UTA014
Engineering Design - II(Buggy)

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CSED

https://sites.google.com/thapar.edu/buggy/home

Course Introduction

Course Name: Engineering Design - II (Buggy)

Course ID: UTA014

Credit: 6.0

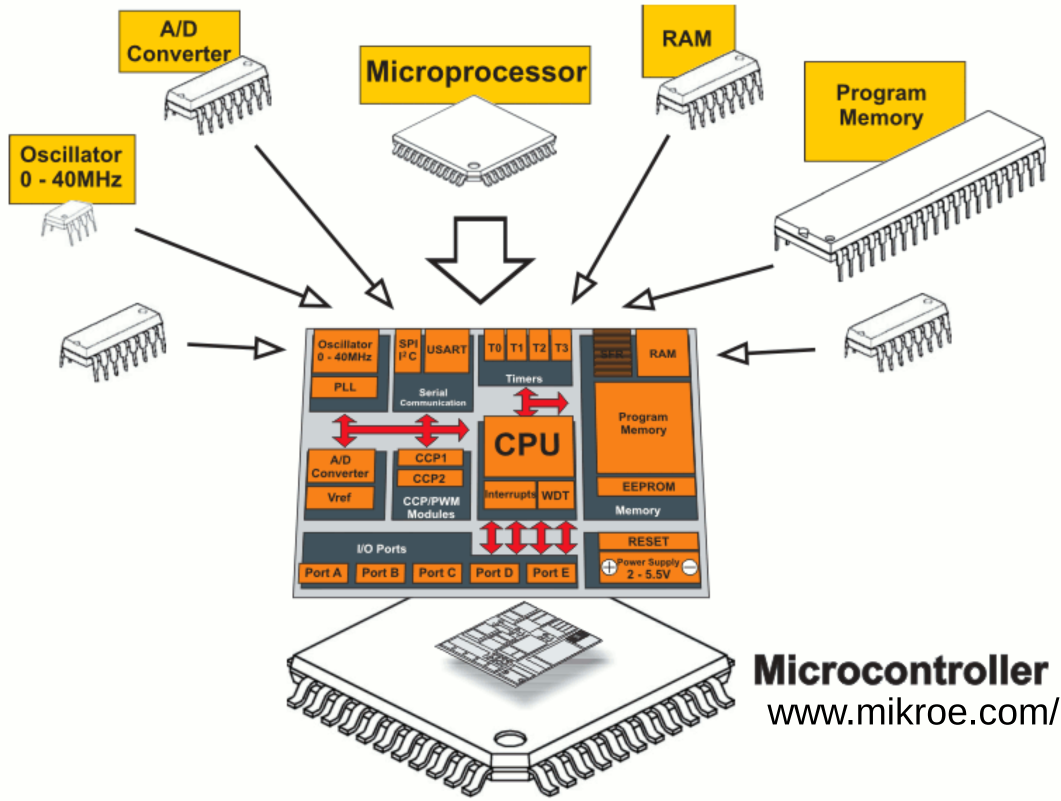
Evaluation Criteria:

- Quiz
- Lab Evaluation (LE1, LE2 and LE3)
- Demonstration of Three different Challenges (Bronze, Silver and Gold)

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

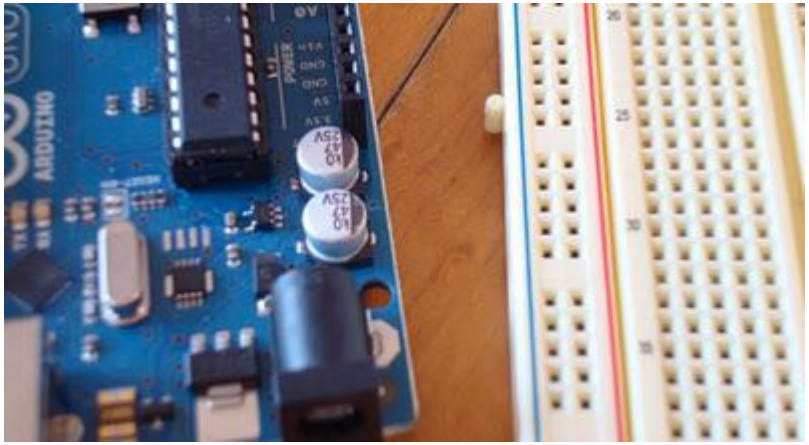


www.mikroe.com/chapters/view/1

Fig. 0-1 Microcontroller versus Microprocessor

- 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

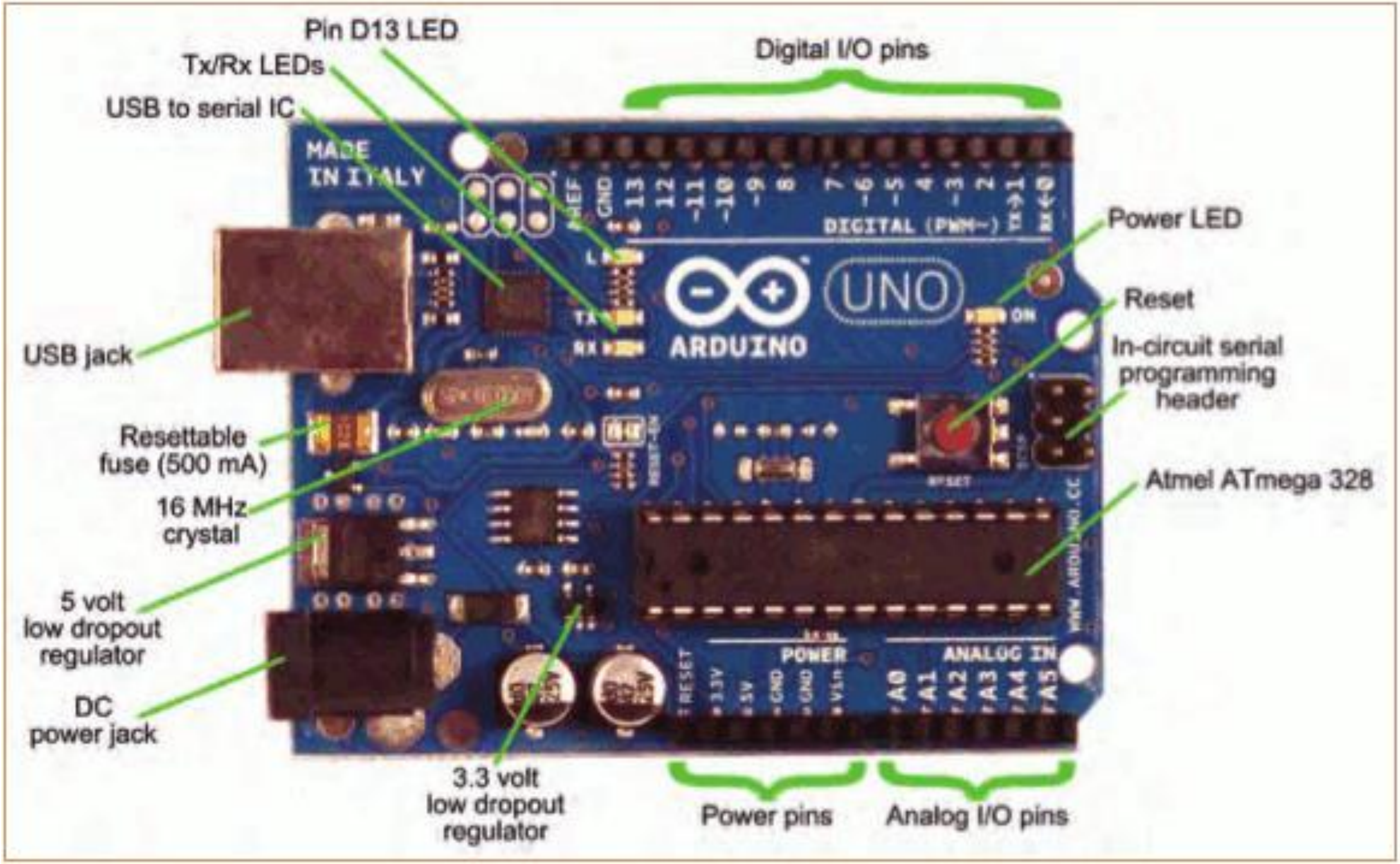
What is a Development Board



- A printed circuit board designed to facilitate work with a particular microcontroller.

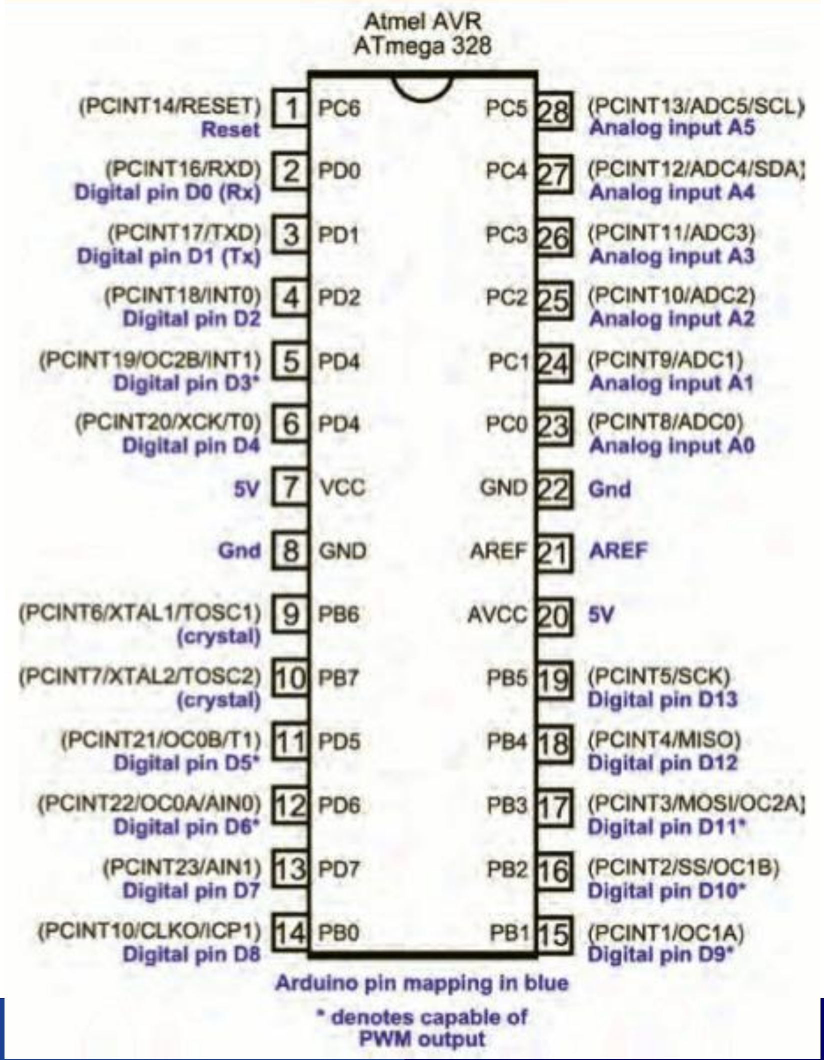
- Typical components include:
  - power circuit
  - programming interface
  - basic input; usually buttons and LEDs
  - I/O pins

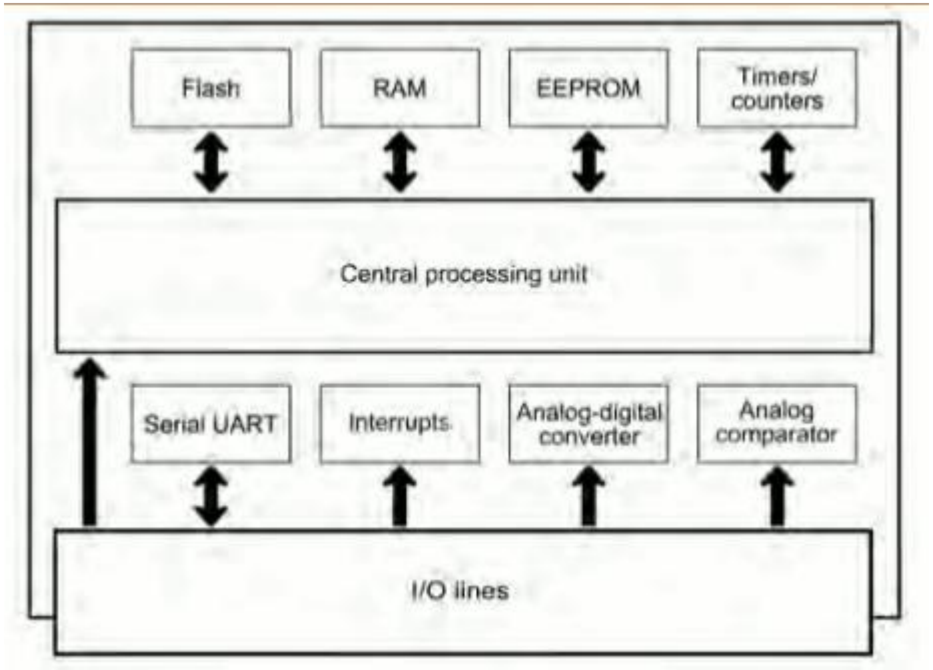
The Arduino Development Board



Making-robots-with-arduino.pdf

The Arduino Microcontroller: Atmel Atmega 328p


Atmel AVR
ATmega 328
(PCINT14/RESET) Reset 1 PC6
(PCINT16/RXD) Digital pin D0 (Rx) 2 PD0
(PCINT17/TXD) Digital pin D1 (Tx) 3 PD1
(PCINT18/INT0) Digital pin D2 4 PD2
(PCINT19/OC2B/INT1) Digital pin D3* 5 PD4
(PCINT20/XCK/T0) Digital pin D4 6 PD4
5V 7 VCC
Gnd 8 GND
(PCINT6/XTAL1/TOSC1) (crystal) 9 PB6
(PCINT7/XTAL2/TOSC2) (crystal) 10 PB7
(PCINT21/OC0B/T1) Digital pin D5* 11 PD5
(PCINT22/OC0A/AIN0) Digital pin D6* 12 PD6
(PCINT23/AIN1) Digital pin D7 13 PD7
(PCINT10/CLKO/ICP1) Digital pin D8 14 PB0
PC5 28 (PCINT13/ADC5/SCL) Analog input A5
PC4 27 (PCINT12/ADC4/SDA) Analog input A4
PC3 26 (PCINT11/ADC3) Analog input A3
PC2 25 (PCINT10/ADC2) Analog input A2
PC1 24 (PCINT9/ADC1) Analog input A1
PC0 23 (PCINT8/ADC0) Analog input A0
GND 22 Gnd
AREF 21 AREF
AVCC 20 5V
PB5 19 (PCINT5/SCK) Digital pin D13
PB4 18 (PCINT4/MISO) Digital pin D12
PB3 17 (PCINT3/MOSI/OC2A) Digital pin D11*
PB2 16 (PCINT2/SS/OC1B) Digital pin D10*
PB1 15 (PCINT1/OC1A) Digital pin D9*
Arduino pin mapping in blue
* denotes capable of PWM output



Specification

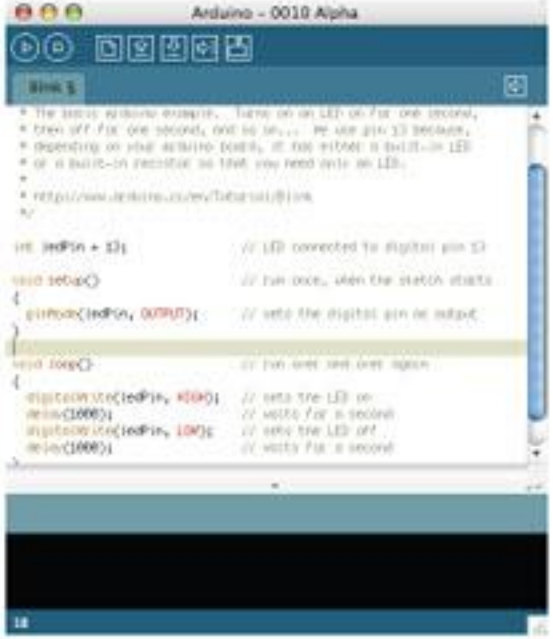
Making-robots-with-arduino.pdf

What is the Arduino

The word "Arduino" can mean 3 things

A physical piece of hardware

A programming environment



```
 * The basic Arduino example.  Turns 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/Tutorial/Blink
 */

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

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

void loop()                     // run 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

:: About the Arduino Playground ::

[illegible]

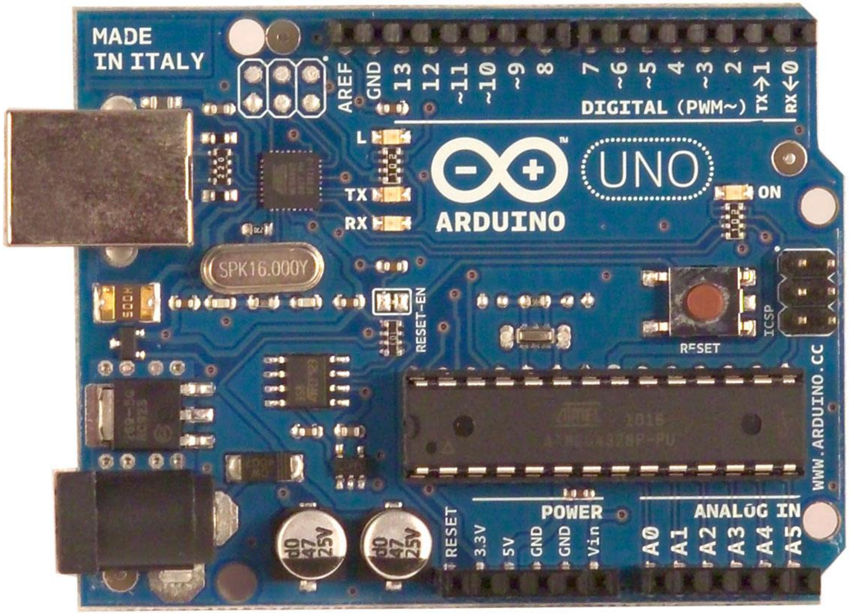
:: RoadMap: What Needs to be Done? ::

[illegible]

todbot.com/blog/bionicarduino

What is an Arduino ?

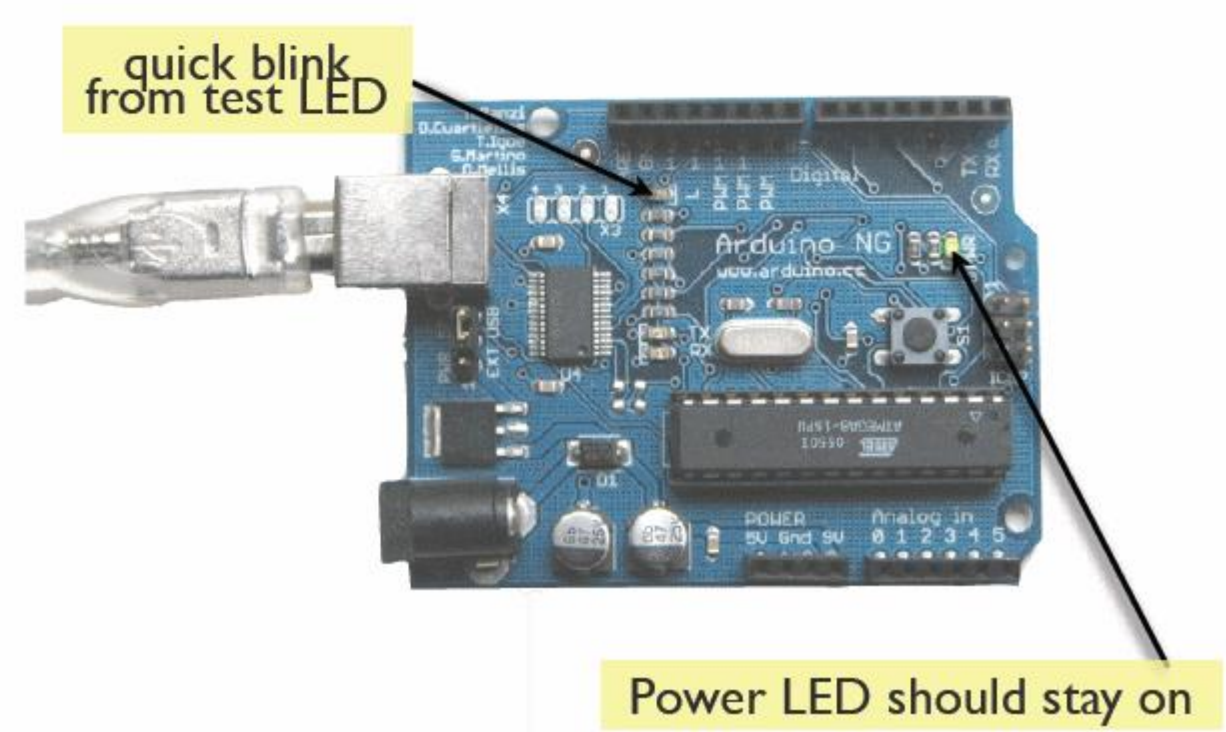
- **Open Source** electronic prototyping **platform** based on flexible **easy to use** hardware and software.



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


quick blink from test LED

Power LED should stay on

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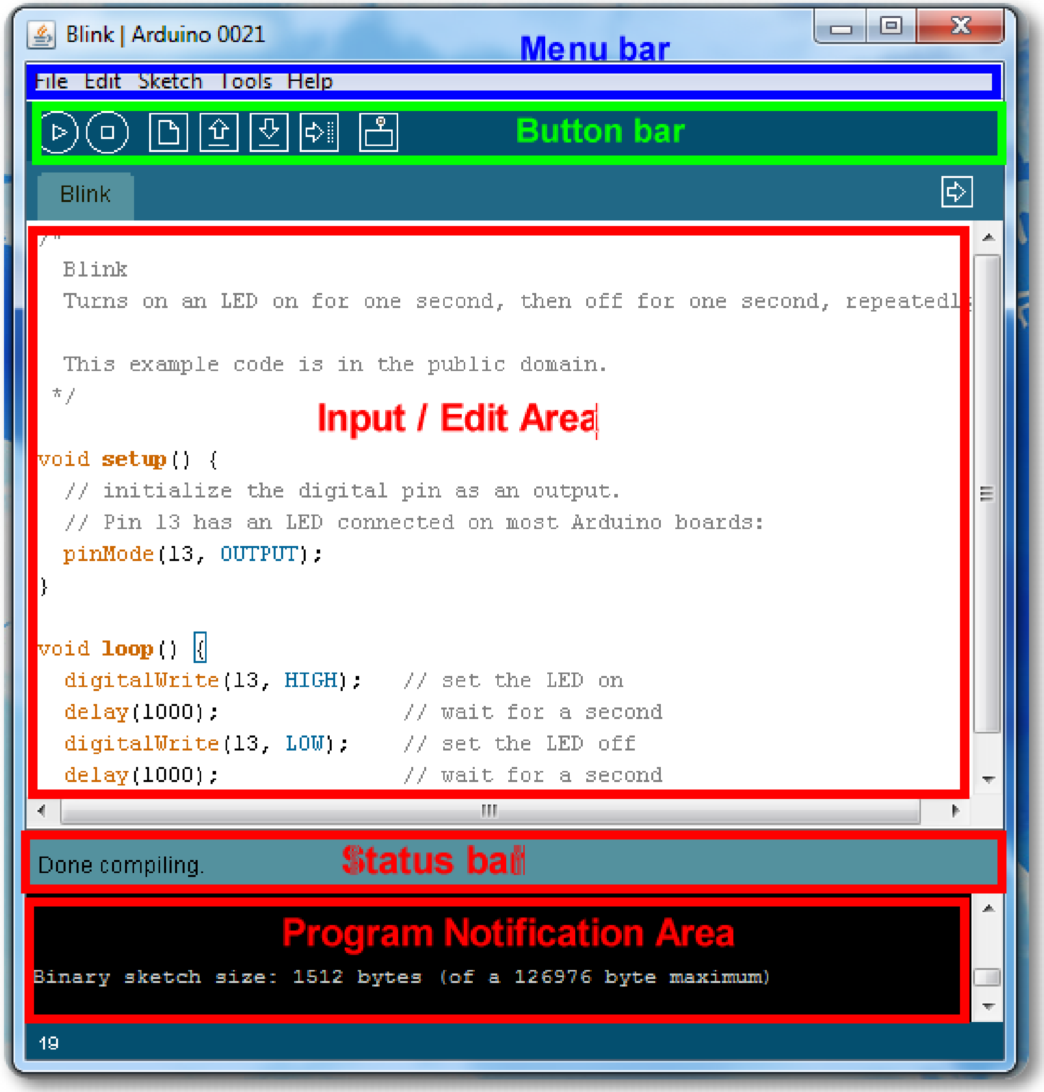
Arduino IDE



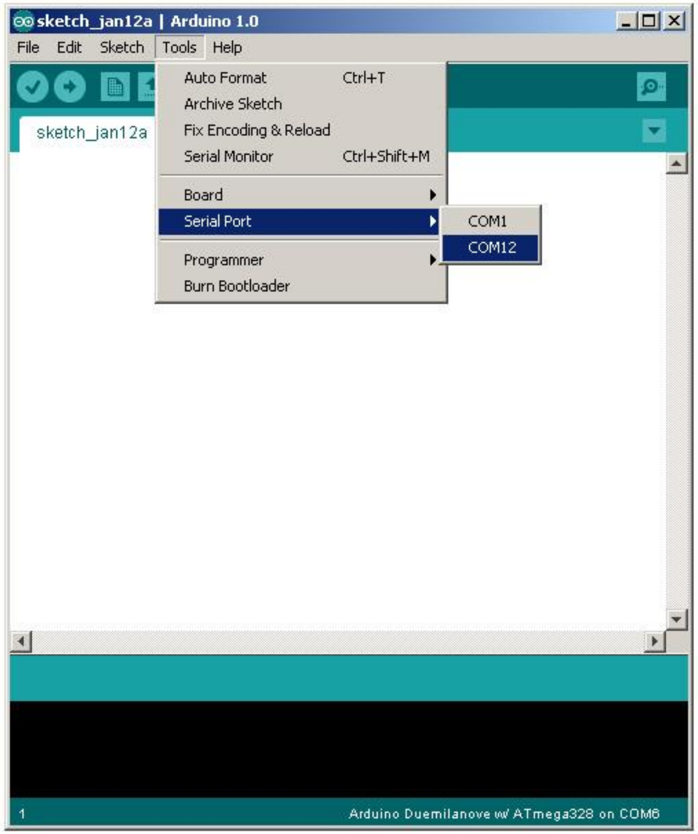
```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedl

  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
```

Done compiling.

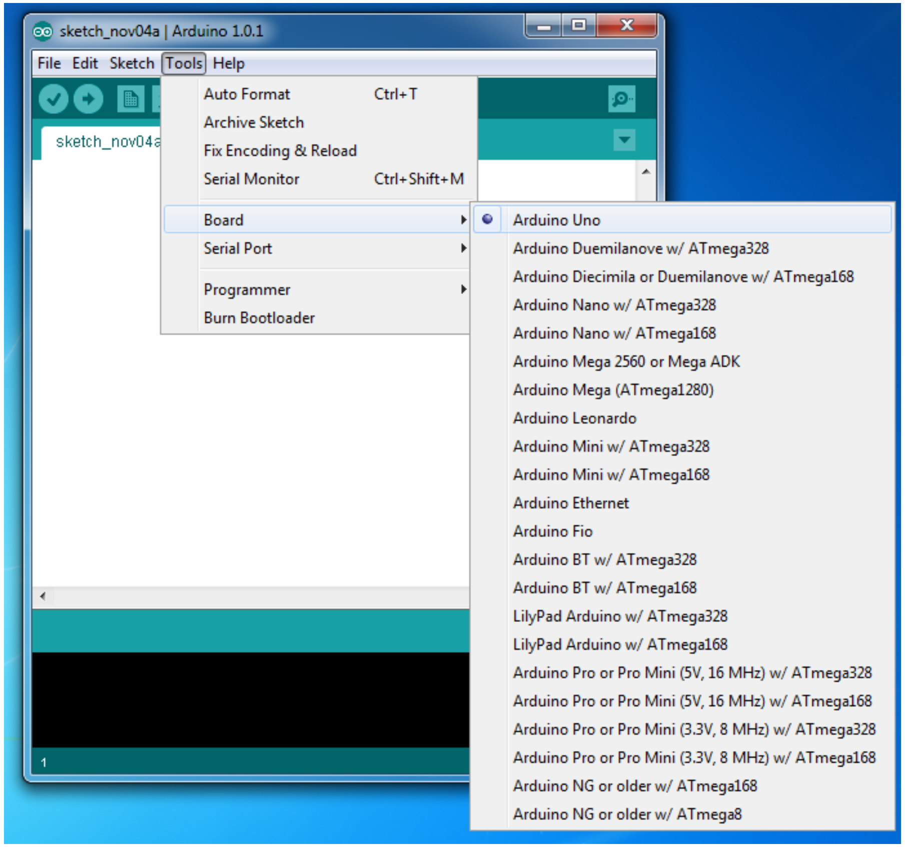
```
Binary sketch size: 1512 bytes (of a 126976 byte maximum)
```

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

Select Serial Port and Board



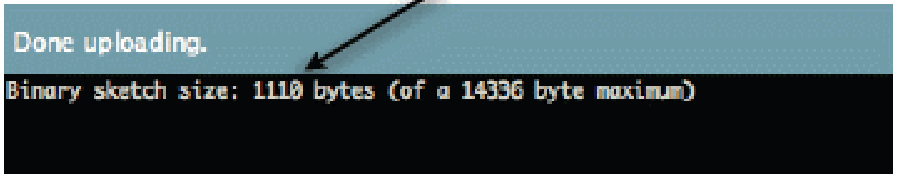
Arduino Duemilanove w/ ATmega328 on COM6


sketch_nov04a | Arduino 1.0.1
File
Edit
Sketch
Tools
Help
sketch_nov04a
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Serial Monitor Ctrl+Shift+M
Board
Serial Port
Programmer
Burn Bootloader
● Arduino Uno
Arduino Duemilanove w/ ATmega328
Arduino Diecimila or Duemilanove w/ ATmega168
Arduino Nano w/ ATmega328
Arduino Nano w/ ATmega168
Arduino Mega 2560 or Mega ADK
Arduino Mega (ATmega1280)
Arduino Leonardo
Arduino Mini w/ ATmega328
Arduino Mini w/ ATmega168
Arduino Ethernet
Arduino Fio
Arduino BT w/ ATmega328
Arduino BT w/ ATmega168
LilyPad Arduino w/ ATmega328
LilyPad Arduino w/ ATmega168
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168
Arduino NG or older w/ ATmega168
Arduino NG or older w/ ATmega8
1

Status Messages

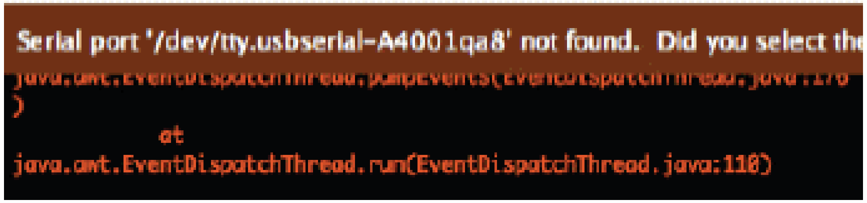
Uploading worked

Size depends on complexity of your sketch



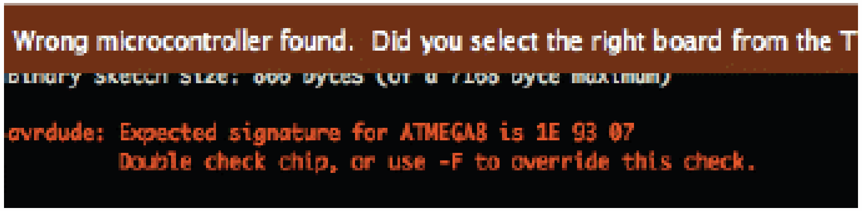
```
Done uploading.
Binary sketch size: 1110 bytes (of a 14336 byte maximum)
```

Wrong serial port selected



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

Wrong board selected



```
Wrong microcontroller found.  Did you select the right board from the T
Binary sketch size: 666 bytes (of a 7168 byte maximum)

avrdude: Expected signature for ATMEGA8 is 1E 93 07
         Double check chip, or use -F to override this check.
```

nerdy cryptic error messages

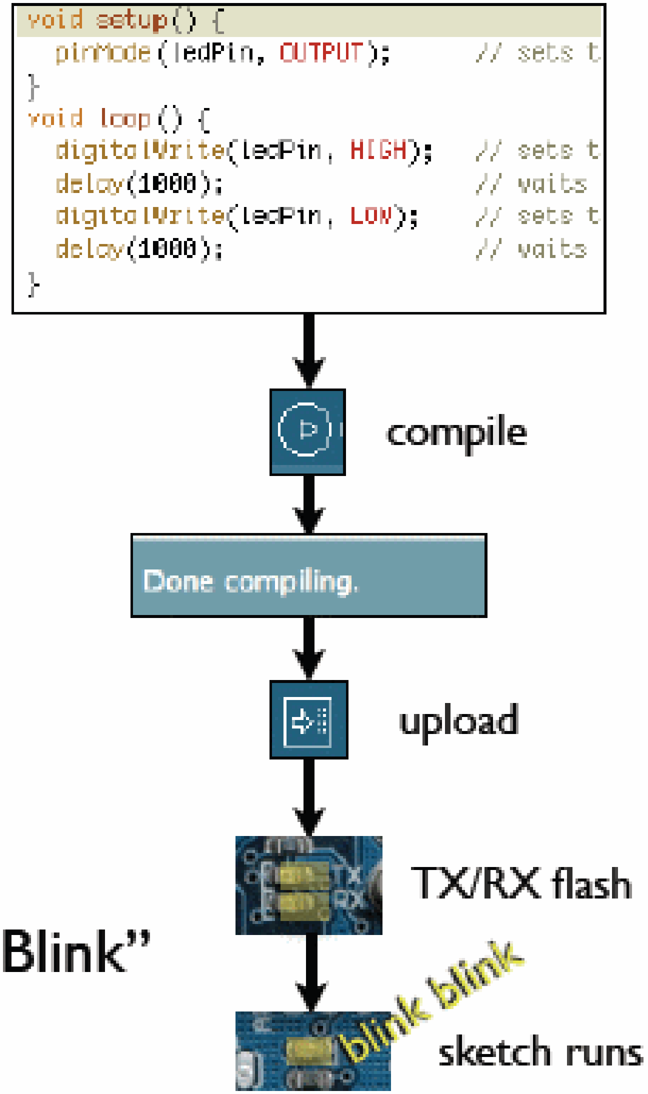
todbot.com/blog/bionicarduino

Using Arduino

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

Try it out with the "Blink" sketch!

Load "File/Sketchbook/Examples/Digital/Blink"



```
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
}
```

Done compiling.

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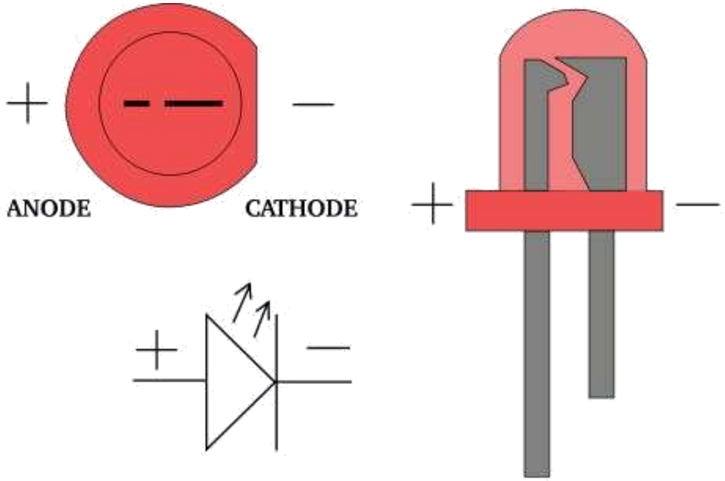
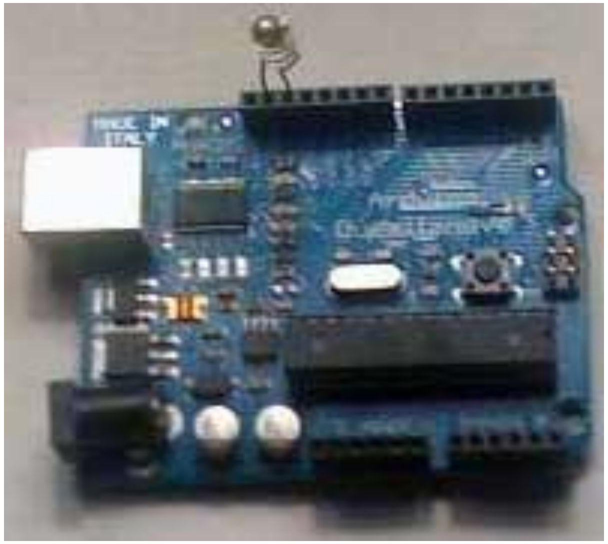
Add an External LED to pin 13

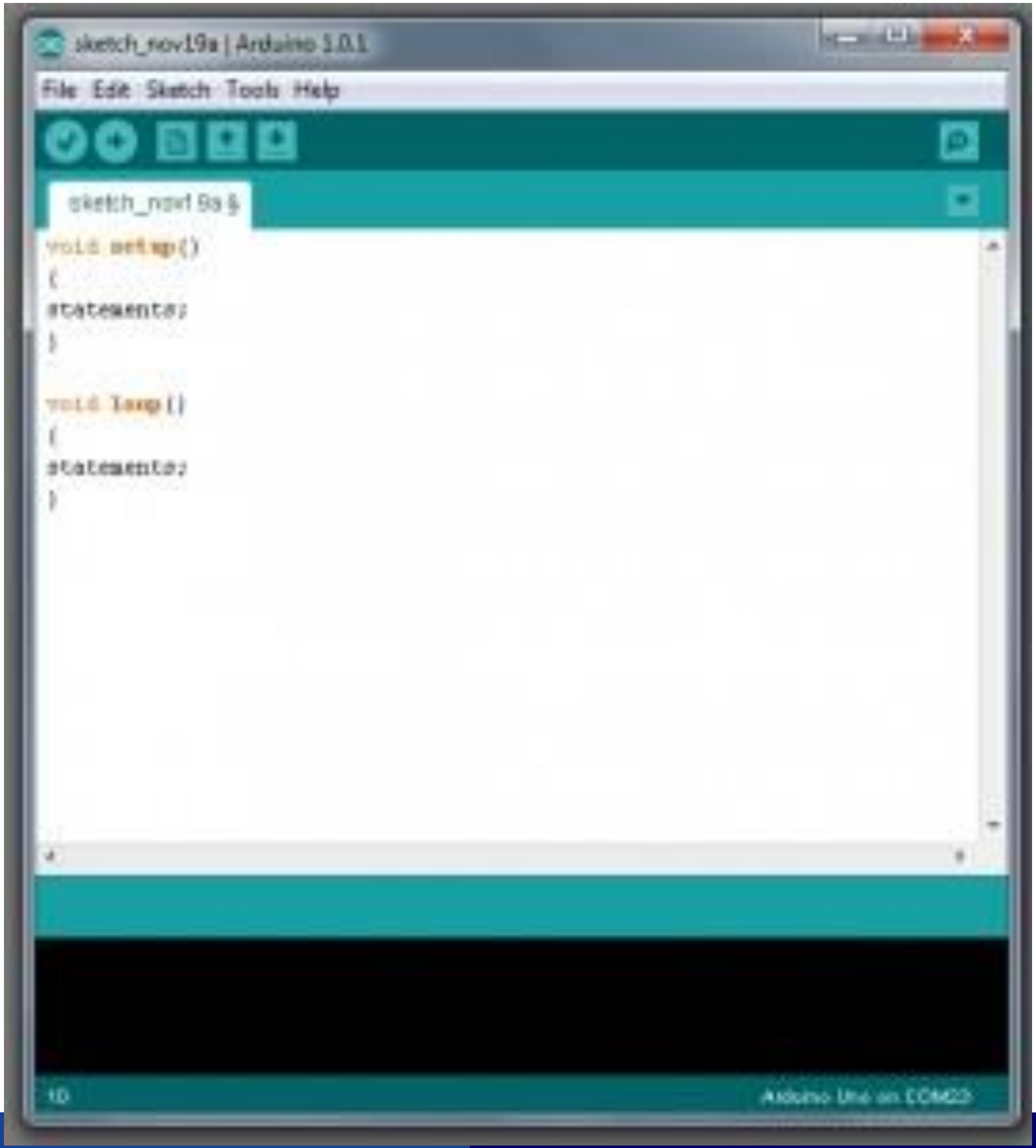
- **File > Examples > Digital > Blink**
- LED’s have polarity
  - Negative indicated by flat side of the housing and a short leg



www.instructables.com



A Little Bit About Programming

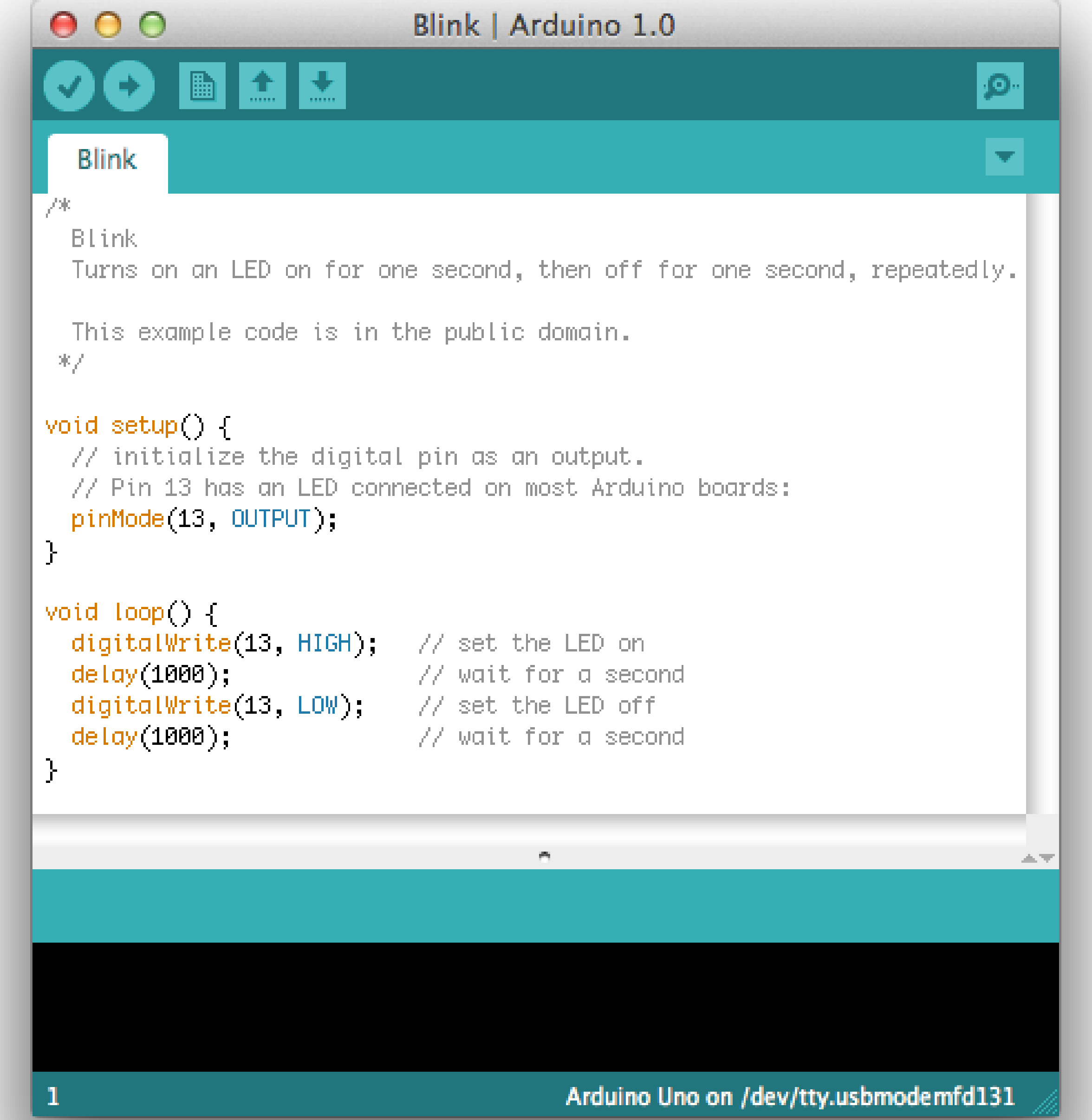


```
void setup()
{
statements;
}

void loop()
{
statements;
}
```

- 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



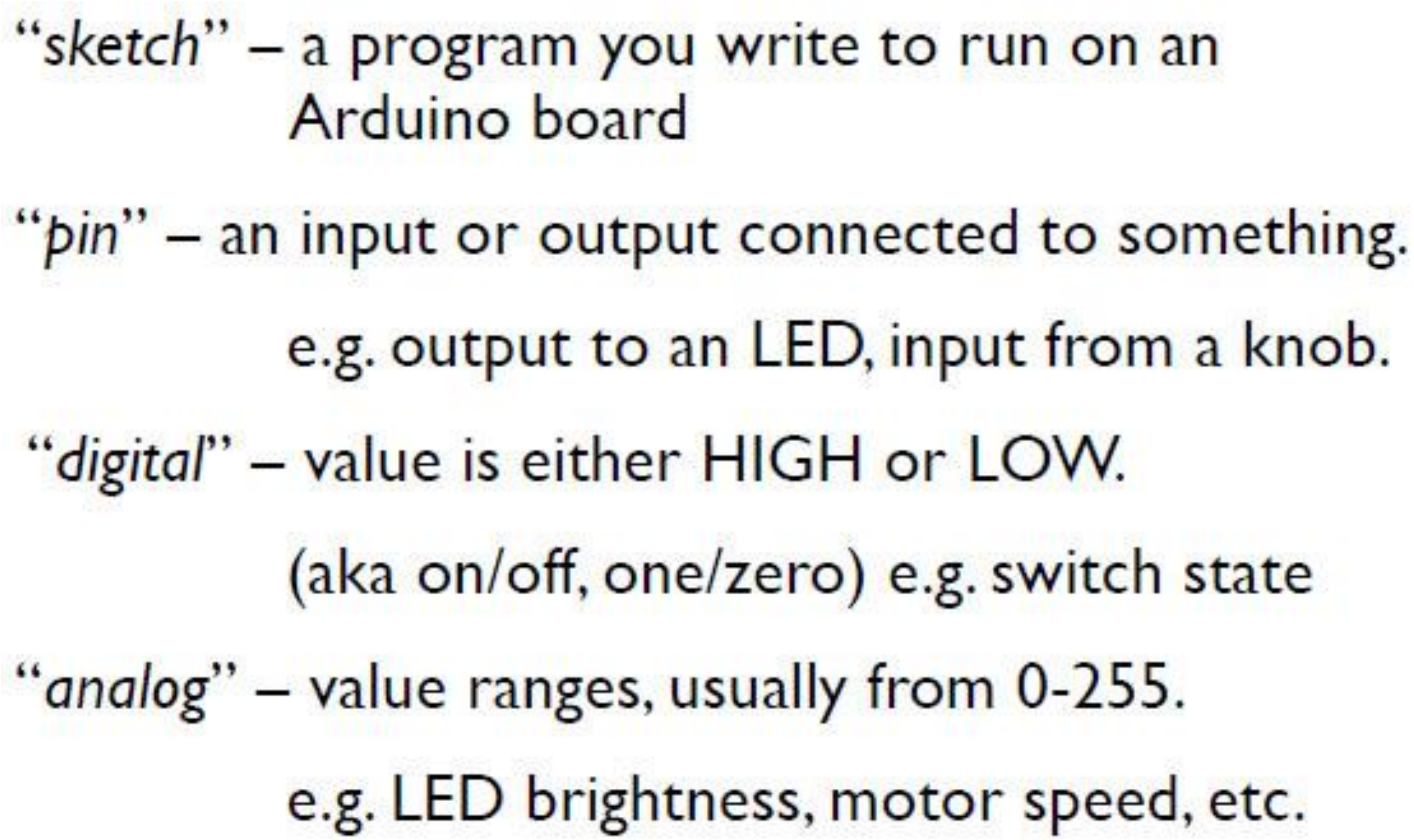
```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  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
}
```

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.

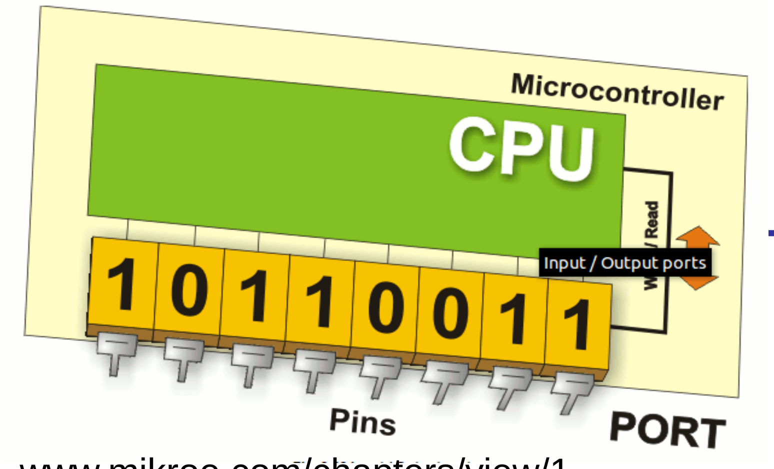
"*digital*" – value is either HIGH or LOW.

(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*)

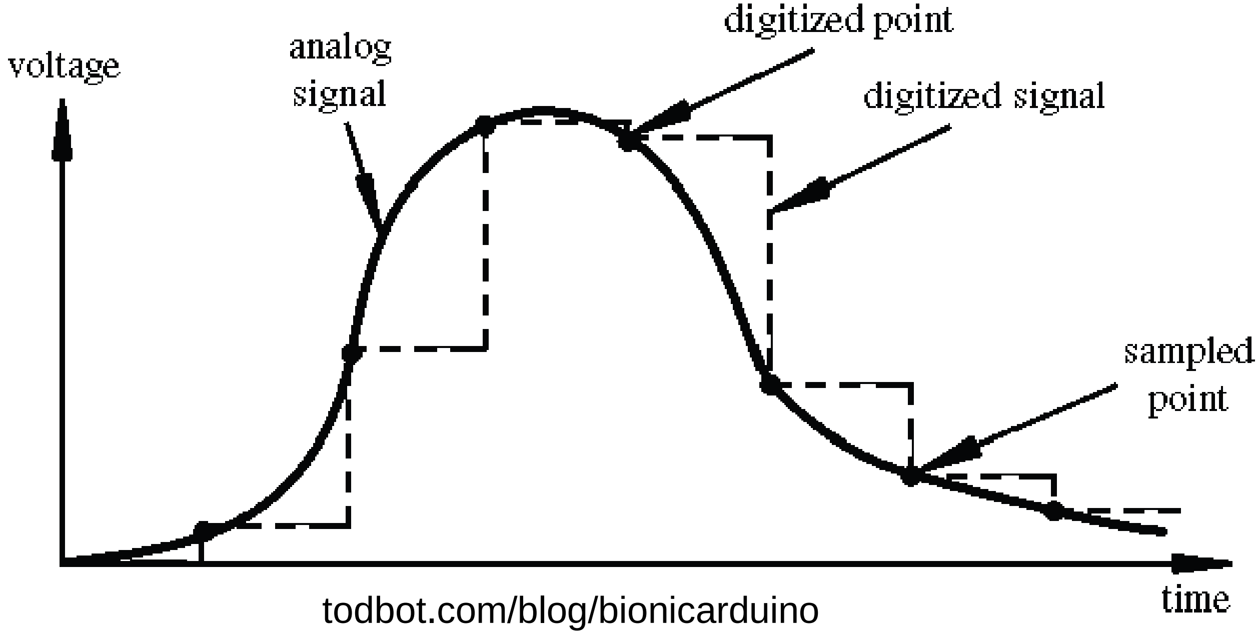
Writes HIGH or LOW to a pin

Arduino Timing

- `delay(`*`ms`*`)`
  - Pauses for a few milliseconds
- `delayMicroseconds(`*`us`*`)`
  - 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



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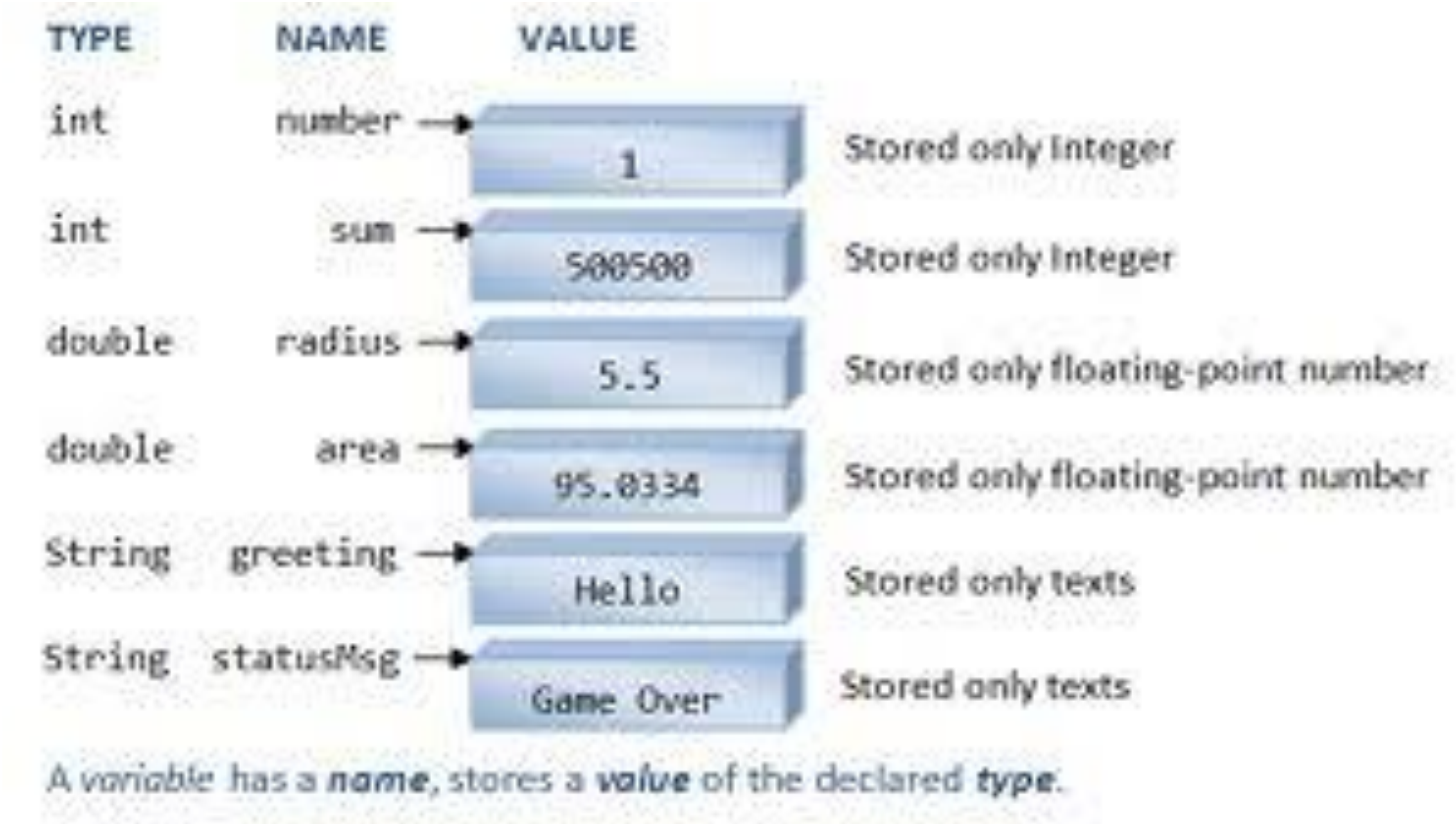
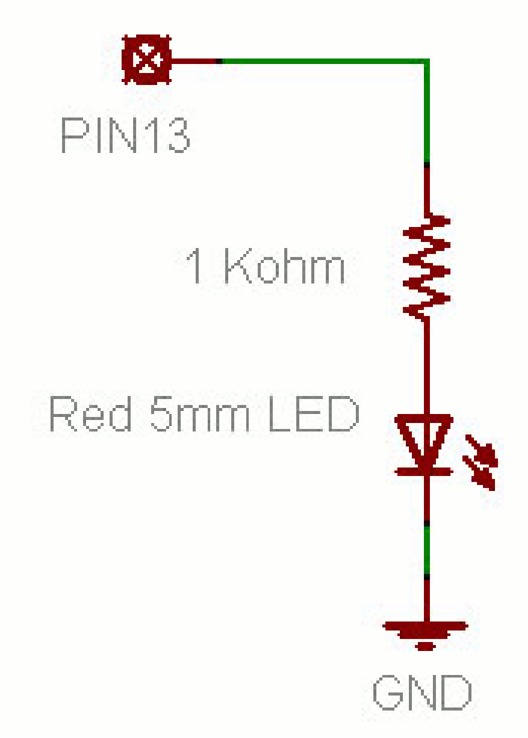
Variables



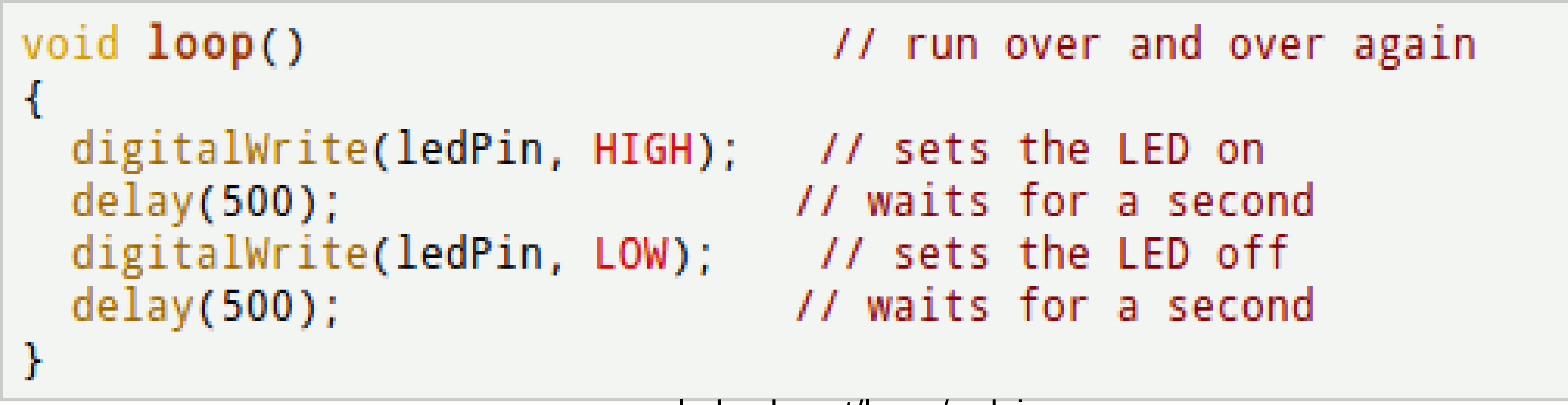
TYPE	NAME	VALUE	
int	number	1	Stored only Integer
int	sum	500500	Stored only Integer
double	radius	5.5	Stored only floating-point number
double	area	95.0334	Stored only floating-point number
String	greeting	Hello	Stored only texts
String	statusMsg	Game Over	Stored only texts

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
}
```

www.ladyada.net/learn/arduino

Analog to Digital Coversion

- 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);

Simulator

https://www.tinkercad.com/

Thanks