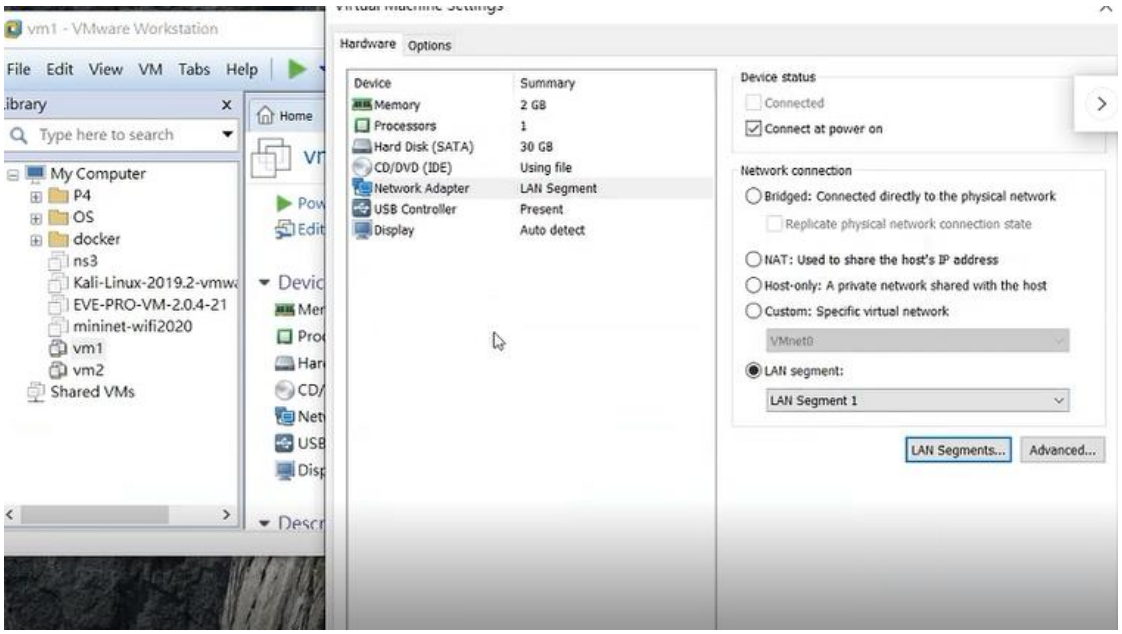
0630 如何做出 p4 軟體交換機

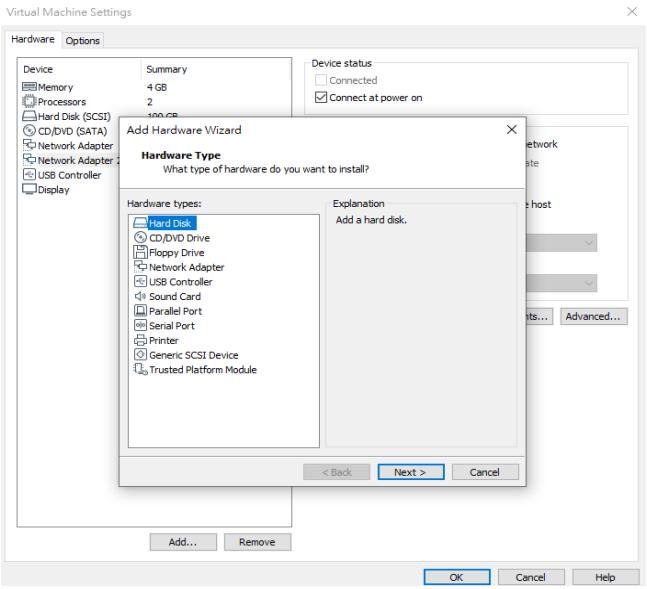
http://csie.nqu.edu.tw/smallko/sdn/p4switch.htm

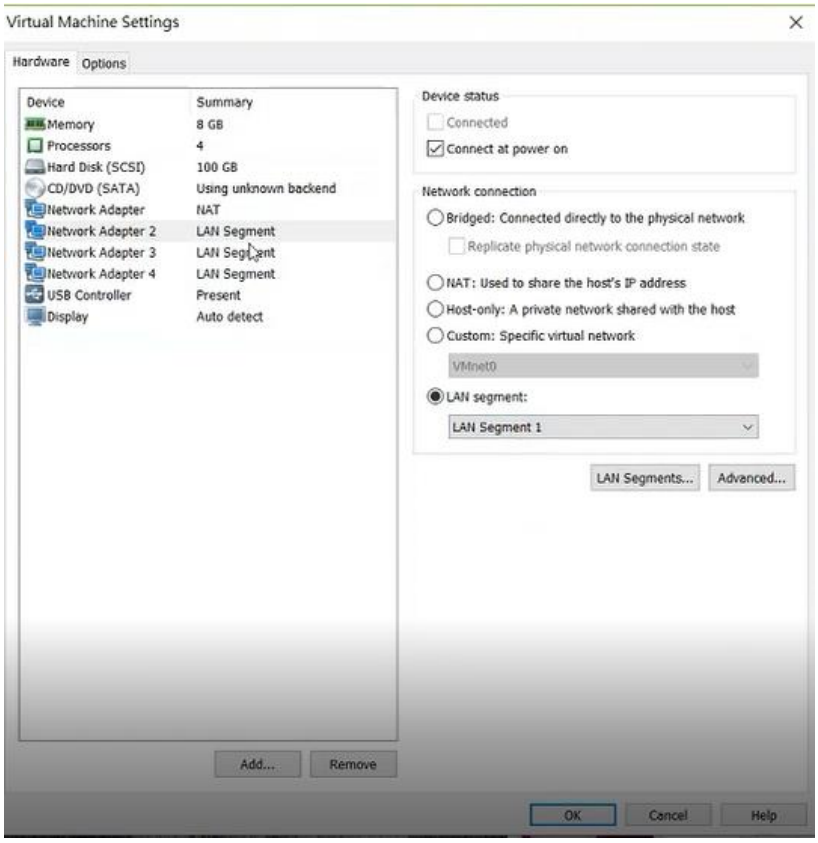
前置操作步驟：

1. 複製兩台 mininet 虛擬機 vm1(h1),vm2(h2)
   游標移至 mininet ->右鍵->manage->clone
2. 在 vm1 點 edit setting，network adapter 選 LAN Segment，如果剛開始沒有，可以點按紐 LAN Segment-> Add 3 個(LAN Segment1,LAN Segment2,LAN Segment3)
3. 第一台(vm1)選 LAN Segment1



4. vm2 重複步驟 2，LAN Segment 改成 LAN Segment2
5. mininet 那台虛擬機，增加總共四張網路卡，第一張用 NAT，第二張用 LAN Segment1，第三張用 LAN Segment2，第四張用 LAN Segment3

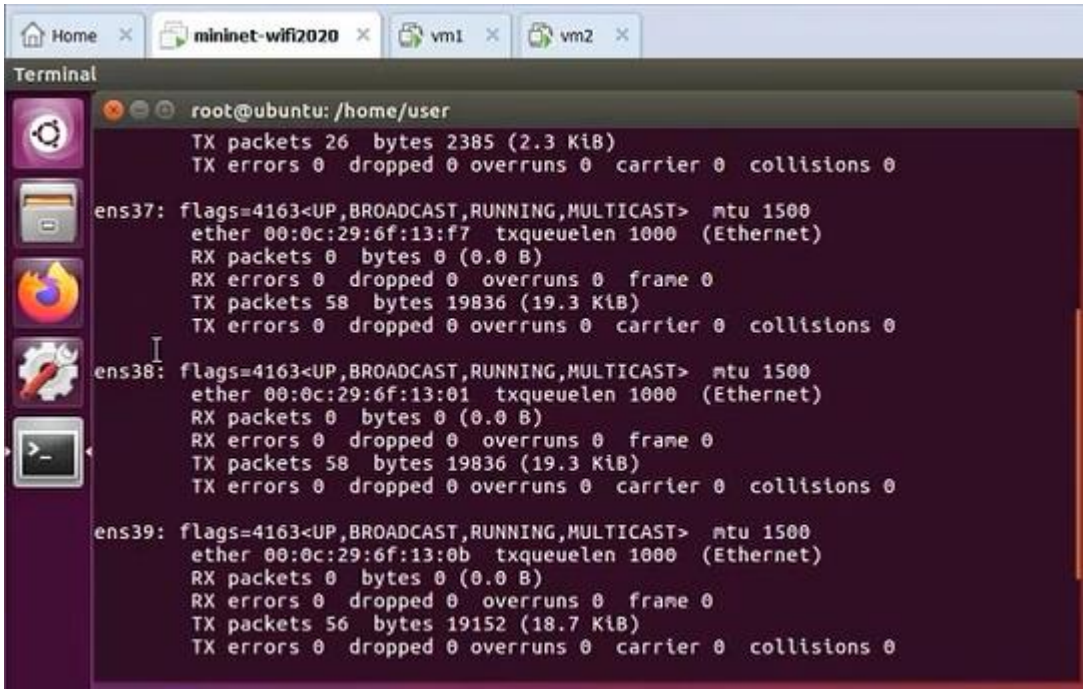




6. 弄好之後把三台機器打開(power on)

執行：

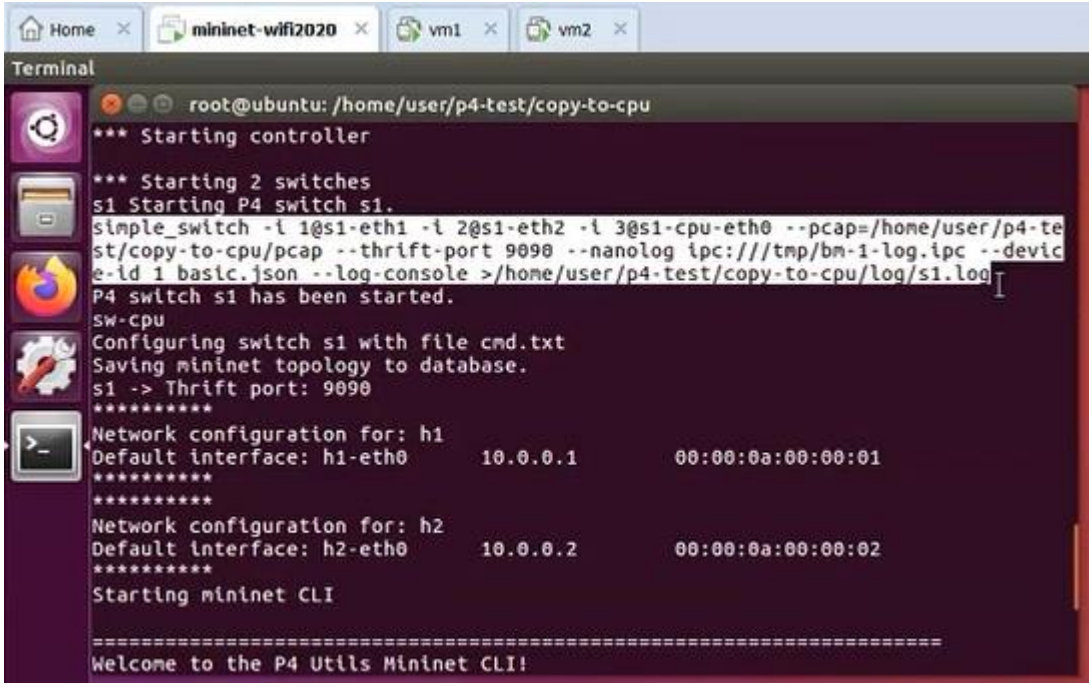
1.切到 mininet，打開終端機，切到超級使用者輸入 ifconfig，會看到



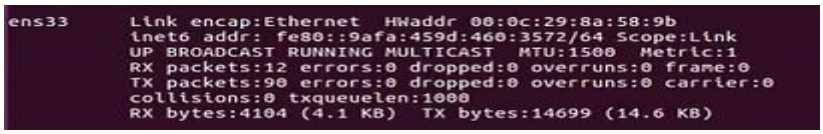
ens37,38,39(不一定是 37,38,39)就是剛剛增加的網路卡 LAN…1, LAN…2, LAN…3

2.切到 p4-test 資料夾(cd p4-test)，切到 copy-to-cpu，然後 p4run

3.把反白部分指令複製，然後結束剛剛 run 的 mininet(exit)



4.然後切到 vm1，切到超級使用者(su)，然後用 ifconfig 查看是不會有 ip 位址的



5. vm1 和 vm2，手動加上 ip 位址

Vm1:

```
root@user-VirtualBox:/home/user# ip addr add 10.0.0.1/24 brd + dev ens33
root@user-VirtualBox:/home/user#
```

10.0.0.1 加上了：

```
ens33     Link encap:Ethernet  HWaddr 00:0c:29:8a:58:9b
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          inet6 addr: fe80::9afa:459d:460:3572/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:12 errors:0 dropped:0 overruns:0 frame:0
          TX packets:127 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:4104 (4.1 KB)  TX bytes:20637 (20.6 KB)
```

Vm2:

```
user@user-VirtualBox:~$ su
Password:
root@user-VirtualBox:/home/user# ip addr add 10.0.0.2/24 brd + dev ens33
```

10.0.0.2 加上了：

```
ens33     Link encap:Ethernet  HWaddr 00:0c:29:3a:e0:04
          inet addr:10.0.0.2  Bcast:10.0.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe3a:e004/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11 errors:0 dropped:0 overruns:0 frame:0
          TX packets:144 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3762 (3.7 KB)  TX bytes:22565 (22.5 KB)
```

切到 vm1

現在用 vm1 去 ping vm2 是不通的

```
root@user-VirtualBox:/home/user# ping 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable
From 10.0.0.1 icmp_seq=2 Destination Host Unreachable
From 10.0.0.1 icmp_seq=3 Destination Host Unreachable
```

7. 切到 mininet 虛擬機，把剛剛複製的指令修改一下貼上
   (倒數第二行 console 後面拿掉，第一行 1@s1-eth1 改 1@ens37，看網卡編號，這邊是 ens37)

   1@:1 號埠,2@:2 號埠

```
root@ubuntu:/home/user/p4-test/copy-to-cpu# simple_switch -i 1@ens37 -i 2@s1-eth
2 -i 3@s1-cpu-eth0 --pcap=/home/user/p4-test/copy-to-cpu/pcap --thrift-port 9090
 --nanolog ipc:///tmp/bm-1-log.ipc --device-id 1 basic.json --log-console

ens37: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        ether 00:0c:29:6f:13:f7  txqueuelen 1000  (Ethernet)
        RX packets 40  bytes 8886 (8.6 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 71  bytes 24282 (23.7 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

8. 然後第一行 2@s1-eth2 改 2@ens38，第二行 3@s1-cpu-eth0 改 3@ens39 然後 enter 執行會跑這樣

```
root@ubuntu:/home/user/p4-test/copy-to-cpu# simple_switch -i 1@ens37 -i 2@ens38
-i 3@ens39 --pcap=/home/user/p4-test/copy-to-cpu/pcap --thrift-port 9090 --nanol
og ipc:///tmp/bm-1-log.ipc --device-id 1 basic.json --log-console
Calling target program-options parser
[14:33:20.266] [bmv2] [D] [thread 3029] Set default default entry for table 'MyI
ngress.phy_forward': MyIngress.drop -
[14:33:20.266] [bmv2] [D] [thread 3029] Set default default entry for table 'tbl
_basic90': basic90 -
[14:33:20.266] [bmv2] [D] [thread 3029] Set default default entry for table 'tbl
_basic94': basic94 -
Adding interface ens37 as port 1
[14:33:20.267] [bmv2] [D] [thread 3029] Adding interface ens37 as port 1
Adding interface ens38 as port 2
[14:33:20.320] [bmv2] [D] [thread 3029] Adding interface ens38 as port 2
Adding interface ens39 as port 3
[14:33:20.373] [bmv2] [D] [thread 3029] Adding interface ens39 as port 3
[14:33:20.435] [bmv2] [I] [thread 3029] Starting Thrift server on port 9090
[14:33:20.437] [bmv2] [I] [thread 3029] Thrift server was started
```

這時候再切到 vm1 去 ping vm2 還是不能通，因為規則還沒下

9. 切到 mininet 下規則，重開一個終端機並切到 copy-to-cpu

```
root@ubuntu:/home/user#
root@ubuntu:/home/user# cd p4-test
root@ubuntu:/home/user/p4-test# cd copy-to-cpu/
root@ubuntu:/home/user/p4-test/copy-to-cpu# ls
basic.json  basic.p4i  log         pcap        topology.db
basic.p4    cmd.txt    p4app.json  receive.py
root@ubuntu:/home/user/p4-test/copy-to-cpu# cat cmd.txt
table_add phy_forward forward 1 => 2
table_add phy_forward forward 2 => 1
mirroring_add 100 3

root@ubuntu:/home/user/p4-test/copy-to-cpu#
```

下規則指令：simple_switch_CLI –thrift-port 9090 < cmd.txt
把命令透過指令丟到 cmd.txt

命令丟進去後長這樣

```
root@ubuntu:/home/user/p4-test/copy-to-cpu# simple_switch_CLI --thrift-port 9090
 < cmd.txt
Obtaining JSON from switch...
Done
Control utility for runtime P4 table manipulation
RuntimeCmd: Adding entry to exact match table phy_forward
match key:           EXACT-00:01
action:              forward
runtime data:        00:02
Entry has been added with handle 0
RuntimeCmd: Adding entry to exact match table phy_forward
match key:           EXACT-00:02
action:              forward
runtime data:        00:01
Entry has been added with handle 1
RuntimeCmd: RuntimeCmd: RuntimeCmd:
root@ubuntu:/home/user/p4-test/copy-to-cpu#
```

在另一台終端機可以看到規則被寫入了

命令是 1 號埠進去 2 號埠出來，2 號埠進去 1 號埠出來

```
root@ubuntu: /home/user/p4-test/copy-to-cpu
[14:33:49.225] [bmv2] [D] [thread 3035] [6.0] [cxt 0] Pipeline 'ingress': end
[14:33:49.225] [bmv2] [D] [thread 3035] [6.0] [cxt 0] Egress port is 511
[14:33:49.225] [bmv2] [D] [thread 3035] [6.0] [cxt 0] Dropping packet at the end
 of ingress
[14:34:08.035] [bmv2] [T] [thread 3047] bm_get_config
[14:34:08.037] [bmv2] [T] [thread 3047] bm_table_add_entry
[14:34:08.037] [bmv2] [D] [thread 3047] Entry 0 added to table 'MyIngress.phy_fo
rward'
[14:34:08.037] [bmv2] [D] [thread 3047] Dumping entry 0
Match key:
* standard_metadata.ingress_port: EXACT     0001
Action entry: MyIngress.forward - 2,

[14:34:08.038] [bmv2] [T] [thread 3047] bm_table_add_entry
[14:34:08.038] [bmv2] [D] [thread 3047] Entry 1 added to table 'MyIngress.phy_fo
rward'
[14:34:08.038] [bmv2] [D] [thread 3047] Dumping entry 1
Match key:
* standard_metadata.ingress_port: EXACT     0002
Action entry: MyIngress.forward - 1,

[14:34:08.038] [bmv2] [T] [thread 3047] mirroring_sesssion_add
[14:34:08.039] [bmv2] [T] [thread 3047] mirroring_sesssion_add
```

10. 再切到 vm1 去 ping vm2 就可以通了
11. 然後回到 mininet 虛擬機，在 copy-to-cpu 資料夾輸入 gedit receive.py &
12. 把 ifac 加 ens39 並 save，如圖

```
*receive.py (/home/user/p4-test/copy-to-cpu) - gedit
File  Edit  View  Search  Tools  Documents  Help
Open ▾                                                    Sav

#!/usr/bin/env python
import sys
import struct
import os

from scapy.all import sniff, sendp, hexdump, get_if_list, get_if_hwaddr, bind_layers
from scapy.all import Packet, IPOption, Ether
from scapy.all import ShortField, IntField, LongField, BitField, FieldListField, FieldLenField
from scapy.all import IP, UDP, Raw, ls
from scapy.layers.inet import _IPOption_HDR

def handle_pkt(pkt):
    print "Controller got a packet"
    print pkt.summary()

def main():
    if len(sys.argv) < 2:
        #iface = 's1-cpu-eth1'
        iface = 'ens39'
    else:
        iface = sys.argv[1]

    print "sniffing on %s" % iface
    sys.stdout.flush()
    sniff(iface = iface,
          prn = lambda x: handle_pkt(x))

if __name__ == '__main__':
    main()
```

13. 執行 python receive.py

```
root@ubuntu:/home/user/p4-test/copy-to-cpu# python receive.py
sniffing on ens39
Controller got a packet
Ether / 10.0.0.1 > 10.0.0.2 icmp
Controller got a packet
Ether / 10.0.0.2 > 10.0.0.1 icmp
Controller got a packet
Ether / 10.0.0.1 > 10.0.0.2 icmp
Controller got a packet
Ether / 10.0.0.2 > 10.0.0.1 icmp
Controller got a packet
Ether / 0.0.0.0 > 255.255.255.255 udp
Controller got a packet
Ether / 0.0.0.0 > 255.255.255.255 udp
Controller got a packet
Ether / 10.0.0.1 > 10.0.0.2 icmp
Controller got a packet
Ether / 10.0.0.2 > 10.0.0.1 icmp
```

LAN1 接的是第一台主機，LAN2 接的是第二台，LAN3 就可以讓他丟到控制器上

裝資料庫系統 logstash&資料庫 influxdb

什麼是 logstash？

https://www.elastic.co/cn/logstash
蒐集資料、解析資料、並進行資料轉換成想要的格式，就可以寫道你想寫進的地方去。Ex:檔案裡、資料庫

我們會先在網路上傳送正常的 ping 的封包，然後讓 logstash 得到 ping 封包的屬性，這個 logstash 會把 ping 的封包寫到資料庫系統裡面。
為什麼要透過它而不直接寫進資料庫，是因為 ping 的封包裡面得到像封包的長度，或其他像來源 IP，這些東西寫進去資料庫的時候，會有一種格式的轉換，或者是有些東西需要做篩選，就需要這樣的工具。

安裝 logstash 步驟：
https://www.elastic.co/guide/en/logstash/current/installing-logstash.html
1. 打開 mininet 虛擬機的終端機，切超級使用者
2. 貼上指令(按順序)

```
wget -qO - https://artifacts.elastic.co/GPG-KEY-elasticsearch
| sudo apt-key add -
```

```
sudo apt-get install apt-transport-https
```

```
echo "deb https://artifacts.elastic.co/packages/7.x/apt stable main" | sudo tee -a /etc/apt/sources.list.d/elastic-7.x.list
```

```
sudo apt-get update && sudo apt-get install logstash
```

什麼是 influxdb？

跟時間有關的資料庫系統

安裝 influxdb 步驟：
https://docs.influxdata.com/influxdb/v1.8/introduction/install/

1. 打開 mininet 虛擬機的終端機，切超級使用者
2. 貼上指令(按順序)

```
wget -qO- https://repos.influxdata.com/influxdb.key | sudo apt-key add -
```

```
source /etc/os-release
```

```
echo "deb https://repos.influxdata.com/debian $(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/influxdb.list
```

```
sudo apt-get update && sudo apt-get install influxdb
```

使用指令啟動資料庫：systemctl start influxdb
查看有沒有成功啟動：systemctl status influxdb

登錄資料庫做基本設定

步驟：
https://dotblogs.com.tw/DizzyDizzy/2018/07/10/influxUbuntu
1.進入資料庫指令：influx

```
root@ubuntu:/home/user/Downloads# influx
Connected to http://localhost:8086 version 1.5.4
InfluxDB shell version: 1.5.4
>
```

2.執行指令

開帳號跟名字。Ex:建立一組帳號叫 admin，密碼也是 admin

```
CREATE USER admin WITH PASSWORD 'admin' WITH ALL PRIVILEGES
```

創建一個資料庫 mydb

```
creat database mydb
```

查看資料庫

```
show database
```

```
> show databases
name: databases
name
----
telegraf
internal
mydb
```

3. 使用 exit 關閉，接著打指令輸入資料庫帳密就可以進去

influx –username admin –password admin

然後輸入 show database 就會出現如上圖的畫面