

ENGINE



Erasmus+

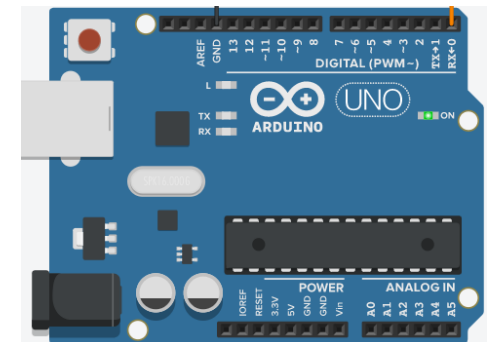
TEACHING ONLINE ELECTRONICS, MICROCONTROLLERS AND PROGRAMMING
IN HIGHER EDUCATION

Module_1-1. Pins as outputs

Arduino Uno with Tinkercad

Contents

- Program structure for the Arduino Uno
- Programming functions for the Arduino Uno
- LED and RGB LED
- Seven segment display
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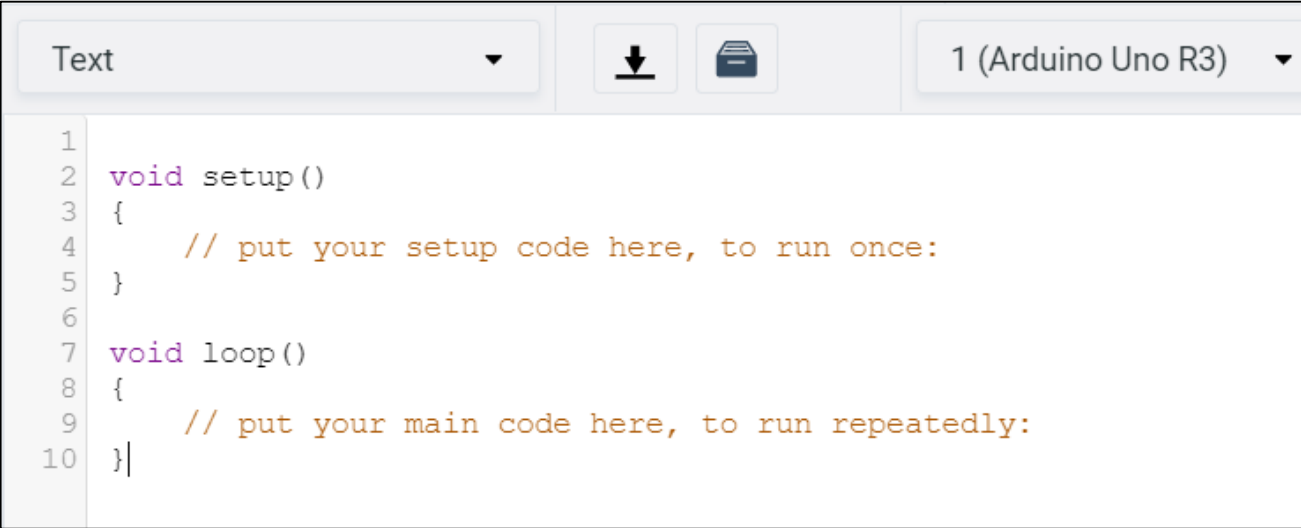


Module_1-1. Pins as outputs

Program structure

Every program for Arduino Uno must contain the functions:

- `setup()`. It runs once at the beginning of the program and usually contains initializations
- `loop()`. It is always running



```
1
2 void setup()
3 {
4     // put your setup code here, to run once:
5 }
6
7 void loop()
8 {
9     // put your main code here, to run repeatedly:
10 }
```

1. https://create.arduino.cc/projecthub/lina-tech-explorations/the-basics-of-arduino-programming-program-structure-functi-f5fb2c?ref=part&ref_id=10308&offset=94
2. <https://www.arduino.cc/en/tutorial/sketch>

Module_1-1. Pins as outputs

Programming functions

There are many functions that can be used in the Arduino Uno. However, the basic functions are:

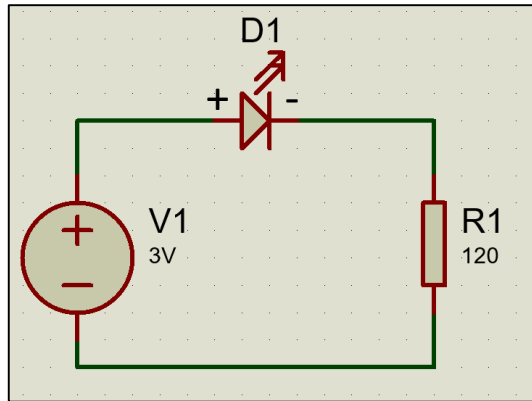
- **pinMode(pin, value)**. This function determines whether a pin will be output, input, or input with built-in pullup resistors => Value: output, input, input_pullup
- **digitalWrite(pin, value)**. This function gives a high or low value to an output pin => Value: high (“1”), low (“0”)
- **delay(value)**. This function stops the program from running in milliseconds => Value: integer
- **analogWrite(pin, value)**. This function creates a PWM waveform in a pin. The pins that support this feature on the Arduino Uno board are 3, 5, 6, 9, 10, 11. The duty cycle is determined by the value => Value: 0 ~ 255 => PWM duty cycle: 0% ~ 100%

1. <https://www.arduino.cc/reference/en/language/functions/digital-io/pinmode/>
2. <https://www.arduino.cc/reference/en/language/functions/digital-io/digitalwrite/>
3. <https://www.arduino.cc/reference/en/language/functions/time/delay/>
4. <https://www.arduino.cc/reference/en/language/functions/analog-io/analogwrite/>
5. <https://www.arduino.cc/en/Tutorial/Foundations/PWM>

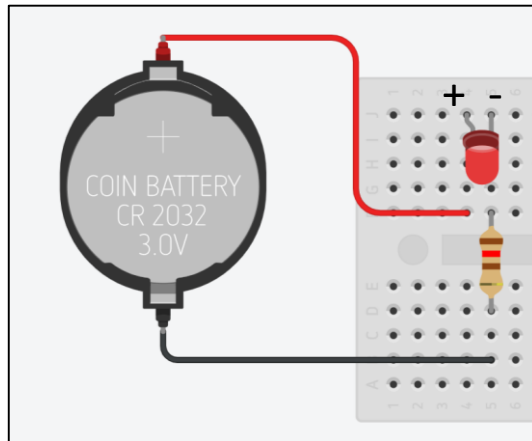
Module_1-1. Pins as outputs

LED and RGB LED

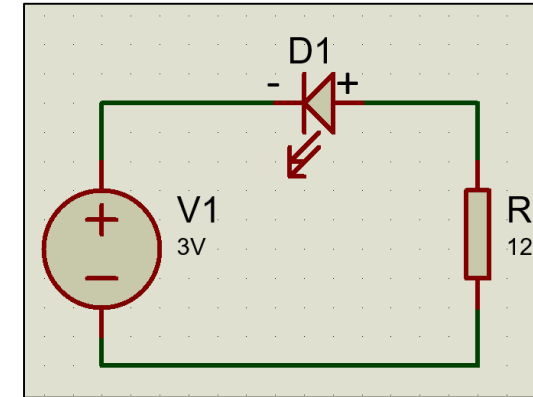
The LED is a diode that when properly polarized conducts, emitting photons. The wavelength of the photons determines the color of the LED.



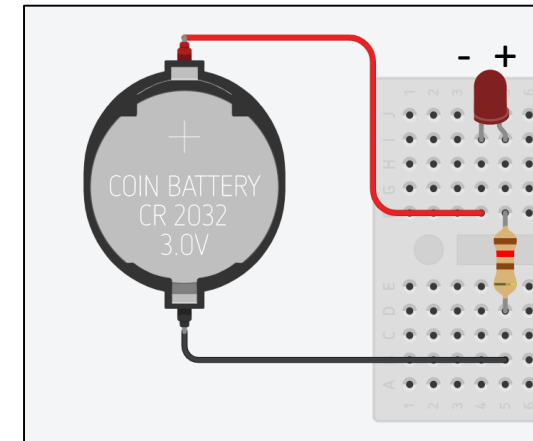
$$\begin{aligned} I_1 &= I_{LED} = I_{R1} \\ &= \frac{V_R}{R_1} = \frac{V_1 - V_{LED}}{R_1} \\ &\approx \frac{3V - 2V}{120\Omega} \\ &= 8.3mA \end{aligned}$$



The LED emits



$$I_1 = 0$$



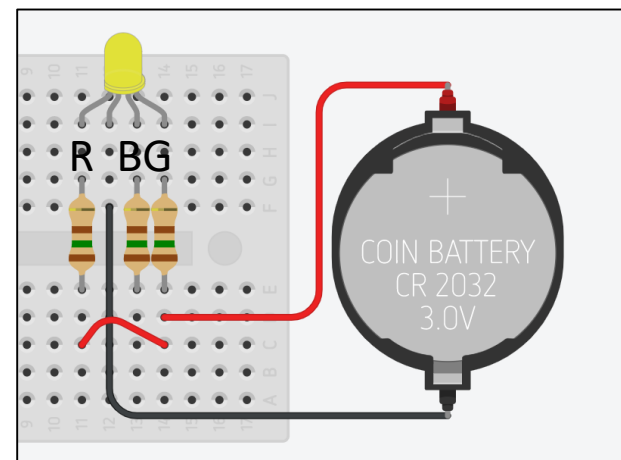
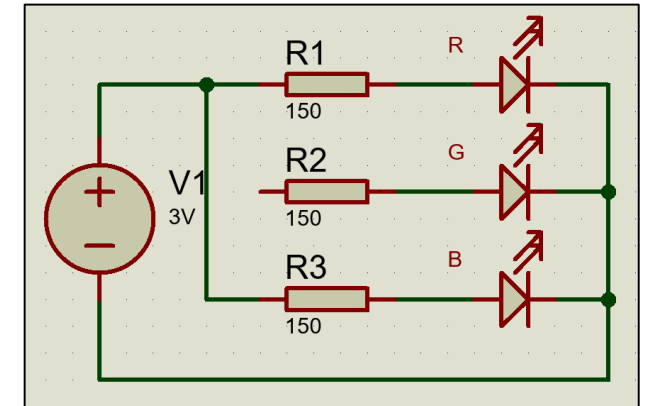
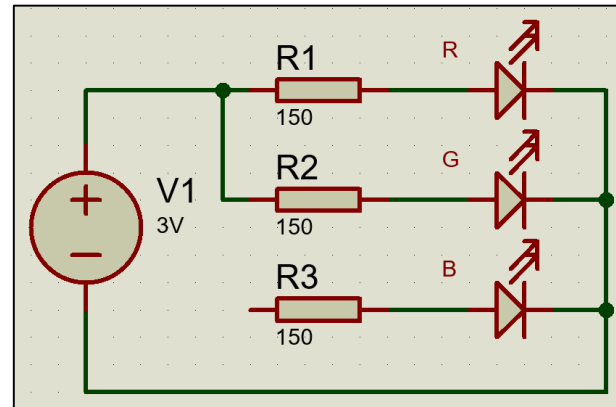
The LED cannot emit

Module_1-1. Pins as outputs

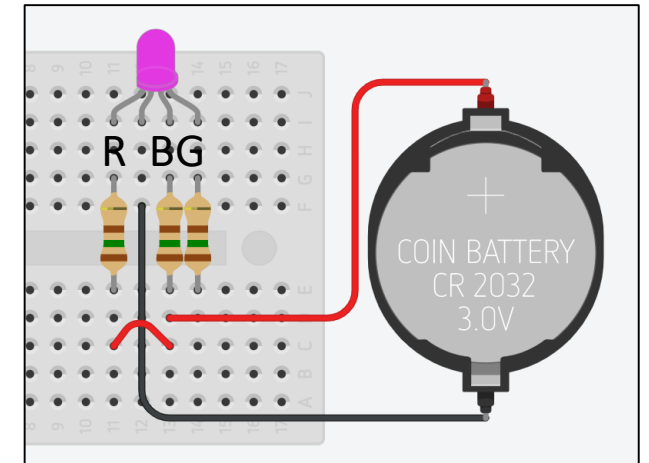
LED and RGB LED

An RGB LED is the combination of 3 LEDs: red, green, and blue in the same package. Mixing these colors can create all colors.

For example: mixing red and green gives yellow, while red and blue gives purple.



Red and green



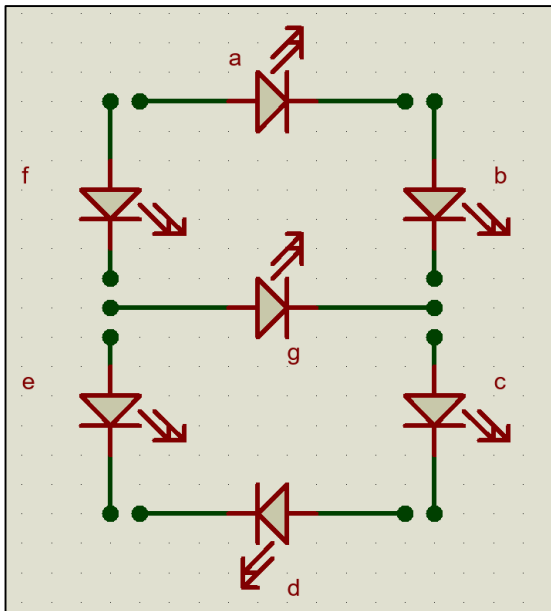
Red and blue

1. <https://howtomechatronics.com/tutorials/arduino/how-to-use-a-rgb-led-with-arduino>
2. https://www.rapidtables.com/web/color/RGB_Color.html
3. <https://randomnerdtutorials.com/electronics-basics-how-do-rgb-leds-work/>

Module_1-1. Pins as outputs

Seven segment display

The seven segment display contains in the same package segments (with names from a to g). Each segment is a LED. The LEDs are arranged so that numbers can be formed by activating appropriate segments.



Array of sections / LEDs

For example: if sectors b and c are activated, the number 1 is obtained. If all sectors are activated, the number 8 is obtained.



Activation of sectors b and c



Activate all sectors

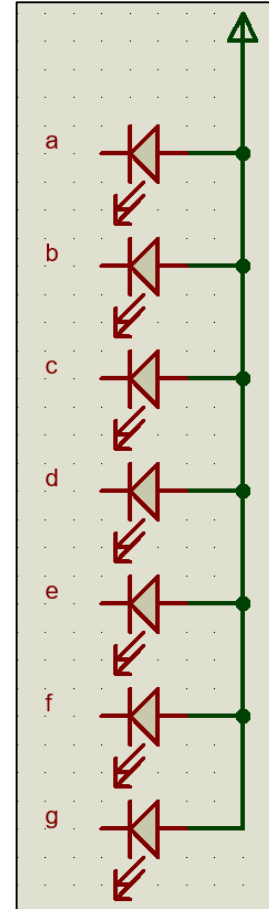
1. <https://lastminuteengineers.com/seven-segment-arduino-tutorial>

Module_1-1. Pins as outputs

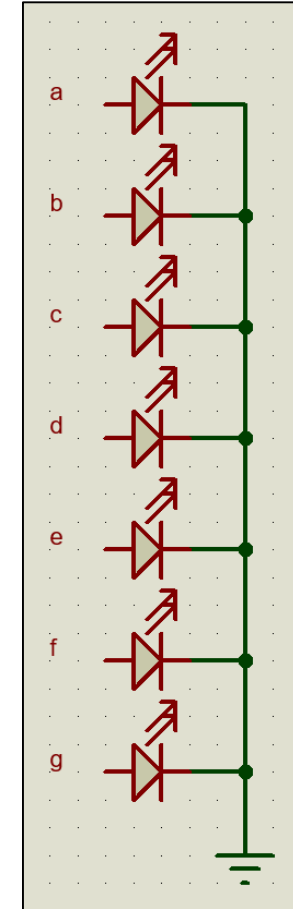
Seven segment display

A seven segment display can be a common anode or a common cathode. That is, all LEDs are connected to a common point, to which either Vcc or Gnd must be connected.

If the display is a common anode, in order to a segment be activated it must have a low voltage – “0” (Gnd). Similarly, if the display is a common cathode, in order to segment be activated it must have a high voltage – “1” (Vcc).



Common anode

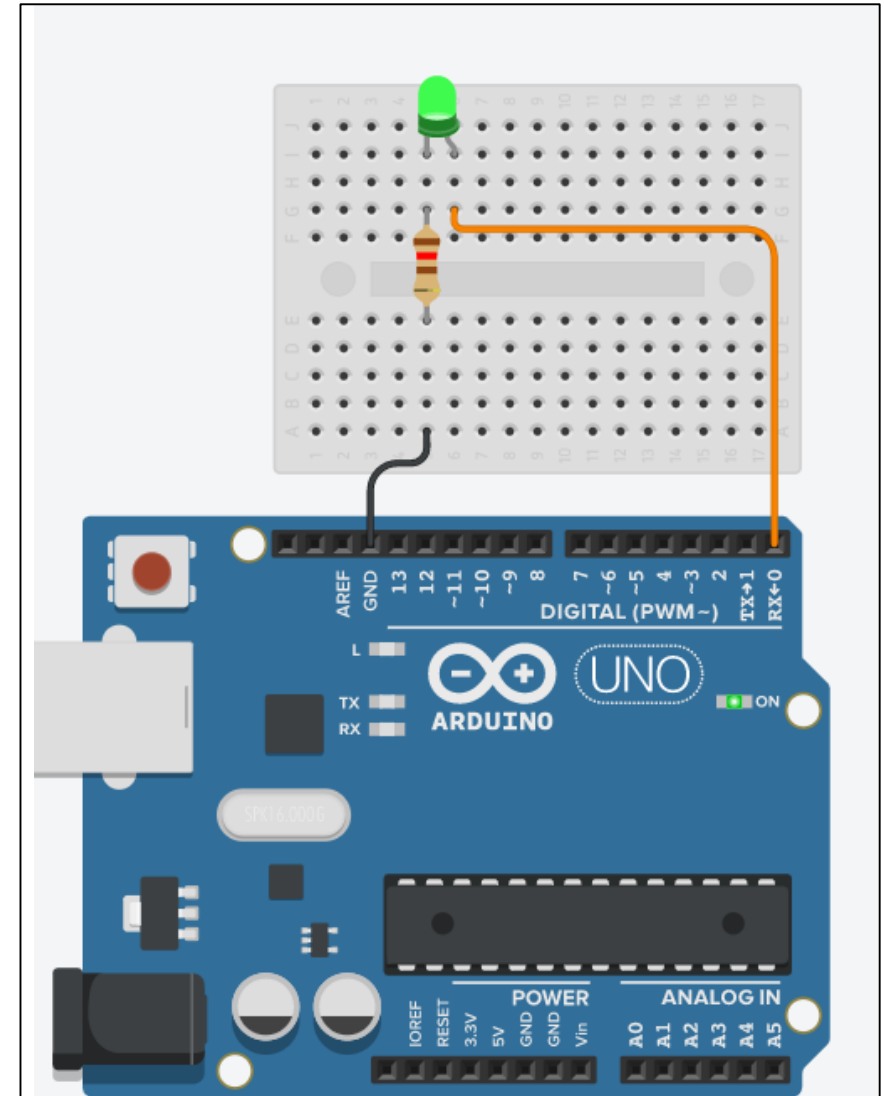


Common cathode

Module_1-1. Pins as outputs

Example

The example uses 1 LED at pin 0. Starting the Arduino Uno lights up the LED for one second, and then stays off for another second. This process is repeated by flashing the LED.



Module_1-1. Pins as outputs

Example

The code:

```
/* This example code is in the public domain.
```

```
https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink */
```

```
// the setup function runs once when you press reset or power the board
```

```
void setup()
```

```
{
```

```
  // initialize digital pin 0 as an output.
```

```
  pinMode(0, OUTPUT);
```

```
}
```

```
// the loop function runs over and over again forever
```

```
void loop()
```

```
{
```

```
  digitalWrite(0, HIGH); // turn the LED on (HIGH is the voltage level)
```

```
  delay(1000);           // wait for a second
```

```
  digitalWrite(0, LOW); // turn the LED off by making the voltage LOW
```

```
  delay(1000);          // wait for a second
```

```
}
```

ENGINE Partnership

- Warsaw University of Technology (PL) - *coordinator*
- IHU - International Hellenic University (GR)
- EDUMOTIVA - European Lab for Educational Technology (GR)
- University of Padova (IT)
- University of Applied Sciences in Tarnow (PL)



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