通訊網路實驗

IoT應用

Android Studio

Dept. of Electrical and Computer Engineering (ECE)
National Chiao Tung University

課程大綱

- 1.認識、使用Socket
- 2.ROS系統、Turtlebot3
- 檔案

https://drive.google.com/drive/folders/1_TWgHtgsxaWKKy9_2kejSMBok70csuYA?usp=sharing

Demo項目

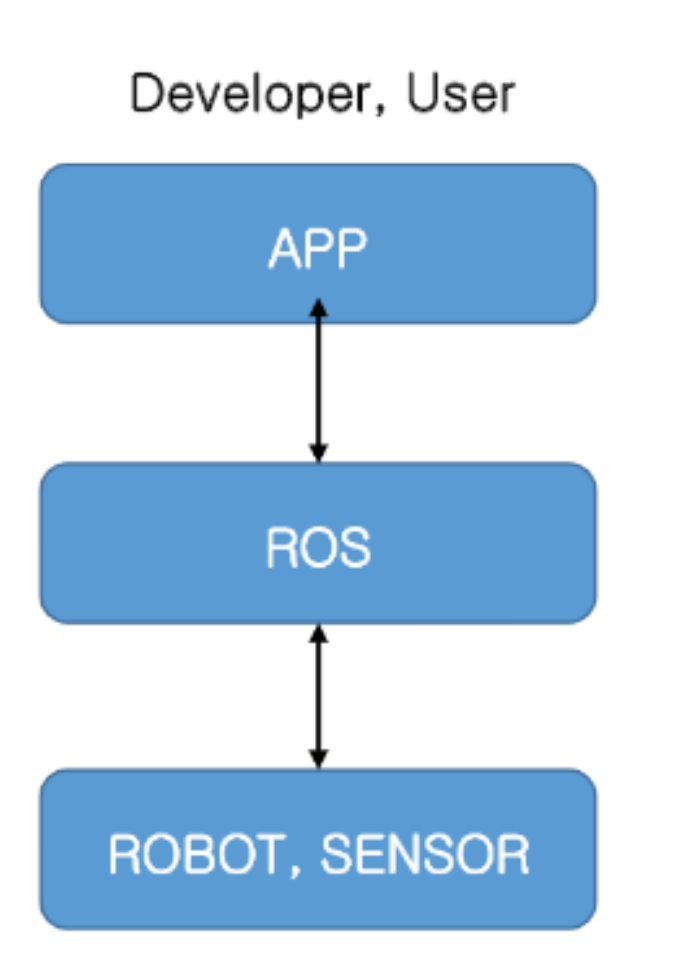
- Q1 :修改Turtlebot 的keyboard控制程式，加上左右移動
- Q2 :以APP控制Turtlebot前後移動
- Bonus : 在APP中加上”左,右”，使Turtlebot可以全方位移動

主要的機器人OS

ROS簡介(1)

- Robot Operating System，用傳統的作業系統(eg. Ubuntu, Windows)處理系統管理、人際介面等，提供多種功能，包含：控制devices、在process間傳遞訊息、管理封包等，都是機器人應用程式的基本功能
- Open-source，可支援不同devices間的溝通
- Goal:建立自己的生態系，讓大家都可以參與機器人軟體的開發
- 簡單來說，ROS結合Sensor、APP、Robot

現在的ROS生態系



ROS 簡介(2)—基本架構

- Node

  Node是最小的執行處理器，可視為一個program。

  在ROS中，是由許多nodes構成的，每一個node都可透過message傳送、接收data。

- Package

  是一個或多個nodes

- Message

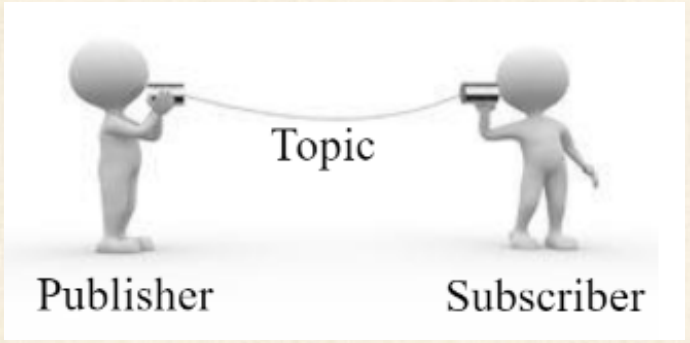
  data藉由messages在nodes間傳送及接收，而message可為integer, floating point, 和boolean等多種類型

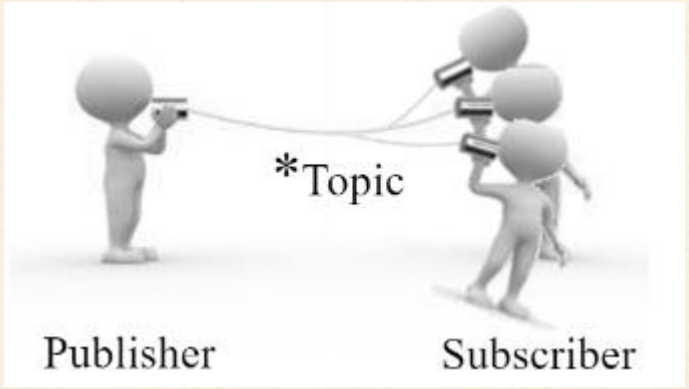
ROS 常用名詞(1)

- Topic

  也使用messages傳送，通常包含location的資料 (eg. X, Y, Θ)

- Publisher & Subscriber

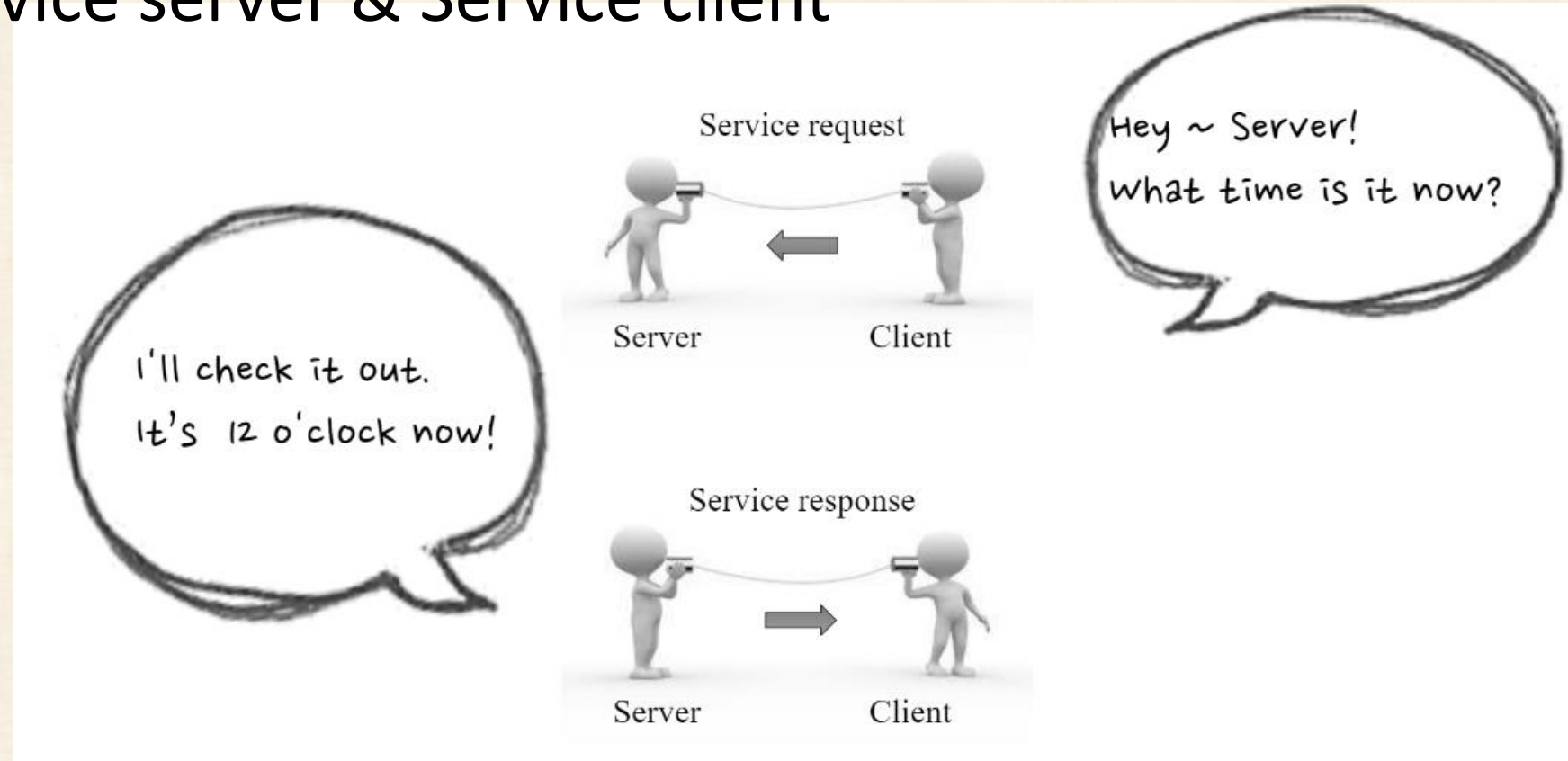




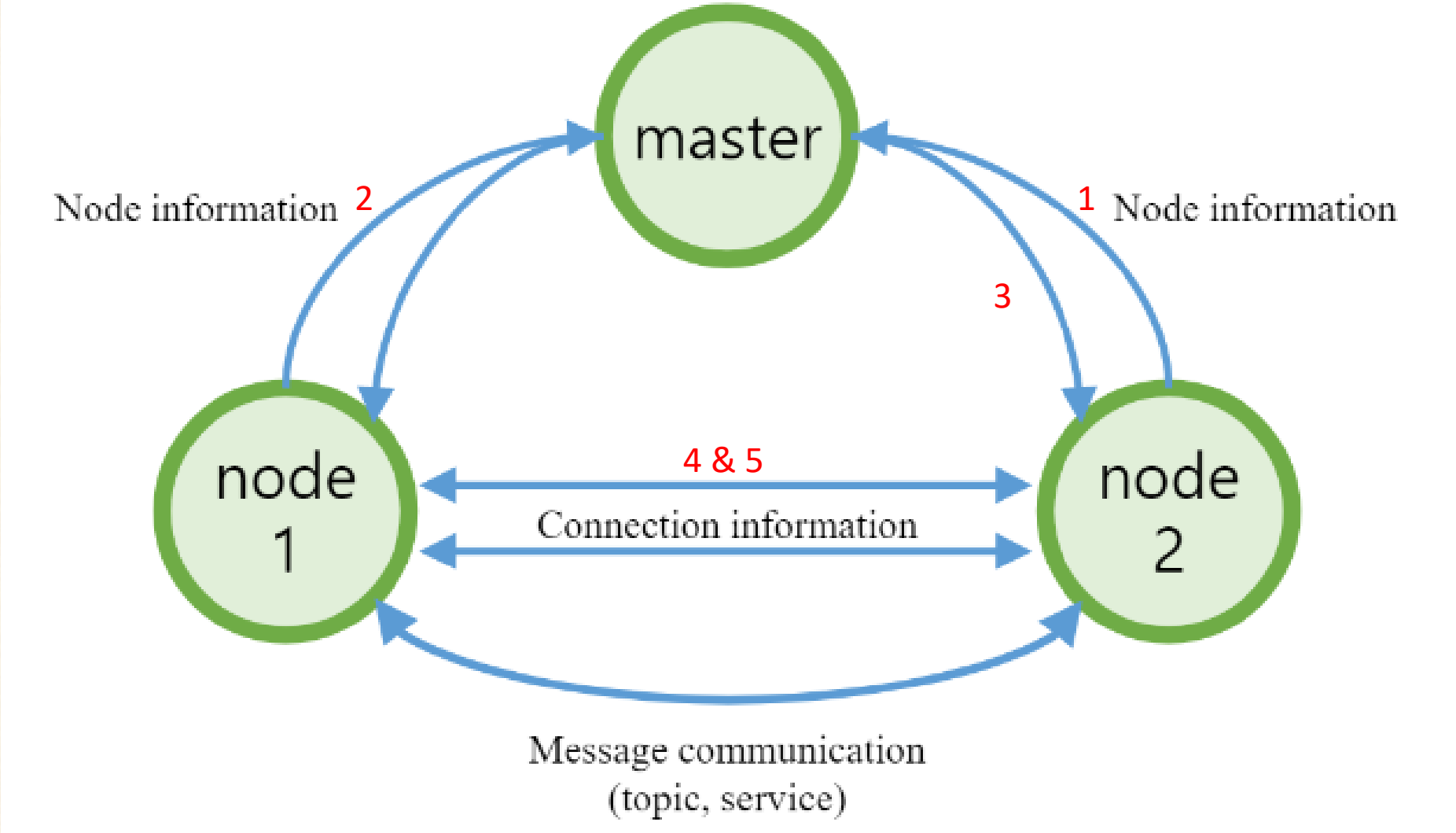
Publisher 和 Subscriber可以是一對一、多對一、一對多傳輸messages

ROS 常用名詞(2)

- Service request/response
- Service server & Service client



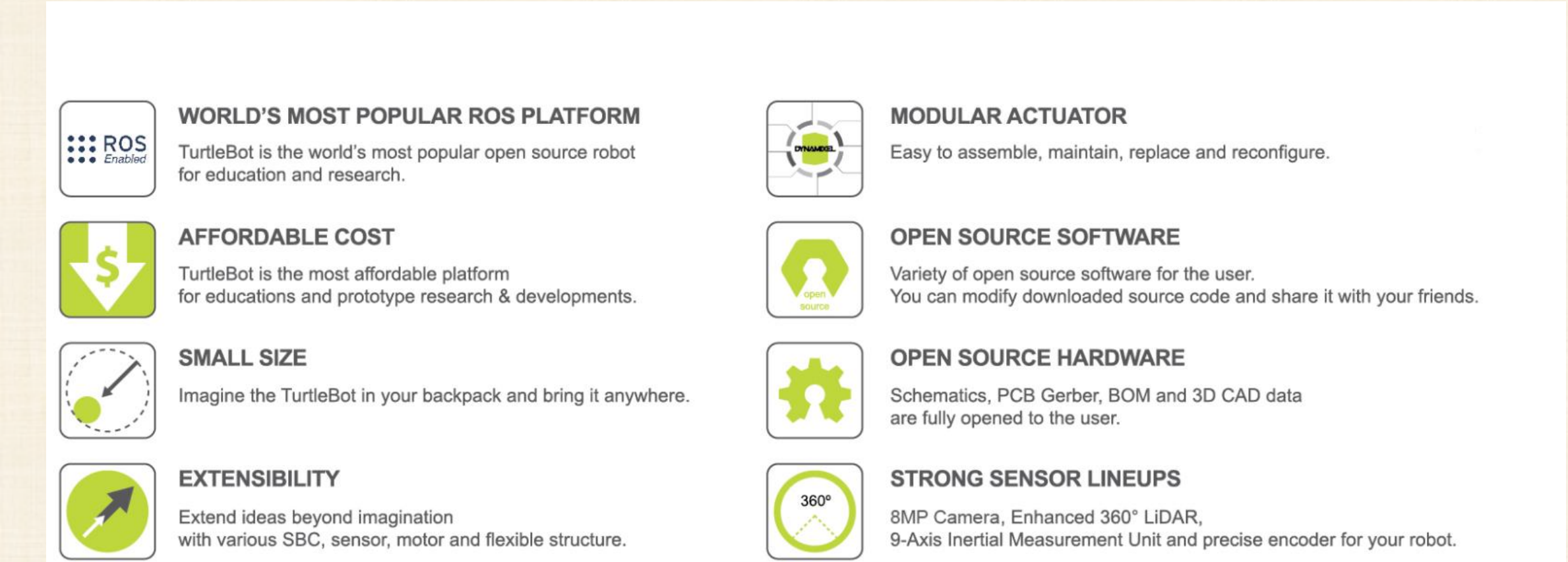
Message Communication among Nodes



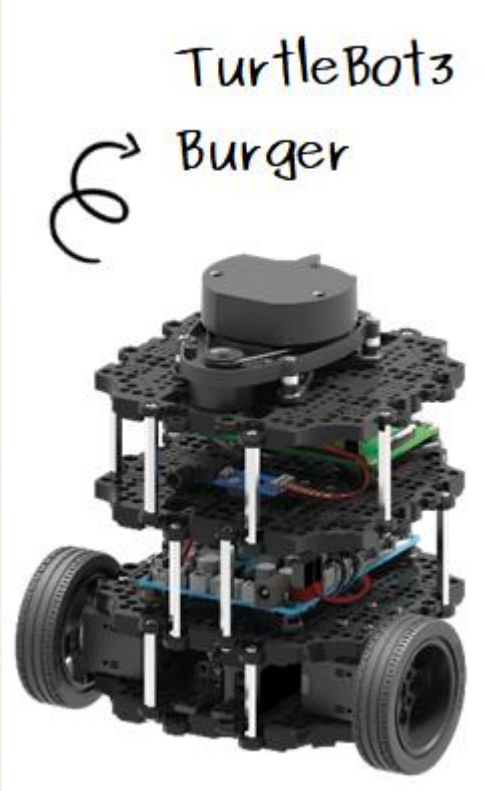
參考連結 : https://github.com/ROBOTIS-GIT/ros_seminar

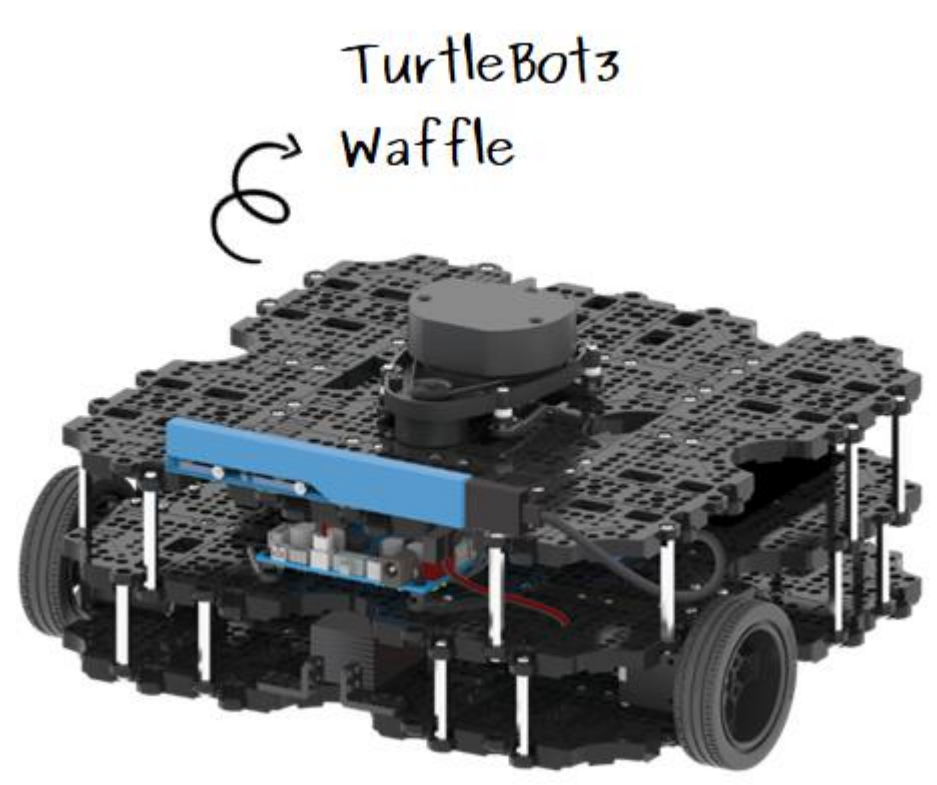
Turtlebot 3

- TurtleBot3 Providers



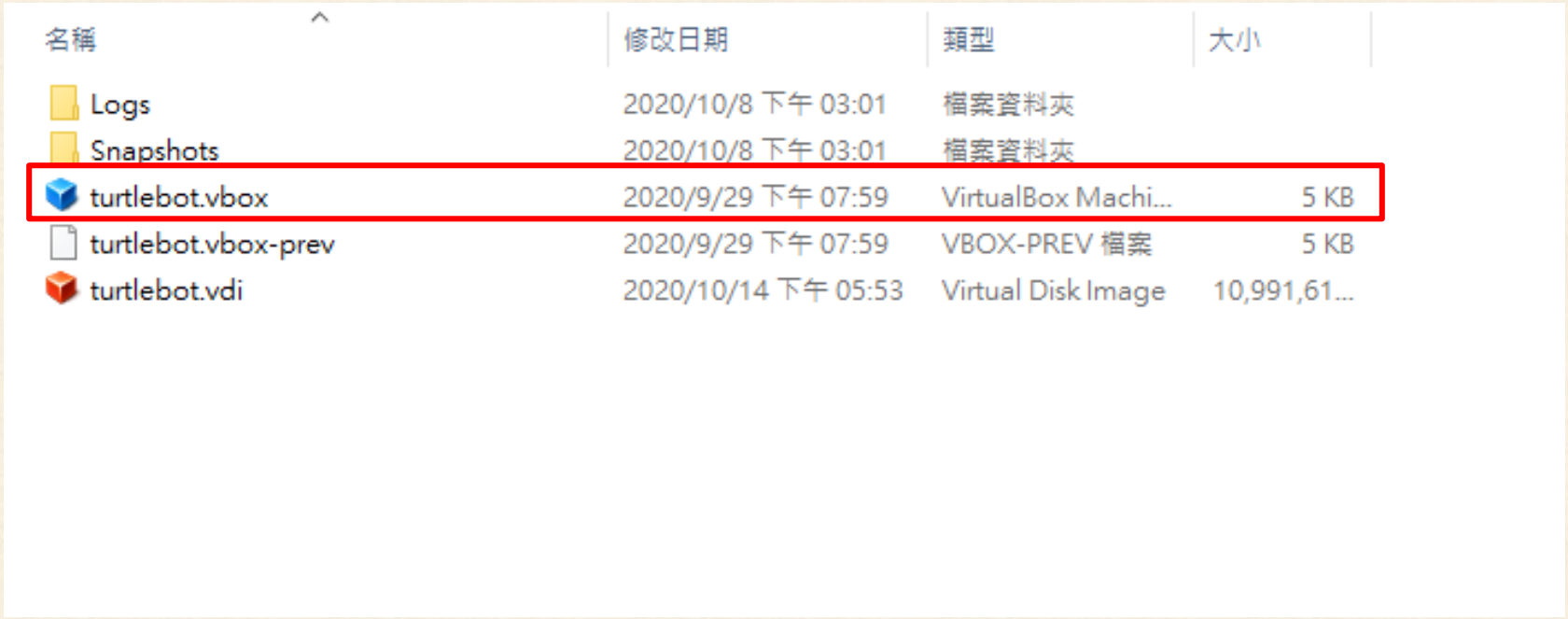
參考連結:https://emanual.robotis.com/docs/en/platform/turtlebot3/overview/#overview


TurtleBot3
Burger


TurtleBot3
Waffle

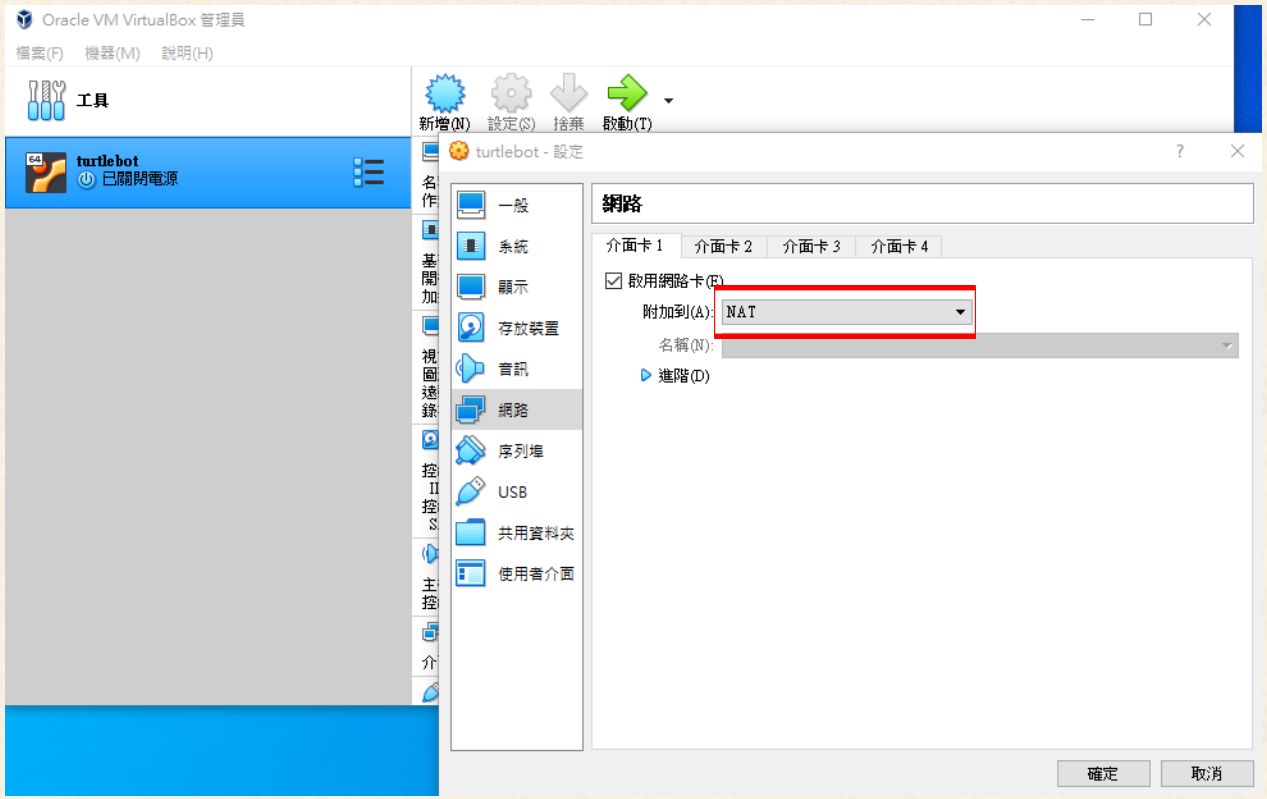
啟用虛擬機

- 下載turtlebot，並解壓縮



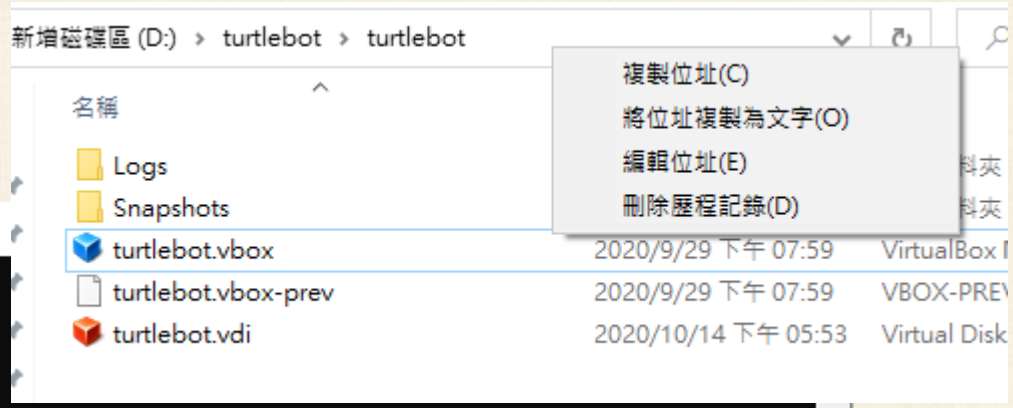
設定Oracle VM

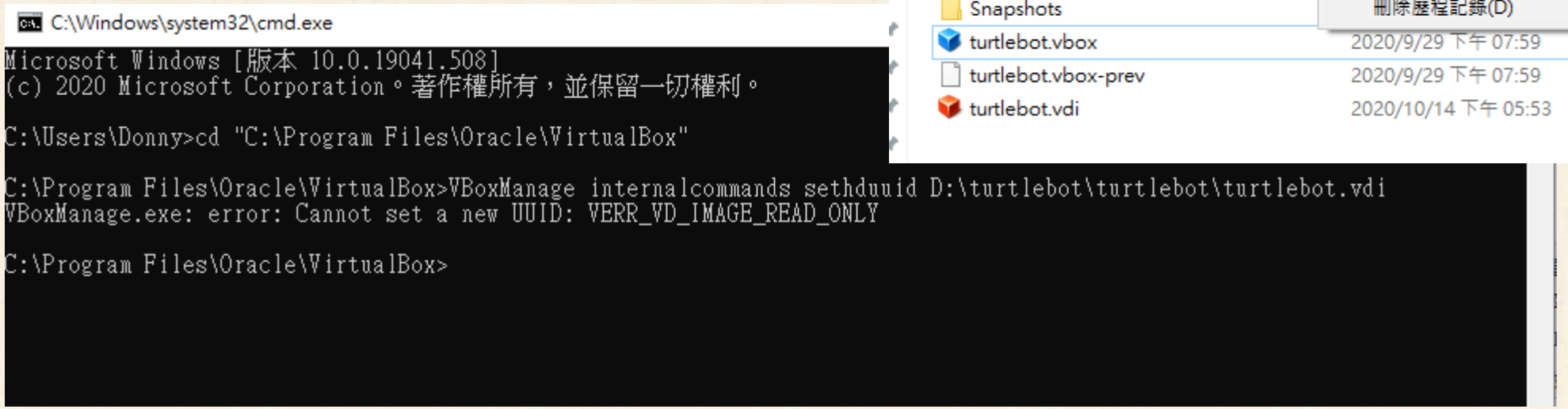
- 選取turtlebot > 設定 > 系統 > 調整基本記憶體(綠色上限)
- 處理器(CPU) > 網路 > 橋接介面卡改成 NAT



UUID error

- cd C:\Program Files\Oracle\VirtualBox
- VBoxManage internalcommands sethduuid XXX
  - XXX為.vdi檔讀路徑

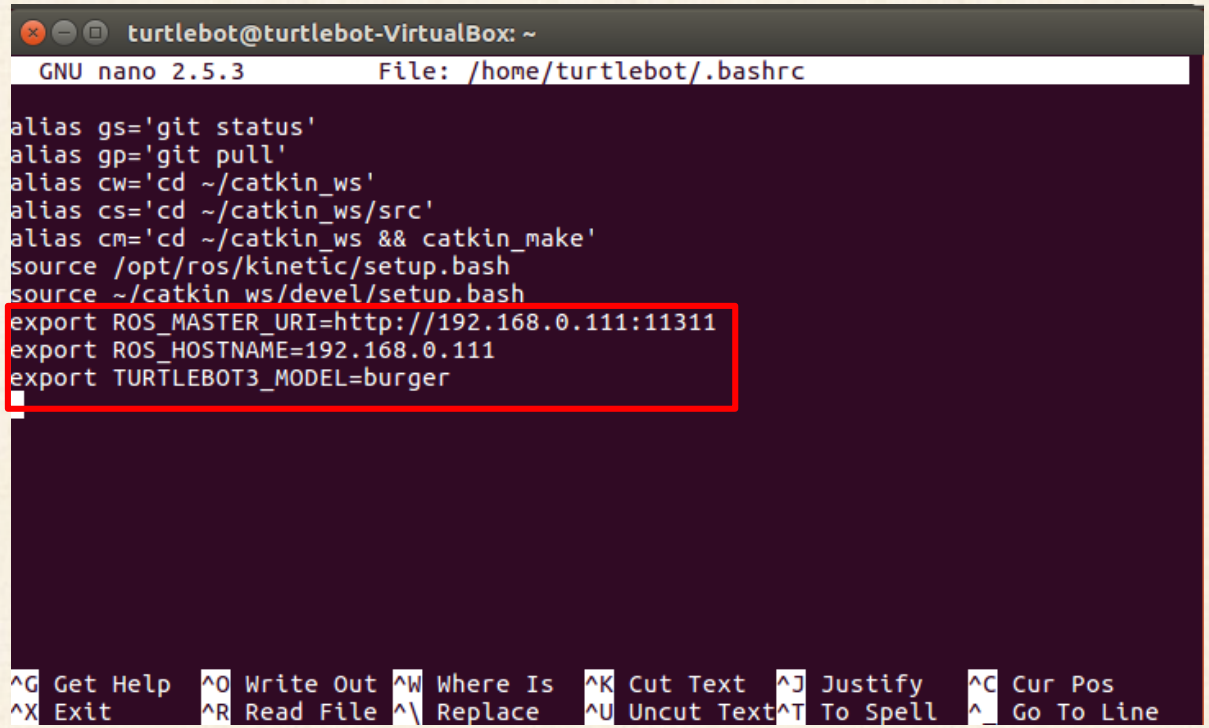




設定 ROS 環境

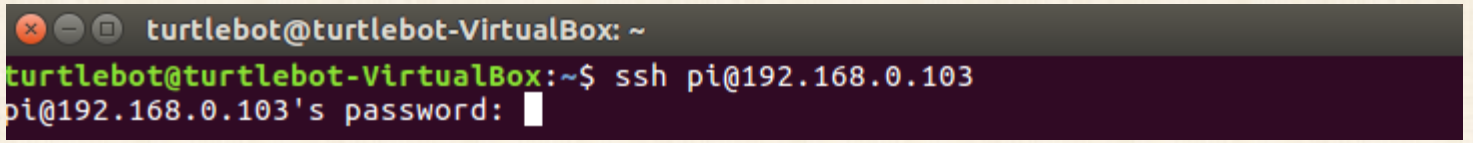
- 密碼 : turtlebot　　wifi : Bun / 7111177117
- 右鍵 > Open Terminal > 輸入: ifconfig 查看IP
- 輸入: nano ~/.bashrc　> PageDown到最下面
- 改成你的IP
- Ctrl + X　>　Y存檔
- 輸入 : source ~/.bashrc

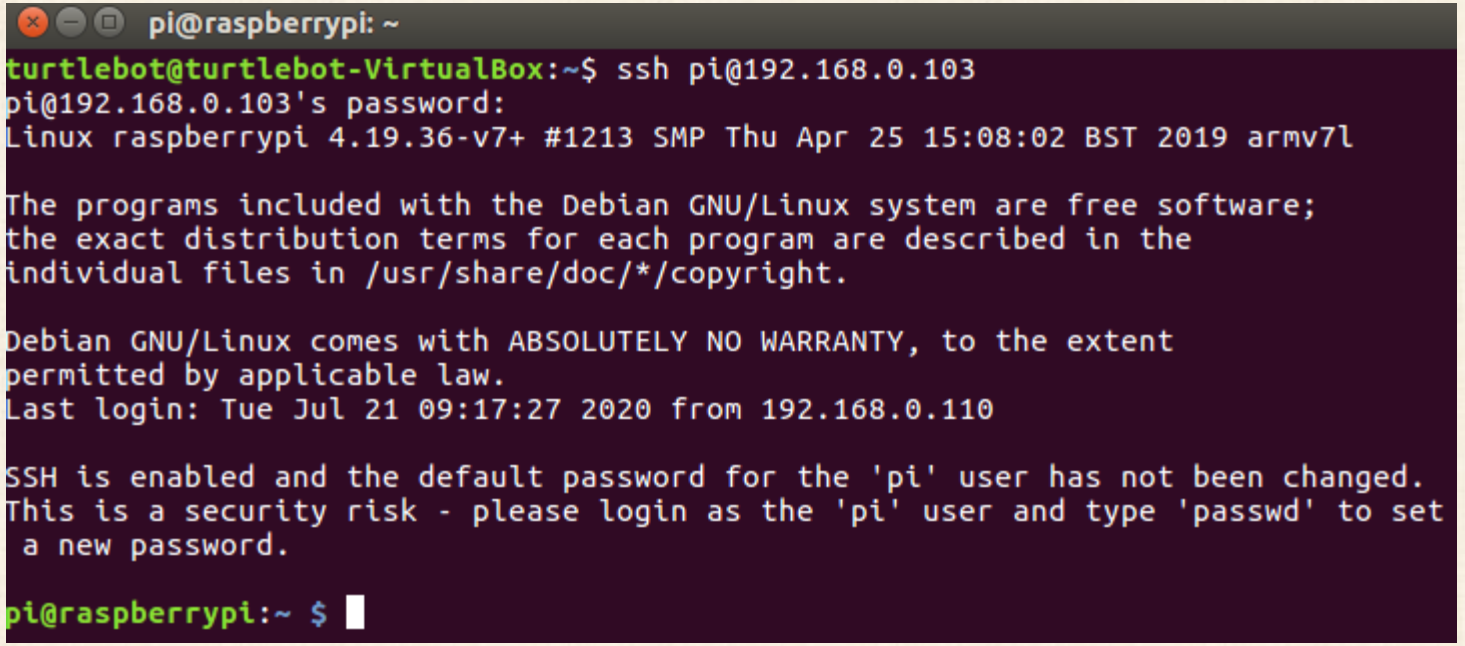
```
turtlebot@turtlebot-VirtualBox:~$ source ~/.bashrc
```



SSH to Turtlebot

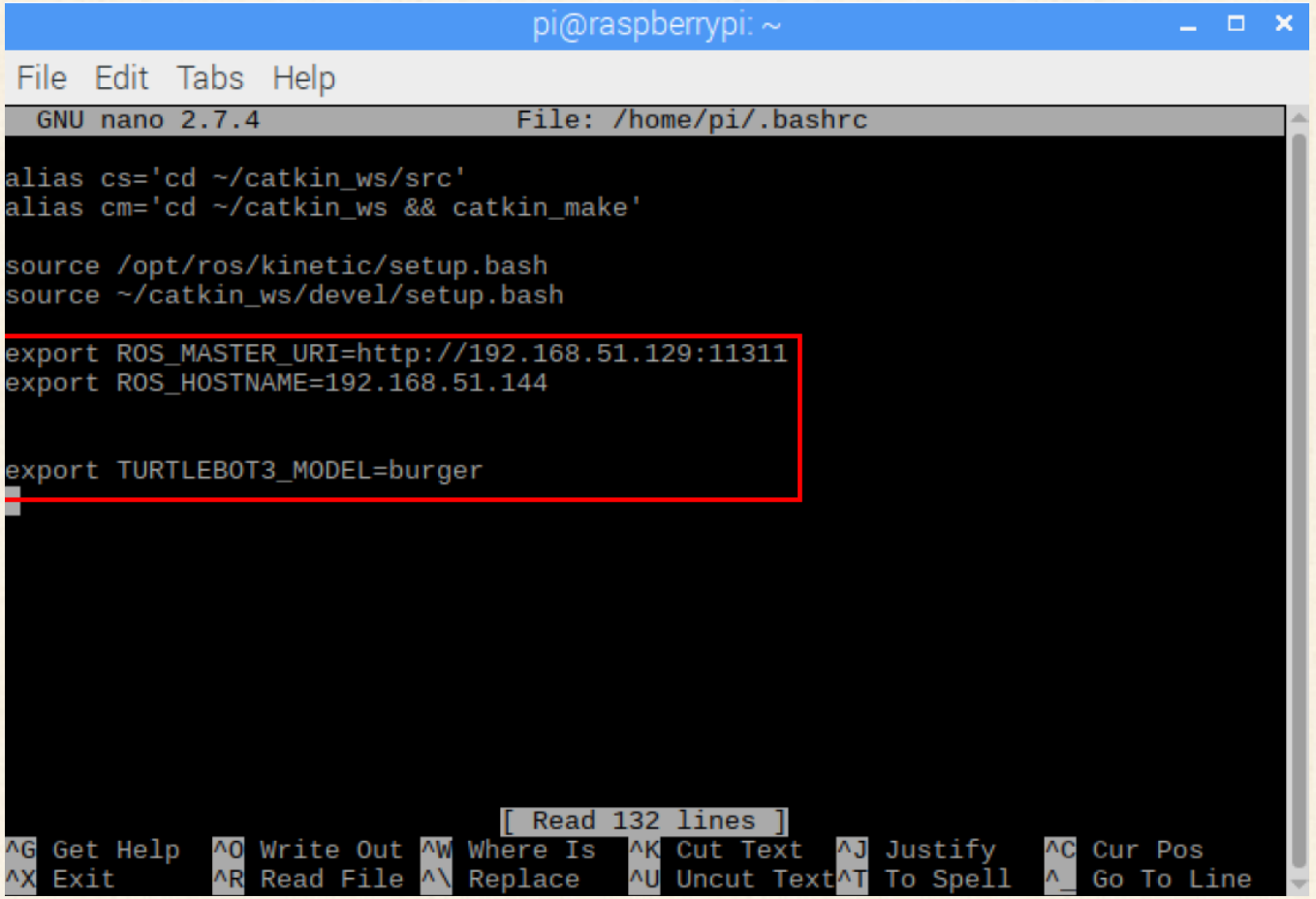
- 看拿到的機器人IP
- 輸入 : ssh pi@192.168.xxx.xxx
- 密碼 : raspberry



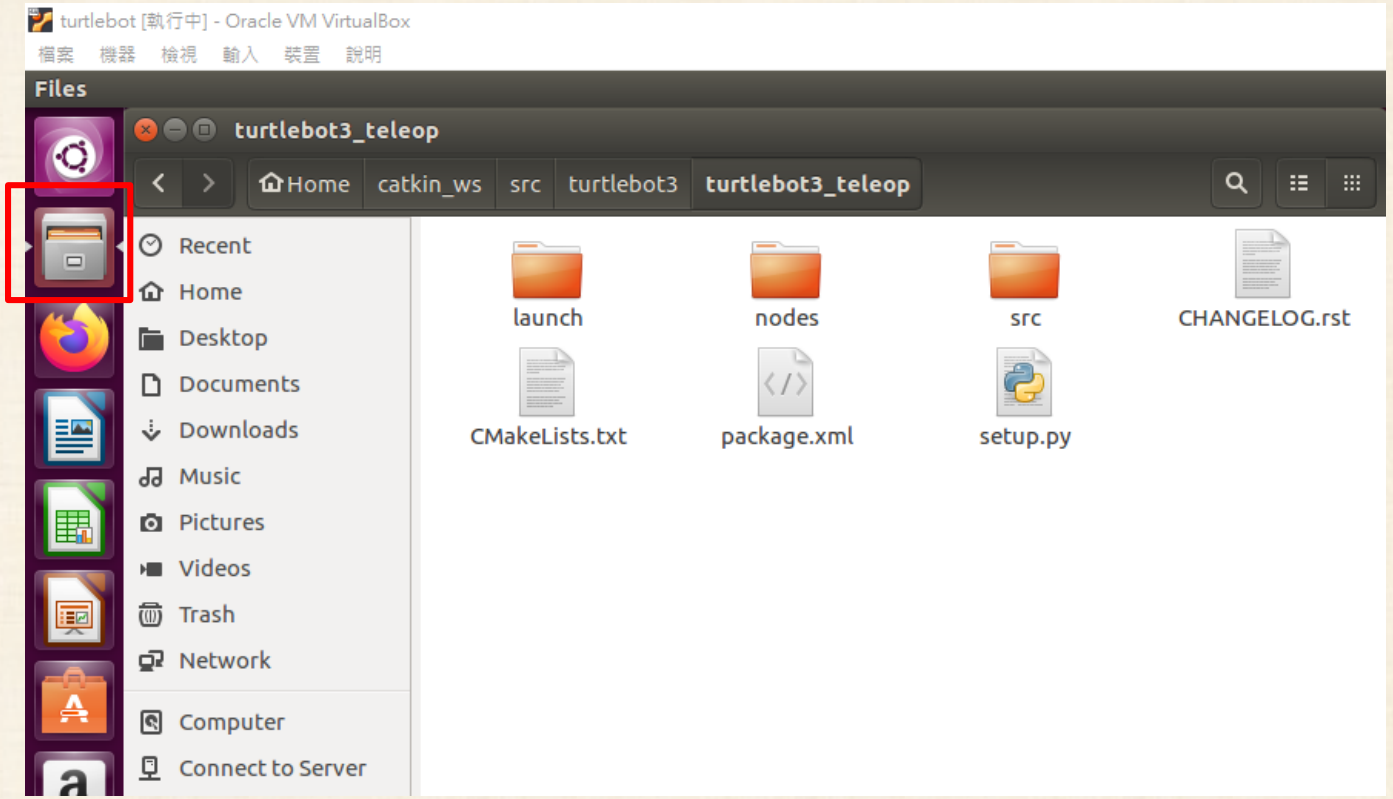


改Turtlebot Master

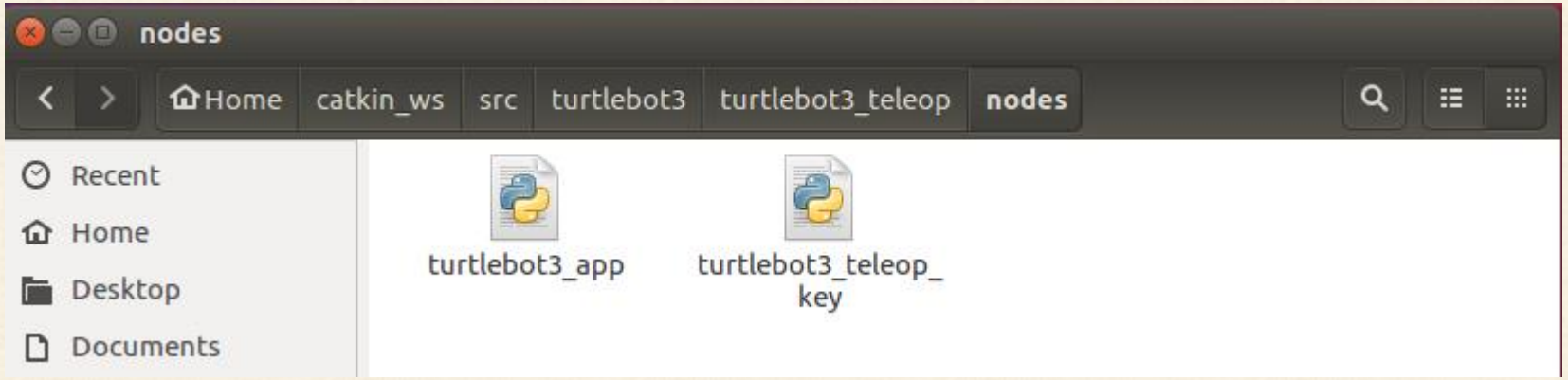
- SSH後,輸入 : nano ~/.bashrc
- PageDown到底
- 改MASTER_URI為
  虛擬機的IP
- Ctrl + X > Y存檔
- 輸入 : source ~/.bashrc



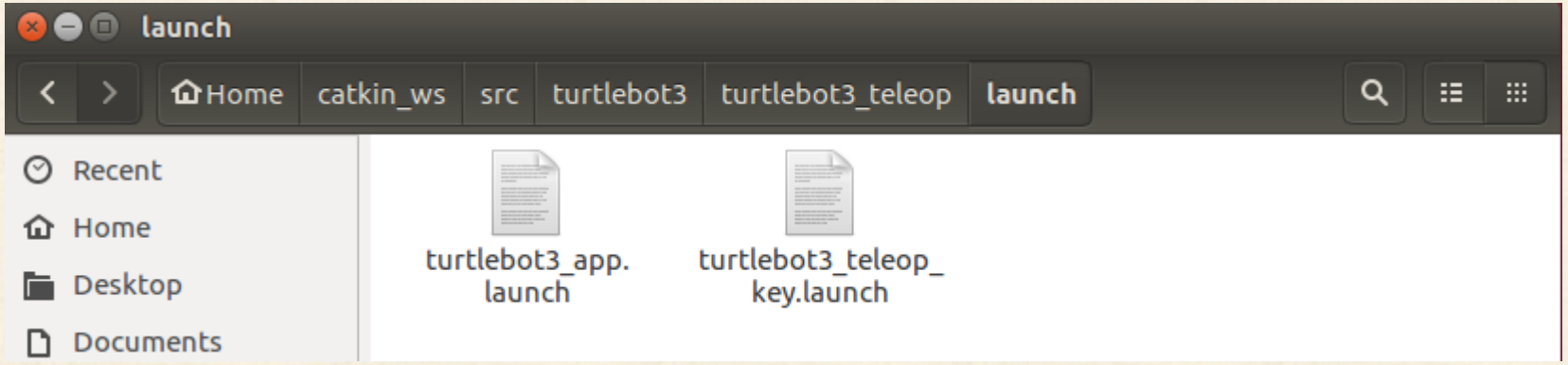
- Home > catkin_ws > src > turtlebot3 > turtlebot3_teleop



- nodes 為 執行程式所在資料夾



- launch 會呼叫node裡的程式



Node,launch 關係

- turtlebot3_teleop_key.launch

```
<launch>
  <arg name="model" default="$(env TURTLEBOT3_MODEL)" doc="model type [burger, waffle, waffle_pi]"/>
  <param name="model" value="$(arg model)"/>

  <!-- turtlebot3_teleop_key already has its own built in velocity smoother -->
  <node pkg="turtlebot3_teleop" type="turtlebot3_teleop_key" name="turtlebot3_teleop_keyboard"  output="screen">
  </node>
</launch>
```

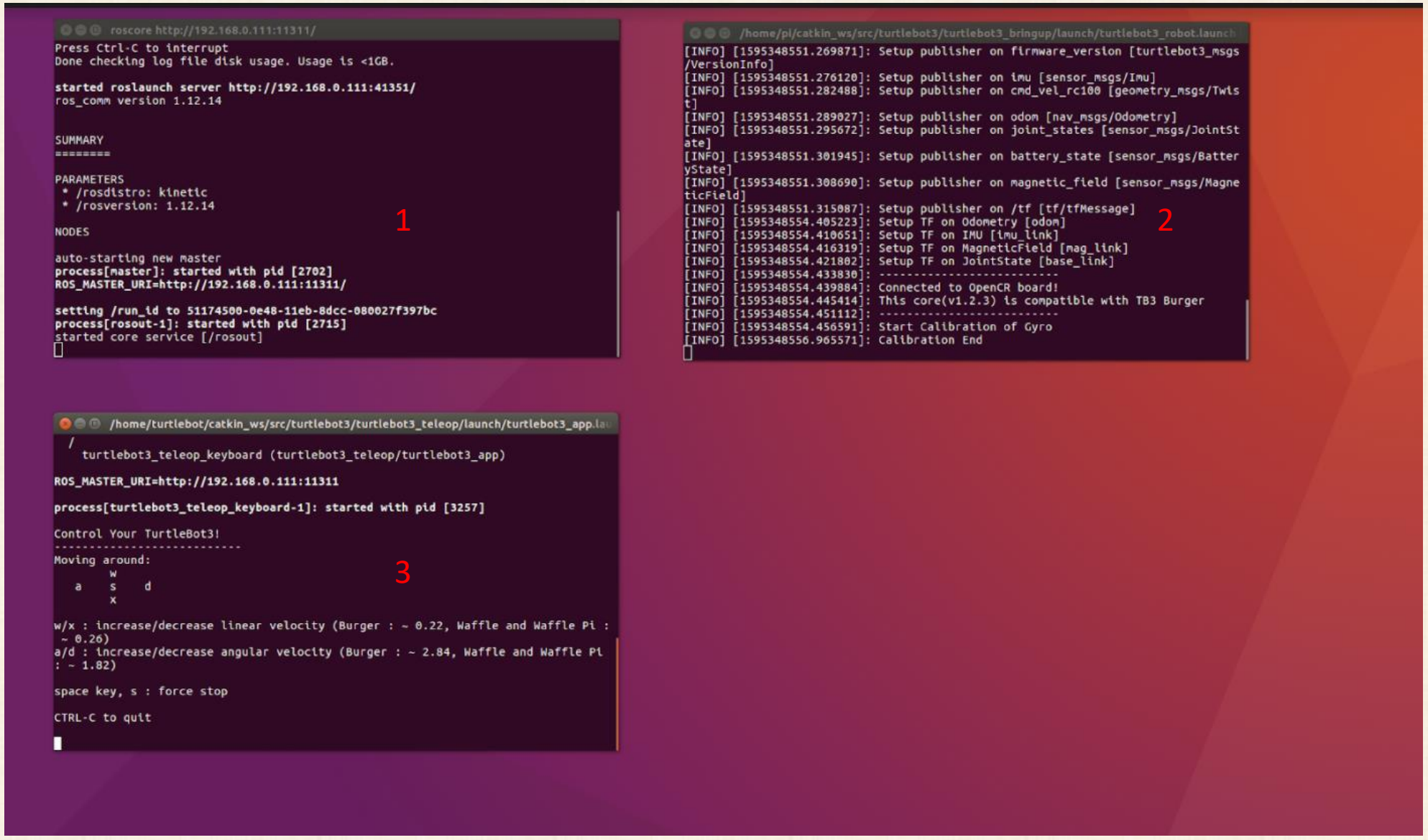
- turtlebot3_app.launch

```
<launch>
  <arg name="model" default="$(env TURTLEBOT3_MODEL)" doc="model type [burger, waffle, waffle_pi]"/>
  <param name="model" value="$(arg model)"/>

  <!-- turtlebot3_teleop_key already has its own built in velocity smoother -->
  <node pkg="turtlebot3_teleop" type="turtlebot3_app" name="turtlebot3_teleop_keyboard"  output="screen">
  </node>
</launch>
```

執行程式

- 共需3個終端機
- 1. 輸入 > roscore
- 2. SSH 到Turtlebot後
  - 輸入 : roslaunch turtlebot3_bringup turtlebot3_robot.launch
- 3.輸入 :roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch

  <3


roscore http://192.168.0.111:11311/
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://192.168.0.111:41351/
ros_comm version 1.12.14
SUMMARY
========
PARAMETERS
* /rosdistro: kinetic
* /rosversion: 1.12.14
NODES
auto-starting new master
process[master]: started with pid [2702]
ROS_MASTER_URI=http://192.168.0.111:11311/
setting /run_id to 51174500-0e48-11eb-8dcc-080027f397bc
process[rosout-1]: started with pid [2715]
started core service [/rosout]
1
/home/pi/catkin_ws/src/turtlebot3/turtlebot3_bringup/launch/turtlebot3_robot.launch
[INFO] [1595348551.269871]: Setup publisher on firmware_version [turtlebot3_msgs/VersionInfo]
[INFO] [1595348551.276120]: Setup publisher on imu [sensor_msgs/Imu]
[INFO] [1595348551.282488]: Setup publisher on cmd_vel_rc100 [geometry_msgs/Twist]
[INFO] [1595348551.289027]: Setup publisher on odom [nav_msgs/Odometry]
[INFO] [1595348551.295672]: Setup publisher on joint_states [sensor_msgs/JointState]
[INFO] [1595348551.301945]: Setup publisher on battery_state [sensor_msgs/BatteryState]
[INFO] [1595348551.308690]: Setup publisher on magnetic_field [sensor_msgs/MagneticField]
[INFO] [1595348551.315087]: Setup publisher on /tf [tf/tfMessage]
[INFO] [1595348554.405223]: Setup TF on Odometry [odom]
[INFO] [1595348554.410651]: Setup TF on IMU [imu_link]
[INFO] [1595348554.416319]: Setup TF on MagneticField [mag_link]
[INFO] [1595348554.421802]: Setup TF on JointState [base_link]
[INFO] [1595348554.433830]: --------------------------
[INFO] [1595348554.439884]: Connected to OpenCR board!
[INFO] [1595348554.445414]: This core(v1.2.3) is compatible with TB3 Burger
[INFO] [1595348554.451112]: --------------------------
[INFO] [1595348554.456591]: Start Calibration of Gyro
[INFO] [1595348556.965571]: Calibration End
2
/home/turtlebot/catkin_ws/src/turtlebot3/turtlebot3_teleop/launch/turtlebot3_app.la
/
turtlebot3_teleop_keyboard (turtlebot3_teleop/turtlebot3_app)
ROS_MASTER_URI=http://192.168.0.111:11311
process[turtlebot3_teleop_keyboard-1]: started with pid [3257]
Control Your TurtleBot3!

Moving around:
w
a s d
x
w/x : increase/decrease linear velocity (Burger : ~ 0.22, Waffle and Waffle Pi : ~ 0.26)
a/d : increase/decrease angular velocity (Burger : ~ 2.84, Waffle and Waffle Pi : ~ 1.82)
space key, s : force stop
CTRL-C to quit
3

Q1

- 修改turtlebot3_teleop_key.py，加上左右移動的程式碼

- Hint

```
44  LIN_VEL_STEP_SIZE = 0.01
45  ANG_VEL_STEP_SIZE = 0.1
```

```
134     target_linear_vel   = 0.0
135     target_angular_vel  = 0.0
136     control_linear_vel  = 0.0
137     control_angular_vel = 0.0
```

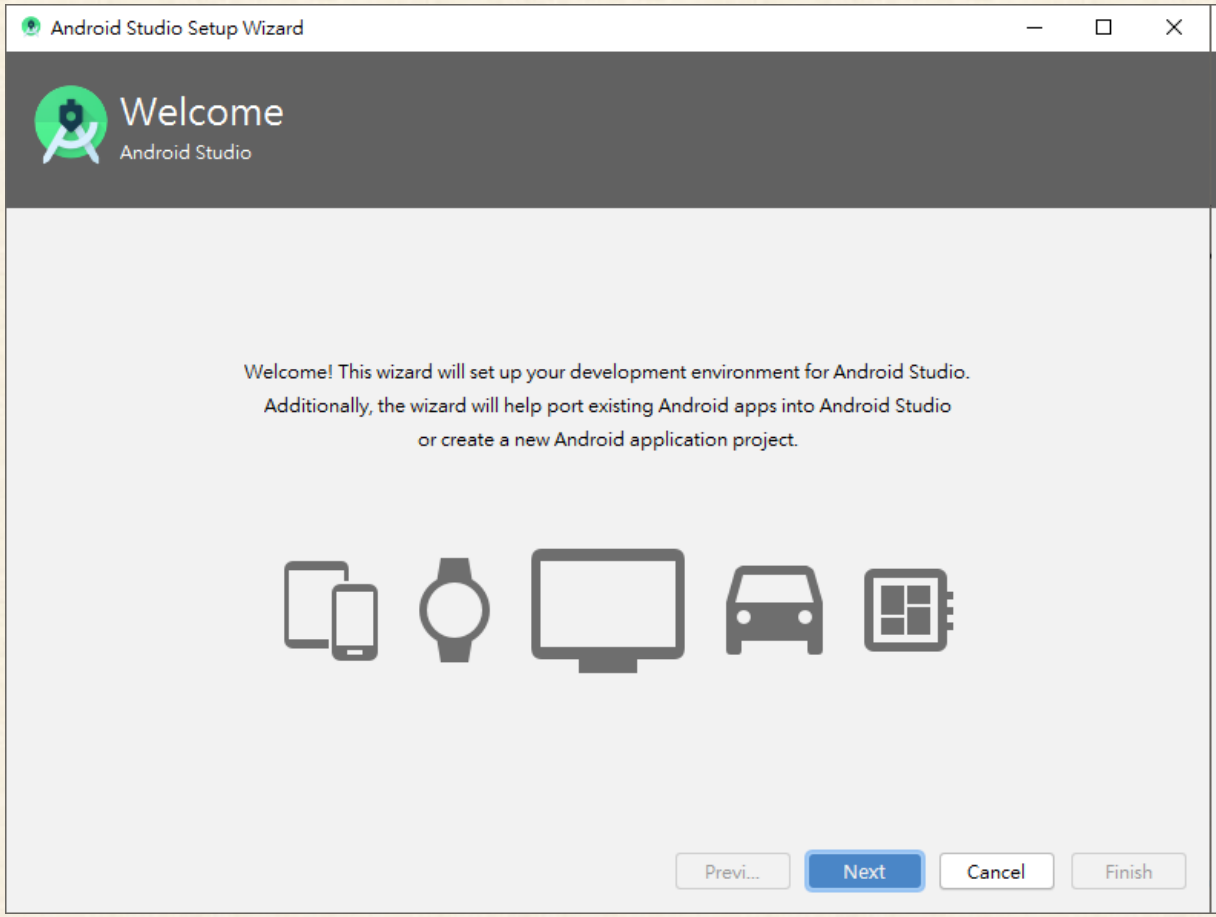
```
114  def checkAngularLimitVelocity(vel):
115      if turtlebot3_model == "burger":
116          vel = constrain(vel, -BURGER_MAX_ANG_VEL, BURGER_MAX_ANG_VEL)
117      elif turtlebot3_model == "waffle" or turtlebot3_model == "waffle_pi":
118          vel = constrain(vel, -WAFFLE_MAX_ANG_VEL, WAFFLE_MAX_ANG_VEL)
119      else:
120          vel = constrain(vel, -BURGER_MAX_ANG_VEL, BURGER_MAX_ANG_VEL)
121
```

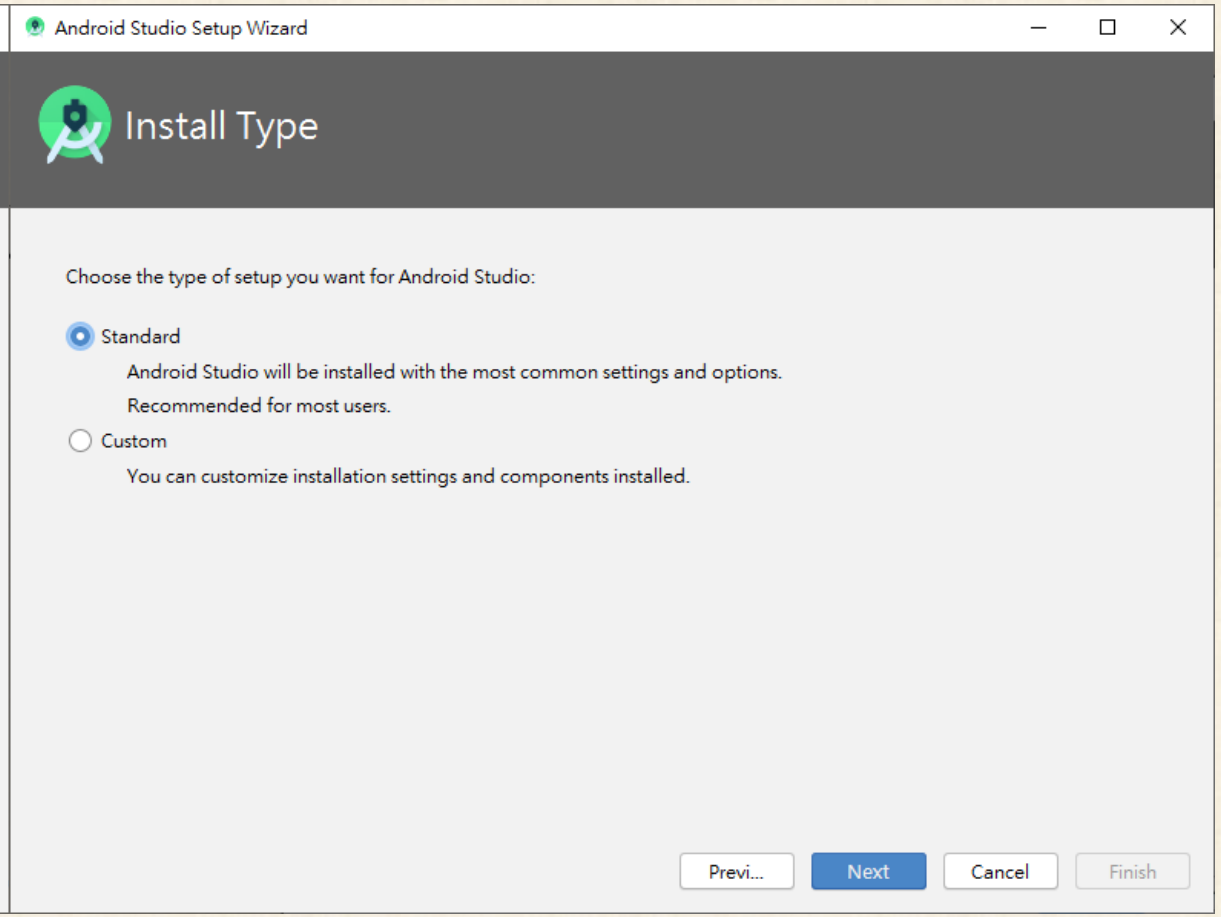
```
139     try:
140         print(msg)
141         while(1):
142             key = getKey()
143             if key == 'w' :
144                 target_linear_vel = checkLinearLimitVelocity(target_linear_vel + LIN_VEL_STEP_SIZE)
145                 status = status + 1
146                 print(vels(target_linear_vel,target_angular_vel))
147             elif key == 'x' :
148                 target_linear_vel = checkLinearLimitVelocity(target_linear_vel - LIN_VEL_STEP_SIZE)
149                 status = status + 1
150                 print(vels(target_linear_vel,target_angular_vel))
151             elif key == 'a' :
152                 #add turn left action
153
154             elif key == 'd' :
155                 #add turn right action
156                 
157             elif key == ' ' or key == 's' :
158                 target_linear_vel   = 0.0
159                 control_linear_vel  = 0.0
160                 target_angular_vel  = 0.0
161                 control_angular_vel = 0.0
162                 print(vels(target_linear_vel, target_angular_vel))
163             else:
164                 if (key == '\x03'):
165                     break
166
167             if status == 20 :
168                 print(msg)
169                 status = 0
```

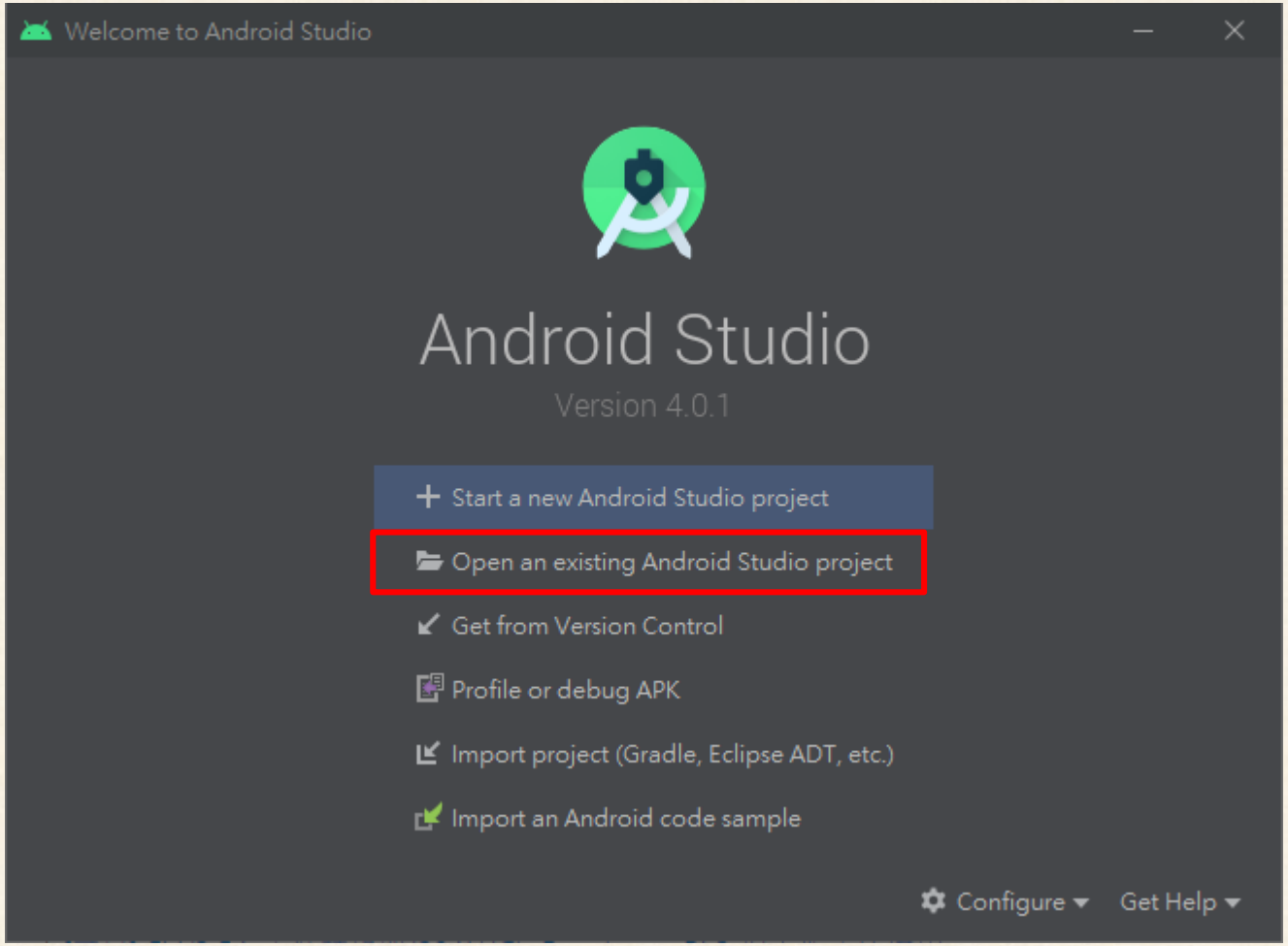
Socket

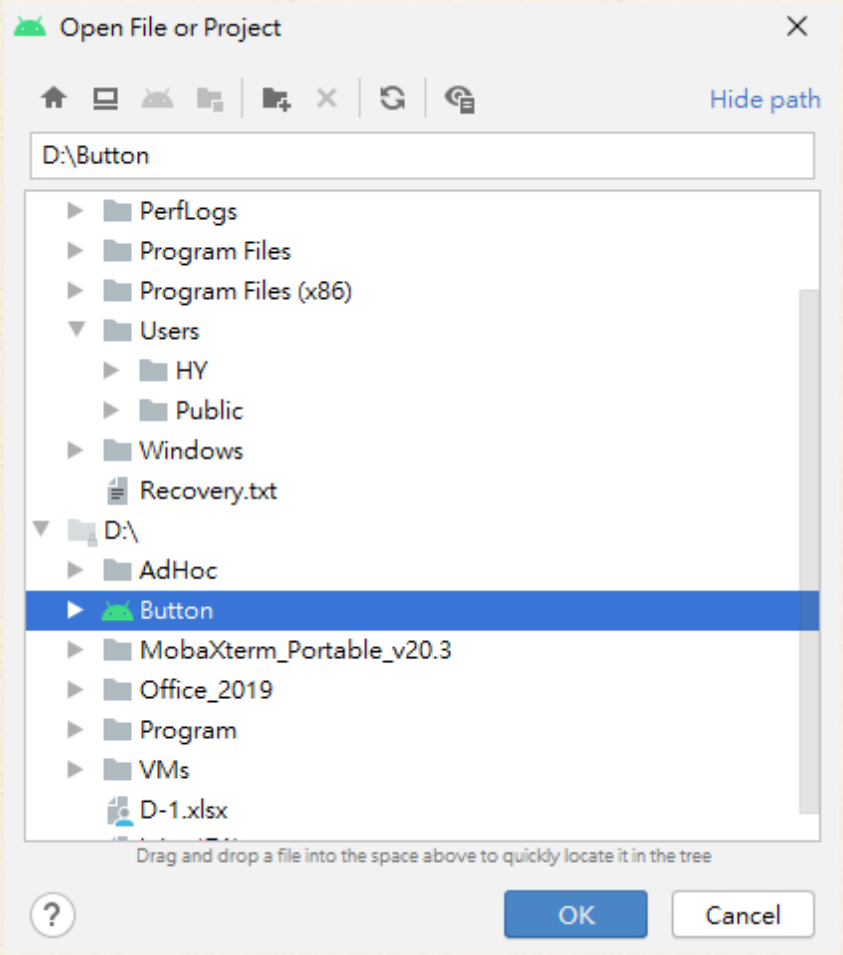
- socket是一個介於兩個在同一網路運行的兩個程式間有著雙向通訊連接端點。一個socket被綁定到一個port number
- Datagram sockets (connectionless) :
  - 利用UDP封包傳送，因此接收端socket 可能會收到次序錯誤的資料，並且部分資料也有可能遺失。
- Stream sockets (connection-oriented) :
  - 利用TCP封包來傳送，因此接收端Socket可以收到順序無誤、無重複，並且正確的資料。好處是比上面那種方式可靠且有序的。

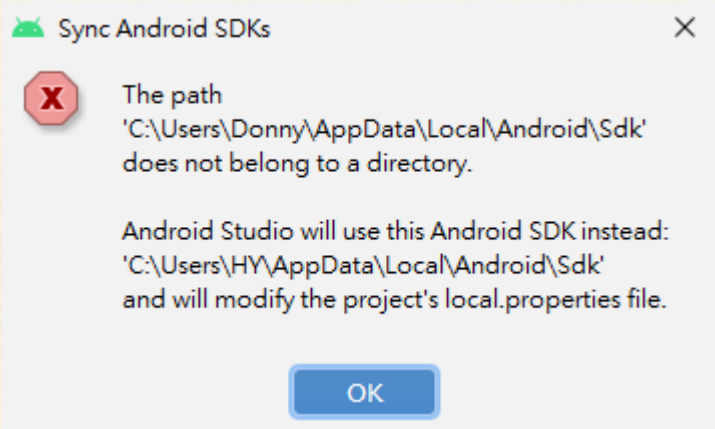
Android Studio

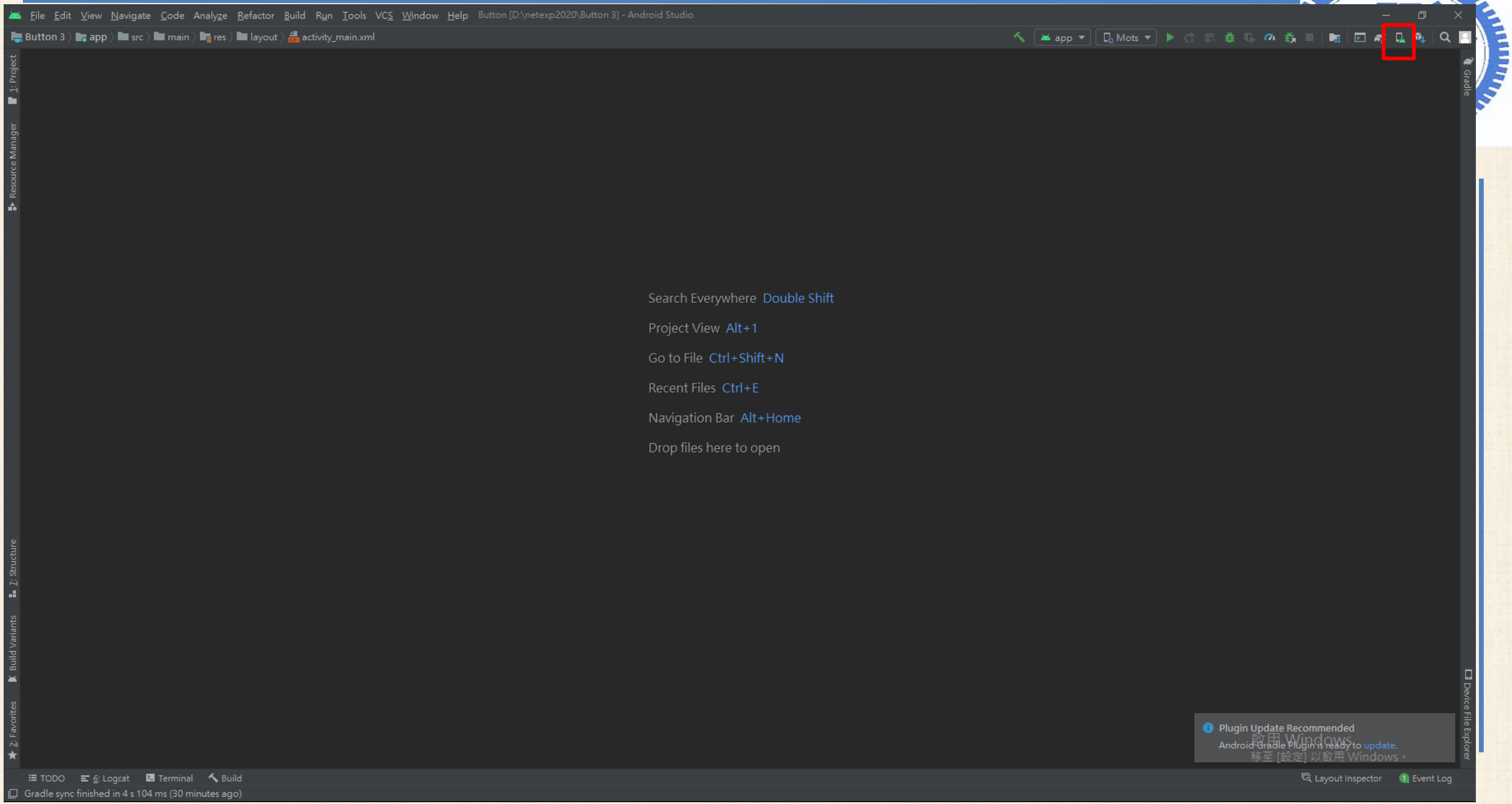


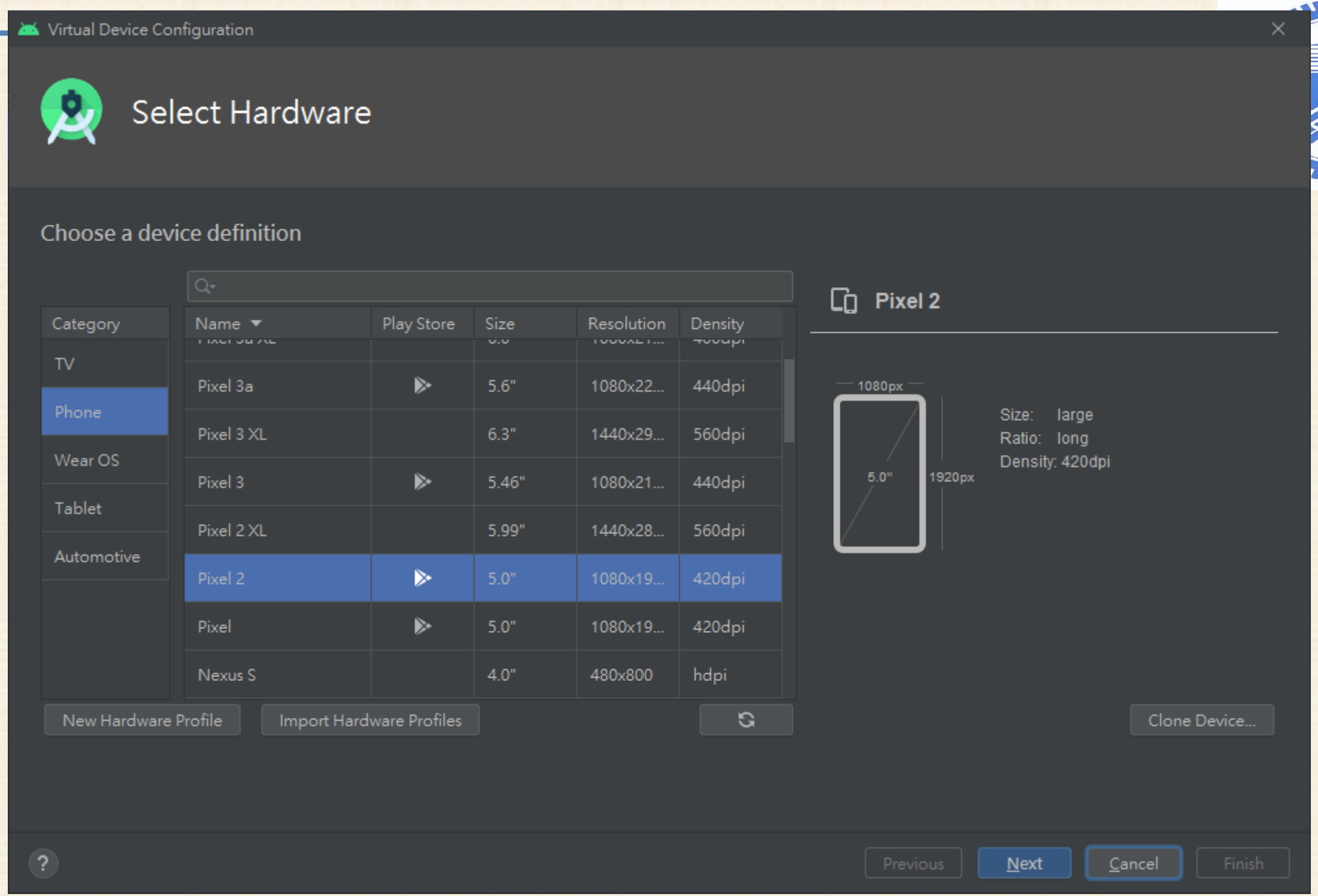


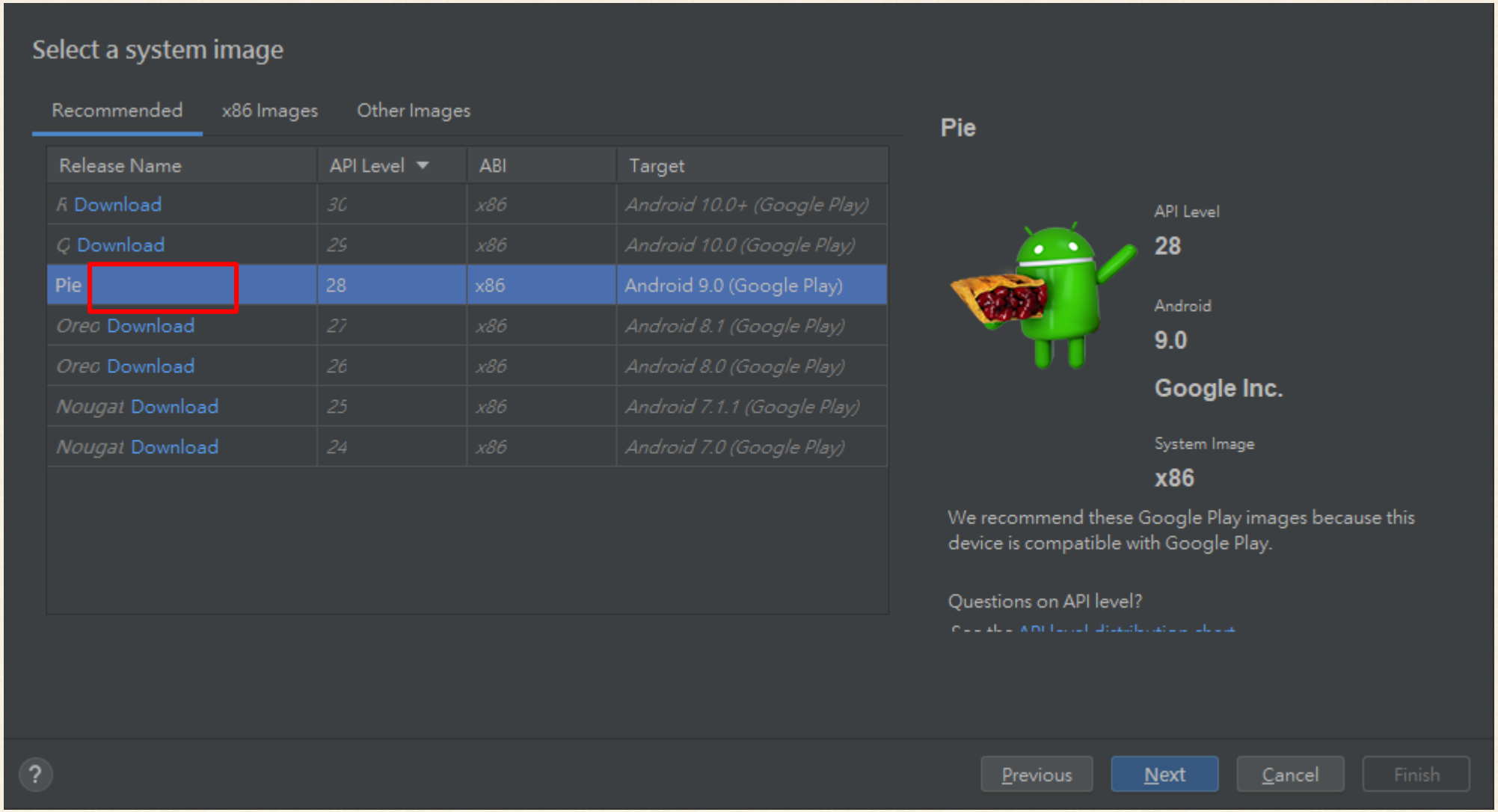

Welcome to Android Studio
Android Studio
Version 4.0.1
Start a new Android Studio project
Open an existing Android Studio project
Get from Version Control
Profile or debug APK
Import project (Gradle, Eclipse ADT, etc.)
Import an Android code sample
Configure
Get Help

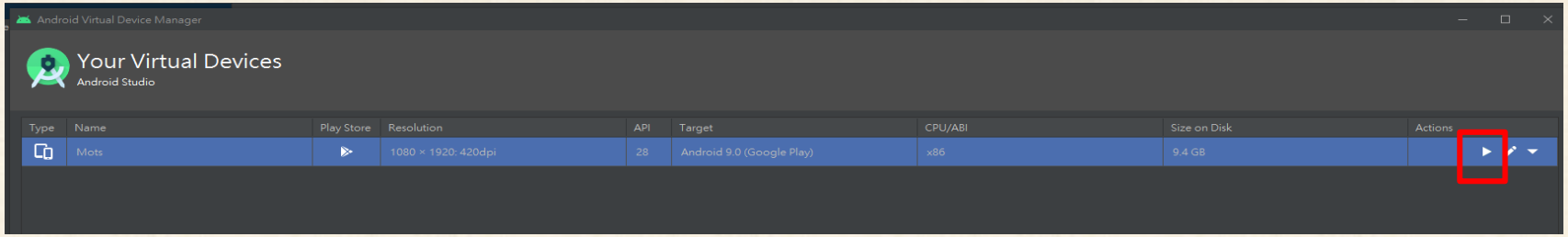

Open File or Project
Hide path
D:\Button
PerfLogs
Program Files
Program Files (x86)
Users
HY
Public
Windows
Recovery.txt
D:\
AdHoc
Button
MobaXterm_Portable_v20.3
Office_2019
Program
VMs
D-1.xlsx
Drag and drop a file into the space above to quickly locate it in the tree
OK
Cancel


Sync Android SDKs
The path
'C:\Users\Donny\AppData\Local\Android\Sdk'
does not belong to a directory.
Android Studio will use this Android SDK instead:
'C:\Users\HY\AppData\Local\Android\Sdk'
and will modify the project's local.properties file.
OK


File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help Button [D:\netexp2020\Button 3] - Android Studio
Button 3 app src main res layout activity_main.xml
app
Mots
1: Project
Resource Manager
Gradle
Search Everywhere Double Shift
Project View Alt+1
Go to File Ctrl+Shift+N
Recent Files Ctrl+E
Navigation Bar Alt+Home
Drop files here to open
Plugin Update Recommended
Android Gradle Plugin is ready to update.
啟用 Windows
移至 [設定] 以啟用 Windows。
Device File Explorer
7: Structure
Build Variants
2: Favorites
TODO
6: Logcat
Terminal
Build
Layout Inspector
Event Log
Gradle sync finished in 4 s 104 ms (30 minutes ago)

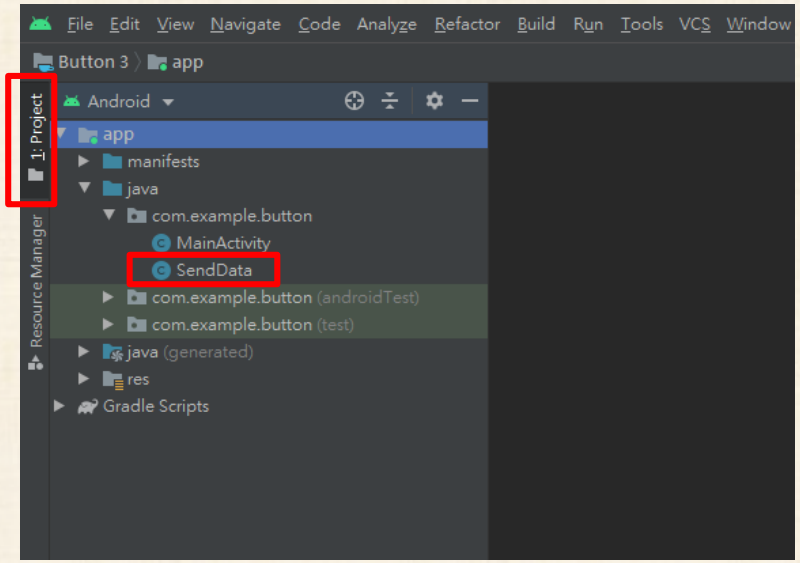

Virtual Device Configuration
Select Hardware
Choose a device definition
Category
TV
Phone
Wear OS
Tablet
Automotive
Name
Play Store
Size
Resolution
Density
Pixel 3a
5.6"
1080x22...
440dpi
Pixel 3 XL
6.3"
1440x29...
560dpi
Pixel 3
5.46"
1080x21...
440dpi
Pixel 2 XL
5.99"
1440x28...
560dpi
Pixel 2
5.0"
1080x19...
420dpi
Pixel
5.0"
1080x19...
420dpi
Nexus S
4.0"
480x800
hdpi
Pixel 2
1080px
5.0"
1920px
Size: large
Ratio: long
Density: 420dpi
New Hardware Profile
Import Hardware Profiles
Clone Device...
Previous
Next
Cancel
Finish


Select a system image
Recommended
x86 Images
Other Images
Release Name
API Level
ABI
Target
R Download
30
x86
Android 10.0+ (Google Play)
Q Download
29
x86
Android 10.0 (Google Play)
Pie
28
x86
Android 9.0 (Google Play)
Oreo Download
27
x86
Android 8.1 (Google Play)
Oreo Download
26
x86
Android 8.0 (Google Play)
Nougat Download
25
x86
Android 7.1.1 (Google Play)
Nougat Download
24
x86
Android 7.0 (Google Play)
Pie
API Level
28
Android
9.0
Google Inc.
System Image
x86
We recommend these Google Play images because this device is compatible with Google Play.
Questions on API level?
Previous
Next
Cancel
Finish



- 如果遇到需要權限、密碼，打X or 略過

- 下載Button app

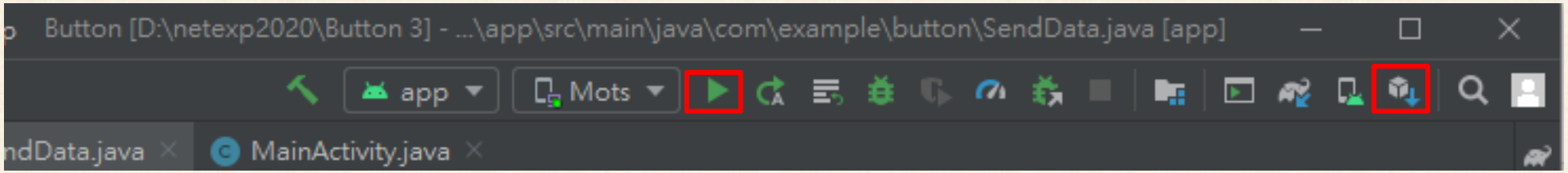


- 改成控制PC的IP

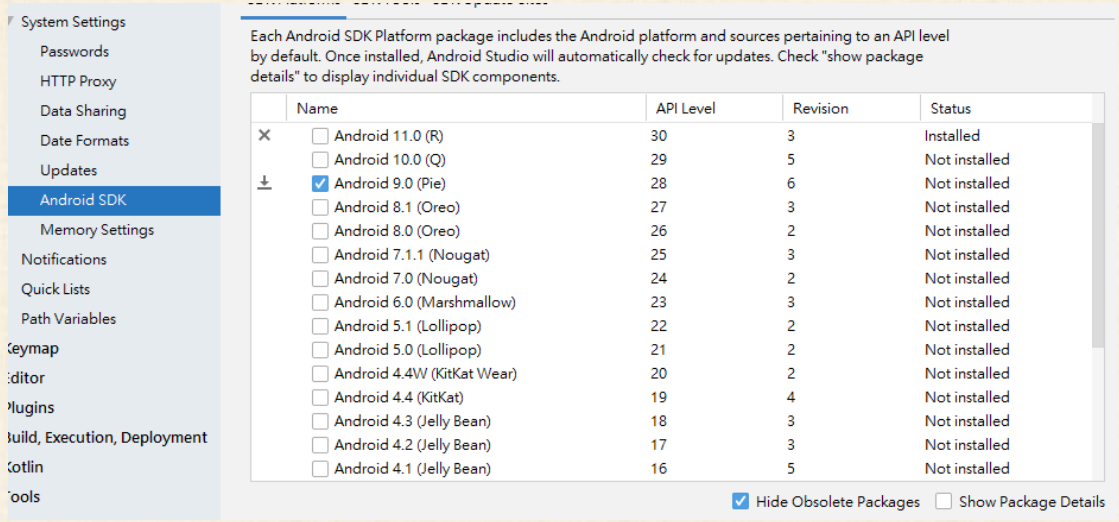
MainActivity.java SendData.java

```java
package com.example.button;
import android.os.AsyncTask;

import java.io.IOException;
import java.io.OutputStreamWriter;
import java.io.PrintWriter;
import java.net.Socket;

public class SendData extends AsyncTask<String, Void, Void>{
    private Exception exception;
    @Override
    protected Void doInBackground(String... params){
        try{
            try{
                Socket socket = new Socket( host: "192.168.50.138", port: 8001);
                PrintWriter outToServer= new PrintWriter(
                        new OutputStreamWriter(
                                socket.getOutputStream()));
                outToServer.print(params[0]);
                outToServer.flush();
            }catch (IOException e){
                e.printStackTrace();
            }
        }catch (Exception e)
        {
            this.exception = e;
            return null;
        }
        return null;
    }
}
```

開啟App



- 點箭頭把App燒入模擬器
- 如果箭頭不能點，點立方體



Debug

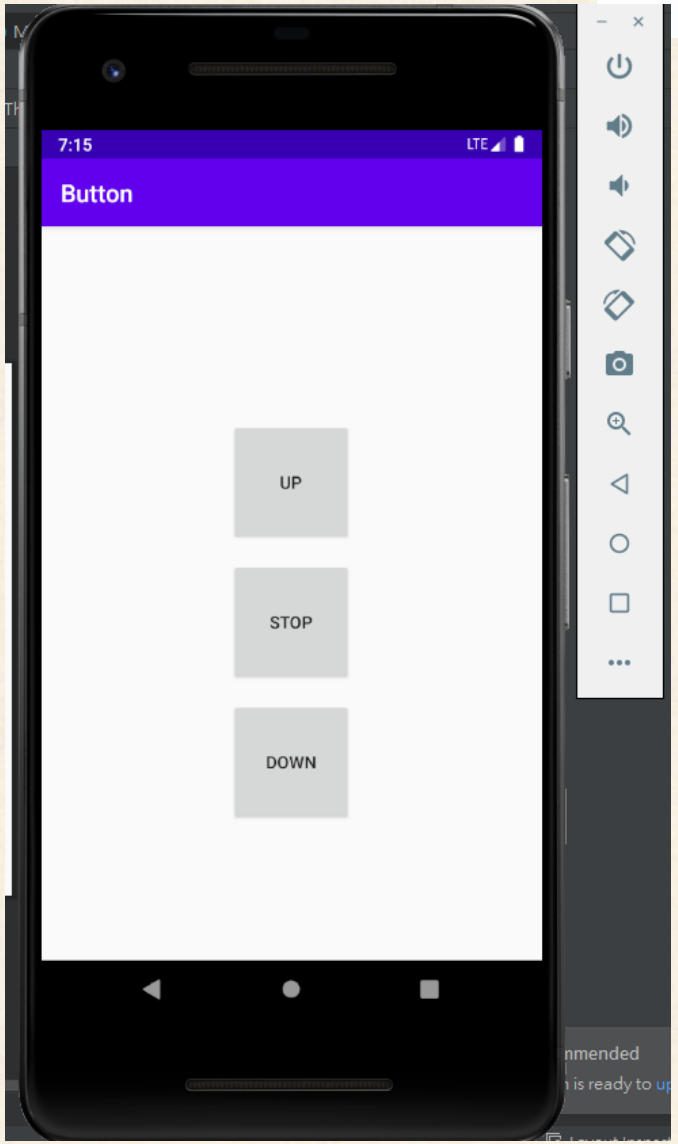
- 如果遇到 unable to delete directory
  - 關掉android studio
  - 到Button在的資料夾下，刪除build資料夾
- Installing missing SDK package

測試用Server

- e3 上的testserver.py 可以測試socket是否成功連線

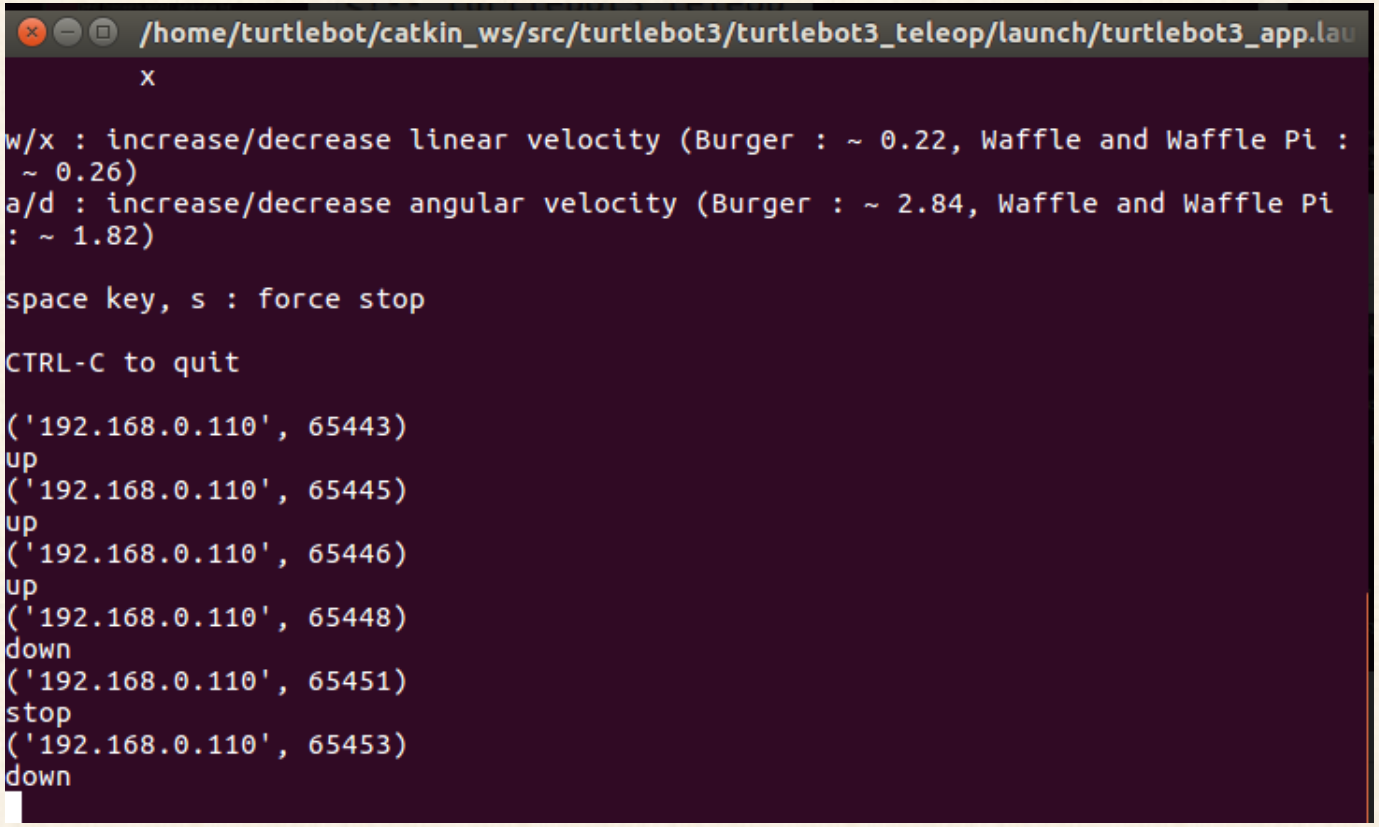
Q2

- 以APP控制Turtlebot前後移動
- 修改turtlebot_app.py
- 執行另一個launch檔
  - turtlebot3_app.launch

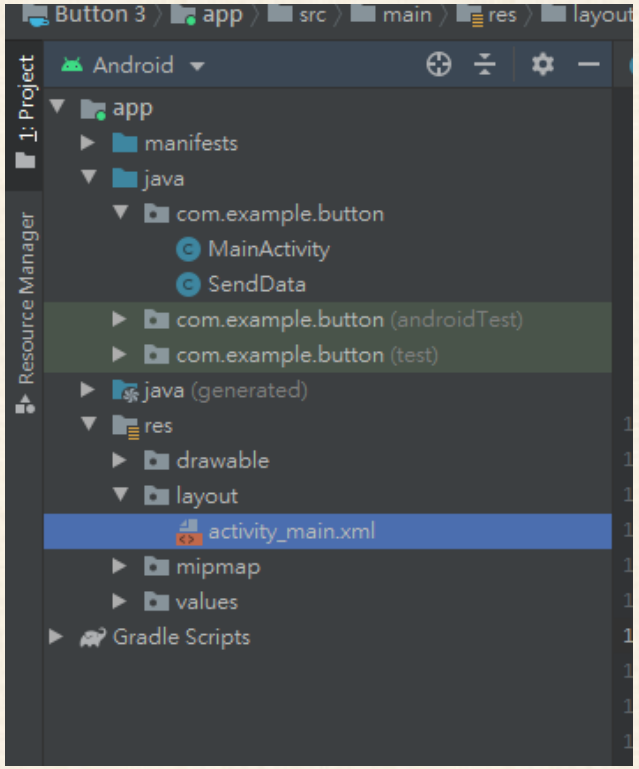


執行結果

- 注意機器人的安全



Bonus

- 綜合Q1,Q2，在APP中加上”左,右”，使Turtlebot可以全方位移動

- android studio layout 的.xml
  - 可以新增按鈕