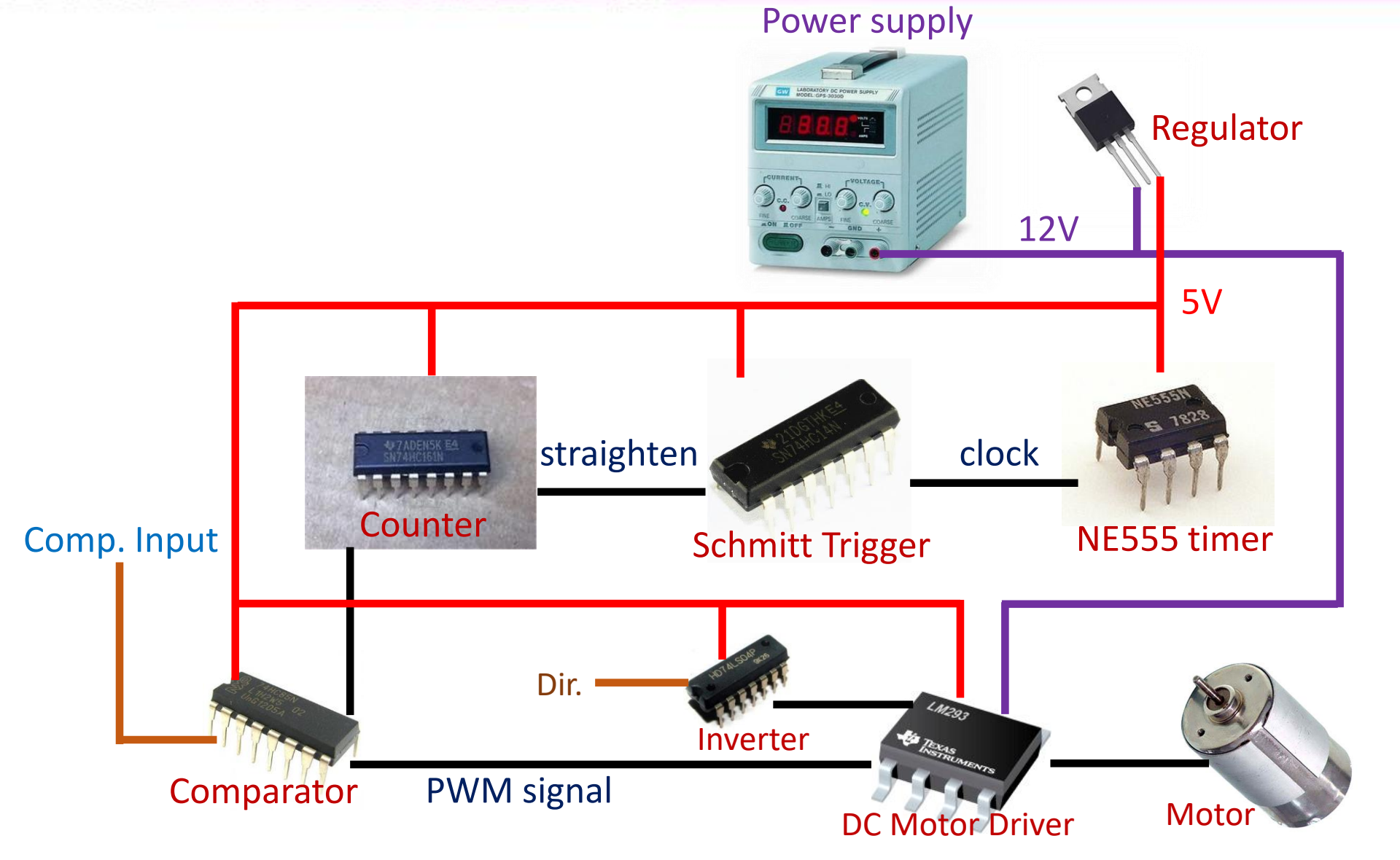
ELEC1100 - Tutorial 6

Sensors & MCU

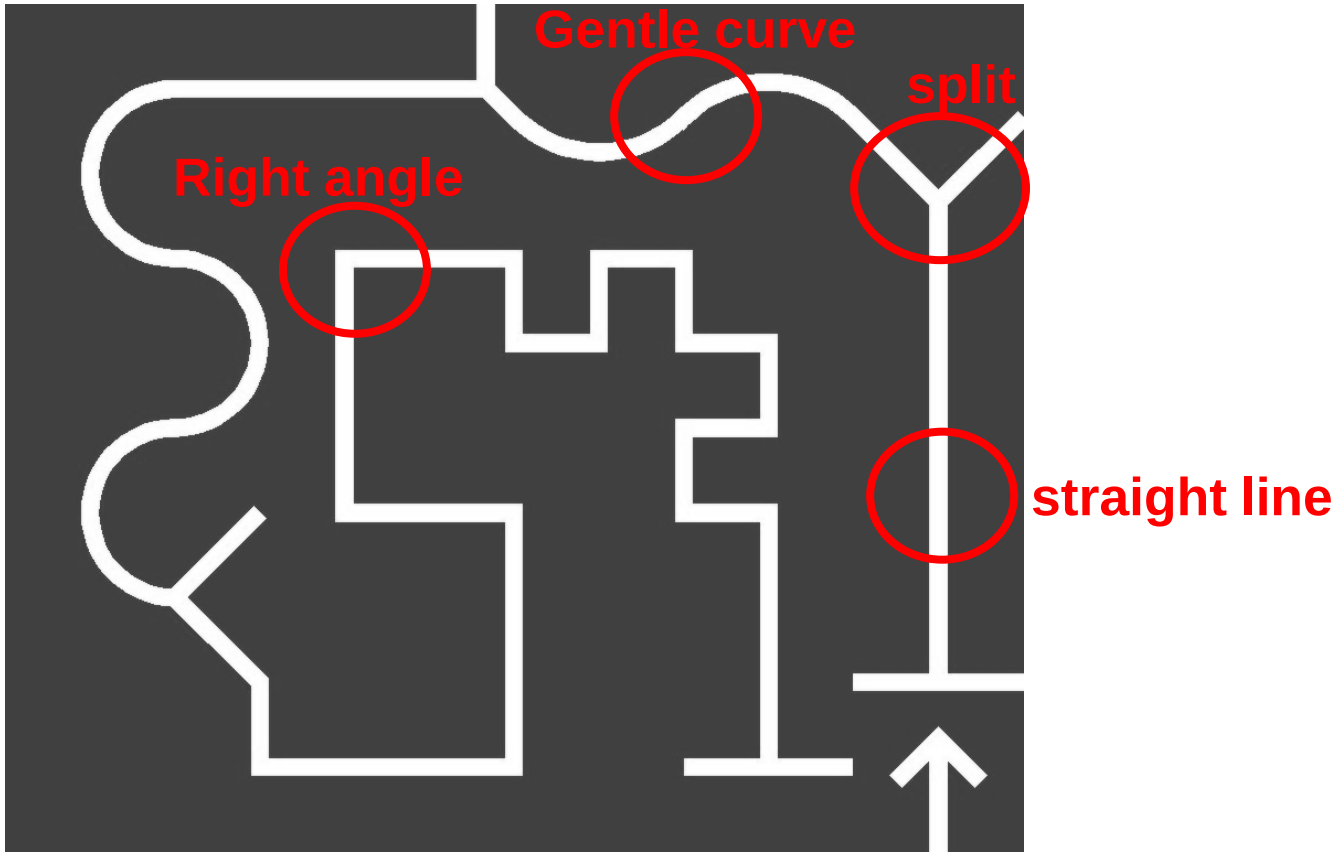
Introduction to Lab#05

Review

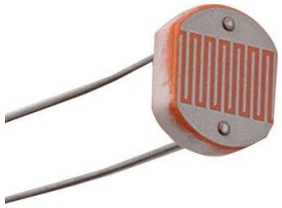

Power supply
Regulator
12V
5V
Counter
straighten
Schmitt Trigger
clock
NE555 timer
Comp. Input
Dir.
Inverter
Comparator
PWM signal
DC Motor Driver
Motor

Your Demo Track

- Use sensors to detect changes in the track, then change the speed/DIR signals accordingly.



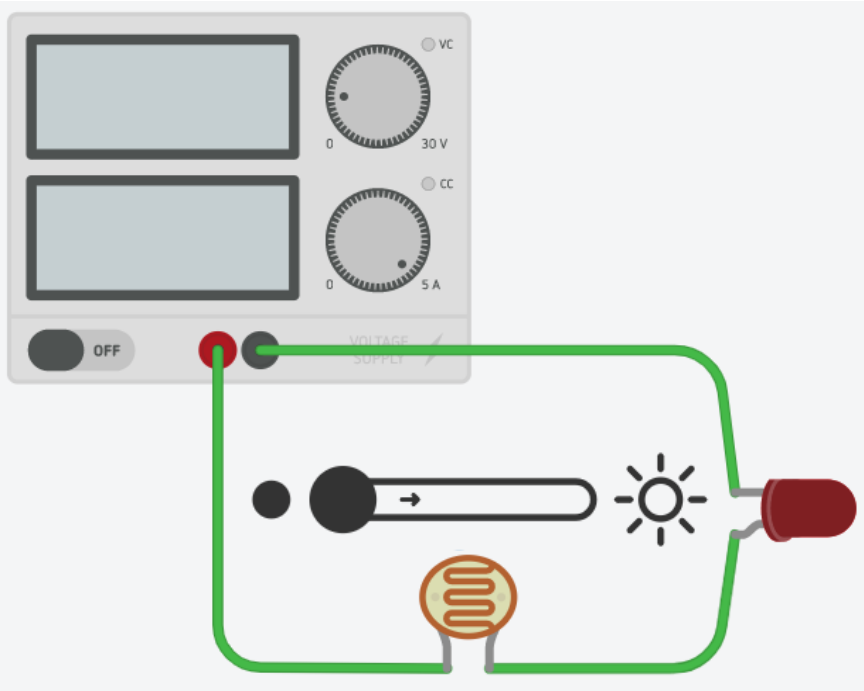
Photoresistor in Tinkercad



LDR
The real component

In Tinkercad

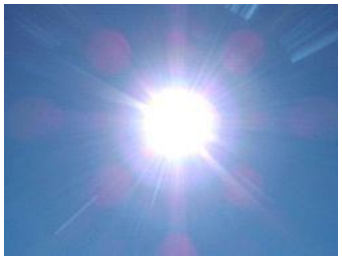
Lab#05: Simulation 1



- Observe the LED brightness changes according to the changes on lightening condition.

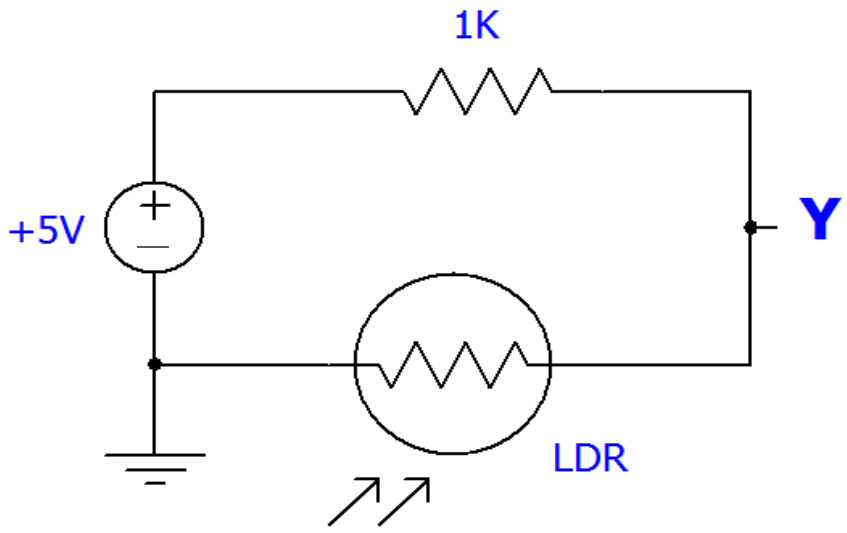
LDR

- “Light Dependent Resistor”



R low

R high



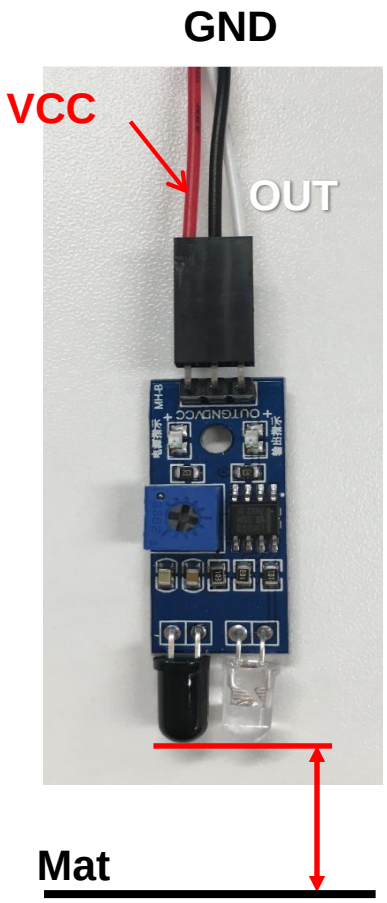
Example:
R = 1k when light
R = 2k when dark
Y = ?

Sensor Connection

❖ **At Physical lab**

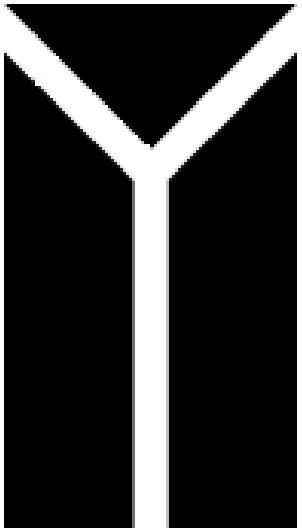
Light sensor connection

- **Red: 5V**
- **Black: GND**
- White: Sensor Output Voltage



Sensor output voltage

- White: Low (0V)
- Black: High (5V)



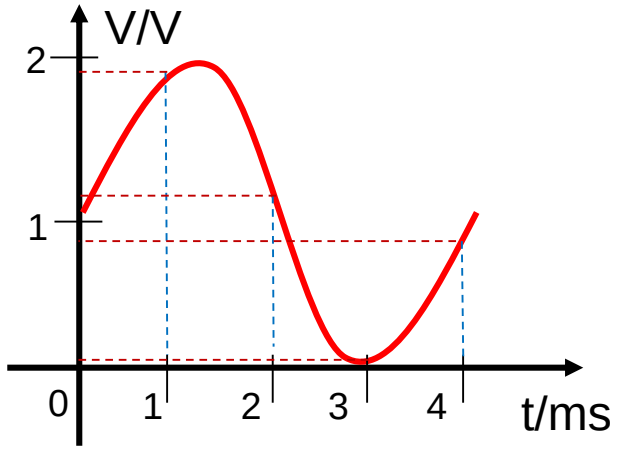
A black Mat with white lines on it

Data Transmission

- Transmit this signal:
  - Convert to binary first
  - E.g. Sample every 1ms
  - E.g. only 2 levels:

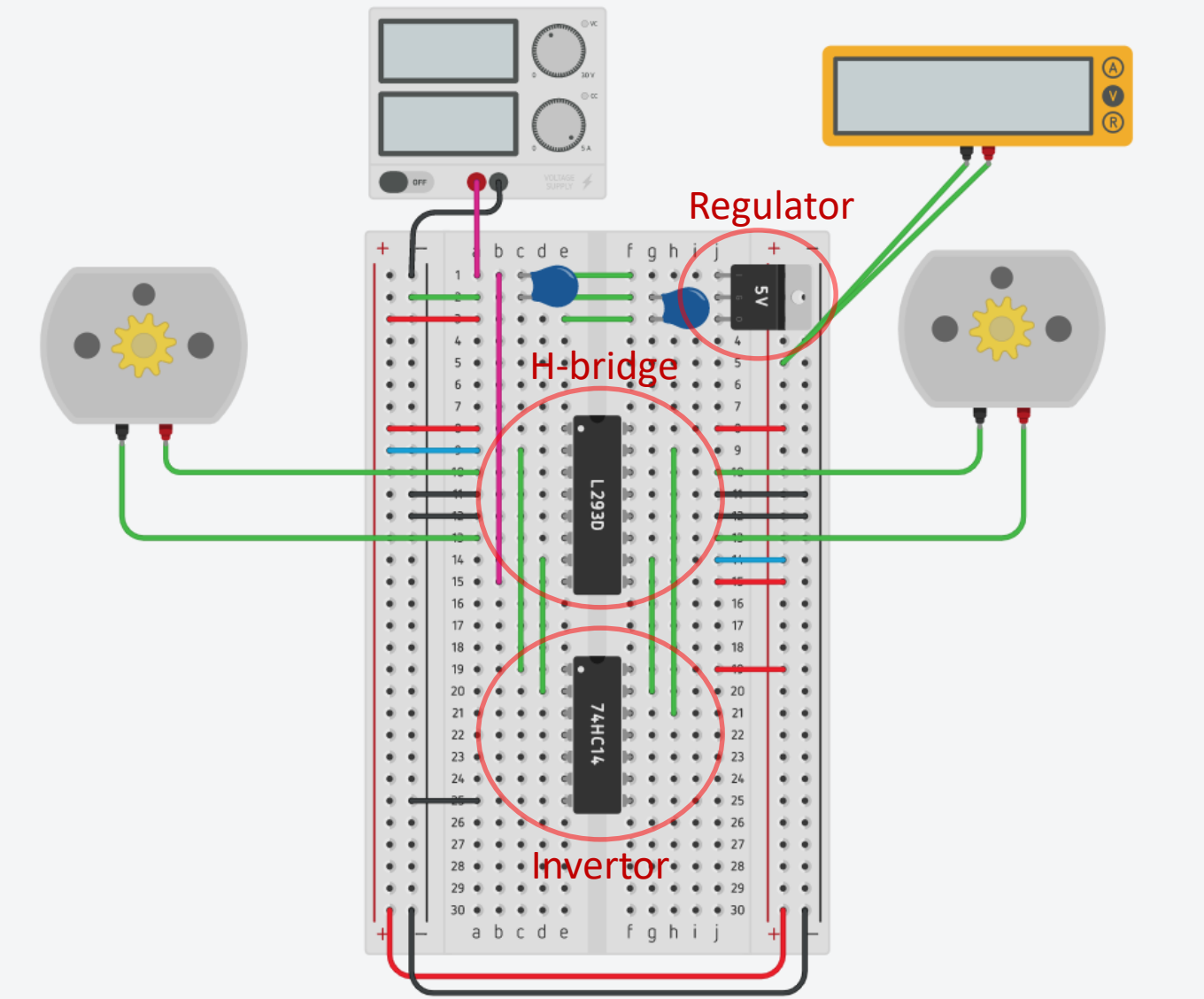
    V > 1V => “1” (5V)

    V < 1V => “0” (0V)
  - Classify each sample into 1/0

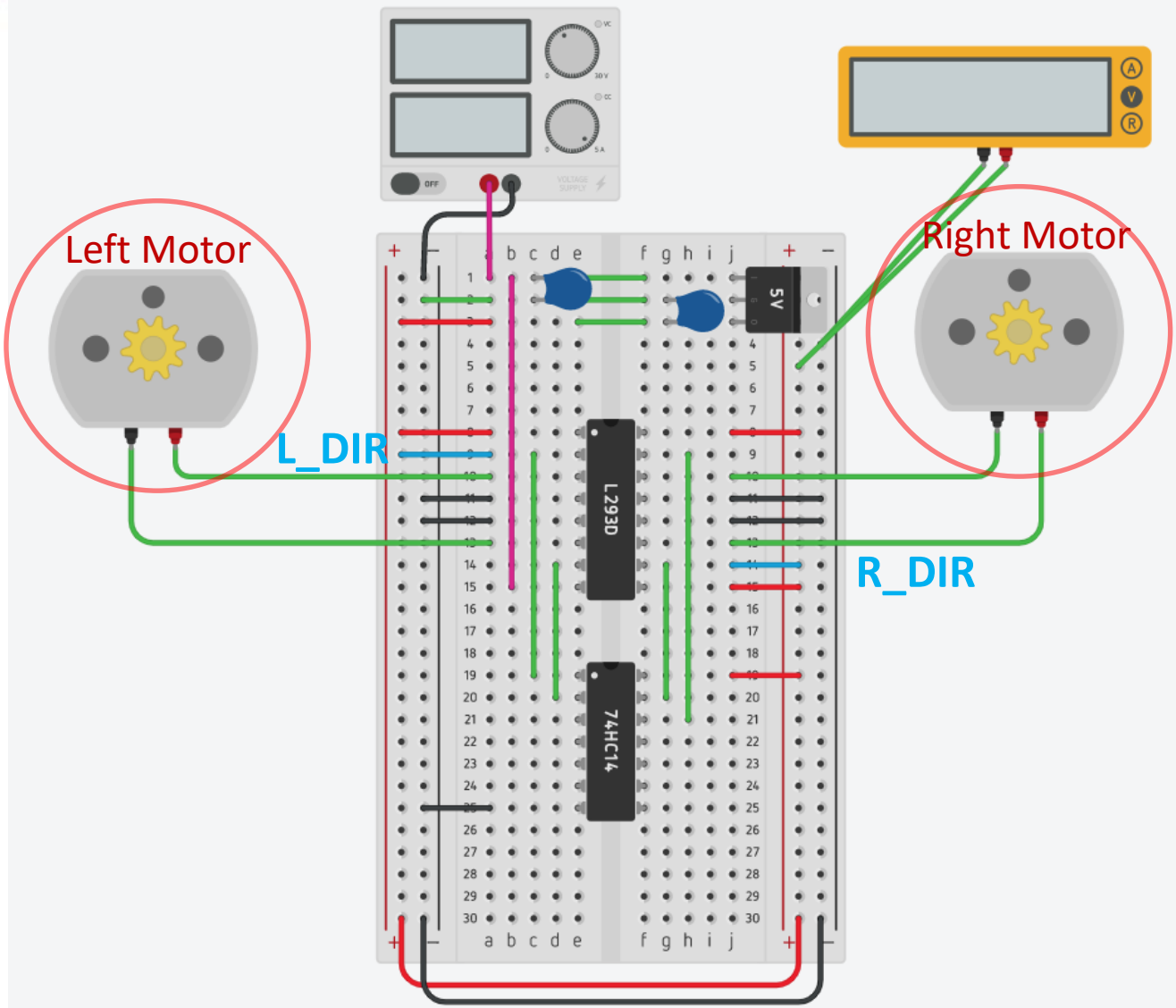


Data loss
Easier to store & duplicate

Review: Circuits on your breadboard

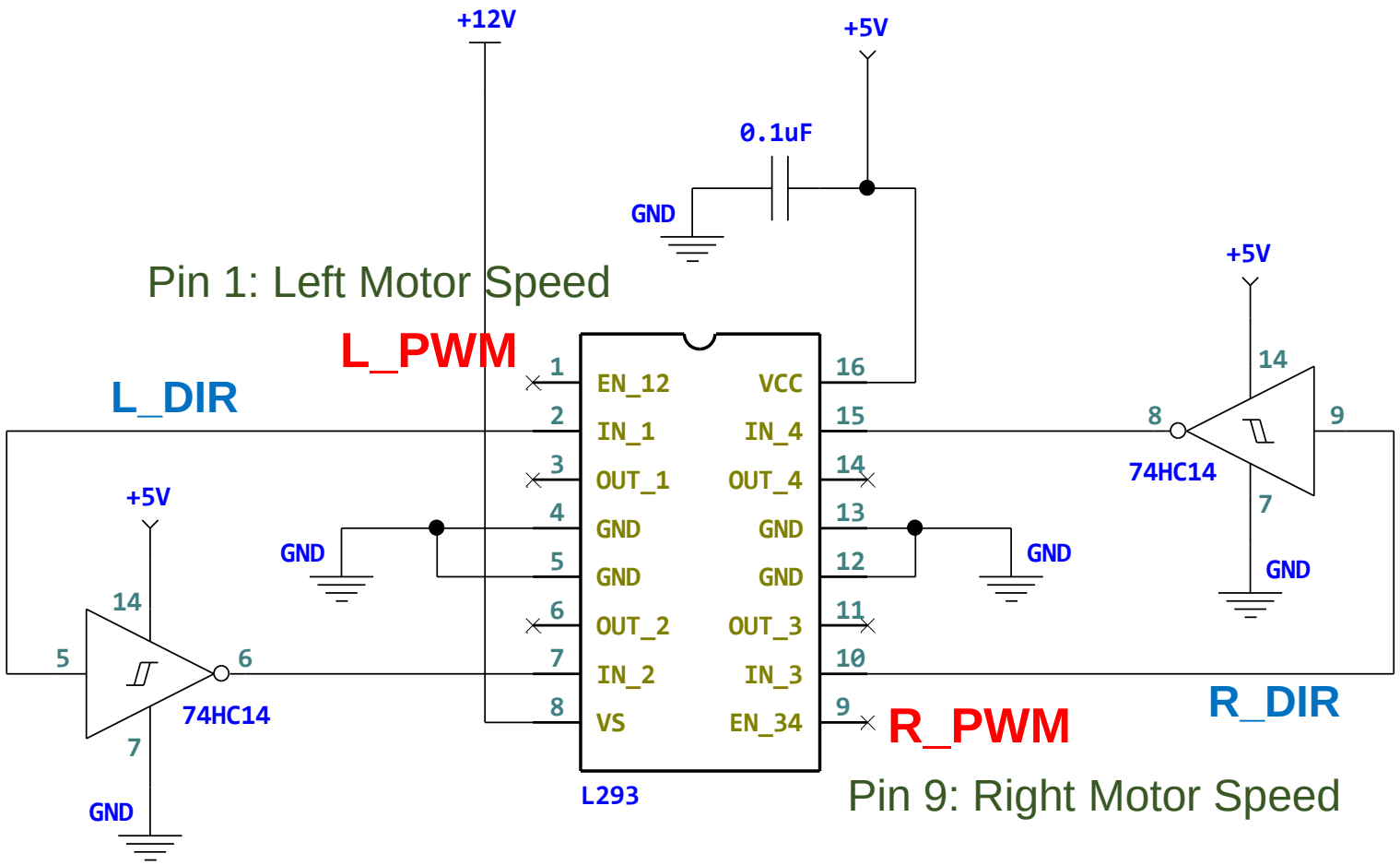


Review: Motor Rotation Control



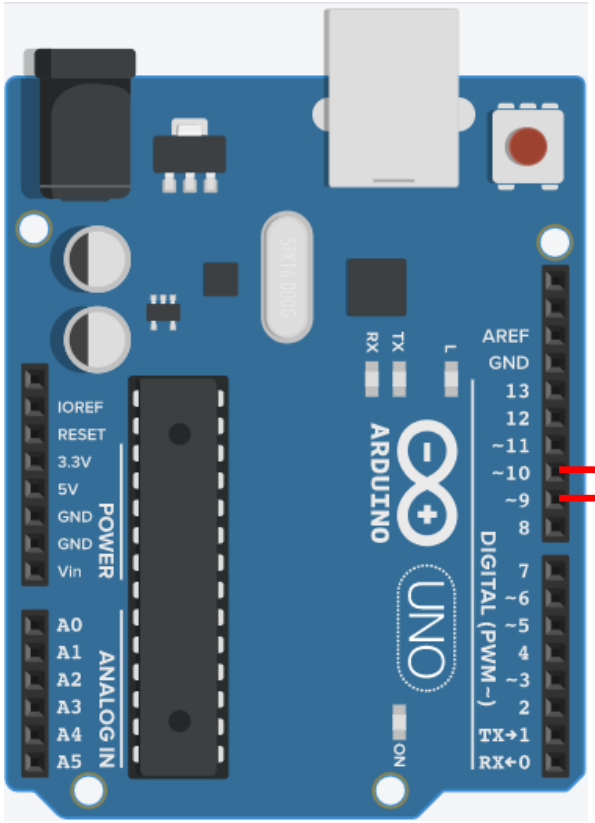
Motor Speed Control

- **PWM: Speed control signal to your motors**



PWM Control using Uno-board

BOARD	PWM PINS	PWM FREQUENCY
Uno, Nano, Mini	3, 5, 6, 9, 10, 11	490 Hz (pins 5 and 6: 980 Hz)



- In your Lab#05:

  Use Pin10 & 9 of your Uno-board to generate PWM signals to control the speed of your left & right motors.

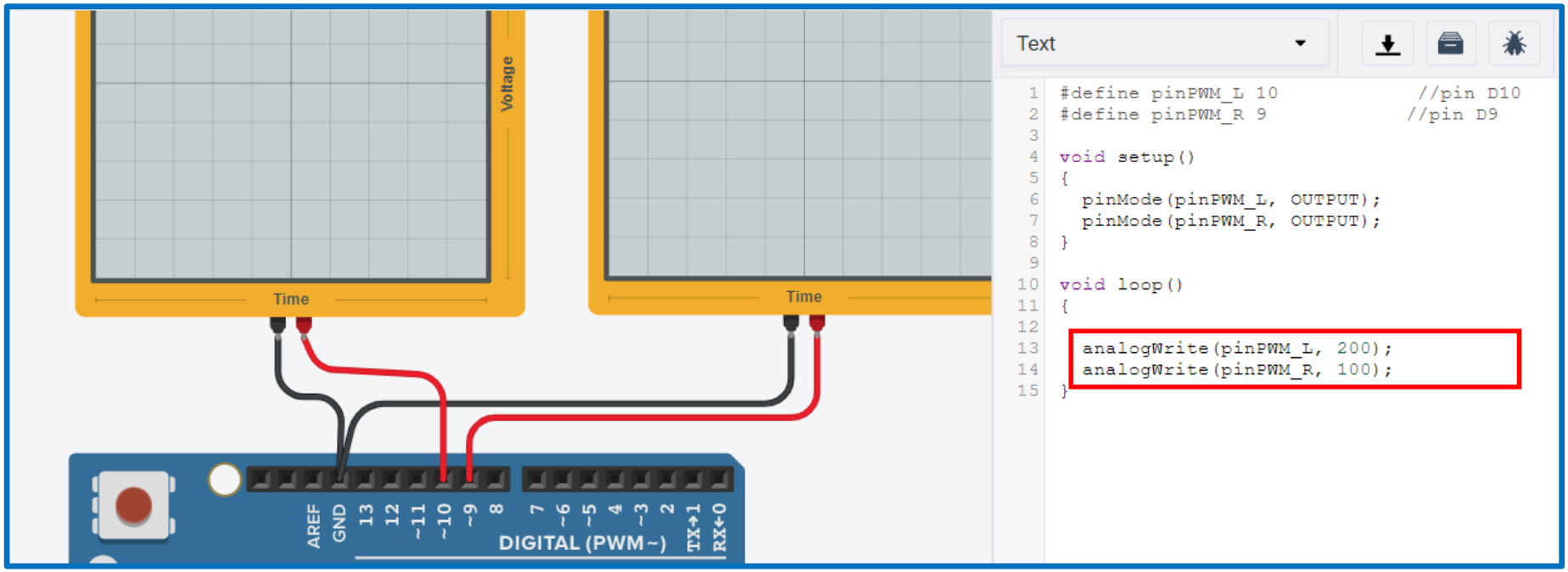
Arduino Coding

- **analogWrite():** Write an analog value (PWM wave) to a pin.

  After a call to analogWrite(), the pin will generate a steady rectangular wave of the specific duty cycle.

```
analogWrite(pin, value)
```

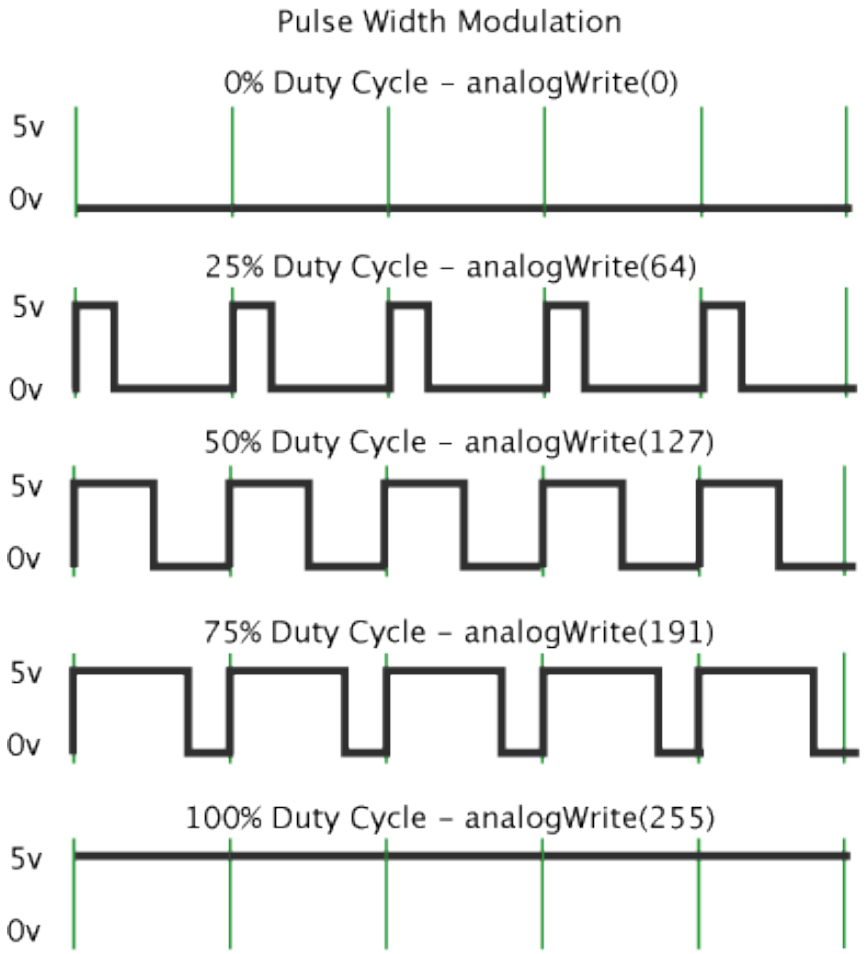
Value: the duty cycle, between 0 (always off) and 255 (always on)



Duty Cycle Value

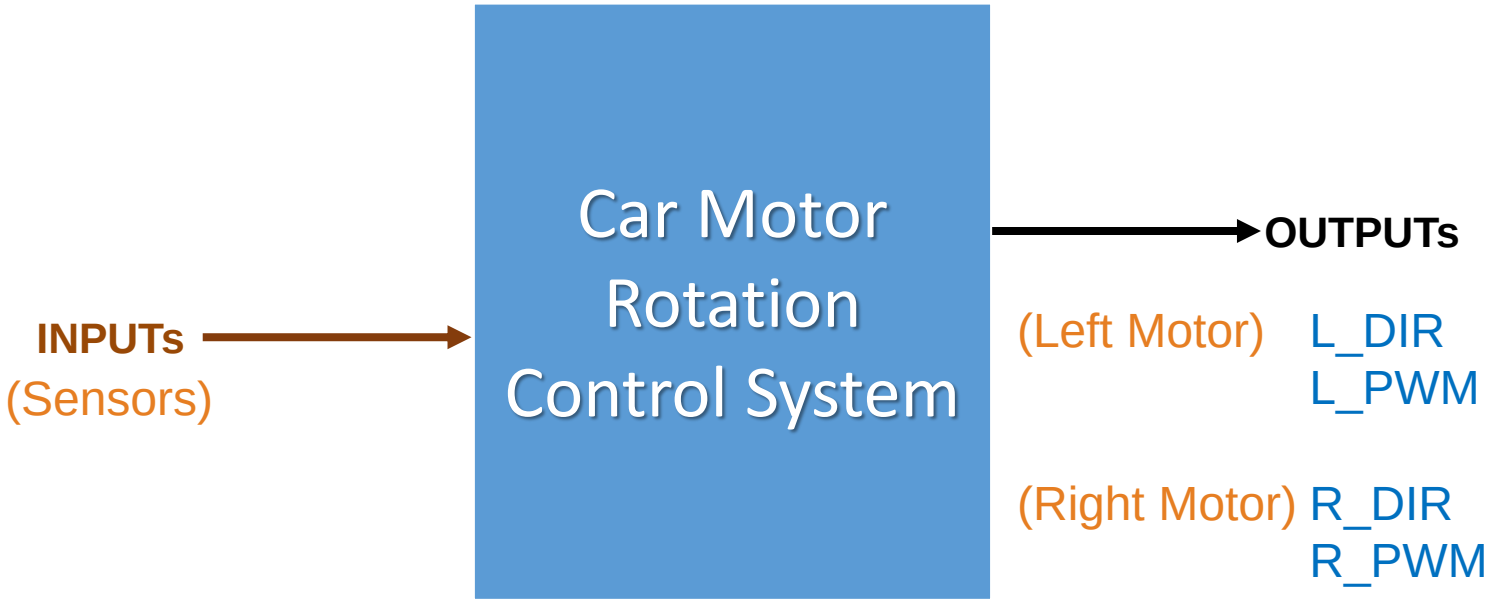
❖ A call to **analogWrite()** is on a scale of 0-255.

- Green lines: a regular time period
- analogWrite(255): 100% duty cycle (always on)
- analogWrite(127): 50% duty cycle (on half the time)



Motor Rotation Control

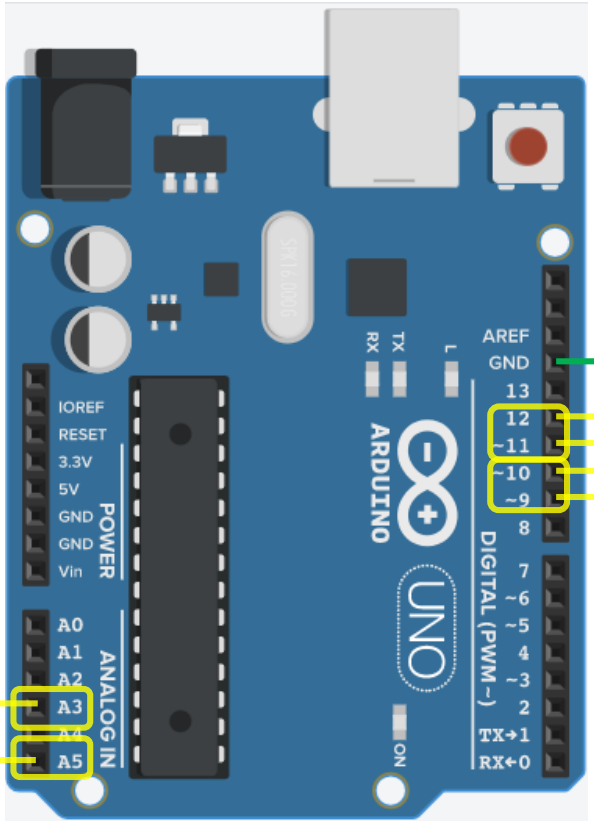
- **Use sensors to control motor rotation**



Motor Rotation Control

- **Use sensors to control motor rotation**

  Connect your Uno-board to the H-bridge circuit on your breadboard.



Lab#05: Simulation 4

GND = 0V

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

OUTPUTs

INPUTs

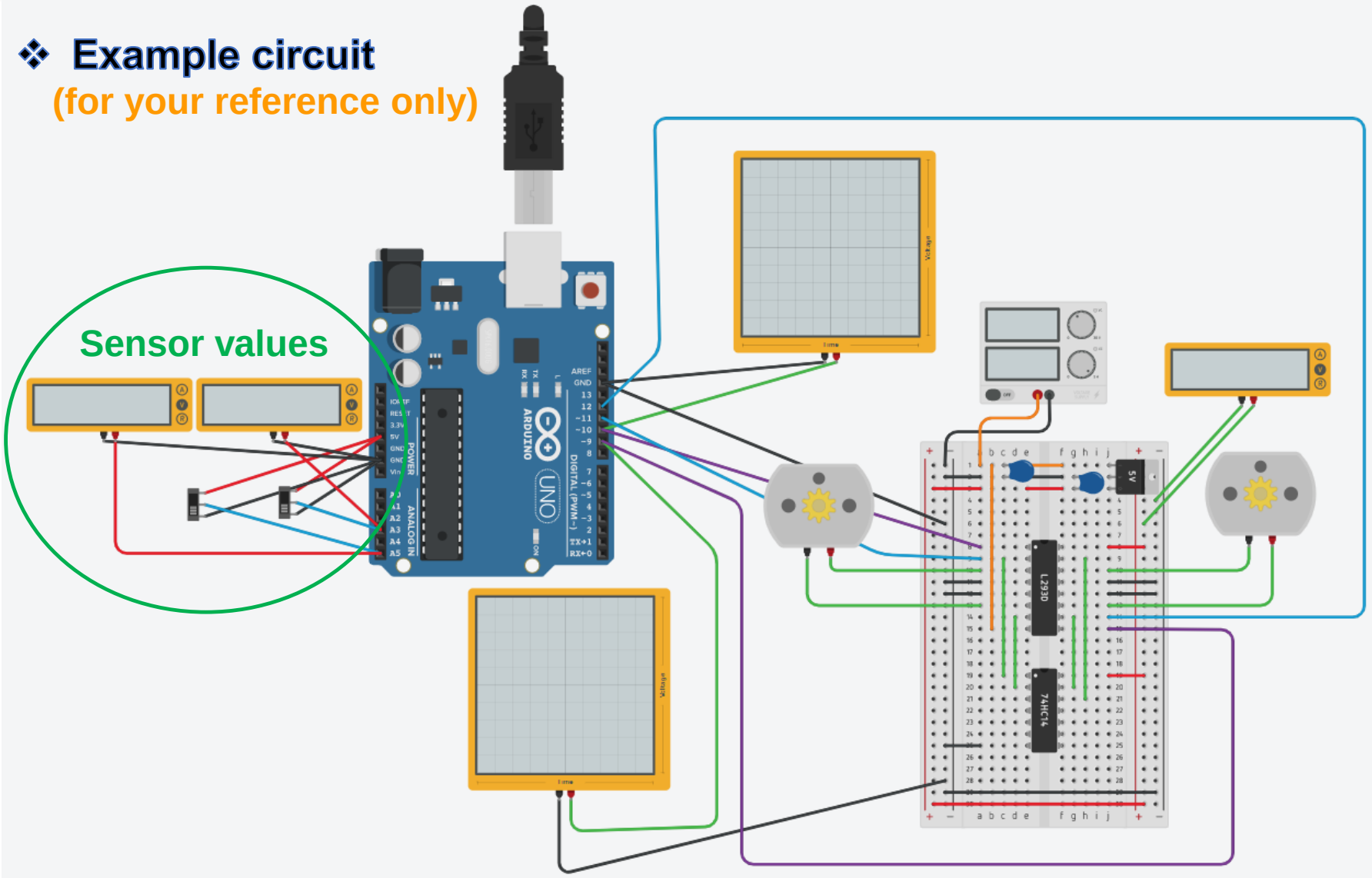
Sensor R – A3
Sensor L – A5

Download Lab#05 Arduino sketch, copy & paste into your Tinkercad coding text.

(for Lab#05 only, we will do *logic design* to control DIR signals at Lab#06)

Motor Rotation Control

- **Example circuit**
  (for your reference only)

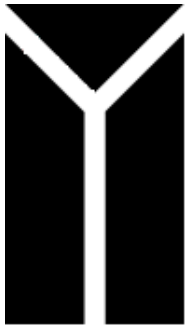


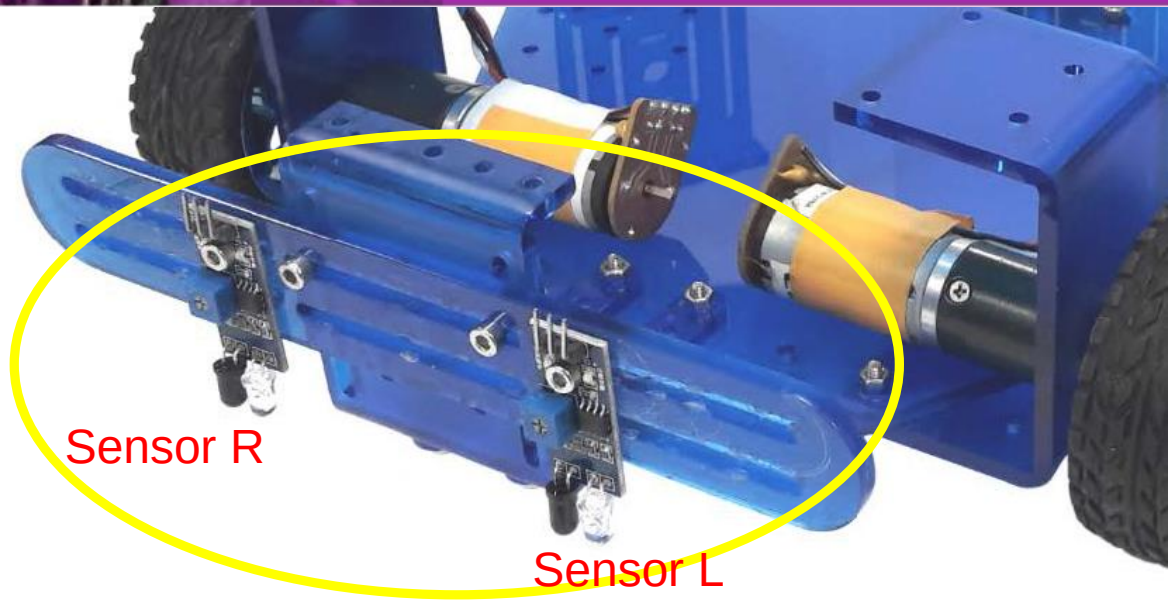
Sensor Value Simulation

❖ Sensors on your car

Measure the surface:

- White: Low (0V)
- Black: High (5V)





❖ Tinkercad Simulation

Two switches:

- Sensor R value (A3)
- Sensor L value (A5)