

# 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](#).

# 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](#).*

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(Printable View of <http://www.arduino.cc/en/Reference/Extended>)