Faculty of Computers and Artificial Intelligence

Embedded Systems

<u>Lab no 01:</u> Traffic Light Prototype
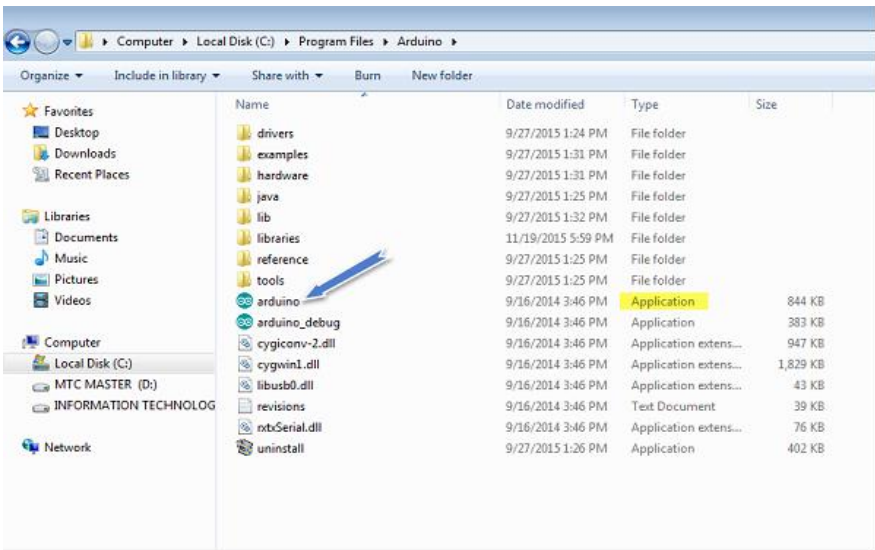## LEDs and Seven-segments display Interfaces

The purpose of this Lab is to learn interfaces with light-emitting diodes (LEDs) and seven-segments display. To do that, you are required to build a prototype for traffic lights using Arduino.

Parts: -

1. Install Arduino IDE.
2. Interface light-emitting diodes and code Arduino to control LEDs.
3. Interface the seven-segments display and code Arduino to control them.
4. Integrate LEDs with the seven-segments display to build a prototype for a traffic light system.
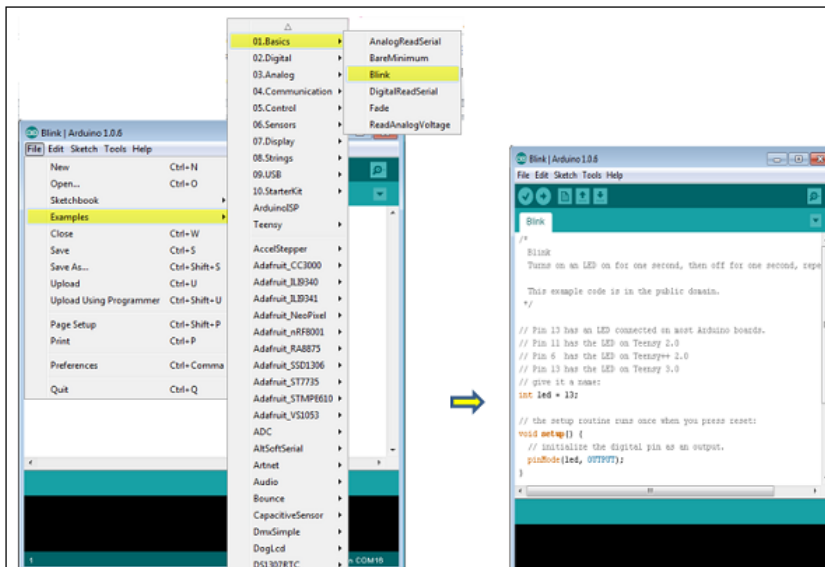
Part 1. Install Arduino IDE

Step	Description
1	After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.
2	Open your first project. Once the software starts, you have two options − • Create a new project. • Open an existing project example. To create a new project, select **File → New**
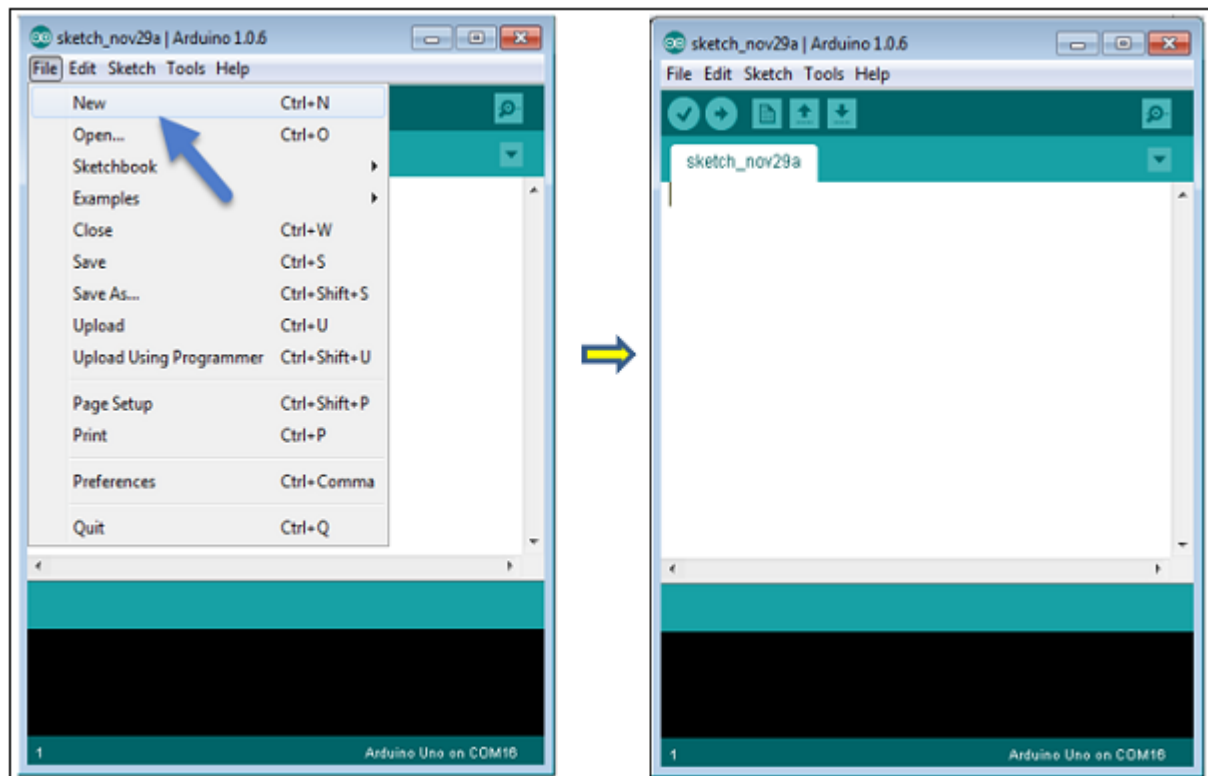
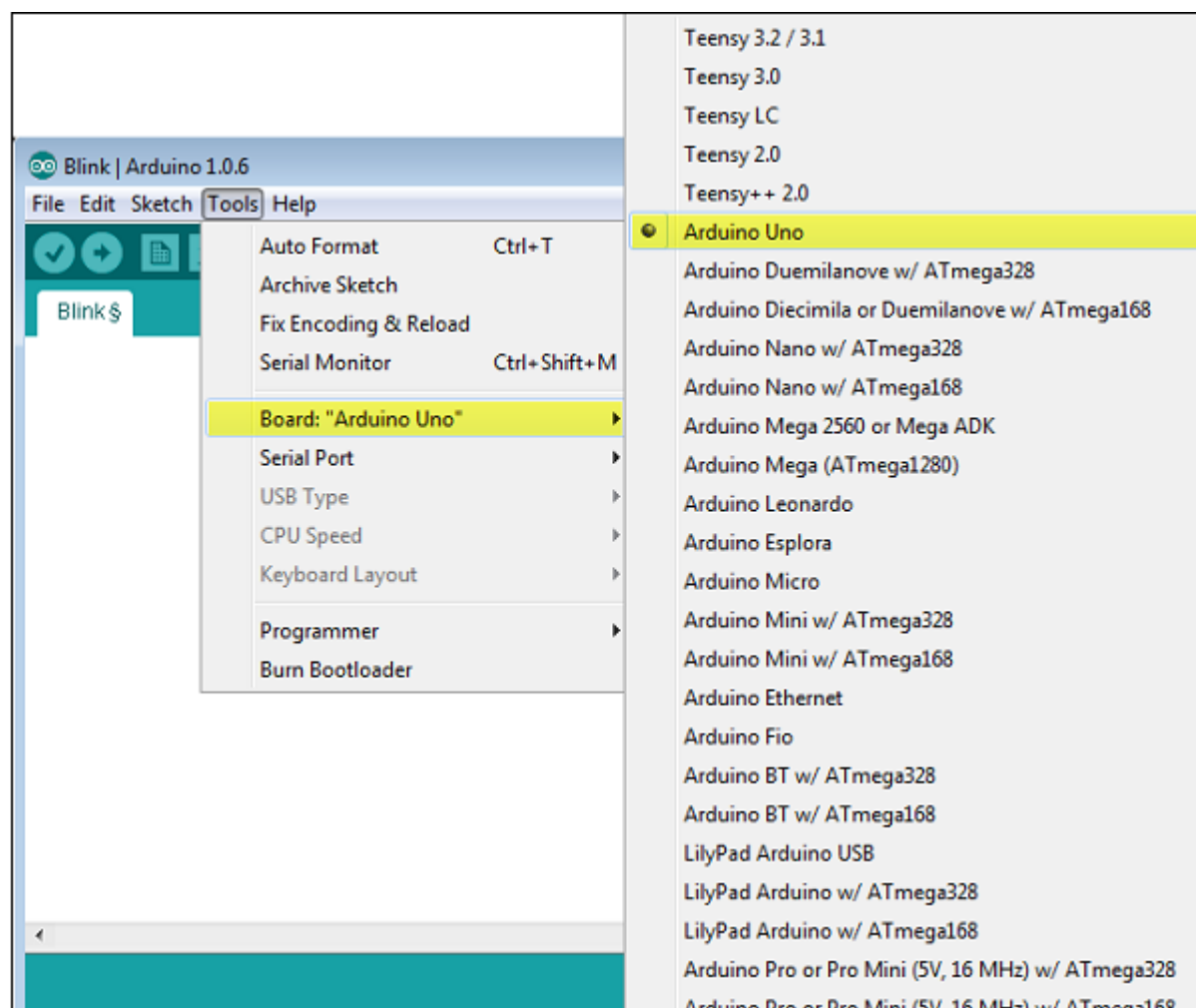| 3	To open an existing project example, **select File → Example → Basics → Blink**.
	Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. You can select any other example from the list.

|	
4	To avoid any error while uploading your program to the board, you must select the correct Arduino board name, which matches with the board connected to your computer. **Go to Tools → Board and select your board.**
5	Select the serial device of the Arduino board. Go to **Tools → Serial Port menu**. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.
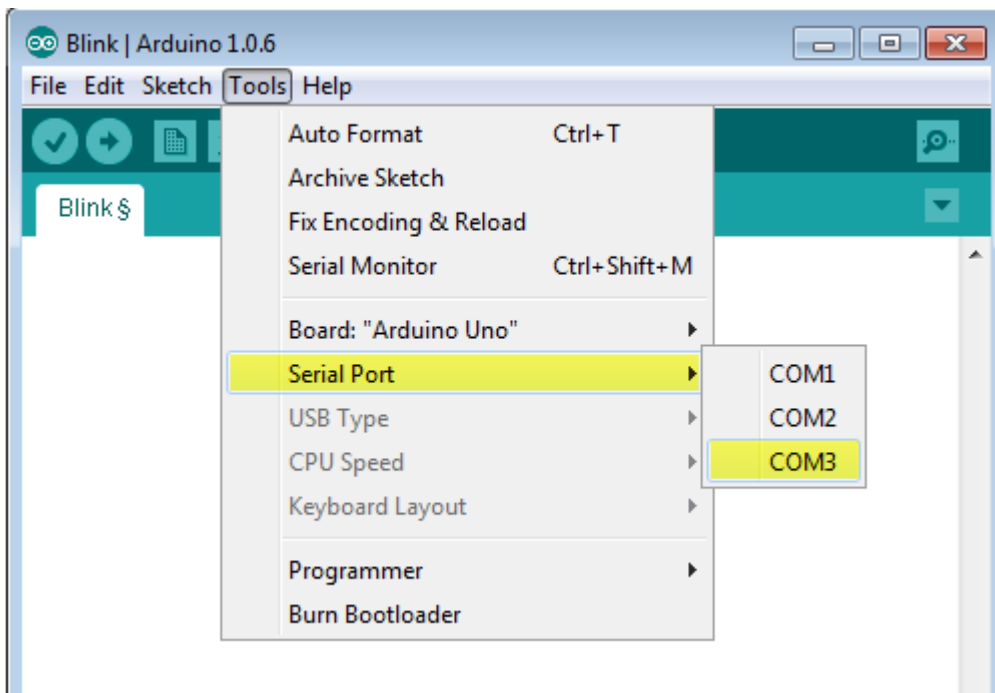
| 6 | Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar. |
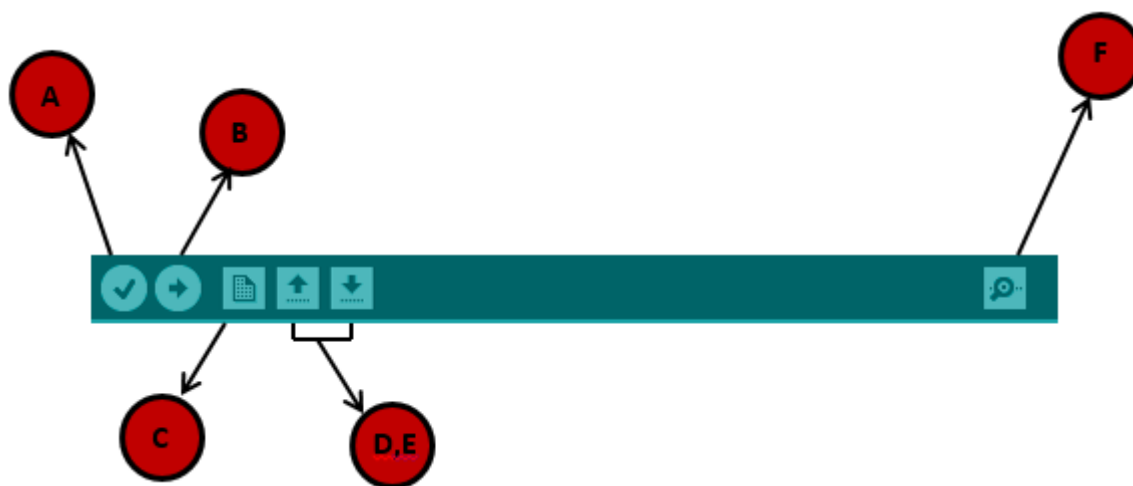
A − Used to check if there is any compilation error.

B − Used to upload a program to the Arduino board.

C − Shortcut used to create a new sketch.

D − Used to directly open one of the example sketch.

E − Used to save your sketch.

F − Serial monitor used to receive serial data from the board and send the serial data to the board.

Now, simply click the "Upload" button in the environment. Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.
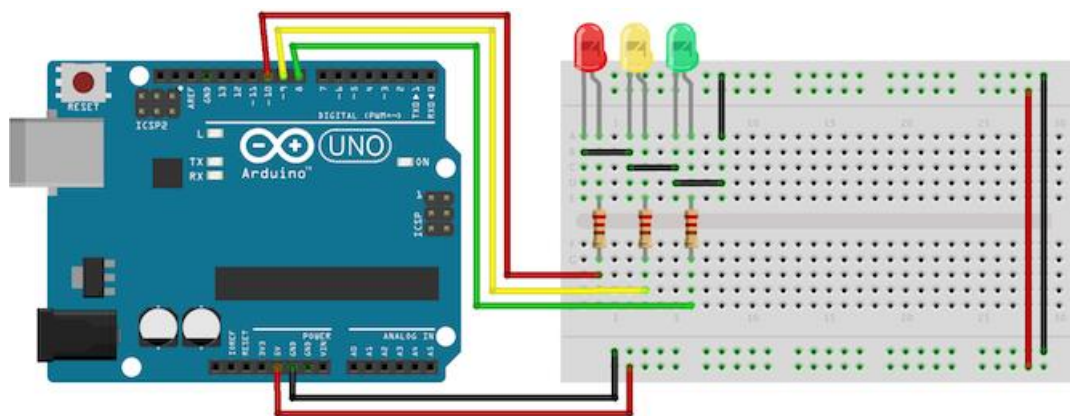

Part 2. Interface LEDs.

a) Connection

Requirements
1.   Red and green LEDs.
2.   A breadboard.
3.   Connecting wires.
4.   3 x 10k ? resistor

Connect the anode (long leg) of each LED to digital pins eight, nine, and ten (via a 220? resistor). Connect the cathodes (short leg) to Arduino ground.
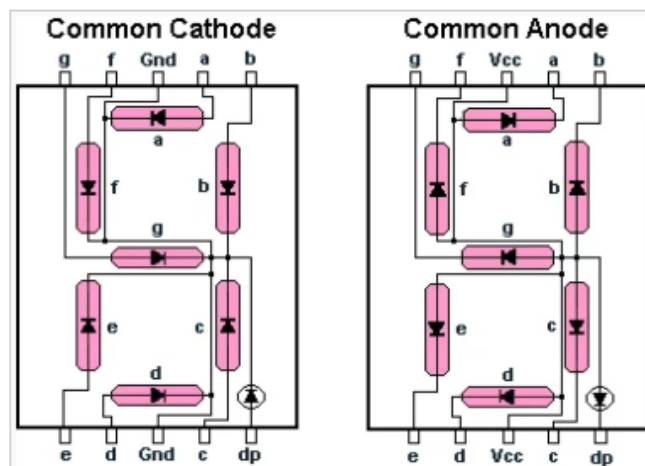
b) Arduino Code

```
int red = 10;
int green = 11;
void setup() {
pinMode(red, OUTPUT);
pinMode(green, OUTPUT);
}
void loop() {
    digitalWrite(red, HIGH);
    digitalWrite(green, LOW);
    delay(20000);
    digitalWrite(red, LOW);
    digitalWrite(green, HIGH);
    delay(40000);
}
```
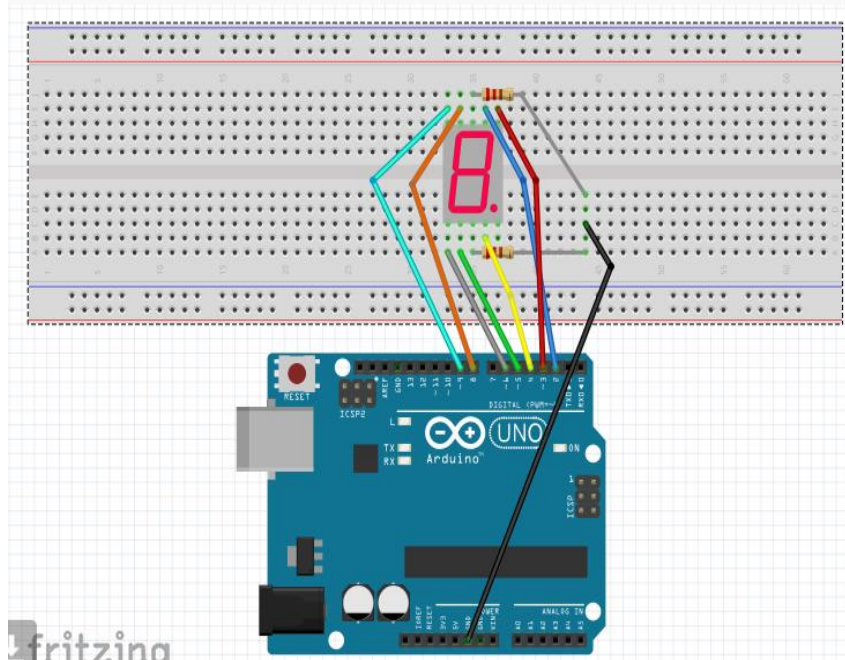

Part 3. Interface the seven-segments display.

Common anode vs common Cathode

a) Connection

b) Connect the pins as described below:

1. Arduino Pin 2 to Pin 9.

2. Arduino Pin 3 to Pin 10.

3. Arduino Pin 4 to Pin 4.

4. Arduino Pin 5 to Pin 2.

5. Arduino Pin 6 to Pin 1.

6. Arduino Pin 8 to Pin 7.

7. Arduino Pin 9 to Pin 6.

8. GND to Pin 3 and Pin 8 each connected with 220 ohm resistors.

c) Arduino Code

```
int a = 2;
int b = 3;
int c = 4;
int d = 5;
int e = 6;
int f = 8;
int g = 9;
void setup() {
  pinMode(a, OUTPUT);   //A
  pinMode(b, OUTPUT);   //B
  pinMode(c, OUTPUT);   //C
  pinMode(d, OUTPUT);   //D
  pinMode(e, OUTPUT);   //E
  pinMode(f, OUTPUT);   //F
  pinMode(g, OUTPUT);   //G
}
void displayDigit(int digit)
{
 //Conditions for displaying segment a
 if(digit!=1 && digit != 4)
 digitalWrite(a,HIGH);
 //Conditions for displaying segment b
 if(digit != 5 && digit != 6)
 digitalWrite(b,HIGH);
 //Conditions for displaying segment c
 if(digit !=2)
 digitalWrite(c,HIGH);
```

```
//Conditions for displaying segment d
if(digit != 1 && digit !=4 && digit !=7)
digitalWrite(d,HIGH);
//Conditions for displaying segment e
if(digit == 2 || digit ==6 || digit == 8 || digit==0)
digitalWrite(e,HIGH);
//Conditions for displaying segment f
if(digit != 1 && digit !=2 && digit!=3 && digit !=7)
digitalWrite(f,HIGH);
if (digit!=0 && digit!=1 && digit !=7)
digitalWrite(g,HIGH);
}
void turnOff()
{
  digitalWrite(a,LOW);
  digitalWrite(b,LOW);
  digitalWrite(c,LOW);
  digitalWrite(d,LOW);
  digitalWrite(e,LOW);
  digitalWrite(f,LOW);
  digitalWrite(g,LOW);
}
void loop() {
 for(int i=0;i<10;i++)
 { displayDigit(i);
   delay(1000);
   turnOff();
 }}
```

Part4. Integrate LEDs and seven-segments display to build a traffic light prototype

Build a prototype for a traffic light system where:

- The red LED turns on for 20 seconds then the green LED turns on for 40 seconds.

- Seven-segments displays seconds.

```
int red = 10;
int green = 11;
int count=0;
int a = 2;
int b = 3;
int c = 4;
int d = 5;
int e = 6;
int f = 8;
int g = 9;
void setup() {
  pinMode(a, OUTPUT);
  pinMode(b, OUTPUT);
  pinMode(c, OUTPUT);
  pinMode(d, OUTPUT);
  pinMode(e, OUTPUT);
  pinMode(f, OUTPUT);
  pinMode(g, OUTPUT);
  pinMode(red, OUTPUT);
  pinMode(green, OUTPUT);
```

```
}
void displayDigit(int digit)
{

 if(digit!=1 && digit != 4)
 digitalWrite(a,HIGH);



 if(digit != 5 && digit != 6)
 digitalWrite(b,HIGH);



 if(digit !=2)
 digitalWrite(c,HIGH);


 if(digit != 1 && digit !=4 && digit !=7)
 digitalWrite(d,HIGH);


 if(digit == 2 || digit ==6 || digit == 8 || digit==0)
 digitalWrite(e,HIGH);


 if(digit != 1 && digit !=2 && digit!=3 && digit !=7)
 digitalWrite(f,HIGH);


 if (digit!=0 && digit!=1 && digit !=7)
 digitalWrite(g,HIGH);


}
```

```
void turnOff()
{
  digitalWrite(a,LOW);
  digitalWrite(b,LOW);
  digitalWrite(c,LOW);
  digitalWrite(d,LOW);
  digitalWrite(e,LOW);
  digitalWrite(f,LOW);
  digitalWrite(g,LOW);
}


void loop() {

 if(count<=2)
 {

   digitalWrite(red, HIGH);
 digitalWrite(green, LOW);


 }
 else
 {
  digitalWrite(red, LOW);
  digitalWrite(green, HIGH);


 }
    if(count==6)
```

```
    {
       count=0;
    }
 for(int i=0;i<10;i++)
 {
   displayDigit(i);
   delay(1000);
   turnOff();
 }
 count++;


}
```