Microprocessors Lab

2- GPIO

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Based on the slides by:

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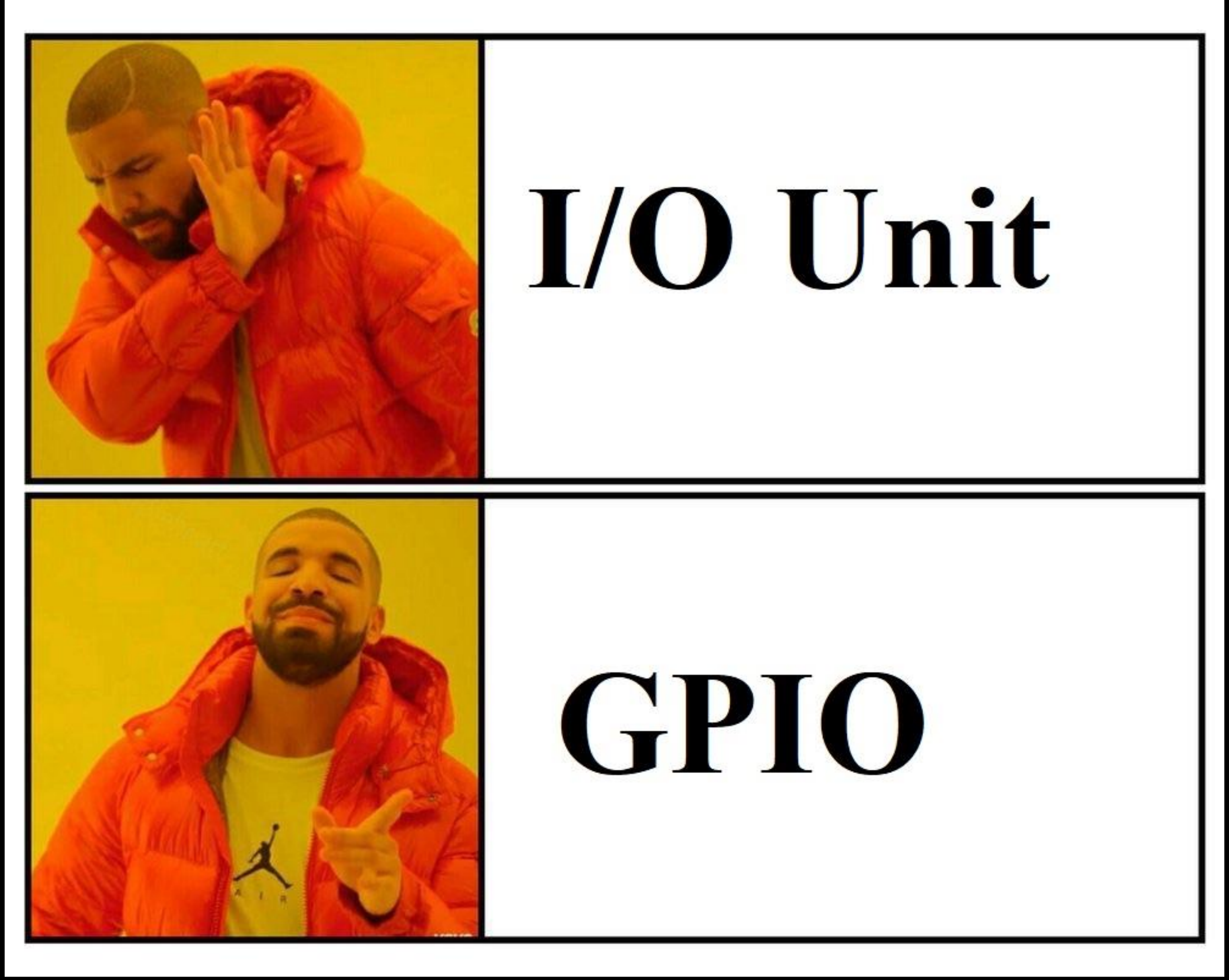
What is GPIO?

GPIO is the Input/Output that we normally use. They gave it a fancy name just to make it look cooler.

Honestly, GPIO a little more than that, but currently, that’s all we need to know.

If you want to feel more “nerdish” or boast to your friends about how much you know, visit this link [Wikipedia].



How do we use it?

That’s pretty easy.

1 - We define the pins we want and then tell the board to use these pins as input or output.

2 – Set the pins mode in the setup() function.

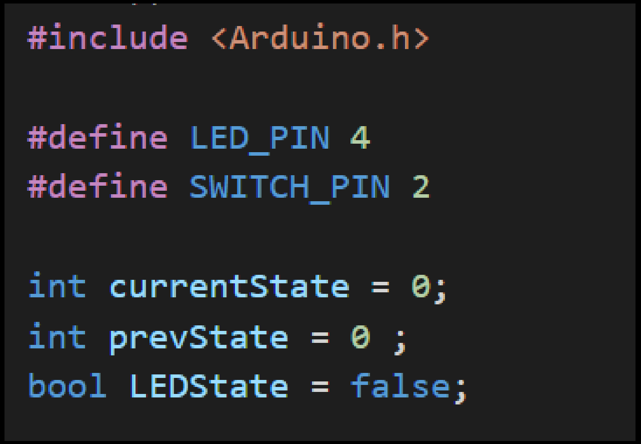
3 – In the void loop() function we change the values of the pins.

4 – Compile the code.

5 – Design.

In the Setup() function, we initialize our variables (if needed) and set pin modes.

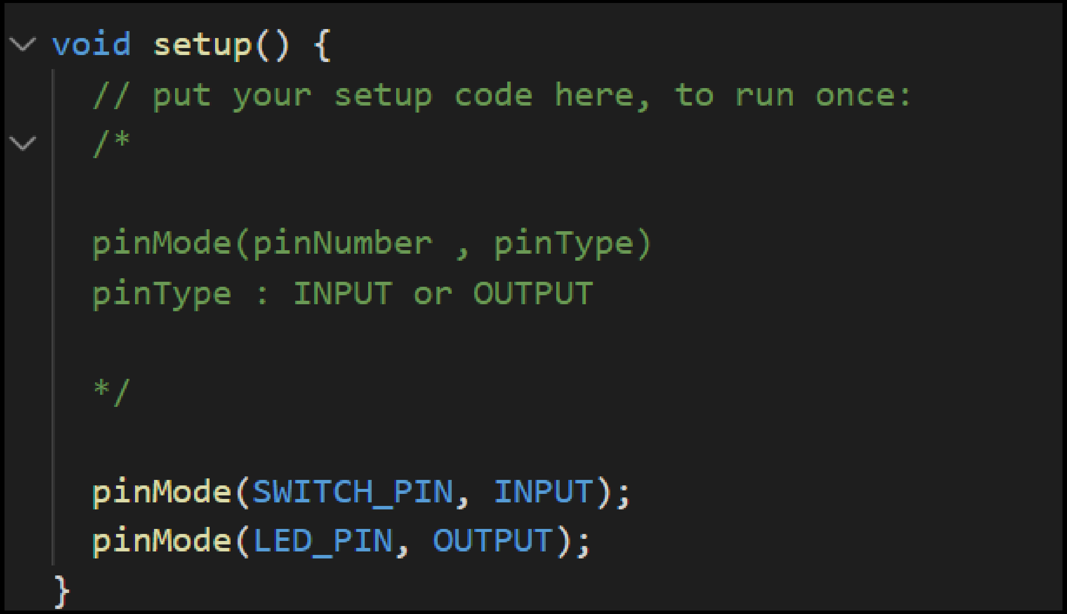
- Step 1: Define the pins.



```
#include <Arduino.h>

#define LED_PIN 4
#define SWITCH_PIN 2

int currentState = 0;
int prevState = 0 ;
bool LEDState = false;
```

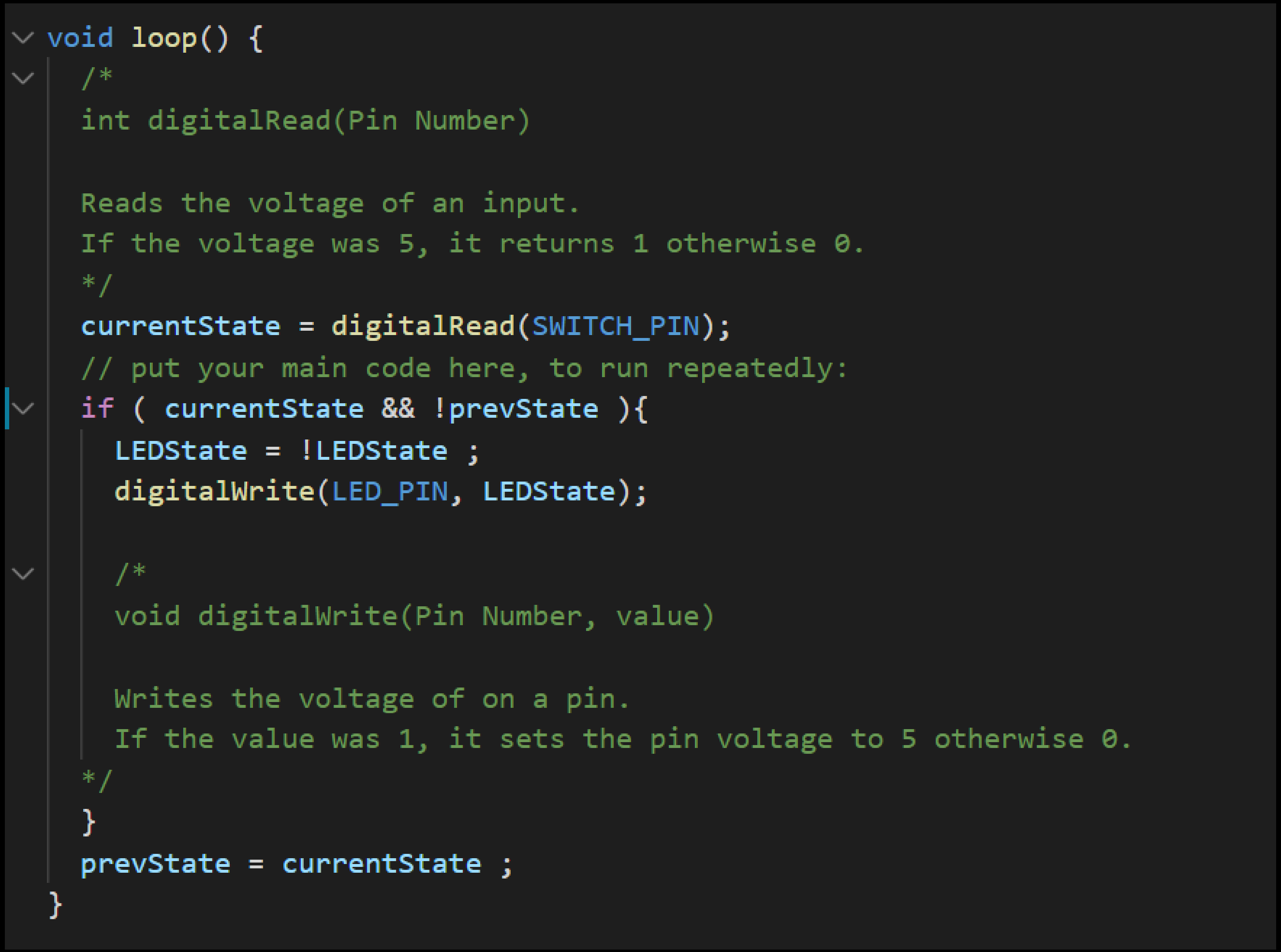
Note: in C/C++ languages, Booleans are treated like Integers, which means that **True = 1** and **False = 0**, therefore, it doesn’t matter if we declare the “lastState” variable as Boolean or Integer.

Step 2 : Pins mode.



```
void setup() {
  // put your setup code here, to run once:
  /*

  pinMode(pinNumber , pinType)
  pinType : INPUT or OUTPUT

  */

  pinMode(SWITCH_PIN, INPUT);
  pinMode(LED_PIN, OUTPUT);
}
```

Step 3: The Void Loop()



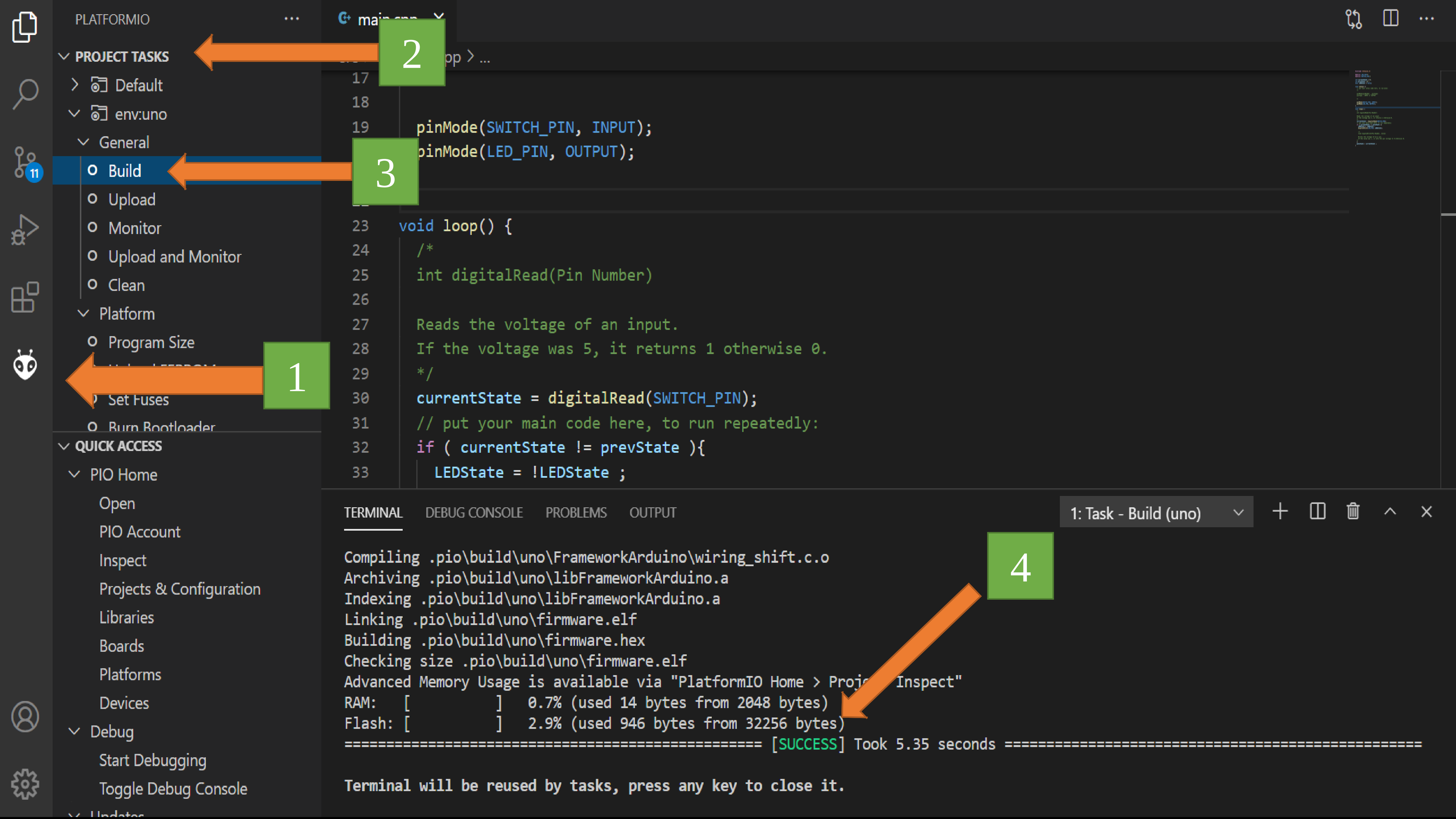
```
void loop() {
  /*
  int digitalRead(Pin Number)

  Reads the voltage of an input.
  If the voltage was 5, it returns 1 otherwise 0.
  */
  currentState = digitalRead(SWITCH_PIN);
  // put your main code here, to run repeatedly:
  if ( currentState && !prevState ){
    LEDState = !LEDState ;
    digitalWrite(LED_PIN, LEDState);

    /*
    void digitalWrite(Pin Number, value)

    Writes the voltage of on a pin.
    If the value was 1, it sets the pin voltage to 5 otherwise 0.
  */
  }
  prevState = currentState ;
}
```

Bonus

Who can say what the code is actually doing?

Answer: Every time the switch is pushed, the state of the LED would change based on its previous state. If the LED was ON, it would go OFF and vice versa.

We write our main code in the loop() function. What ever needs to be done by/on the Arduino Chipset must be written and specified here.



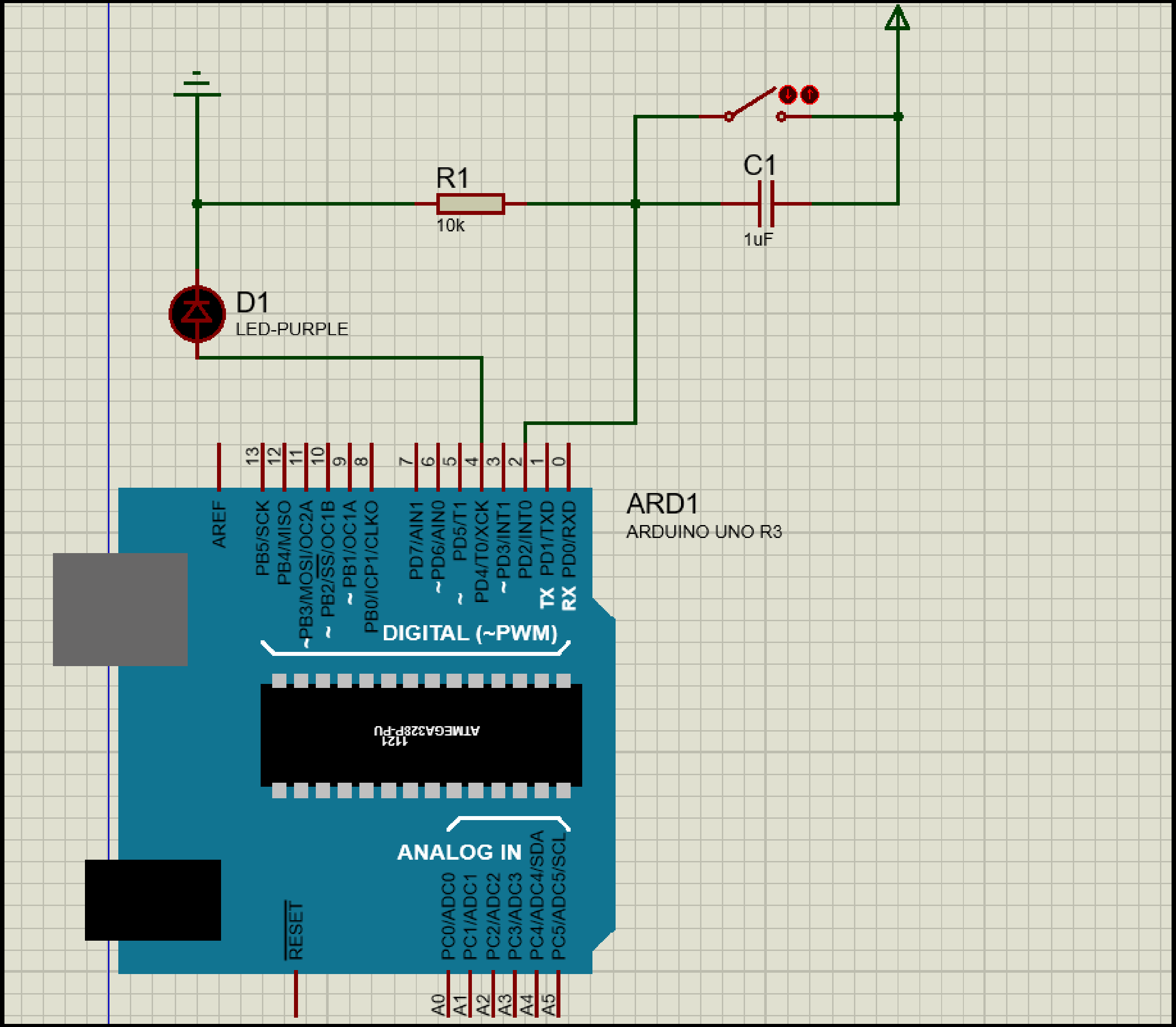
```
  pinMode(SWITCH_PIN, INPUT);
  pinMode(LED_PIN, OUTPUT);


void loop() {
  /*
  int digitalRead(Pin Number)

  Reads the voltage of an input.
  If the voltage was 5, it returns 1 otherwise 0.
  */
  currentState = digitalRead(SWITCH_PIN);
  // put your main code here, to run repeatedly:
  if ( currentState != prevState ){
    LEDState = !LEDState ;
```

```
Compiling .pio\build\uno\FrameworkArduino\wiring_shift.c.o
Archiving .pio\build\uno\libFrameworkArduino.a
Indexing .pio\build\uno\libFrameworkArduino.a
Linking .pio\build\uno\firmware.elf
Building .pio\build\uno\firmware.hex
Checking size .pio\build\uno\firmware.elf
Advanced Memory Usage is available via "PlatformIO Home > Proj   Inspect"
RAM:   [          ]   0.7% (used 14 bytes from 2048 bytes)
Flash: [          ]   2.9% (used 946 bytes from 32256 bytes)
============================================ [SUCCESS] Took 5.35 seconds ============================================

Terminal will be reused by tasks, press any key to close it.
```

Step 5: Design

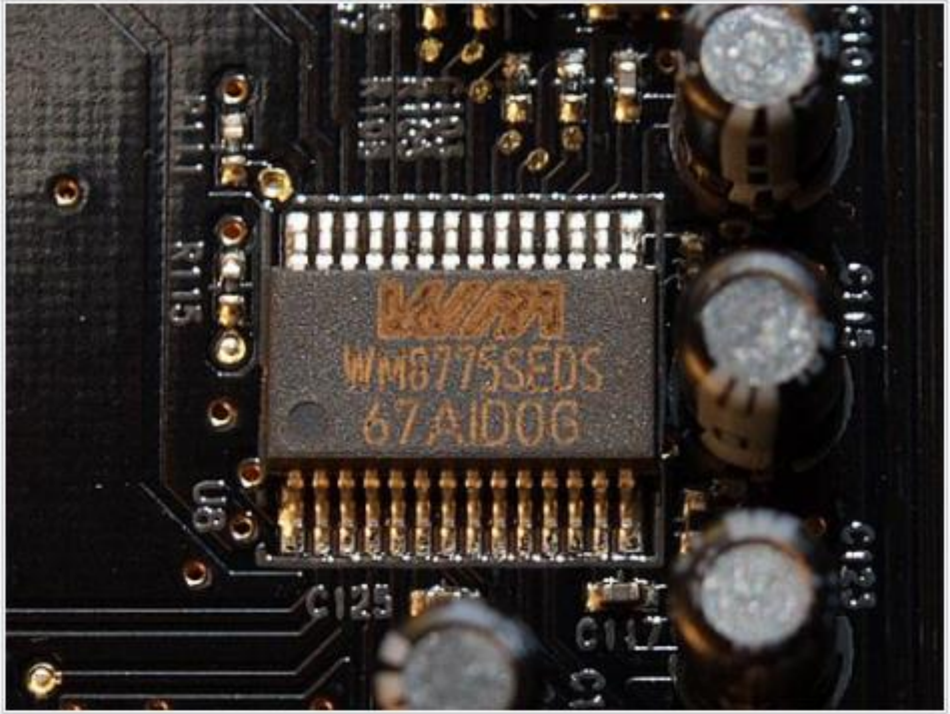
Remember that the switch circuit contains a low-pass filter.

After our design is completed, we should connect our board to the "firmware.hex" file, which is produced by the time we compiled our C/C++ code in the Visual Studio Code.



ADC

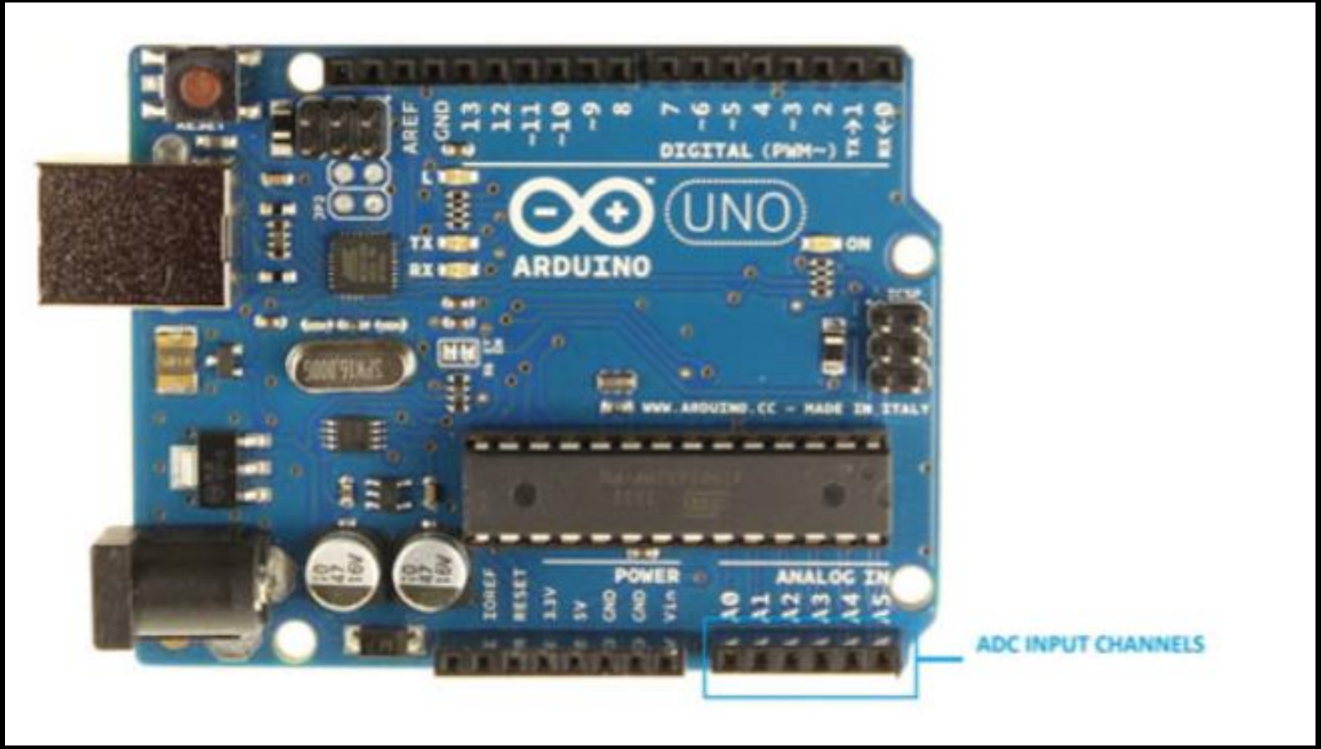
In electronics, an analog-to-digital converter (ADC, A/D, or A-to-D) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities. [Wikipedia]



4-channel stereo multiplexed analog-to-digital converter WM8775SEDS made by Wolfson Microelectronics placed on an X-Fi Fatal1ty Pro sound card.

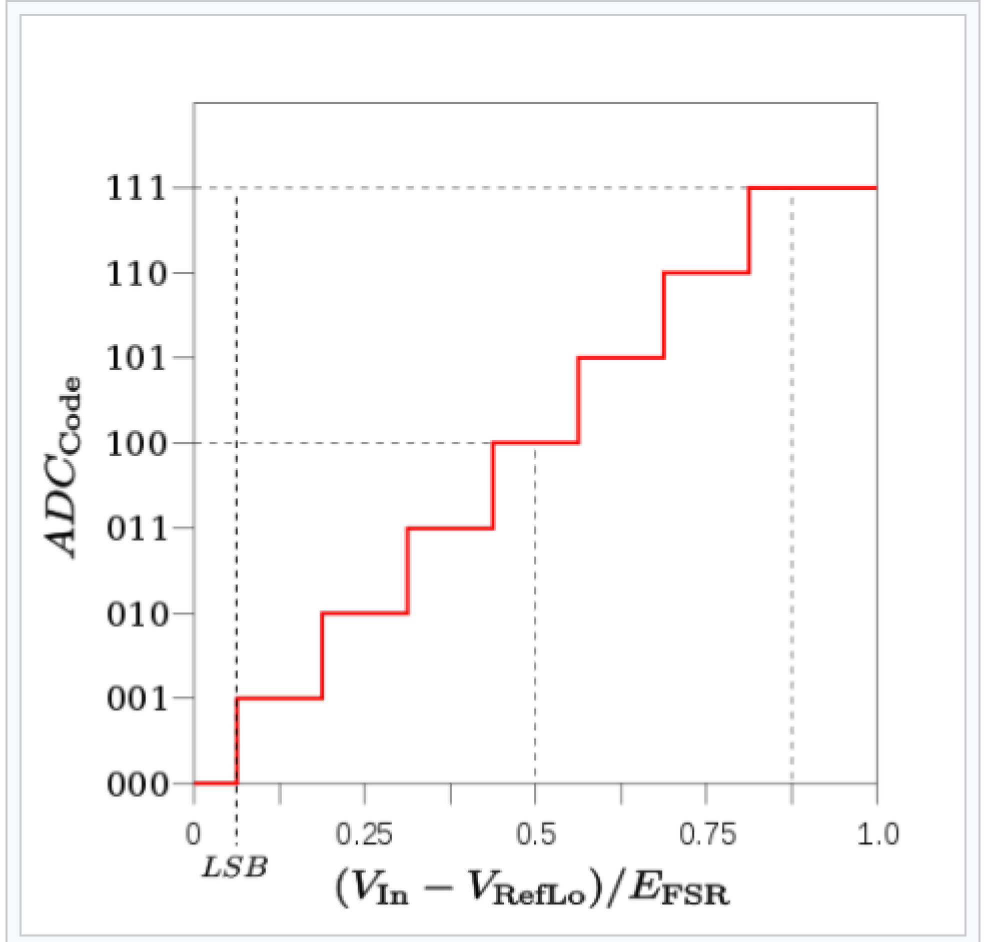
In this tutorial we are introducing concept of ADC (Analog to Digital Conversion) in ARDUINO UNO. Arduino board has six ADC channels, as show in figure. Among those any one or all of them can be used as inputs for analog voltage.

The **Arduino Uno ADC** is of 10 bit resolution (so the integer values from (0-(2^10) 1023)). This means that it will map input voltages between 0 and 5 volts into integer values between 0 and 1023. So for every (5/1024= 4.9mV) per unit.



You have already been acquainted with the concept of ADC in the Microprocessors. How can we use it here?

In the following slides, we are going to design and implement a project using ADC.

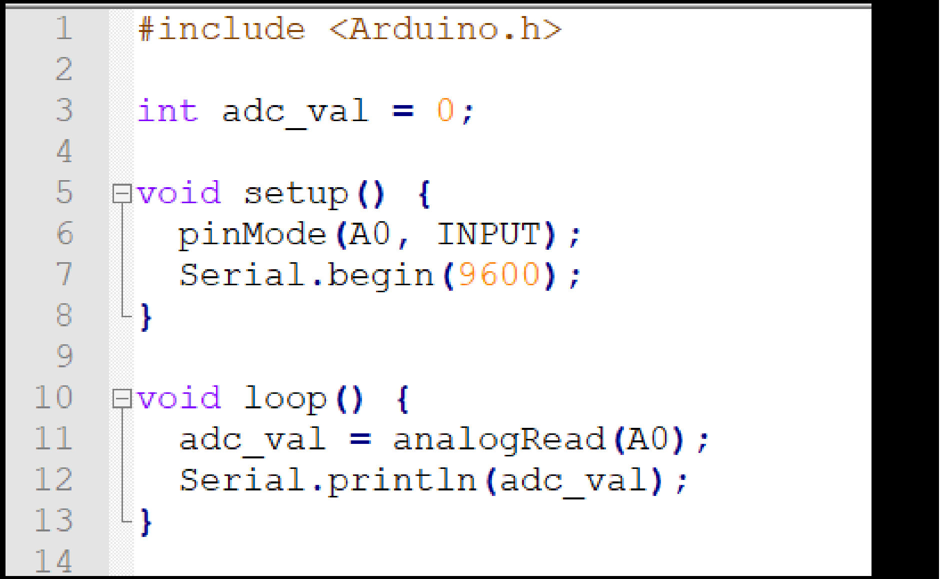


The figure demonstrates mapping 1 volt in 3 bits

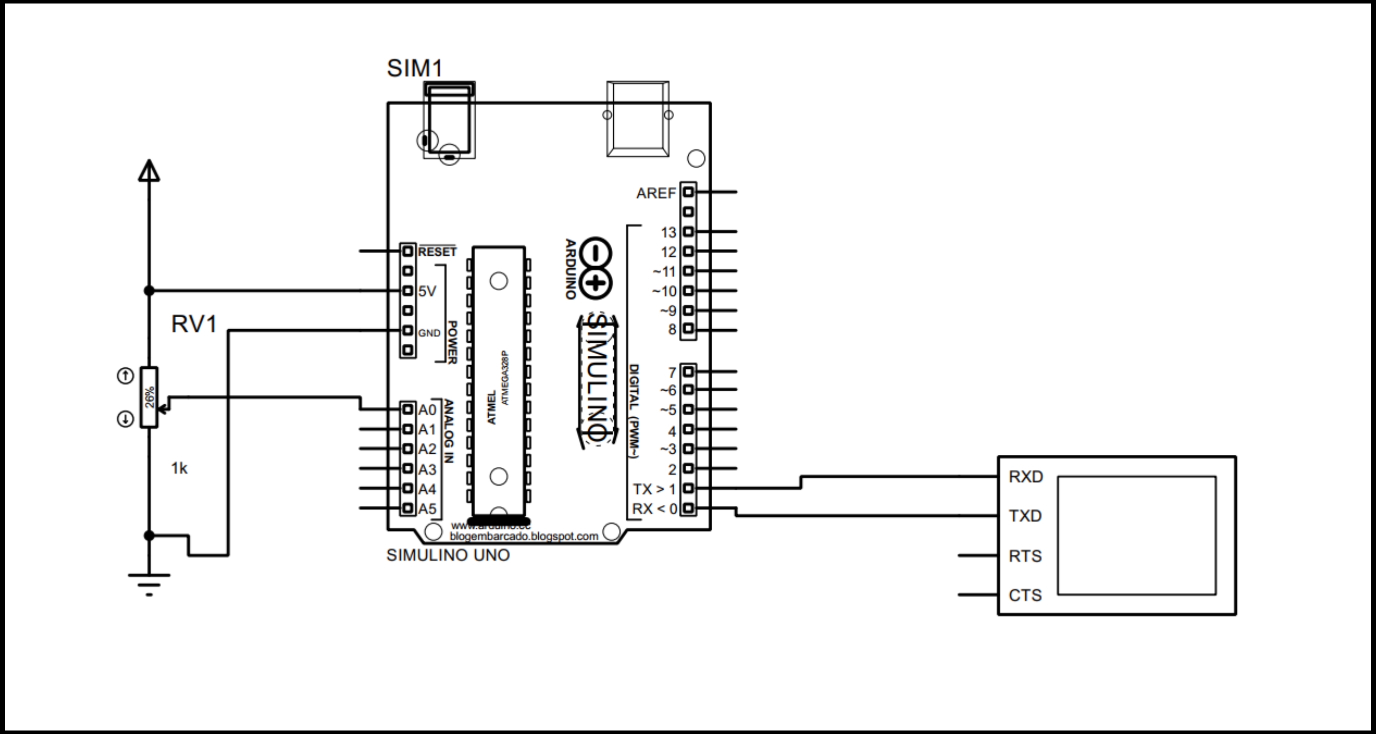
ADC Sample Project Description:

In all of this we are going to connect a potentiometer or pot to the ‘A0’ channel, and we are going to show the ADC result in the terminal.

The description is pretty simple; get the ADC result and print it :\
We use a potentiometer and connect its inputs to GND and VDD and its third wire to A0 port. In order to print the result in the terminal we should use the Serial Communication Unit (which will be thoroughly explained later).



```
#include <Arduino.h>

int adc_val = 0;

void setup() {
  pinMode(A0, INPUT);
  Serial.begin(9600);
}

void loop() {
  adc_val = analogRead(A0);
  Serial.println(adc_val);
}

```

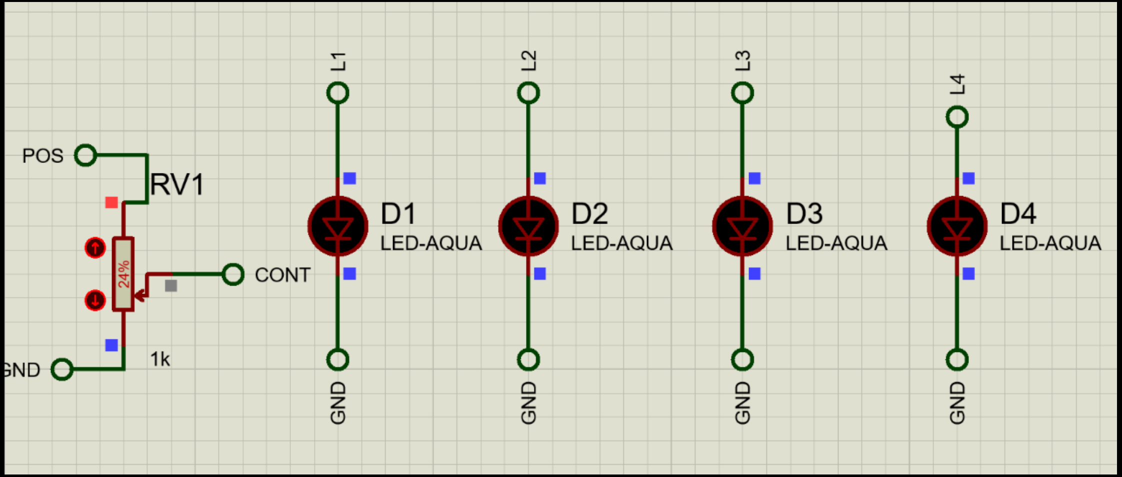


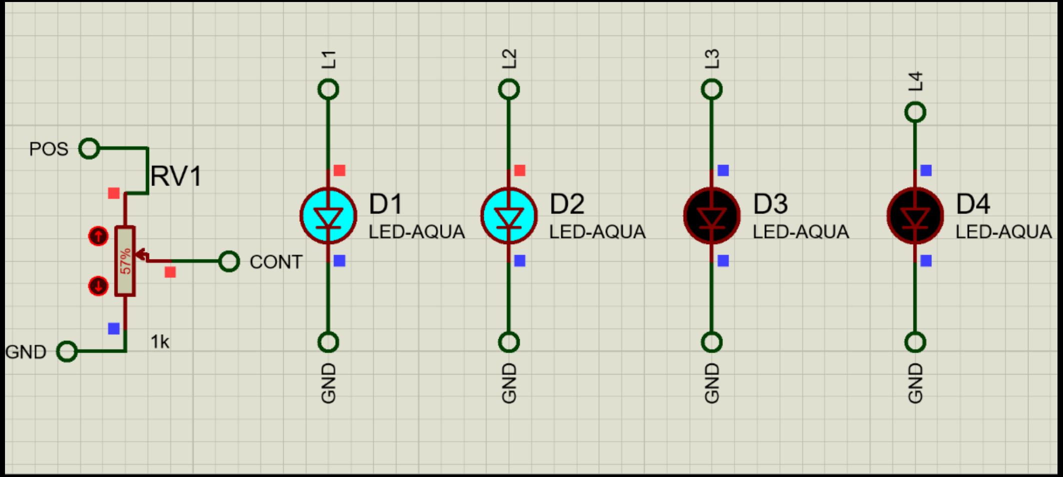
Class Work:

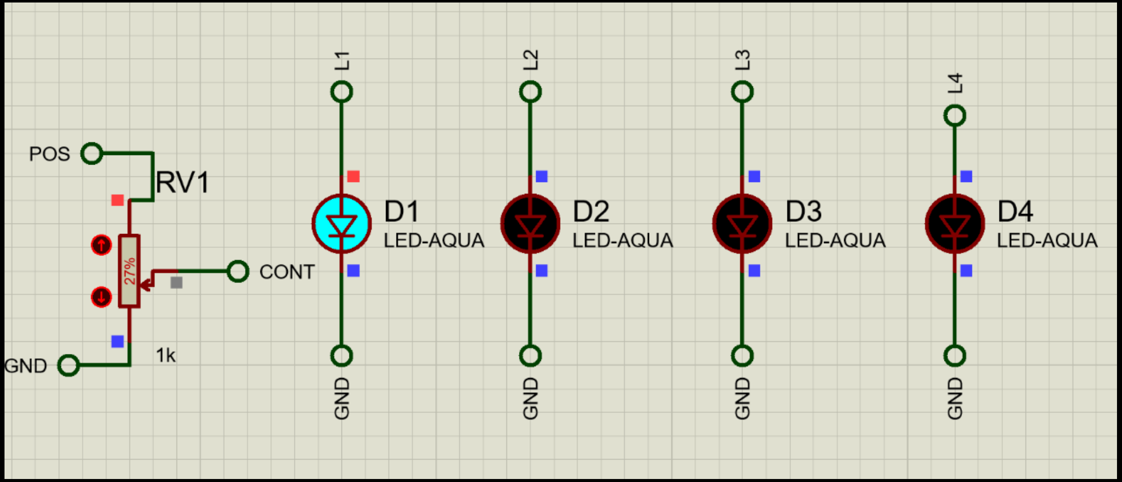
Design a horizontal bar graph using 4 LEDs which is used to display potentiometer’s value as described:

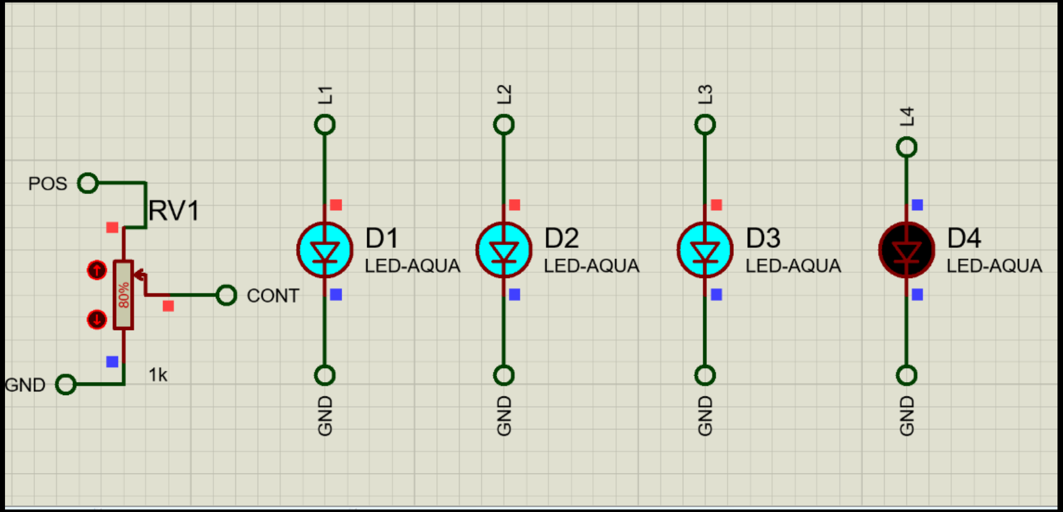
0%:	No LED is ON
1-25%:	One LED is ON
25-50%:	Two LEDs are ON
50-75%:	Three LEDs are ON
75-100%:	Four LEDs are ON

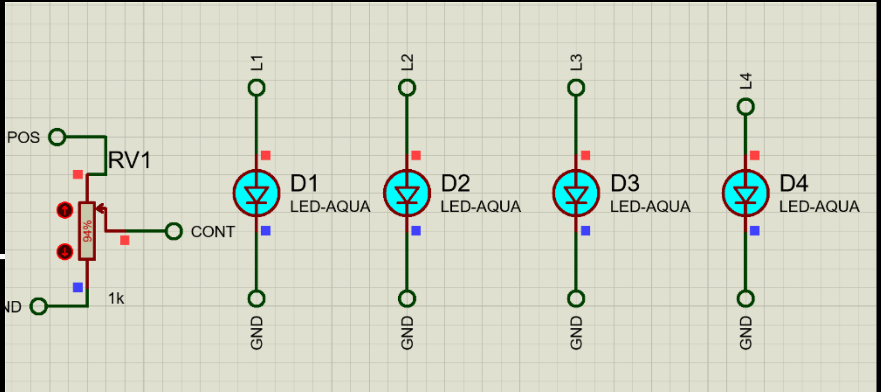
Look at the schematics on the next page.


POS
RV1
24%
CONT
ND
1k
L1
L2
L3
L4
D1
LED-AQUA
D2
LED-AQUA
D3
LED-AQUA
D4
LED-AQUA
GND
GND
GND
GND


POS
RV1
57%
CONT
GND
1k
L1
L2
L3
L4
D1
LED-AQUA
D2
LED-AQUA
D3
LED-AQUA
D4
LED-AQUA
GND
GND
GND
GND


POS
RV1
27%
CONT
GND
1k
L1
L2
L3
L4
D1
LED-AQUA
D2
LED-AQUA
D3
LED-AQUA
D4
LED-AQUA
GND
GND
GND
GND


POS
RV1
80%
CONT
GND
1k
L1
L2
L3
L4
D1
LED-AQUA
D2
LED-AQUA
D3
LED-AQUA
D4
LED-AQUA
GND
GND
GND
GND


POS
RV1
94%
CONT
ND
1k
L1
L2
L3
L4
D1
LED-AQUA
D2
LED-AQUA
D3
LED-AQUA
D4
LED-AQUA
GND
GND
GND
GND

If you had any questions:

1. Google is your friend!
2. If you did not find your answer on Google, search it on YouTube. There is definitely an Indian fellow answering your questions.
3. After all, you can also ask your graders (: