Electronics

Programming 103

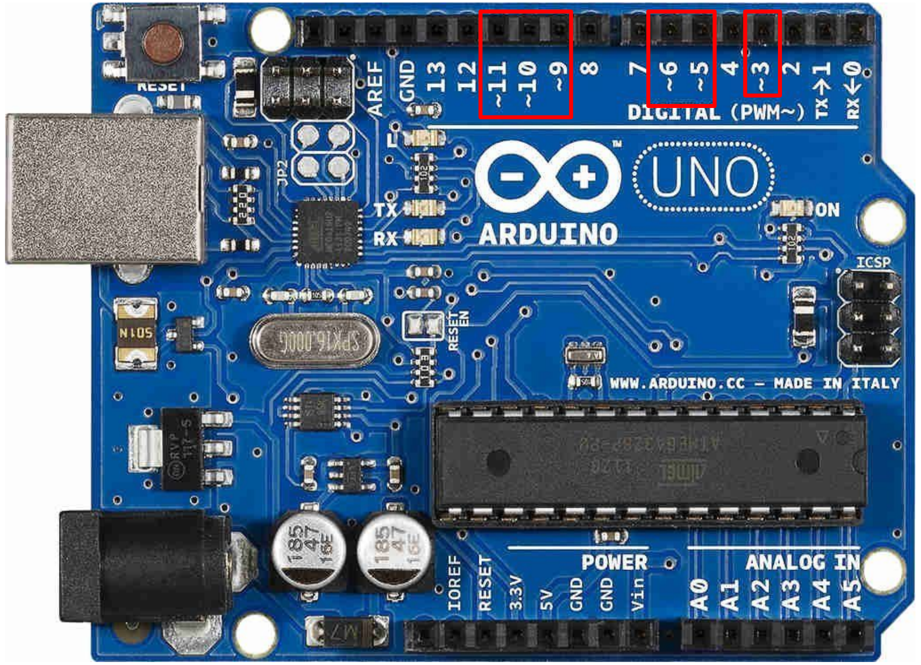
Danny Freedman 2023

Programming 103 >> PWM

Only digital pins with a '~' can be used as PWM.

On an arduino uno, these are:

3, 5, 6, 9, 10, 11.



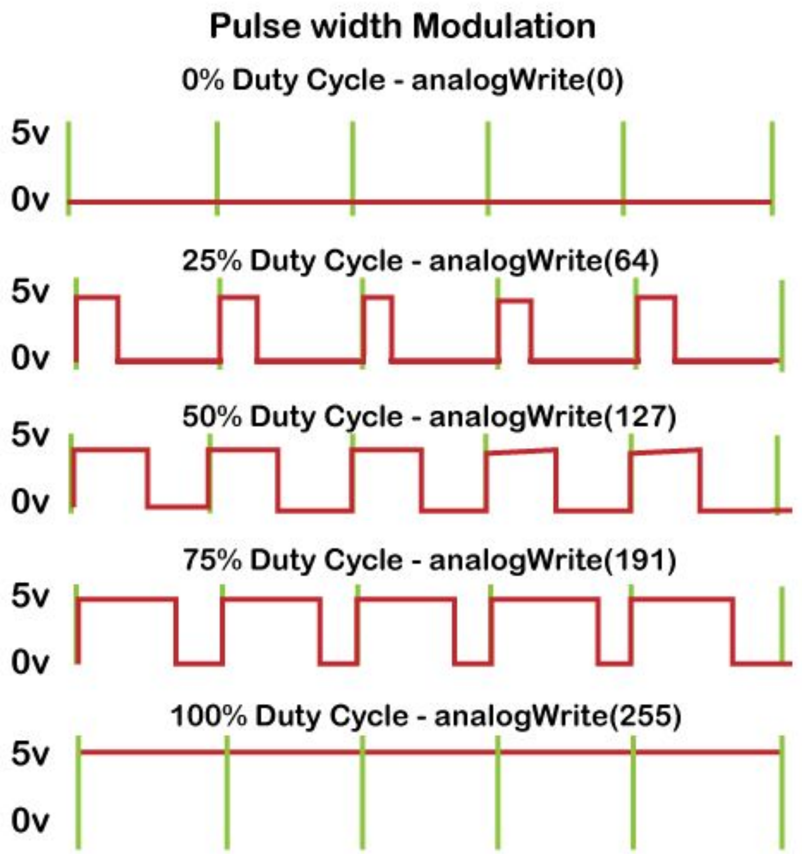
Programming 103 >> PWM

PWM is a trick to send an 'analog' signal through digital pin, for loads that can only work with 5V.

By quickly switching between 5V and 0V, we can get 256 different values.

These can be used to set the brightness of a LED, speed of a motor etc.

The syntax is similar to a usual analogWrite, but you can use a digital pin.
analogWrite(led_pin, 55);


Pulse width Modulation
0% Duty Cycle - analogWrite(0)
25% Duty Cycle - analogWrite(64)
50% Duty Cycle - analogWrite(127)
75% Duty Cycle - analogWrite(191)
100% Duty Cycle - analogWrite(255)
5v
0v

Danny Freedman 2023

Programming 103 >> PWM

For example, in this code, we use a for loop on a PWM pin to dim an LED on and off.

```
const int LED_pin = 3;

void setup() {
  pinMode(LED_pin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
for (int i=255; i>=10; i= i-1){
  analogWrite(LED_pin, i);
  delay(10);
  }

delay(100);

for (int i=10; i<=255; i++){
  analogWrite(LED_pin, i);
  delay(10);
  }
delay(100);
}
```

Programming 103 >> Flags

Flag are a concept in coding, where a variable is used to indicate the state of something or control whether or not something happens.

Flags will contain a boolean values.

We can use the ‘!’ to flip the value of the boolean when something occurs.

This example uses the pressing of a button the flip the value of the flag, which acts as an on/off button for the LED.

```
const int button_pin = 3;
bool button_state = false;
const int LED_pin = 4;

void setup() {
pinMode(button_pin, INPUT_PULLUP);
pinMode(LED_pin, OUTPUT);
}

void loop() {
 if (digitalRead(button_pin) == 0){
  button_state= !button_state;
}

if (button_state == true){
  digitalWrite(LED_pin, HIGH);
}
      else{
        digitalWrite(LED_pin, LOW);
      }
delay(100);
}
```

Danny Freedman 2023

Programming 103 >> Flags

Another example for the use of a flag is to execute something only once within the loop.

We'll switch the value inside the {statement}, and that way it will only run once whenever we restart the programme.

```
bool flashing_flag = false;

void loop() {
  // put your main code here, to run repeatedly:
if (flashing_flag == 0){
  digitalWrite(LED_pin, HIGH);
  delay(100);
  digitalWrite(LED_pin, LOW);
  delay(100);
  digitalWrite(LED_pin, HIGH);
  delay(100);
  digitalWrite(LED_pin, LOW);
  flashing_flag = true;
}
Rest of code…
```

Programming 103 >> For loop

For loops are used to execute
a piece of code for a specific
amount of times.
The syntax is:

```
for (initialization; condition; increment) {
  // statement(s);
}
```

Note the different parts are separated
with a ‘;’ sign.

Programming 103 >> For loop >> Initialization

The initialization happens once, and is usually used to set a variable.

We can declare a new variable, which will only exist in the scope of the loop, or use an existing one that was declared before.

In this case we declared an int variable i, with a starting value of 1.

Note that we then use the variable inside the statement: Serial.println(i);

```
void setup() {
          // put your setup code here, to run once:
          Serial.begin(9600);
          }

void loop() {
          // put your main code here, to run repeatedly:
          for (int i = 1; i<=5; i=i+1){
            Serial.println(i);
            delay(500);
                   }
          Serial.println("finished!");
          }
```

Programming 103 >> For loop >> Condition

The condition is tested each time through the loop. If it's TRUE, then the statement in the '{ }'is executed.

Once the condition is tested FALSE, the loop exists.

In this case we want the loop to execute as long an i is no greater than 5.

```
void setup() {
          // put your setup code here, to run once:
          Serial.begin(9600);
          }

void loop() {
          // put your main code here, to run repeatedly:
          for (int i = 1; i<=5; i=i+1){
            Serial.println(i);
            delay(500);
                   }
          Serial.println("finished!");
          }
```

Programming 103 >> For loop >> Increment

Increment is used to chance the value of the variable, so that at some point the condition is tested FALSE and the loop exits.

In this case, the variable i increases by 1 each iteration. Since this is most often the way the loop is used, there's a shortened way to increase or decrease by 1:
Instead of
i=i+1
We can write:
i++
or
i--

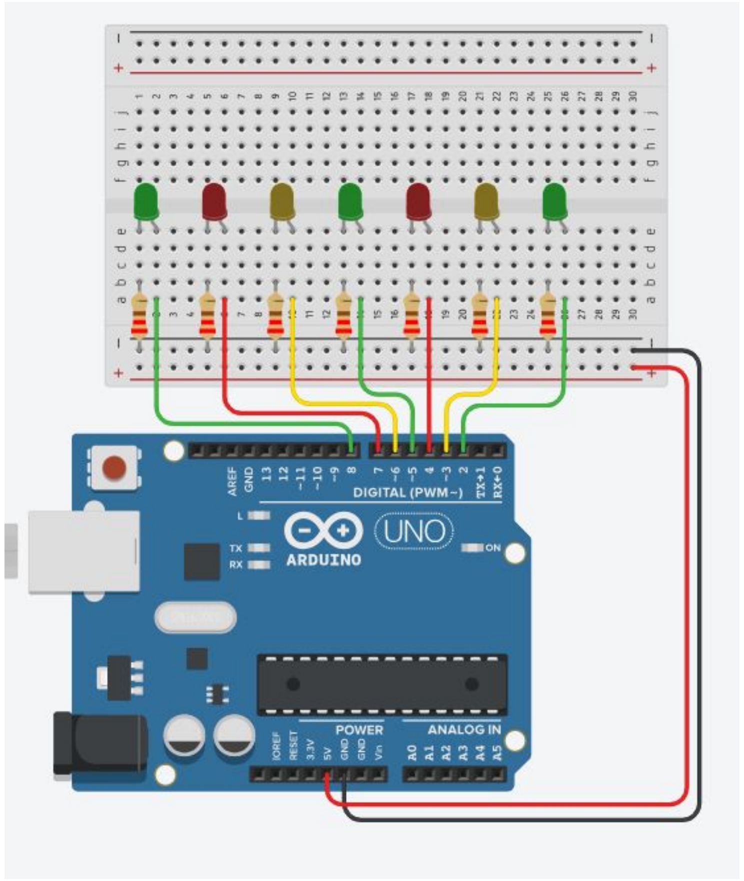
```
void setup() {
         // put your setup code here, to run once:
         Serial.begin(9600);
         }

void loop() {
         // put your main code here, to run repeatedly:
         for (int i = 1; i<=5; i=i+1){
           Serial.println(i);
           delay(500);
                  }
         Serial.println("finished!");
         }
```

Programming 103 >> For loop

```
void setup() {
        // put your setup code here, to run once:
            pinMode(2, OUTPUT);
            pinMode(3, OUTPUT);
            pinMode(4, OUTPUT);
            pinMode(5, OUTPUT);
            pinMode(6, OUTPUT);
            pinMode(7, OUTPUT);
            pinMode(8, OUTPUT);
            }

void loop() {
        // put your main code here, to run repeatedly:
            digitalWrite(2, HIGH);
            delay(500);
            digitalWrite(3, HIGH);
            delay(500);
            digitalWrite(4, HIGH);
            …
```



Danny Freedman 2023

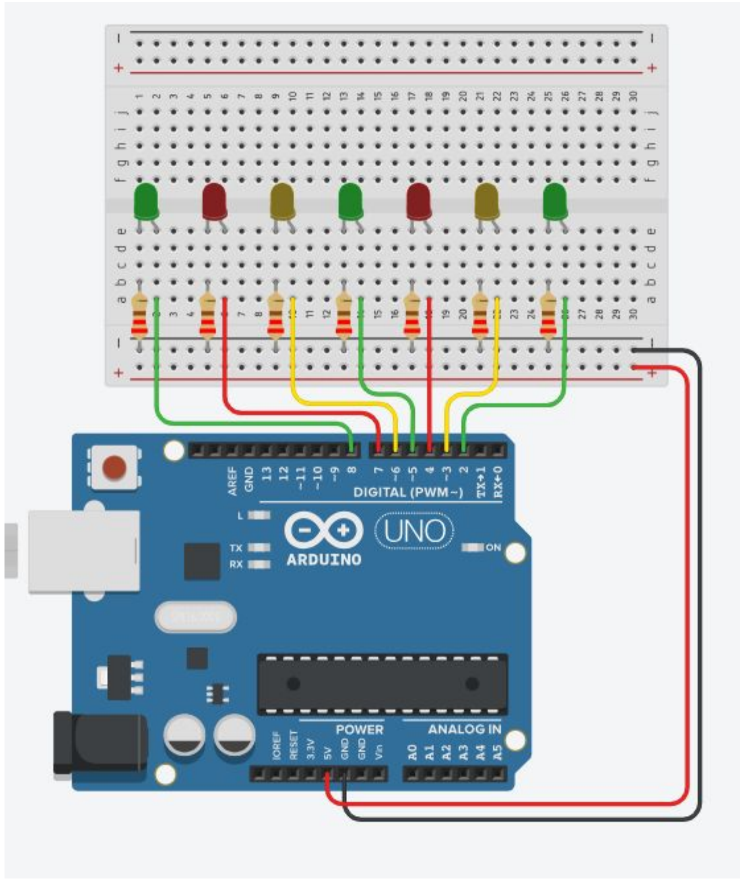
Programming 103 >> For loop

```
int num_of_leds = 7;
int first_pin = 2;

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

      for (int i=first_pin; i<= first_pin+num_of_leds; i++ ){
            pinMode(i, OUTPUT);
          }
    }

void loop() {
       // put your main code here, to run repeatedly:
     for (int i=2; i< i+num_of_leds; i++ ){
            digitalWrite(i, HIGH);
            delay(500);
            }
    }
```



Programming 103 >> Libraries

Libraries are used to extend the use of arduino with hardware or operation-specific functionality.

Some libraries are already included in the IDE.

To include a library in a sketch, the syntax is:

```
#include <Name_of_library.h>
```

For example:

```
#include <Servo.h>
```

Programming 103 >> Libraries >> Syntax

Most libraries include a functionality called objects.

We need to declare this object the same way we declare variables:

```
Servo myservo;
```

We then use the library functions using this variable name:

```
myservo.attach(9);
```

Programming 103 >> Libraries >> Syntax

Notice that the syntax of a function from a library will include the a '.' in between the name of the library/ object and the function name.

We saw this in
Serial.begin()

Because we are effectively using the Serial library.