

Lab 6: Arduino Programming

Submission Instructions:

- You are required to submit **demo videos**, **answer sheet**, and **Arduino codes** to Blackboard.
- Create each Arduino project with a project name based on the lab and question numbers, e.g. **Lab6_Q1**.
- Answer all the questions in the .docx answer sheet
- Compress all the files to .zip file with your SID, e.g. **1155123456_Lab3.zip**
- Upload the .zip file to Blackboard before the deadline stated in Blackboard
- 10 marks will be deducted per day for late submission

For each question below, you are required to record a short mp4 **video** to demonstrate the answers. In the video, the following elements are required:

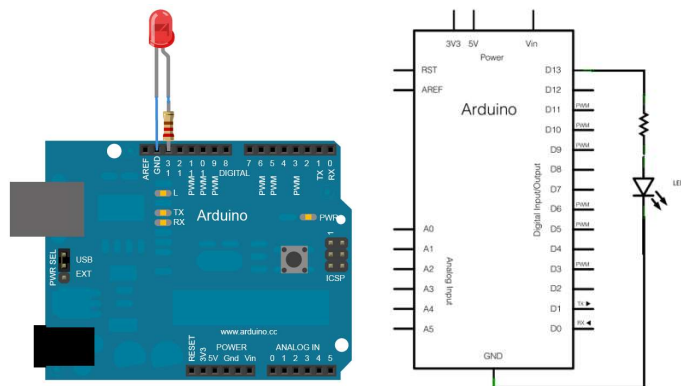
- A. Show your full name and SID on a paper next to your circuit [8 marks]
- B. Voice descriptions in English/Cantonese/Mandarin on what you are doing [8 marks]
- C. Demonstrate your works by presenting all possible cases clearly [20 marks]

List of Components and Equipment:

- Arduino: 1x Arduino UNO Board with USB cable
- Breadboard: 1x Breadboard and Wires
- Resistors: 1x 270 Ω , 1x 10k Ω
- LED: 1x LED
- Button: 1x Push Button

1. Digital Output

Construct the following circuit by connecting the LED and 270 Ω resistor to the Arduino UNO Board. For more information on the Arduino UNO Board, please visit <https://store.arduino.cc/usa/arduino-uno-rev3>



- a. Hardware Connections
 - i. If necessary, you may connect the above circuit using a breadboard
 - ii. Connect one end of the 270 Ω resistor to digital I/O pin 13
 - iii. Connect the anode (i.e. the positive terminal, and normally the longer pin) of the LED to the other end of the resistor
 - iv. Connect the cathode (i.e. the negative terminal, and normally the shorter pin) of the LED to the GND pin of the Arduino UNO board
 - v. Connect the Arduino UNO Board to your computer by using the USB cable
 - vi. **Answer the questions on the answer sheet**

b. Software Programming

- i. Download and install the Arduino Integrated Development Environment (IDE) at <https://www.arduino.cc/en/software>



- ii. On the desktop of your computer, double click the Arduino icon to run the Arduino IDE.



- iii. Create a new project by:

1. Click File > New, a new window will pop up
2. Copy the following codes

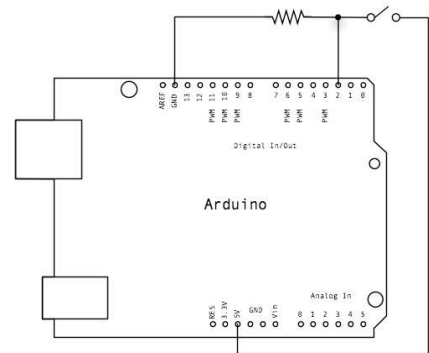
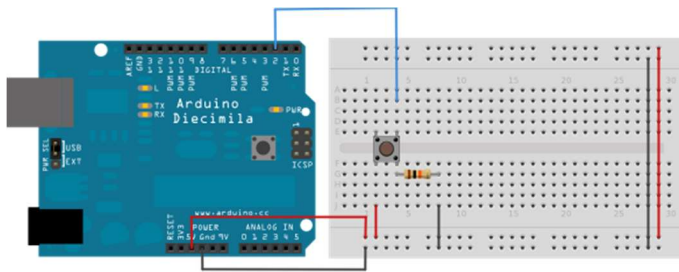
```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);  // turn the LED on (HIGH voltage level)
  delay(1000);             // wait for a second
  digitalWrite(13, LOW);   // turn the LED off (LOW voltage level)
  delay(1000);             // wait for a second
}
```

3. As remarked in the codes, a basic Arduino program consists of two functions, setup() and loop(). The setup() function runs only once, and the loop() function runs over and over again forever
 4. Paste the codes and replace everything in the new pop up window
 5. In the codes, the built-in constant LED_BUILTIN refers to the digital I/O pin 13. Therefore, if you have connected the resistor to pin 13 for instance, you have to replace all LED_BUILTIN by 13 instead
 6. Click Sketch > Verify/Compile, change the name of the folder/program and Save
 7. If the codes are compiled correctly without error, "Done compiling." will be shown
- iv. Check the following Arduino settings:
1. Click and choose Tools > Boards: "Arduino/Genuino Uno"
 2. Click and choose Tools > Port > COM??? (other than COM1 normally)
- v. Compile and upload the program to the Arduino
1. Click Sketch > Upload
 2. If there is no error, "Done uploading." will be shown
- vi. Answer the questions on the answer sheet

2. Digital Input

Keeping the circuit of Question 1 connected. On top of the circuit, construct the following circuit by connecting the button and 10k Ω resistor to the Arduino UNO Board. Therefore, two resistors, the LED, and the button should be connected properly.



a. Hardware Connections

- i. If necessary, you may connect the above circuit using a breadboard
- ii. Connect the circuit as shown in the circuit diagram above
- iii. Connect the 10k Ω resistor between digital I/O pin 2 and the GND pin of the Arduino UNO board
- iv. Connect the button between digital I/O pin 2 and the 5V pin of the Arduino UNO board.
(Please note that some buttons may have more than 2 terminals physically, but some of the pins are internally connected together. Therefore, it has only 2 isolated terminals actually, please check this out carefully. Pressing down the button is a closed circuit, while releasing the button is an open circuit.)
- v. Connect the Arduino UNO Board to your computer by using the USB cable
- vi. **Answer the questions on the answer sheet**

b. Software Programming

- i. On the desktop of your computer, double click the following Arduino icon to execute the Arduino IDE (i.e. Integrated Development Environment)
- ii. Create a new project by:
 1. Click File > New, a new window will pop up
 2. Copy the following codes

```
// constants won't change. They're used here to set pin numbers:
const int buttonPin = 2;    // the number of the pushbutton pin
const int ledPin = 13;      // the number of the LED pin

// variables will change:
int buttonState = 0;        // variable for reading the pushbutton status

void setup() {
  // initialize the LED pin as an output:
  pinMode(ledPin, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinMode(buttonPin, INPUT);
}

void loop() {
  // read the state of the pushbutton value:
  buttonState = digitalRead(buttonPin);

  // check if the pushbutton is pressed. If it is, the buttonState is HIGH:
  if (buttonState == HIGH) {
    // turn LED on:
    digitalWrite(ledPin, HIGH);
  } else {
    // turn LED off:
    digitalWrite(ledPin, LOW);
  }
}
```

3. Paste the codes and replace everything in the new pop up window
 4. Click Sketch > Verify/Compile, change the name of the folder/program and Save
 5. If the codes are compiled correctly without error, "Done compiling." will be shown
- iii. Check the following Arduino settings:
1. Click and choose Tools > Boards: "Arduino/Genuino Uno"
 2. Click and choose Tools > Port > COM??? (other than COM1 normally)
- iv. Compile and upload the program to the Arduino
1. Click Sketch > Upload
 2. If there is no error, "Done uploading." will be shown
- v. **Answer the questions on the answer sheet**

Lab 6: Arduino Programming

Answer Sheet

For the questions below, please type all the answers in one single text/word file (e.g. txt/docx file) with clear question numbers.

1. Digital Output

[32%]

a. Hardware Connections

- i. What is the purpose of connecting a resistor in the circuit?

- ii. We have not connected the DC Power Supply to the Arduino Board, where does it get the power from?

b. Software Programming

- i. What is the program statement to set the digital pin to be input or output?

- ii. If the parameter of the delay() function is set to 500 instead of 1000, the LED will blink faster or slower?

2. Digital Input

[32%]

a. Hardware Connections

- i. When the button is being pressed, what should be the voltage at pin 2 of the Arduino UNO Board?

- ii. What does GND on the Arduino UNO Board stand for?

b. Software Programming

- i. What happen when the button is being pressed?

- ii. Which statement in the codes are used to get the button input?

THE END