DSL 124
Design with contemporary technologies

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Topic 3: Microcontroller Programming

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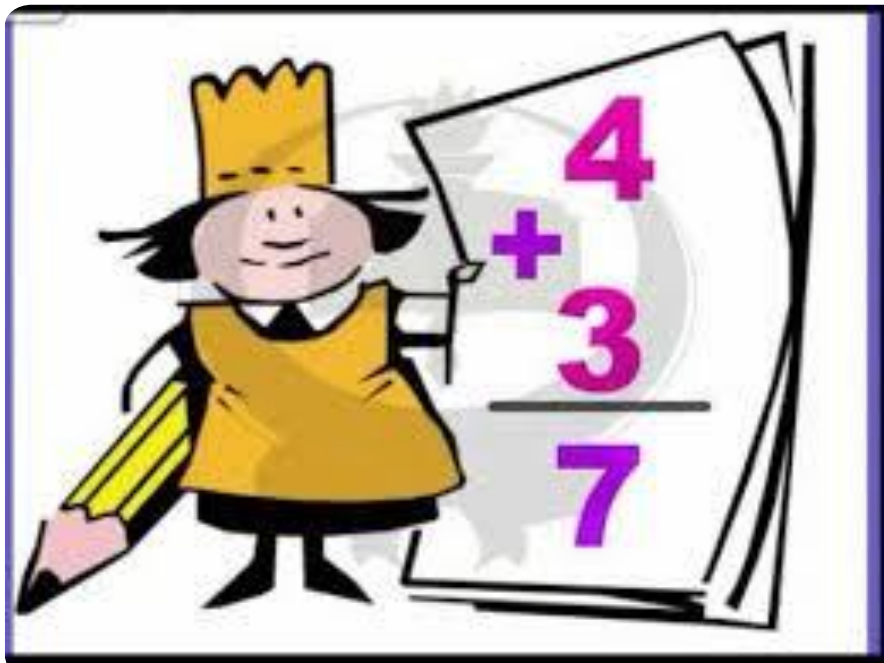
Programming

- Programming – instruction to perform task
- English or Hindi – grammar, similarly programming languages have syntax
- How would a calculator add two numbers?

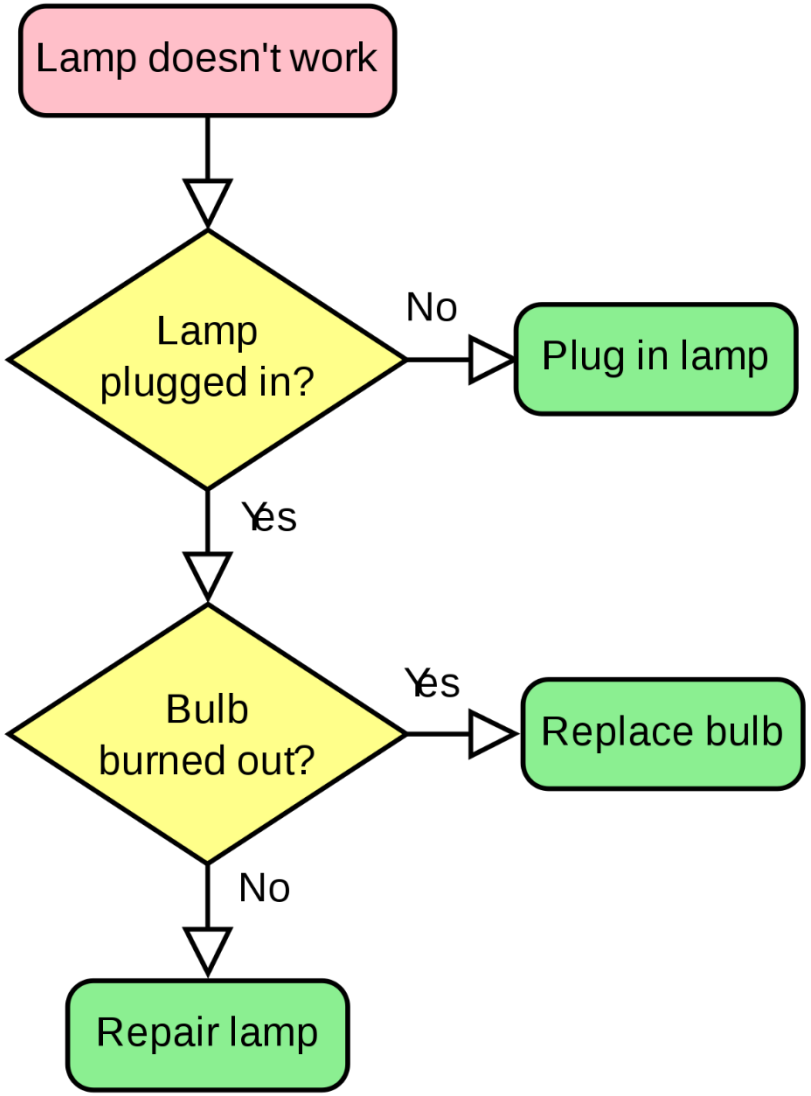
Algorithm for adding two numbers

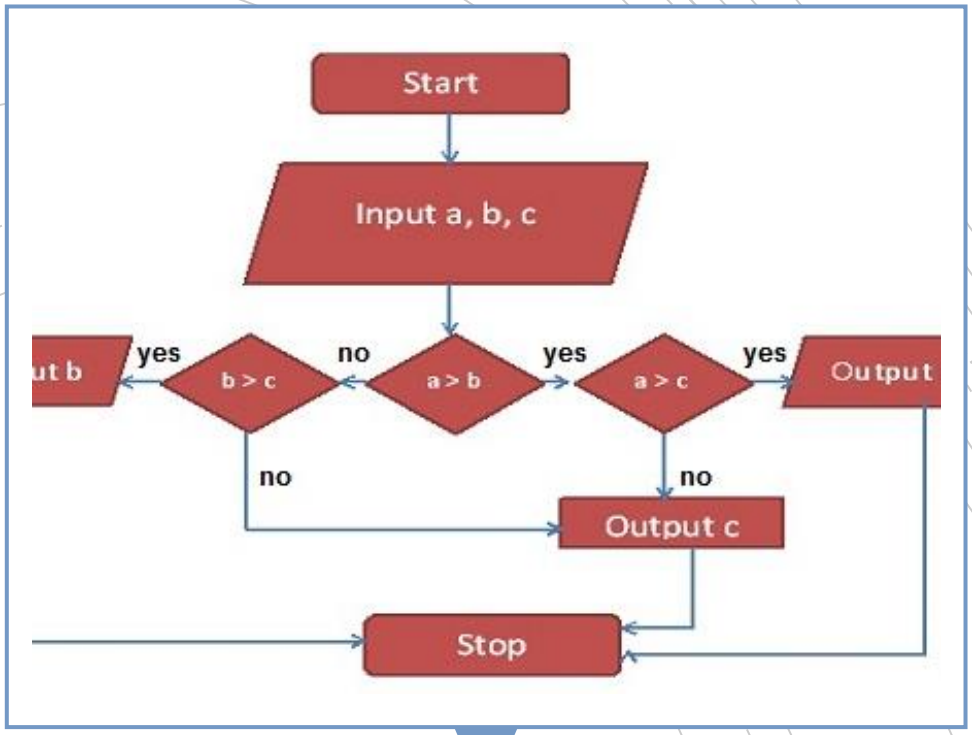
- Input number 1
- Input number 2
- Add number1 and number 2
- Print the result.



Flowchart

- Languages have different syntax but are largely similar.
- Learn one language and you can learn others quickly.
- Flowchart/Algorithm is the key.





Flowchart for largest of three numbers

Programming Language	Application
C	Microcontroller/ Embedded programming, Efficient at runtime. 95% embedded programming in C.
Python	One of the best to teach programming, Scientific computations, Raspberry Pi. Efficient in development times.
Javascript	Creating web pages. Run in browsers. HTML+CSS+Javascript
Scratch	Graphical language, flowchart based for children. MIT App Inventor related to it.
Processing	GUI for Arduino
Visual Basic	Windows based, Event based programming, Easy to build GUI, VBA in Excel.
.NET	Software framework from Microsoft

Scratch

- Getting started with Scratch
- Scratch games
- Arduino with Scratch

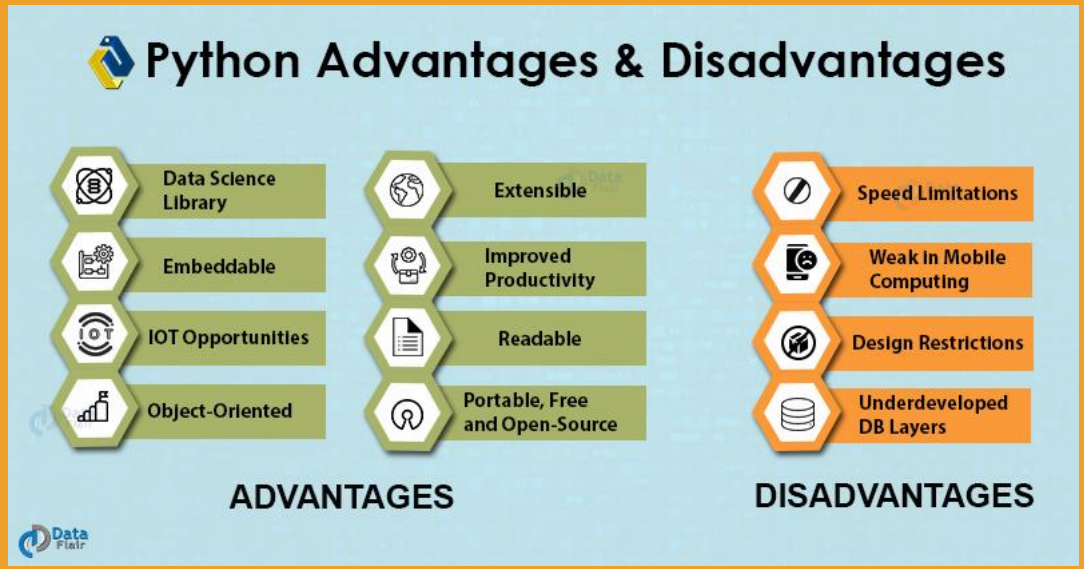
C programming

- Online compiler
- C for beginners
- Examples

Basic elements of programming language

- Programming Environment
- Data Types, Variables, Keywords
- Input and Output Operationss
- Logical and Arithmetical Operators
- If else conditions, Loops
- Functions
- Comments, Indentation, Bottom up debugging

Python



- Python basics from Sanju Ahuja
- Python interpreter
- Python examples
- Fab Academy tutorial on python

Processing IDE

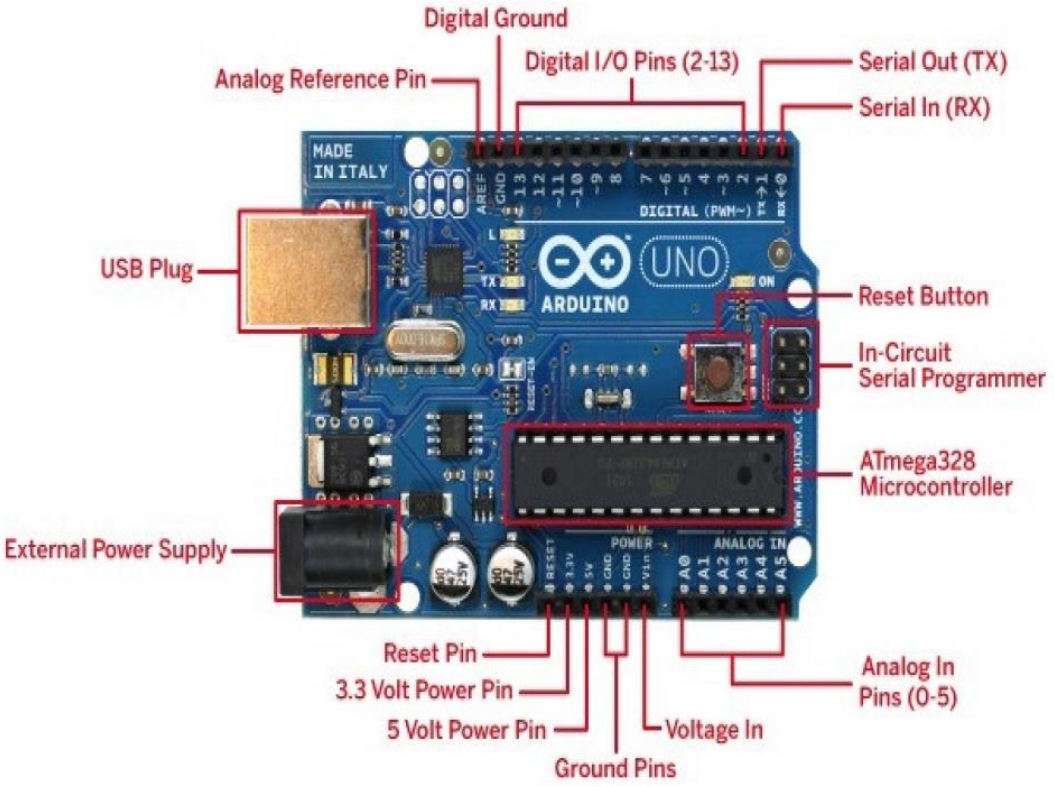
- Graphical programming language –visual design, images, creative applications
- Youtube tutorials
- Extendable through libraries (written in Java)
- Use for creating GUI for Arduino projects. For visualizing the output from sensors.
- Other applications: Motion graphics, Data visualization, Music visualization

Processing examples

- Writing simple programs
- Processing functions reference
- Examples, import libraries
- Creative, Fun programming
- Setup, draw, events, random, other functions, rendering a processing sketch
- Processing for Android

Assignment 3

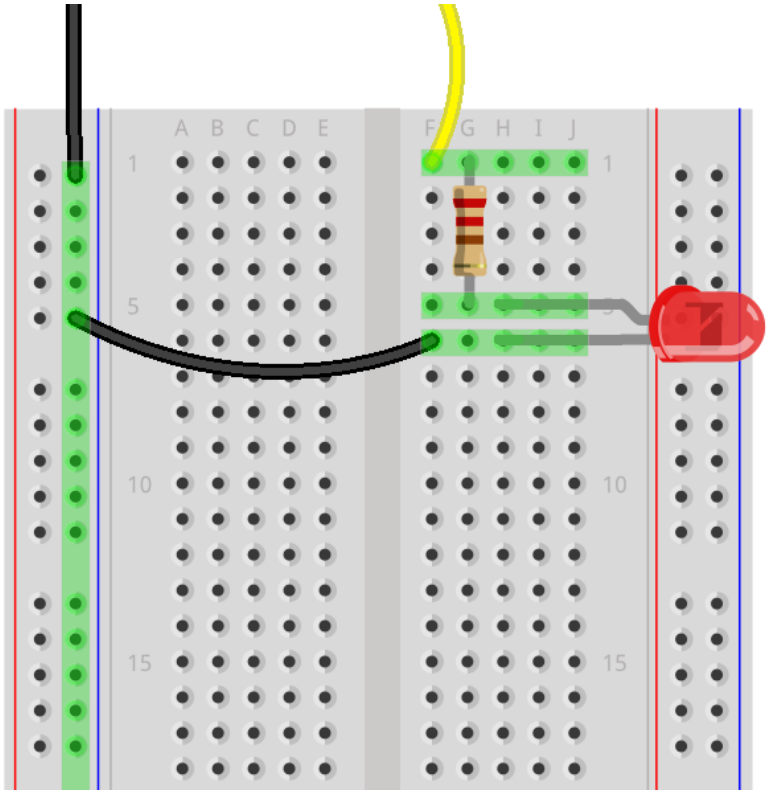
Microcontroller programming

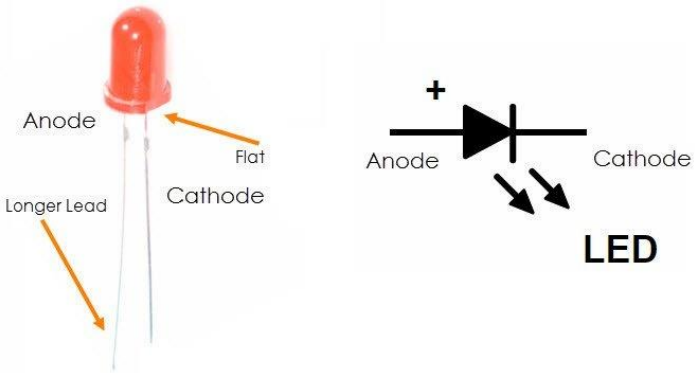


- DIY devices
- Arduino hardware
- Arduino IDE
- Arduino libraries

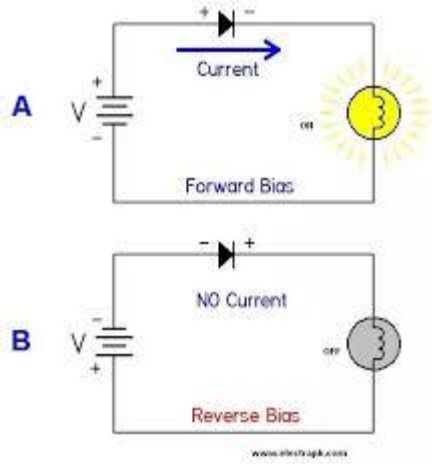
Getting started with Arduino

- Download Arduino IDE
- Arduino kit pdf for instructions
- Part 1 Preparation
- Open Arduino IDE
- Blink sketch with pin 13
- Blink sketch initialize pin 13





Diode is like a one-way valve of electronics

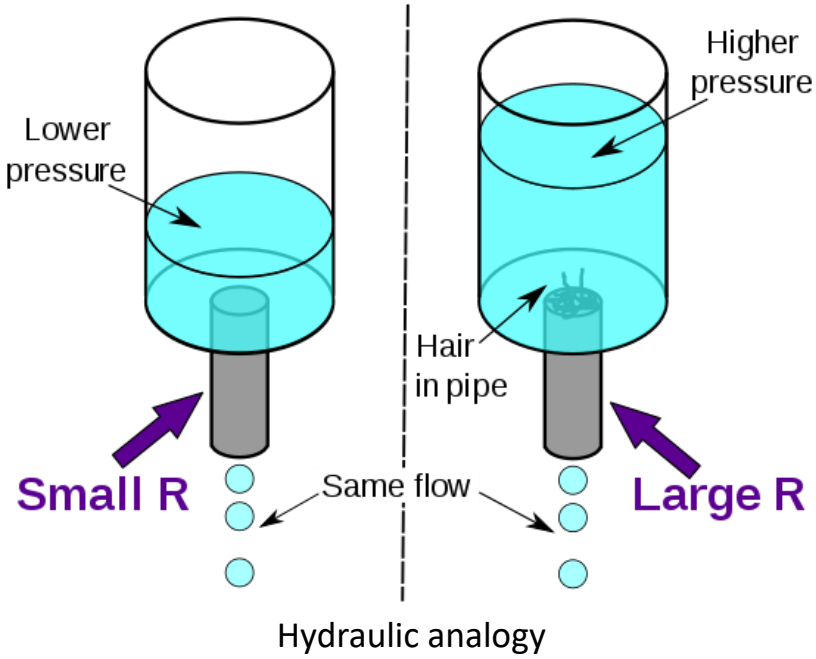


LED is a diode

- LED is a diode which makes the current flow only in one direction

Blinking LEDs

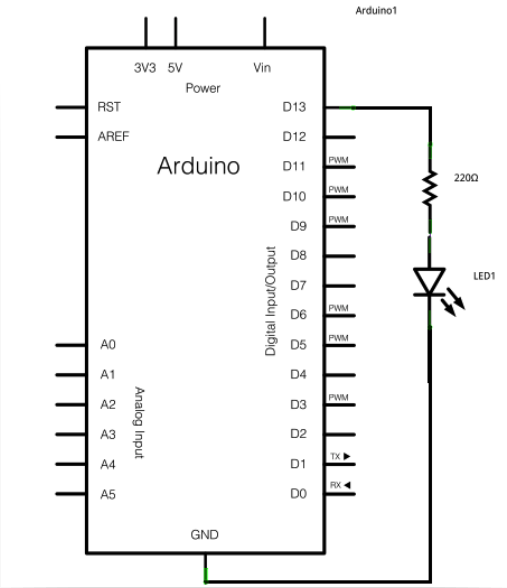
- Part 2 Module Learning
- 2.1 LED
- Blink sketch (pin 12) with own LEDs and resistors

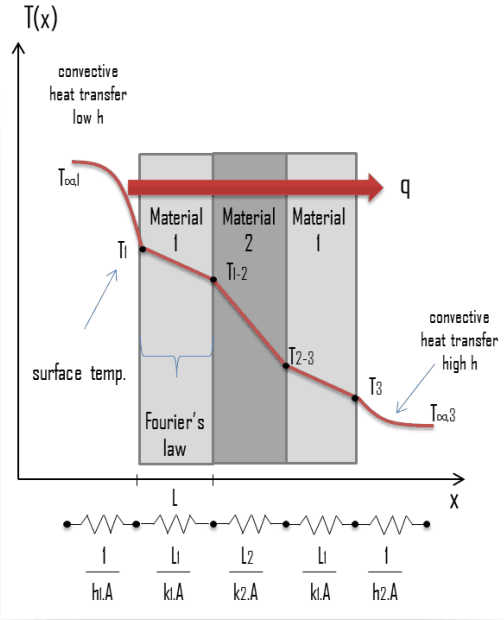


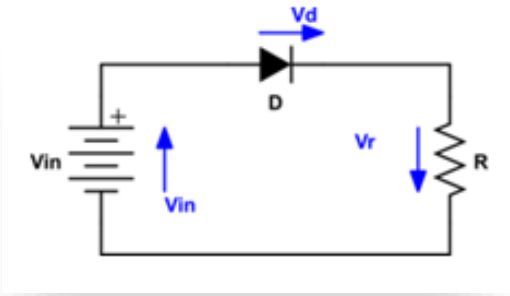
Hydraulic analogy

Ohm's Law, V=IR

Thermal analogy, Q = dT/R , I = V/R





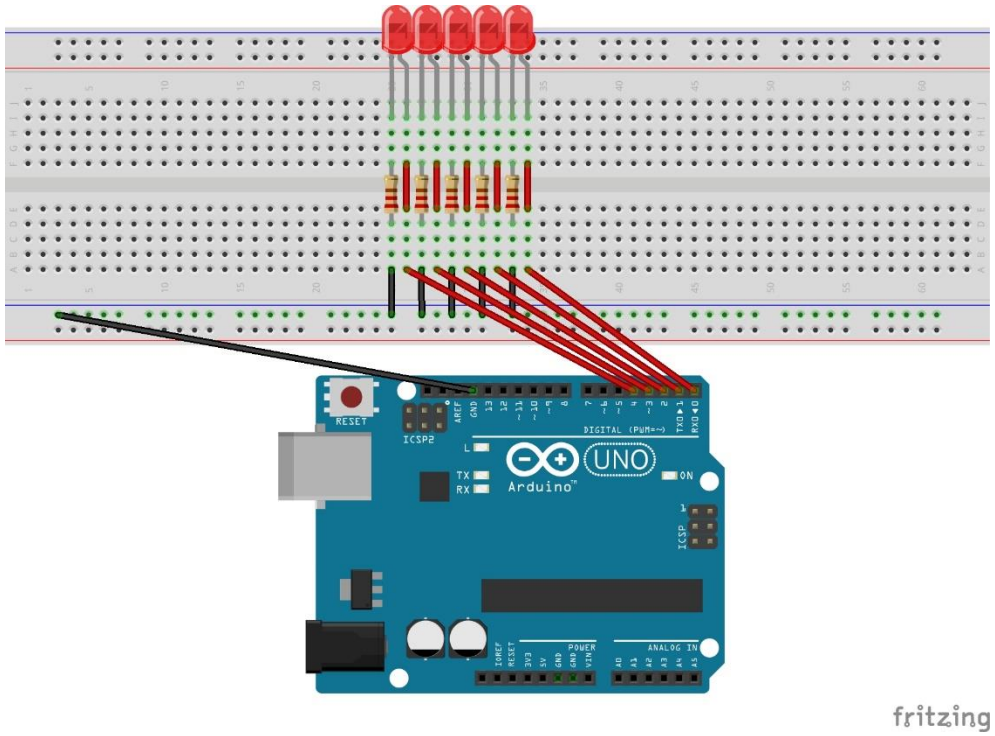


$$\sum_{k=1}^{n} V_k = 0$$

Kirchoff's Voltage Law

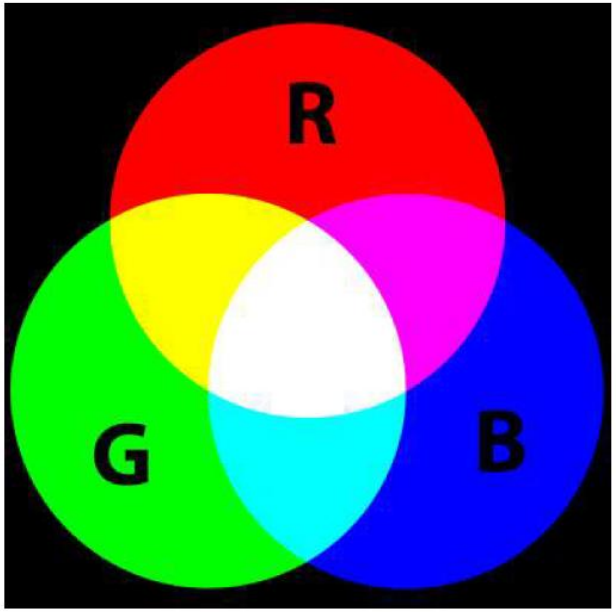
Blinking LEDs

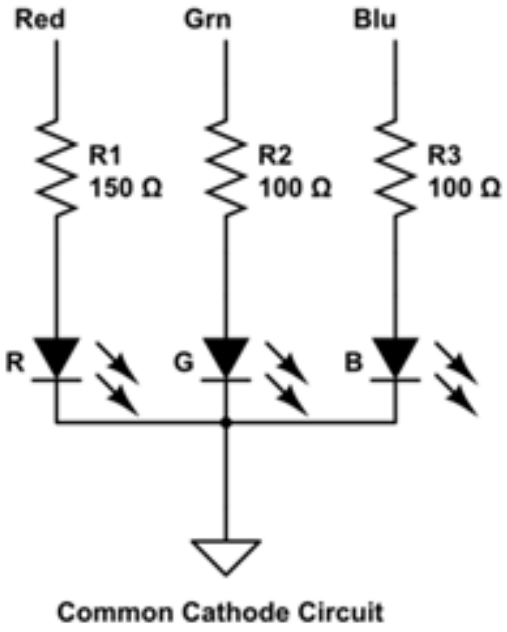
- Blink sketch (pin 12) with own LEDs and resistors
- Blink sketch (pin 12) with own LEDs and resistors and pin 13. (Sequentially on and off vs. Both on and Both off.) Arduino code

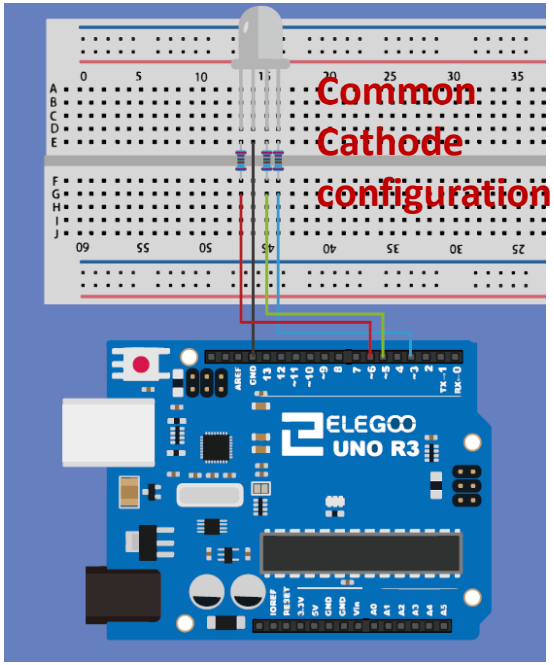


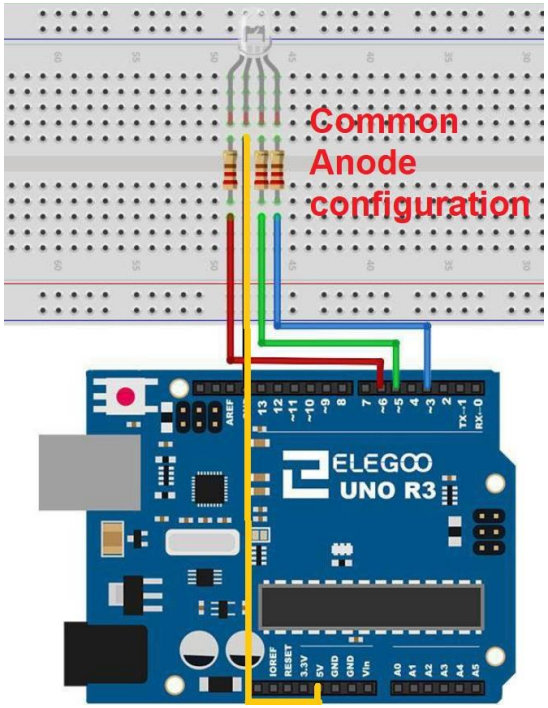
RGB LED

- PWM with RGB LED with common cathode (Lesson 2.2). NOTE: Longest leg of RGB LED goes to ground pin.
- RGB code RGB_basic RGB_favorite_color



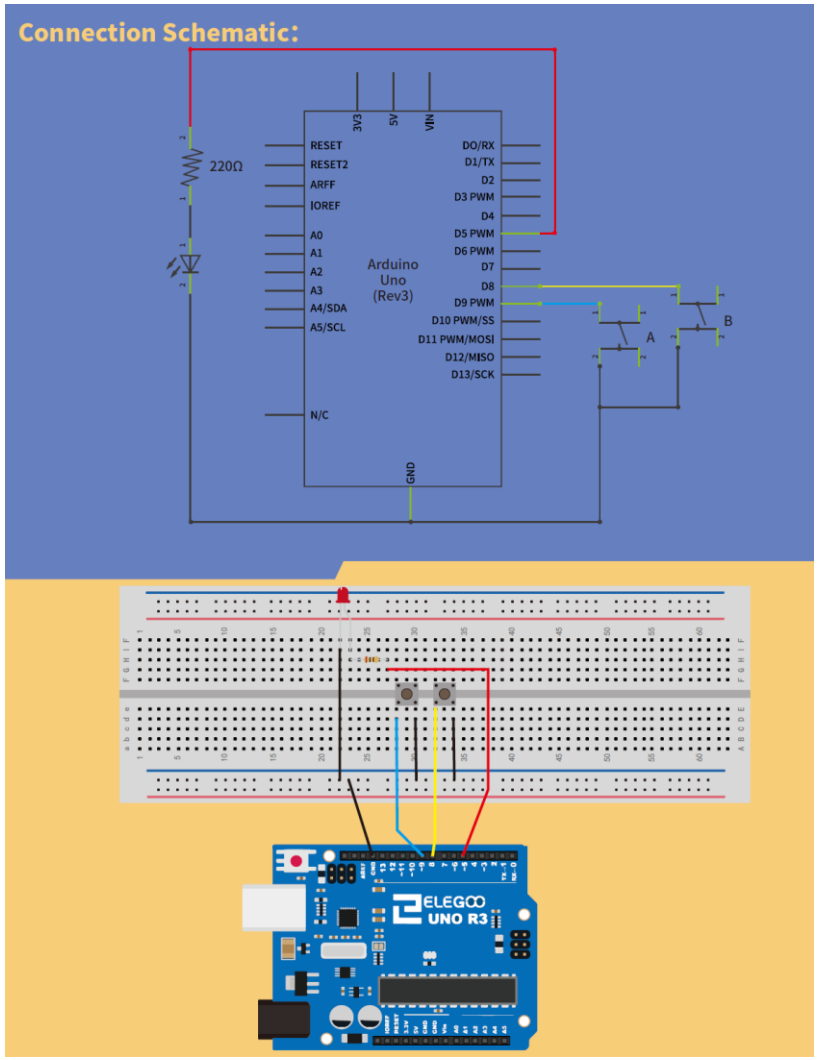




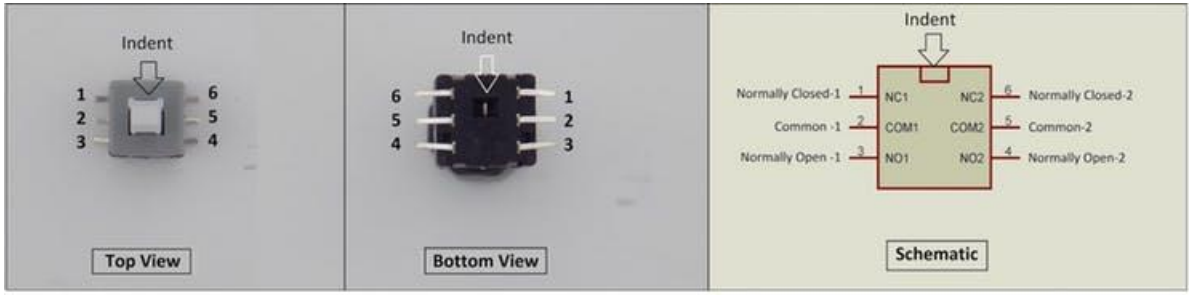


RGB LED circuit

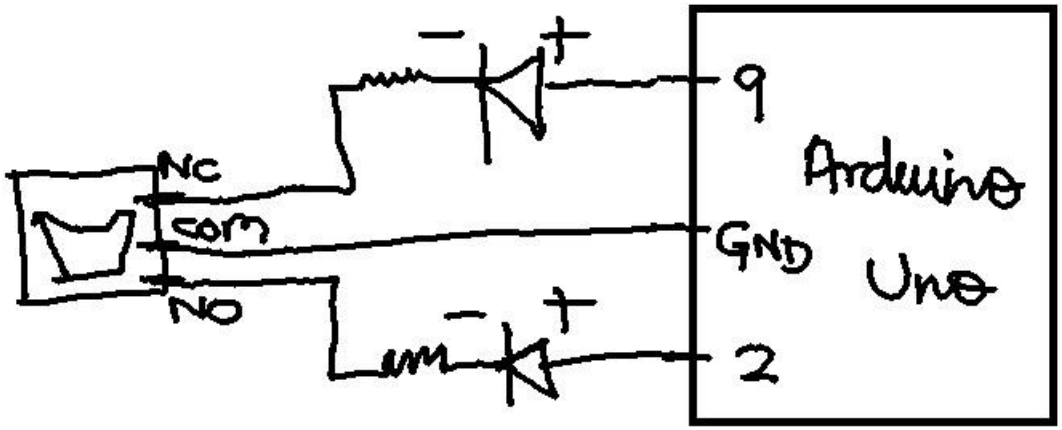
Push buttons (Input Pullup) – Lesson 2.3

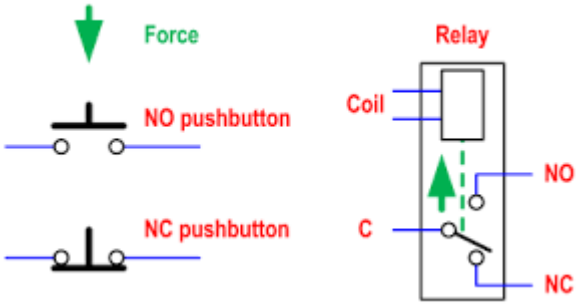


- By default, input pullup pin is High, when push button pressed, it gets to Low. Video



6 Pin Push Switch (Mini DPDT Push Switch) Pinout

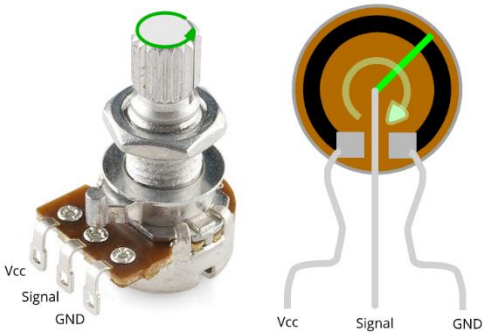


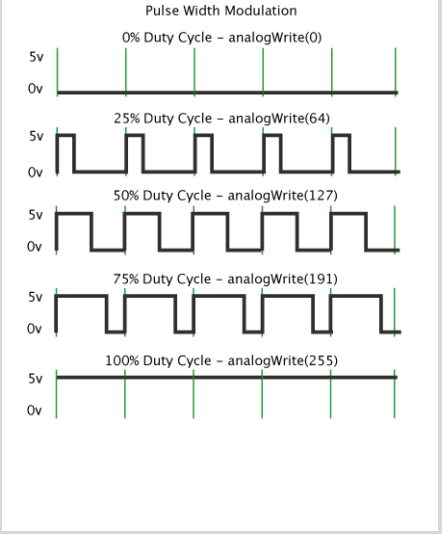


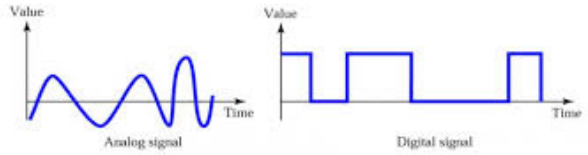
- DPDT switch video

Digital vs. Analog signal

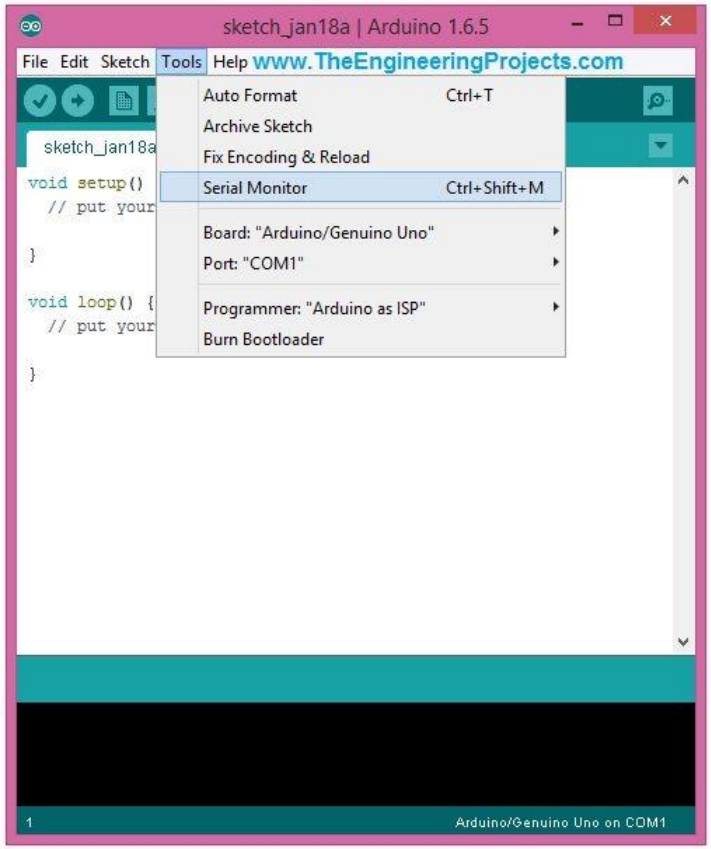
- digital output = Blink sketch
- digital input_pullup = push button example, Lesson 2.3
- analog output = Fade example, PWM pins (~)
- Analog input = AnalogInOutSerial (potentiometer)
- Multimeter = voltages, resistors, continuity.



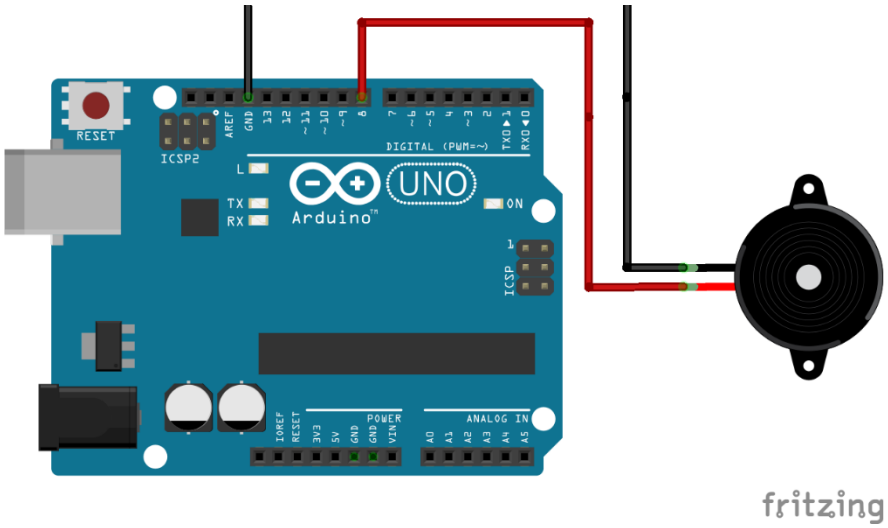


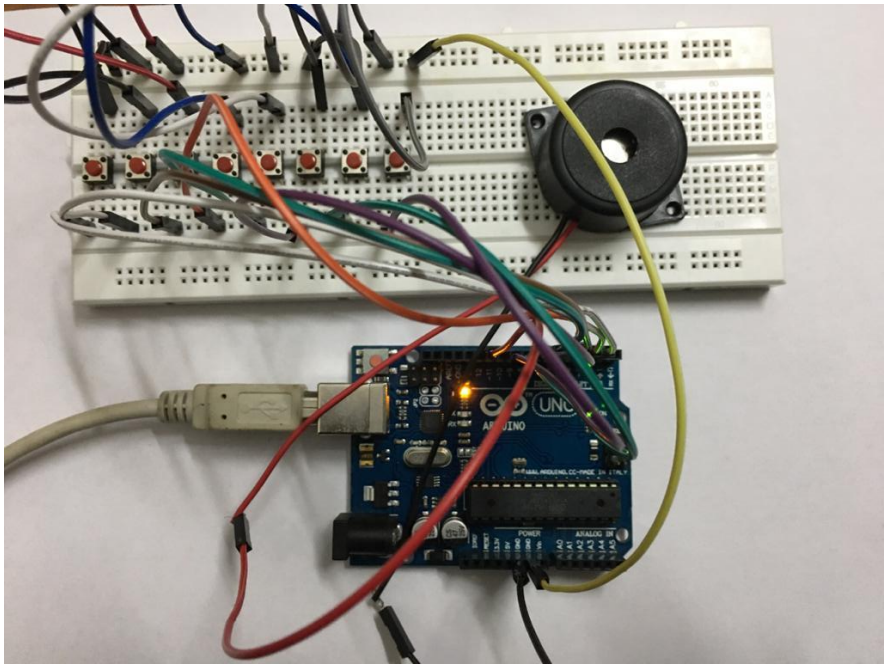


Arduino features



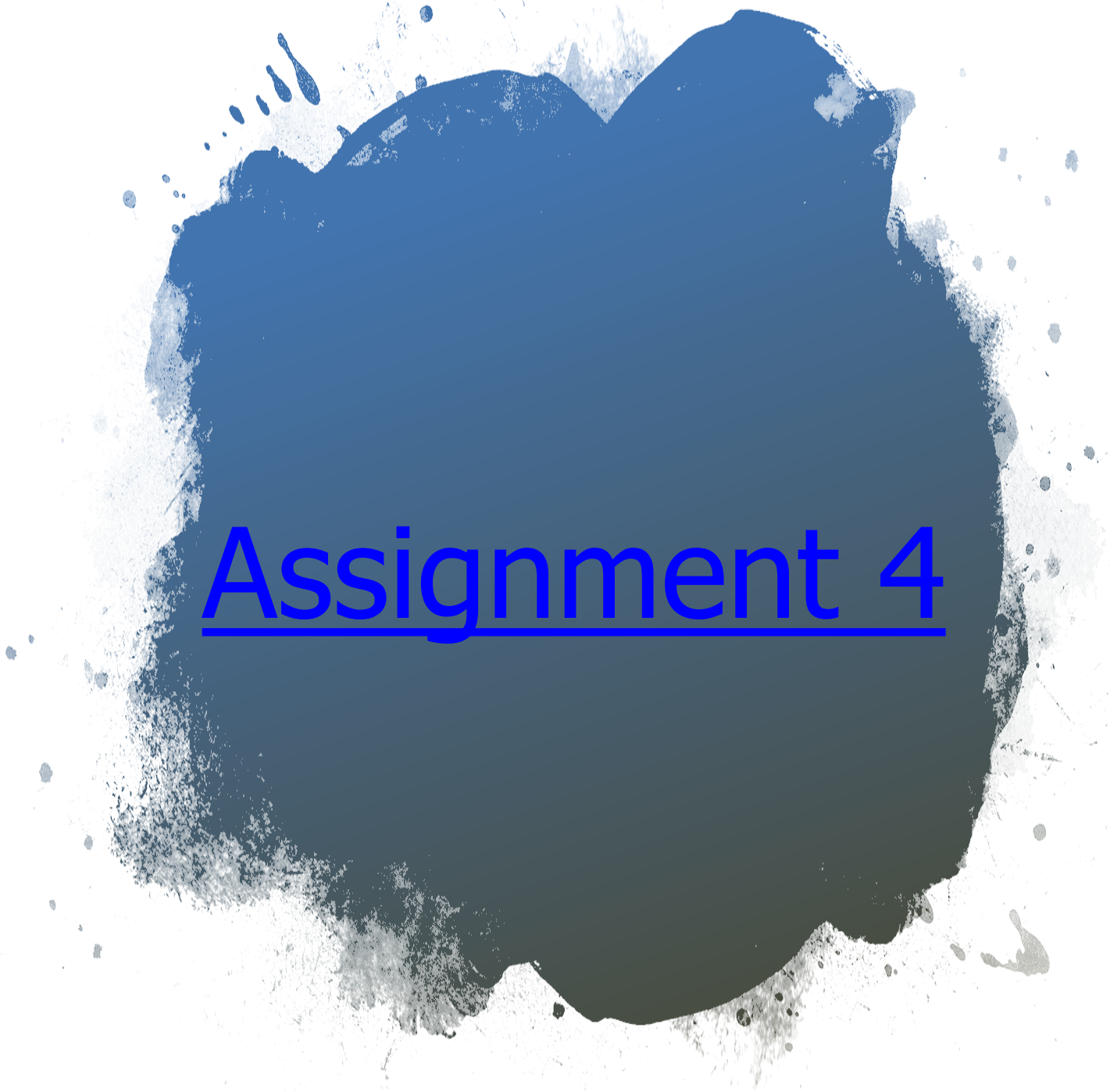
- If then else
- function, for loop, serial communication, serial monitor
- Arduino examples: Arduino codes





[Basic musical instrument]

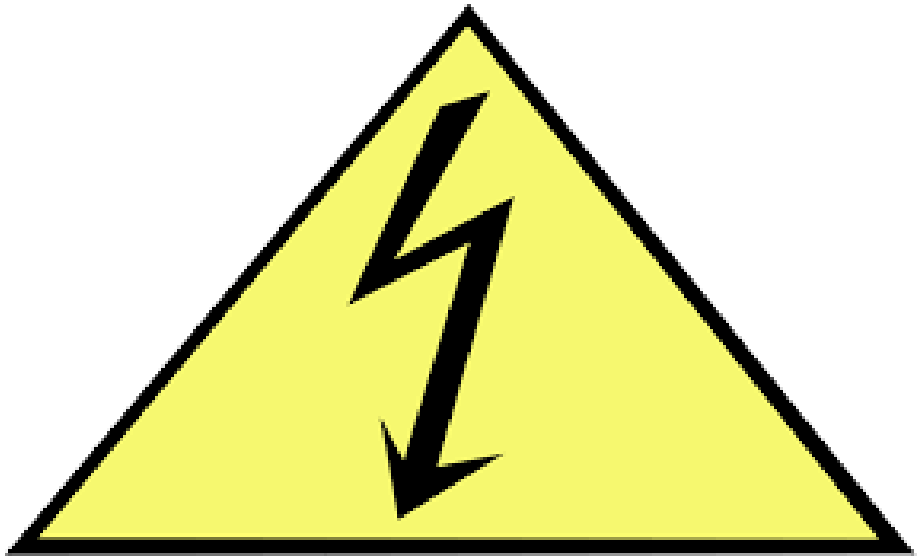
Piezo buzzer (Lesson 2.6)


Assignment 4

Summary

- Algorithm, Flowchart, Programming in C, Python, Processing
- Arduino based programming
- LEDs, buttons, buzzer
- Analog and Digital signals (read and write)
- Serial communication

Electrical Safety and handling



- Video (1:30 - 4:00 minutes)
- Take utmost care of the electronics. Shouldn't be exposed to water. Keep in Ziploc bags. Delicate stuff.

Announcements

- Assignments are skills learnt in the class
- We would give you a chance to resubmit your assignment for re-evaluation once after we evaluate your assignment.