學號：405410117

姓名：郭紘安　　　　　　　　　Email：andy8766kuo@gmail.com

實驗名稱：Remote debug

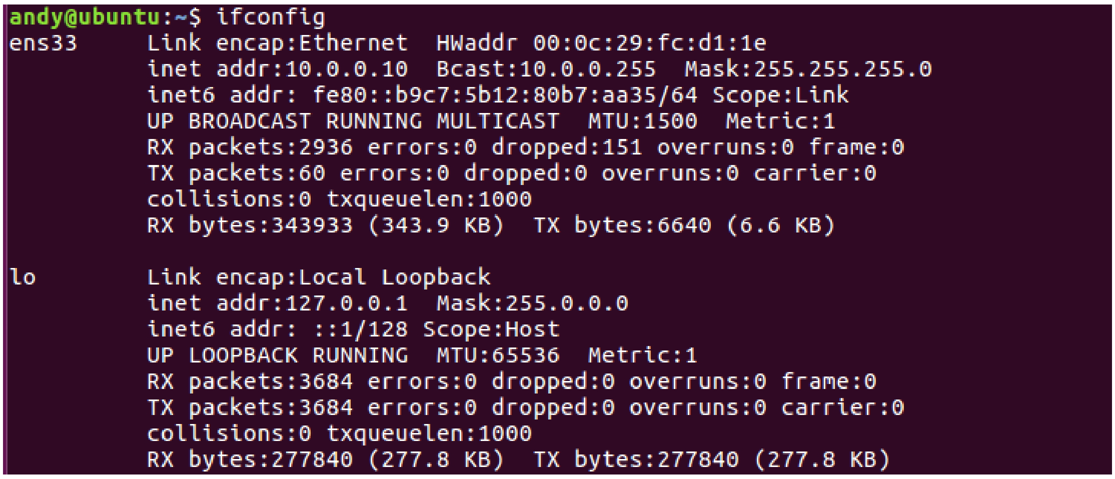
實驗目的：

- 如何進行 remote debugging
- 編譯 GDB server

實驗步驟：

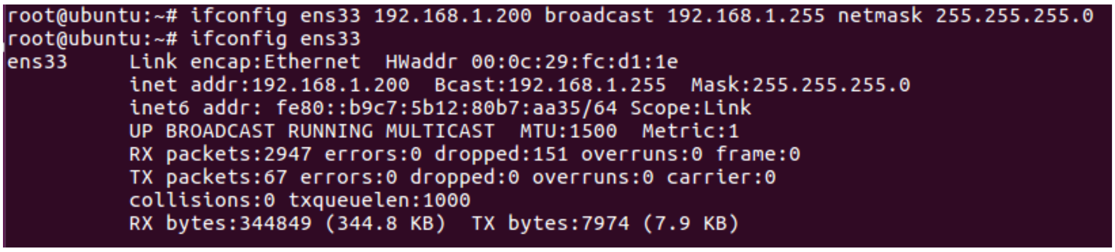
Part1: 設定 Linux PC 與 Raspberry Pi 的 IP

- 設定前的 Linux PC:



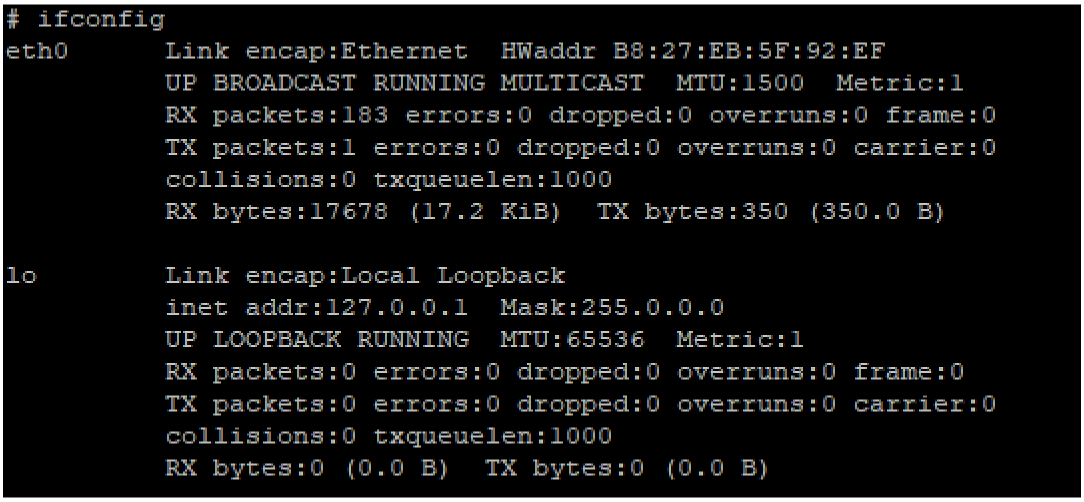
```
andy@ubuntu:~$ ifconfig
ens33     Link encap:Ethernet  HWaddr 00:0c:29:fc:d1:1e  
          inet addr:10.0.0.10  Bcast:10.0.0.255  Mask:255.255.255.0
          inet6 addr: fe80::b9c7:5b12:80b7:aa35/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2936 errors:0 dropped:151 overruns:0 frame:0
          TX packets:60 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000 
          RX bytes:343933 (343.9 KB)  TX bytes:6640 (6.6 KB)

lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:3684 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3684 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000 
          RX bytes:277840 (277.8 KB)  TX bytes:277840 (277.8 KB)
```

- 設定後的 Linux PC:



```
root@ubuntu:~# ifconfig ens33 192.168.1.200 broadcast 192.168.1.255 netmask 255.255.255.0
root@ubuntu:~# ifconfig ens33
ens33     Link encap:Ethernet  HWaddr 00:0c:29:fc:d1:1e  
          inet addr:192.168.1.200  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::b9c7:5b12:80b7:aa35/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2947 errors:0 dropped:151 overruns:0 frame:0
          TX packets:67 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000 
          RX bytes:344849 (344.8 KB)  TX bytes:7974 (7.9 KB)
```

- 設定前的 Raspberry Pi:



```
# ifconfig
eth0      Link encap:Ethernet  HWaddr B8:27:EB:5F:92:EF  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:183 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000 
          RX bytes:17678 (17.2 KiB)  TX bytes:350 (350.0 B)

lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000 
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

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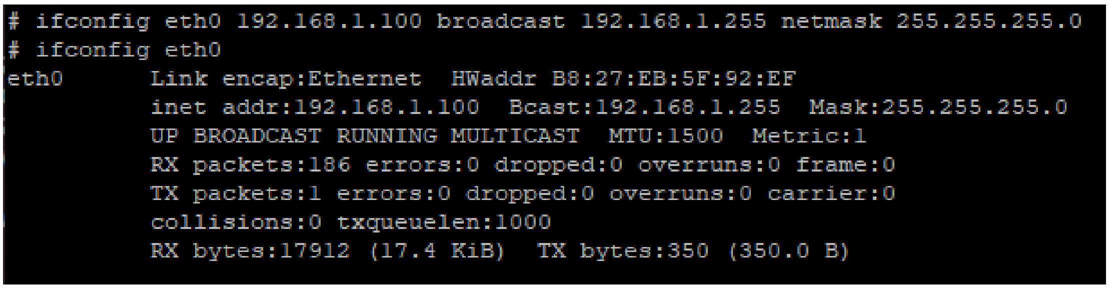
● 設定後的 Raspberry Pi:



```
# ifconfig eth0 192.168.1.100 broadcast 192.168.1.255 netmask 255.255.255.0
# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr B8:27:EB:5F:92:EF
          inet addr:192.168.1.100  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:186 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:17912 (17.4 KiB)  TX bytes:350 (350.0 B)
```

Part2: 編譯 gdbserver 執行檔

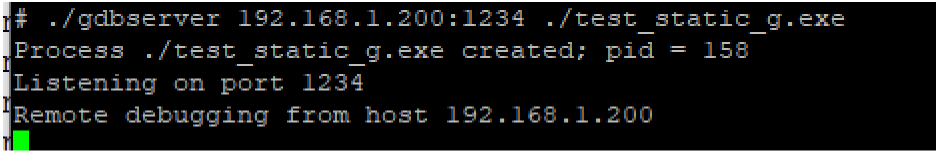
```
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ export
CC=arm-linux-gnueabihf-gcc
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ export
CXX=arm-linux-gnueabihf-g++
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ export
CFLAGS=-static
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ export
CXXFLAGS=-static
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ ./configure
--host=arm-linux-gnueabihf --target=arm-linux-gnueabihf
andy@ubuntu:~/myWORK/gdb-8.1/gdb/gdbserver$ make
```

Part3: Generate Debugged Program

```
andy@ubuntu:~/Pi$ arm-linux-gnueabihf-gcc -static test.c -o
test_static_g.exe
andy@ubuntu:~/Pi$ arm-linux-gnueabihf-gcc test.c -o test_static_g.exe

andy@ubuntu:~/Pi$ arm-linux-gnueabihf-gcc -static -g test.c -o
test_static_g.exe
andy@ubuntu:~/Pi$ arm-linux-gnueabihf-gcc -g test.c -o
test_static_g.exe
```

Part4: Target Mahine



```
# ./gdbserver 192.168.1.200:1234 ./test_static_g.exe
Process ./test_static_g.exe created; pid = 158
Listening on port 1234
Remote debugging from host 192.168.1.200
```

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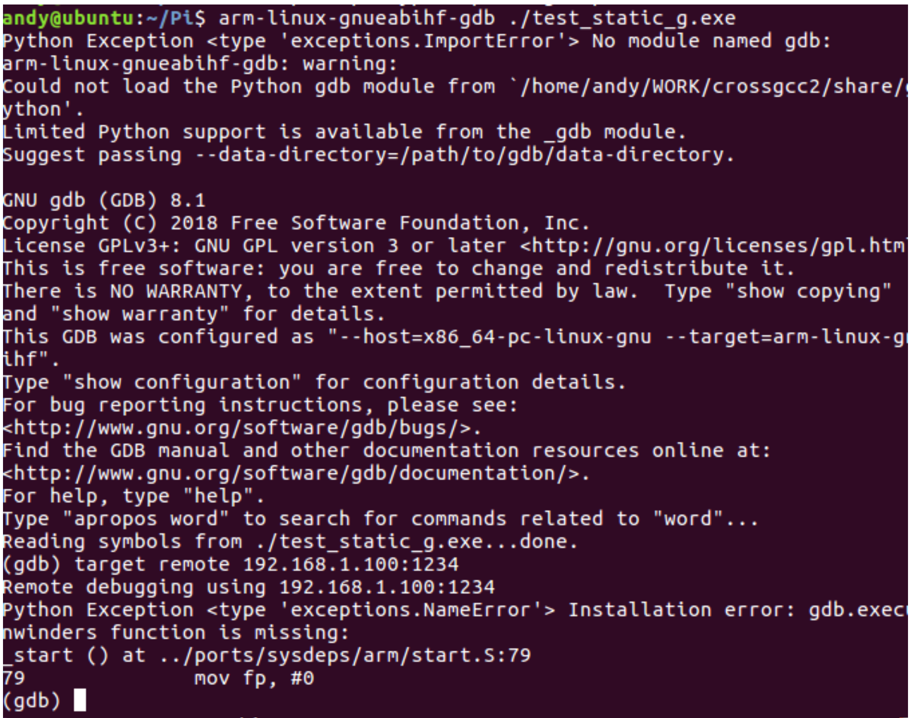
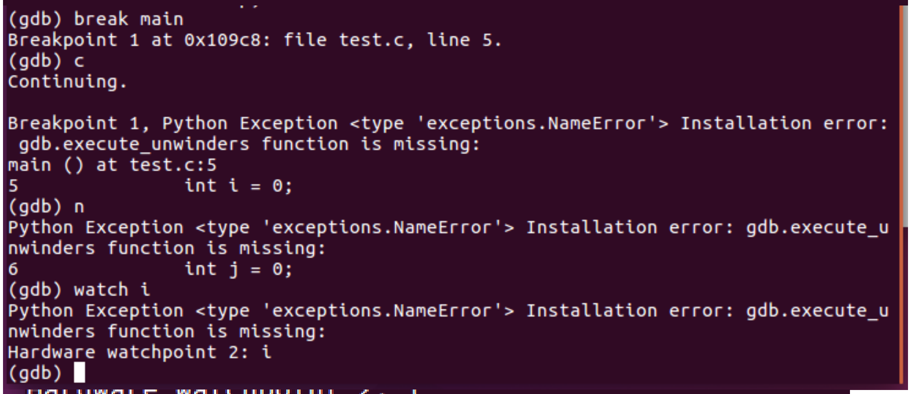
Part5: Host Mahine



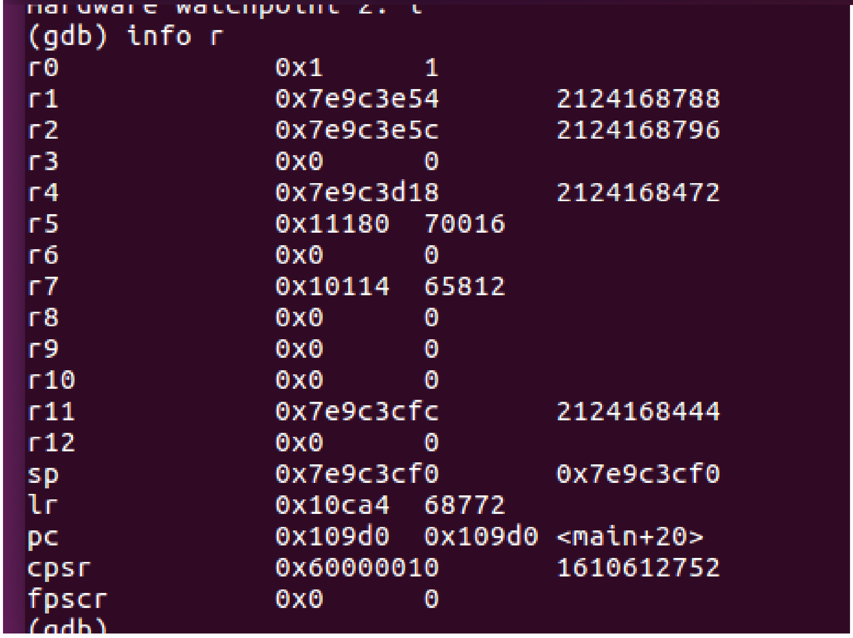
```
andy@ubuntu:~/Pi$ arm-linux-gnueabihf-gdb ./test_static_g.exe
Python Exception <type 'exceptions.ImportError'> No module named gdb:
arm-linux-gnueabihf-gdb: warning:
Could not load the Python gdb module from `/home/andy/WORK/crossgcc2/share/
ython'.
Limited Python support is available from the _gdb module.
Suggest passing --data-directory=/path/to/gdb/data-directory.

GNU gdb (GDB) 8.1
Copyright (C) 2018 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.htm
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "--host=x86_64-pc-linux-gnu --target=arm-linux-g
ihf".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./test_static_g.exe...done.
(gdb) target remote 192.168.1.100:1234
Remote debugging using 192.168.1.100:1234
Python Exception <type 'exceptions.NameError'> Installation error: gdb.exec
nwinders function is missing:
_start () at ../ports/sysdeps/arm/start.S:79
79              mov fp, #0
(gdb) 
```



```
(gdb) break main
Breakpoint 1 at 0x109c8: file test.c, line 5.
(gdb) c
Continuing.

Breakpoint 1, Python Exception <type 'exceptions.NameError'> Installation error:
 gdb.execute_unwinders function is missing:
main () at test.c:5
5               int i = 0;
(gdb) n
Python Exception <type 'exceptions.NameError'> Installation error: gdb.execute_u
nwinders function is missing:
6               int j = 0;
(gdb) watch i
Python Exception <type 'exceptions.NameError'> Installation error: gdb.execute_u
nwinders function is missing:
Hardware watchpoint 2: i
(gdb) 
```



```
Hardware watchpoint 2: i
(gdb) info r
r0             0x1      1
r1             0x7e9c3e54       2124168788
r2             0x7e9c3e5c       2124168796
r3             0x0      0
r4             0x7e9c3d18       2124168472
r5             0x11180  70016
r6             0x0      0
r7             0x10114  65812
r8             0x0      0
r9             0x0      0
r10            0x0      0
r11            0x7e9c3cfc       2124168444
r12            0x0      0
sp             0x7e9c3cf0       0x7e9c3cf0
lr             0x10ca4  68772
pc             0x109d0  0x109d0 <main+20>
cpsr           0x60000010       1610612752
fpscr          0x0      0
(gdb)
```

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問題與討論：

Q1:請問test.exe、test_g.exe、test_static.exe、test_static_g.exe 在Pi上執行的結果如何? 它們之間的差別是什麼?

Ans:

test.exe 和 test_g.ext 無法在 pi 上順利執行

但 test_static.exe 和 test_static_g.exe 可以在 pi 上順利執行

因為有使用-static 將程式需要用到的 lib static link 到執行檔中

雖然 test_static.exe 和 test_static_g.exe 都可以在 pi 上順利執行

但能使用 GDB 除錯的只有 test_static_g.exe

因為他有使用-g 將 GDB 需要用到的 debug information 加入到執行檔中

心得：

這次的實驗讓我了解如何透過跳線來與樹梅派相連,並且透過跳線來對在樹梅派上執行的程式做 debug.