Al-Mustaqbal University
Science college
Dep. Medical Physics

Medical Physics

Second Stage

Lab2

Computer 4

MS.c Mortada Sabri
MS.c Noor Mohammed

Programming of Arduino:

The concept of programming is generally composed of two main parts: variables and functions. The language of the Arduino also contains these two concepts.

In Arduino programming we need three phases:

1- **Variables**: uses of variables and constants to facilitate the naming of Inputs and Outputs of the microcontroller:

```
Data_Type Variable_Name = pin Number;
```

Ex: int led=3;

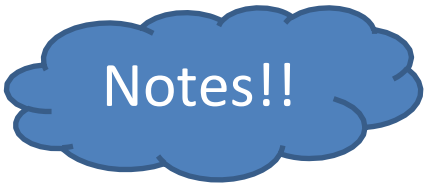
2- **Initialization**: The microcontroller features that its pins can be either input or output, so at this phase must determine whether the pin is input or output. This phase is done by a **setup()** function:
Void setup ( ) {write your configurations here}

```
pinMode(pin number, STATE);
```

Ex: pinMode(led, OUTPUT);

3- **Implementation**: At this phase, the main code is written inside the loop() function, which will be read and repeated repeatedly:
Void loop ( ) {your program}

```
digitalWrite(pin number, STATE);

digitalRead(pin number);

delay(ms)

and so on…
```



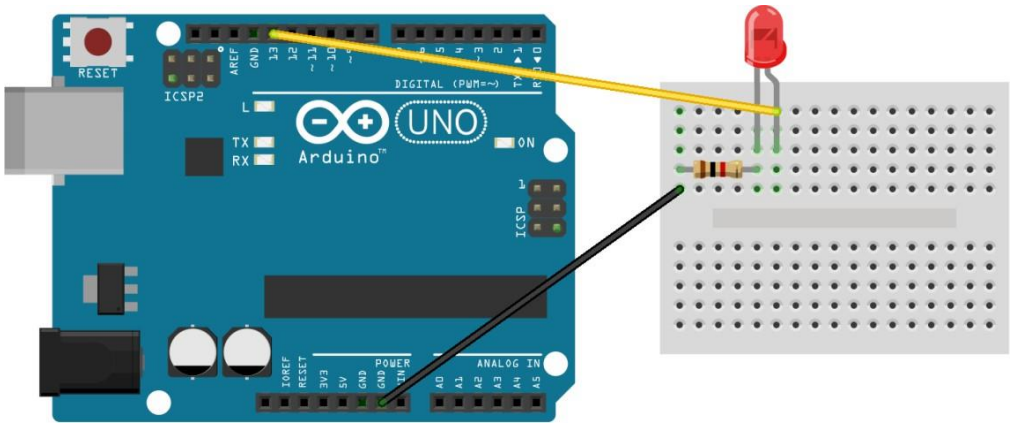
1- Each programming line ends with a semicolon.
2- The Arduino programming language is written in camel style.
3- Often the state written in capital letters (ex: INPUT, OUTPUT, HIGH, LOW and so on...).
4- There are two ways to write comments:
   a- One line comment: add // (ex: //Hello World)
   b- More than one line: add /**/ (ex: /*Hello World*/)
5- The condition is written as follows:
   a- for(){} else{} or else if(){}
   b- switch() case1; case2; … break; default;
6- Repetition writes as follows:
   a- while (){}
   b- for(; ;){}

Example 1:

(Blinking led)

Requirements: Arduino, BreadBoard, Resistor, Led, wires.

Connection map:



Code:

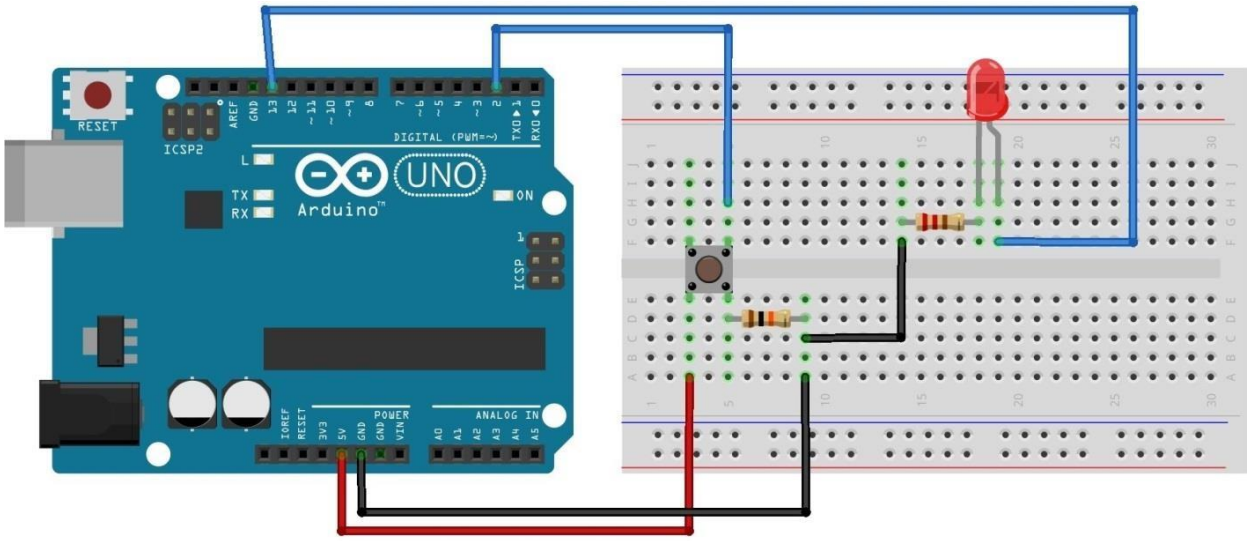
```
int LED = 13;
void setup ()
  {
    pinMode(LED, OUTPUT);
  }
void loop()
{
  digitalWrite(LED, HIGH);
  delay(1000);
  digitalWrite(LED, LOW);
  delay(1000);
}
```

Example 2:

(Turn on the led by Push bottom)

Requirements: Arduino, BreadBoard, 2Resistor, Led, Push bottom, wires.

Connection map:



Code:

```
int led = 13;
int button = 2;
void setup() {
pinMode(led, OUTPUT);
pinMode(button, INPUT);
}
void loop() {
if(digitalRead(button)==HIGH){
digitalWrite(led, HIGH);
}
}
```

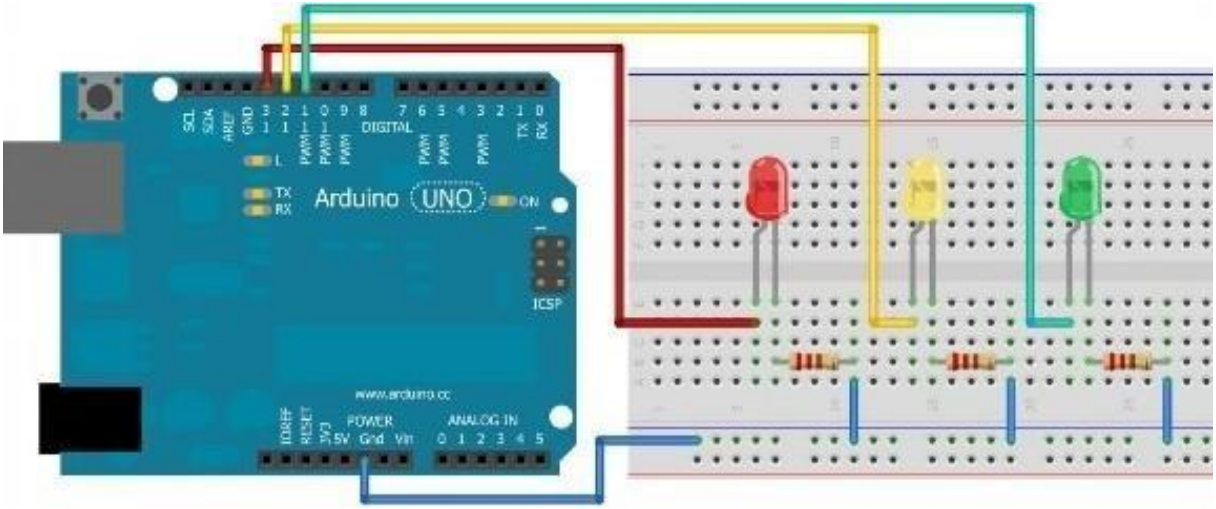
Quizzes

Quiz1:

(Traffic light)

Requirements: Arduino, BreadBoard, 3Resistor, 3Led, wires.

Connection map:



Code:

```
int GREEN = 3;
int YELLOW = 4;
int RED = 5;

void setup()
{
  pinMode(GREEN, OUTPUT);
  pinMode(YELLOW, OUTPUT);
  pinMode(RED, OUTPUT);
}
```

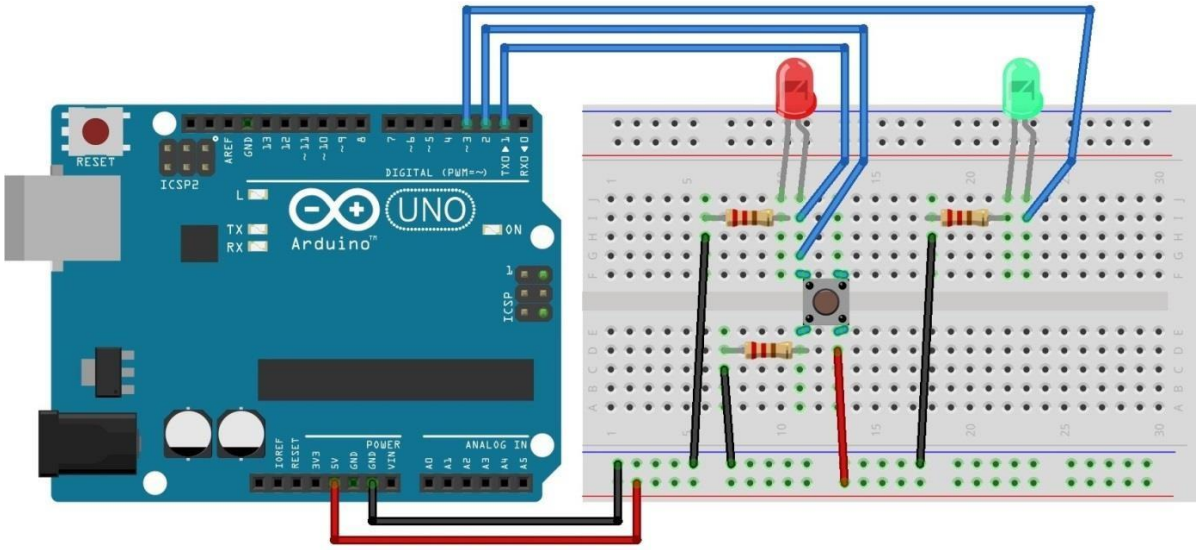
```
void loop()
{

  digitalWrite(GREEN, HIGH);
  digitalWrite(YELLOW, LOW);
  digitalWrite(RED, LOW);
  delay(5000);

  digitalWrite(GREEN, LOW);
  digitalWrite(YELLOW, HIGH);
  digitalWrite(RED, LOW);
  delay(2000);

  digitalWrite(GREEN, LOW);
  digitalWrite(YELLOW, LOW);
  digitalWrite(RED, HIGH);
  delay(5000);
}
```

Quiz3:

(Waiting system)

Requirements: Arduino, BreadBoard, 3Resistor, 2Led, Push bottom, wires.

Connection map:



Code:

```
int led1 = 3;
int led2 = 5;
int button = 1;
void setup ( )
{
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(button, INPUT);
}
void loop ( )
{
  if (digitalRead(button) == HIGH) {
    digitalWrite(led1, LOW);
    digitalWrite(led2, HIGH);
    delay(5000);
    digitalWrite(led1, HIGH);
    digitalWrite(led2, LOW);
    }else{
      digitalWrite(led1, HIGH);
    }
}
```

Solution of H.W lab1:

1- Compare between microcontroller and microprocessor?

microcontroller	microprocessor
1- have RAM, ROM, EEPROM embedded in it	1- have to use external circuits
2- on single chip it is compact so it makes them favorable and efficient system for small products and applications	2- is bulky so they are preferred for larger applications
3- Made by using complementary metal oxide semiconductor technology so they are far cheaper than microprocessors. In addition the applications made with it are cheaper because they need lesser external components	3- the overall cost of systems made with it are high because of the high number of external components required for such systems
4- Processing speed is about 8 MHz to 50 MHz	4- above 1 GHz so it works much faster than microcontrollers
5- have power saving system	5- no power saving system
6- Tasks performed by it are limited and generally less complex	6- task performed by it are software development, Game development, website, documents making etc

2- What types of Arduino? And why did these species exist?

Name	Processor	Operating Voltage	CPU Speed	Analog In/ Out	Digital IO/ PWM	EEPROM	SRAM (KB)	Flash (KB)
Uno	ATmega328	5 V/7-12 V	16MHz	6/0	14/6	1	2	32
Due	AT91SAM3X8E	3.3 V/7-12 V	84 MHz	12/0	54/12	–	96	512
Leonardo	ATmega32u4	5 V/7-12 V	16MHz	12/0	20/7	1	2.5	32
Mega 2560	ATmega2560	5 V/7-12 V	16MHz	16/0	54/15	4	8	256
Mega ADK	ATmega2560	5 V/7-12 V	16MHz	16/0	54/15	4	8	256
Micro	ATmega32u4	5 V/7-12 V	16MHz	12/0	20/7	1	2.5	32
Mini	ATmega328	5 V/7-9 V	16MHz	8/0	14/6	1	2	32

Nano	ATmega168	5 V/7-9 V	16MHz	8/0	14/6	0.5121	1	16
Ethernet	ATmega328	5 V/7-12 V	16MHz	6/0	14/4	1	2	32
Esplora	ATmega32u4	5 V/7-12 V	16MHz	–	–	1	2.5	32
ArduinoBT	ATmega328	5 V/2.5-12 V	16MHz	6/0	14/6	1	2	32
Fio	ATmega328P	3.3 V/3.7-7 V	8MHz	8/0	14/6	1	2	32
Pro (168)	ATmega168	3.3 V/3.35-12 V	8MHz	6/0	14/6	0.512	1	16
Pro (328)	ATmega328	5 V/5-12 V	16MHz	6/0	14/6	1	2	32
Pro Mini	ATmega168	3.3 V/3.35-12 V	8MHz	6/0	14/6	0.512	1	16

LilyPad	ATmega168V	2.7-5.5 V/2.7-5.5 V	8MHz	6/0	14/6	0.512	1	16
LilyPad USB	ATmega32u4	3.3 V/3.8-5V	8MHz	4/0	9/4	1	2.5	32
LilyPad	ATmega328	2.7-5.5 V/2.7-5.5 V	8MHz	4/0	9/4	1	2	32

H.W

1- What is the difference between data and information?

2- What is the difference between signal and System?

3- Compare between digital and analog signals?

4- What is the PCM?