



Intro to Arduino

Zero to Virtual Prototyping in Seven Hours

Overview of Class

Getting Started:

Installation, Applications and Materials

Electrical:

Components, Ohm's Law, Input and Output, Analog and Digital

One Hour Break For Lunch

Programming:

Split into groups depending on experience

Serial Communication Basics:

Troubleshooting and Debugging

Virtual Prototyping:

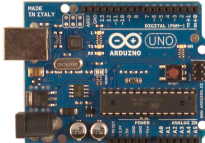
Schematics and PCB Layout in Fritzing

Arduino Board

"Strong Friend" Created in Ivrea, Italy
in 2005 by Massimo Banzi & David Cuartielles
Open Source Hardware

Atmel Processor

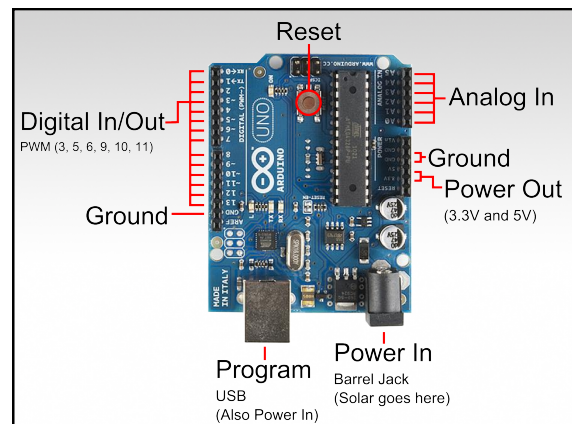
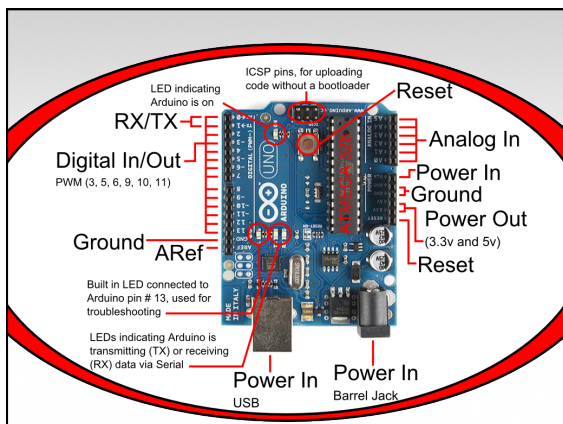
Coding is accessible (C++, Processing, ModKit and MiniBlox)



Team Arduino: (Left to right)
David Cuartielles, Massimo Banzi & Gianluca Martino

Getting Started

- **Installation:** Arduino (v.22) and Fritzing
Java and Drivers
- **Materials:** SIK Guide
Analog I/O, Digital I/O, Serial,
& Fritzing handouts
- **Applications:** Arduino IDE for programming board
Fritzing for creating PCBs
Modkit (combo Arduino & Scratch)

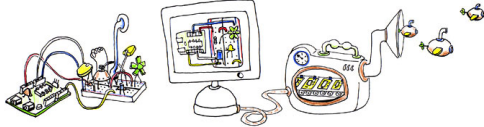


Fritzing

Virtual Electrical Prototyping Project
started in 2007 by the Interaction Design Lab
at the University of Applied Science Potsdam, Germany

Open Source

Prototypes: Document, Share, Teach, Manufacture

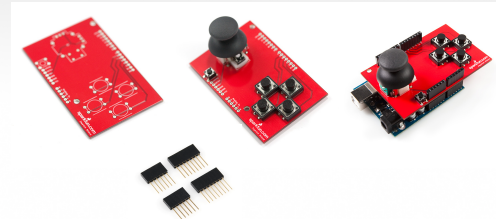


Arduino Shields

PCB

Built Shield

Inserted Shield



Arduino Shields

Micro SD

MP3 Trigger

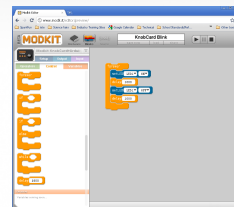
Joystick



MODKit, Alpha & Beta

Graphical User Interface for intuitive coding of Arduino
Developed by Ed Baafi and Collin Reisdorf

Two components: Online Editor and Download



Above: MODKit download in toolbar.
Right click for quit and autostart. This
download is for uploading to your
Arduino board.

Left: MODKit programming
environment.

Components

Name	Image	Type	Function	Notes
Button		Digital Input	Closes or opens circuit	Polarized, needs resistor
Trimpot		Analog Input	Variable resistor	
Photoresistor		Analog Input	Variable resistor	
Relay		Digital Output & Input	Switches between circuits	Used to control larger voltages
Temp Sensor		Analog Input	Variable resistor	
Flex Sensor		Analog Input	Variable resistor	Only bends one way
Soft Trimpot		Analog Input	Variable resistor	Careful of shorts
RGB LED		Dig. & Analog Output	16,777,216 different colors	Ooh... So pretty.

Ohm's Law

Ohm's Law describes the direct relationship between the Voltage, Current and Resistance of a circuit.

The three different forms of Ohm's Law are as follows:

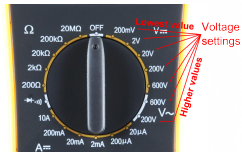
$$V = I * R \quad I = V / R \quad R = V / I$$

Where V is Voltage, I is Current and R is Resistance.

Ohm's Law

Why do I care about Voltage?

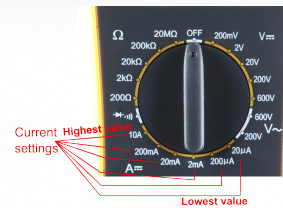
Voltage allows electricity to travel through all the components of the circuit. Voltage of your power source must be more than the total voltage drop of your circuit so the electricity can travel from power to ground.



Ohm's Law

Why do I care about Current?

Current is the aspect of electricity that performs physical work or movement.



Not Ohm's Law

Why do I care about Continuity?

Continuity is important to make portions of circuits are connect. Continuity is the simplest and possibly the most important setting on your multimeter.



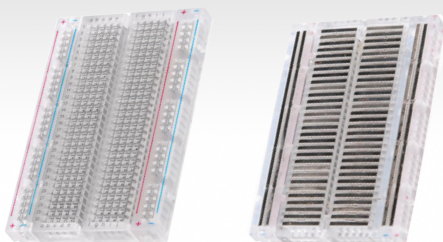
What's a Breadboard?

One of the most useful tools in an engineer or Maker's toolkit. The three most important thing to remember:

- A breadboard is easier than soldering
- A lot of those little holes are connected, which ones?
- Sometimes breadboards break



What's a Breadboard?



Analog and Digital

- All Arduino signals are either Analog or Digital
- All computers including Arduino, only understand Digital
- It is important to understand the difference between Analog and Digital signals since Analog signals require an Analog to Digital conversion

Output

Output is any signal exiting an electrical system

- Almost all systems that use physical computing will have some form of output
- The outputs in SIK include LEDs, a motor, a servo, a piezo element, a relay and an RGB LED

Output

Output is always Digital

To Output a Digital signal (On or Off) use this code:

`digitalWrite ( pinNumber , value );`

Where value is **HIGH** or **LOW**

To output a signal that pretends to be Analog use this code:

`analogWrite ( pinNumber , value );`

Where value is a number 0 - 255

Output

Output is always Digital

Using a Digital signal that pretends to be an Analog signal is called Pulse Width Modulation

Use Pulse Width Modulation, or P.W.M., for anything that requires a signal between **HIGH** and **LOW**

P.W.M. is available on Arduino pins # 3, 5, 6, 9, 10, and 11

Output

Output is always Digital, even when it's P.W.M.

For P.W.M. the Arduino pin turns on then off very fast



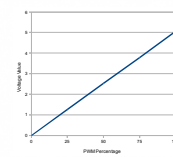
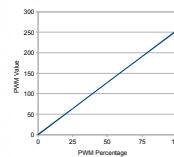
P.W.M. Signal @ 25%



P.W.M. Signal @ 75%



P.W.M. Signal rising



Input

Input is any signal entering an electrical system

- Both digital and analog sensors are forms of input
- Input can also take many other forms: Keyboards, a mouse, infrared sensors, biometric sensors, or just plain voltage from a circuit



Analog Input

- To connect an analog Input to your Arduino use Analog Pins # 0 - 5
- To get an analog reading:
`analogRead ( pinNumber );`
- Analog Input varies from 0 to 1023 on an Arduino

Analog Sensors

Examples:

Sensors	Variables	Values	Signals
Mic	Volume	Decibels	Voltage
Photoresistor	Light	Photons	Voltage
Potentiometer	Dial Position	Resistance	Voltage
Temp Sensor	Temperature	Celsius	Voltage
Flex Sensor	Bend	Resistance	Voltage
Accelerometer	Motion/Tilt/Acceleration	Acceleration	Voltage

Digital Input

- To connect digital input to your Arduino use Digital Pins # 0 – 13 (Although pins # 0 & 1 are also used for serial)
- Digital Input needs a pinMode command:
`pinMode ( pinNumber, INPUT );`
Make sure to use caps for INPUT
- To get a digital reading: **`digitalRead ( pinNumber );`**
- Digital Input values are only **HIGH** (On) or **LOW** (Off)

Digital Sensors

- Digital sensors are more straight forward than Analog
- No matter what the sensor there are only two settings: On and Off
- Signal is always either HIGH (On) or LOW (Off)
- Voltage signal for HIGH will be a little less than 5V on your Uno
- Voltage signal for LOW will be 0V on most systems

Questions?



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