



AMERICAN CENTER MAKER WORKSHOP SERIES ARDUINO CLASS

2020

Agenda

Lab 0 – What is Arduino?

Lab 1 – Connecting to PC

Lab 2 – Blink LED

Lab 3 – Basic output (LED)

Lab 4 – Basic input (Switch)

Lab 5 – Analog to Digital conversion

Lab 6 – Buzzer

Lab 7 – Sound sensor

Lab 8 – Temperature/Humidity

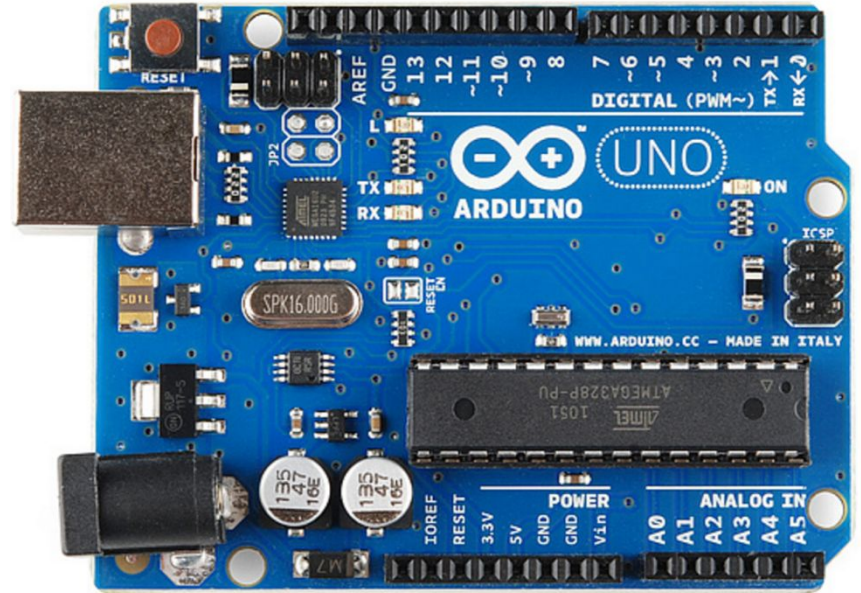
Lab 9 - OLED display

- Lab 10 – Light sensor
- Lab 11 – Pressure sensor
- Lab 12 – Accelerometer

Lab 0 : What is Arduino?

Arduino is an open-source prototyping platform based on easy-to-use hardware and software.
(Source: <https://www.arduino.cc>)

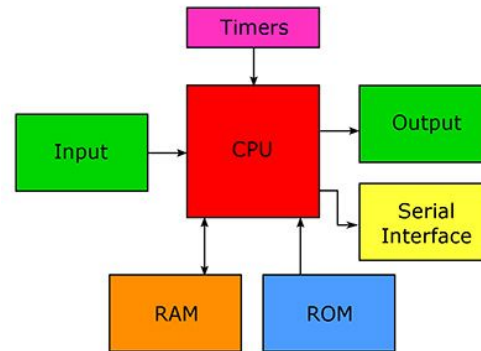
Arduino started from two open-sourced platforms "*Wiring*" (Hardware) and "*Processing*" (Software) for non-engineers to create electronic projects.



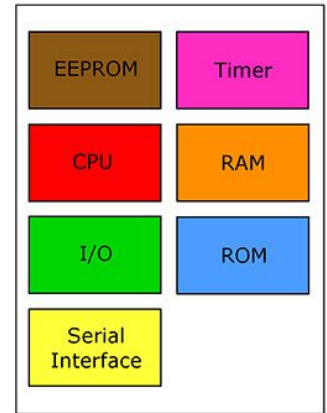
Lab 0 : Why Arduino?

- Why should we use Arduino?
- What if we don't use?

Microprocessor: CPU and several supporting chips.



Microcontroller: CPU on a single chip.



Lab 0 : Different types of Arduino



ARDUINO UNO



ARDUINO LEONARDO



ARDUINO 101



ARDUINO YUN



ARDUINO ETHERNET



ARDUINO INDUSTRIAL 101



ARDUINO ESPLORA



ARDUINO MICRO



ARDUINO NANO



MKR FOX 1200



MKR WAN 1300



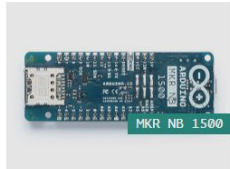
MKR GSM 1400



MKR WiFi 1010



UNO WiFi REV2



MKR NB 1500



ARDUINO MEGA 2560



ARDUINO ZERO



ARDUINO DUE



MKR VIDOR 4000



ARDUINO MKR1000



ARDUINO YUN SHIELD



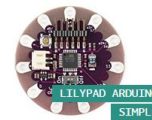
ARDUINO M0 PRO



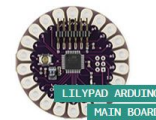
ARDUINO MKR ZERO



ARDUINO MOTOR SHIELD



LILYPAD ARDUINO SIMPLE



LILYPAD ARDUINO MAIN BOARD



LILYPAD ARDUINO USB



LILYPAD ARDUINO SIMPLE SNAP

|| Lab 0 : Arduino Projects (Visual Arts)

Users walk into a dark and foggy room revealing lasers pointed across the room. As they move, sounds are triggered and ultrasonic sensors change the pitch or sample based on the movement of the body. Midi information received from the sensors in Max is sent to a larger laser which changes

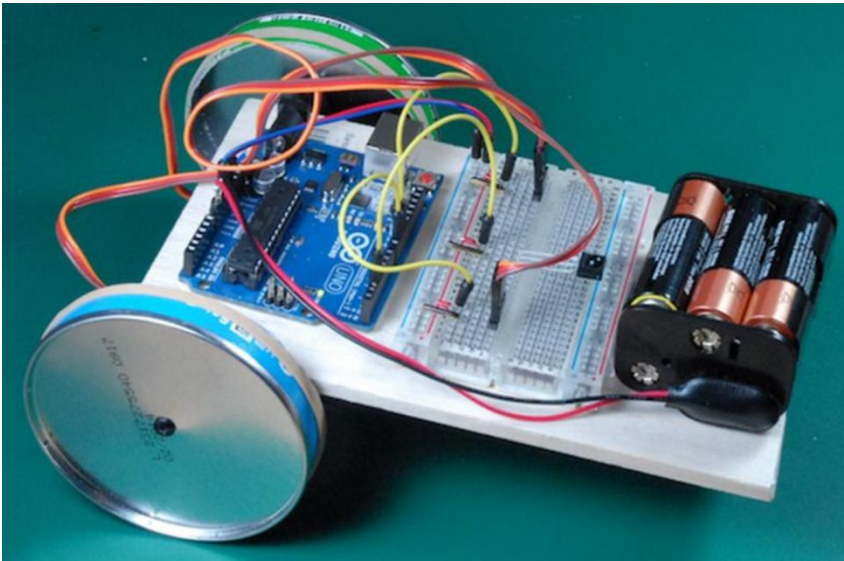


|| Lab 0 : Arduino Projects (Visual Arts)

control 135 servos with a single Arduino!

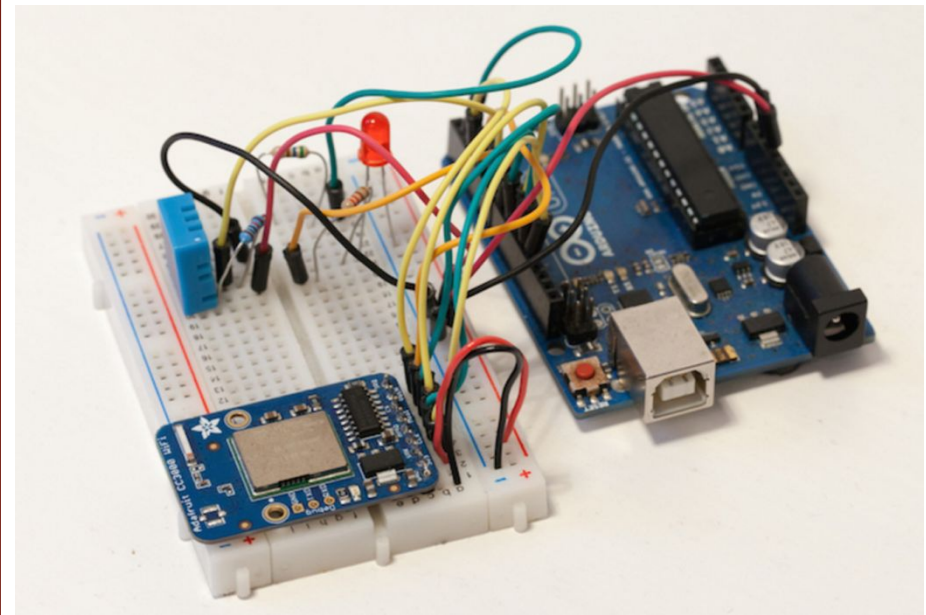
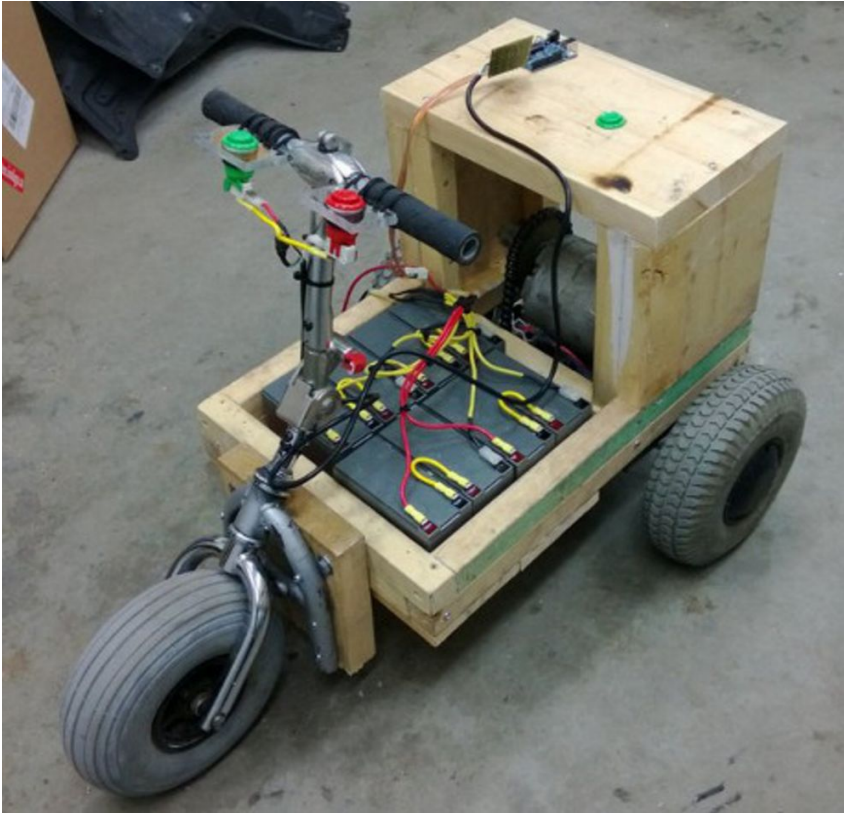


Lab 0 : Arduino Projects

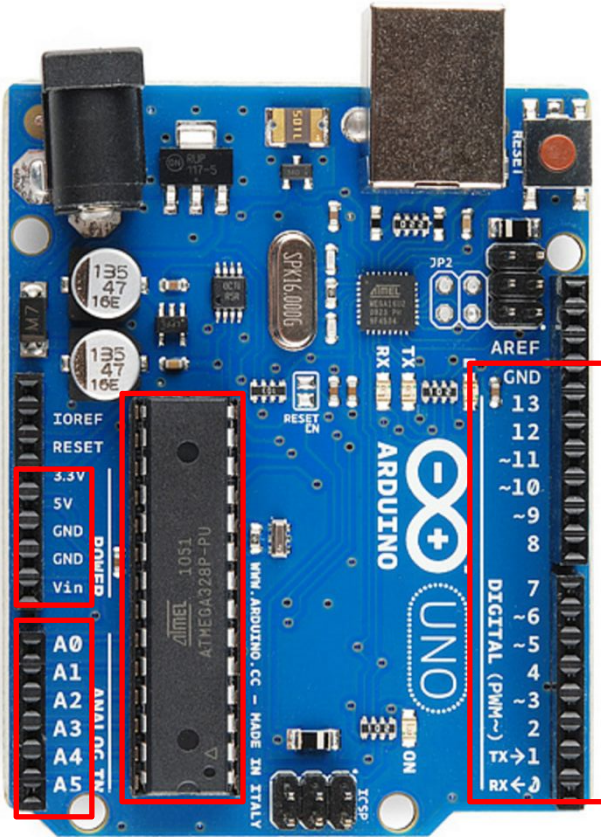


<http://www.theinebriator.com/>

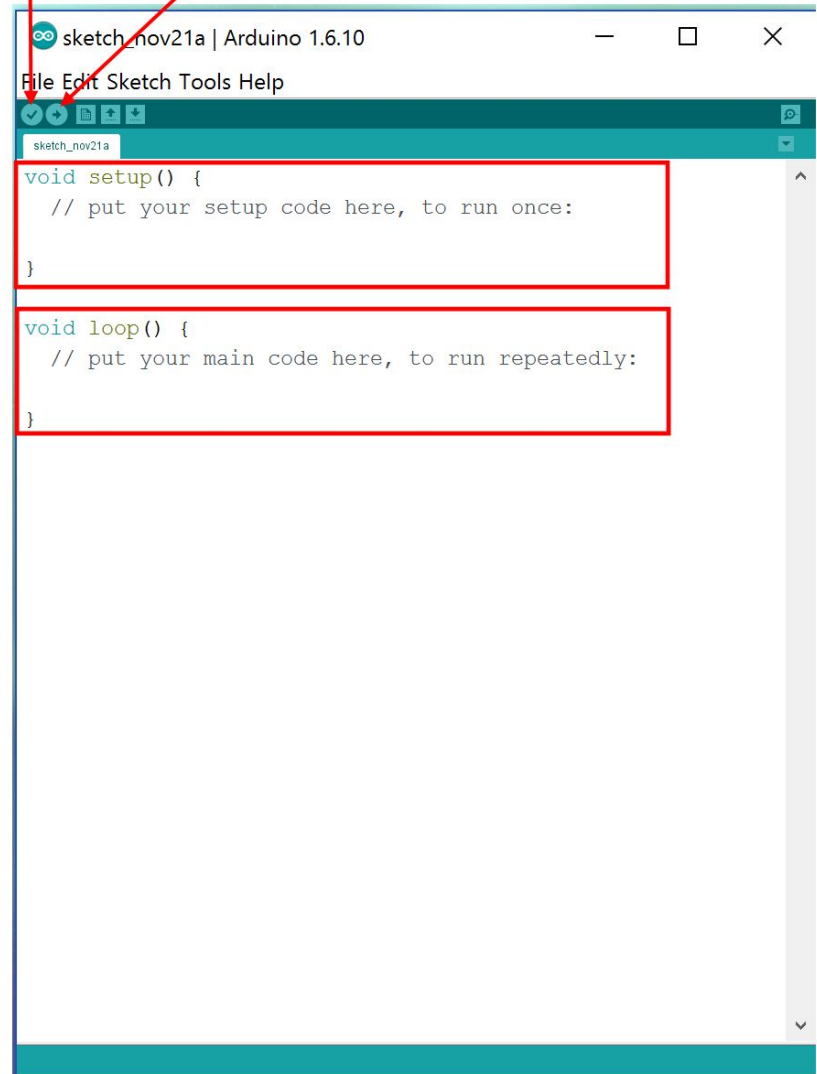
|| Lab 0 : Arduino Projects



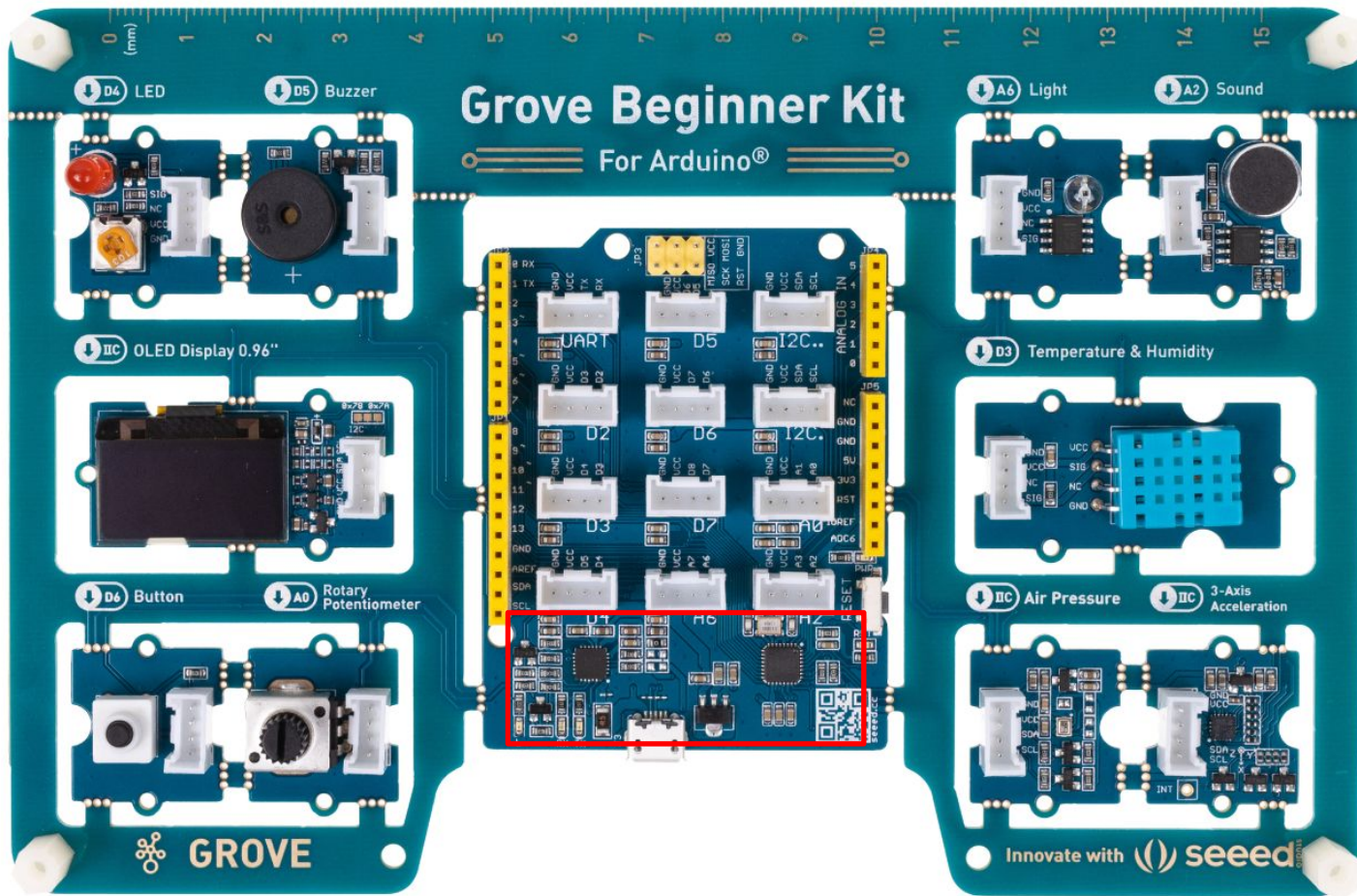
Lab 0 : Hardware / Software



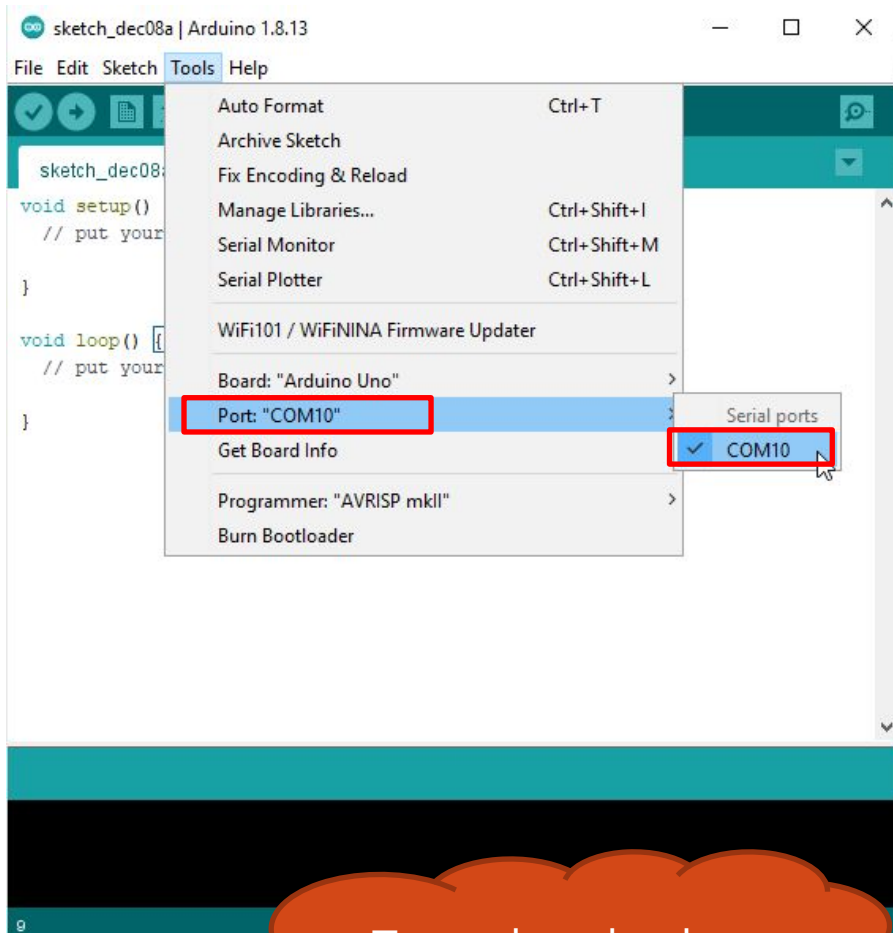
Verify (compile) Download



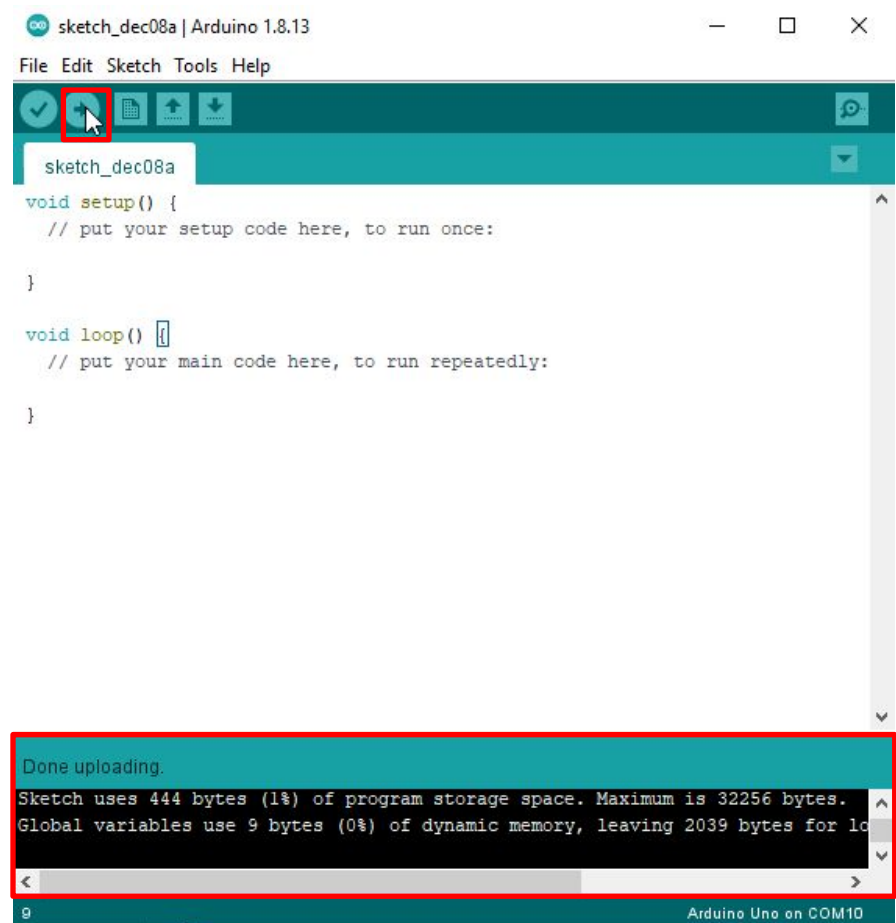
Lab 0 : Hardware



Lab 0 : Software



Try to download
blank code!



|| Lab 1 : Connecting to PC

Background

- Arduino could communicate with PC through USB cable
- It was enabled by protocol called UART (**U**niversal **A**synchronous **R**eceiver/**T**ransmitter)
- This feature allows user for easy debugging program, logging data etc



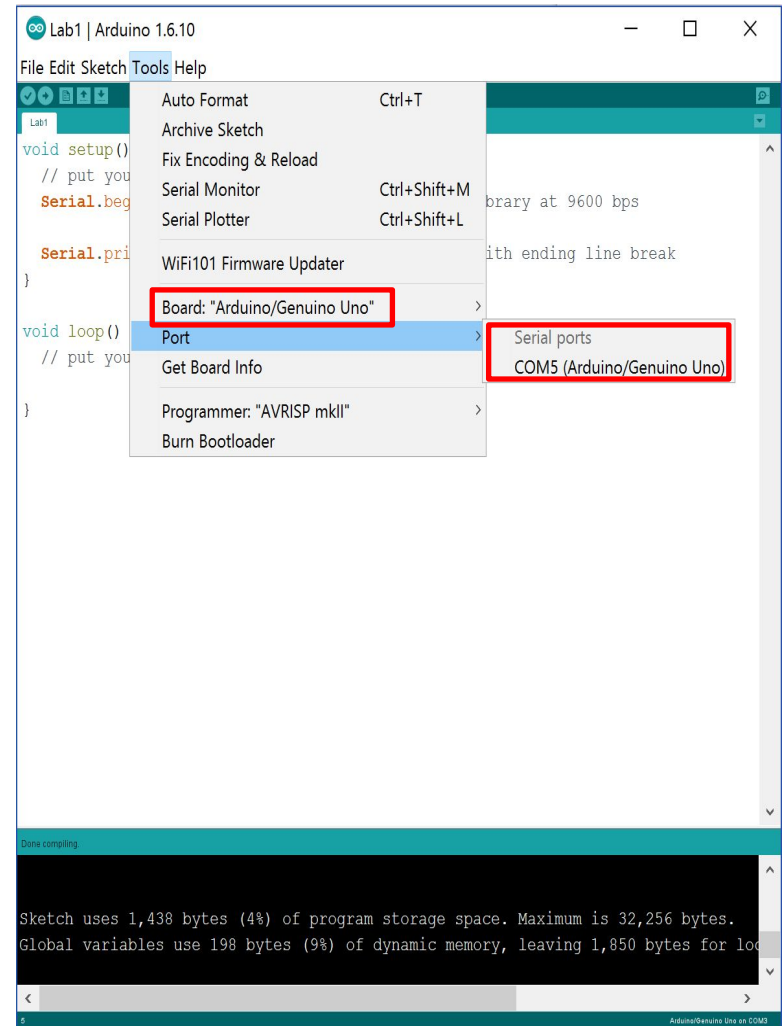
Lab 1 : Connecting to PC

Step 1: Connect Arduino with PC

Step 2: Set correct COM port

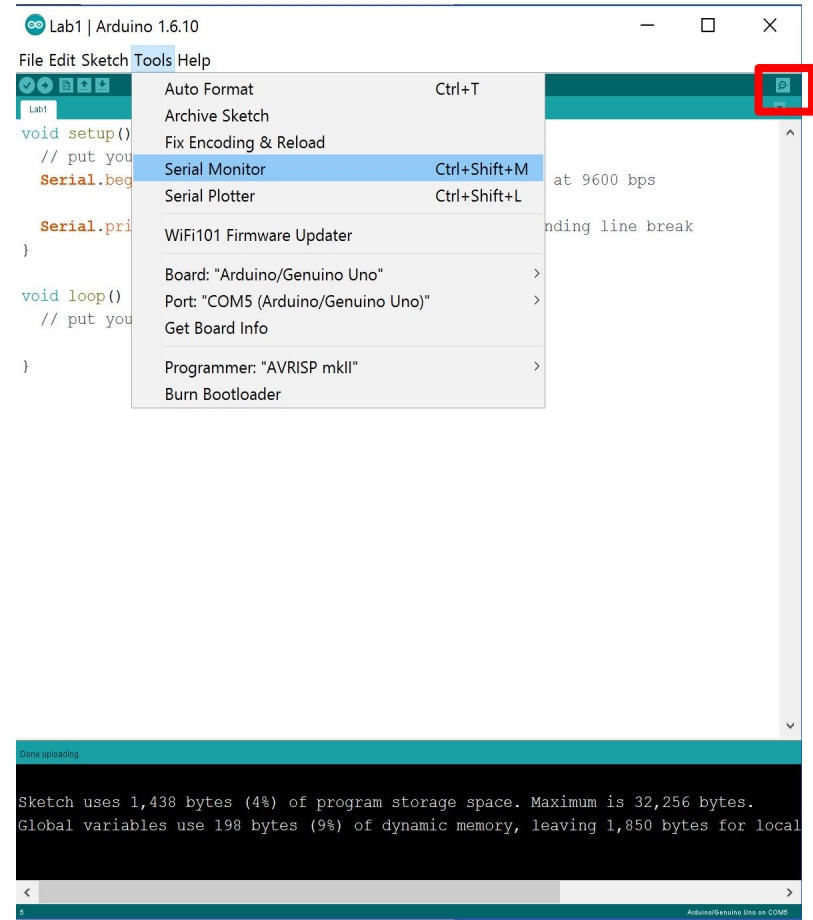
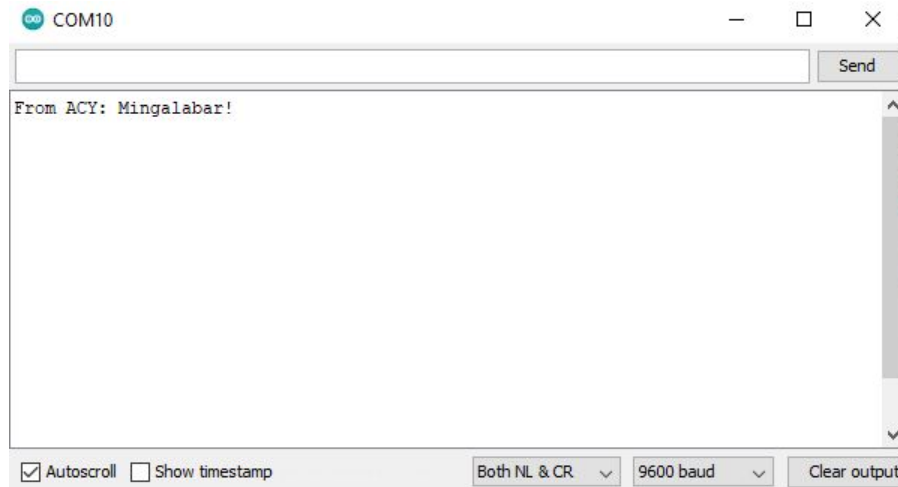
Step 3: Set correct type of Arduino
(Arduino/Genuino UNO)

Step 4: Load sketch from
(\\Lab1\\Lab1.ino) -> Upload code



Lab 1 : Connecting to PC

Step 5: Open “Serial Monitor” for output or use shortcut



Fun exercise:

- Which line make program communicate with PC?
- Change to your name?

Age Group	Percentage
18-24	10%
25-34	10%
35-44	10%
45-54	10%
55-64	10%
65-74	10%
75+	40%

- Blinking LED is always first step in embedded programming
- It is like “Hello world!” program in other programming language.
- It also help programmers in debugging their programs.



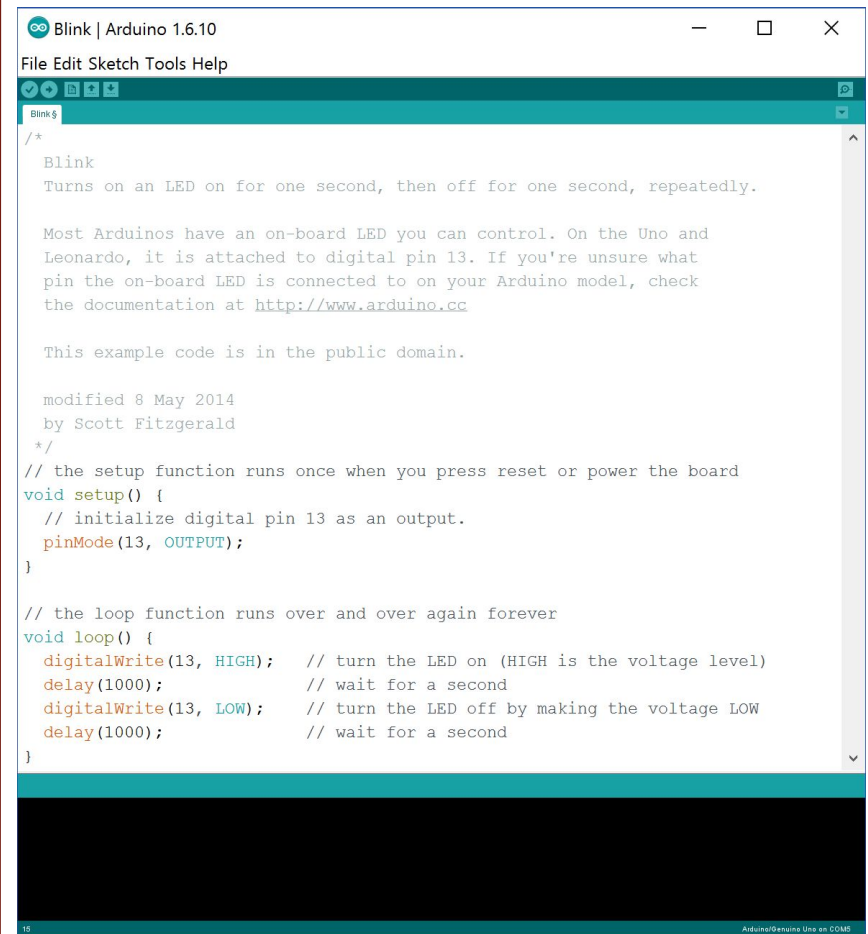
Lab 2 : Blink LED

Step 1: Load sketch from
(\Lab2\Lab2.ino) -> Upload code

Result : On board LED will blink with
1 second interval

Fun exercise:

- Could we change the interval time?
- What line of program make the LED blink?
- What does "13" means?

A screenshot of the Arduino IDE window titled "Blink | Arduino 1.6.10". The window has a menu bar with "File", "Edit", "Sketch", "Tools", and "Help". Below the menu bar is a toolbar with icons for opening files, saving, and other functions. The main text area contains the following code:

```
/*  
  Blink  
  Turns on an LED on for one second, then off for one second, repeatedly.  
  
  Most Arduinos have an on-board LED you can control. On the Uno and  
  Leonardo, it is attached to digital pin 13. If you're unsure what  
  pin the on-board LED is connected to on your Arduino model, check  
  the documentation at http://www.arduino.cc  
  
  This example code is in the public domain.  
  
  modified 8 May 2014  
  by Scott Fitzgerald  
*/  
  
// the setup function runs once when you press reset or power the board  
void setup() {  
  // initialize digital pin 13 as an output.  
  pinMode(13, OUTPUT);  
}  
  
// the loop function runs over and over again forever  
void loop() {  
  digitalWrite(13, HIGH);  // turn the LED on (HIGH is the voltage level)  
  delay(1000);             // wait for a second  
  digitalWrite(13, LOW);   // turn the LED off by making the voltage LOW  
  delay(1000);             // wait for a second  
}
```

The status bar at the bottom of the window shows "16" and "Arduino/Genuino Uno on COM6".

|| Lab 3 : Basic output (LED)

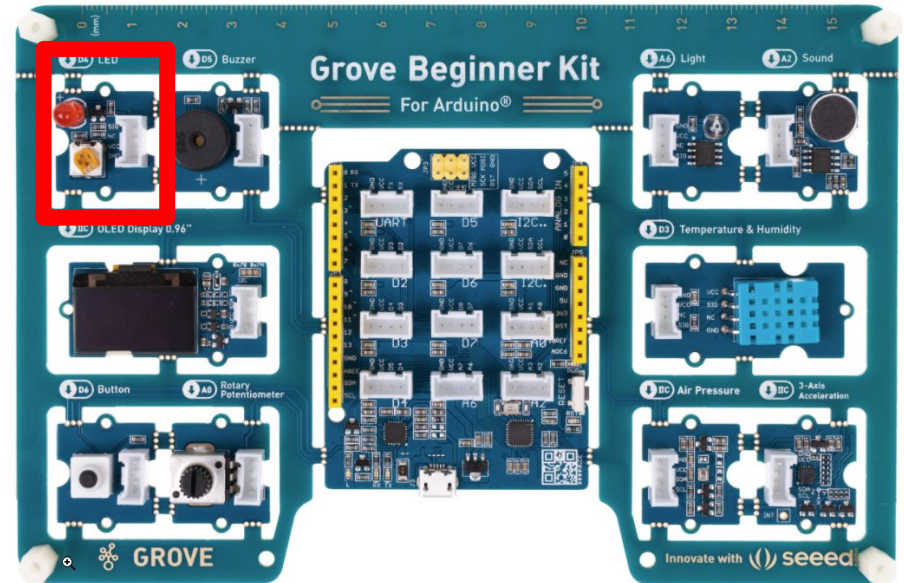
Background

- LEDs has been used extensively in the digital system as output device
- Found in almost every system as indication of system information, user interface etc.



Lab 3 : Basic output (LED)

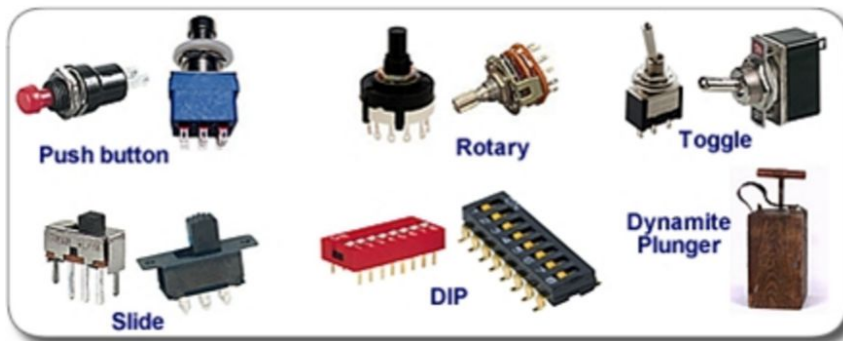
- Step 1: Load sketch from (\Lab3\Lab3.ino) -> Upload code
- Result : LED module will light up color based on program sequence
- Fun exercise:
-



|| Lab 4 : Basic input (Button)

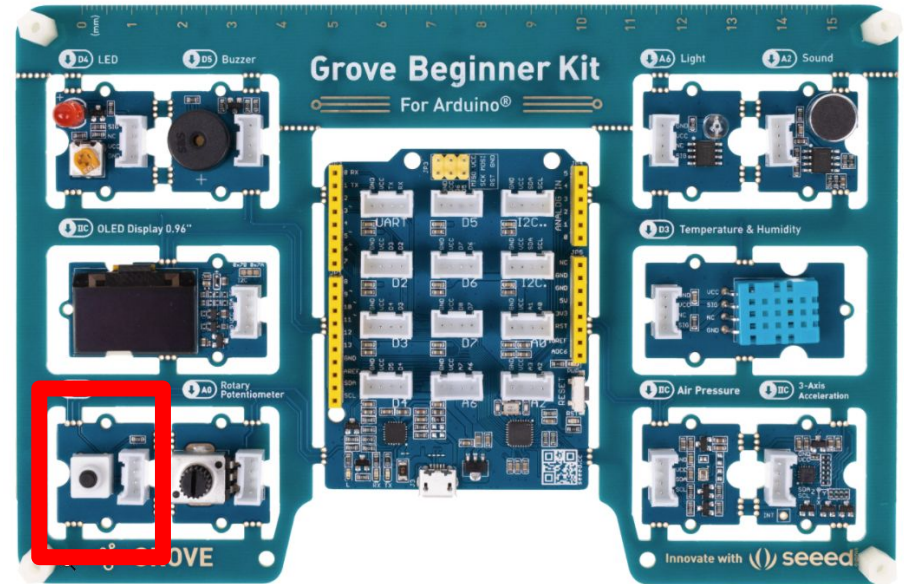
Background

- Buttons are input for digital system
- Different forms of buttons (switches) can be found.



Lab 4 : Basic output (Button)

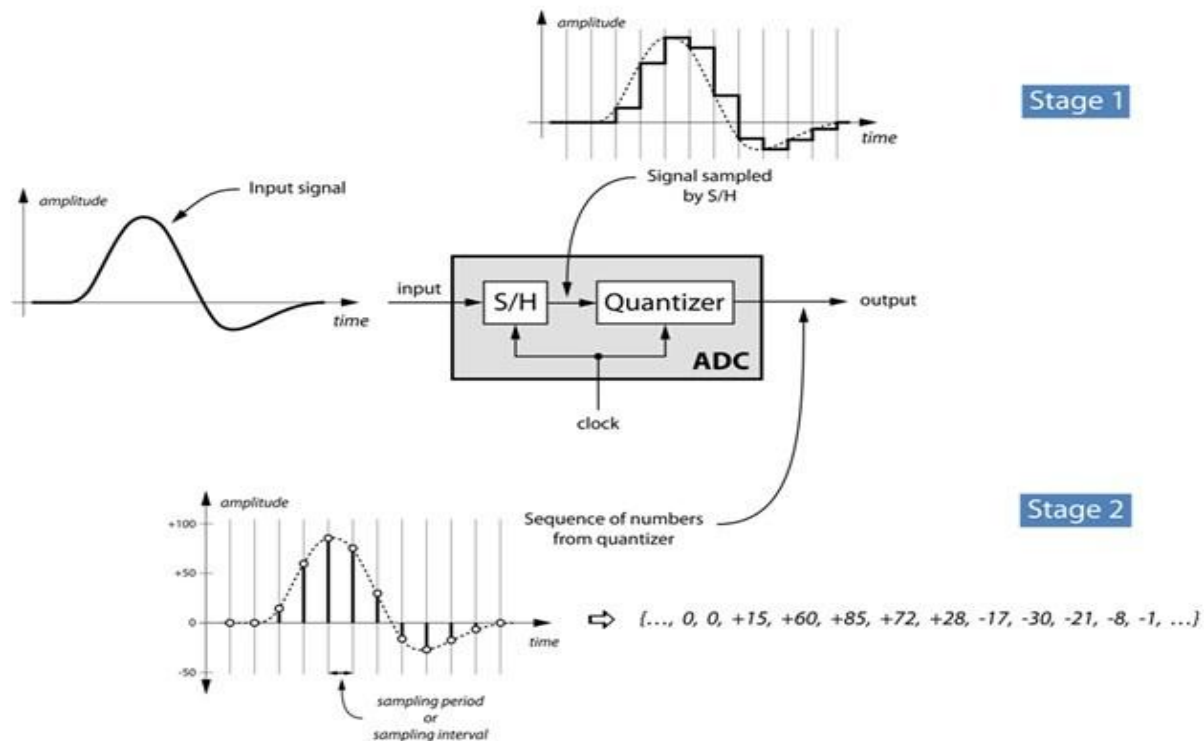
- Step 1: Load sketch from (\Lab4\Lab4.ino) -> Upload code
- Result : LED (4) will light off when the button is pressed.
- Fun exercise:
- What if you need the light to be switch off when the button is pressed?



Lab 5 : Analog to Digital conversion

Background

- Our daily life deal with analog input (e.g weight, temperature, light etc)
- Digital system needs to deal with analog input to be useful.

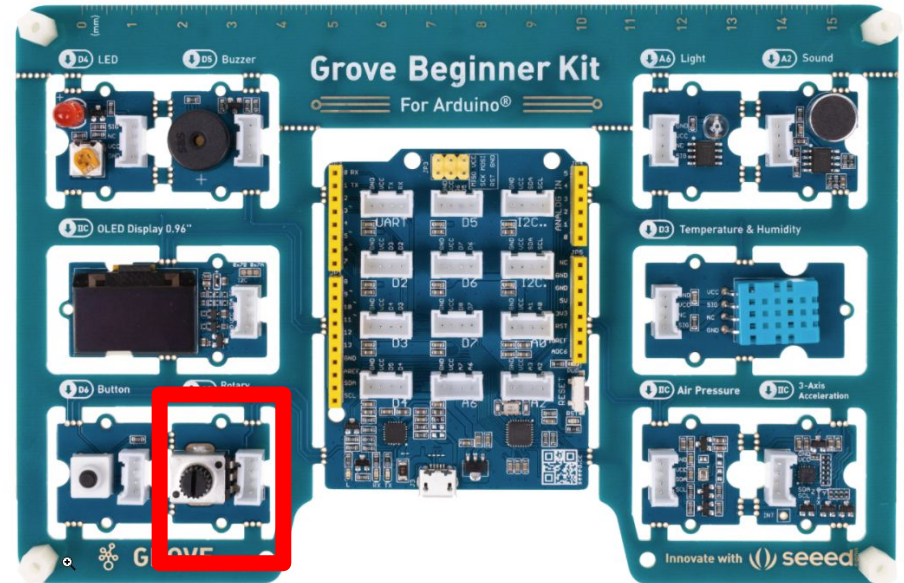


|| Lab 5 : Analog to Digital conversion

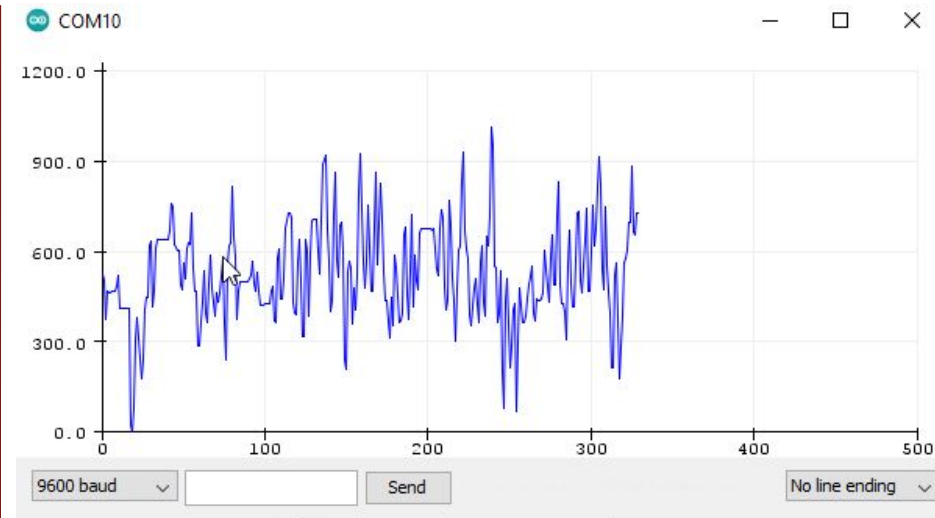
- Step 1: Load sketch from (\Lab5\Lab5.ino) -> Upload code
- Result : Turn the knob and check with serial monitor/serial plotter

Points to ponder:

- Any application used for A2D?



Lab 5 : Analog to Digital conversion

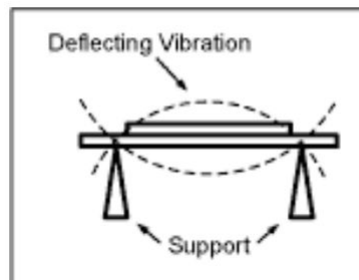
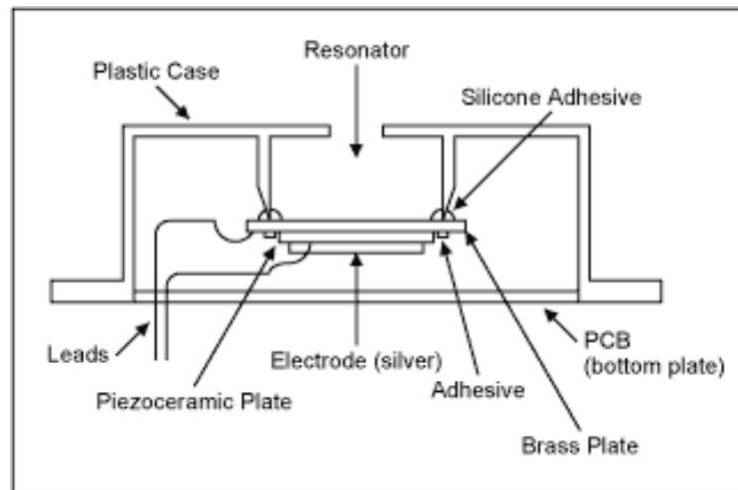


- Try "Serial Plotter"

Lab 6 : Buzzer

Background

- Buzzers are output device

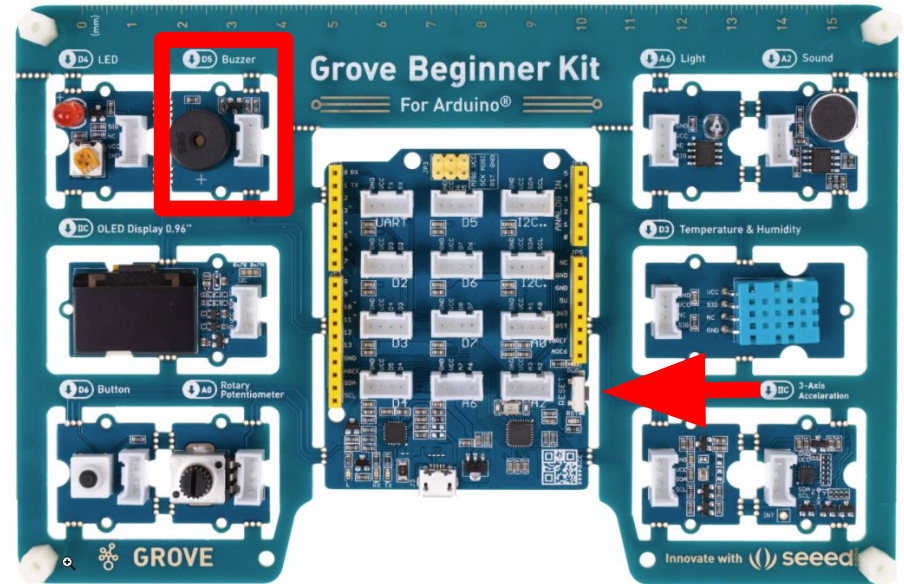


Lab 6 : Buzzer

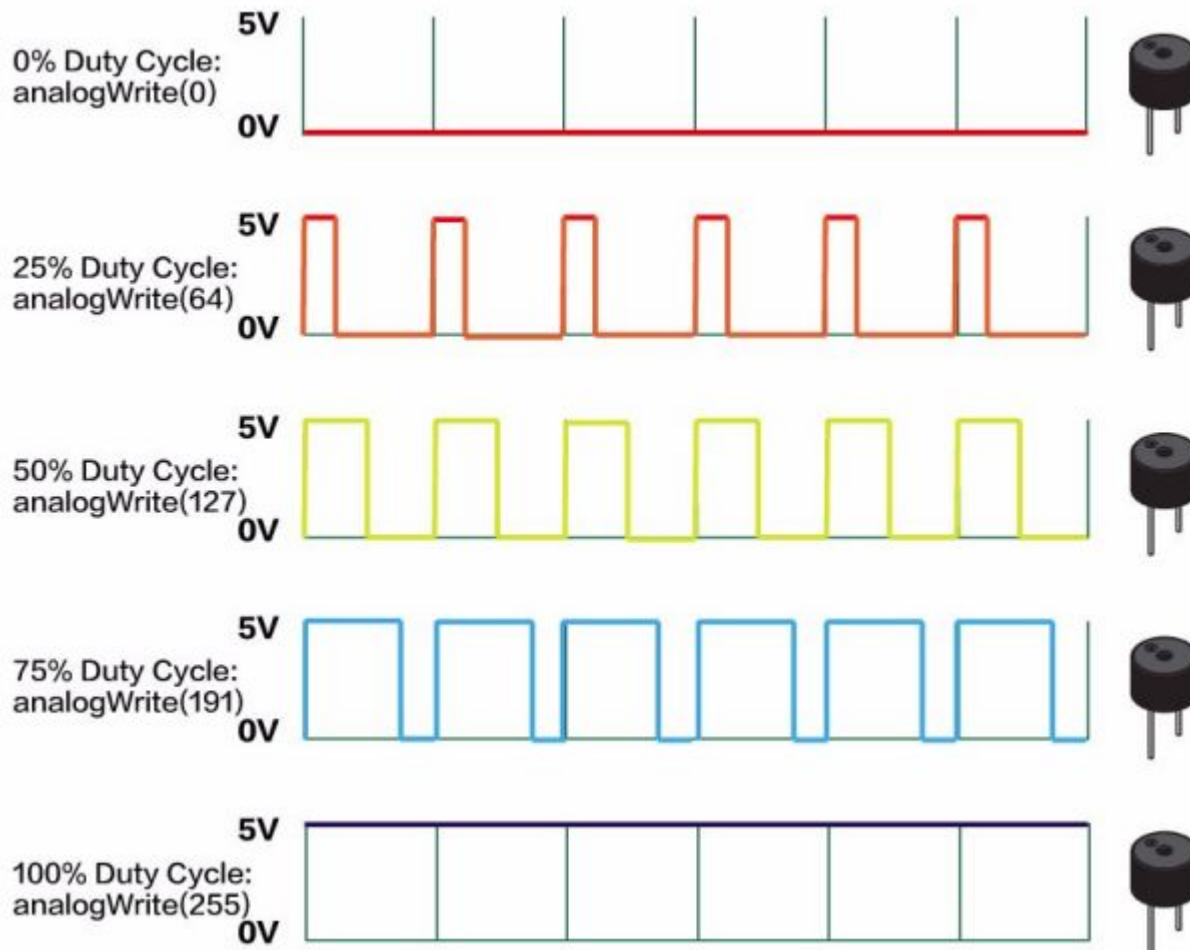
- Step 1: Load sketch from (\Lab6\Lab6.ino) -> Upload code
- Result : single tone is generated. To repeat press RESET button of Arduino

Points to ponder:

- Could you observe any difference if you change TONEdelay?
- Could you sequence the tones?
- \Mario.ino



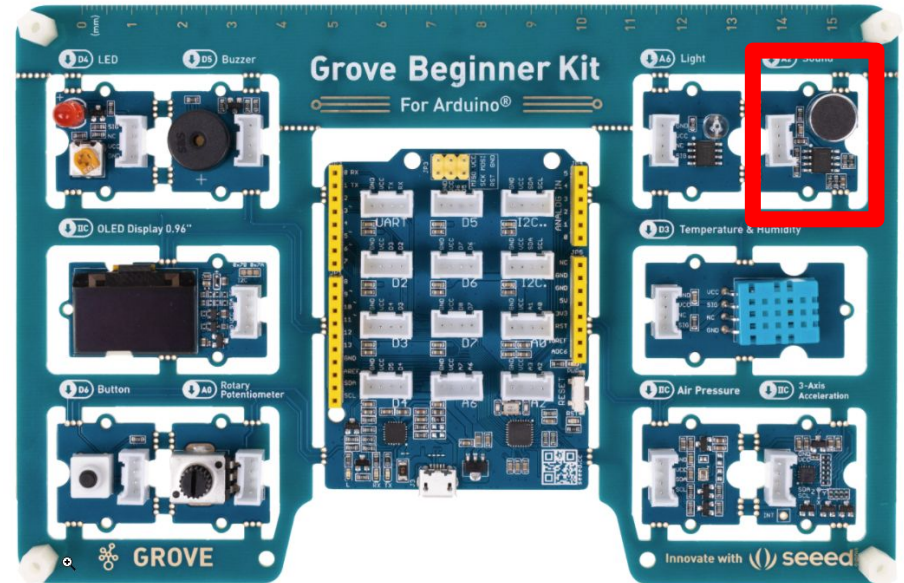
Lab 6 : Buzzer



Lab 7 : Sound sensor

Background

- Mic collect sound wave and feed back to Arduino



Lab 7 : Sound sensor

- Step 1: Load sketch from (\Lab7\Lab7.ino) -> Upload code
- Result : Change sound level value and see you can turn on light when clapping or whistling
- Fun exercise:
- One clap will turn on and another clap will turn off the light.

```
int soundPin = A2; // Analog sound sensor is to be
int ledPin = 4; // Digital LED is to be attached t
int soundlevel = 700;

// the setup function runs once when you press res
void setup() {
    pinMode(ledPin, OUTPUT);
    Serial.begin(9600);
}

// the loop function runs over and over again fore
void loop() {
    int soundState = analogRead(soundPin); // Read
    Serial.println(soundState);
    // if the sound sensor's value is greater than
    //Otherwise, the light will be turned off
    if (soundState > soundlevel) {
        digitalWrite(ledPin, HIGH);
        delay(100);
    }else{
        digitalWrite(ledPin, LOW);
    }
}
```

Lab 8 : Temperature/Humidity sensor

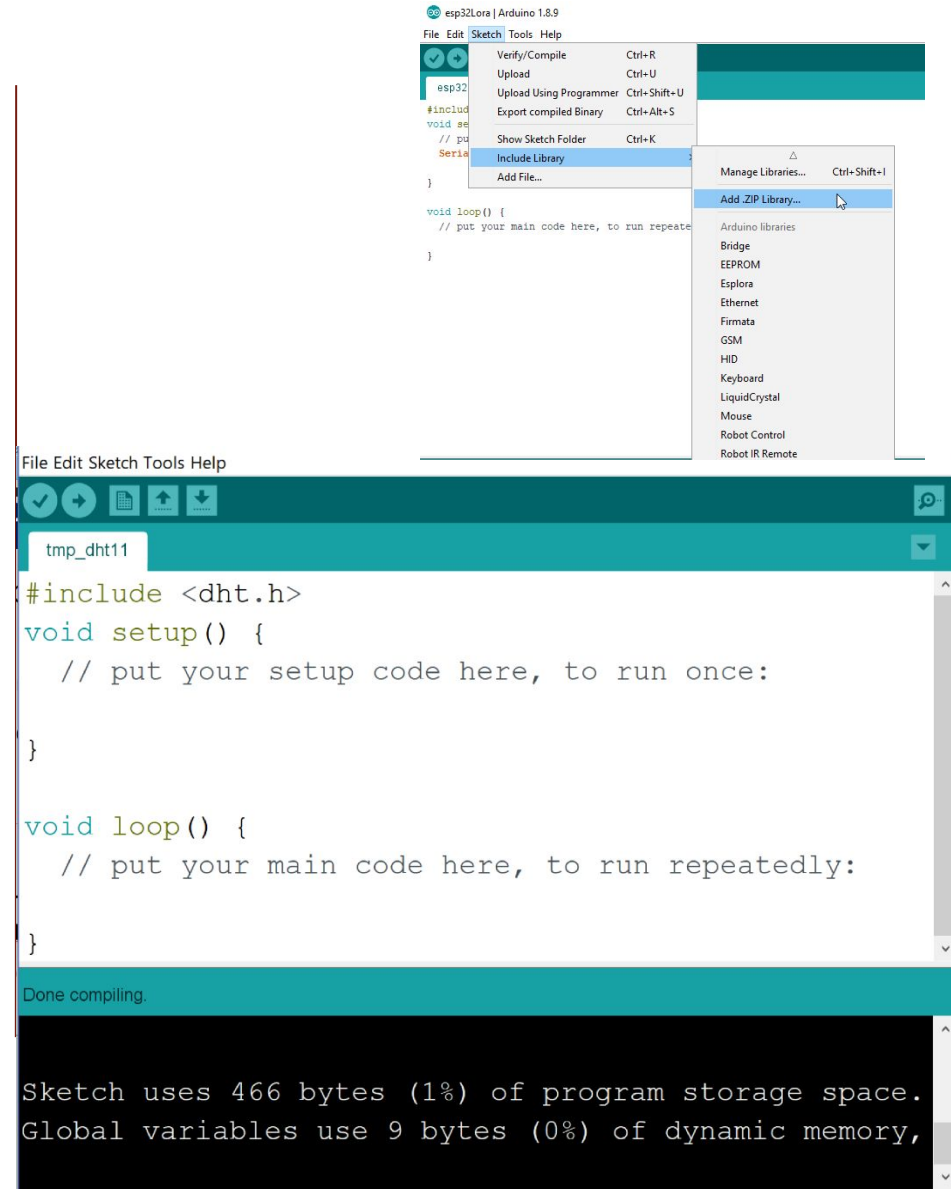
Background

- One of the reasons for Arduino's success is due to abundance of third party libraries.

How to import 3rd party library?
(Method 1)

How to import 3rd party library?

- Sketch -> Include Library -> Add .ZIP Library
- To test, compile blank program with header included



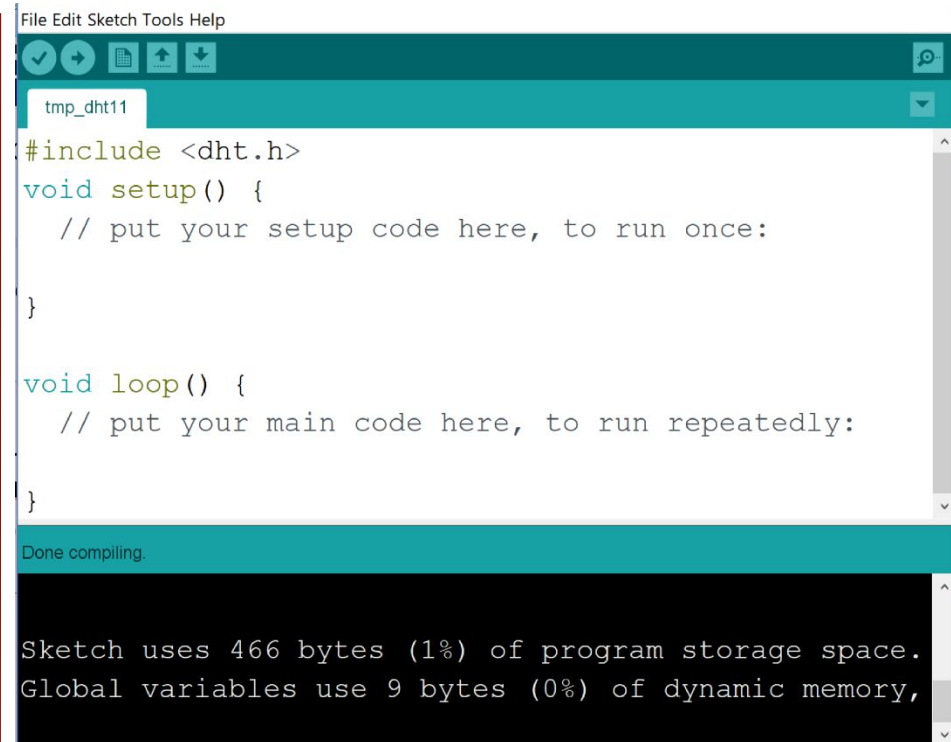
Lab 8 : Temperature/Humidity sensor

Background

- One of the reasons for Arduino's success is due to abundance of third party libraries.

How to import 3rd party library?
(Method 2)

- Copy library folder \Lab8\DHTLib\ to \Documents\Arduino\libraries\ (For some PC, it will be under C:\Program Files\)
- Close all Arduino programs and restart Arduino IDE
- To test, compile blank program with header included



```
File Edit Sketch Tools Help
tmp_dht11
#include <dht.h>
void setup() {
    // put your setup code here, to run once:
}

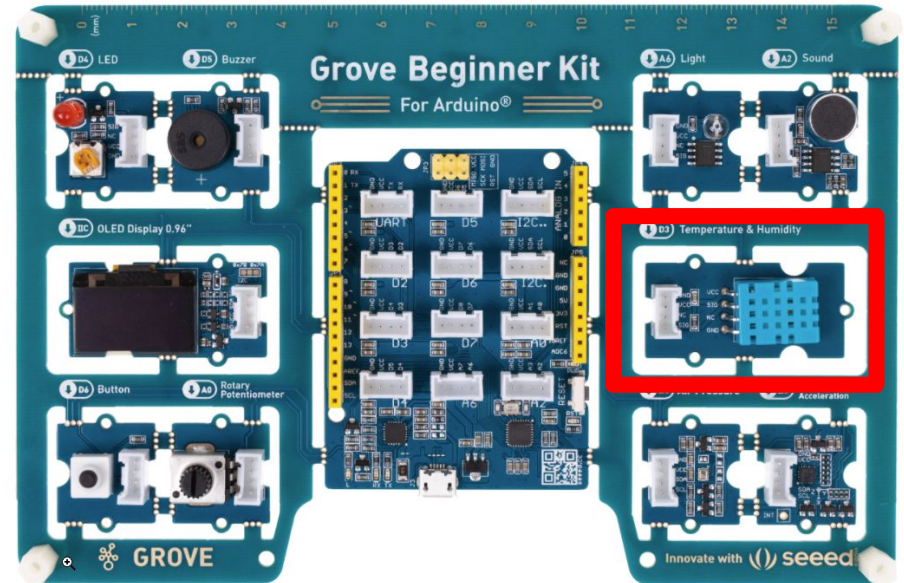
void loop() {
    // put your main code here, to run repeatedly:
}

Done compiling.

Sketch uses 466 bytes (1%) of program storage space.
Global variables use 9 bytes (0%) of dynamic memory,
```

Lab 8 : Temperature/Humidity sensor

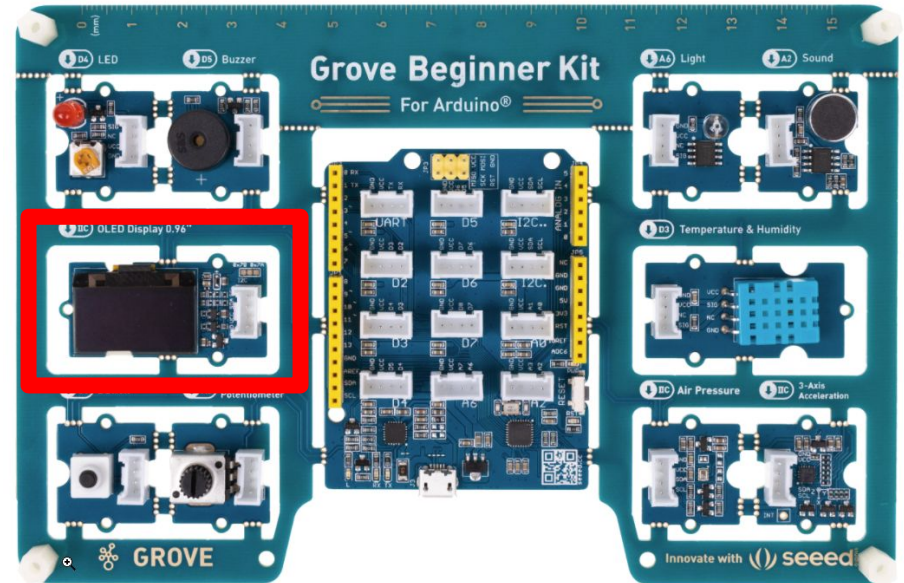
- Step 1: Load sketch from (\Lab8\Lab8.ino) -> Upload code
- Result : Open serial monitor and observe the temperature



Lab 9 : OLED display

Background

- When handling LCD/OLED display, it will need 3rd party library.
- Use "Sketch>Include Library>Add .ZIP Library"



|| Lab 9 : OLED display

- Step 1: Load sketch from
(\Lab9\Lab9.ino) -> Upload code
- Result : Change sound level value
and see you can turn on light when
clapping or whistling
- Fun exercise:
- Change your name
- Add graphic

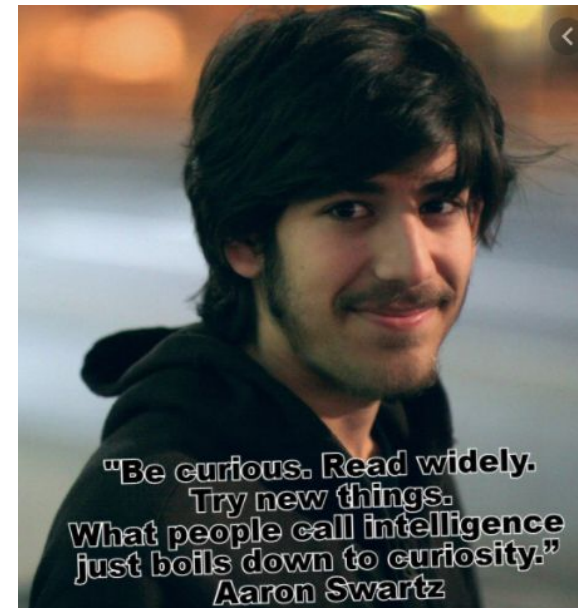
Ref

- <https://www.seeedstudio.com/Grove-Beginner-Kit-for-Arduino-p-4549.html>
- C / C++ programming
- Algorithm / Electronic circuit

If I have seen further than others, it is
by standing upon the shoulders of giants.

Isaac Newton

www.thequotes.in

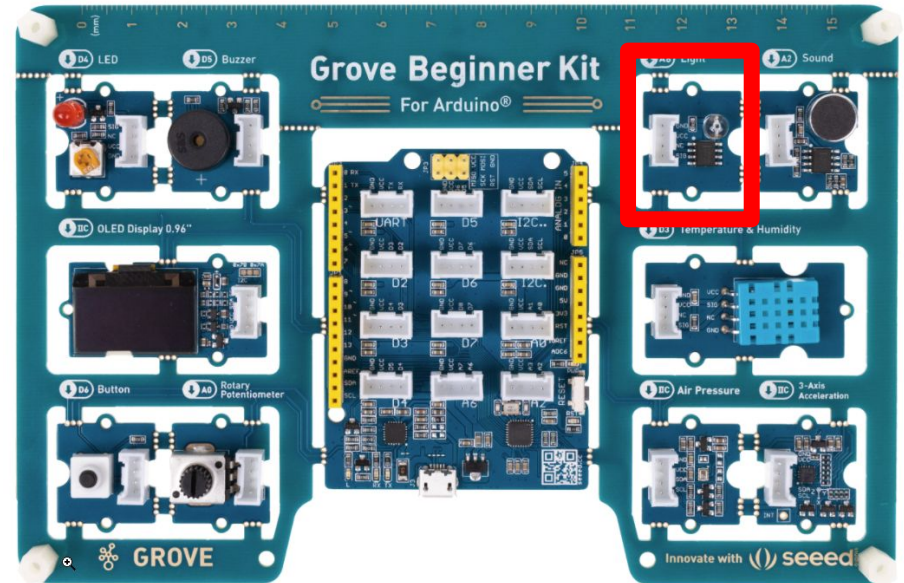
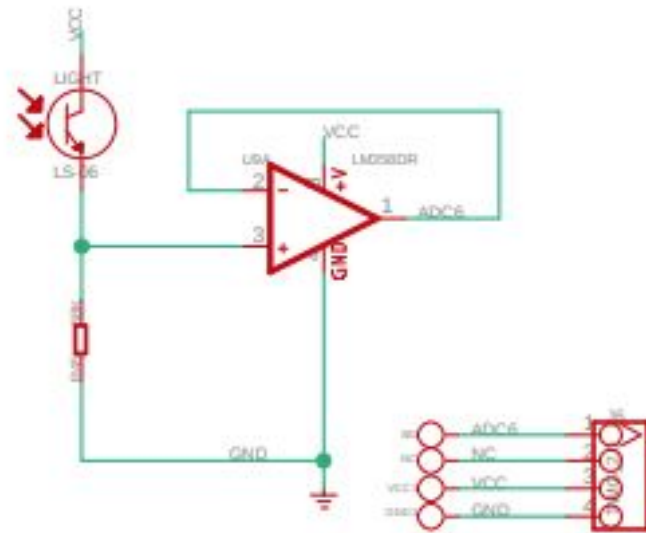


|| Q&A

- Challenges:
 - Buzz when temperature/humidity is high (Fire alarm/ Crops monitoring)
 - Change LED frequency by potentiometer
 -
- Mini competition-----
- Feedback form : <http://bit.ly/2YrzBzM>

Lab 10 : Light sensor

- Light sensor respond to light fall on its surface.



Lab 10 : Light sensor

- Step 1: Load sketch from (\\Lab10\\Lab10.ino) -> Upload code
- Result : Light turn off when the sensor is covered
- Fun exercise:
- Will it be practical to use? If not, how?

```
int lightPin = A6; // Analog sound sensor is to be attached to analog
int ledPin = 4; // Digital LED is to be attached to digital
int lightlevel = 300;

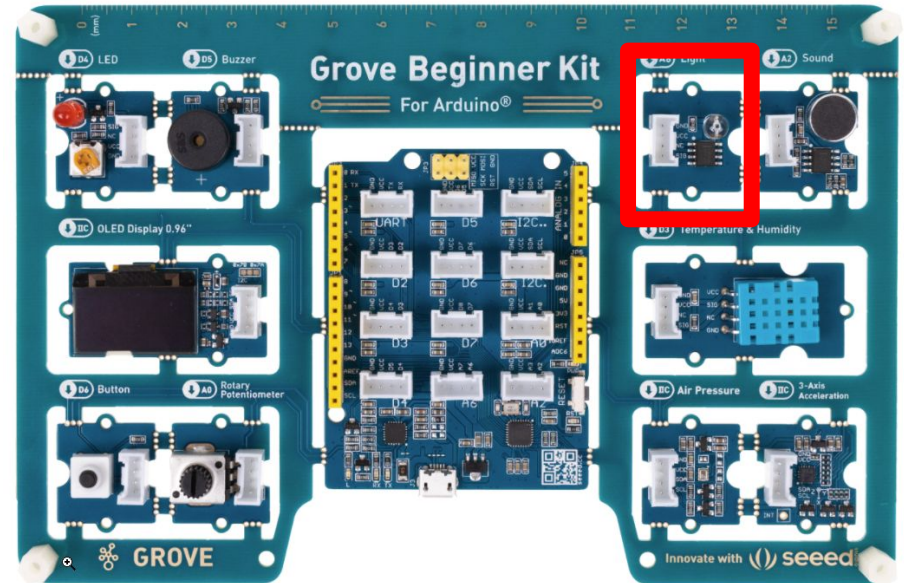
// the setup function runs once when you press reset or power the board
void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}

// the loop function runs over and over again forever
void loop() {
  int lightState = analogRead(lightPin); // Read sound sensor's value
  Serial.println(lightState);
  if (lightState > lightlevel) {
    digitalWrite(ledPin, HIGH);
    delay(100);
  }else{
    digitalWrite(ledPin, LOW);
  }
}
```


Lab 11 : Pressure sensor

- Step 1: Load sketch from (`\Lab11\Lab11.ino`) -> Upload code
- Result : Check result from Serial Monitor

- Fun exercise:
- What will it be practical use?



Lab 12 : Accelerometer

- Step 1: Load sketch from (`\\Lab12\\Lab12.ino`) -> Upload code
- Result : Check result from Serial Monitor

