storage, and store a 2 byte value. This yields a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1).

Int's store negative numbers with a technique called 2's complement math. The highest bit, sometimes refered to as the "sign" bit is flags the number as a negative number. The rest of the bits are inverted and 1 is added.

The Arduino takes care of dealing with negative numbers for you so arithmetic operations work in the expected manner. There can be an additional complication in dealing with the bitshift right operator (>>) however.

Changed line 42 from:
to:

- >>?

Restore
April 16, 2007, at 05:08 PM by David A. Mellis -
Changed line 22 from:

[@ unsigned int x

to:

[@ int x

Restore
April 16, 2007, at 05:08 PM by David A. Mellis -
Changed lines 11-12 from:

Parameters

to:

Syntax

Restore
April 16, 2007, at 05:07 PM by David A. Mellis -
Changed lines 31-32 from:
to:

See Also

- byte
- unsigned int
- long
- unsigned long

Restore
April 16, 2007, at 02:25 PM by Paul Badger -
Changed lines 18-20 from:

to:

Coding Tip

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions

```
unsigned int x
x = -32,768;
x = x - 1;       // x now contains 32,767 - rolls over in neg. direction

x = 32,767;
x = x + 1;       // x now contains -32,768 - rolls over
```

Restore
April 16, 2007, at 11:12 AM by Paul Badger -
Deleted lines 20-22:

Reference Home

Restore
April 16, 2007, at 01:08 AM by Paul Badger -
Changed lines 5-6 from:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of 2^15 - 1).

to:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1).

Restore
April 16, 2006, at 03:27 PM by David A. Mellis -
Changed lines 5-6 from:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,768 (minimum value of -2^15 and a maximum value of 2^15 - 1).

to:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of 2^15 - 1).

Restore
April 16, 2006, at 03:27 PM by David A. Mellis - int is 2 bytes, not 4.
Changed lines 5-6 from:

Integers are your primary datatype for number storage, and store a 4 byte value. This gives you a range of -2147483647 to 2147483647 (minimum value of - 2^31 and a maximum value of 2^31 - 1).

to:

Integers are your primary datatype for number storage, and store a 2 byte value. This gives you a range of -32,768 to 32,768 (minimum value of -2^15 and a maximum value of 2^15 - 1).

Restore
March 24, 2006, at 01:55 PM by Jeff Gray -
Changed lines 5-6 from:

Integers are your primary form of number storage, and store a 4 byte value. This gives you a range of -2147483647 to 2147483647 (minimum value of - 2^31 and a maximum value of 2^31 - 1).

to:

Integers are your primary datatype for number storage, and store a 4 byte value. This gives you a range of -2147483647 to 2147483647 (minimum value of - 2^31 and a maximum value of 2^31 - 1).

Restore
March 24, 2006, at 01:55 PM by Jeff Gray -

Changed lines 13-14 from:

int var = val;

to:

```
int var = val;
```

Restore
March 24, 2006, at 01:55 PM by Jeff Gray -
Changed lines 13-14 from:

[int var = val;]

to:

int var = val;

Restore
March 24, 2006, at 01:55 PM by Jeff Gray -
Changed lines 13-14 from:

int var = val;

to:

[int var = val;]

Restore
March 24, 2006, at 01:54 PM by Jeff Gray -
Added lines 1-8:

int

Description

Integers are your primary form of number storage, and store a 4 byte value. This gives you a range of -2147483647 to 2147483647 (minimum value of - 2^31 and a maximum value of 2^31 - 1).

Example

Changed lines 11-23 from:

A data type that is 4 bytes long with a minimum value of - 2^31 and a maximum value of 2^31 - 1. Needed before declaring a new variable in your code.

to:

Parameters

int var = val;

- var - your int variable name
- val - the value you assign to that variable

Reference Home

Restore
February 14, 2006, at 09:58 AM by Erica Calogero -
Added lines 1-3:

```
int ledPin = 13;
```

A data type that is 4 bytes long with a minimum value of - 2^31 and a maximum value of 2^31 - 1. Needed before declaring a new variable in your code.

Restore

int

Description

Integers are your primary datatype for number storage, and store a 2 byte value. This yields a range of -32,768 to 32,767 (minimum value of -2^15 and a maximum value of (2^15) - 1).

Int's store negative numbers with a technique called 2's complement math. The highest bit, sometimes refered to as the "sign" bit, flags the number as a negative number. The rest of the bits are inverted and 1 is added.

The Arduino takes care of dealing with negative numbers for you, so that arithmetic operations work transparently in the expected manner. There can be an unexpected complication in dealing with the bitshift right operator (>>) however.

Example

```
int ledPin = 13;
```

Syntax

```
int var = val;
```

- var - your int variable name
- val - the value you assign to that variable

Coding Tip

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions.

```
int x
x = -32,768;
x = x - 1;       // x now contains 32,767 - rolls over in neg. direction

x = 32,767;
x = x + 1;       // x now contains -32,768 - rolls over
```

See Also

- byte
- unsigned int
- long
- unsigned long

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.UnsignedInt History

Hide minor edits - Show changes to markup

May 05, 2008, at 11:51 PM by David A. Mellis -
Changed lines 12-13 from:

```
int ledPin = 13;
```

to:

```
unsigned int ledPin = 13;
```

Changed lines 16-18 from:

```
int var = val;
```

- var - your int variable name

to:

```
 unsigned int var = val;
```

- var - your unsigned int variable name

Restore
May 26, 2007, at 08:51 PM by Paul Badger -
Changed lines 8-9 from:

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type (which is signed), if the high bit is a "1", the number is interpreted as a negative number, and the other 15 bits are interpreted with 2's complement math.

to:

The difference between unsigned ints and (signed) ints, lies in the way the highest bit, sometimes refered to as the "sign" bit, is interpreted. In the Arduino int type (which is signed), if the high bit is a "1", the number is interpreted as a negative number, and the other 15 bits are interpreted with 2's complement math.

Restore
May 17, 2007, at 10:41 PM by Paul Badger -
Changed lines 8-9 from:

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type, which is signed, if the high bit is a "1", the number is interpreted as a negative number and the other 15 bits are interpreted with 2's complement math.

to:

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type (which is signed), if the high bit is a "1", the number is interpreted as a negative number, and the other 15 bits are interpreted with 2's complement math.

Restore
May 17, 2007, at 10:39 PM by Paul Badger -
Changed lines 8-9 from:

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type, if the high bit is a "1", the number is interpreted as a negative number and the other 15 bits are interpreted with 2's complement math.

to:

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type, which is signed, if the high bit is a "1", the number is interpreted as a negative number and the other 15 bits are interpreted with 2's complement math.

Restore
April 24, 2007, at 05:52 PM by Paul Badger -
Restore
April 16, 2007, at 05:09 PM by David A. Mellis - not sure that unsigned int x = 65536; does what you expect (constant are signed ints, I believe)
Deleted lines 28-29:

```
   x = 65535;
```

Restore
April 16, 2007, at 05:08 PM by David A. Mellis -
Changed lines 14-15 from:

Parameters

to:

Syntax

Changed lines 34-36 from:

to:

See Also

- byte
- int
- long
- unsigned long

Restore
April 16, 2007, at 02:23 PM by Paul Badger -
Added lines 24-25:

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions

Restore
April 16, 2007, at 11:35 AM by Paul Badger -
Changed lines 24-28 from:

[@unsigned int x x = 0; x = x - 1; // x now contains 65535 - rolls over x = 65535; x = x + 1; // x now contains 0

to:

[@ unsigned int x

```
   x = 0;
   x = x - 1;       // x now contains 65535 - rolls over in neg direction

   x = 65535;
   x = x + 1;       // x now contains 0 - rolls over
```

Restore
April 16, 2007, at 11:33 AM by Paul Badger -
Changed lines 29-33 from:

to:

@]

Restore
April 16, 2007, at 11:32 AM by Paul Badger -
Added lines 1-33:

unsigned int

Description

Unsigned ints (unsigned integers) are the same as ints in that they store a 2 byte value. Instead of storing negative numbers however they only store positive values, yielding a useful range of 0 to 65,535 (2^16) - 1).

The difference lies in the way the highest bit, sometimes refered to as the "sign" bit is interpreted. In the Arduino int type, if the high bit is a "1", the number is interpreted as a negative number and the other 15 bits are interpreted with 2's complement math.

Example

```
int ledPin = 13;
```

Parameters

```
int var = val;
```

- var - your int variable name
- val - the value you assign to that variable

Coding Tip

[@unsigned int x x = 0; x = x - 1; // x now contains 65535 - rolls over x = 65535; x = x + 1; // x now contains 0

Restore

unsigned int

Description

Unsigned ints (unsigned integers) are the same as ints in that they store a 2 byte value. Instead of storing negative numbers however they only store positive values, yielding a useful range of 0 to 65,535 (2^16) - 1).

The difference between unsigned ints and (signed) ints, lies in the way the highest bit, sometimes refered to as the "sign" bit, is interpreted. In the Arduino int type (which is signed), if the high bit is a "1", the number is interpreted as a negative number, and the other 15 bits are interpreted with 2's complement math.

Example

```
    unsigned int ledPin = 13;
```

Syntax

```
     unsigned int var = val;
```

- var - your unsigned int variable name
- val - the value you assign to that variable

Coding Tip

When variables are made to exceed their maximum capacity they "roll over" back to their minimum capacitiy, note that this happens in both directions

```
   unsigned int x
   x = 0;
   x = x - 1;       // x now contains 65535 - rolls over in neg direction
   x = x + 1;       // x now contains 0 - rolls over
```

See Also

- byte
- int
- long
- unsigned long

Reference Home

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Reference.Long History

Hide minor edits - Show changes to markup

April 16, 2007, at 05:06 PM by David A. Mellis -
Changed lines 24-25 from:

Parameters

to:

Syntax

Changed lines 36-37 from:
to:

- unsigned int
- unsigned long

Restore
April 16, 2007, at 04:17 PM by Paul Badger -
Deleted lines 37-38:

Reference Home

Restore
April 16, 2007, at 01:53 AM by David A. Mellis -
Changed line 34 from:

- [[byte]

to:

- byte

Restore
April 16, 2007, at 01:53 AM by David A. Mellis -
Changed lines 32-35 from:

to:

See Also

- [[byte]
- int

Restore
April 16, 2007, at 01:07 AM by Paul Badger -
Changed lines 5-6 from:

Long variables are extended size varialbes for number storage, and store 32 bits, from -2,147,483,648 to 2,147,483,647.

to:

Long variables are extended size variables for number storage, and store 32 bits (4 bytes), from -2,147,483,648 to 2,147,483,647.

Restore
March 31, 2006, at 02:58 PM by Jeff Gray -
Changed line 28 from:

- var - your int variable name

to:

- var - your long variable name

Restore
March 31, 2006, at 02:50 PM by Jeff Gray -
Changed lines 1-2 from:

long

to:

long

Restore
March 31, 2006, at 02:50 PM by Jeff Gray -
Deleted line 23:
Restore
March 31, 2006, at 02:49 PM by Jeff Gray -
Changed lines 9-10 from:

```
    int ledPin = 13;
```

to:

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Restore
March 31, 2006, at 02:48 PM by Jeff Gray -
Changed lines 1-2 from:

32 bits, from -2,147,483,648 to 2,147,483,647.

to:

long

Description

Long variables are extended size varialbes for number storage, and store 32 bits, from -2,147,483,648 to 2,147,483,647.

Example

```
    int ledPin = 13;
```

Parameters

```
    long var = val;
```

- var - your int variable name
- val - the value you assign to that variable

Reference Home

Restore
March 31, 2006, at 02:46 PM by Jeff Gray -

Added lines 1-2:

32 bits, from -2,147,483,648 to 2,147,483,647.

Restore

long

Description

Long variables are extended size variables for number storage, and store 32 bits (4 bytes), from -2,147,483,648 to 2,147,483,647.

Example

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Syntax

```
    long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

See Also

- byte
- int
- unsigned int
- unsigned long

Reference Home

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Arduino

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Reference.UnsignedLong History

Hide minor edits - Show changes to markup

July 17, 2007, at 01:22 PM by David A. Mellis -
Changed lines 10-11 from:

long time;

to:

unsigned long time;

Restore
July 17, 2007, at 01:16 PM by David A. Mellis - minor edits
Changed lines 5-6 from:

Unsigned long variables are extended size variables for number storage, and store 32 bits (4 bytes). Unlike standard longs unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32) - 1).

to:

Unsigned long variables are extended size variables for number storage, and store 32 bits (4 bytes). Unlike standard longs unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32 - 1).

Changed lines 12-13 from:

void setup(){

to:

void setup() {

Changed lines 16-18 from:

void loop(){

to:

void loop() {

Restore
April 16, 2007, at 05:10 PM by David A. Mellis -
Changed lines 26-27 from:

```
    long var = val;
```

to:

```
    unsigned long var = val;
```

Restore
April 16, 2007, at 05:06 PM by David A. Mellis -
Changed lines 24-25 from:

Parameters

to:

Syntax

Added line 36:

- unsigned int

Restore
April 16, 2007, at 04:22 PM by Paul Badger -
Added lines 1-38:

unsigned long

Description

Unsigned long variables are extended size variables for number storage, and store 32 bits (4 bytes). Unlike standard longs unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32) - 1).

Example

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Parameters

```
    long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

See Also

- byte
- int
- long

Restore

unsigned long

Description

Unsigned long variables are extended size variables for number storage, and store 32 bits (4 bytes). Unlike standard longs unsigned longs won't store negative numbers, making their range from 0 to 4,294,967,295 (2^32 - 1).

Example

```
unsigned long time;

void setup()
{
  Serial.begin(9600);
}

void loop()
{
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Syntax

```
    unsigned long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

See Also

- byte
- int
- unsigned int
- long

Reference Home

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Arduino

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Reference.Float History

Hide minor edits - Show changes to markup

May 28, 2007, at 10:24 PM by David A. Mellis -
Changed lines 7-8 from:

Floating point math is much slower than integer math in performing calculations, so should be avoided if, for example, a loop has to run at top speed for a critical timing function. Programmers often go to some lengths to convert floating point calculations to integer math to increase speed.

to:

Floating point numbers are not exact, and may yield strange results when compared. For example `6.0 / 3.0` may not equal `2.0`. You should instead check that the absolute value of the difference between the numbers is less than some small number.

Floating point math is also much slower than integer math in performing calculations, so should be avoided if, for example, a loop has to run at top speed for a critical timing function. Programmers often go to some lengths to convert floating point calculations to integer math to increase speed.

Restore
May 28, 2007, at 08:08 PM by Paul Badger -
Changed line 31 from:

```
   y = x / 2;   // y now contains 0, integers can't hold fractions
```

to:

```
   y = x / 2;            // y now contains 0, ints can't hold fractions
```

Restore
April 16, 2007, at 05:05 PM by David A. Mellis -
Changed lines 17-18 from:

Parameters

to:

Syntax

Restore
April 16, 2007, at 11:38 AM by Paul Badger -
Changed lines 26-33 from:

int x; int y; float z;

x = 1; y = x / 2; // y now contains 0, integers can't hold fractions z = (float)x / 2.0; // z now contains .5 (you have to use 2.0, not 2)@]

to:

```
   int x;
   int y;
   float z;

   x = 1;
   y = x / 2;   // y now contains 0, integers can't hold fractions
   z = (float)x / 2.0;   // z now contains .5 (you have to use 2.0, not 2)@]
```

Restore
April 16, 2007, at 11:36 AM by Paul Badger -
Deleted line 37:

Reference Home

Restore
April 14, 2007, at 03:14 PM by Paul Badger -
Changed lines 32-33 from:

z = x / 2.0; // z now contains .5 (you have to use 2.0, not 2)@]

to:

z = (float)x / 2.0; // z now contains .5 (you have to use 2.0, not 2)@]

Restore
April 14, 2007, at 11:01 AM by David A. Mellis - correcting float = int / int; to float = int / float;
Changed lines 32-33 from:

z = x / 2; // z now contains .5@]

to:

z = x / 2.0; // z now contains .5 (you have to use 2.0, not 2)@]

Restore
April 14, 2007, at 12:06 AM by Paul Badger -
Changed line 9 from:

That being said, floating point math is one of the things missing from many beginning microcontroller systems.

to:

That being said, floating point math is useful for a wide range of physical computing tasks, and is one of the things missing from many beginning microcontroller systems.

Changed lines 22-24 from:

- val - the value you assign to that variable

to:

- val - the value you assign to that variable

Example Code

```
int x;
int y;
float z;

x = 1;
y = x / 2;   // y now contains 0, integers can't hold fractions
z = x / 2;   // z now contains .5
```

Programming Tip

Serial.println() truncates floats (throws away the fractions) into integers when sending serial. Multiply by power of ten to preserve resolution.

Restore
April 13, 2007, at 11:54 PM by Paul Badger -
Changed lines 14-15 from:

```
 float myfloat;
```

float sensorCalbrate = 1.117;

to:

```
    float myfloat;
    float sensorCalbrate = 1.117;
```

Restore
April 13, 2007, at 11:51 PM by Paul Badger -
Changed lines 7-9 from:

Floats are much slower than integers to perform calculations with, so should be avoided if, for example, a loop has to run at top speed for a critical timing function.

to:

Floating point math is much slower than integer math in performing calculations, so should be avoided if, for example, a loop has to run at top speed for a critical timing function. Programmers often go to some lengths to convert floating point calculations to integer math to increase speed.

That being said, floating point math is one of the things missing from many beginning microcontroller systems.

Changed lines 18-20 from:

```
int var = val;
```

- var - your int variable name

to:

```
float var = val;
```

- var - your float variable name

Deleted lines 23-26:

Restore
April 13, 2007, at 11:43 PM by Paul Badger -
Added lines 1-26:

float

Description

Datatype for floating-point numbers, a number that has a decimal point. Floating-point numbers are often used to approximate analog and continuous values because they have greater resolution than integers. Floating-point numbers can be as large as 3.4028235E+38 and as low as -3.4028235E+38. They are stored as 32 bits (4 bytes) of information.

Floats are much slower than integers to perform calculations with, so should be avoided if, for example, a loop has to run at top speed for a critical timing function.

Examples

```
 float myfloat;
```

float sensorCalbrate = 1.117;

Parameters

```
int var = val;
```

- var - your int variable name
- val - the value you assign to that variable

Reference Home

Restore

float

Description

Datatype for floating-point numbers, a number that has a decimal point. Floating-point numbers are often used to approximate analog and continuous values because they have greater resolution than integers. Floating-point numbers can be as large as 3.4028235E+38 and as low as -3.4028235E+38. They are stored as 32 bits (4 bytes) of information.

Floating point numbers are not exact, and may yield strange results when compared. For example `6.0 / 3.0` may not equal `2.0`. You should instead check that the absolute value of the difference between the numbers is less than some small number.

Floating point math is also much slower than integer math in performing calculations, so should be avoided if, for example, a loop has to run at top speed for a critical timing function. Programmers often go to some lengths to convert floating point calculations to integer math to increase speed.

That being said, floating point math is useful for a wide range of physical computing tasks, and is one of the things missing from many beginning microcontroller systems.

Examples

```
    float myfloat;
    float sensorCalbrate = 1.117;
```

Syntax

```
    float var = val;
```

- var - your float variable name
- val - the value you assign to that variable

Example Code

```
   int x;
   int y;
   float z;

   x = 1;
   y = x / 2;            // y now contains 0, ints can't hold fractions
   z = (float)x / 2.0;   // z now contains .5 (you have to use 2.0, not 2)
```

Programming Tip

Serial.println() truncates floats (throws away the fractions) into integers when sending serial. Multiply by power of ten to preserve resolution.

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Login to Arduino

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Reference.Double History

Hide minor edits - Show changes to markup

April 09, 2008, at 09:01 AM by David A. Mellis -
Changed lines 5-6 from:

Double precision floating point number. Occupies 8 bytes. The maximum value a double can represent is 1.7976931348623157 x 10^308. Yes that's 10 to the 308th power. Just in case you get your Arduino project a spot as a space shuttle experiment.

to:

Double precision floating point number. Occupies 4 bytes.

Restore
April 27, 2007, at 10:22 PM by Paul Badger -
Added lines 3-4:

Desciption

Restore
April 27, 2007, at 10:16 PM by Paul Badger -
Changed lines 5-6 from:

See:

to:

See:

Restore
April 27, 2007, at 10:15 PM by Paul Badger -
Added lines 1-7:

double

Double precision floating point number. Occupies 8 bytes. The maximum value a double can represent is 1.7976931348623157 x 10^308. Yes that's 10 to the 308th power. Just in case you get your Arduino project a spot as a space shuttle experiment.

See:

- Float

Restore

double

Desciption

Double precision floating point number. Occupies 4 bytes.

See:

- Float

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

Arduino

search

Login to Arduino

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Reference.String History

Hide minor edits - Show changes to markup

January 10, 2008, at 10:52 PM by Paul Badger -
Changed lines 50-51 from:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

to:

It is often convenient, when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

Restore
November 17, 2007, at 11:14 PM by Paul Badger -
Restore
November 17, 2007, at 11:11 PM by Paul Badger -
Changed lines 29-32 from:

Generally, strings are terminated with a null character (ASCII code 0). This allows function (like Serial.print()) to tell where the end of a string is. Otherwise, they would continue reading subsequent bytes of memory that aren't actually part of the string.

This means that your string needs to have space for one more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled by a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

to:

Generally, strings are terminated with a null character (ASCII code 0). This allows functions (like Serial.print()) to tell where the end of a string is. Otherwise, they would continue reading subsequent bytes of memory that aren't actually part of the string.

This means that your string needs to have space for one more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled with a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

Restore
November 05, 2007, at 03:02 PM by Paul Badger -
Changed lines 50-53 from:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an expample of a two-dimensional array.

It isn't necessary to understand this construction in detail to use it effectively. The code fragments below illustrate the idea.

to:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

In the code below, the asterisk after the datatype char "char*" indicates that this is an array of "pointers". All array names are actually pointers, so this is required to make an array of arrays. Pointers are one of the more esoteric parts of C for beginners to understand, but it isn't necessary to understand pointers in detail to use them effectively here.

Example

Restore
October 27, 2007, at 09:58 PM by Paul Badger -
Changed lines 72-79 from:

array PROGMEM

to:

- array
- PROGMEM

Restore
October 27, 2007, at 09:58 PM by Paul Badger -
Changed lines 70-76 from:

to:

See Also

array PROGMEM

Restore
October 27, 2007, at 09:50 PM by Paul Badger -
Changed line 65 from:

```
   Serial.print(myStrings[i]);
```

to:

```
   Serial.println(myStrings[i]);
```

Restore
October 27, 2007, at 09:36 PM by Paul Badger -
Restore
October 27, 2007, at 09:29 PM by Paul Badger -
Changed lines 50-53 from:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually a two-dimensional array.

It isn't necessary to understand this contruction in detail to use it effectively. The code fragments below illustrate the idea.

to:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an expample of a two-dimensional array.

It isn't necessary to understand this construction in detail to use it effectively. The code fragments below illustrate the idea.

Restore
October 27, 2007, at 09:26 PM by Paul Badger -
Deleted line 63:
Restore
October 27, 2007, at 09:26 PM by Paul Badger -
Changed line 56 from:

char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",//

to:

char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",

Restore
October 27, 2007, at 09:25 PM by Paul Badger -
Changed lines 56-59 from:

char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",
"This is string 4", "This is string 5","This is string 6", };

to:

char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",// "This is string 4", "This is string 5","This is string 6"};

Restore
October 27, 2007, at 09:24 PM by Paul Badger -
Changed lines 50-51 from:

It is often useful when working with several strings, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually a two-dimensional array. The code fragments below illustrate the idea.

to:

It is often convenient when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually a two-dimensional array.

It isn't necessary to understand this contruction in detail to use it effectively. The code fragments below illustrate the idea.

Changed lines 56-57 from:

char* myStrings[]={"This is string 1", "This is string 2"};

to:

char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",
"This is string 4", "This is string 5","This is string 6", };

Changed lines 65-68 from:

Serial.print(myStrings[0]); delay(100); Serial.print(myStrings[1]); delay(100);

to:

for (int i = 0; i < 6; i++){

```
   Serial.print(myStrings[i]);
   delay(500);
   }
```

Restore
October 27, 2007, at 09:16 PM by Paul Badger -
Changed lines 18-19 from:

Possibilities for declaring strings

to:

Possibilities for declaring strings

Changed lines 35-36 from:

Single quotes or double quotes?

to:

Single quotes or double quotes?

Changed lines 39-40 from:

Wrapping long strings

to:

Wrapping long strings

Changed lines 48-53 from:

to:

Arrays of strings

It is often useful when working with several strings, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually a two-dimensional array. The code fragments below illustrate the idea.

```
char* myStrings[]={"This is string 1", "This is string 2"};

void setup(){
Serial.begin(9600);
}

void loop(){
Serial.print(myStrings[0]);
delay(100);
Serial.print(myStrings[1]);
delay(100);
}
```

Restore
October 27, 2007, at 09:09 PM by Paul Badger -
Changed lines 27-28 from:

Null termination

to:

Null termination

Restore
September 27, 2007, at 12:34 PM by David A. Mellis -
Changed lines 5-6 from:

Strings in the C programming language are represented as arrays of type char.

to:

Strings are represented as arrays of type char and are null-terminated.

Restore
September 27, 2007, at 10:50 AM by Paul Badger -
Changed lines 5-6 from:

Strings in the C programming language are represented as arrays of chars.

to:

Strings in the C programming language are represented as arrays of type char.

Restore
September 27, 2007, at 10:47 AM by Paul Badger -
Changed lines 31-32 from:

This means that your string needs to have space for more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled by a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

to:

This means that your string needs to have space for one more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled by a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

Restore
May 31, 2007, at 09:30 AM by David A. Mellis -
Changed line 7 from:

String declarations

to:

Examples

Restore

May 31, 2007, at 09:29 AM by David A. Mellis - Clarifying the language.
Changed lines 5-6 from:

Strings in the C programming language are defined as arrays of type char.

to:

Strings in the C programming language are represented as arrays of chars.

Changed line 12 from:

```
  char Str3[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
```

to:

```
  char Str3[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o', '\0'};
```

Changed lines 23-24 from:

- Initialization is in the form of a string constant in quotation marks, the compiler will size the array to fit the constant and add the extra null, Str4
- Initialize the array with an explicit size, Str5

to:

- Initialize with a string constant in quotation marks; the compiler will size the array to fit the string constant and a terminating null character, Str4
- Initialize the array with an explicit size and string constant, Str5

Deleted line 26:
Changed lines 29-32 from:

Note the differences between Str2 & Str3, in theory it seems the array of Str1 should be able to be contained with a declaration of 7 elements in the array, since there are only 7 letters in "Arduino". However the Arduino language enforces "null termination" meaning that the last character of an array must be a null (denoted by \0), as in Str2.

When declaring a string, you must declare an extra character for this null or the compiler will complain with an error about the initialization string being too long. For the same reasons, Str3 can hold only 14 characters, not 15, as one might assume.

to:

Generally, strings are terminated with a null character (ASCII code 0). This allows function (like Serial.print()) to tell where the end of a string is. Otherwise, they would continue reading subsequent bytes of memory that aren't actually part of the string.

This means that your string needs to have space for more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled by a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

Note that it's possible to have a string without a final null character (e.g. if you had specified the length of Str2 as seven instead of eight). This will break most functions that use strings, so you shouldn't do it intentionally. If you notice something behaving strangely (operating on characters not in the string), however, this could be the problem.

Restore
May 31, 2007, at 09:16 AM by David A. Mellis - don't want {} around a multi-line string - it makes it into an array of strings.
Changed line 42 from:

char myString[] = {"This is the first line"

to:

char myString[] = "This is the first line"

Changed line 44 from:

" etcetera"};

to:

" etcetera";

Restore

May 29, 2007, at 02:16 PM by Paul Badger -
Changed lines 38-39 from:
to:

Wrapping long strings

You can wrap long strings like this:

```
char myString[] = {"This is the first line"
" this is the second line"
" etcetera"};
```

Restore
April 16, 2007, at 11:03 AM by Paul Badger -
Changed line 39 from:

Reference Home

to:
Restore
April 15, 2007, at 03:00 PM by Paul Badger -
Changed lines 21-27 from:

- Declare an array of chars (with one extra char)and the compiler will add the required null character
- Explicitly add the null character
- Initialization is in the form of a string constant in quotation marks, the compiler will size the array to fit the constant and add the extra null
- Initialize the array with an explicit size
- Initialize the array, leaving extra space for a larger string

to:

- Declare an array of chars (with one extra char) and the compiler will add the required null character, as in Str2
- Explicitly add the null character, Str3
- Initialization is in the form of a string constant in quotation marks, the compiler will size the array to fit the constant and add the extra null, Str4
- Initialize the array with an explicit size, Str5
- Initialize the array, leaving extra space for a larger string, Str6

Restore
April 15, 2007, at 12:54 PM by Paul Badger -
Changed line 8 from:

All of the following are valid declarations of valid strings.

to:

All of the following are valid declarations for strings.

Changed lines 17-18 from:

Facts about strings

to:
Restore
April 15, 2007, at 12:53 PM by Paul Badger -
Changed line 8 from:

Strings can be declared in any of the following manners

to:

All of the following are valid declarations of valid strings.

Changed lines 10-12 from:

```
  char Str1[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char Str2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char Str3[4];
```

to:

```
  char Str1[15];
  char Str2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char Str3[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
```

Changed lines 17-56 from:

Null termination

Note the differences between Str1 & Str2, in theory it seems the array of Str1 should be able to be contained with a declaration of 7 elements in the array, since there are only 7 letters in "Arduino". However the Arduino language enforces "null termination" meaning that the last character of an array must be a null (denoted by \0), as in Str2. If you haven't declared an extra character for this null, the compiler will complain with an error about the initialization string being too long.

In the first example the array is initialized with constants of type **char**, 'a', 'r'. 'd', etc. These constants (letters in this case, but any ASCII symbols really) are declared by enclosing them in single quotes. In example four, the initialization of the string is shown with the whole word in **quotation marks** as in "arduino"

Note that in example 4 above, the

Example

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Parameters

```
    long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

to:

Facts about strings

Possibilities for declaring strings

- Declare an array of chars without initializing it as in Str1
- Declare an array of chars (with one extra char)and the compiler will add the required null character
- Explicitly add the null character
- Initialization is in the form of a string constant in quotation marks, the compiler will size the array to fit the constant and add the extra null
- Initialize the array with an explicit size
- Initialize the array, leaving extra space for a larger string

Null termination

Note the differences between Str2 & Str3, in theory it seems the array of Str1 should be able to be contained with a declaration of 7 elements in the array, since there are only 7 letters in "Arduino". However the Arduino language enforces "null termination" meaning that the last character of an array must be a null (denoted by \0), as in Str2.

When declaring a string, you must declare an extra character for this null or the compiler will complain with an error about the initialization string being too long. For the same reasons, Str3 can hold only 14 characters, not 15, as one might assume.

Single quotes or double quotes?

Strings are always defined inside double quotes ("Abc") and characters are always defined inside single quotes('A').

Restore
April 14, 2007, at 11:24 PM by Paul Badger -
Restore
April 14, 2007, at 11:24 PM by Paul Badger -
Changed lines 10-15 from:

```
  char myStr1[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char myStr2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char myStr3[4];
  char myStr4[ ] = "arduino";
  char myStr5[8] = "arduino";
  char myStr6[15] = "arduino";
```

to:

```
  char Str1[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char Str2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char Str3[4];
  char Str4[ ] = "arduino";
  char Str5[8] = "arduino";
  char Str6[15] = "arduino";
```

Changed lines 17-18 from:

A couple of things to note.

to:

Null termination

Note the differences between Str1 & Str2, in theory it seems the array of Str1 should be able to be contained with a declaration of 7 elements in the array, since there are only 7 letters in "Arduino". However the Arduino language enforces "null termination" meaning that the last character of an array must be a null (denoted by \0), as in Str2. If you haven't declared an extra character for this null, the compiler will complain with an error about the initialization string being too long.

Restore
April 14, 2007, at 11:12 PM by Paul Badger -
Changed lines 10-15 from:

```
  char myStr[7] = {'a', 'r', 'd', 'u', 'i' 'n' 'o'};
  char myStr[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char myStr[4];
  char myStr[ ] = "arduino";
  char myStr[7] = "arduino";
  char myStr[15] = "arduino";
```

to:

```
  char myStr1[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char myStr2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char myStr3[4];
  char myStr4[ ] = "arduino";
  char myStr5[8] = "arduino";
  char myStr6[15] = "arduino";
```

Changed lines 19-22 from:

In the first example the array is initialized with constants of type **char** 'a', 'r'. 'd', etc. These constants (letters in this case, but any ASCII symbols really) are declared by enclosing in single quotes. In example four, the initialization of the string is shown with the whole word in **quotation marks**

to:

In the first example the array is initialized with constants of type **char**, 'a', 'r'. 'd', etc. These constants (letters in this case, but any ASCII symbols really) are declared by enclosing them in single quotes. In example four, the initialization of the string is shown with the whole word in **quotation marks** as in "arduino"

Restore
April 14, 2007, at 11:07 PM by Paul Badger -
Changed lines 10-15 from:

```
  char str[5] = {'a', 'r', 'd', 'u', 'i' 'n' 'o'};
  char str[6] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char str[3];
  char str[ ] = "arduino";
  char str[7] = "arduino";
  char str[15] = "arduino";
```

to:

```
  char myStr[7] = {'a', 'r', 'd', 'u', 'i' 'n' 'o'};
  char myStr[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char myStr[4];
  char myStr[ ] = "arduino";
  char myStr[7] = "arduino";
  char myStr[15] = "arduino";
```

Changed lines 19-21 from:

In the first example the array is initialized with constants of type **char**.

to:

In the first example the array is initialized with constants of type **char** 'a', 'r'. 'd', etc. These constants (letters in this case, but any ASCII symbols really) are declared by enclosing in single quotes. In example four, the initialization of the string is shown with the whole word in **quotation marks**

Restore
April 14, 2007, at 11:02 PM by Paul Badger -
Added lines 1-53:

string

Description

Strings in the C programming language are defined as arrays of type char.

String declarations

Strings can be declared in any of the following manners

```
  char str[5] = {'a', 'r', 'd', 'u', 'i' 'n' 'o'};
  char str[6] = {'a', 'r', 'd', 'u', 'i', 'n', 'o','\0'};
  char str[3];
  char str[ ] = "arduino";
  char str[7] = "arduino";
  char str[15] = "arduino";
```

A couple of things to note. In the first example the array is initialized with constants of type **char**.

Note that in example 4 above, the

Example

```
long time;

void setup(){
  Serial.begin(9600);
}
void loop(){
  Serial.print("Time: ");
  time = millis();
  //prints time since program started
  Serial.println(time);
  // wait a second so as not to send massive amounts of data
  delay(1000);
}
```

Parameters

```
long var = val;
```

- var - your long variable name
- val - the value you assign to that variable

Reference Home

Restore

string

Description

Strings are represented as arrays of type char and are null-terminated.

Examples

All of the following are valid declarations for strings.
```
  char Str1[15];
  char Str2[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o'};
  char Str3[8] = {'a', 'r', 'd', 'u', 'i', 'n', 'o', '\0'};
  char Str4[ ] = "arduino";
  char Str5[8] = "arduino";
  char Str6[15] = "arduino";
```

Possibilities for declaring strings

- Declare an array of chars without initializing it as in Str1
- Declare an array of chars (with one extra char) and the compiler will add the required null character, as in Str2
- Explicitly add the null character, Str3
- Initialize with a string constant in quotation marks; the compiler will size the array to fit the string constant and a terminating null character, Str4
- Initialize the array with an explicit size and string constant, Str5
- Initialize the array, leaving extra space for a larger string, Str6

Null termination

Generally, strings are terminated with a null character (ASCII code 0). This allows functions (like Serial.print()) to tell where the end of a string is. Otherwise, they would continue reading subsequent bytes of memory that aren't actually part of the string.

This means that your string needs to have space for one more character than the text you want it to contain. That is why Str2 and Str5 need to be eight characters, even though "arduino" is only seven - the last position is automatically filled with a null character. Str4 will be automatically sized to eight characters, one for the extra null. In Str3, we've explicitly included the null character (written '\0') ourselves.

Note that it's possible to have a string without a final null character (e.g. if you had specified the length of Str2 as seven instead of eight). This will break most functions that use strings, so you shouldn't do it intentionally. If you notice something behaving strangely (operating on characters not in the string), however, this could be the problem.

Single quotes or double quotes?

Strings are always defined inside double quotes ("Abc") and characters are always defined inside single quotes('A').

Wrapping long strings

You can wrap long strings like this:
```
char myString[] = "This is the first line"
" this is the second line"
" etcetera";
```

Arrays of strings

It is often convenient, when working with large amounts of text, such as a project with an LCD display, to setup an array of strings. Because strings themselves are arrays, this is in actually an example of a two-dimensional array.

In the code below, the asterisk after the datatype char "char*" indicates that this is an array of "pointers". All array names are actually pointers, so this is required to make an array of arrays. Pointers are one of the more esoteric parts of C for beginners to understand, but it isn't necessary to understand pointers in detail to use them effectively here.

Example

```
char* myStrings[]={"This is string 1", "This is string 2", "This is string 3",
"This is string 4", "This is string 5","This is string 6"};

void setup(){
Serial.begin(9600);
}

void loop(){
for (int i = 0; i < 6; i++){
   Serial.println(myStrings[i]);
   delay(500);
   }
}
```

See Also

- array
- PROGMEM

Reference Home

Corrections, suggestions, and new documentation should be posted to the Forum.

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Reference.Array History

Hide minor edits - Show changes to markup

January 10, 2008, at 10:49 PM by Paul Badger -
Changed lines 35-36 from:

Unlike in some version of BASIC, the C compiler does no checking to see if array access is within legal bounds of the array size that you have declared.

to:

Unlike in some versions of BASIC, the C compiler does no checking to see if array access is within legal bounds of the array size that you have declared.

Restore
May 26, 2007, at 08:07 PM by Paul Badger -
Added lines 35-36:

Unlike in some version of BASIC, the C compiler does no checking to see if array access is within legal bounds of the array size that you have declared.

Restore
May 26, 2007, at 08:05 PM by Paul Badger -
Added lines 32-34:

For this reason you should be careful in accessing arrays. Accessing past the end of an array (using an index number greater than your declared array size - 1) is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Deleted lines 55-58:

Coding Tip

Be careful in accessing arrays. Accessing past the end of an array (using an index number greater than your declared array size - 1) is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Restore
May 26, 2007, at 08:01 PM by Paul Badger -
Changed line 26 from:

It also means that in an array with ten elements, that index nine is the last element. Hence:

to:

It also means that in an array with ten elements, index nine is the last element. Hence:

Restore
May 26, 2007, at 08:01 PM by Paul Badger -
Changed line 30 from:

```
    // myArray[10]   is invalid and contains random       information (other memory address)
```

to:

```
    // myArray[10]   is invalid and contains random information (other memory address)
```

Restore
May 26, 2007, at 08:00 PM by Paul Badger -
Changed lines 31-32 from:
to:

@]

Restore
May 26, 2007, at 08:00 PM by Paul Badger -
Changed line 26 from:

To assign a value to an array:

to:

It also means that in an array with ten elements, that index nine is the last element. Hence:

Added lines 28-34:

int myArray[10]={9,3,2,4,3,2,7,8,9,11};

```
     // myArray[9]    contains 11
     // myArray[10]   is invalid and contains random       information (other memory address)
```

To assign a value to an array:

[@

Changed lines 56-57 from:

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

to:

Be careful in accessing arrays. Accessing past the end of an array (using an index number greater than your declared array size - 1) is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Restore
May 26, 2007, at 07:52 PM by Paul Badger -
Deleted line 42:
Restore
May 26, 2007, at 07:51 PM by Paul Badger -
Changed line 23 from:

Arrays are **zero indexed**, that is, refering to the assignment above, the first element of the array is at index 0, hence\\\

to:

Arrays are **zero indexed**, that is, referring to the array initialization above, the first element of the array is at index 0, hence\\\

Restore
May 26, 2007, at 07:49 PM by Paul Badger -
Changed line 23 from:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence\\\

to:

Arrays are **zero indexed**, that is, refering to the assignment above, the first element of the array is at index 0, hence\\\

Restore
April 18, 2007, at 02:00 AM by David A. Mellis -
Changed line 11 from:

```
  int myPins[] = {1, 5, 17, -2, 3};
```

to:

```
  int myPins[] = {2, 4, 8, 3, 6};
```

Added line 13:

```
  char message[6] = "hello";
```

Changed lines 17-18 from:

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and adds one more element for a required null character terminator.

to:

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and creates an array of the appropriate size.

Changed line 40 from:

```
  Serial.println(pins[i]);
```

to:

```
  Serial.println(myPins[i]);
```

Restore
April 17, 2007, at 08:29 PM by Paul Badger -
Changed line 25 from:

To assign a value to an array:

to:

To assign a value to an array:

Changed lines 27-28 from:

mySensVals[0] = 10; @] **To retrieve a value from an array:**

to:

mySensVals[0] = 10;@]

To retrieve a value from an array:

Changed lines 34-35 from:

Arrays are often manipulated inside **for** loops, where the loop counter is used as the index for each array element. To print the elements of an array over the serial port, you could do something like this:

to:

Arrays are often manipulated inside **for** loops, where the loop counter is used as the index for each array element. For example, to print the elements of an array over the serial port, you could do something like this:

Restore
April 17, 2007, at 08:27 PM by Paul Badger -
Changed lines 28-29 from:

@] **To retrieve a value from an array:**

to:

@] **To retrieve a value from an array:**

Added lines 31-32:

Arrays and FOR Loops

Restore
April 17, 2007, at 08:26 PM by Paul Badger -
Changed lines 18-19 from:

Finally you can both initialize and size your array, as in mySensVals. Note however that one more element than your initialization is required, to hold the required null character.

to:

Finally you can both initialize and size your array, as in mySensVals. Note that when declaring an array of type char, one more element than your initialization is required, to hold the required null character.

Changed lines 22-24 from:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence `mySensVals[0] == 2, mySensVals[1] == 4`, and so forth.

To assign a value to an array, do something like this

to:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence

`mySensVals[0] == 2, mySensVals[1] == 4`, and so forth.

To assign a value to an array:

Changed line 29 from:

To retrieve a value from an array, something like

to:

To retrieve a value from an array:

Restore
April 16, 2007, at 11:49 PM by Paul Badger -
Changed lines 22-23 from:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence @@mySensVals[0] == 2, mySensVals[1] == 4, and so forth.

to:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence `mySensVals[0] == 2, mySensVals[1] == 4`, and so forth.

Restore
April 16, 2007, at 11:47 PM by Paul Badger -
Changed lines 22-23 from:

Arrays are zero indexed, that is, the first element of the array is at index 0 so @@mySensVals[0] == 2, mySensVals[1] == 4, and so forth.

to:

Arrays are **zero indexed**, that is, the first element of the array is at index 0, hence @@mySensVals[0] == 2, mySensVals[1] == 4, and so forth.

Restore
April 16, 2007, at 11:46 PM by Paul Badger -
Changed lines 16-19 from:

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and adds one more element for a required null character.

Finally you can both initialize and size your array. Note however that one more element than your initialization is required, to hold the required null character.

to:

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and adds one more element for a required null character terminator.

Finally you can both initialize and size your array, as in mySensVals. Note however that one more element than your initialization is required, to hold the required null character.

Changed lines 31-32 from:

To print the elements of an array over the serial port, you could do something like this:

to:

Arrays are often manipulated inside **for** loops, where the loop counter is used as the index for each array element. To print the elements of an array over the serial port, you could do something like this:

Restore
April 16, 2007, at 11:42 PM by Paul Badger -
Changed lines 3-4 from:

An array is a collection of variables that are accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but using simple arrays is relatively easy.

to:

An array is a collection of variables that are accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but using simple arrays is relatively straightforward.

Restore
April 16, 2007, at 11:41 PM by Paul Badger -
Changed lines 7-8 from:

To create an array, of, say, 5 integers, place a statement like this at the top of your sketch or the start of a function:

to:

All of the methods below are valid ways to create (declare) an array.

Changed lines 10-12 from:

int pins[5];

to:

```
  int myInts[6];
  int myPins[] = {1, 5, 17, -2, 3};
  int mySensVals[6] = {2, 4, -8, 3, 2};
```

Changed lines 15-16 from:

If you want to give the elements of the array initial values, use a statement like this instead:

to:

You can declare an array without initializing it as in myInts.

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and adds one more element for a required null character.

Finally you can both initialize and size your array. Note however that one more element than your initialization is required, to hold the required null character.

Accessing an Array

Arrays are zero indexed, that is, the first element of the array is at index 0 so @@mySensVals[0] == 2, mySensVals[1] == 4, and so forth.

To assign a value to an array, do something like this

Changed line 26 from:

int pins[5] = { 11, 3, 5, 4, 2 };

to:

mySensVals[0] = 10;

Changed lines 28-34 from:

This will assign the value 11 to the first elements in the array, the value 3 to the second, etc.

Accessing an Array

The first thing you need to know is that **arrays are zero indexed**, that is, the first element of the array is at index 0 and is accessed with a statement like:

to:

To retrieve a value from an array, something like `x = mySensVals[4];`

To print the elements of an array over the serial port, you could do something like this:

Changed lines 34-37 from:

pins[0] = 10;

to:

int i; for (i = 0; i < 5; i = i + 1) {

```
  Serial.println(pins[i]);
```

```
}
```

Deleted lines 39-47:

To print the elements of an array over the serial port, you could do something like this:

```
int i;
for (i = 0; i < 5; i = i + 1) {
  Serial.println(pins[i]);
}
```

Restore
April 16, 2007, at 11:19 PM by Paul Badger -
Changed lines 3-4 from:

An array is a group of variables that is accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but simple things should be relatively easy. The basics operations are:

to:

An array is a collection of variables that are accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but using simple arrays is relatively easy.

Restore
April 16, 2007, at 11:50 AM by Paul Badger -
Changed lines 5-6 from:

Creating (declaring) an array

to:

Creating (Declaring) an Array

Changed lines 21-22 from:

Accessing an Array

to:

Accessing an Array

Changed lines 38-39 from:

Example

to:

Example

Restore

April 16, 2007, at 11:48 AM by Paul Badger -
Changed lines 5-6 from:

Creating an Array

to:

Creating (declaring) an array

Restore
April 16, 2007, at 11:44 AM by Paul Badger -
Changed lines 44-45 from:

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

to:

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Restore
April 16, 2007, at 11:43 AM by Paul Badger -
Changed lines 3-6 from:

Arrays in the C programming language, on which Arduino is based, can be complicated, but simple things should be relatively easy. The basics operations are:

Creating an Array

to:

An array is a group of variables that is accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but simple things should be relatively easy. The basics operations are:

Creating an Array

Restore
April 16, 2007, at 11:40 AM by Paul Badger -
Changed lines 1-2 from:

Arrays

to:

Arrays

Changed lines 42-43 from:

Tip

to:

Coding Tip

Restore
April 15, 2007, at 10:13 PM by Paul Badger -
Restore
April 15, 2007, at 10:12 PM by Paul Badger -
Changed lines 42-43 from:

Tip

to:

Tip

Restore
April 15, 2007, at 10:11 PM by Paul Badger -
Deleted lines 37-40:

Tip

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Changed lines 40-44 from:

For a complete program that demonstrates the use of arrays, see the Knight Rider example from the Tutorials.

to:

For a complete program that demonstrates the use of arrays, see the Knight Rider example from the Tutorials.

Tip

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Restore
April 15, 2007, at 10:10 PM by Paul Badger -
Added lines 38-41:

Tip

Be careful in accessing arrays. Accessing past the end of an array is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Restore
August 12, 2006, at 12:00 PM by David A. Mellis - adding link to Knight Rider example
Changed lines 36-40 from:

@]

to:

@]

Example

For a complete program that demonstrates the use of arrays, see the Knight Rider example from the Tutorials.

Restore
August 01, 2006, at 02:01 PM by David A. Mellis -
Changed lines 5-6 from:

Creating an Array

to:

Creating an Array

Changed lines 21-22 from:

Accessing an Array

to:

Accessing an Array

Restore
August 01, 2006, at 01:57 PM by David A. Mellis -

Changed lines 23-36 from:

The first thing you need to know is that **arrays are zero indexed**, that is, the first element of the array is at index 0.

to:

The first thing you need to know is that **arrays are zero indexed**, that is, the first element of the array is at index 0 and is accessed with a statement like:

```
pins[0] = 10;
```

To print the elements of an array over the serial port, you could do something like this:

```
int i;
for (i = 0; i < 5; i = i + 1) {
  Serial.println(pins[i]);
}
```

Restore
August 01, 2006, at 01:39 PM by David A. Mellis -
Added lines 1-23:

Arrays

Arrays in the C programming language, on which Arduino is based, can be complicated, but simple things should be relatively easy. The basics operations are:

Creating an Array

To create an array, of, say, 5 integers, place a statement like this at the top of your sketch or the start of a function:

```
int pins[5];
```

If you want to give the elements of the array initial values, use a statement like this instead:

```
int pins[5] = { 11, 3, 5, 4, 2 };
```

This will assign the value 11 to the first elements in the array, the value 3 to the second, etc.

Accessing an Array

The first thing you need to know is that **arrays are zero indexed**, that is, the first element of the array is at index 0.

Restore

Arrays

An array is a collection of variables that are accessed with an index number. Arrays in the C programming language, on which Arduino is based, can be complicated, but using simple arrays is relatively straightforward.

Creating (Declaring) an Array

All of the methods below are valid ways to create (declare) an array.

```
  int myInts[6];
  int myPins[] = {2, 4, 8, 3, 6};
  int mySensVals[6] = {2, 4, -8, 3, 2};
  char message[6] = "hello";
```

You can declare an array without initializing it as in myInts.

In myPins we declare an array without explicitly choosing a size. The compiler counts the elements and creates an array of the appropriate size.

Finally you can both initialize and size your array, as in mySensVals. Note that when declaring an array of type char, one more element than your initialization is required, to hold the required null character.

Accessing an Array

Arrays are **zero indexed**, that is, referring to the array initialization above, the first element of the array is at index 0, hence

`mySensVals[0] == 2, mySensVals[1] == 4`, and so forth.

It also means that in an array with ten elements, index nine is the last element. Hence:

```
int myArray[10]={9,3,2,4,3,2,7,8,9,11};
     // myArray[9]    contains 11
     // myArray[10]   is invalid and contains random information (other memory address)
```

For this reason you should be careful in accessing arrays. Accessing past the end of an array (using an index number greater than your declared array size - 1) is reading from memory that is in use for other purposes. Reading from these locations is probably not going to do much except yield invalid data. Writing to random memory locations is definitely a bad idea and can often lead to unhappy results such as crashes or program malfunction. This can also be a difficult bug to track down.

Unlike in some versions of BASIC, the C compiler does no checking to see if array access is within legal bounds of the array size that you have declared.

To assign a value to an array:

```
mySensVals[0] = 10;
```

To retrieve a value from an array:

```
x = mySensVals[4];
```

Arrays and FOR Loops

Arrays are often manipulated inside **for** loops, where the loop counter is used as the index for each array element.

For example, to print the elements of an array over the serial port, you could do something like this:

```
int i;
for (i = 0; i < 5; i = i + 1) {
  Serial.println(myPins[i]);
}
```

Example

For a complete program that demonstrates the use of arrays, see the Knight Rider example from the Tutorials.

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Corrections, suggestions, and new documentation should be posted to the Forum.

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