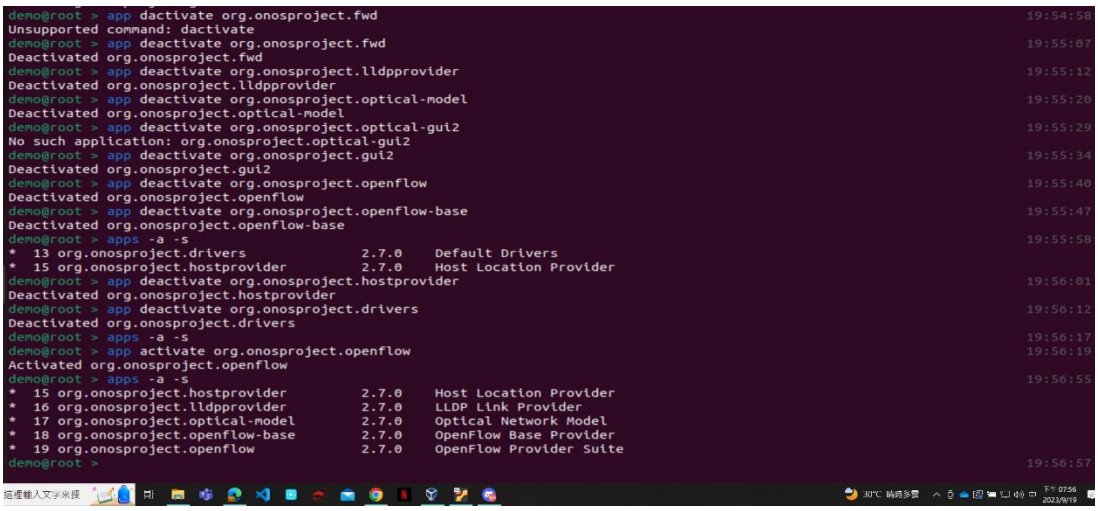
Part1:

Q1: When ONOS activates “org.onosproject.openflow,” what are the APPs which it also activates?

Ans: 如圖一所示，我先將所有 app deactivate，再 activate org.onosproject.openflow,後，以下這四個 app 會隨著 org.onosproject.openflow, 一起 activate:

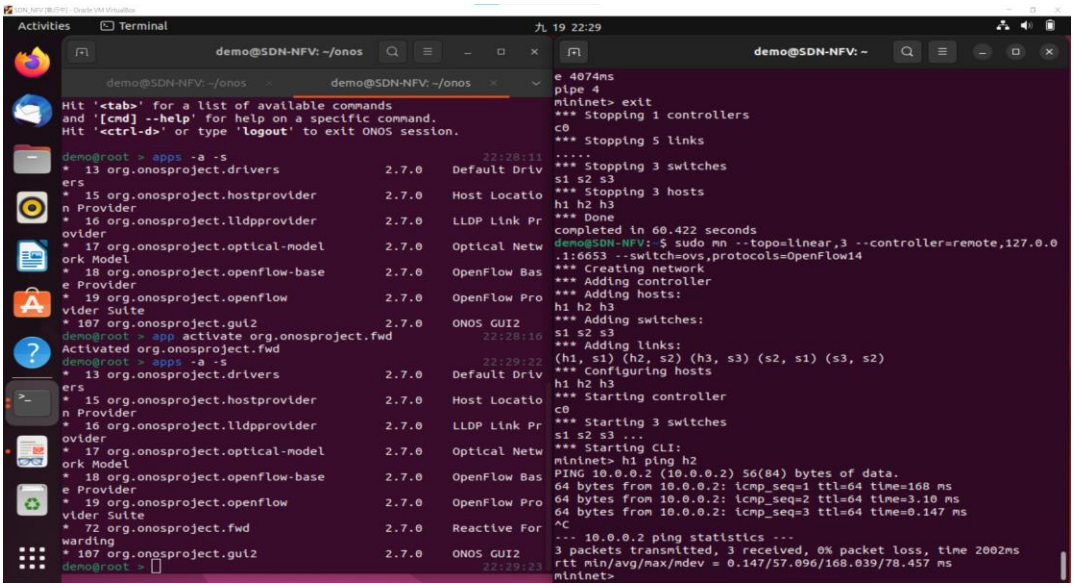
1. org.onosproject.hostprovider
2. org.onosproject.lldpprovider
3. org.onosproject.optical-model
4. org.onosproject.openflow-base



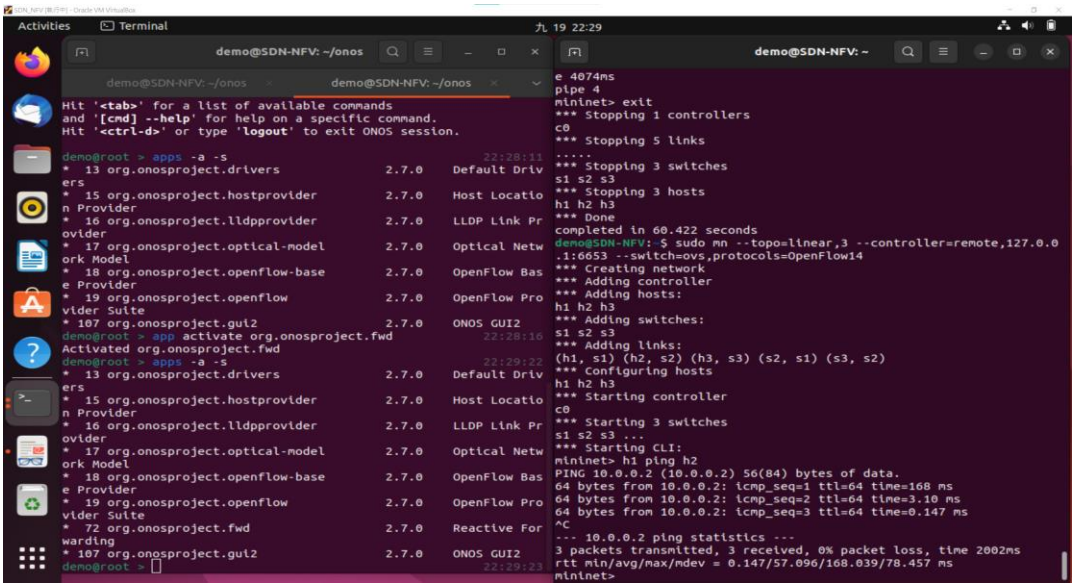
圖一

Q2: After activating ONOS and running the commands on P.17 and P.20. Will H1 ping H2 successfully? Why or why not?

Ans: 如圖二所示，在沒有 activate org.onosproject.fwd 前，h1 ping 不到 h2，原因是 there are no flows installed on the data-plane，which forward the traffic appropriately，在圖三 activate org.onosproject.fwd 後，h1 就可以 ping 到 h2 了



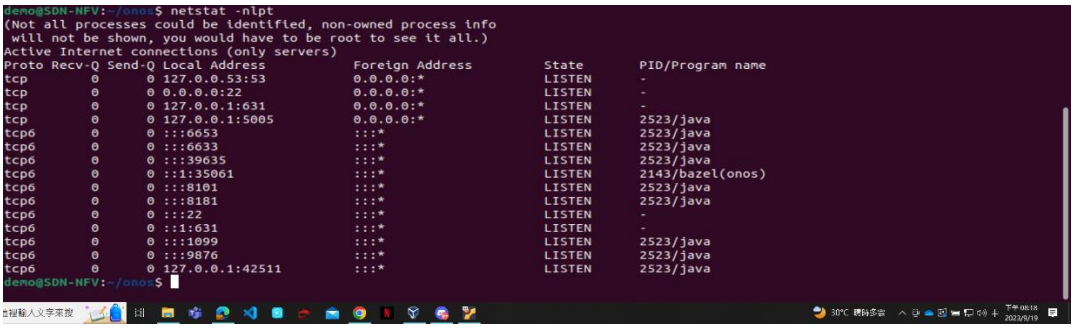
圖二



圖三

Q3: Which TCP port the controller listens for the OpenFlow connection request from the switch? Screenshot

Ans: 如圖四所示，Controller 會 listen 6653 port 或 6633 port 並請求建立 OpenFlow connection，6653 和 6633 都是 OpenFlow port，較新的 Openflow version 使用 6653，較舊的 version 則使用 6633



```
demo@SDN-NFV:~/onos$ netstat -nlpt
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN      -
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.1:5005          0.0.0.0:*               LISTEN      2523/java
tcp6       0      0 :::6653                 :::*                    LISTEN      2523/java
tcp6       0      0 :::6633                 :::*                    LISTEN      2523/java
tcp6       0      0 :::39635                :::*                    LISTEN      2523/java
tcp6       0      0 ::1:35061               :::*                    LISTEN      2143/bazel(onos)
tcp6       0      0 :::8101                 :::*                    LISTEN      2523/java
tcp6       0      0 :::8181                 :::*                    LISTEN      2523/java
tcp6       0      0 :::22                   :::*                    LISTEN      -
tcp6       0      0 ::1:631                 :::*                    LISTEN      -
tcp6       0      0 :::1099                 :::*                    LISTEN      2523/java
tcp6       0      0 :::9876                 :::*                    LISTEN      2523/java
tcp6       0      0 127.0.0.1:42511         :::*                    LISTEN      2523/java
demo@SDN-NFV:~/onos$
```

圖四

Q4: In question 3, which APP enables the controller to listen on the TCP port?

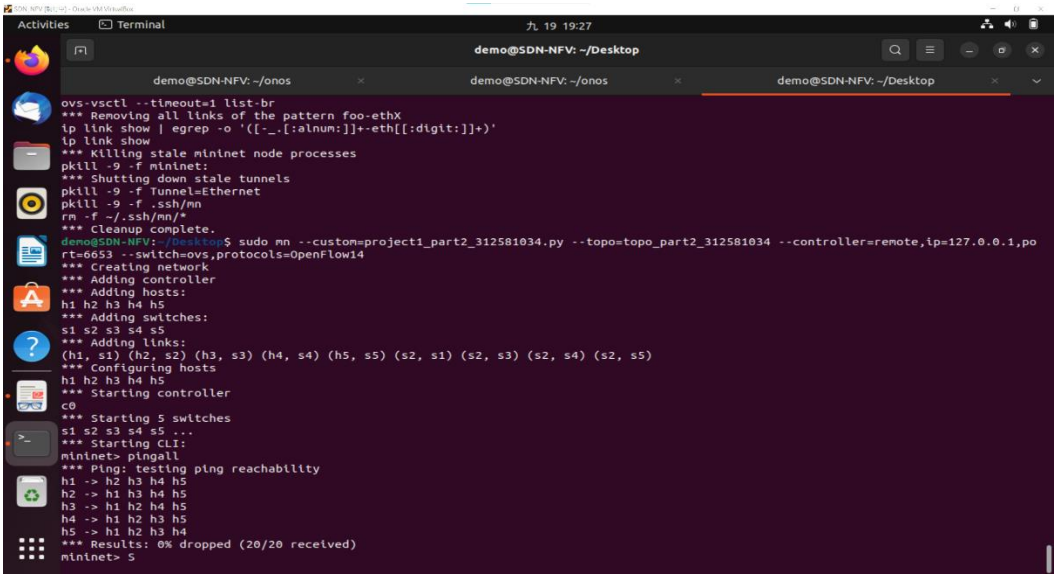
Ans: openflow-base enable controller to listen on the TCP port，openflow-base 是 openflow 的 dependacy app 之一，如 Q1 列出的 app 都是 openflow 的 dependancy app，openflow-base 控制 controller listen TCP port，其餘無關。

Part2

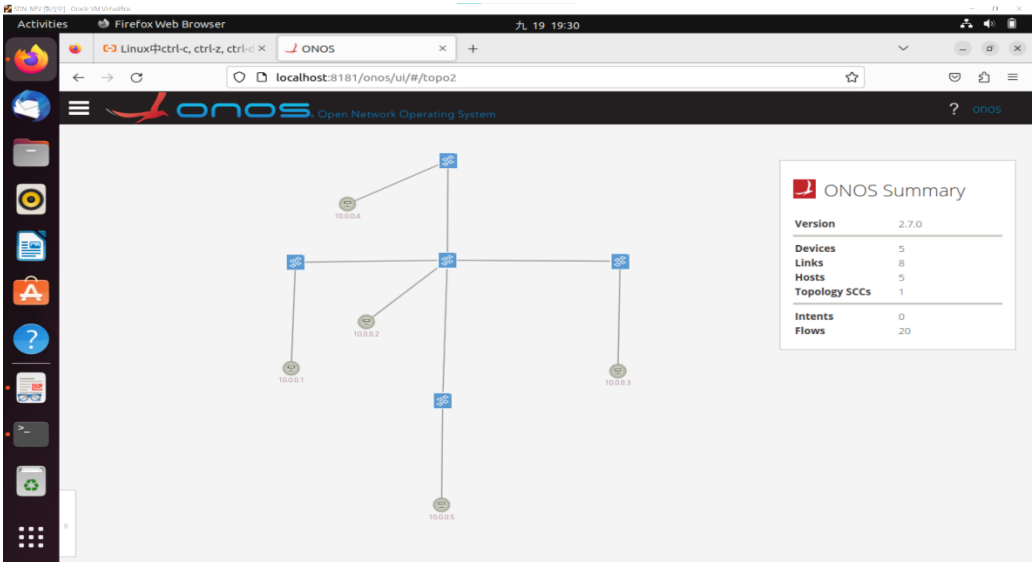
如圖五，我按照題目設定 5 個 host 跟 5 個 switch，並按照題目的拓樸在他們之間建立 Link，建出來的 network 如圖六，pingall 成功，圖七是拓樸圖，如題目所要求的一樣。

```python
from mininet.topo import Topo

class Project1_Topo_312581034( Topo ):
    def __init__( self ):
        Topo.__init__( self )

        h1 = self.addHost( 'h1' )
        h2 = self.addHost( 'h2' )
        h3 = self.addHost( 'h3' )
        h4 = self.addHost( 'h4' )
        h5 = self.addHost( 'h5' )

        s1 = self.addSwitch( 's1' )
        s2 = self.addSwitch( 's2' )
        s3 = self.addSwitch( 's3' )
        s4 = self.addSwitch( 's4' )
        s5 = self.addSwitch( 's5' )


        self.addLink( h1, s1 )
        self.addLink( h2, s2 )
        self.addLink( h3, s3 )
        self.addLink( h4, s4 )
        self.addLink( h5, s5 )

        self.addLink( s2, s1 )
        self.addLink( s2, s3 )
        self.addLink( s2, s4 )
        self.addLink( s2, s5 )



topos = { 'topo_part2_312581034': Project1_Topo_312581034}
```

圖五



圖六



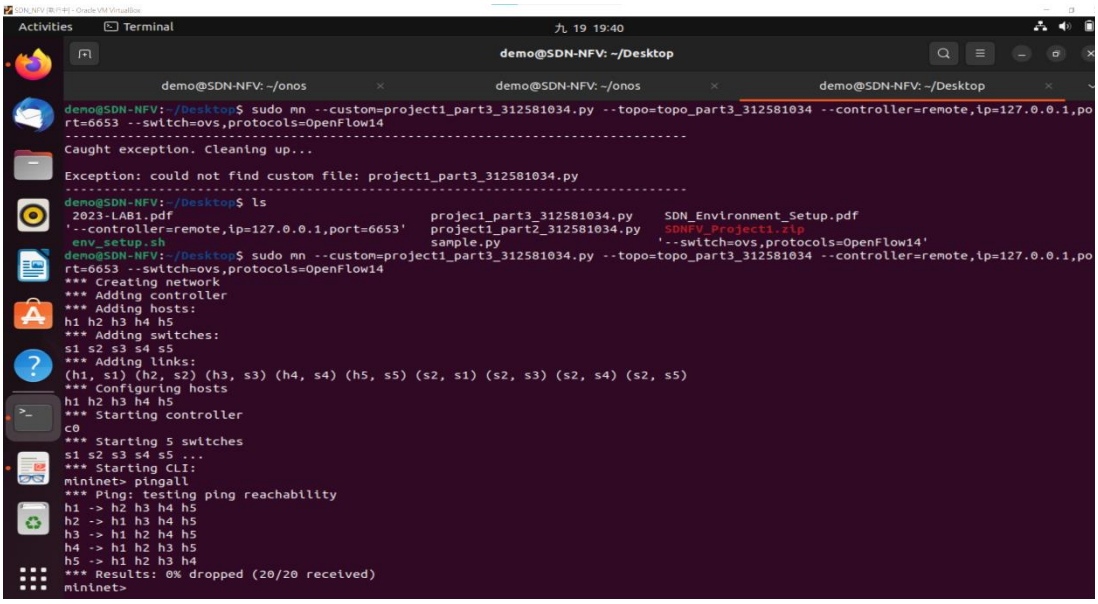
圖七

Part3

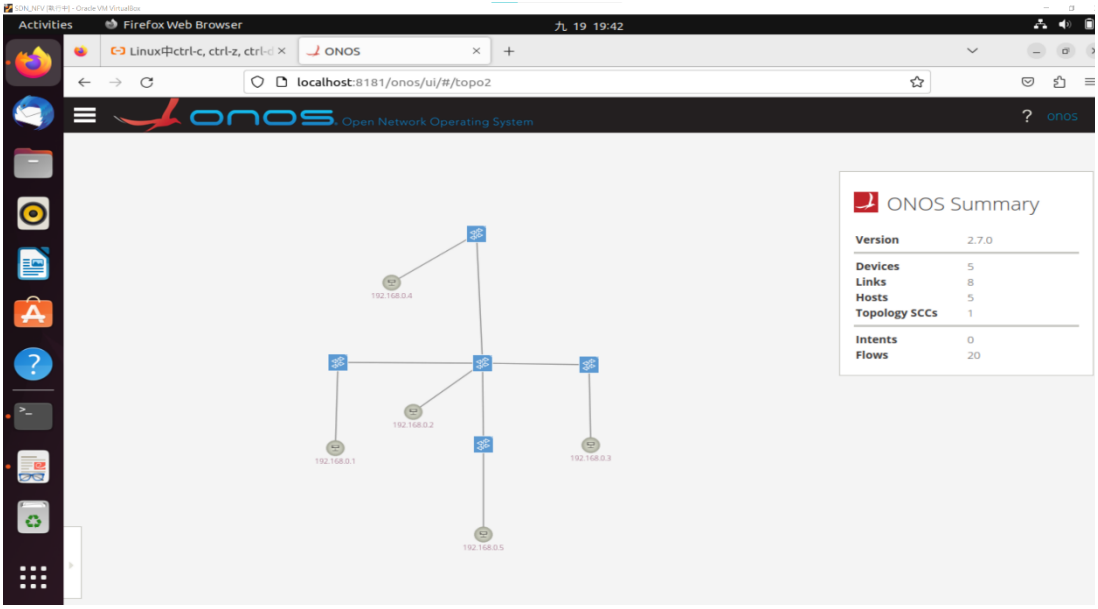
如圖八，程式碼與 part2 基本一樣，差別在於為每個 host 設定各自的 static ip，建立起的網路與拓樸圖如圖九與圖十，pingall 成功，拓樸圖上 host 顯示的是自己設定的 static ip，圖十一 ~ 圖十六是 dump 與各個 host ifconfig 的截圖，可以看到 ip 都有設定成功

```python
from mininet.topo import Topo

class Project1_Topo_312581034( Topo ):
    def __init__( self ):
        Topo.__init__( self )

        h1 = self.addHost( 'h1' , ip = '192.168.0.1/27' )
        h2 = self.addHost( 'h2' , ip = '192.168.0.2/27' )
        h3 = self.addHost( 'h3' , ip = '192.168.0.3/27' )
        h4 = self.addHost( 'h4' , ip = '192.168.0.4/27' )
        h5 = self.addHost( 'h5' , ip = '192.168.0.5/27' )

        s1 = self.addSwitch( 's1' )
        s2 = self.addSwitch( 's2' )
        s3 = self.addSwitch( 's3' )
        s4 = self.addSwitch( 's4' )
        s5 = self.addSwitch( 's5' )


        self.addLink( h1, s1 )
        self.addLink( h2, s2 )
        self.addLink( h3, s3 )
        self.addLink( h4, s4 )
        self.addLink( h5, s5 )

        self.addLink( s2, s1 )
        self.addLink( s2, s3 )
        self.addLink( s2, s4 )
        self.addLink( s2, s5 )



topos = { 'topo_part3_312581034': Project1_Topo_312581034}

```

圖八



圖九

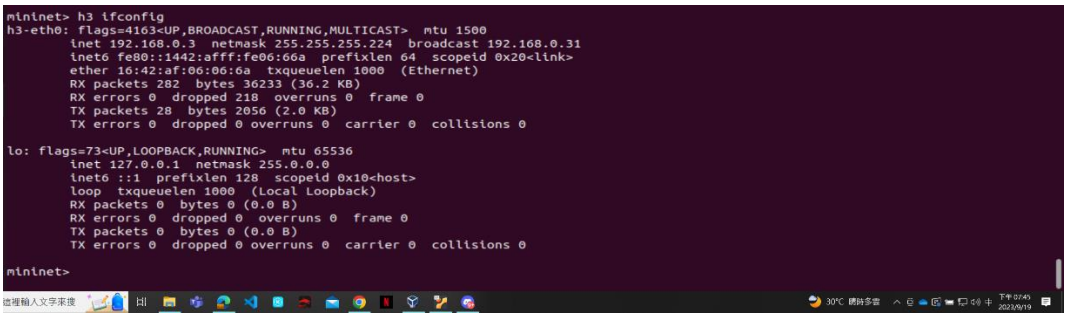


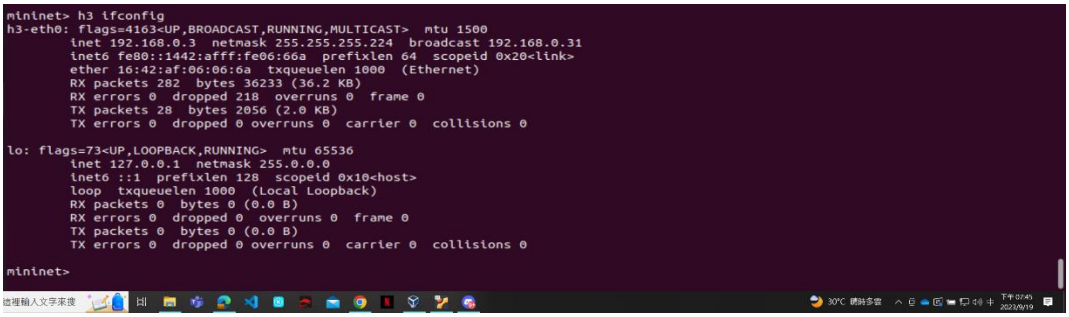
圖十

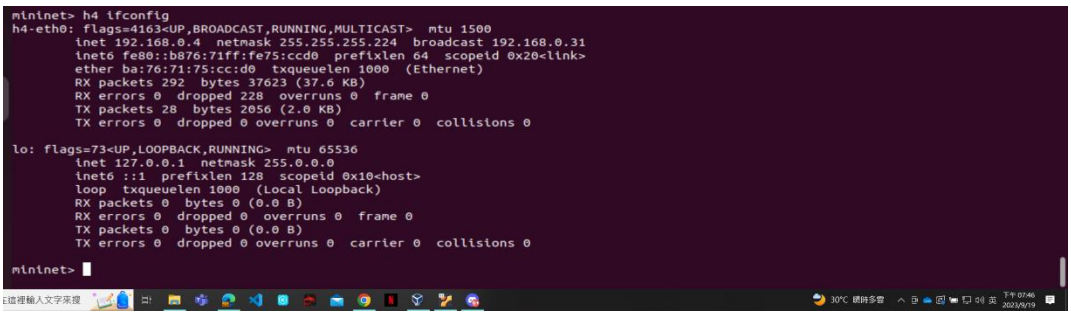
```
mininet> dump
<Host h1: h1-eth0:192.168.0.1 pid=7321>
<Host h2: h2-eth0:192.168.0.2 pid=7323>
<Host h3: h3-eth0:192.168.0.3 pid=7325>
<Host h4: h4-eth0:192.168.0.4 pid=7327>
<Host h5: h5-eth0:192.168.0.5 pid=7329>
<OVSSwitch{'protocols': 'OpenFlow14'} s1: lo:127.0.0.1,s1-eth1:None,s1-eth2:None pid=7334>
<OVSSwitch{'protocols': 'OpenFlow14'} s2: lo:127.0.0.1,s2-eth1:None,s2-eth2:None,s2-eth3:None,s2-eth4:None,s2-eth5:None pid=7337>
<OVSSwitch{'protocols': 'OpenFlow14'} s3: lo:127.0.0.1,s3-eth1:None,s3-eth2:None pid=7340>
<OVSSwitch{'protocols': 'OpenFlow14'} s4: lo:127.0.0.1,s4-eth1:None,s4-eth2:None pid=7343>
<OVSSwitch{'protocols': 'OpenFlow14'} s5: lo:127.0.0.1,s5-eth1:None,s5-eth2:None pid=7346>
<RemoteController{'ip': '127.0.0.1', 'port': 6653} c0: 127.0.0.1:6653 pid=7315>
mininet>
```

```
mininet> h1 ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.0.1  netmask 255.255.255.224  broadcast 192.168.0.31
        inet6 fe80::6894:20ff:fe7c:75c  prefixlen 64  scopeid 0x20<link>
        ether 6a:94:20:7c:07:5c  txqueuelen 1000  (Ethernet)
        RX packets 270  bytes 34125 (34.1 KB)
        RX errors 0  dropped 198  overruns 0  frame 0
        TX packets 28  bytes 2056 (2.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

mininet> s
```

```
mininet> h2 ifconfig
h2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.0.2  netmask 255.255.255.224  broadcast 192.168.0.31
        inet6 fe80::5461:35ff:fe76:c82f  prefixlen 64  scopeid 0x20<link>
        ether 56:61:35:76:c8:2f  txqueuelen 1000  (Ethernet)
        RX packets 282  bytes 35793 (35.7 KB)
        RX errors 0  dropped 210  overruns 0  frame 0
        TX packets 28  bytes 2056 (2.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

mininet> s
```







圖十一 ~ 圖十六

What I learned or solved:

有學到關於 SDN 的技術，如何建立一個網路，以及查看他的的拓樸圖，和如何客製自己的網路拓樸。