

Engineering Design - II(Buggy)

Course Introduction

Subject: Engineering Design - II (Buggy)

Course Code: UTA014

Credit: 6.0

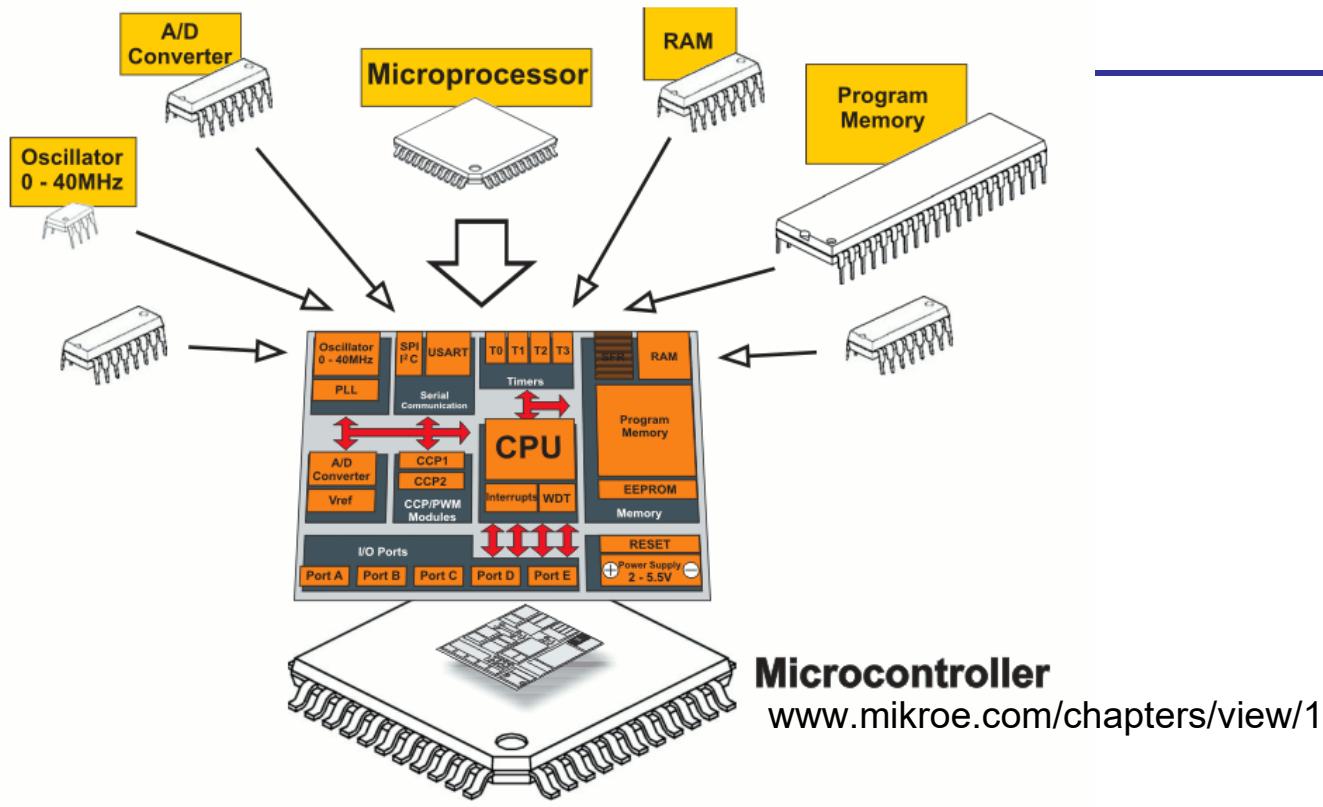
Evaluation Criteria:

- Quizzes
- Lab Evaluation
- Demonstration of Three different Challenges (Bronze, Silver and Gold)
- End Term Exam

Resources

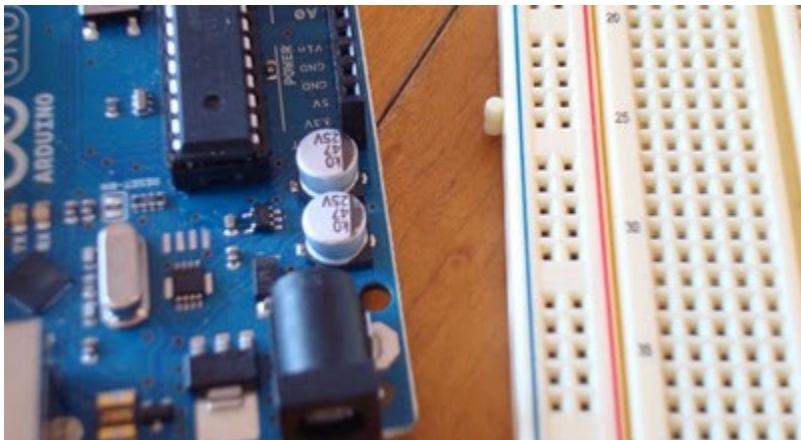
- <http://www.tutorialspoint.com/arduino/>
- <https://www.arduino.cc/en/Tutorial/HomePage>
- <https://www.tutorialspoint.com/csharp/>
- <http://www.completecsharptutorial.com/>

What is a Microcontroller



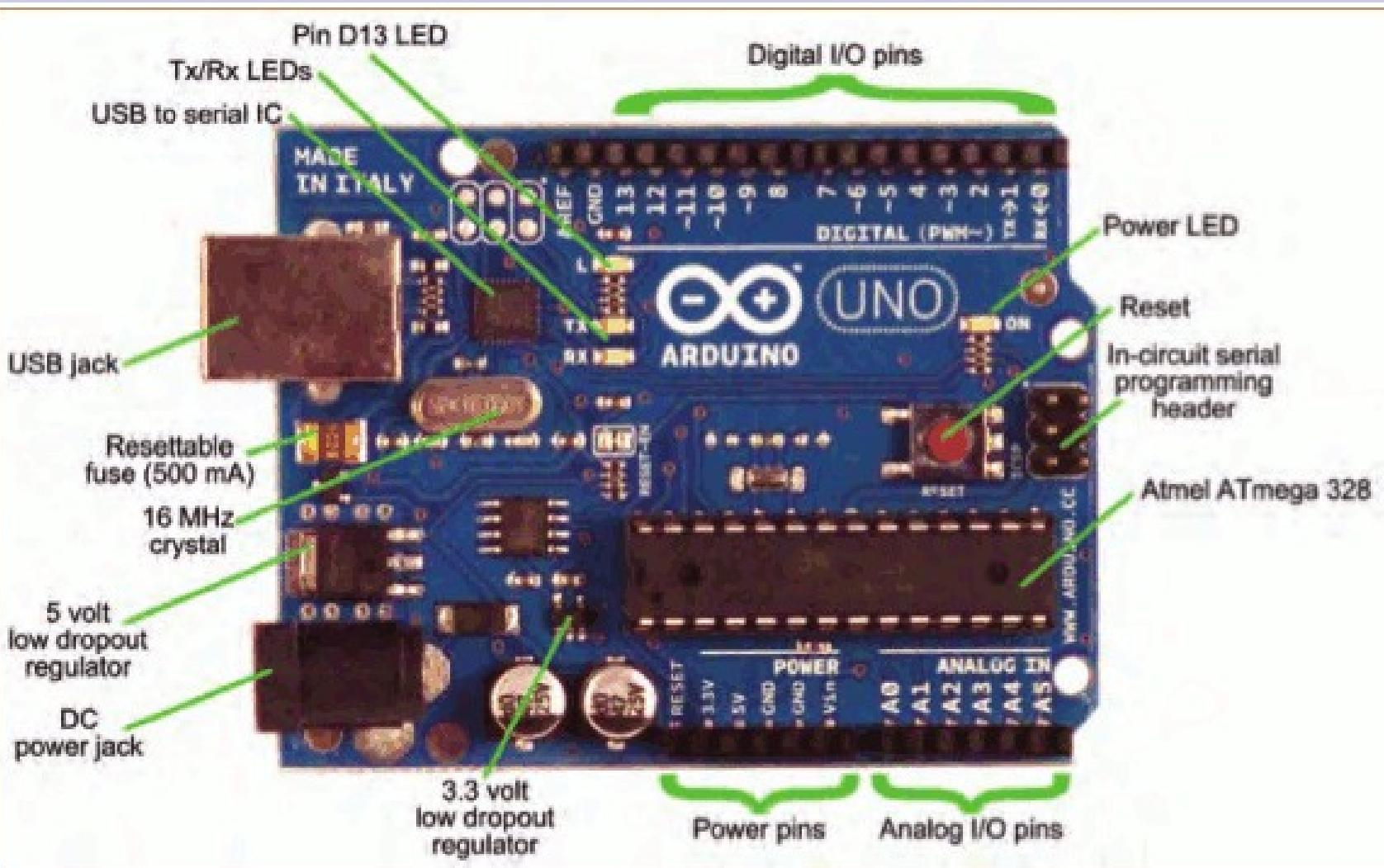
- A small computer on a single chip
 - containing a processor, memory, and input/output
- Typically "**embedded**" inside some device that they control
- A microcontroller is often small and low cost

What is a Development Board



- A printed circuit board designed to facilitate work with a particular microcontroller.
- Typical components include:
 - power circuit
 - programming interface
 - basic input; usually buttons and LEDs
 - I/O pins

The Arduino Development Board

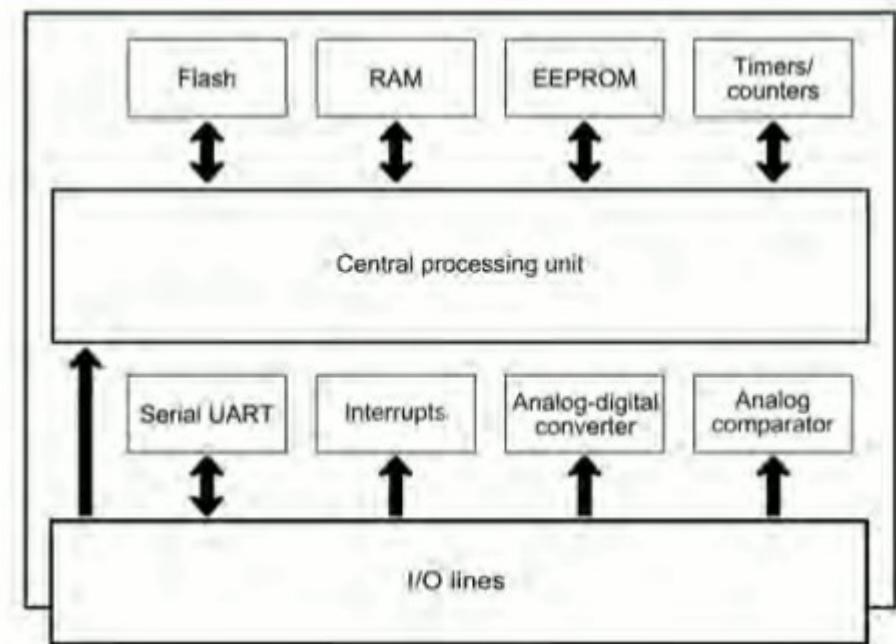


The Arduino Microcontroller: Atmel ARV Atmega 328

Atmel AVR ATmega 328		
(PCINT14/RESET) Reset	1 PC6	PC5 (PCINT13/ADC5/SCL) Analog input A5
(PCINT16/RXD) Digital pin D0 (Rx)	2 PD0	PC4 (PCINT12/ADC4/SDA) Analog input A4
(PCINT17/TXD) Digital pin D1 (Tx)	3 PD1	PC3 (PCINT11/ADC3) Analog input A3
(PCINT18/INT0) Digital pin D2	4 PD2	PC2 (PCINT10/ADC2) Analog input A2
(PCINT19/OC2B/INT1) Digital pin D3*	5 PD4	PC1 (PCINT9/ADC1) Analog input A1
(PCINT20/XCK/T0) Digital pin D4	6 PD4	PC0 (PCINT8/ADC0) Analog input A0
5V	7 VCC	GND 22 Gnd
Gnd	8 GND	AREF 21 AREF
(PCINT6/XTAL1/TOSC1) (crystal)	9 PB6	AVCC 20 5V
(PCINT7/XTAL2/TOSC2) (crystal)	10 PB7	PB5 (PCINT5/SCK) Digital pin D13
(PCINT21/OC0B/T1) Digital pin D5*	11 PD5	PB4 (PCINT4/MISO) Digital pin D12
(PCINT22/OC0A/AIN0) Digital pin D6*	12 PD6	PB3 (PCINT3/MOSI/OC2A) Digital pin D11*
(PCINT23/AIN1) Digital pin D7	13 PD7	PB2 (PCINT2/SS/OC1B) Digital pin D10*
(PCINT10/CLKO/ICP1) Digital pin D8	14 PB0	PB1 (PCINT1/OC1A) Digital pin D9*

Arduino pin mapping in blue

* denotes capable of
PWM output

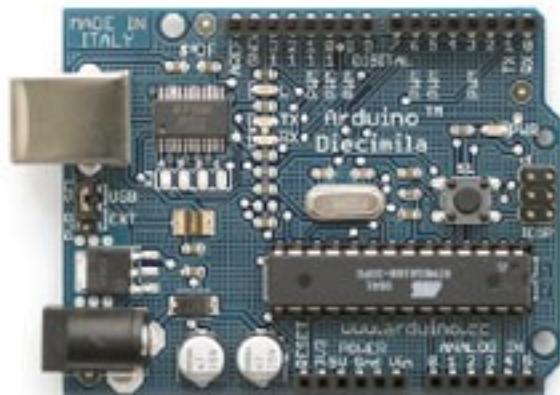


Specification

What is the Arduino

The word “Arduino” can mean 3 things

A physical piece
of hardware



A programming
environment

Arduino - 0010 Alpha

Blink

```
* The basic Arduino example. Turn on an LED on for one second,
* then off for one second, and so on... We use pin 13 because
* depending on your Arduino board, it has either a built-in LED
* or a built-in resistor so that you need only an LED.
*
* http://www.arduino.cc/en/Tutorials/Blink
*/
int ledPin = 13; // LED connected to digital pin 13

void setup() { // This code runs when the sketch starts
  pinMode(ledPin, OUTPUT); // sets the digital pin as output;
}

void loop() { // This code runs over and over again
  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
}
```

A community
& philosophy

Arduino playground

Arduino playground

Search []

Projects Built with Arduino

Recent

Arduino Tutorials

- Official tutorial page
- Information on the Arduino Uno
- Bluetooth tutorial
- Introduction to Sensors
- RF Antennas tutorial
- Relay (2) tutorial
- Learning Electronics
- Learning Programming
- Robot Robot with Arduino
- Let's Play Robots
- Robotics
- Circuits
- Blind arms 3.3V & 5V
- Programming the Bluetooth-WTF!
- Retracting Seconds
- Autonomous
- Series "Dynamixel" Upgrade

Recent Articles

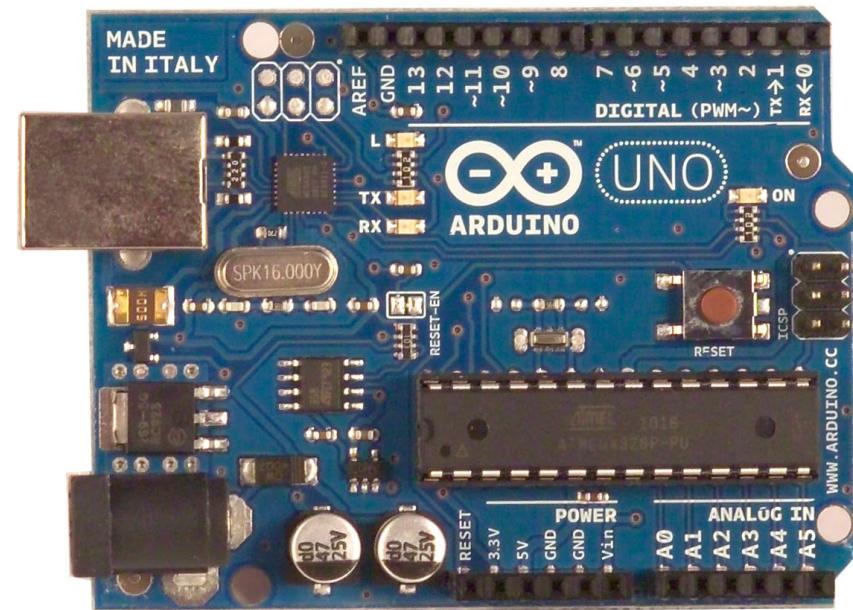
- Linux
- Ubuntu Linux
- Debian Linux
- CentOS Linux
- MacOSX (10)
- Windows
- Android
- The complete list

Workshop Arduino with...

- Introduction (102)
- Flash
- Processing
- Pinvise Flash

What is an Arduino ?

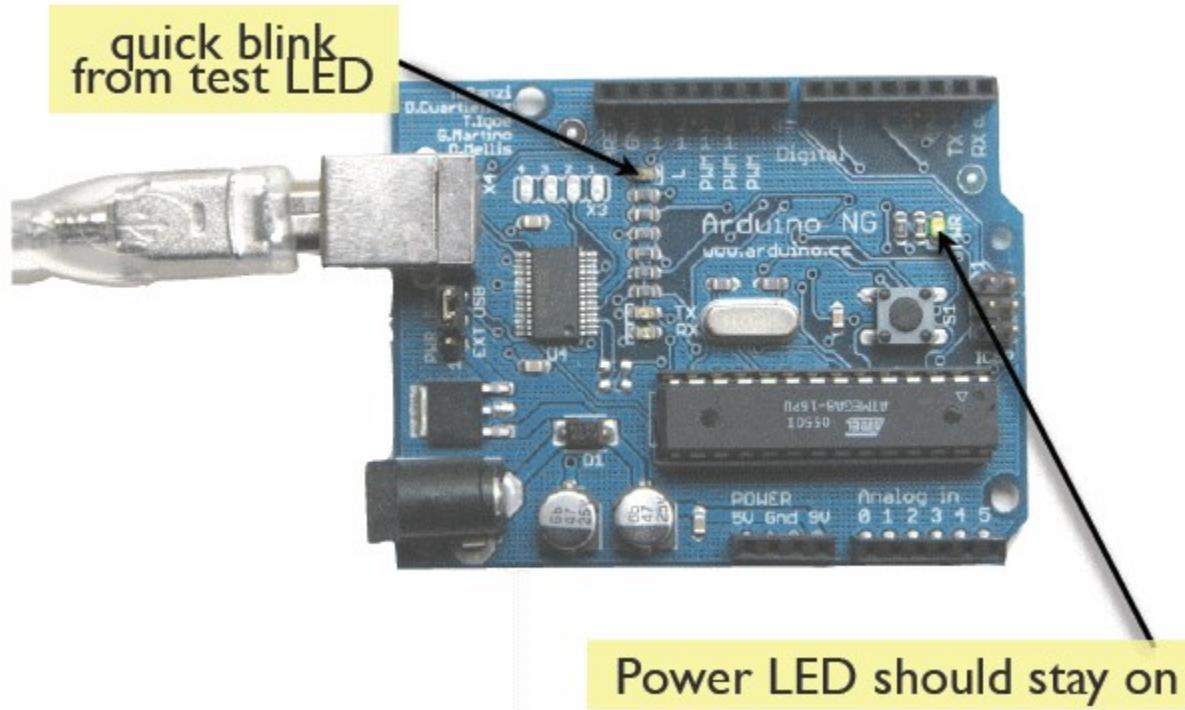
- Open Source electronic prototyping platform based on flexible easy to use hardware and software.



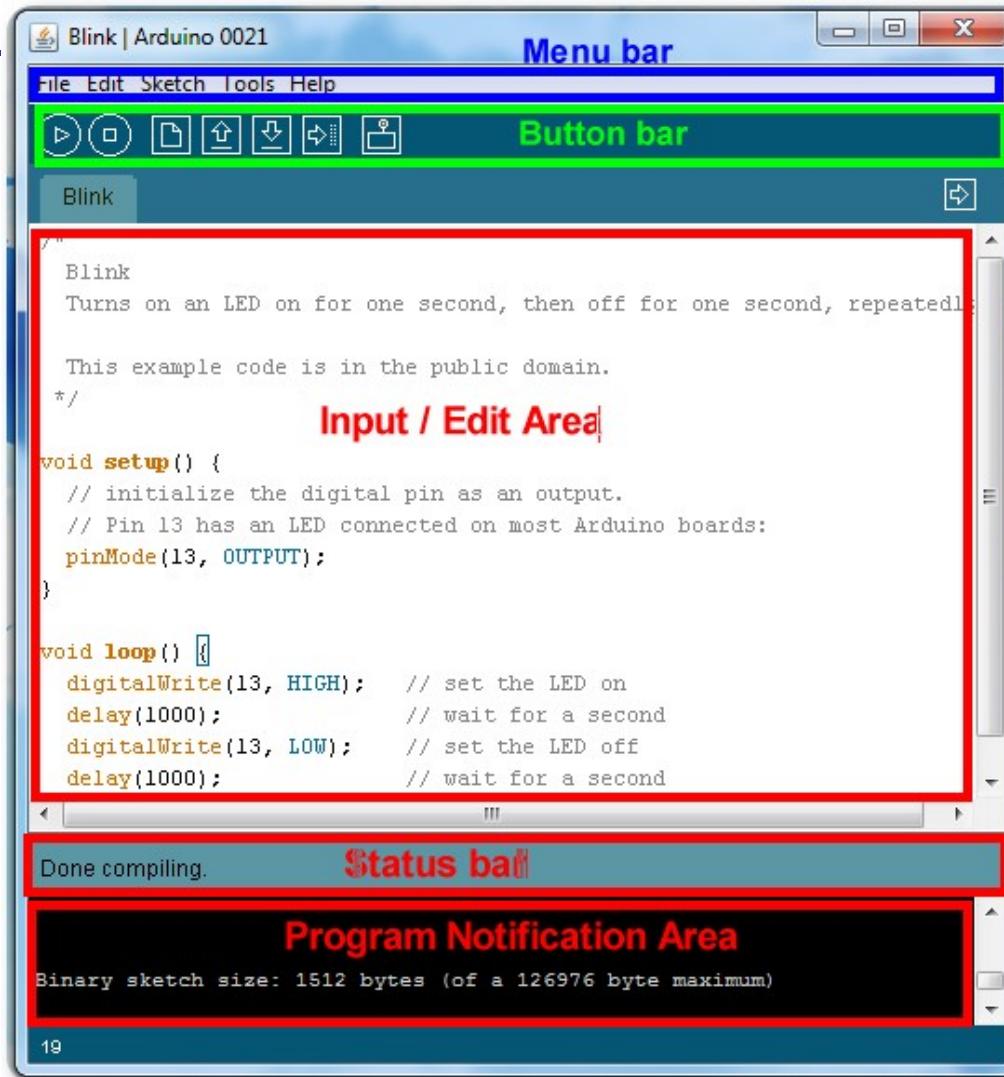
Getting Started

- Check out: <http://arduino.cc/en/Guide/HomePage>
 1. **Download & install the Arduino environment (IDE)**
 2. **Connect the board to your computer via the UBS cable**
 3. **If needed, install the drivers**
 4. **Launch the Arduino IDE**
 5. **Select your board**
 6. **Select your serial port**
 7. **Open the program code**
 8. **Upload the program**

Try It: Connect the USB Cable

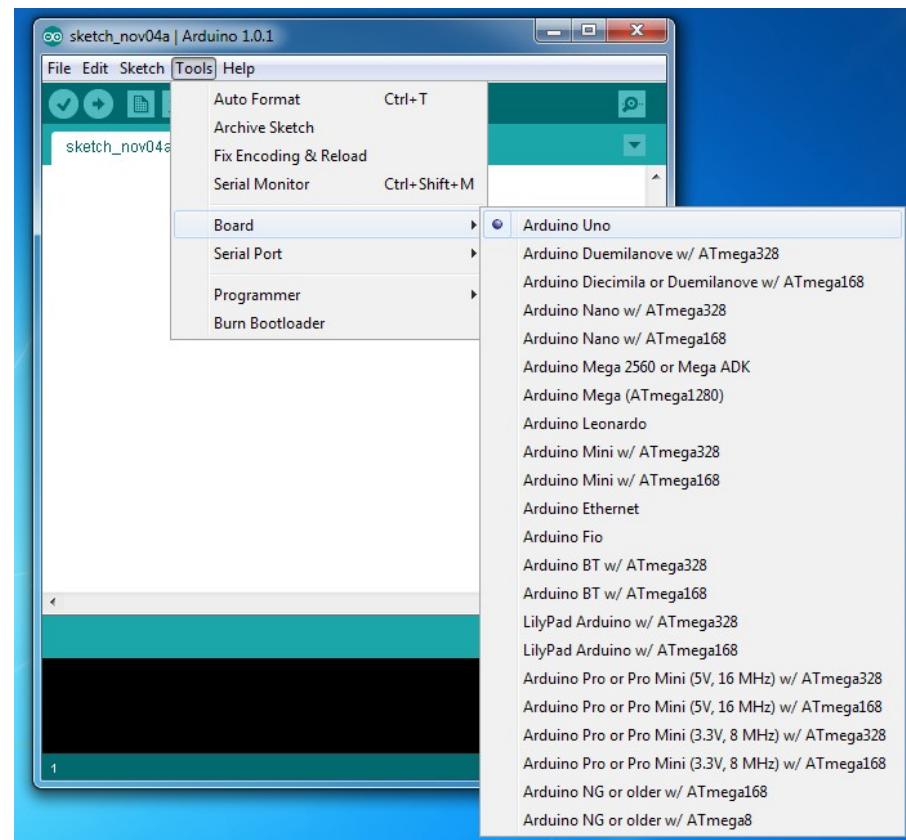
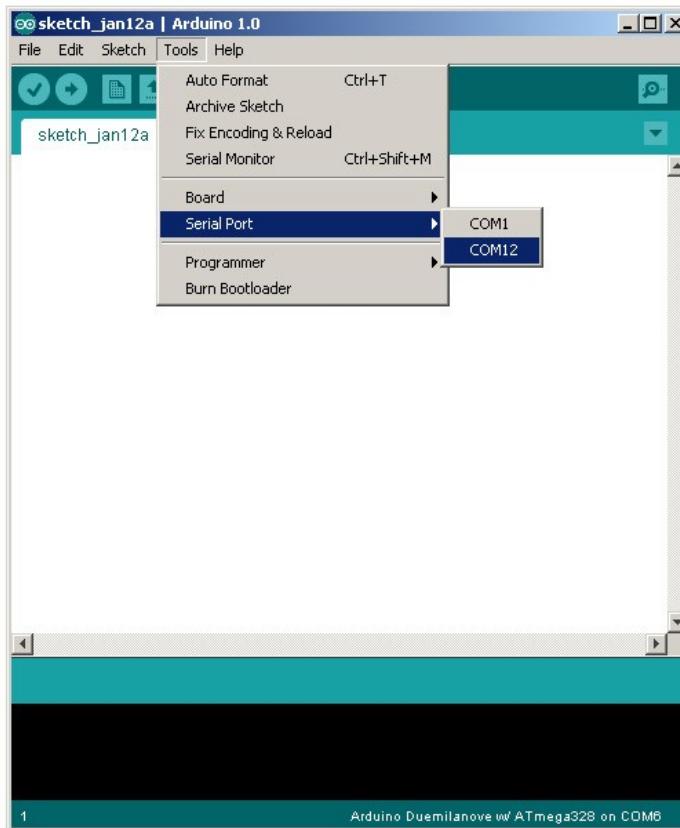


Arduino IDE



See: <http://arduino.cc/en/Guide/Environment> for more information

Select Serial Port and Board



Status Messages

Uploading worked

```
Done uploading.  
Binary sketch size: 1110 bytes (of a 14396 byte maximum)
```

Size depends on complexity of your sketch

Wrong serial port selected

```
Serial port '/dev/tty.usbserial-A4001qa8' not found. Did you select the  
java.awt.EventQueue.readAndDispatch(EventQueue.java:170  
)  
at  
java.awt.EventQueue.read(EventDispatchThread.java:110)
```

Wrong board selected

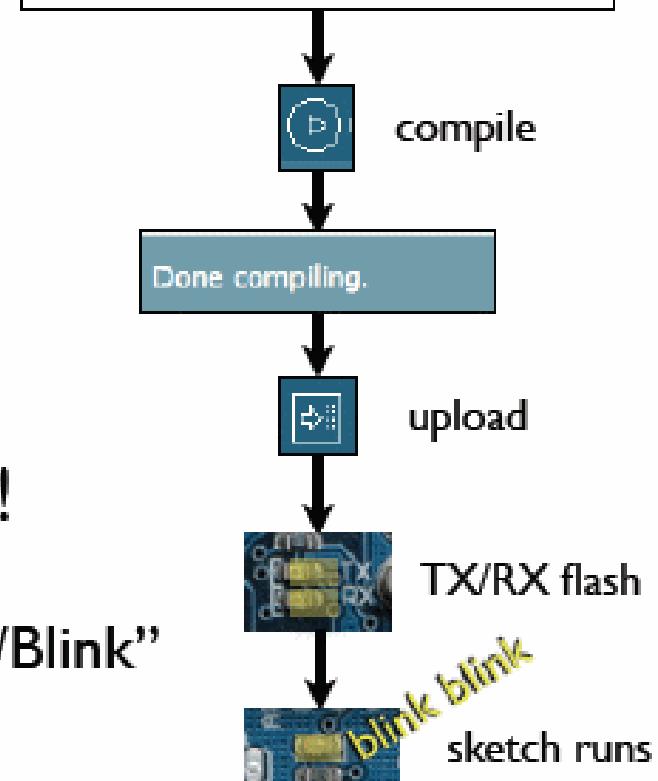
nerdy cryptic error messages

```
Wrong microcontroller found. Did you select the right board from the T  
Binary sketch size: 000 bytes (of a 7100 byte maximum)  
  
avrdude: Expected signature for ATMEGA8 is 1E 93 07  
Double check chip, or use -F to override this check.
```

Using Arduino

- Write your sketch
- Press Compile button (to check for errors)
- Press Upload button to program Arduino board with your sketch

```
void setup() {  
    pinMode(ledPin, OUTPUT);      // sets t  
}  
void loop() {  
    digitalWrite(ledPin, HIGH);   // sets t  
    delay(1000);                // waits  
    digitalWrite(ledPin, LOW);    // sets t  
    delay(1000);                // waits  
}
```

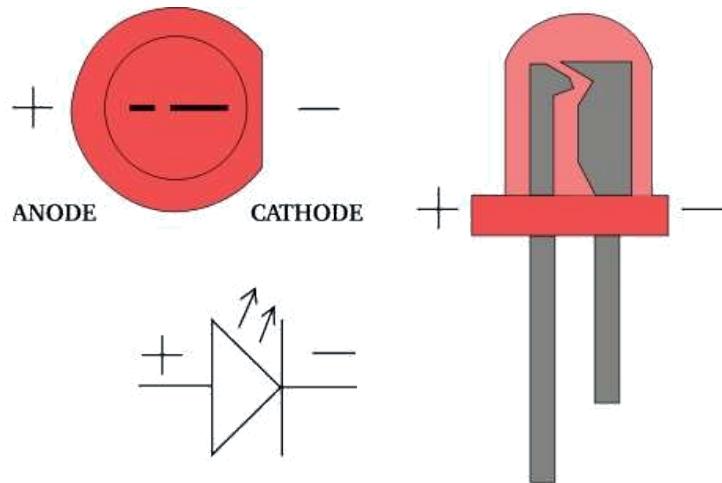


Try it out with the “Blink” sketch!

Load “File/Sketchbook/Examples/Digital/Blink”

Add an External LED to pin 13

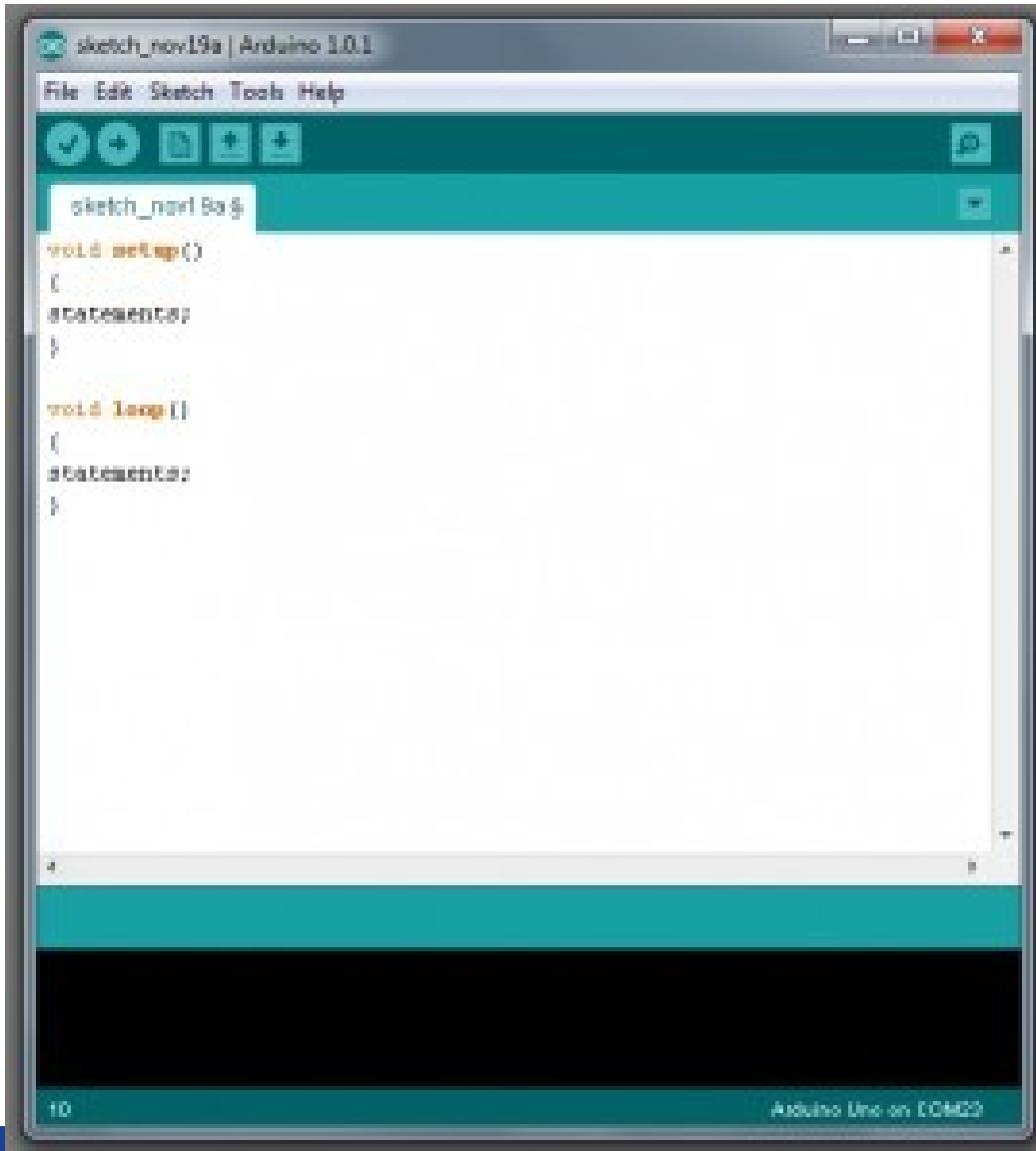
- File > Examples > Digital > Blink
- LED's have polarity
 - Negative indicated by flat side of the housing and a short leg



www.instructables.com

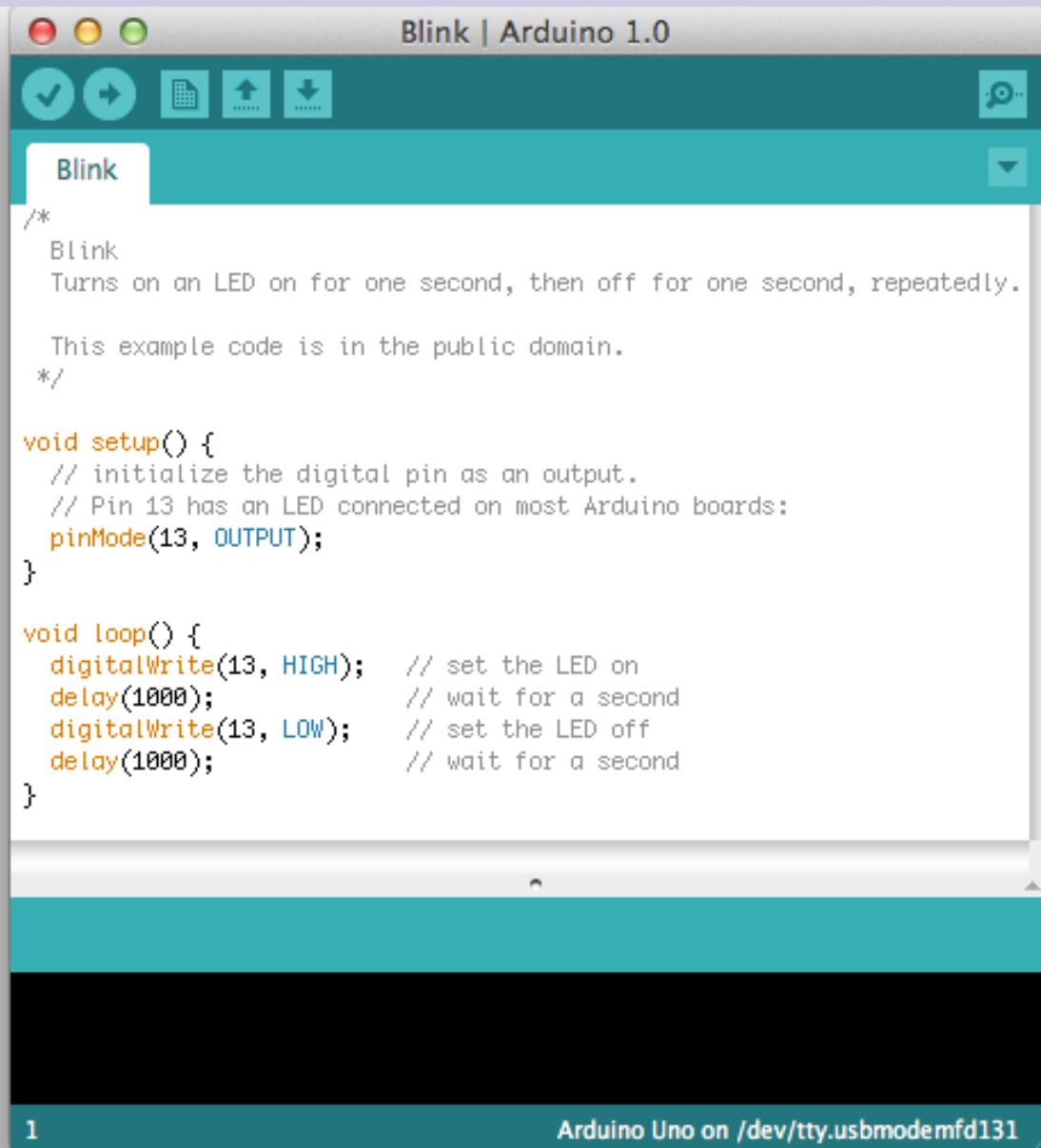


A Little Bit About Programming



- Code is case sensitive
- Statements are commands and must end with a semi-colon
- Comments follow a // or begin with /* and end with */
- loop and setup

Our First Program



The image shows a screenshot of the Arduino IDE. The title bar reads "Blink | Arduino 1.0". The main window displays the "Blink" sketch. The code is as follows:

```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.

This example code is in the public domain.
*/

void setup() {
  // initialize the digital pin as an output.
  // Pin 13 has an LED connected on most Arduino boards:
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);      // set the LED on
  delay(1000);                // wait for a second
  digitalWrite(13, LOW);       // set the LED off
  delay(1000);                // wait for a second
}
```

The status bar at the bottom indicates "Arduino Uno on /dev/tty.usbmodemfd131".

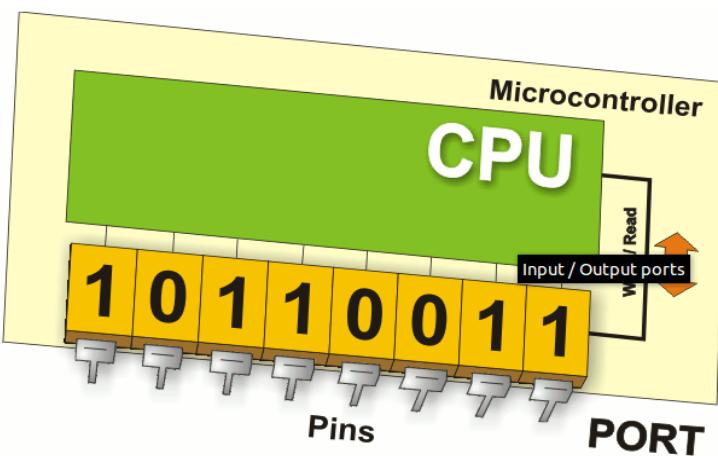
Terminology

“*sketch*” – a program you write to run on an Arduino board

“*pin*” – an input or output connected to something.
e.g. output to an LED, input from a knob.

“*digital*” – value is either HIGH or LOW.
(aka on/off, one/zero) e.g. switch state

“*analog*” – value ranges, usually from 0-255.
e.g. LED brightness, motor speed, etc.



Digital I/O

www.mikroe.com/chapters/view/1

`pinMode(pin, mode)`

Sets pin to either INPUT or OUTPUT

`digitalRead(pin)`

Reads HIGH or LOW from a pin

`digitalWrite(pin, value)`

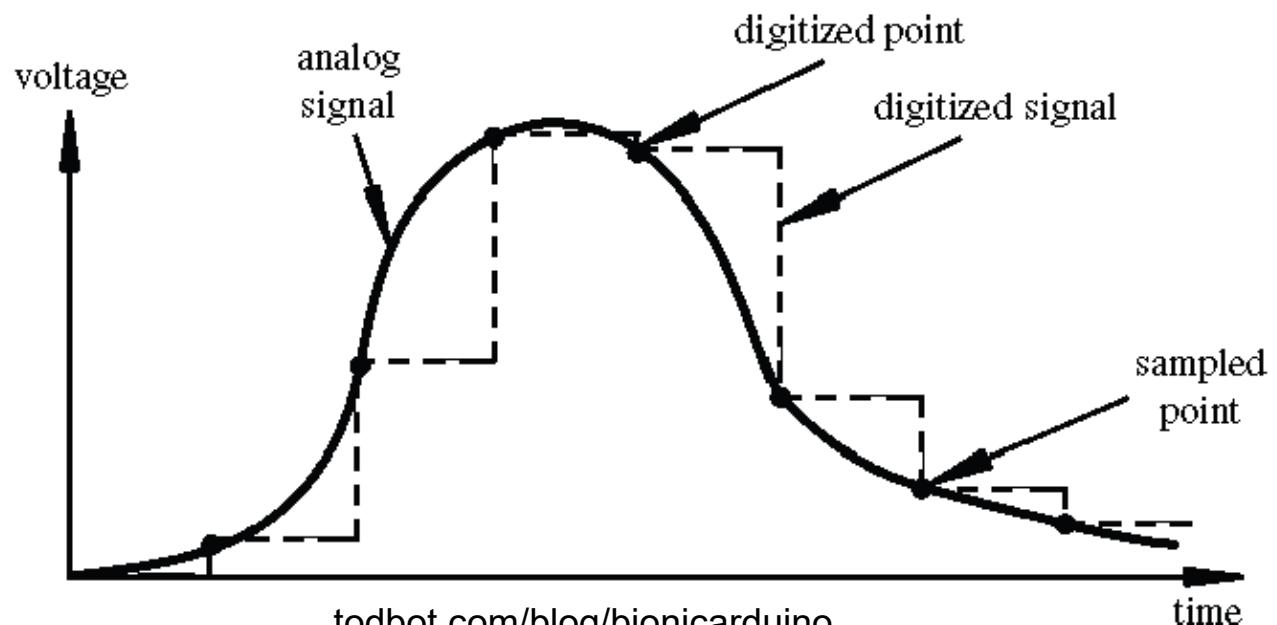
Writes HIGH or LOW to a pin

Arduino Timing

- `delay(ms)`
 - Pauses for a few milliseconds
- `delayMicroseconds(μs)`
 - Pauses for a few microseconds

Digital? Analog?

- Digital has two values: **on** and **off**
- Analog has many (infinite) values
- Computers don't really do analog, they *quantize*
- Remember the 6 analog input pins---here's how they work

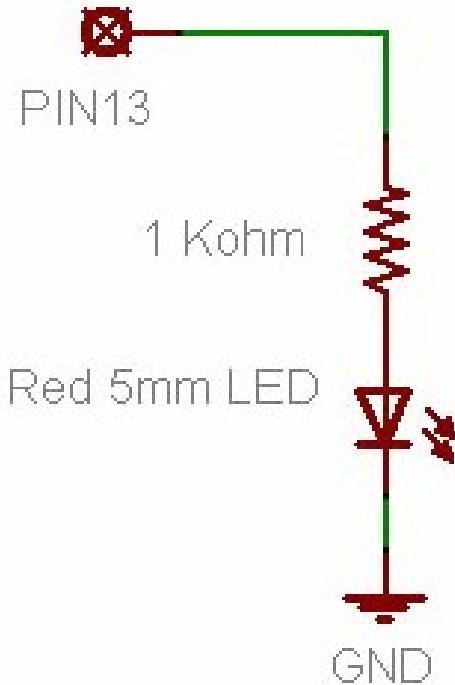


Variables

TYPE	NAME	VALUE	
int	number	→ 1	Stored only Integer
int	sum	→ 588588	Stored only Integer
double	radius	→ 5.5	Stored only floating-point number
double	area	→ 98.8334	Stored only floating-point number
String	greeting	→ Hello	Stored only texts
String	statusMsg	→ Game Over	Stored only texts

A variable has a name, stores a value of the declared type.

Putting It Together



- Complete the sketch (program) below.
- What output will be generated by this program?
- What if the schematic were changed? →

```
void loop() // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(500); // waits for a second
  digitalWrite(ledPin, LOW); // sets the LED off
  delay(500); // waits for a second
}
```

Analog to Digital Coverstion

- What is analog ?
- It is continuous range of voltage values (not just 0 or 5V)

- Why convert to digital ?
- Because our microcontroller only understands digital.

ADC in Arduino

- The Arduino Uno board contains 6 pins for ADC
- 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

Reading/Writing Analog Values

- `analogRead(A0); // used to read the analog value from the pin A0`
- `analogWrite(2,128);`