

Lesson 1 - Make The Car Move

Points of this section

Learning part :



Learn how to use Arduino IDE



Make the car move by uploading program

Preparations:



One car (with a battery)

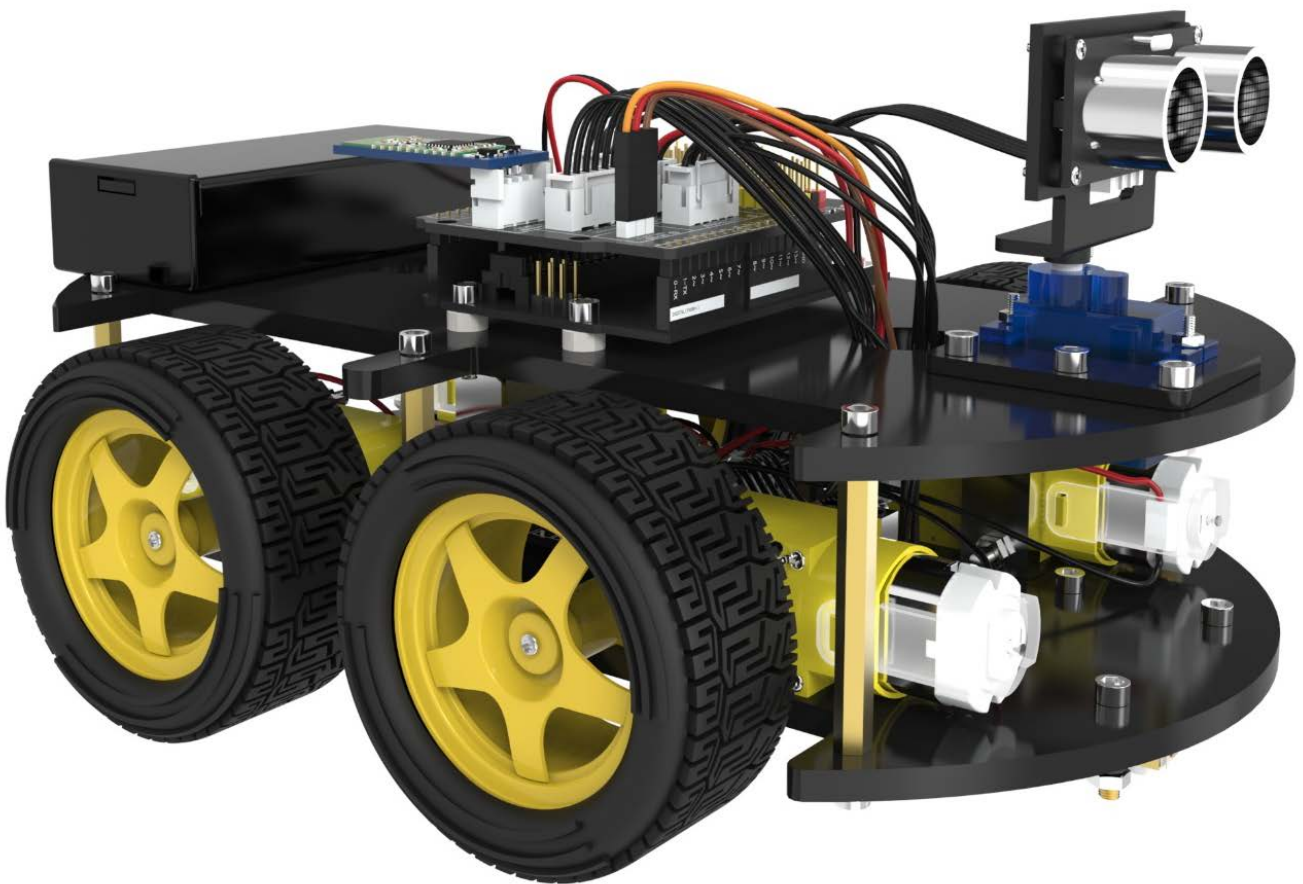


One USB cable

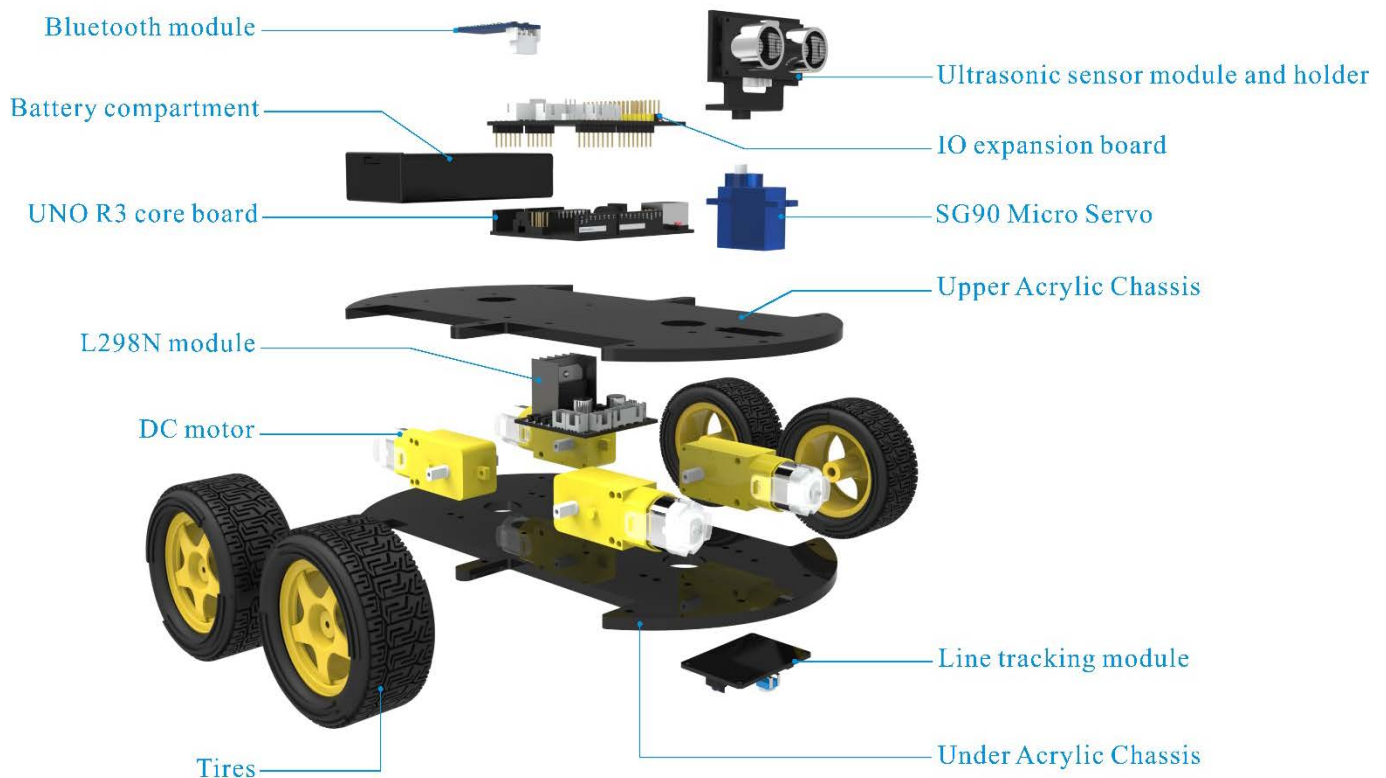
I . Introduction of the car

This kit is an extremely flexible vehicular kit particularly designed for education, competition and entertainment purposes. The upper panel of the kit is directly compatible with 9-gram steering engine. It also carries supersonic sensor, battery and other fixed holes to facilitate installation of various sensors. This is a very funny and versatile robot that meets learning and production purposes. With it, you can implement diverse interesting ideas, such as Bluetooth and infrared remote control, automatic avoidance of obstacles, and line inspection.

Let's describe the small vehicle that will accompany us for a long time in the future.



Each parts of the car is as below:



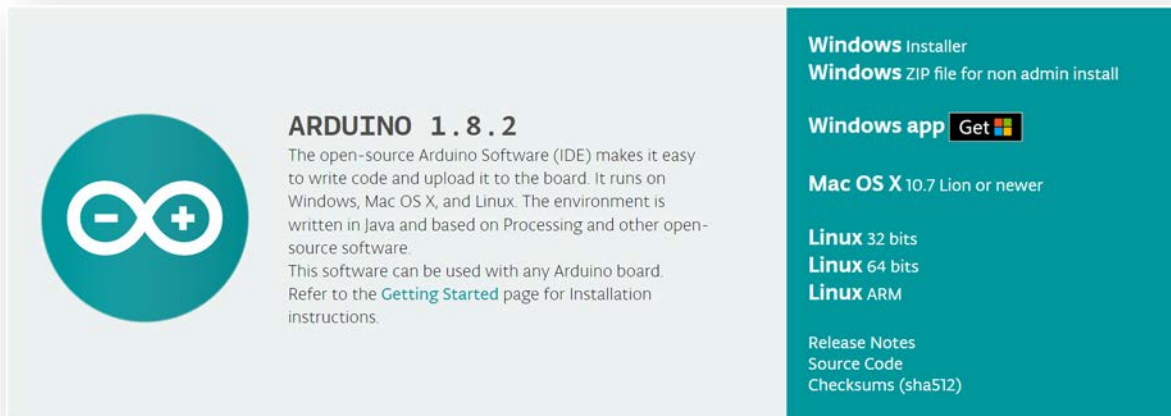
Function of each part:

1. Battery holder with a switch: provide power supply for the vehicle
2. Electric motor + wheel: drive the vehicle to move
3. acrylic plate: the frame of the car
4. L298N motor driving board: drive the motor to rotate
5. UNO controller board: the brain of the car, controls all the parts
6. V5 sensor expansion board: combined with the UNO, make the connection become more easier
7. Servo and cloud platform: enable the GP2Y0A21 distance sensor to rotate 180 degrees
8. Ultrasonic sensor module: distance measurement and obstacle avoidance
9. Line tracking module: black and white sensor for recognition of the white and black lanes
10. Infrared receiver and remote control: provide the infrared remote control function
11. Bluetooth module: provide the Bluetooth control function

II. Upload program

Each movement of the vehicle is controlled by the program so it's necessary to get the program installed and set up correctly. We will use the Arduino Software IDE (Integrated Development Environment) as a programming tool.

STEP 1: Go to <https://www.arduino.cc/en/Main/Software> and find below page.



The version available at this website is usually the latest version, and the actual version may be newer than the version in the picture.

STEP2: Download the development software that is suited for the operating system of your computer.

Take Windows as an example here.

You can install it using the EXE installation package or the green package.

Windows Installer
Windows ZIP file for non admin install

The following is the exe implementation of the installation procedures.

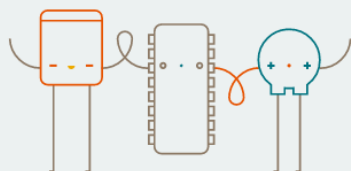
Press the char “Windows Installer”

Windows Installer

Press the button “JUST DOWNLOAD” to download the software.

Support the Arduino Software

Consider supporting the Arduino Software by contributing to its development. (US tax payers, please note this contribution is not tax deductible). Learn more on how your contribution will be used.



SINCE MARCH 2015, THE ARDUINO IDE HAS BEEN DOWNLOADED **8,808,272** TIMES. (IMPRESSIVE!) NO LONGER JUST FOR ARDUINO AND GENUINO BOARDS, HUNDREDS OF COMPANIES AROUND THE WORLD ARE USING THE IDE TO PROGRAM THEIR DEVICES, INCLUDING COMPATIBLES, CLONES, AND EVEN COUNTERFEITS. HELP ACCELERATE ITS DEVELOPMENT WITH A SMALL CONTRIBUTION! REMEMBER: OPEN SOURCE IS LOVE!

\$3

\$5

\$10

\$25

\$50


OTHER

JUST DOWNLOAD

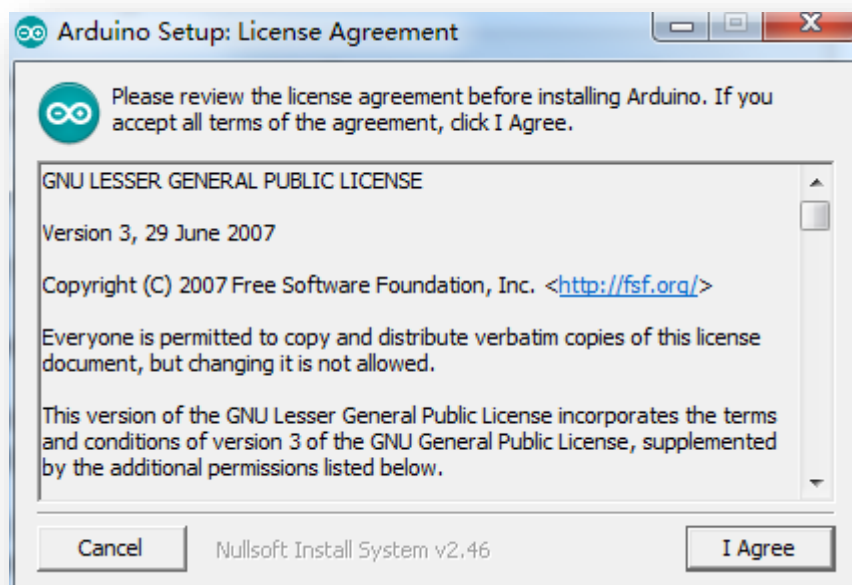
CONTRIBUTE & DOWNLOAD

JUST DOWNLOAD

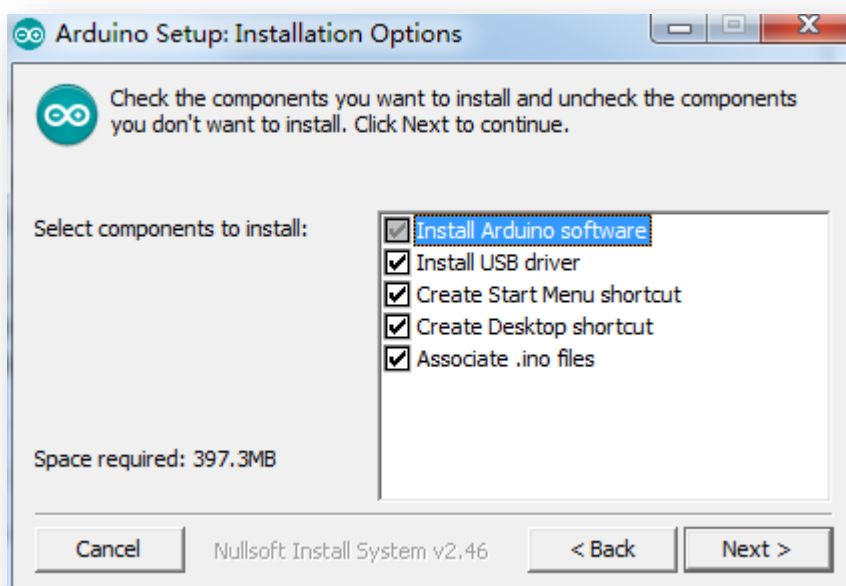
The download file

 arduino-1.8.2-windows.exe

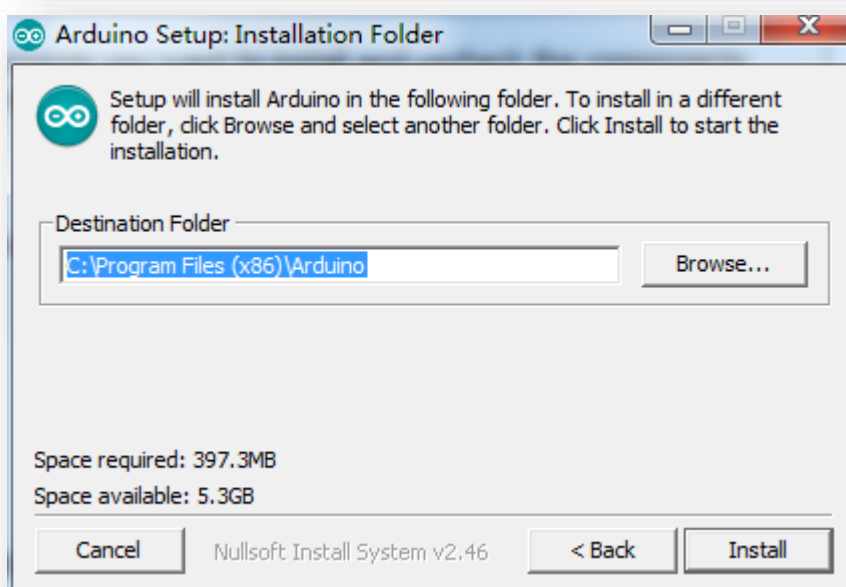
These are available in the materials we provide, and the versions of our materials are the latest versions when this course was made.



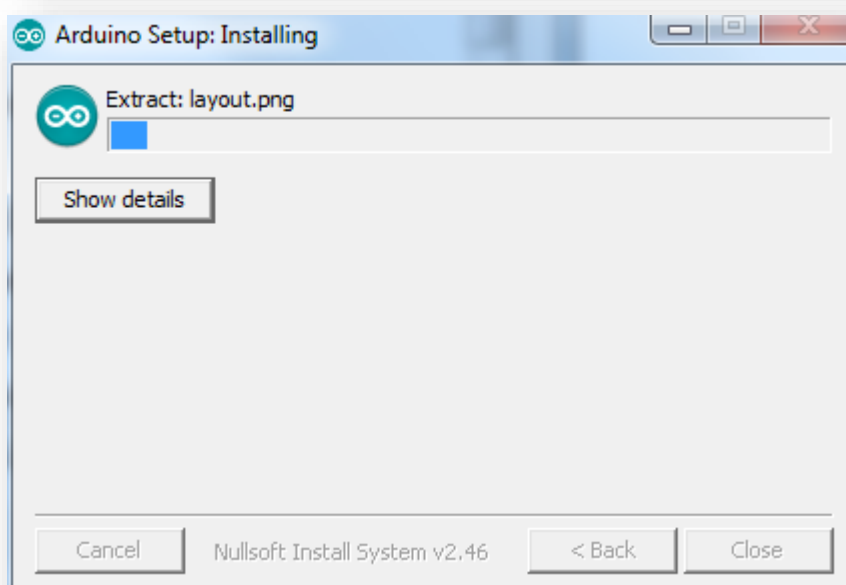
Choose I Agree to see the following interface



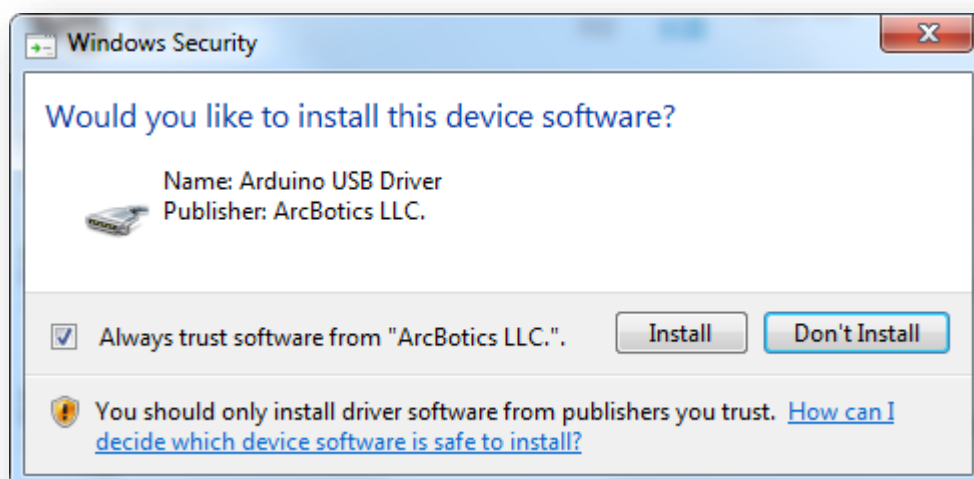
Choose Next



Press Install to initiate installation



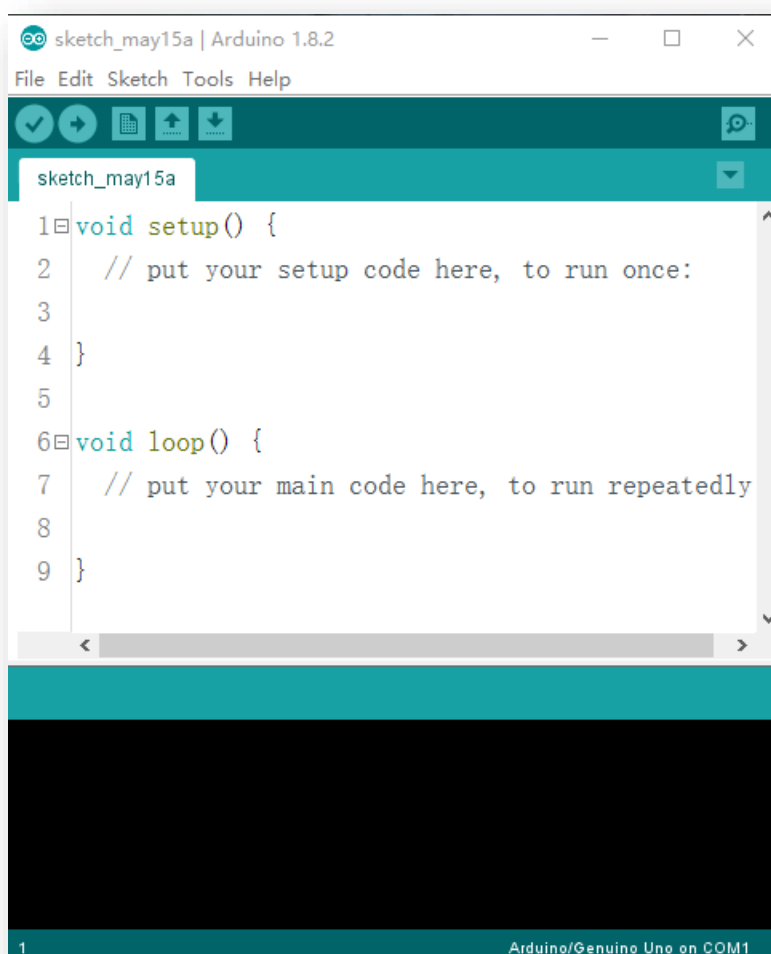
Finally, the following interface appears, you should choose Install to ensure correctness of development



Next, the following icon appears on the desktop



Double-click to enter the desired development environment

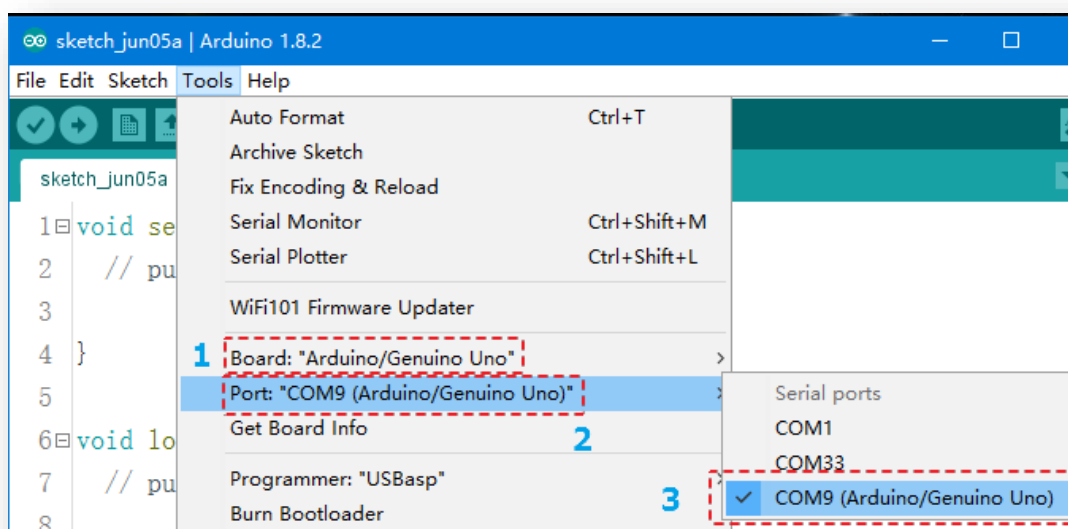


STEP3: Connect the car to the computer.



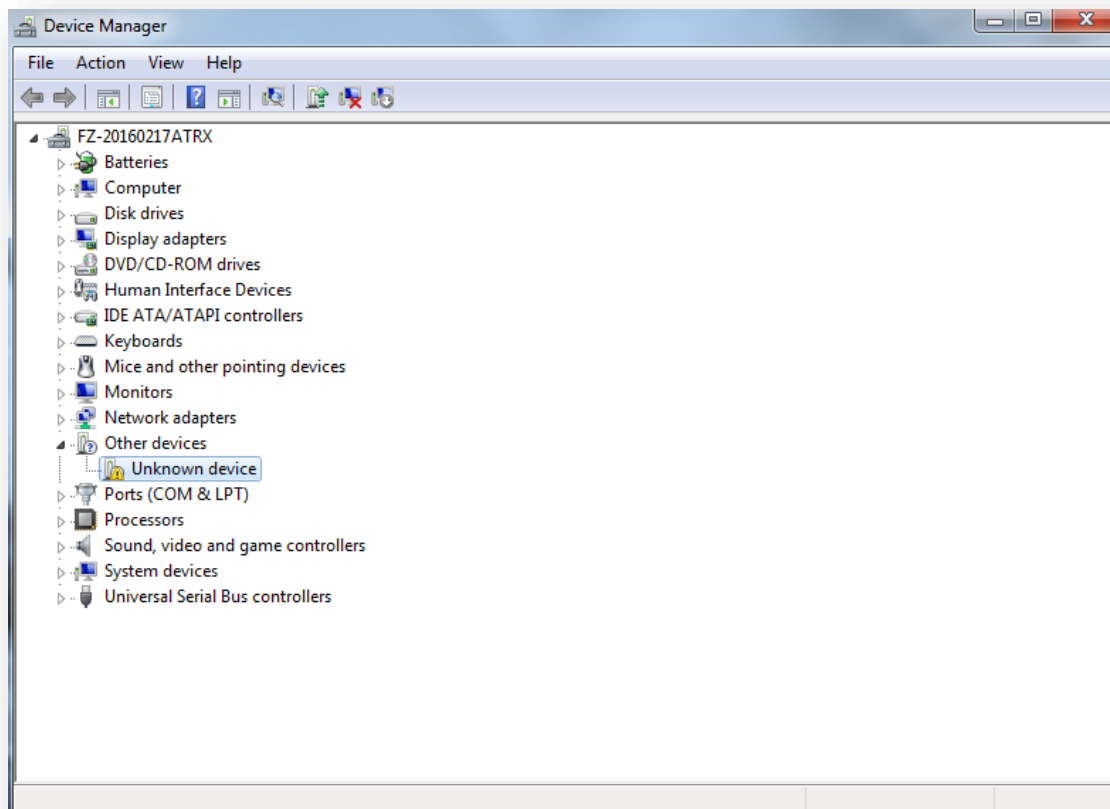
STEP 4: Open the Arduino IDE. Select "Tool" → "Board:" → "Arduino/Genuino Uno". Select "Tool" → "Port:" → "COM (Arduino/Genuino Uno)".

Each Arduino Uno board has a different COM number on the same computer and usually the COM number with a suffix name "(Arduino/Genuino Uno)" in Arduino 1.8.2. You should choose the COM number of the actual display.

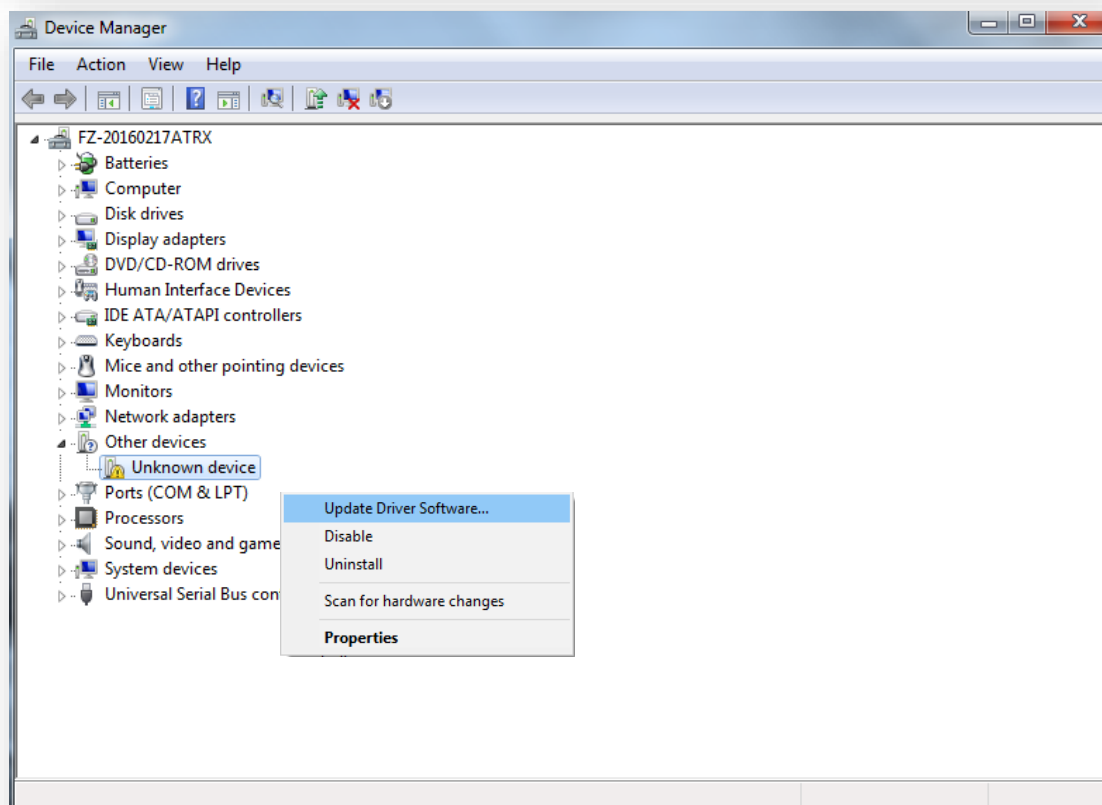


If you see the port "COM (Arduino/Genuino Uno)", it means that the vehicle has been connected correctly to the computer. In this case, you can jump to STEP 5 directly. Otherwise, you need to install the driver in the following way.

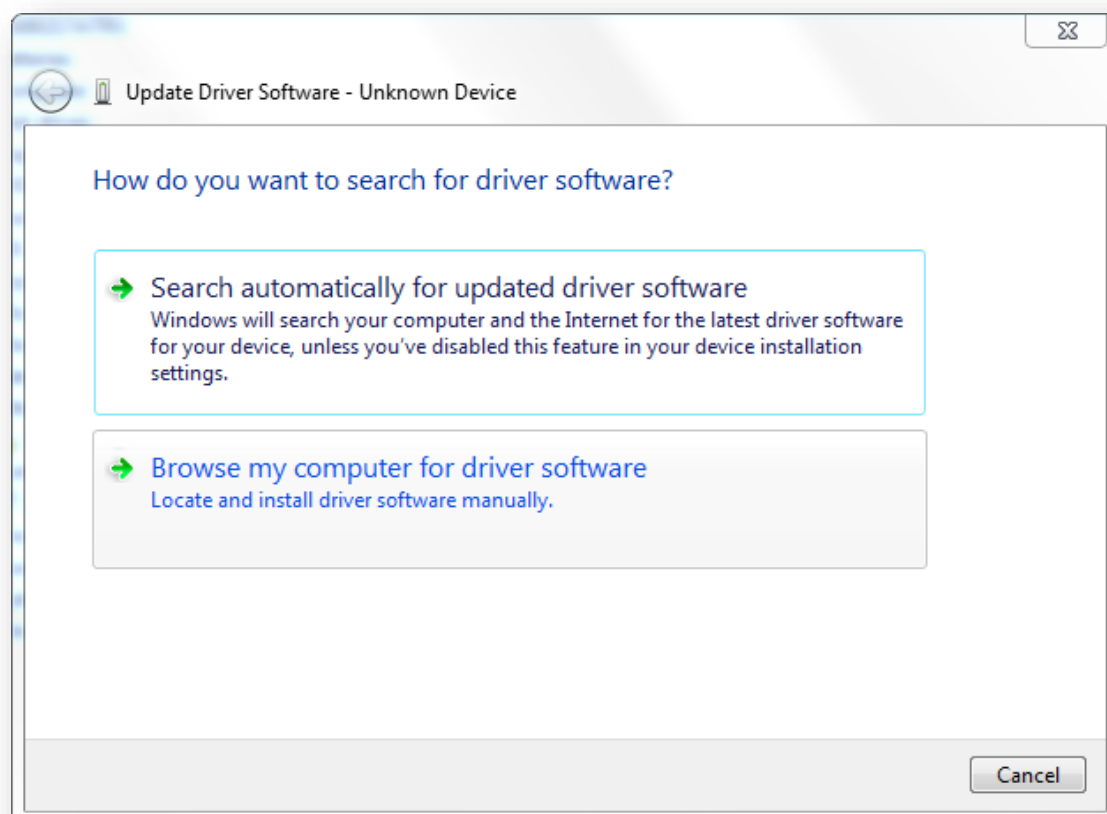
Open Device Manager by right clicking My Computer—Management—Device Manager



Right click unknown device-----update device software



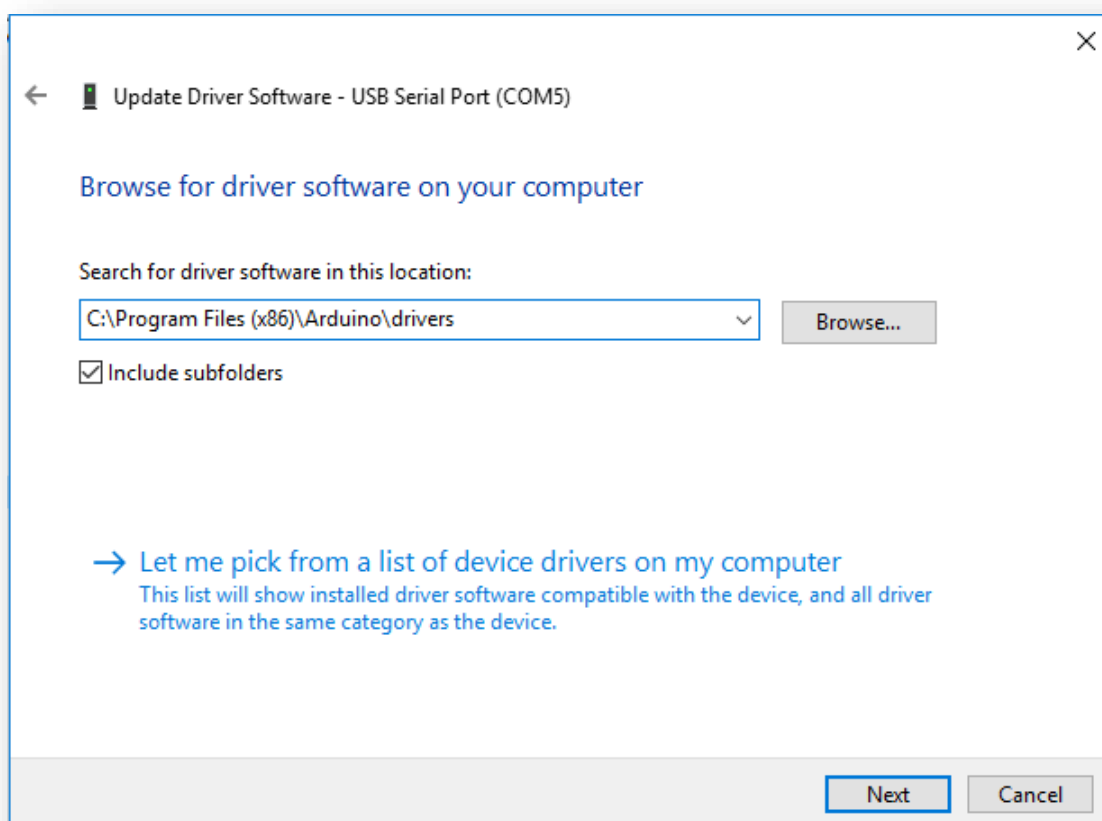
It shows that the driver has not been installed, and you need to click Browse my computer for driver software to find the drivers. The drives is in the Arduino folder. Normally you will install the folder in C:\Program Files (x86)\Arduino.



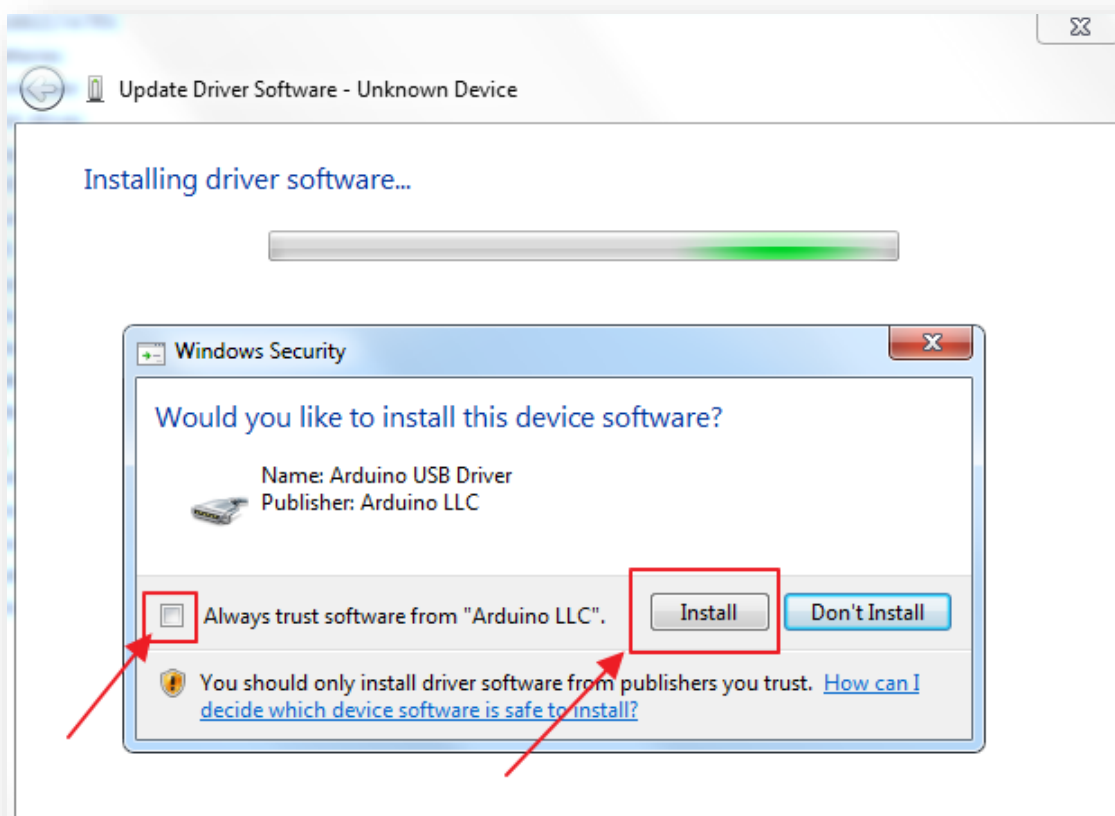
Arduino install folder

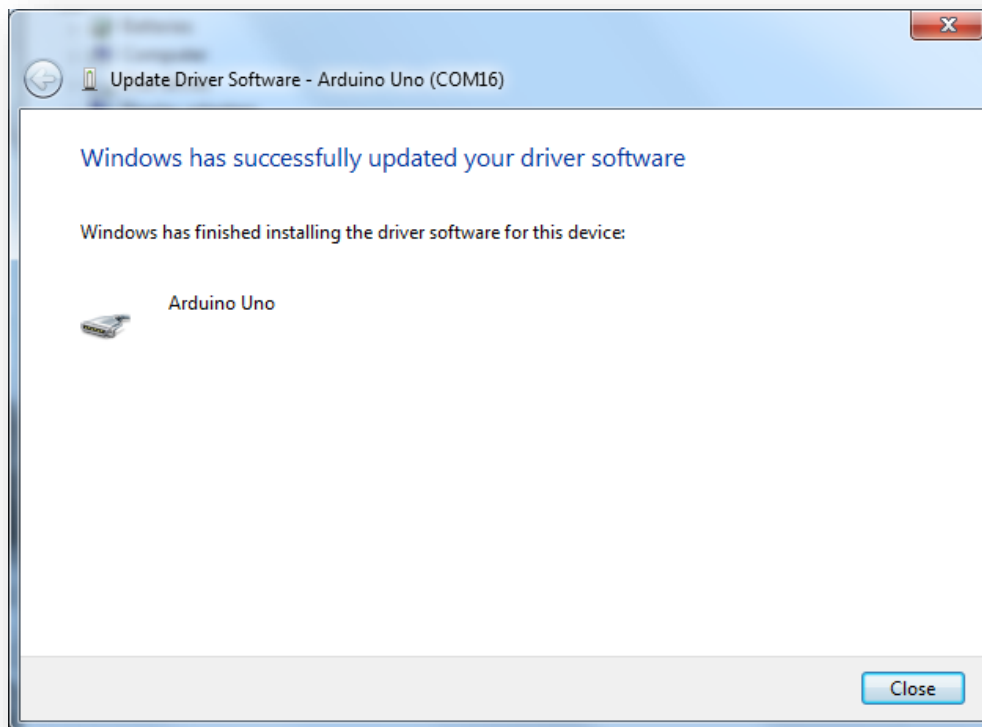
This PC > Win10 (C:) > Program Files (x86) > Arduino >				
Name	Date modified	Type	Size	
drivers	1/16/2017 9:18 AM	File folder		
examples	1/16/2017 9:18 AM	File folder		
hardware	1/16/2017 9:18 AM	File folder		
java	1/16/2017 9:18 AM	File folder		
lib	1/16/2017 9:18 AM	File folder		
libraries	1/16/2017 9:18 AM	File folder		
reference	1/16/2017 9:18 AM	File folder		
tools	1/16/2017 9:18 AM	File folder		
tools-builder	1/16/2017 9:18 AM	File folder		
arduino.exe	1/9/2017 7:35 PM	Application	395 KB	
arduino.l4j.ini	1/9/2017 7:35 PM	Configuration sett...	1 KB	
arduino_debug.exe	1/9/2017 7:35 PM	Application	392 KB	
arduino_debug.l4j.ini	1/9/2017 7:35 PM	Configuration sett...	1 KB	
arduino-builder.exe	1/9/2017 7:32 PM	Application	3,192 KB	
libusb0.dll	1/9/2017 7:32 PM	Application extens...	43 KB	
msvcp100.dll	1/9/2017 7:32 PM	Application extens...	412 KB	
msvcr100.dll	1/9/2017 7:32 PM	Application extens...	753 KB	
revisions.txt	1/9/2017 7:32 PM	Text Document	81 KB	
uninstall.exe	1/16/2017 9:18 AM	Application	404 KB	
wrapper-manifest.xml	1/9/2017 7:35 PM	XML Document	1 KB	

Select the Arduino driver folder

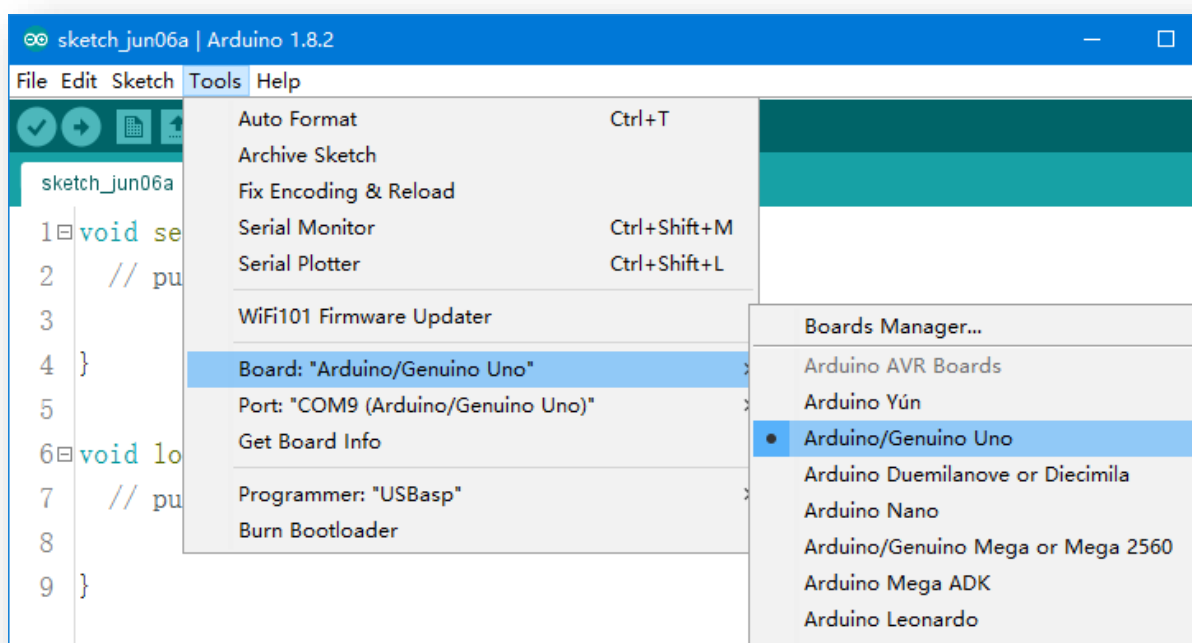


Install Arduino USB device

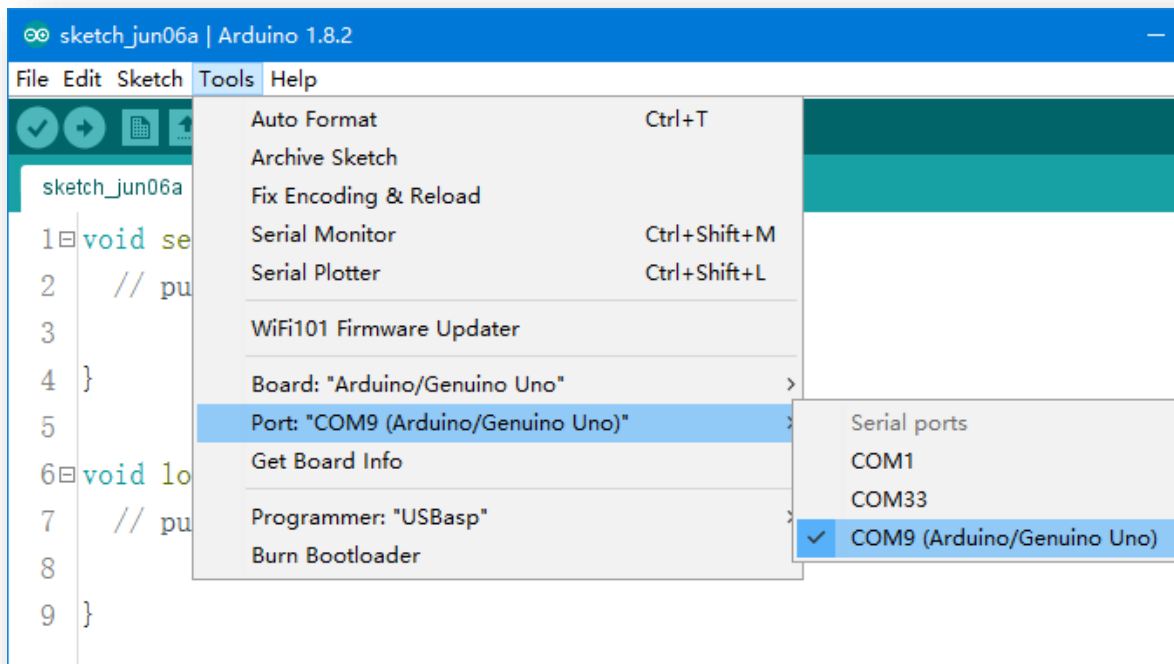




STEP5: After the driver is installed, please open the IDE and then click “Tools”→”Board”→
“Arduino/Genuino Uno”.

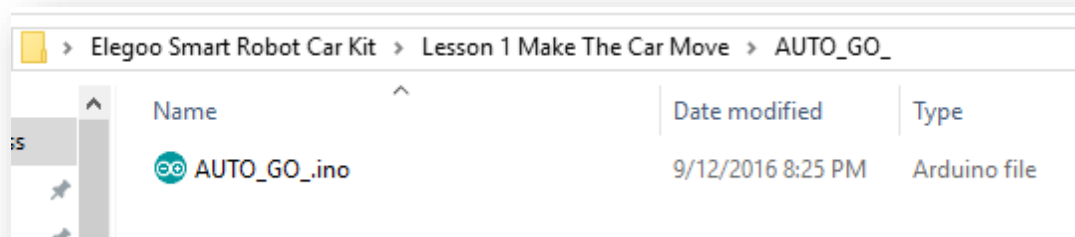


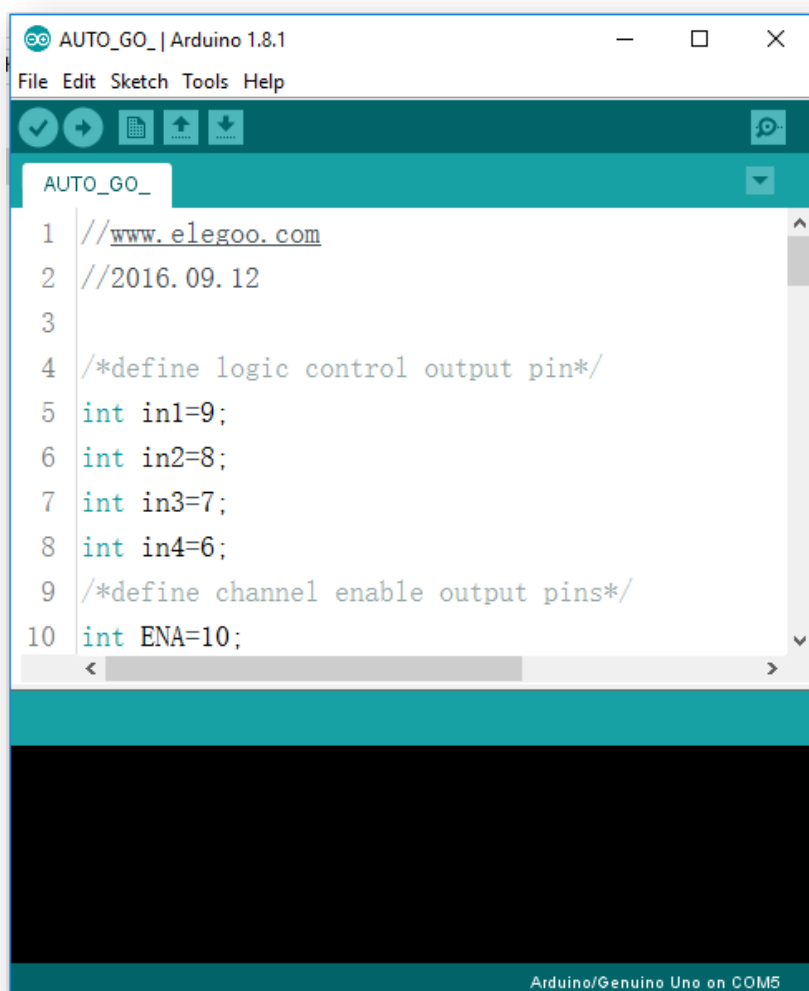
STEP6: Click “Tools”→”Port”→COM.



STEP7: Open the code file in the directory “\Lesson 1 Make The Car Move

\AUTO_GO_\AUTO_GO.ino” and upload to the UNO controller board. **(TIPS: The bluetooth module should be pulled out when you upload the program every time, or it will be failed to upload the program.)**

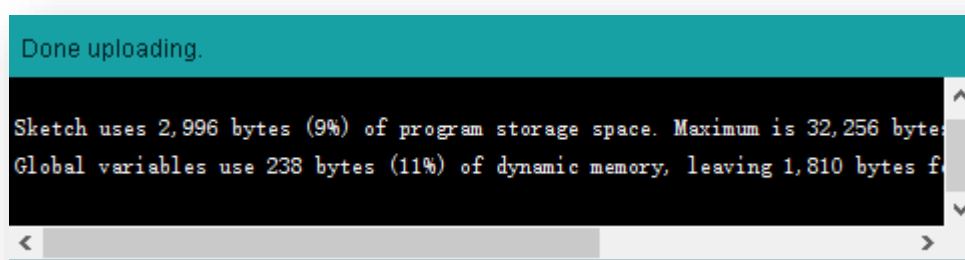




```
Arduino IDE - AUTO_GO_ | Arduino 1.8.1
File Edit Sketch Tools Help

AUTO_GO_
1 //www.elegoo.com
2 //2016.09.12
3
4 /*define logic control output pin*/
5 int in1=9;
6 int in2=8;
7 int in3=7;
8 int in4=6;
9 /*define channel enable output pins*/
10 int ENA=10;

Arduino/Genuino Uno on COM5
```



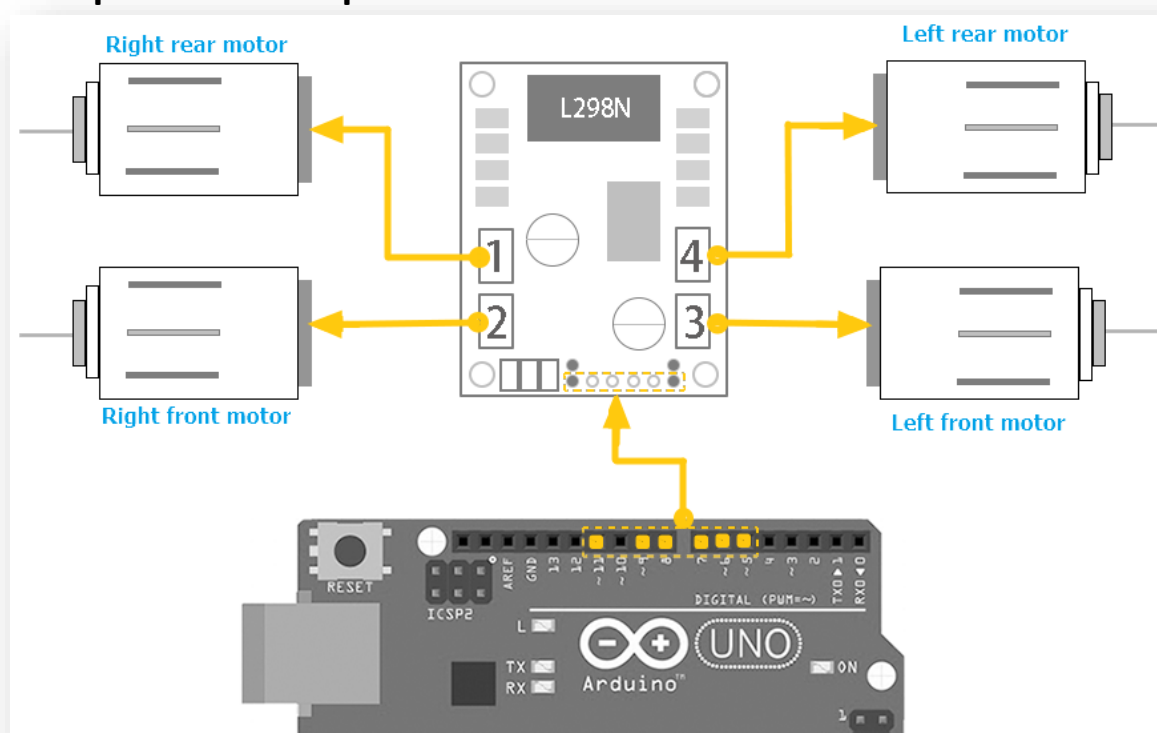
```
Done uploading.

Sketch uses 2,996 bytes (9%) of program storage space. Maximum is 32,256 bytes.
Global variables use 238 bytes (11%) of dynamic memory, leaving 1,810 bytes free.
```

The picture above shows that it is uploaded successfully.

STEP8: Let's have a look at the results. Upload the program to the UNO controller board. After disconnecting the car to the computer, you can turn on the power switch and put the car on the ground. Then you will see the car moving.

III. Description of Principles



How to use L298N motor driver board

Definition of the connection ports on L298N board have been marked above. The motors should be connected to the L298N board as the picture above, and if you find the rotational direction of one of the motors is opposite, please change the connecting position of its black and red wires.

L298N GND is connected to battery box GND;

L298N VCC is connected to battery box VCC;

UNO board is also connected to battery box.

L298N 5V here cannot be connected to UNO 5V;

ENA and ENB control the speed of right motor and speed of left motor separately by PWM.

IN1, IN2, IN3, IN4: IN1 and IN2 are used to control left motor, IN3 and IN4 are used to control right motor. About the principle, please look at the sheet below: (We take left motor for example)

ENA	IN1	IN2	DC MOTOR STATUS
0	X	X	STOP
1	0	0	BRAKING
1	1	0	FORWARD
1	0	1	BACKWARD
1	1	1	BARKING

IV. Make the Car Move

The first step: Drive the motor

We will try to move the motor without speed controlling. Because it is easy to write program without speed controlling.

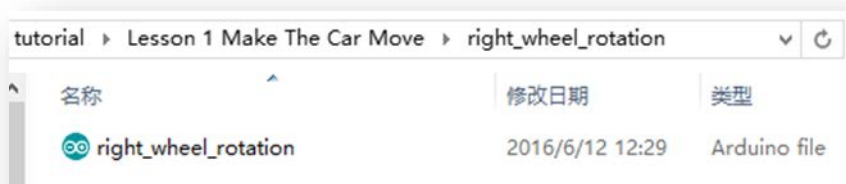
First of all, let's see the connection of the motor the L298N board, we will use Arduino 5, 6, 7, 8, 9, 11 pins to control the car. 9 and 11 pins control the right wheel. 7 and 8 pins control the left wheel. 5 and 6 pins control ENA and ENB.

So the connection is as below:

L298N	V5 expansion board
ENA	5
ENB	6
IN1	7
IN2	8
IN3	9
IN4	11

Based on the sheet given above, we first design a simple program to make the right wheel turn 0.5s in positive direction, stop 0.5s, turn 0.5s in negative direction and stop 0.5s. And the wheel will repeat the reaction.

Connect the UNO controller board to the computer, open the code file in the path “\Lesson 1 Make The Car Move\right_wheel_rotation\ right_wheel_rotation.ino”. Upload the program to the UNO board.



Code preview:

```
//www.elegoo.com

//    Right motor truth table
//Here are some handy tables to show the various modes of operation.
//  ENB      IN3      IN4      Description
//  LOW   Not Applicable  Not Applicable  Motor is off
//  HIGH    LOW          LOW          Motor is stopped (brakes)
//  HIGH    LOW          HIGH         Motor is on and turning forwards
```

```
// HIGH      HIGH      LOW      Motor is on and turning backwards
// HIGH      HIGH      HIGH     Motor is stopped (brakes)

// define IO pin
#define ENB 6
#define IN3 9
#define IN4 11

//init the car
void setup() {
  pinMode(IN3, OUTPUT); //set IO pin mode OUTPUT
  pinMode(IN4, OUTPUT);
  pinMode(ENB, OUTPUT);
  digitalWrite(ENB, HIGH); //Enable right motor
}

//main loop
void loop() {
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, HIGH); //Right wheel turning forwards
  delay(500);              //delay 500ms
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, LOW); //Right wheel stoped
  delay(500);
  digitalWrite(IN3, HIGH);
  digitalWrite(IN4, LOW); //Right wheel turning backwards
  delay(500);
  digitalWrite(IN3, HIGH);
  digitalWrite(IN4, HIGH); //Right wheel stoped
  delay(500);
}
```

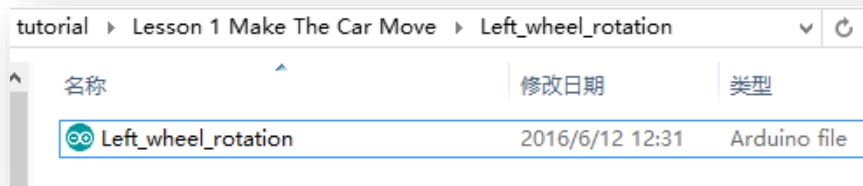
Disconnect it from the computer, and then switch on the car's power supply. You will see that the right wheel moves as you expected.

If the car is not moving, press the reset button on the UNO board.

If the moving direction of the motor is different from the direction you set, you can change the connection of black and red lines from the motor to L298N board.

Then, we make the left wheel rotate in the same way.

Connect the UNO controller board to the computer, open the code file in the path "Lesson 1 Make The Car Move\Left_wheel_rotation\ Left_wheel_rotation.ino". Upload the program to the UNO board.



Code preview:

```
//www.elegoo.com

//    Left motor truth table
//Here are some handy tables to show the various modes of operation.
//  ENA      IN1      IN2      Description
//  LOW  Not Applicable  Not Applicable  Motor is off
//  HIGH     LOW      LOW      Motor is stopped (brakes)
//  HIGH     HIGH     LOW      Motor is on and turning forwards
//  HIGH     LOW      HIGH     Motor is on and turning backwards
//  HIGH     HIGH     HIGH     Motor is stopped (brakes)

// define IO pin
#define ENA 5
#define IN1 7
#define IN2 8

//init the car
void setup() {
  pinMode(IN1, OUTPUT);  //set IO pin mode OUTPUT
  pinMode(IN2, OUTPUT);
  pinMode(ENA, OUTPUT);
  digitalWrite(ENA, HIGH); //Enable left motor
}

//mian loop
void loop() {
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW); //Right wheel turning forwards
  delay(500);             //delay 500ms
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, LOW); //Right wheel stoped
  delay(500);
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, HIGH); //Right wheel turning backwards
  delay(500);
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, HIGH); //Right wheel stoped
}
```

```
delay(500);
}
```

Disconnect it from the computer, and then switch on the car's power supply. You will see that the right wheel moves as you expected.

The second step: Move forward and backward

After finishing debugging the car, you can write programs to make the car move.

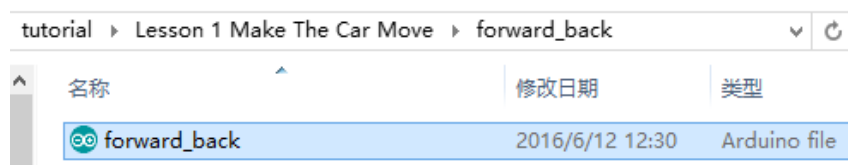
Below is the way how car moves:

CAR	forward	back	stop
Left wheel	Forward	back	stop
Right wheel	Forward	back	stop

CAR	Turn left	Turn right	stop
Left wheel	back	Forward	Stop
Right wheel	forward	back	stop

Next, we will write a simple program to make the car go forward 0.5s , then stop 0.5s, then back up 0.5s and then stop 0.5s.

Connect the UNO controller board to the computer, open the code file in the path "Lesson 1 Make The Car Move\forward_back\forward_back.ino". Upload the program to the UNO board.



Code preview:

```
//www.elegoo.com

// Left motor truth table
// ENA      IN1      IN2      Description
// LOW      Not Applicable  Not Applicable  Motor is off
// HIGH      LOW      LOW      Motor is stopped (brakes)
// HIGH      HIGH      LOW      Motor is on and turning forwards
// HIGH      LOW      HIGH      Motor is on and turning backwards
// HIGH      HIGH      HIGH      Motor is stopped (brakes)
```

```
// Right motor truth table
// ENB      IN3      IN4      Description
// LOW      Not Applicable      Not Applicable      Motor is off
// HIGH      LOW      LOW      Motor is stopped (brakes)
// HIGH      LOW      HIGH      Motor is on and turning forwards
// HIGH      HIGH      LOW      Motor is on and turning backwards
// HIGH      HIGH      HIGH      Motor is stopped (brakes)

// The direction of the car's movement
// Left motor      Right motor      Description
// stop(off)      stop(off)      Car is stopped
// forward        forward        Car is running forwards
// forward        backward        Car is turning right
// backward        forward        Car is turning left
// backward        backward        Car is running backwards

//define the L298n IO pin
#define ENA 5
#define ENB 6
#define IN1 7
#define IN2 8
#define IN3 9
#define IN4 11

void setup() {
  pinMode(IN1, OUTPUT);
  pinMode(IN2, OUTPUT);
  pinMode(IN3, OUTPUT);
  pinMode(IN4, OUTPUT);
  pinMode(ENA, OUTPUT);
  pinMode(ENB, OUTPUT);
  digitalWrite(ENA, HIGH);
  digitalWrite(ENB, HIGH);
}

void loop() {
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, HIGH); //go forward
  delay(500);
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, LOW); //stop
}
```

```

delay(500);
digitalWrite(IN1, LOW);
digitalWrite(IN2, HIGH);
digitalWrite(IN3, HIGH);
digitalWrite(IN4, LOW); //go back
delay(500);
digitalWrite(IN1, LOW);
digitalWrite(IN2, LOW);
digitalWrite(IN3, HIGH);
digitalWrite(IN4, HIGH); //stop
delay(500);
}

```

Upload the program to the UNO board, disconnect it from the computer, and then switch on the car's power supply. You will see that the right wheel moves as you expected.

The third step: Write the program

It may be a difficult for you to write the whole program to make the car move automatically. So we separate the movements into different function, for example moving forward and turning left. And when we write the program in the final step, we can call the function.

Next, we begin to write programs for each movement:

Code preview:

```

void forward(){
    digitalWrite(ENA,HIGH); //enable L298n A channel
    digitalWrite(ENB,HIGH); //enable L298n B channel
    digitalWrite(IN1,HIGH); //set IN1 high level
    digitalWrite(IN2,LOW); //set IN2 low level
    digitalWrite(IN3,LOW); //set IN3 low level
    digitalWrite(IN4,HIGH); //set IN4 high level
    Serial.println("Forward");//send message to serial monitor
}

void back(){
    digitalWrite(ENA,HIGH);
    digitalWrite(ENB,HIGH);
    digitalWrite(IN1,LOW);
    digitalWrite(IN2,HIGH);
    digitalWrite(IN3,HIGH);
}

```

```

digitalWrite(IN4,LOW);
Serial.println("Back");
}

void left(){
  digitalWrite(ENA,HIGH);
  digitalWrite(ENB,HIGH);
  digitalWrite(IN1,LOW);
  digitalWrite(IN2,HIGH);
  digitalWrite(IN3,LOW);
  digitalWrite(IN4,HIGH);
  Serial.println("Left");
}

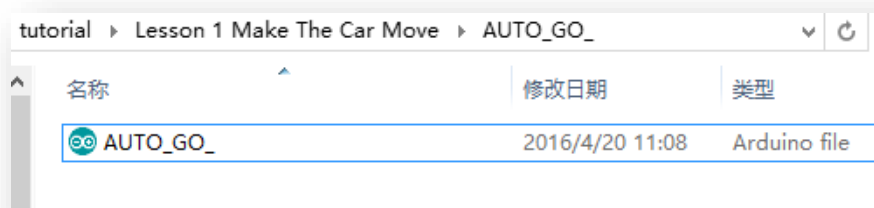
void right(){
  digitalWrite(ENA,HIGH);
  digitalWrite(ENB,HIGH);
  digitalWrite(IN1,HIGH);
  digitalWrite(IN2,LOW);
  digitalWrite(IN3,HIGH);
  digitalWrite(IN4,LOW);
  Serial.println("Right");
}

```

The fourth step: Move automatically

We start to write program to make the car move automatically: go forward 0.4s - back up 0.4s - turn left 0.4s - turn right 0.4s.

Connect the UNO controller board to the computer, open the code file in the directory “Lesson 1 Make The Car Move\AUTO_GO_\AUTO_GO.ino”. Upload the program to the UNO board.



Code preview:

```

//www.elegoo.com

// The direction of the car's movement
// ENA  ENB  IN1  IN2  IN3  IN4  Description
// HIGH HIGH HIGH LOW  LOW  HIGH  Car is runing forward

```



```
// HIGH HIGH LOW HIGH HIGH LOW Car is runing back
// HIGH HIGH LOW HIGH LOW HIGH Car is turning left
// HIGH HIGH HIGH LOW HIGH LOW Car is turning right
// HIGH HIGH LOW LOW LOW LOW Car is stoped
// HIGH HIGH HIGH HIGH HIGH HIGH Car is stoped
// LOW LOW N/A N/A N/A N/A Car is stoped

//define L298n module IO Pin
#define ENA 5
#define ENB 6
#define IN1 7
#define IN2 8
#define IN3 9
#define IN4 11

void forward(){
    digitalWrite(ENA,HIGH); //enable L298n A channel
    digitalWrite(ENB,HIGH); //enable L298n B channel
    digitalWrite(IN1,HIGH); //set IN1 hight level
    digitalWrite(IN2,LOW); //set IN2 low level
    digitalWrite(IN3,LOW); //set IN3 low level
    digitalWrite(IN4,HIGH); //set IN4 hight level
    Serial.println("Forward");//send message to serial monitor
}

void back(){
    digitalWrite(ENA,HIGH);
    digitalWrite(ENB,HIGH);
    digitalWrite(IN1,LOW);
    digitalWrite(IN2,HIGH);
    digitalWrite(IN3,HIGH);
    digitalWrite(IN4,LOW);
    Serial.println("Back");
}

void left(){
    digitalWrite(ENA,HIGH);
    digitalWrite(ENB,HIGH);
    digitalWrite(IN1,LOW);
    digitalWrite(IN2,HIGH);
    digitalWrite(IN3,LOW);
    digitalWrite(IN4,HIGH);
    Serial.println("Left");
}
```

```

}

void right(){
    digitalWrite(ENA,HIGH);
    digitalWrite(ENB,HIGH);
    digitalWrite(IN1,HIGH);
    digitalWrite(IN2,LOW);
    digitalWrite(IN3,HIGH);
    digitalWrite(IN4,LOW);
    Serial.println("Right");
}

//before execute loop() function,
//setup() function will execute first and only execute once
void setup() {
    Serial.begin(9600);//open serial and set the baudrate
    pinMode(IN1,OUTPUT);//before using io pin, pin mode must be set first
    pinMode(IN2,OUTPUT);
    pinMode(IN3,OUTPUT);
    pinMode(IN4,OUTPUT);
    pinMode(ENA,OUTPUT);
    pinMode(ENB,OUTPUT);
}

//Repeat execution
void loop() {
    forward(); //go forward
    delay(1000);//delay 1000 ms
    back();    //go back
    delay(1000);
    left();    //turning left
    delay(1000);
    right();   //turning right
    delay(1000);
}


```

Disconnect it from the computer, and then switch on the car's power supply. You will see that the right wheel moves as you expected.

The fifth step: speed_control

The code to achieve the function is to control the speed of the car: go forward and reduce the speed → stop 1s → running back and accelerate → stop 2s.

Connect the UNO controller board to the computer, open the code file in the directory “Lesson 1 Make The Car Move\speed_control\speed_control.ino”. Upload the program to the UNO board.

Elegoo Smart Robot Car Kit V3.0 > Lesson 1 Make The Car Move > speed_control			
材	名称	修改日期	类型
	 speed_control.ino	2017/5/11 15:35	Arduino file

Code preview:

```
//www.elegoo.com
#define ENA 5
#define ENB 6
#define IN1 7
#define IN2 8
#define IN3 9
#define IN4 11
void setup() {
  pinMode(IN1,OUTPUT);
  pinMode(IN2,OUTPUT);
  pinMode(IN3,OUTPUT);
  pinMode(IN4,OUTPUT);
  pinMode(ENA,OUTPUT);
  pinMode(ENB,OUTPUT);
}

void loop() {
  //go forward
  digitalWrite(IN1,HIGH);
  digitalWrite(IN2,LOW);
  digitalWrite(IN3,LOW);
  digitalWrite(IN4,HIGH);
  //reduce the speed
  for(int i = 255; i >= 0; i--){
    analogWrite(ENB,i);
    analogWrite(ENA,i);
    delay(20);
  }
}
```

```
//stop
analogWrite(ENB,0); //speed = 0
analogWrite(ENA,0);
delay(1000);

//runing back
digitalWrite(IN1,LOW);
digitalWrite(IN2,HIGH);
digitalWrite(IN3,HIGH);
digitalWrite(IN4,LOW);
//accelerate
for(int i = 0; i <= 255; i++){
    analogWrite(ENB,i);
    analogWrite(ENA,i);
    delay(20);
}

//stop
digitalWrite(ENB,LOW); //Motor is off
digitalWrite(ENA,LOW);
delay(2000);
}
```