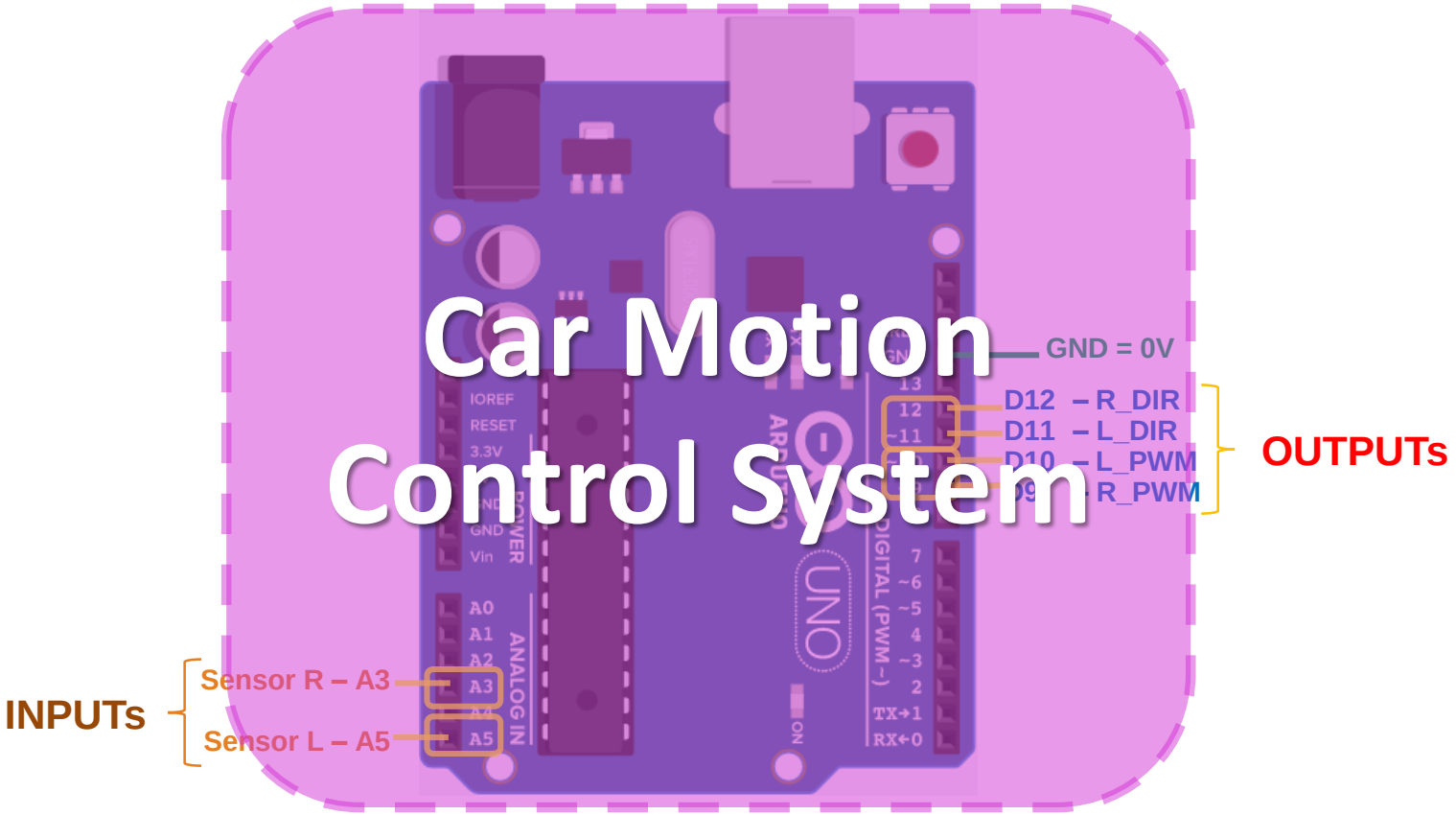
# ELEC1100 - Tutorial 7

## Robot Car & Logic

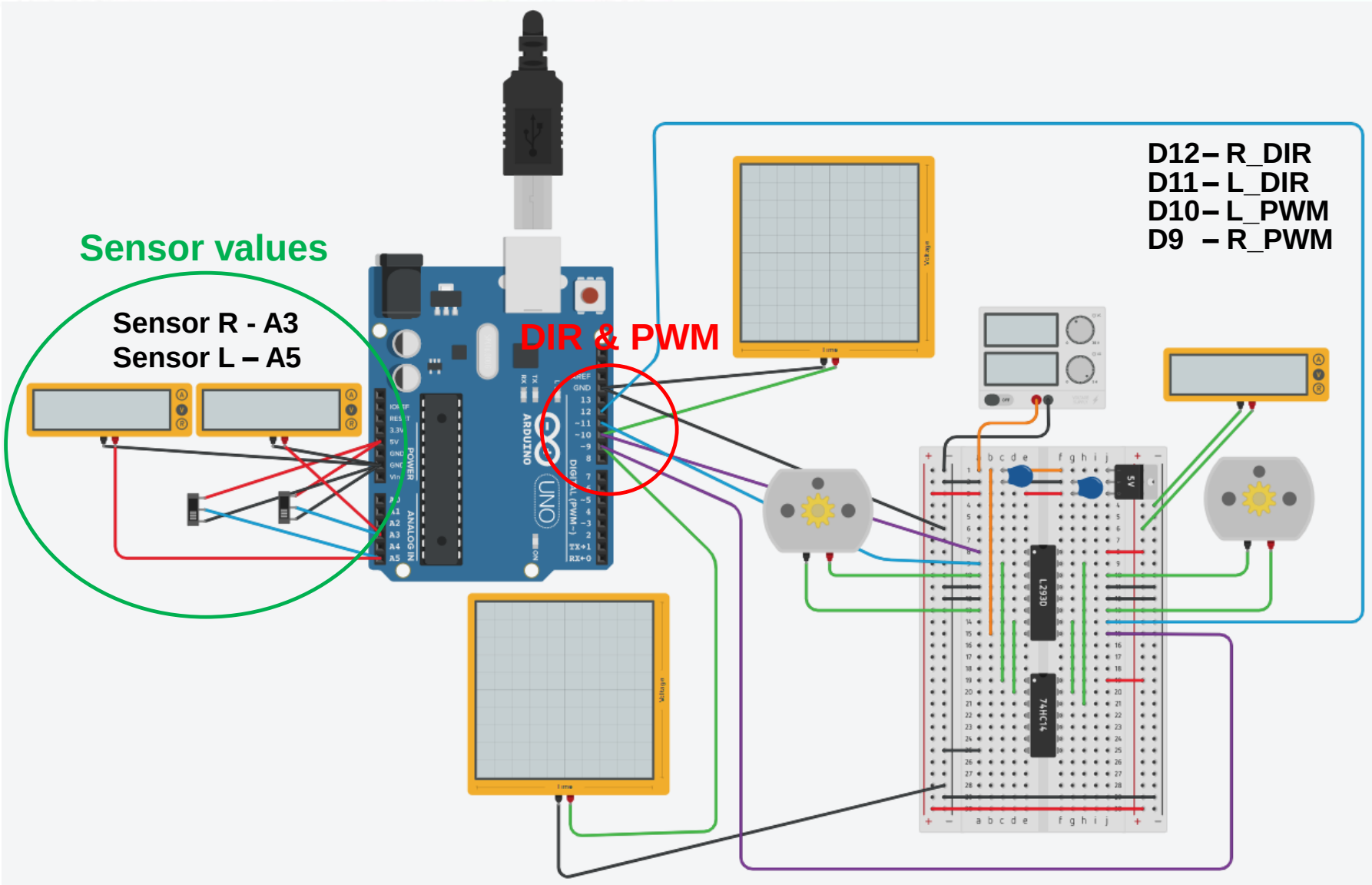
Introduction to Lab#06

# Review

- **Arduino Uno-board: Your logic control unit**



# Schematic in Tinkercad



# Motors Setting

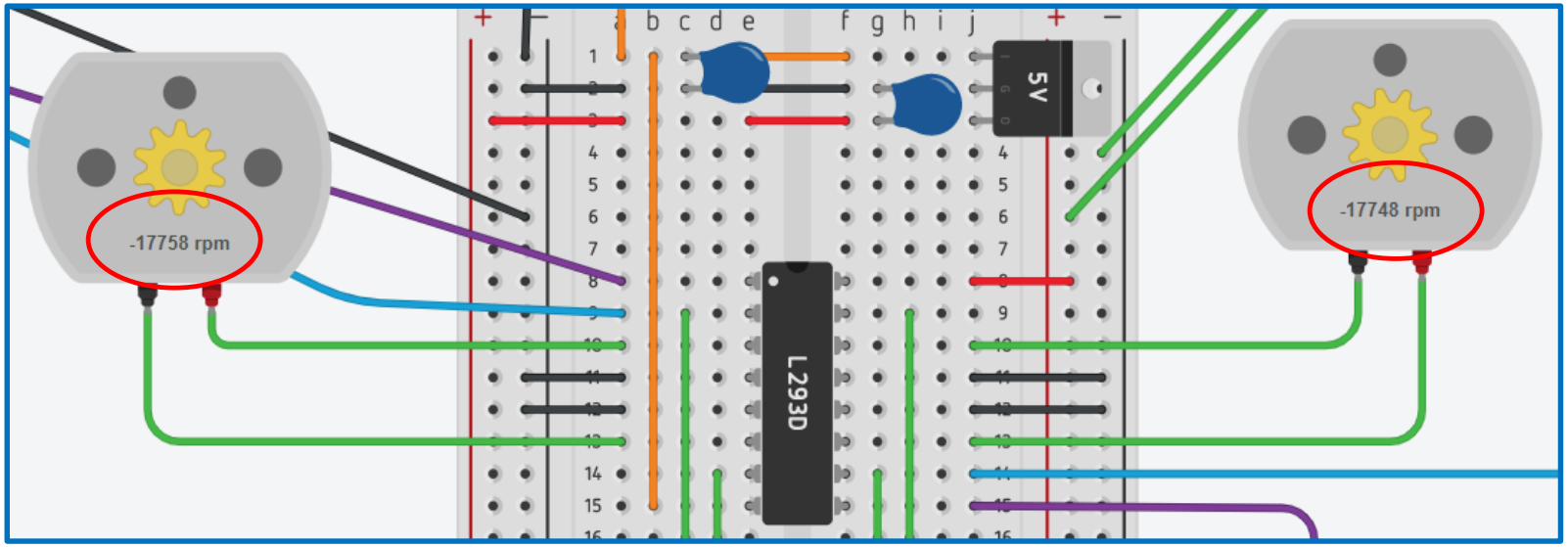
- Your project coding standard

[Sensors] → [Motors]

White: 0V → Backward

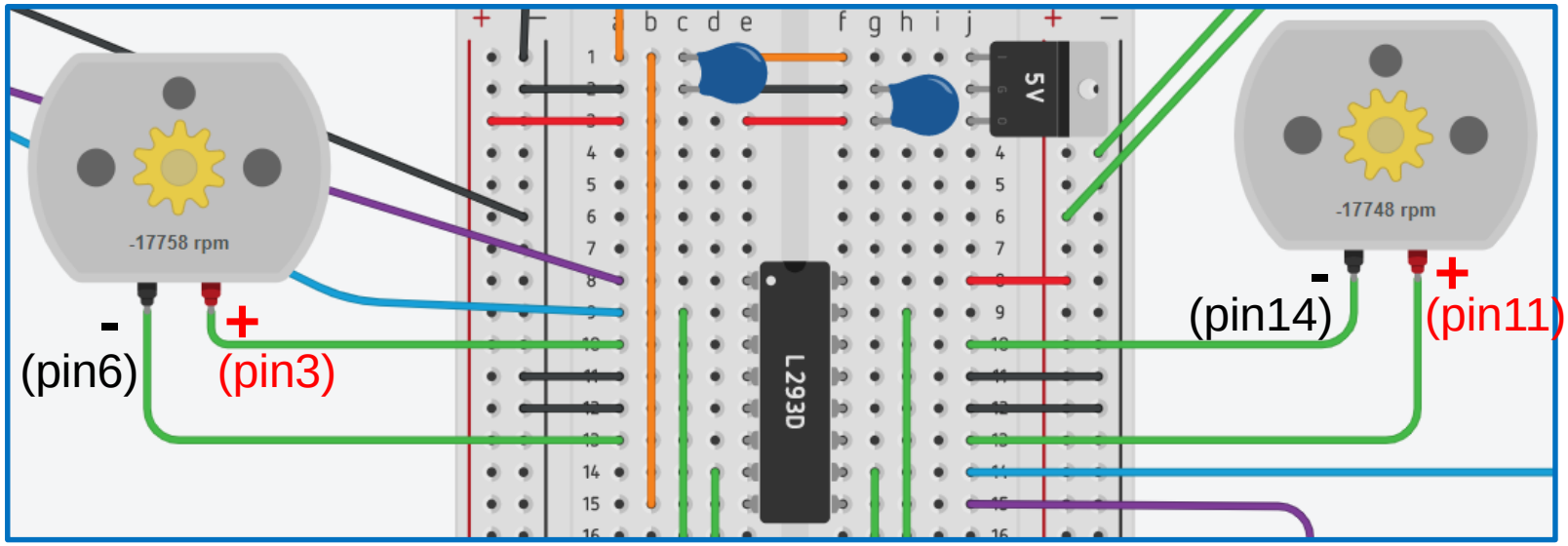
**Dark: 5V → Forward**

| Case | Sensor L | Sensor R | L_DIR | R_DIR | Left Motor | Right Motor |
|---|---|---|---|---|---|---|
| (a) | 0V \| white | 0V \| white | 0 | 0 | -ve rpm | -ve rpm |
| (b) | 0V \| white | 5V \| dark | 0 | 1 | -ve rpm | +ve rpm |
| (c) | 5V \| dark | 0V \| white | 1 | 0 | +ve rpm | -ve rpm |
| (d) | 5V \| dark | 5V \| dark | 1 | 1 | +ve rpm | +ve rpm |



# Sensors Adjustment

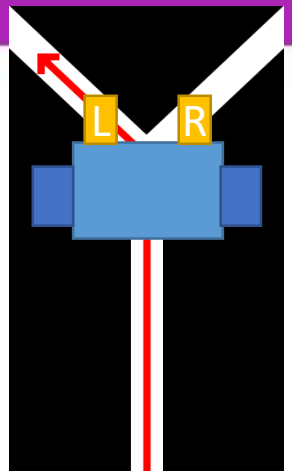
- Your motor terminals




- If not, try <u>reversely</u> connecting the motor terminals to H-bridge (L293).

These are related to the project coding so please follow this standard.

# Lab#06: Logic Design




- Given the sensor signals **L** & **R**, determine the **DIR** signals and speed signals (**PWM_L** & **PWM_R**) for the motors

| Sensors | | Car Action | Rotation | | Left Motor | | Right Motor | |
|---|---|---|---|---|---|---|---|---|
| L | R | | Left | Right | L_DIR | PWM_L | R_DIR | PWM_R |
| 0 | 0 | Turn left | -ve | +ve | | | | |
| 0 | 1 | Turn left | -ve | +ve | | | | |
| 1 | 0 | Turn right | +ve | -ve | | | | |
| 1 | 1 | Forward | +ve | +ve | | | | |

2 sensors: 4 combinations

You decide your own control signals
Design your own systems

# Lab#06: Example

- **Direction Control Example**
  (for your reference)

[Motors Direction]
0V → Backward → "0"
**5V → Forward → "1"**

| Sensors | | Car Action | Rotation | | Left Motor | | Right Motor | |
|---|---|---|---|---|---|---|---|---|
| L | R | | Left | Right | L_DIR | PWM_L | R_DIR | PWM_R |
| 0 | 0 | Turn left | -ve | +ve | 0 | Constant (from your Uno-board) | 1 | Constant (from your Uno-board) |
| 0 | 1 | Turn left | -ve | +ve | 0 | | 1 | |
| 1 | 0 | Turn right | +ve | -ve | 1 | | 0 | |
| 1 | 1 | Forward | +ve | +ve | 1 | | 1 | |

(control signals: change the motor directions)

# Pin Assignment

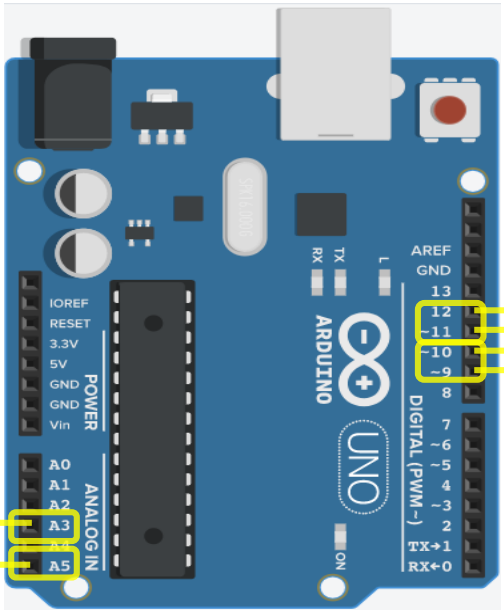
- Download the "Lab#06_logic" Arduino sketch, copy & paste into your Tinkercad coding text.

Text | 1 (Arduino Uno R3)

```
/*
  ELEC1100 Lab06

  To program the car turning left at split

*/

// assign meaningful names to those pins that will be used

#define pinLeftSensor A5       //pin A5
#define pinRightSensor A3      //pin A3

#define pinLdir 11             //pin D11
#define pinRdir 12             //pin D12

#define pinPWM_L 10             //pin D10
#define pinPWM_R 9             //pin D9

//define variables to be used in script
int leftSensor = 1;
int rightSensor = 1;
```

**INPUTs**

Sensor R – A3
Sensor L – A5

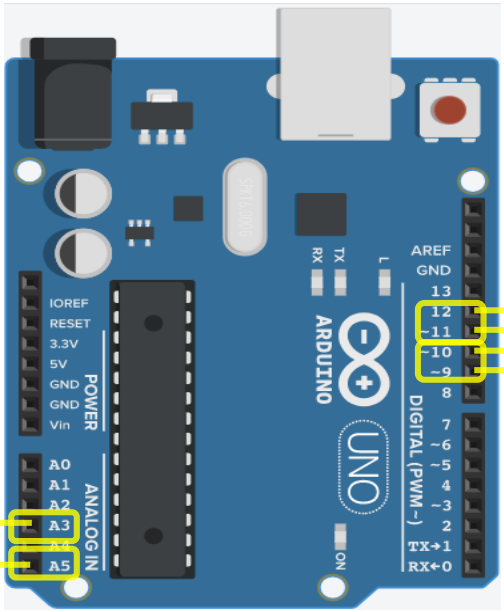



**OUTPUTs**

D12– R_DIR
D11– L_DIR
D10– L_PWM
D9– R_PWM

# Define Inputs & Outputs

```
23  // the setup function runs once when you press reset
24
25  void setup ()
26  {
27    // define pins as input and output.
28    pinMode(pinLeftSensor, INPUT);
29    pinMode(pinRightSensor, INPUT);
30
31    pinMode(pinLdir, OUTPUT);
32    pinMode(pinRdir, OUTPUT);
33
34    pinMode(pinPWM_L, OUTPUT);
35    pinMode(pinPWM_R, OUTPUT);
36
37    // initialize output pins.
38    digitalWrite(pinLdir, HIGH);
39    digitalWrite(pinRdir, HIGH);
40  }
```



# Lab#06 Code: Direction Control Signals

| Sensors L | Sensors R |
|---|---|
| 1 | 1 |
| 0 | 1 |
| 1 | 0 |
| 0 | 0 |

```
41
42  // the loop function runs over and over again forever
43  void loop()
44  {
45    analogWrite(pinPWM_L, 200);
46    analogWrite(pinPWM_R, 200);
47
48    leftSensor = digitalRead(pinLeftSensor);
49    rightSensor = digitalRead(pinRightSensor);
50
51    if ( leftSensor && rightSensor ) {
52      digitalWrite(pinLdir, ???);
53      digitalWrite(pinRdir, ???);
54    }
55
56    if ( !leftSensor && rightSensor ) {
57      digitalWrite(pinLdir, ???);
58      digitalWrite(pinRdir, ???);
59    }
60
61    if ( leftSensor && !rightSensor ) {
62      digitalWrite(pinLdir, ???);
63      digitalWrite(pinRdir, ???);
64    }
65
66    if ( !leftSensor && !rightSensor ) {
67      digitalWrite(pinLdir, ???);
68      digitalWrite(pinRdir, ???);
69    }
70  }
```

PWM

HIGH HIGH

LOW HIGH

HIGH LOW

LOW HIGH

"!" logic NOT

"&&" logic AND

| Sensors | | DIR | |
|---|---|---|---|
| L | R | L_DIR | R_DIR |
| 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 |

# Next week

Intro. to Final Project & Online Exam

**You have learned all the basics.**

**You are now ready for your project !**