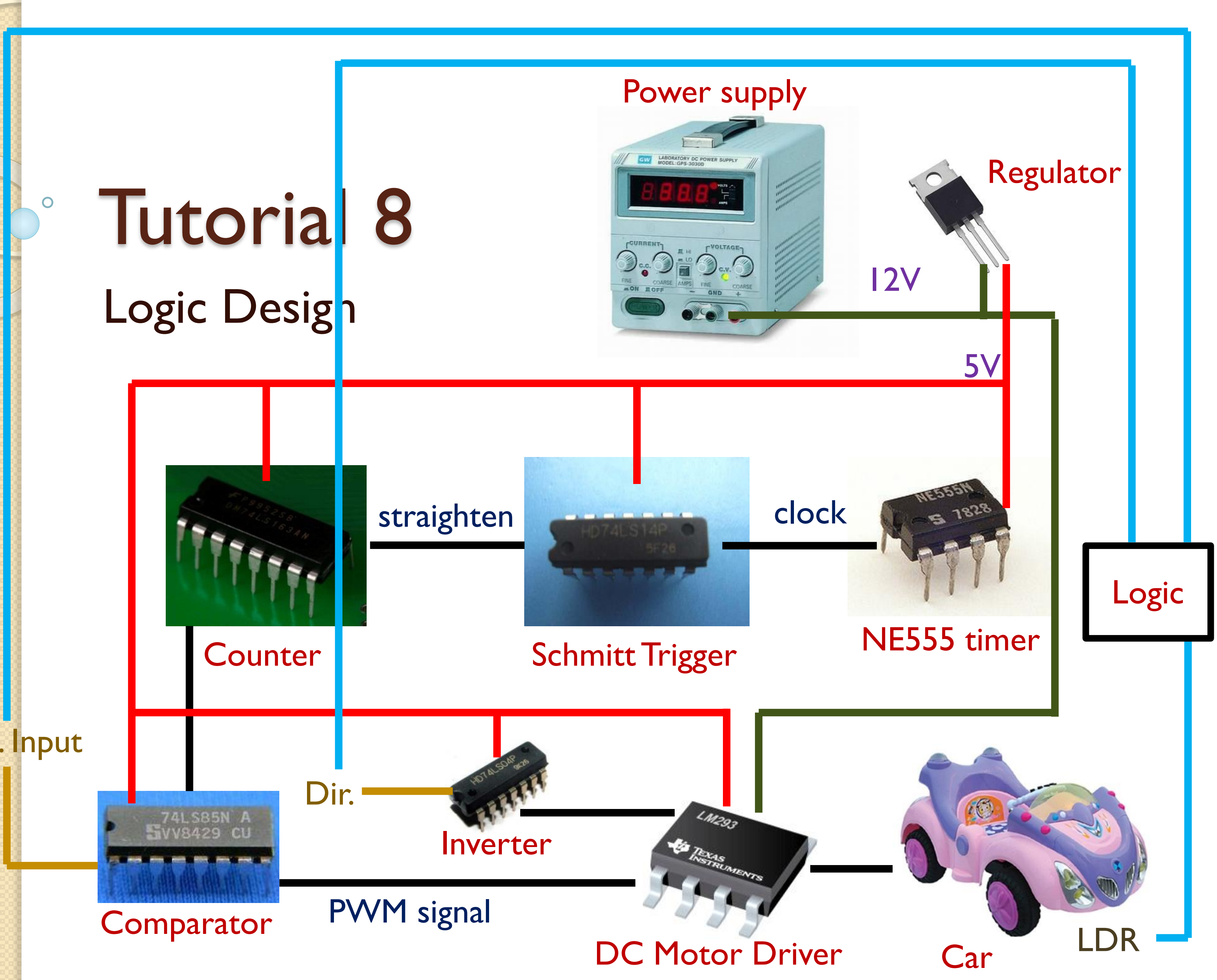
Tutorial 8

Logic Design



Power supply

Regulator

12V

5V

straighten

clock

Counter

Schmitt Trigger

NE555 timer

Logic

Comp. Input

Dir.

Inverter

Comparator

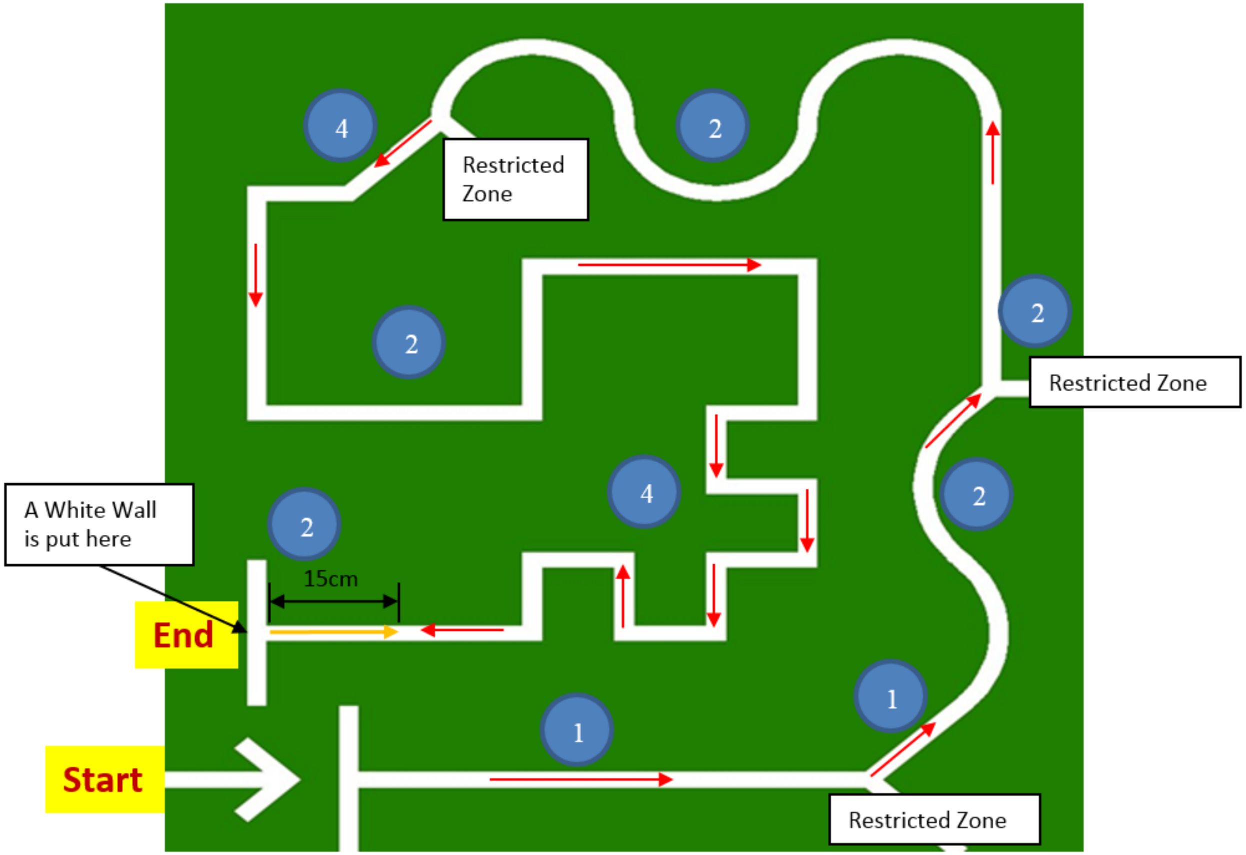
PWM signal

DC Motor Driver

Car

LDR

Example track (last year)

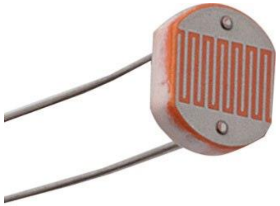


Use sensors to detect changes in the track, then change the inputs accordingly.

Sensors

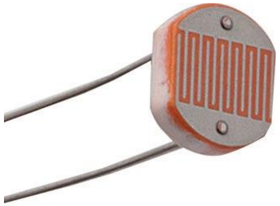
- There are many kinds of sensors, e.g.
- Light sensor
- Temperature sensor
- Sound sensor
- Motion sensor

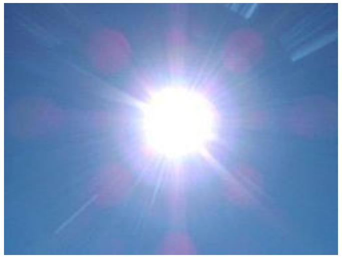
- Project: Light sensor



LDR

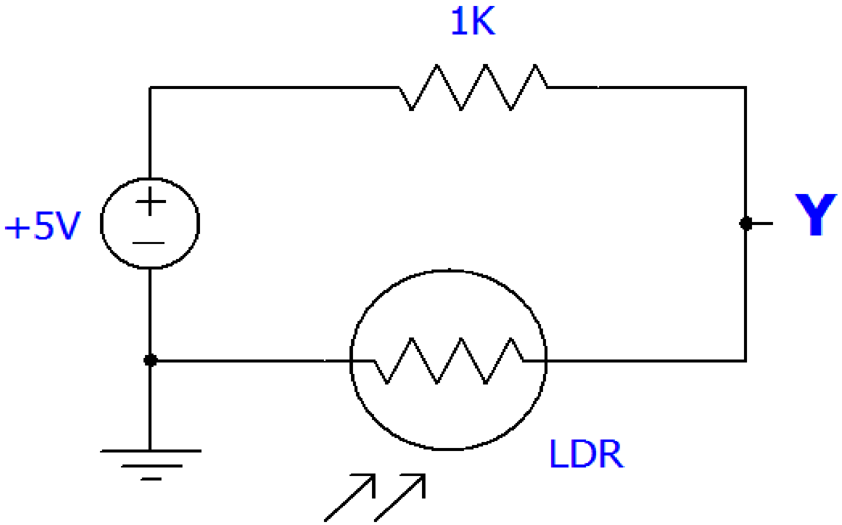
- “Light Dependent Resistor”





R low

R high



Example:

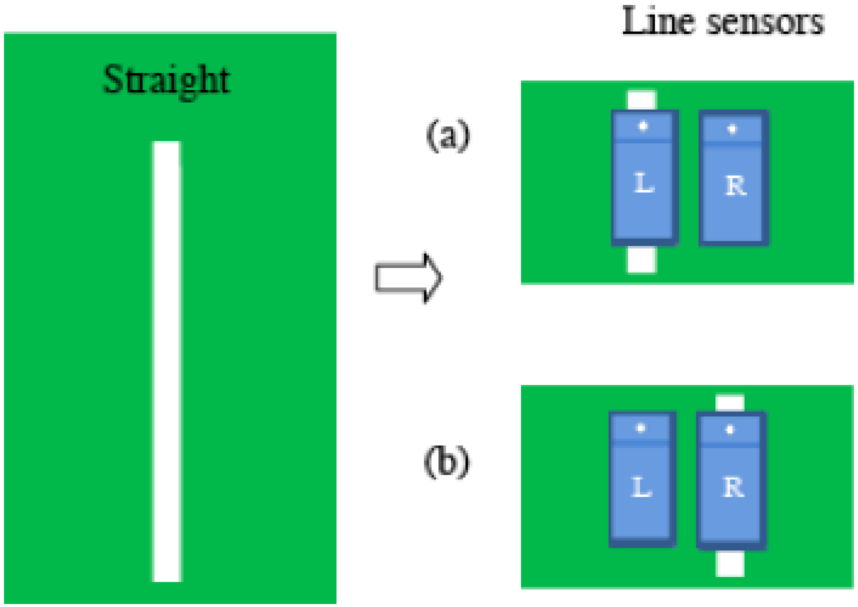
R = 1k when light

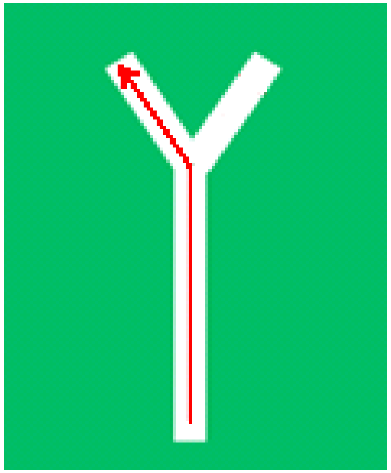
R = 2k when dark

Y = ?

Your project

- Light sensor in your project:
- How to detect straight line, split?
  - White: low, Green: high



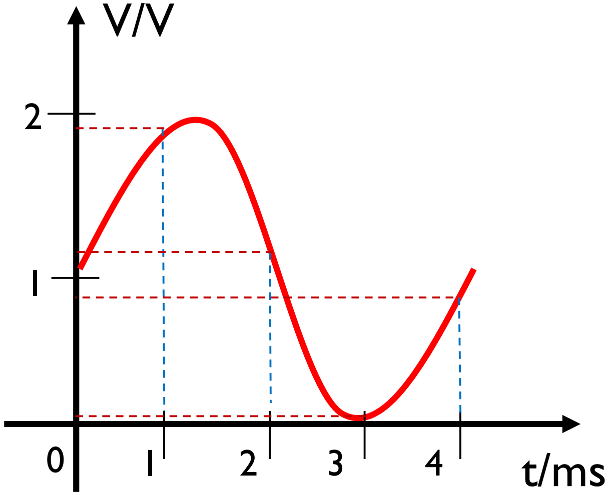


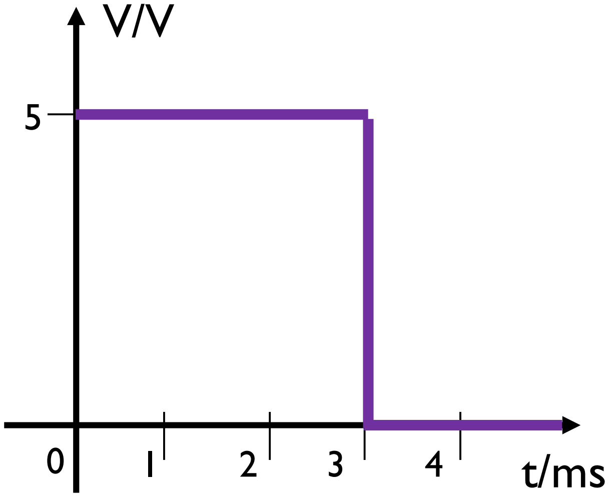
Data Transmission

Data loss

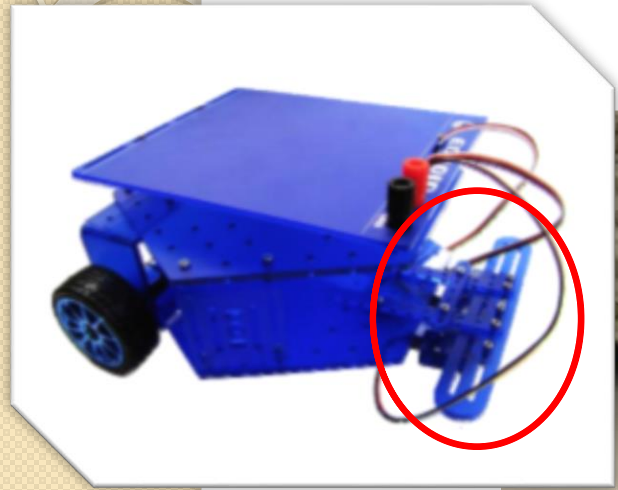
Easier to store & duplicate

- 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

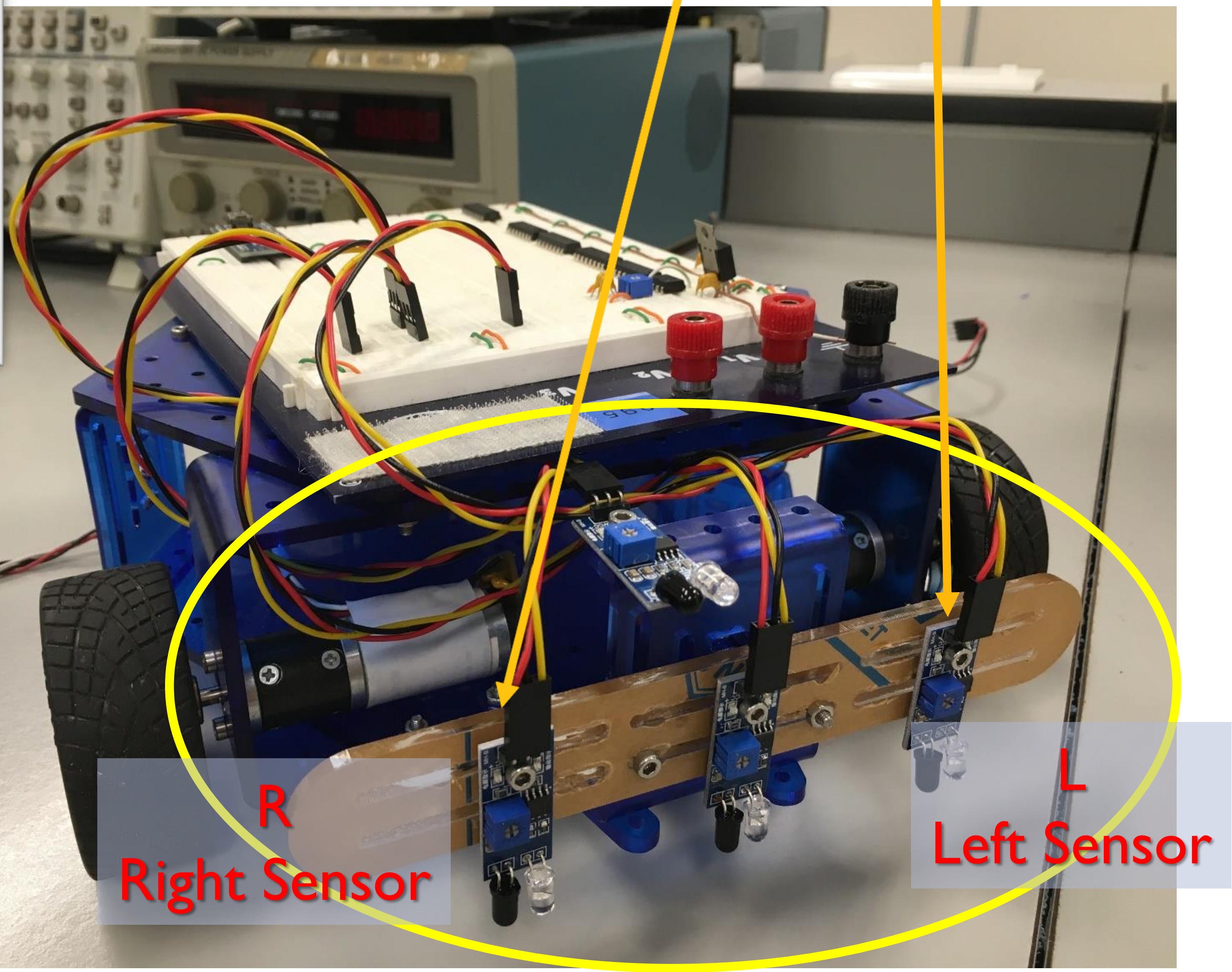




Sensor Placement



Two Sensors at Lab#06



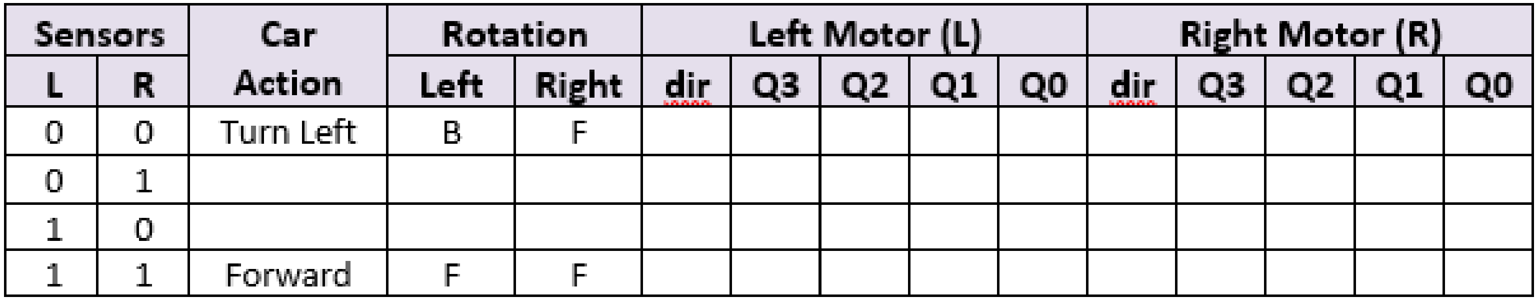
R
Right Sensor

L
Left Sensor

Lab 06

Read Lab Sheet
Do Pre-lab

Given the sensor signals, determine the Direction & Speed signals for the motor



Sensors		Car Action	Rotation		Left Motor (L)					Right Motor (R)				
L	R		Left	Right	dir	Q3	Q2	Q1	Q0	dir	Q3	Q2	Q1	Q0
0	0	Turn Left	B	F										
0	1													
1	0													
1	1	Forward	F	F										

Fill in the entries in your summary sheet
(You may refer to Tutorial 8 slides)

2 sensors:
Place carefully

You decide your own comparator signals
Design your own systems

Lab06 Example

- Draw the truth table

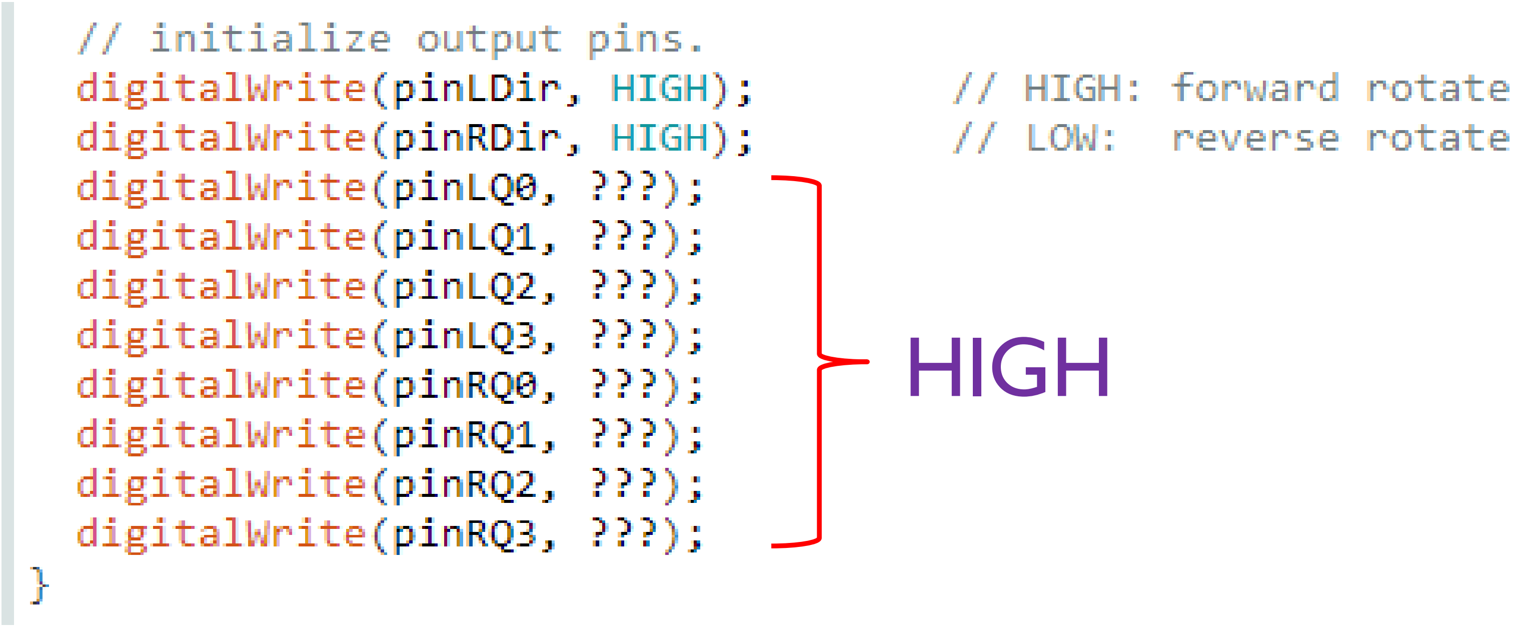
(for your reference)

Direction Control

dir: Forward=1 Back=0

Sensors		Car Action	Rotation		Left Motor (L)					Right Motor (R)				
L	R		Left	Right	dir	Q3	Q2	Q1	Q0	dir	Q3	Q2	Q1	Q0
0	0	Turn left	B	F	0	1	1	1	1	1	1	1	1	1
0	1	Turn left	B	F	0	1	1	1	1	1	1	1	1	1
1	0	Turn right	F	B	1	1	1	1	1	0	1	1	1	1
1	1	Forward	F	F	1	1	1	1	1	1	1	1	1	1

Speed: LQ & RQ

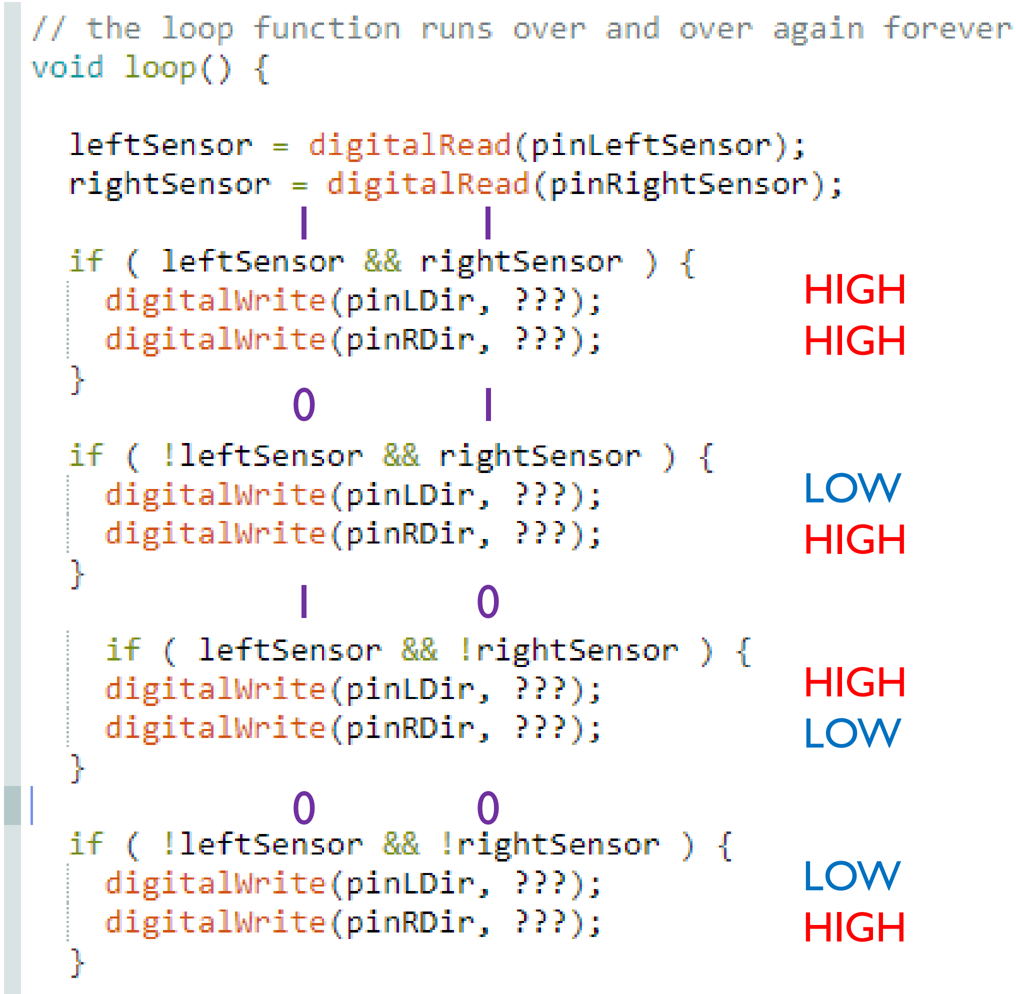


```
  // initialize output pins.
  digitalWrite(pinLDir, HIGH);         // HIGH: forward rotate
  digitalWrite(pinRDir, HIGH);         // LOW:  reverse rotate
  digitalWrite(pinLQ0, ???);
  digitalWrite(pinLQ1, ???);
  digitalWrite(pinLQ2, ???);
  digitalWrite(pinLQ3, ???);
  digitalWrite(pinRQ0, ???);
  digitalWrite(pinRQ1, ???);
  digitalWrite(pinRQ2, ???);
  digitalWrite(pinRQ3, ???);
}
```

HIGH

Direction: Ldir & Rdir

- “!” logic NOT
- “&&” Logical AND



```
// the loop function runs over and over again forever
void loop() {

  leftSensor = digitalRead(pinLeftSensor);
  rightSensor = digitalRead(pinRightSensor);
             1         1
  if ( leftSensor && rightSensor ) {
    digitalWrite(pinLDir, ???);                     HIGH
    digitalWrite(pinRDir, ???);                     HIGH
  }
             0         1
  if ( !leftSensor && rightSensor ) {
    digitalWrite(pinLDir, ???);                     LOW
    digitalWrite(pinRDir, ???);                     HIGH
  }
             1         0
    if ( leftSensor && !rightSensor ) {
    digitalWrite(pinLDir, ???);                     HIGH
    digitalWrite(pinRDir, ???);                     LOW
  }
             0         0
  if ( !leftSensor && !rightSensor ) {
    digitalWrite(pinLDir, ???);                     LOW
    digitalWrite(pinRDir, ???);                     HIGH
  }
```