



# Armstrong

## School Program 2023-2024

### Orientation Session



# Armstrong

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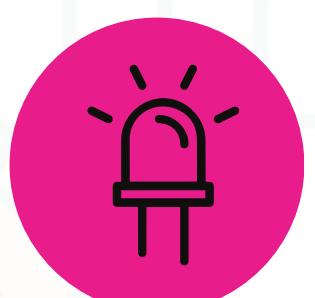
<https://armstrongedu.com/>



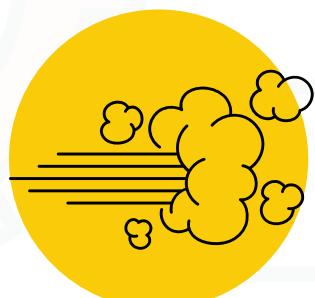
# Lesson Content



**Revising motor movement**



**PWM**



**Control speed**



# Remember

How to move wheel forward and backwards?

## Pins:

- Enable -> D10
- Input 1 -> A1 (15)
- Input2 -> A2 (16)





# Remember

## How to move wheel forward and backwards?

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(9, OUTPUT); //back right motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //setting all PWM pins to HIGH  
    digitalWrite(5, HIGH);  
    digitalWrite(6, HIGH);  
    digitalWrite(9, HIGH);  
    digitalWrite(10, HIGH);
```

```
//defining motors directions pin  
pinMode(7, OUTPUT); //back left motor pin 1  
pinMode(8, OUTPUT); //back left motor pin 2  
  
pinMode(11, OUTPUT); //front left motor pin 1  
pinMode(12, OUTPUT); //front left motor pin 2  
  
pinMode(13, OUTPUT); //back right motor pin 1  
pinMode(A0, OUTPUT); //back right motor pin 2  
  
pinMode(A1, OUTPUT); //front right motor pin 1  
pinMode(A2, OUTPUT); //front right motor pin 2  
}
```



# Remember

## How to move wheel forward and backwards?

```
void loop() {  
    //////////////forward/////////  
    //Back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //back right motor forward  
    digitalWrite(13, HIGH);  
    digitalWrite(A0, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
  
    delay(2500);
```

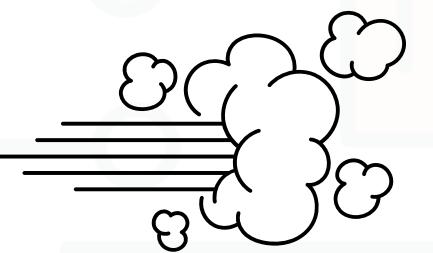
```
//////////stop/////////  
//Back left motor stop  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
//front left motor stop  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//back right motor stop  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor stop  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
  
delay(100);
```

```
//////////Backward/////////  
//Back left motor backward  
digitalWrite(7, LOW);  
digitalWrite(8, HIGH);  
//front left motor backward  
digitalWrite(11, LOW);  
digitalWrite(12, HIGH);  
//back right motor backward  
digitalWrite(13, LOW);  
digitalWrite(A0, HIGH);  
//front right motor backward  
digitalWrite(A1, LOW);  
digitalWrite(A2, HIGH);  
  
delay(2500);
```

```
//////////stop/////////  
//Back left motor stop  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
//front left motor stop  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//back right motor stop  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor stop  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
  
delay(100);
```

# Think

## How can we control robot's speed?

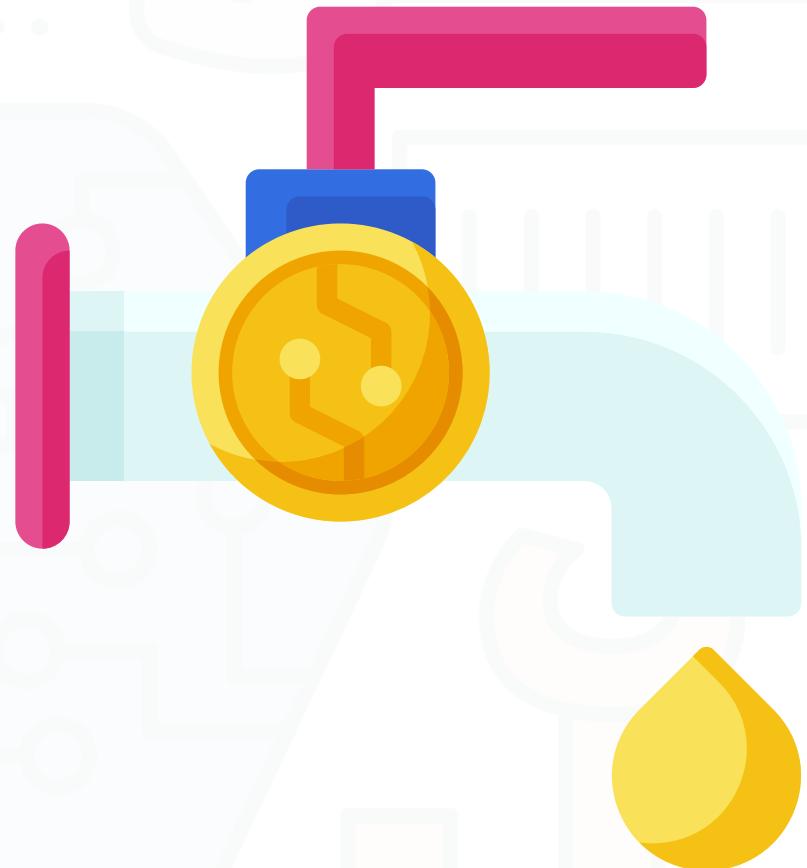


# Analogy ≡

Imagine you have a faucet that can only be fully open or fully closed.

**How can you control how much water comes out?**

By turning the faucet on and off very quickly.



# Analogy ≡

If you have to fill a bucket by turning the faucet on and off:

**How can you get a small amount of water?**

if you turn it on for a short time and then off for a long time.

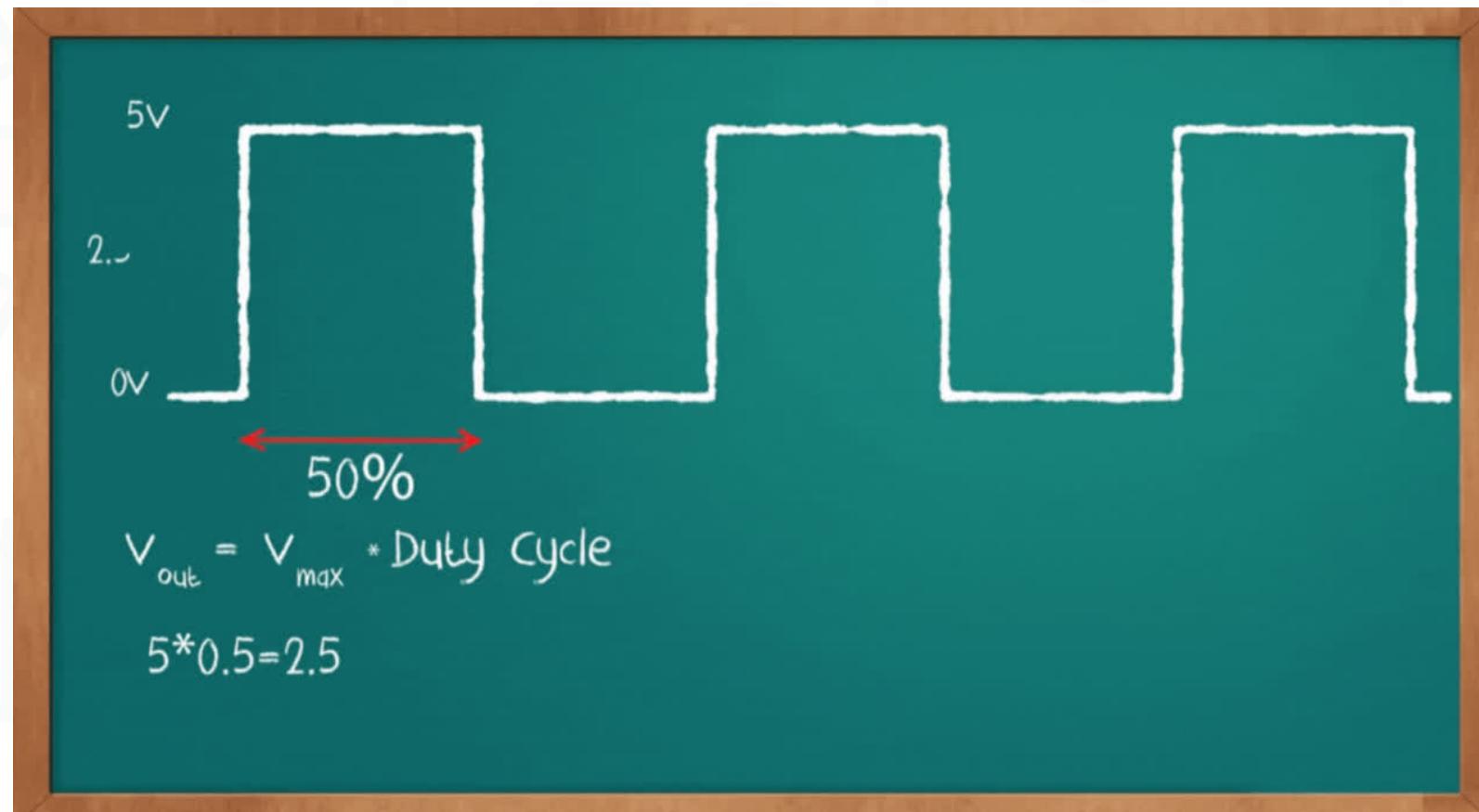


**How can you get a bigger amount?**

If you turn the faucet on for a long time and then off for a short time, you will get more water.

# Analogy ≡

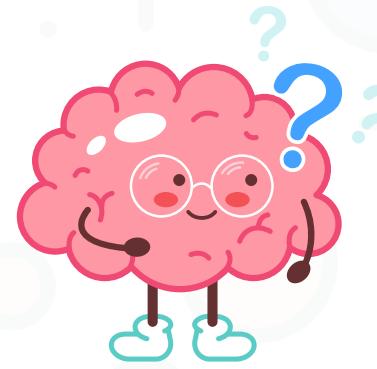
The amount of water that comes out depends on how long the faucet is on compared to how long it is off. This is called the **duty cycle**.



## Duty cycle

The duty cycle is like the brightness of an LED. If the LED is on for a long time and then off for a short time, it will be brighter than if it is on for a short time and then off for a long time.

# Think



If the switch is on for a long time and then off for a short time, the light bulb will be bright. If the switch is on for a short time and then off for a long time, the light bulb will be dim.

Can you see the flickering of the light?

# Think



If the switch is on for a long time and then off for a short time, the light bulb will be bright. If the switch is on for a short time and then off for a long time, the light bulb will be dim.

**Can you see the flickering of the light?**

The human eye cannot see the flickering of the light, but it can perceive the average brightness.

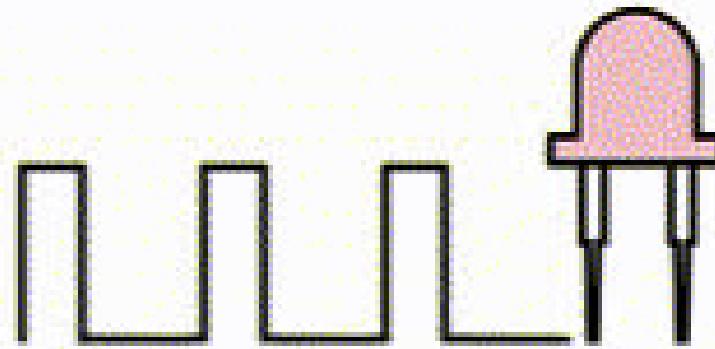
# PWM

**What does PWM stands for?**

Pulse width modulation.

**What is PWM?**

PWM is a way to control the amount of electricity that goes to a device by turning it on and off very quickly, like a water faucet.

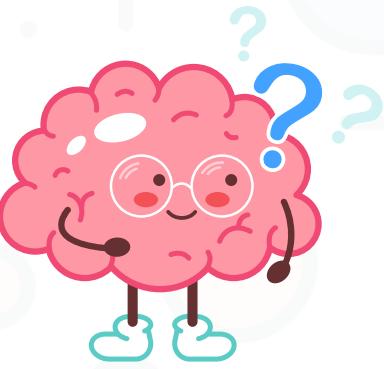


# Think

## Applications of PWM?

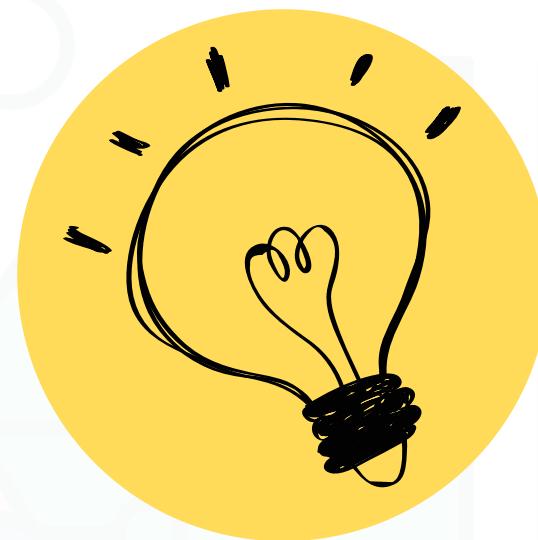
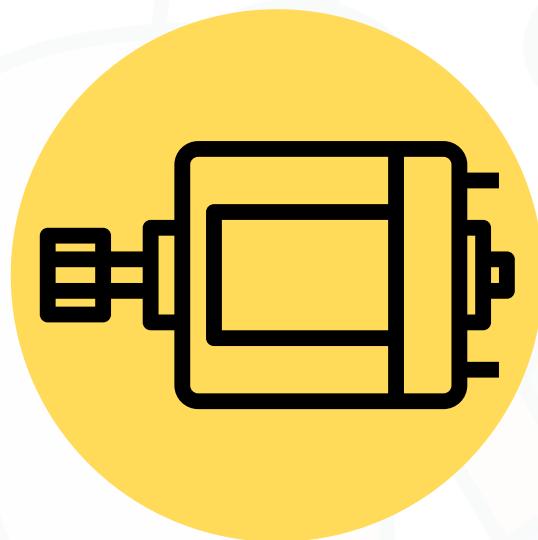
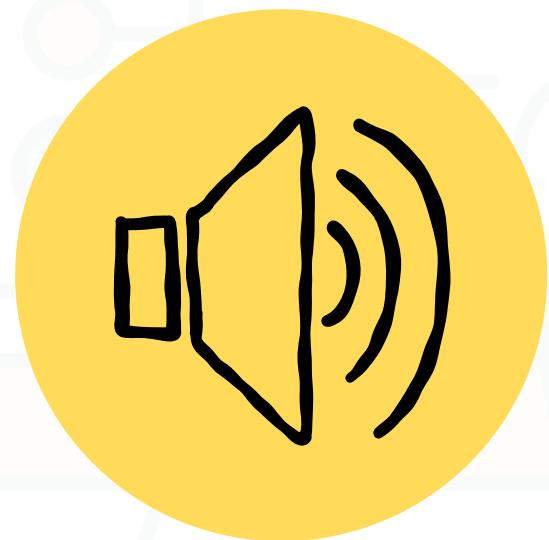


# Think

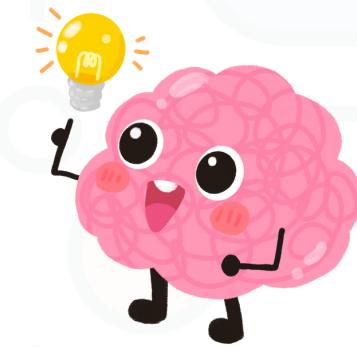


## Applications of PWM

PWM can be used for various purposes, such as dimming an LED, producing audio signals, or controlling motor's speed.



# Conclusion

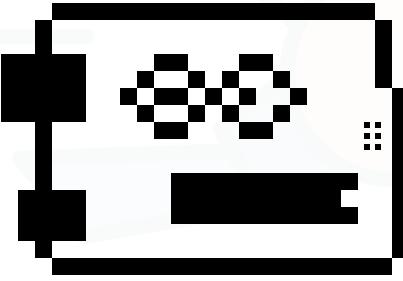


## What do we conclude?

We can use the enable pin PWM to control ←  
wheel's speed in a certain way.

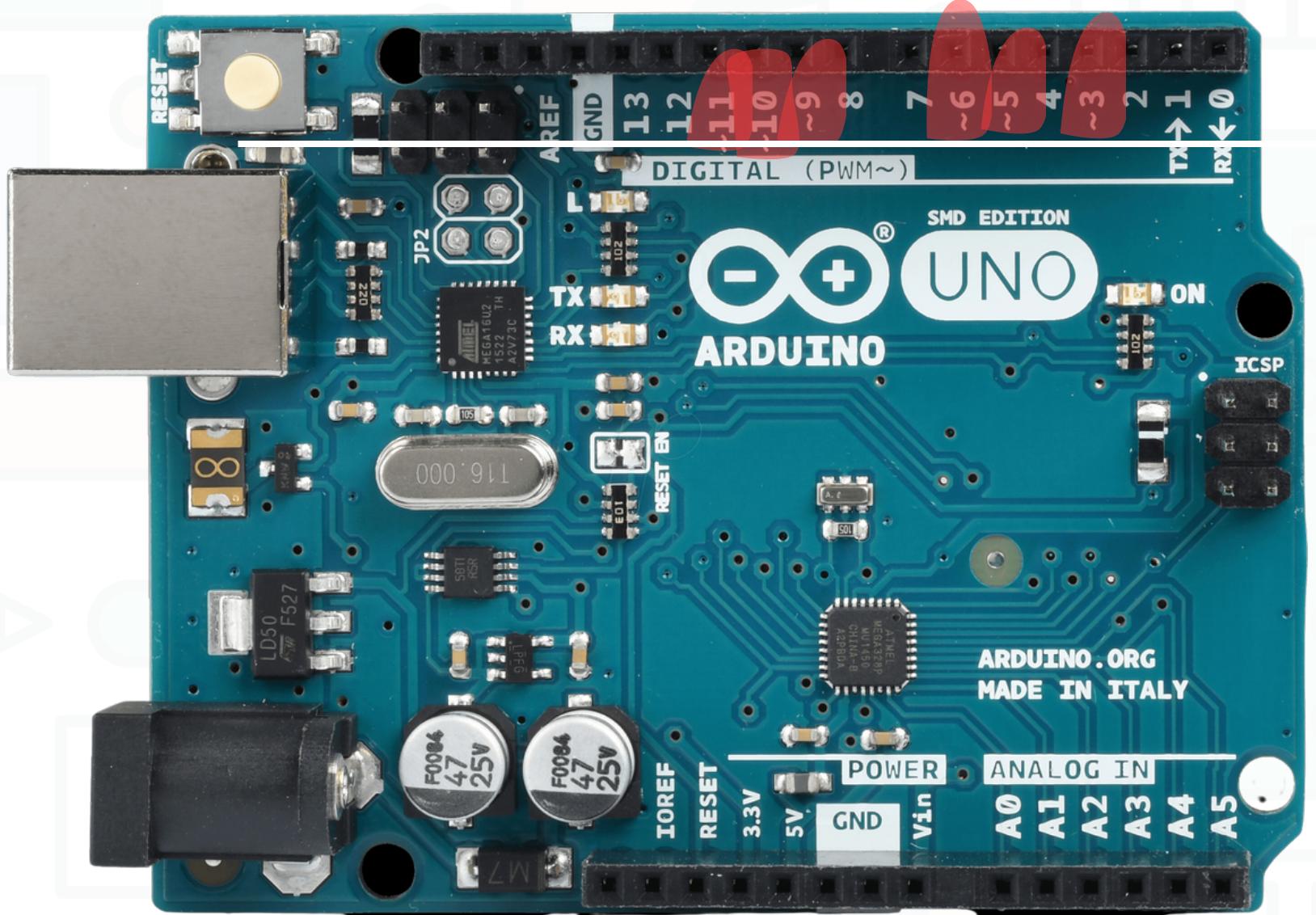
```
void setup() {  
    //define motors PWM pins  
    pinMode(6, OUTPUT); //front left motor PWM pin  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    //setting motor speed to 70/255  
    analogWrite(6, 70);  
}
```

# PWM on Arduino



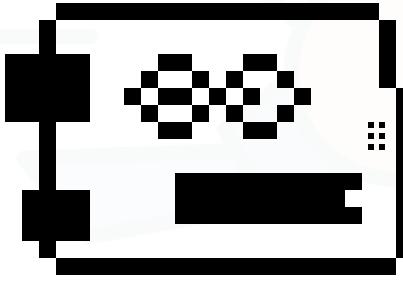
## PWM pins

The PWM pins on Arduino are labeled with a ~ sign.



PWM pins are 3, 5, 6, 9, 10, 11.

# PWM on Arduino



## How to write the code



```
void setup() {  
    pinMode(5, OUTPUT);  
}
```

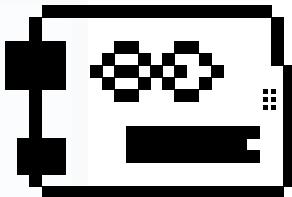
PWM pins 3, 5, 6, 9, 10, 11.

```
void loop() {  
    analogWrite(3, 0);
```

number between 0 and 255

# Note

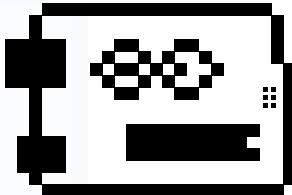
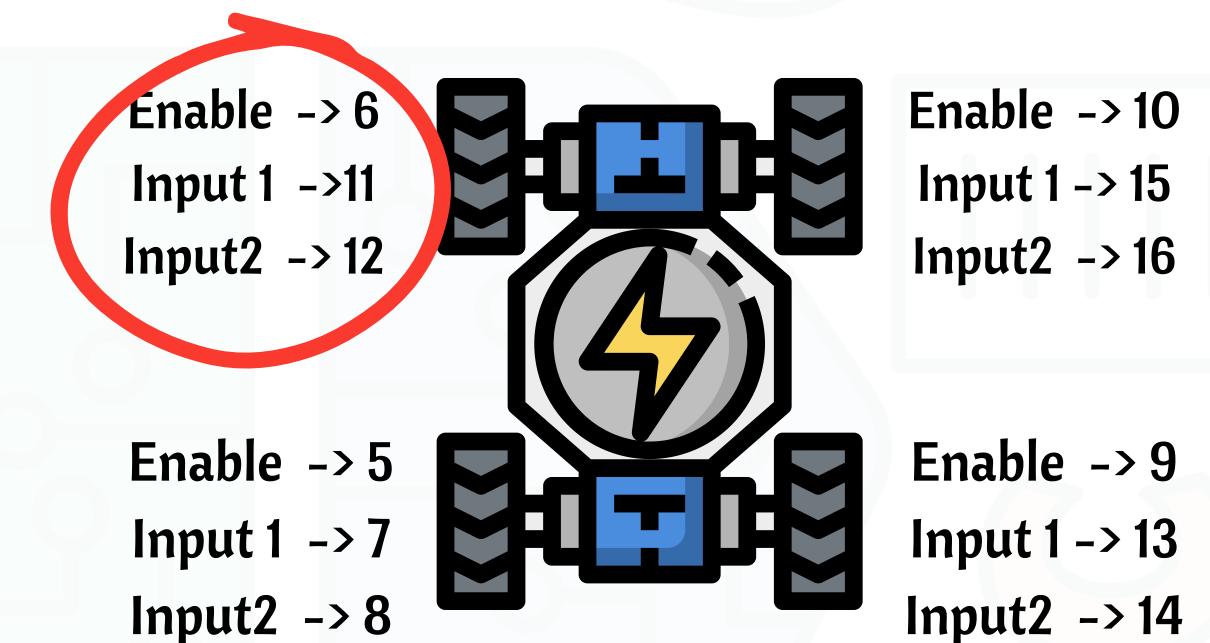
MOTOR	WHEEL	DIRECTION	SPEED
MOTOR 1	Back left wheel	D7, D8	D5
MOTOR 2	Front left wheel	D11, D12	D6
MOTOR 3	Back right wheel	D13, A0(14)	D9
MOTOR 4	Front right wheel	A1(15), A2(16)	D10



# Code

**Step 1: Write code to move first wheel forward with speed**

**Try it by yourself**

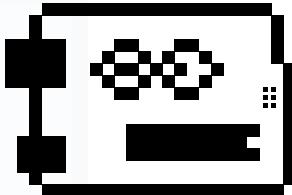
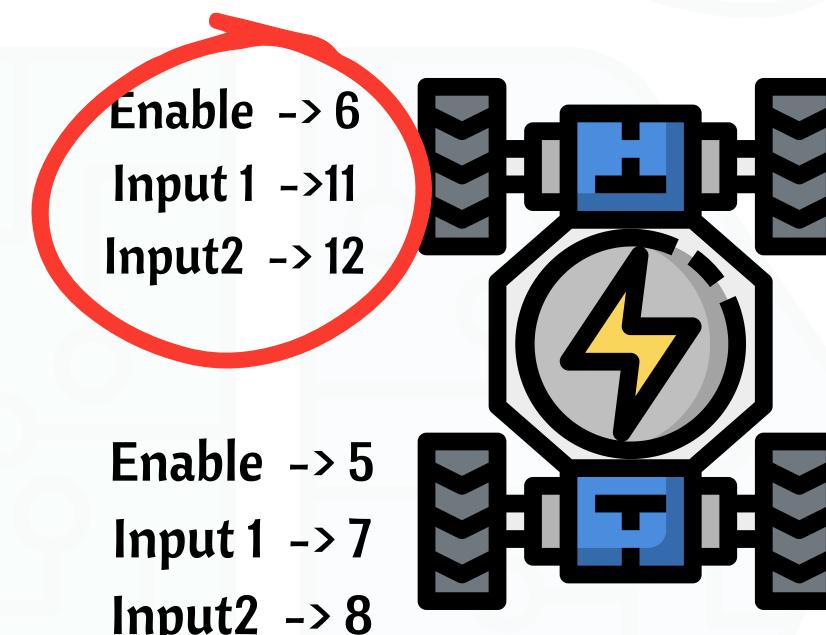


# Code



## Step 1: Write code to move first wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(6, OUTPUT); //front left motor PWM pin  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    //setting motor speed to 70/255  
    analogWrite(6, 70);  
}
```



# Code

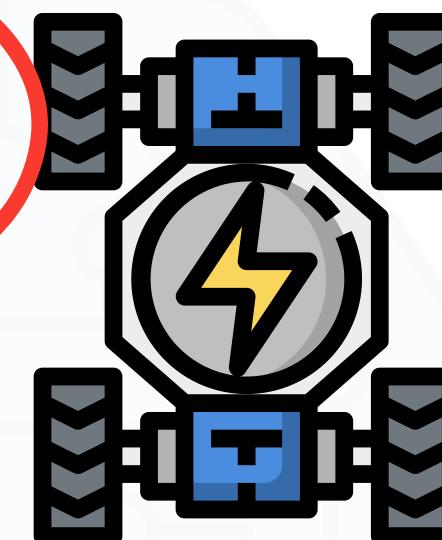


## Step 1: Write code to move first wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(6, OUTPUT); //front left motor PWM pin  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    //setting motor speed to 70/255  
    analogWrite(6, 70);  
}
```

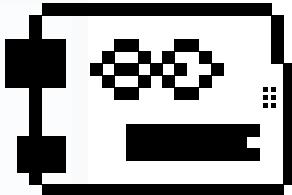
```
void loop() {  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
}
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

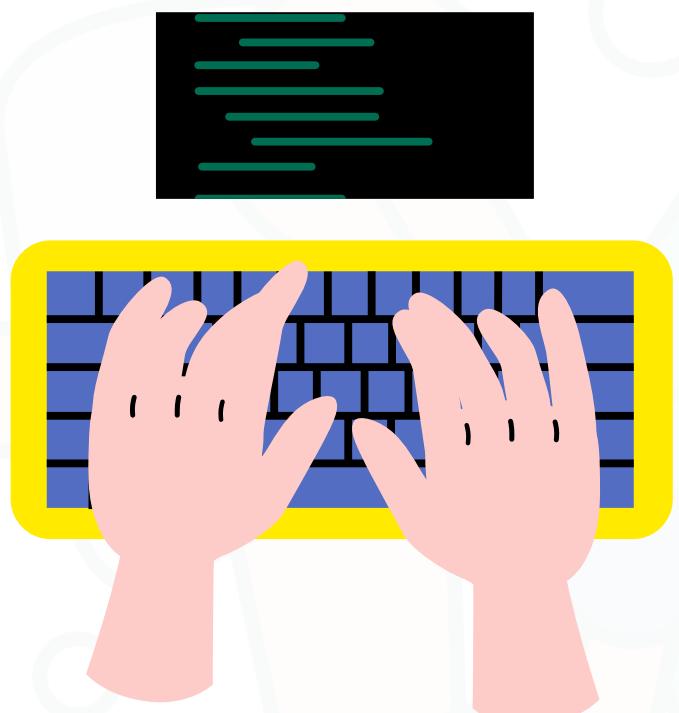
Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

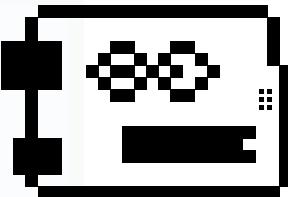
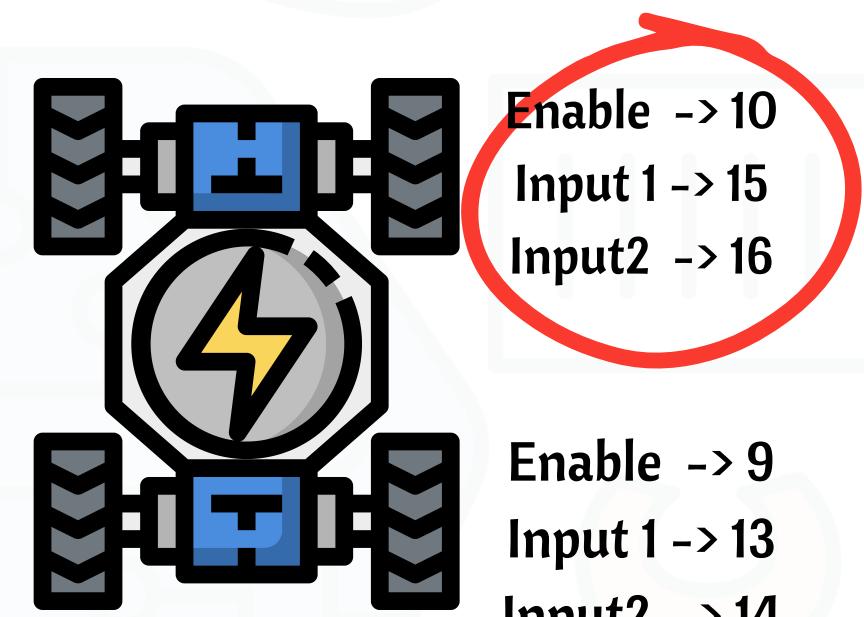
**Step 2: Write code to move second wheel forward with speed**

Try it by yourself



Enable -> 6  
Input 1 ->11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



# Code

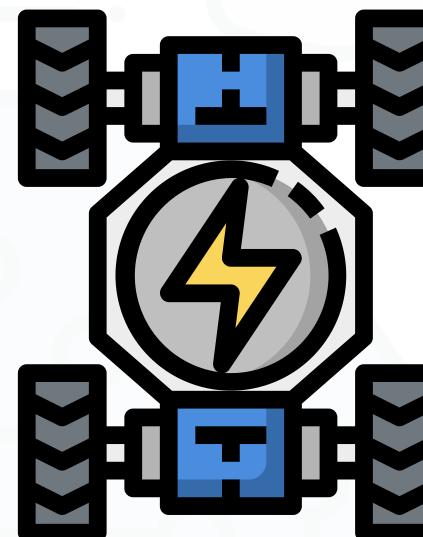


## Step 2: Write code to move second wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(6, 70);  
    analogWrite(10, 70);  
}
```

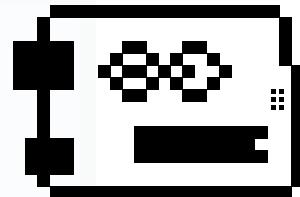
Enable -> 6  
Input 1 -> 11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



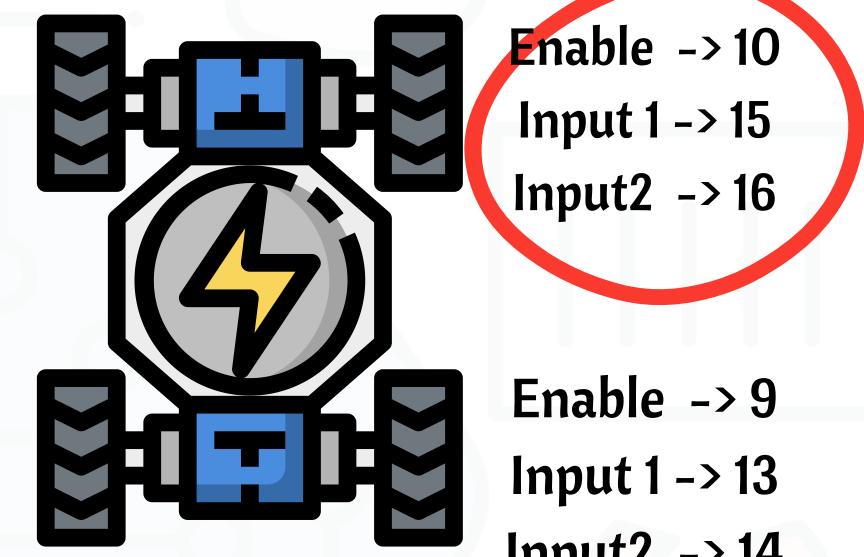
# Code



## Step 2: Write code to move second wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(6, 70);  
    analogWrite(10, 70);  
}
```

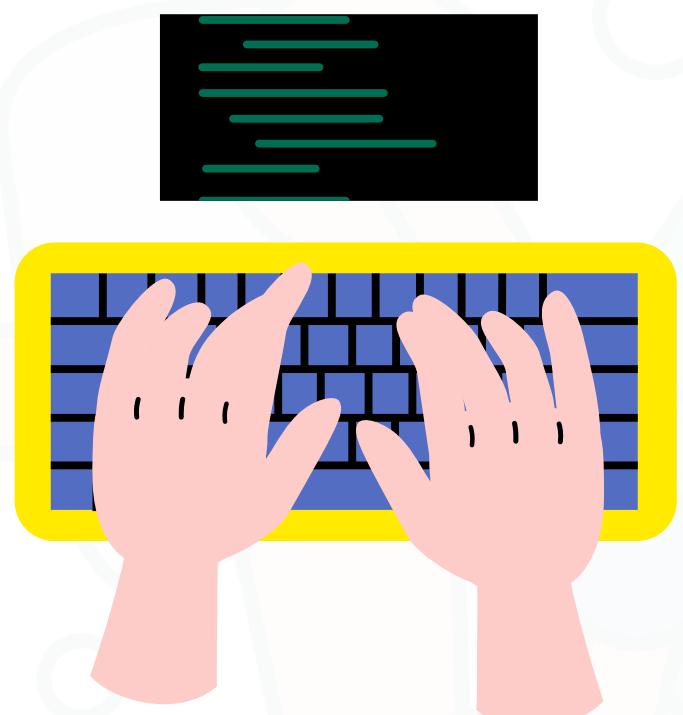
```
void loop() {
    //front left motor forward
    digitalWrite(11, HIGH);
    digitalWrite(12, LOW);
    //front right motor forward
    digitalWrite(A1, HIGH);
    digitalWrite(A2, LOW);
}
```



# Code

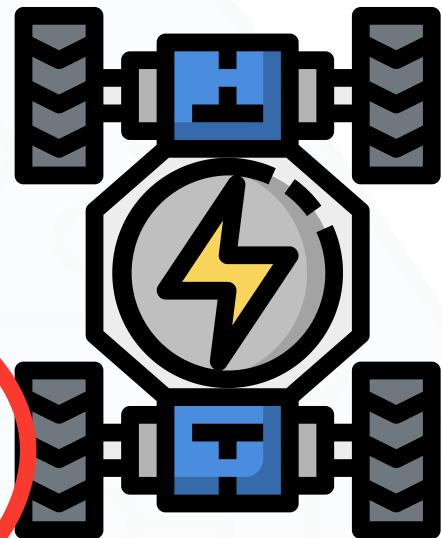
**Step 3: Write code to move third wheel forward with speed**

Try it by yourself



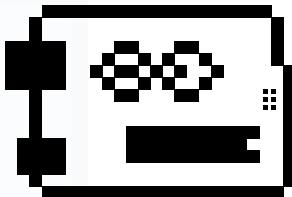
Enable -> 6  
Input 1 -> 11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14

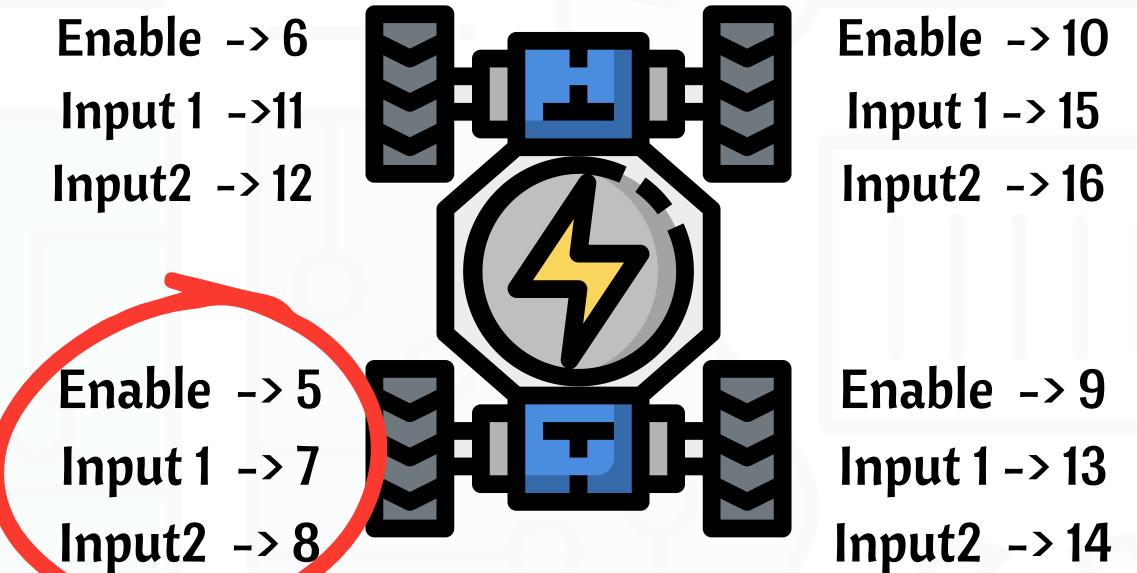
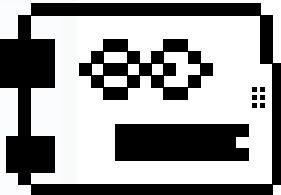


# Code



## Step 3: Write code to move third wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(7, OUTPUT); //back left motor pin 1  
    pinMode(8, OUTPUT); //back left motor pin 2  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(10, 70);  
}
```



# Code



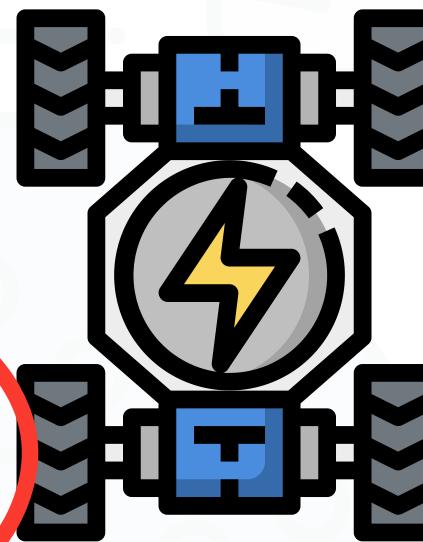
## Step 3: Write code to move third wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(7, OUTPUT); //back left motor pin 1  
    pinMode(8, OUTPUT); //back left motor pin 2  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(10, 70);  
}  
}
```

```
void loop() {  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
    //back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
}
```

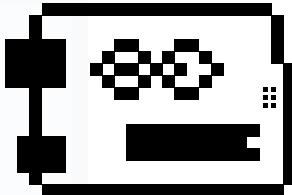
Enable -> 6  
Input 1 -> 11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

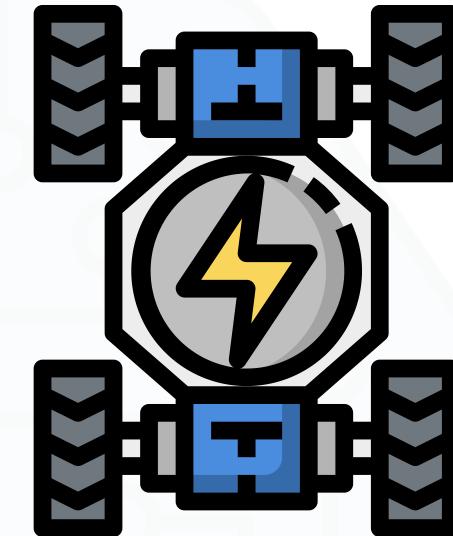
**Step 4: Write code to move forth wheel forward with speed**

Try it by yourself



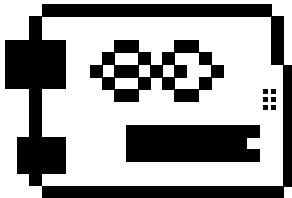
Enable -> 6  
Input 1 ->11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



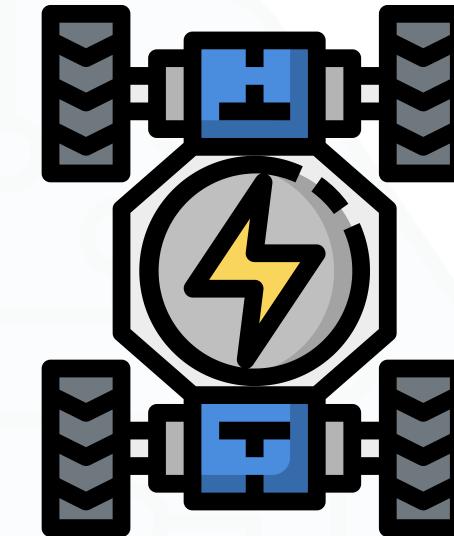
# Code



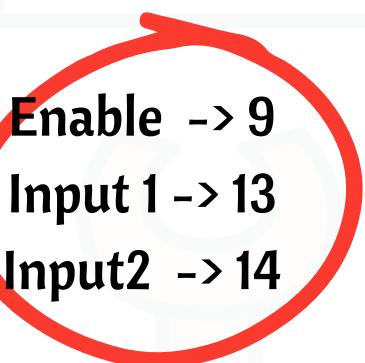
## Step 4: Write code to move forth wheel forward with speed

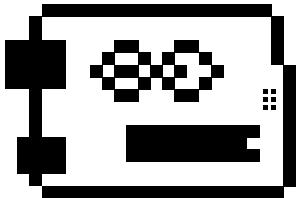
```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(9, OUTPUT); //back right motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(7, OUTPUT); //back left motor pin 1  
    pinMode(8, OUTPUT); //back left motor pin 2  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(13, OUTPUT); //back right motor pin 1  
    pinMode(A0, OUTPUT); //back right motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(9, 70);  
    analogWrite(10, 70);  
}
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12



Enable -> 10  
Input 1 -> 15  
Input2 -> 16





# Code



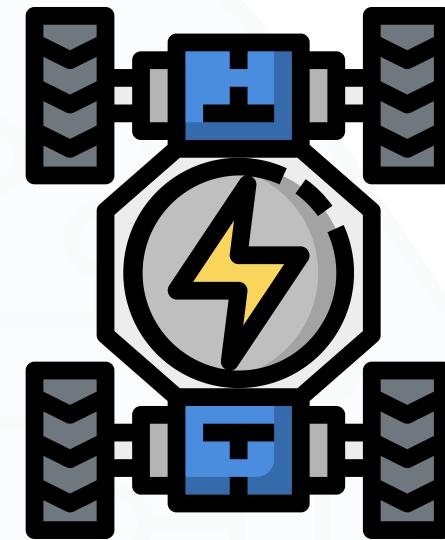
## Step 4: Write code to move forth wheel forward with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(9, OUTPUT); //back right motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
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    pinMode(7, OUTPUT); //back left motor pin 1  
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    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(13, OUTPUT); //back right motor pin 1  
    pinMode(A0, OUTPUT); //back right motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(9, 70);  
    analogWrite(10, 70);  
}  
 
```

```
void loop() {  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //Back right motor forward  
    digitalWrite(13, HIGH);  
    digitalWrite(A0, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
    //back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
}
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12

Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14

# Code

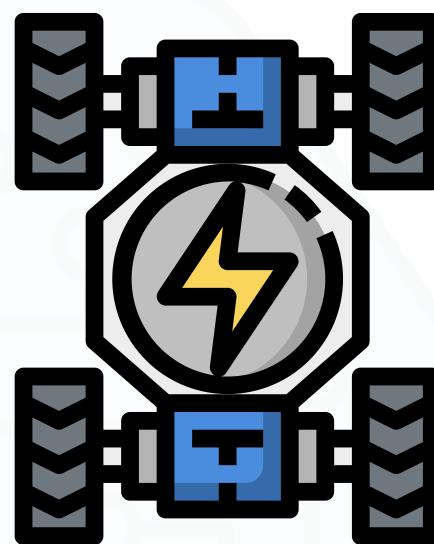
**Step 5: Write code to move robot backwards with speed**

**Try it by yourself**



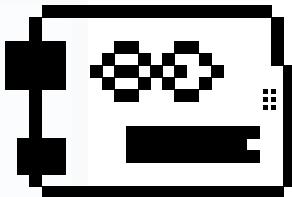
Enable -> 6  
Input 1 ->11  
Input2 -> 12

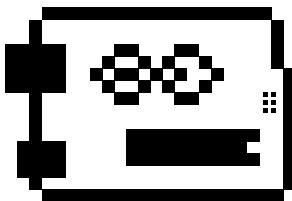
Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14





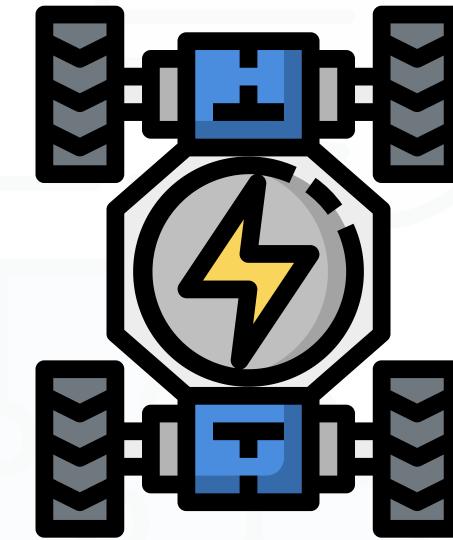
# Code



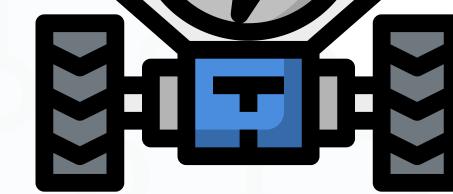
## Step 5: Write code to move robot backwards with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(9, OUTPUT); //back right motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(7, OUTPUT); //back left motor pin 1  
    pinMode(8, OUTPUT); //back left motor pin 2  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(13, OUTPUT); //back right motor pin 1  
    pinMode(A0, OUTPUT); //back right motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(9, 70);  
    analogWrite(10, 70);  
}
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12

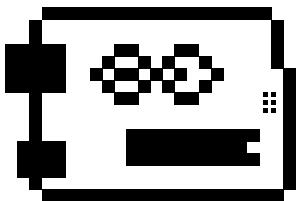


Enable -> 5  
Input 1 -> 7  
Input2 -> 8



Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

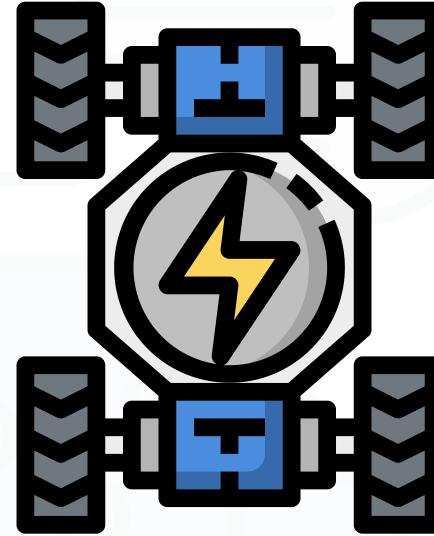


## Step 5: Write code to move robot backwards with speed

```
void setup() {  
    //define motors PWM pins  
    pinMode(5, OUTPUT); //back left motor PWM pin  
    pinMode(6, OUTPUT); //front left motor PWM pin  
    pinMode(9, OUTPUT); //back right motor PWM pin  
    pinMode(10, OUTPUT); //front right motor PWM pin  
  
    //defining motors directions pin  
    pinMode(7, OUTPUT); //back left motor pin 1  
    pinMode(8, OUTPUT); //back left motor pin 2  
  
    pinMode(11, OUTPUT); //front left motor pin 1  
    pinMode(12, OUTPUT); //front left motor pin 2  
  
    pinMode(13, OUTPUT); //back right motor pin 1  
    pinMode(A0, OUTPUT); //back right motor pin 2  
  
    pinMode(A1, OUTPUT); //front right motor pin 1  
    pinMode(A2, OUTPUT); //front right motor pin 2  
  
    //setting motors speeds to 70/255  
    analogWrite(5, 70);  
    analogWrite(6, 70);  
    analogWrite(9, 70);  
    analogWrite(10, 70);  
}  
 
```

```
void loop() {  
    //////////////forward/////////////  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //Back right motor forward  
    digitalWrite(13, HIGH);  
    digitalWrite(A0, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
    //back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
  
    delay(2000);  
}
```

Enable -> 6  
Input 1 -> 11  
Input 2 -> 12

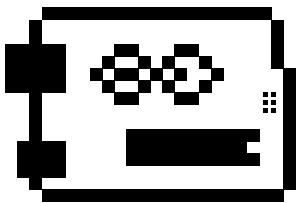


Enable -> 10  
Input 1 -> 15  
Input 2 -> 16

Enable -> 5  
Input 1 -> 7  
Input 2 -> 8



Enable -> 9  
Input 1 -> 13  
Input 2 -> 14



# Code

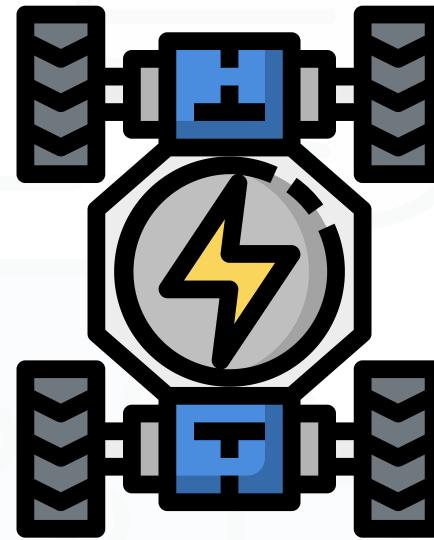


## Step 5: Write code to move robot backwards with speed

```
void loop() {  
    //forward  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //Back right motor forward  
    digitalWrite(13, HIGH);  
    digitalWrite(A0, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
    //back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
  
    delay(2000);
```



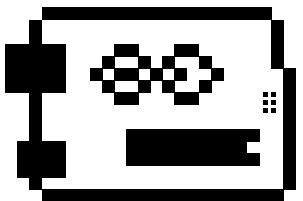
Enable -> 6  
Input 1 -> 11  
Input2 -> 12



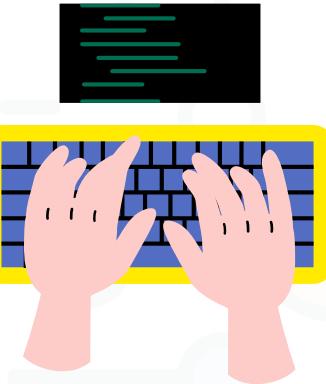
Enable -> 5  
Input 1 -> 7  
Input2 -> 8

Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

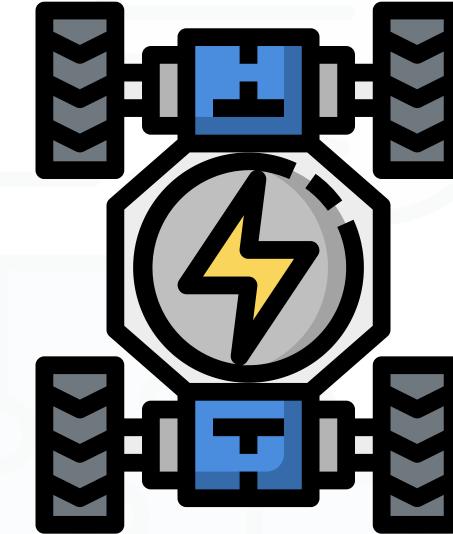


## Step 5: Write code to move robot backwards with speed

```
void loop() {  
    //forward  
    //front left motor forward  
    digitalWrite(11, HIGH);  
    digitalWrite(12, LOW);  
    //Back right motor forward  
    digitalWrite(13, HIGH);  
    digitalWrite(A0, LOW);  
    //front right motor forward  
    digitalWrite(A1, HIGH);  
    digitalWrite(A2, LOW);  
    //back left motor forward  
    digitalWrite(7, HIGH);  
    digitalWrite(8, LOW);  
  
    delay(2000);
```

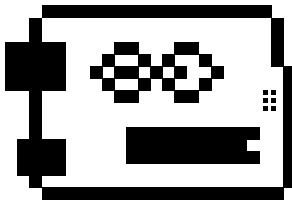
```
//////////stop/////////  
//front left motor forward  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//Back right motor forward  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor forward  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
//back left motor forward  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
  
delay(100);
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12

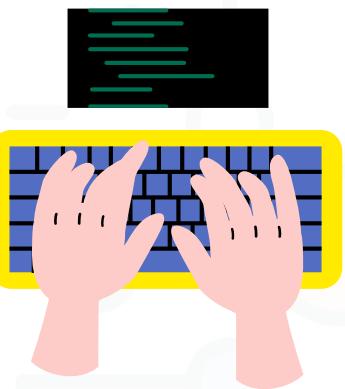


Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

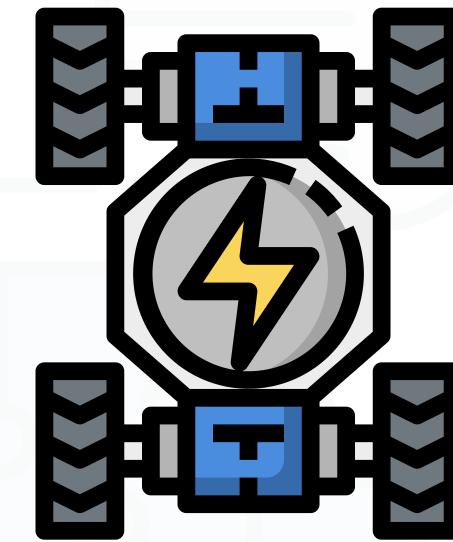


## Step 5: Write code to move robot backwards with speed

```
//////////stop/////////  
//front left motor foraward  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//Back right motor foraward  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor foraward  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
//back left motor foraward  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
  
delay(100);
```



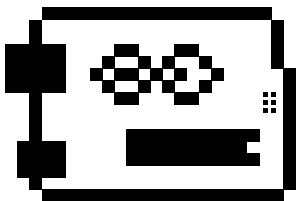
Enable -> 6  
Input 1 ->11  
Input2 -> 12



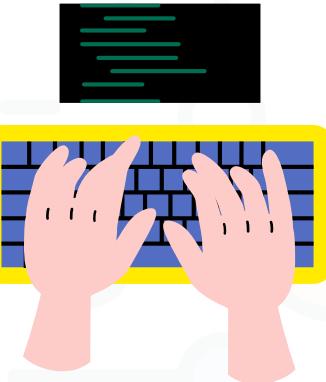
Enable -> 5  
Input 1 -> 7  
Input2 -> 8

Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

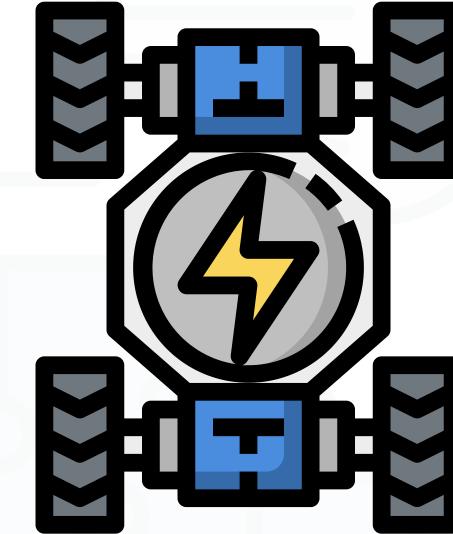


## Step 5: Write code to move robot backwards with speed

```
//////////stop/////////  
//front left motor foraward  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//Back right motor foraward  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor foraward  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
//back left motor foraward  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
  
delay(100);
```

```
//////////backward/////////  
//front left motor backward  
digitalWrite(11, HIGH);  
digitalWrite(12, LOW);  
//Back right motor backward  
digitalWrite(13, HIGH);  
digitalWrite(A0, LOW);  
//front right motor backward  
digitalWrite(A1, HIGH);  
digitalWrite(A2, LOW);  
//back left motor backward  
digitalWrite(7, HIGH);  
digitalWrite(8, LOW);  
  
delay(2000);
```

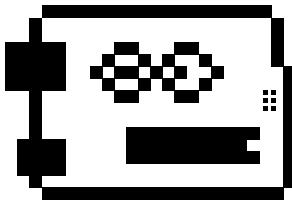
Enable -> 6  
Input 1 -> 11  
Input2 -> 12



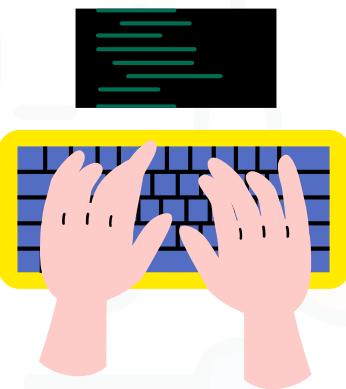
Enable -> 5  
Input 1 -> 7  
Input2 -> 8

Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



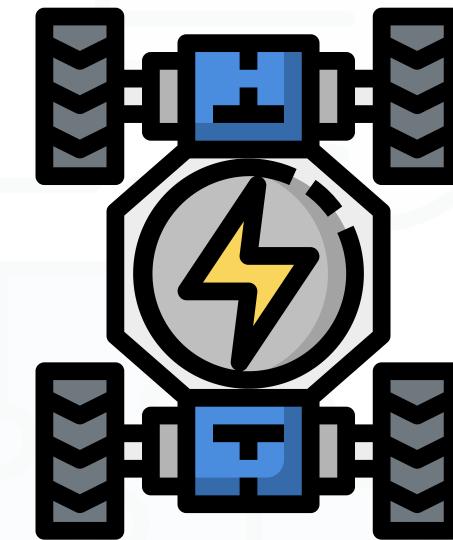
# Code



## Step 5: Write code to move robot backwards with speed

```
////////backward/////////  
//front left motor backward  
digitalWrite(11, LOW);  
digitalWrite(12, HIGH);  
//Back right motor backward  
digitalWrite(13, LOW);  
digitalWrite(A0, HIGH);  
//front right motor backward  
digitalWrite(A1, LOW);  
digitalWrite(A2, HIGH);  
//back left motor backward  
digitalWrite(7, LOW);  
digitalWrite(8, HIGH);  
  
delay(2000);
```

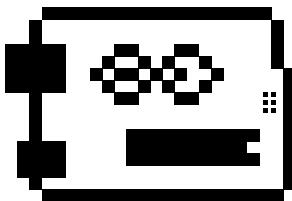
Enable -> 6  
Input 1 ->11  
Input2 -> 12



Enable -> 5  
Input 1 -> 7  
Input2 -> 8

Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Code

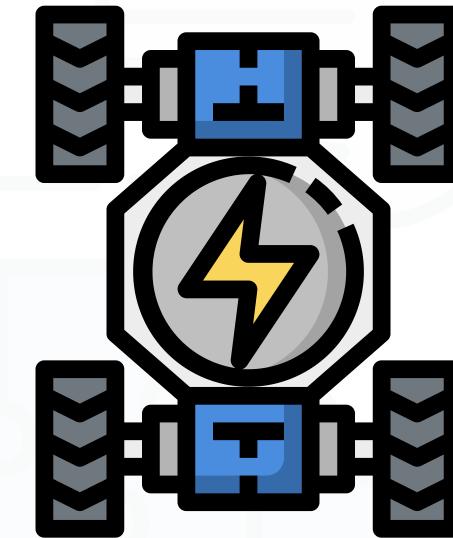


## Step 5: Write code to move robot backwards with speed

```
/////////backward/////////  
//front left motor backward  
digitalWrite(11, LOW);  
digitalWrite(12, HIGH);  
//Back right motor backward  
digitalWrite(13, LOW);  
digitalWrite(A0, HIGH);  
//front right motor backward  
digitalWrite(A1, LOW);  
digitalWrite(A2, HIGH);  
//back left motor backward  
digitalWrite(7, LOW);  
digitalWrite(8, HIGH);  
  
delay(2000);
```

```
/////////stop/////////  
//front left motor forward  
digitalWrite(11, LOW);  
digitalWrite(12, LOW);  
//Back right motor forward  
digitalWrite(13, LOW);  
digitalWrite(A0, LOW);  
//front right motor forward  
digitalWrite(A1, LOW);  
digitalWrite(A2, LOW);  
//back left motor forward  
digitalWrite(7, LOW);  
digitalWrite(8, LOW);  
  
delay(100);
```

Enable -> 6  
Input 1 -> 11  
Input2 -> 12



Enable -> 5  
Input 1 -> 7  
Input2 -> 8

Enable -> 10  
Input 1 -> 15  
Input2 -> 16

Enable -> 9  
Input 1 -> 13  
Input2 -> 14



# Remember

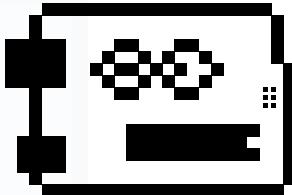
```
void loop() {  
    analogWrite(3, 0);
```

number between 0 and 255

# Code

**Step 6: Experiment with different speeds**

**Try it by yourself**



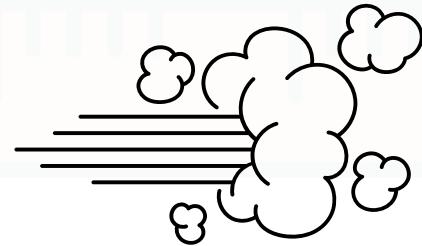
# Observe

What did you notice?



# Think

What if we tried different speeds for each wheel?



# Code

Try different speeds for each wheel

Try it by yourself

