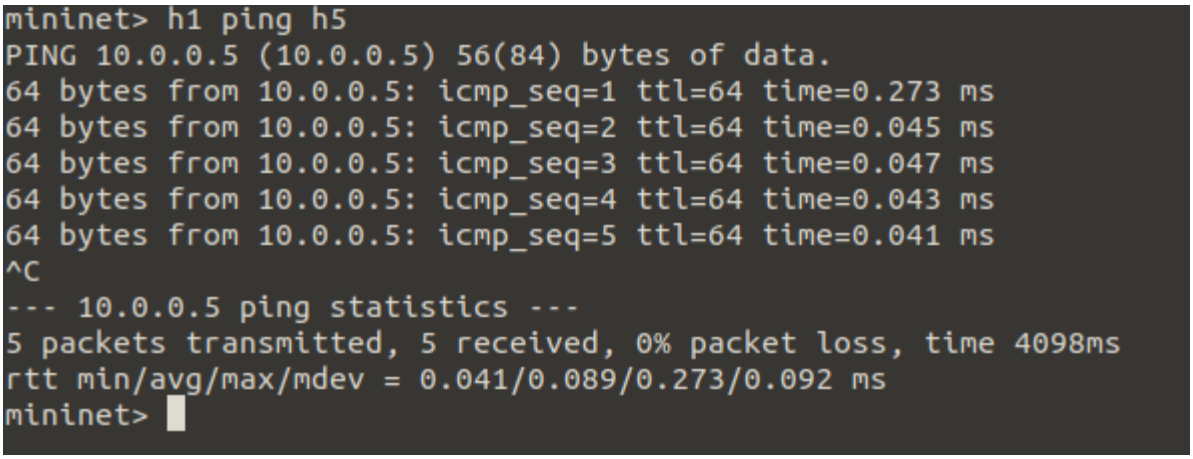
```
INFO:openflow.discovery:link detected: 00-00-00-00-00-01.1 -> 00-00-00-00-00-02.3
INFO:openflow.discovery:link detected: 00-00-00-00-00-03.3 -> 00-00-00-00-00-02.1
INFO:openflow.discovery:link detected: 00-00-00-00-00-02.2 -> 00-00-00-00-00-04.3
INFO:openflow.discovery:link detected: 00-00-00-00-00-01.2 -> 00-00-00-00-00-05.3
INFO:openflow.discovery:link detected: 00-00-00-00-00-07.3 -> 00-00-00-00-00-05.2
INFO:openflow.discovery:link detected: 00-00-00-00-00-05.1 -> 00-00-00-00-00-06.3
INFO:openflow.discovery:link detected: 00-00-00-00-00-02.3 -> 00-00-00-00-00-01.1
INFO:openflow.discovery:link detected: 00-00-00-00-00-05.3 -> 00-00-00-00-00-01.2
INFO:openflow.discovery:link detected: 00-00-00-00-00-02.1 -> 00-00-00-00-00-03.3
INFO:openflow.discovery:link detected: 00-00-00-00-00-04.3 -> 00-00-00-00-00-02.2
INFO:openflow.discovery:link detected: 00-00-00-00-00-05.2 -> 00-00-00-00-00-07.3
INFO:host_tracker:Learned 3 1 00:00:00:00:00:01
INFO:host_tracker:Learned 3 1 00:00:00:00:00:01 got IP 10.0.0.1
INFO:host_tracker:Learned 6 1 00:00:00:00:00:05
INFO:host_tracker:Learned 6 1 00:00:00:00:00:05 got IP 10.0.0.5
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:05.1 -> 00:00:00:00:00:01.3
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:05.1 -> 00:00:00:00:00:01.3
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:05.2 -> 00:00:00:00:00:01.1
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:05.3 -> 00:00:00:00:00:01.1
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:05.3 -> 00:00:00:00:00:01.1
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:01.1 -> 00:00:00:00:00:05.3
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:01.1 -> 00:00:00:00:00:05.3
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:01.1 -> 00:00:00:00:00:05.2
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:01.3 -> 00:00:00:00:00:05.1
DEBUG:forwarding.l2_learning:installing flow for 00:00:00:00:00:01.3 -> 00:00:00:00:00:05.1
INFO:openflow.discovery:link detected: 00-00-00-00-00-06.3 -> 00-00-00-00-00-05.1
DEBUG:openflow.of_01:1 connection aborted
```

The INFO lines before the section that begins with “INFO:host_tracker:Learned 3 1 00:00:00:00:00:01” shows links being detected such as the first line “INFO:openflow.discovery:link detected: 00-00-00-00-00-01.1 -> 00-00-00-00-00-02.3” showing that there is a link between 1.1 and 2.3. The entire first section is exactly what was explained will happen when we ran the scripts required in part C 3 and 4 as the tree topology was created and then the POX controller was connected to all the switches. This can be seen by looking at where each of the left connection links attach to the right, switch 5 connects to switch 6 port 3 and switch 7 port 3. And switch 5 is connected to switch 1 via its port 2.

The second section beginning at “INFO:host_tracker:Learned 3 1 00:00:00:00:00:01” is after we ran “h1 ping h5” in mininet. POX first tells us that it has found the switch=3 that connects host=1 which has a MAC address 00:00:00:00:00:1 and obtains an IP for the subnet 10.0.0.1. Then it does the same for host 5.

The final section is the section that contains the flow rules that are being installed so that host 5 can ping host 1 and vice versa.



The RTT of the first message took much longer than the subsequent ones by a factor of 6 times. This is because the controller had to install the flow sequences during the first RTT which made the ping take extra time as all subsequent pings took roughly the same amount of time.

Flow tables before the ping

```
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s1
 cookie=0x0, duration=7.663s, table=0, n_packets=6, n_bytes=246, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=7.646s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s2
 cookie=0x0, duration=9.064s, table=0, n_packets=7, n_bytes=287, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=9.032s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s3
 cookie=0x0, duration=10.194s, table=0, n_packets=3, n_bytes=123, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=10.153s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s4
 cookie=0x0, duration=11.117s, table=0, n_packets=3, n_bytes=123, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=11.098s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s5
 cookie=0x0, duration=12.004s, table=0, n_packets=7, n_bytes=287, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=11.984s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s6
 cookie=0x0, duration=12.973s, table=0, n_packets=4, n_bytes=164, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=12.960s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s7
 cookie=0x0, duration=13.825s, table=0, n_packets=4, n_bytes=164, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=13.789s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
```

Flow tables after the ping

```
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s1
 cookie=0x0, duration=4.894s, table=0, n_packets=3, n_bytes=238, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
 cookie=0x0, duration=4.873s, table=0, n_packets=2, n_bytes=196, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s1-eth2"
 cookie=0x0, duration=35.930s, table=0, n_packets=17, n_bytes=697, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=35.913s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s2
 cookie=0x0, duration=7.675s, table=0, n_packets=4, n_bytes=280, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s2-eth1"
 cookie=0x0, duration=7.654s, table=0, n_packets=3, n_bytes=238, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s2-eth3"
 cookie=0x0, duration=38.657s, table=0, n_packets=25, n_bytes=1025, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=38.625s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s3
 cookie=0x0, duration=9.345s, table=0, n_packets=4, n_bytes=280, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s3-eth1"
 cookie=0x0, duration=9.326s, table=0, n_packets=3, n_bytes=238, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s3-eth3"
 cookie=0x0, duration=40.338s, table=0, n_packets=9, n_bytes=369, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=40.297s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s4
 cookie=0x0, duration=42.520s, table=0, n_packets=9, n_bytes=369, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=42.501s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s5
 cookie=0x0, duration=13.425s, table=0, n_packets=4, n_bytes=280, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s5-eth3"
 cookie=0x0, duration=13.402s, table=0, n_packets=3, n_bytes=238, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s5-eth1"
 cookie=0x0, duration=44.383s, table=0, n_packets=26, n_bytes=1066, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=44.363s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s6
 cookie=0x0, duration=15.540s, table=0, n_packets=4, n_bytes=280, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s6-eth3"
 cookie=0x0, duration=15.515s, table=0, n_packets=3, n_bytes=238, hard_timeout=1800, priority=65001,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s6-eth1"
 cookie=0x0, duration=46.520s, table=0, n_packets=11, n_bytes=451, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=46.507s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$ sudo ovs-ofctl dump-flows s7
 cookie=0x0, duration=48.645s, table=0, n_packets=11, n_bytes=451, priority=65000,dl_dst=01:23:20:00:00:01,dl_type=0x88cc actions=CONTROLLER:65535
 cookie=0x0, duration=48.609s, table=0, n_packets=0, n_bytes=0, priority=32769,arp,dl_dst=02:00:00:00:be:ef actions=CONTROLLER:65535
mininet@mininet-vm:~/cs456-a3/part-C$
```

In the first screenshot we can see that before the ping had taken place the flow tables only had 2 entries which were connecting it to the controller and not allowing any actions. But after the ping we see that the flow table entries for every switch on the path h1 to h5 had been updated, the switches s3, s2, s1, s5, s6 have had 2 entries added which correspond to the links on the path h1 to h5.

These flows do seem to be different than the ones we installed manually in part A since we limited the traffic to ensure that only packets from hosts to their destination are let through. Which means that the controller implements destination-based forwarding.