UID	2019230064
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Batch	A [TE Comps]
Subject	DCCN

Experiment : 2

AIM: Basic Network Utilities

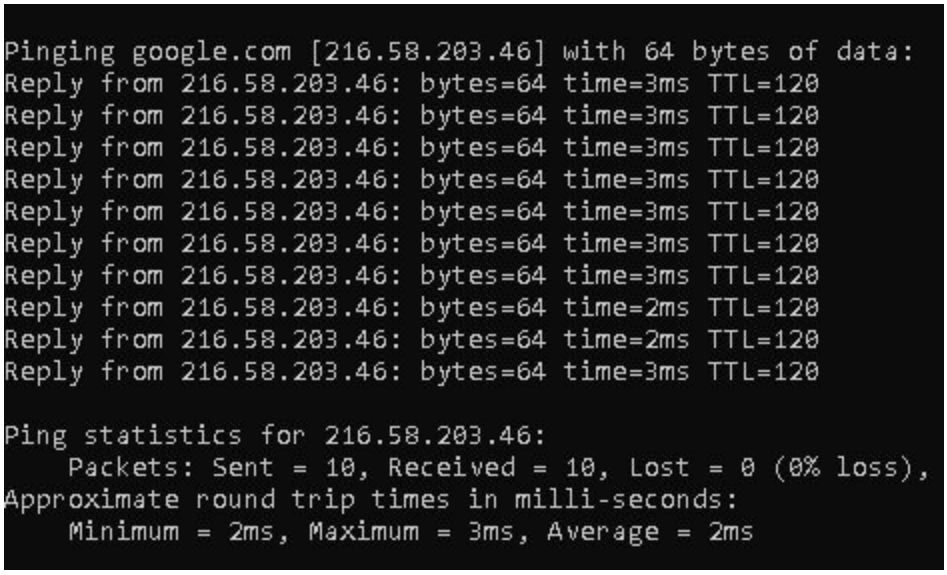
Theory:

- **Ping (reff :-** https://www.geeksforgeeks.org/ping-command-in-linux-with-examples/**)**

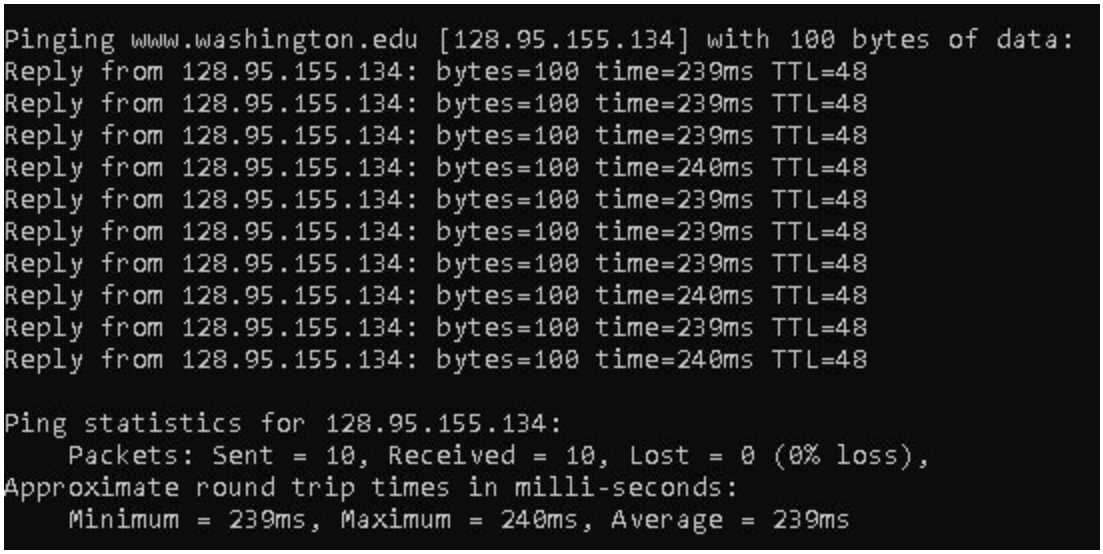
  PING (Packet Internet Groper) command is used to check the network connectivity between host and server/host. This command takes as input the IP address or the URL and sends a data packet to the specified address with the message “PING” and get a response from the server/host this time is recorded which is called latency. Fast ping low latency means faster connection. Ping uses ICMP(Internet Control Message Protocol) to send an ICMP echo message to the specified host if that host is available then it sends ICMP reply message. Ping is generally measured in millisecond every modern operating system has this ping pre-installed.

- Experiments :
  - Ping the any hosts 10 times (i.e., packet count is 10) with a packet size of 64 bytes, 100 bytes, 500 bytes, 1000 bytes, 1400 bytes

(1) ping -n 10 -l 64 google.com



ping -n 10 -l 100 www.uw.edu



ping -n 10 -l 500 berkeley.edu

```
Pinging berkeley.edu [35.163.72.93] with 500 bytes of data:
Reply from 35.163.72.93: bytes=500 time=268ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34
Reply from 35.163.72.93: bytes=500 time=270ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34
Reply from 35.163.72.93: bytes=500 time=269ms TTL=34
Reply from 35.163.72.93: bytes=500 time=272ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34
Reply from 35.163.72.93: bytes=500 time=267ms TTL=34

Ping statistics for 35.163.72.93:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 267ms, Maximum = 272ms, Average = 268ms
```

ping -n 10 -l 1000 www.ox.ac.uk

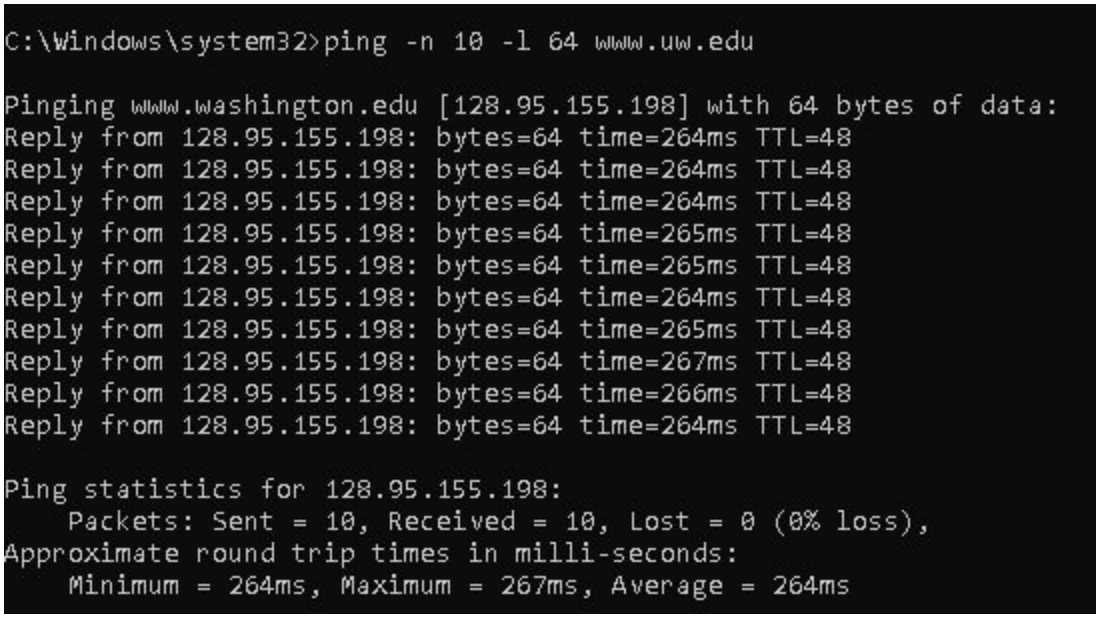
```
Pinging www.ox.ac.uk [151.101.130.133] with 1000 bytes of data:
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=6ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=7ms TTL=60
Reply from 151.101.130.133: bytes=1000 time=5ms TTL=60

Ping statistics for 151.101.130.133:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 5ms, Maximum = 7ms, Average = 5ms
```

ping -n 10 -l 1400 www.mozilla.org

```
Pinging www.mozilla.org.cdn.cloudflare.net [104.18.164.34] with 1400 bytes of data:
Reply from 104.18.164.34: bytes=1400 time=9ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=7ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=8ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=8ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=14ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=10ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=8ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=8ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=9ms TTL=60
Reply from 104.18.164.34: bytes=1400 time=9ms TTL=60

Ping statistics for 104.18.164.34:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 14ms, Average = 9ms
```

Questions :

```
C:\Windows\system32>ping -n 10 -l 64 google.com

Pinging google.com [216.58.203.46] with 64 bytes of data:
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120
Reply from 216.58.203.46: bytes=64 time=2ms TTL=120
Reply from 216.58.203.46: bytes=64 time=2ms TTL=120
Reply from 216.58.203.46: bytes=64 time=3ms TTL=120

Ping statistics for 216.58.203.46:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 3ms, Average = 2ms
```



- Does the average RTT vary between different hosts? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?

  Yes, the average RTT differs. The differences may be caused by variation in propagation delay and queueing delay.Transmit delay can also have an impact if the bandwidth is different.

- Does the average RTT vary with different packet sizes? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?

  Yes, the average RTT differs. The differences are likely caused by transmit delay

- **Exercise 1: (reff :** https://www.imperva.com/learn/performance/round-trip-time-rtt/ **)**
  Experiment with ping to find the round trip times to a variety of destinations. Write up any interesting observations, including in particular how the round trip time compares to the physical distance.

- The length a signal has to travel correlates with the time taken for a request to reach a server.
- The medium used to route a signal (e.g., copper wire, fiber optic cables) can impact how quickly a request is received by a server and routed back to a user.
- Intermediate routers or servers take time to process a signal, increasing RTT. The more hops a signal has to travel through, the higher the RTT.
- RTT typically increases when a network is congested with high levels of traffic. Conversely, low traffic times can result in decreased RTT.

- **Ipconfig: (reff :** https://www.geeksforgeeks.org/ipconfig-full-form/ **)**
  IPCONFIG stands for Internet Protocol Configuration. This is a command-line application which displays all the current TCP/IP (Transmission Control Protocol/Internet Protocol) network configuration, refreshes the DHCP (Dynamic Host Configuration Protocol) and DNS (Domain Name Server). It also displays IP address, subnet mask, and default gateway for all adapters. It is available for Microsoft Windows, ReactOS, and Apple macOS. ReactOS version was developed by Ged Murphy and licensed under the General Public License.

```
(base) affanansari@affans-MacBook-Air ~ % ifconfig
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> mtu 16384
        options=1203<RXCSUM,TXCSUM,TXSTATUS,SW_TIMESTAMP>
        inet 127.0.0.1 netmask 0xff000000
        inet6 ::1 prefixlen 128
        inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
        nd6 options=201<PERFORMNUD,DAD>
gif0: flags=8010<POINTOPOINT,MULTICAST> mtu 1280
stf0: flags=0<> mtu 1280
XHC20: flags=0<> mtu 0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether e0:ac:cb:7d:9a:16
        inet6 fe80::41b:f7d7:d3ed:f07f%en0 prefixlen 64 secured scopeid 0x
        inet 192.168.0.101 netmask 0xffffff00 broadcast 192.168.0.255
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: active
en1: flags=8963<UP,BROADCAST,SMART,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu
        options=460<TSO4,TSO6,CHANNEL_IO>
        ether 82:18:0c:cc:fd:80
        media: autoselect <full-duplex>
        status: inactive
bridge0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=63<RXCSUM,TXCSUM,TSO4,TSO6>
        ether 82:18:0c:cc:fd:80
        Configuration:
                id 0:0:0:0:0:0 priority 0 hellotime 0 fwddelay 0
                maxage 0 holdcnt 0 proto stp maxaddr 100 timeout 1200
                root id 0:0:0:0:0:0 priority 0 ifcost 0 port 0
                ipfilter disabled flags 0x0
        member: en1 flags=3<LEARNING,DISCOVER>
                ifmaxaddr 0 port 6 priority 0 path cost 0
        nd6 options=201<PERFORMNUD,DAD>
        media: <unknown type>
        status: inactive
p2p0: flags=8843<UP,BROADCAST,RUNNING,SIMPLEX,MULTICAST> mtu 2304
        options=400<CHANNEL_IO>
        ether 02:ac:cb:7d:9a:16
        media: autoselect
        status: inactive
awdl0: flags=8943<UP,BROADCAST,RUNNING,PROMISC,SIMPLEX,MULTICAST> mtu 1484
        options=400<CHANNEL_IO>
        ether b2:c9:2d:22:b0:5c
        inet6 fe80::b0c9:2dff:fe22:b05c%awdl0 prefixlen 64 scopeid 0x9
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: active
llw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        options=400<CHANNEL_IO>
        ether b2:c9:2d:22:b0:5c
        inet6 fe80::b0c9:2dff:fe22:b05c%llw0 prefixlen 64 scopeid 0xa
        nd6 options=201<PERFORMNUD,DAD>
        media: autoselect
        status: active
utun0: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 1380
        inet6 fe80::f261:5af6:290e:3957%utun0 prefixlen 64 scopeid 0xb
        nd6 options=201<PERFORMNUD,DAD>
utun1: flags=8051<UP,POINTOPOINT,RUNNING,MULTICAST> mtu 2000
        inet6 fe80::f543:2f85:1c5:1f0c%utun1 prefixlen 64 scopeid 0xc
        nd6 options=201<PERFORMNUD,DAD>
```

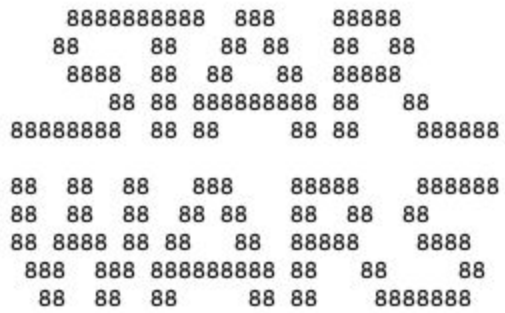
- **Nslookup: (reff :** https://www.geeksforgeeks.org/nslookup-command-in-linux-with-examples/ **)**
  Nslookup (stands for "Name Server Lookup") is a useful command for getting information from a DNS server. It is a network administration tool for querying the Domain Name System (DNS) to obtain domain name or IP address mapping or any other specific DNS record. It is also used to troubleshoot DNS related problems.

```
(base) affanansari@affans-MacBook-Air ~ % nslookup www.google.com
Server:         192.168.0.1
Address:        192.168.0.1#53

Non-authoritative answer:
Name:   www.google.com
Address: 216.58.203.4

(base) affanansari@affans-MacBook-Air ~ %
```

- **Netstat: (reff :** https://www.geeksforgeeks.org/netstat-command-linux/ **)**
  Netstat command displays various network related information such as network connections, routing tables, interface statistics, masquerade connections, multicast memberships etc.,
  In computing, netstat (network statistics) is a command-line network utility that displays network connections for Transmission Control Protocol (both incoming and outgoing), routing tables, and a number of network interface (network interface controller or software-defined network interface) and network protocol statistics

```
(base) affanansari@affans-MacBook-Air ~ % netstat -t -n
Active Internet connections
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp4       0      0  192.168.0.101.62317    52.202.248.184.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62316    52.202.248.184.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62315    18.140.27.177.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62314    18.140.27.177.443      ESTABLISHED
tcp4      31      0  192.168.0.101.62313    64.202.112.191.443     CLOSE_WAIT
tcp4       0      0  192.168.0.101.62312    51.210.112.236.443     CLOSE_WAIT
tcp4       0      0  192.168.0.101.62311    64.202.112.191.443     CLOSE_WAIT
tcp4       0      0  192.168.0.101.62310    158.69.224.51.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62309    158.69.224.51.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62308    104.98.14.107.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62306    18.206.41.185.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62305    18.206.41.185.443      ESTABLISHED
tcp4       0      0  192.168.0.101.62304    136.243.130.25.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62303    136.243.130.25.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62302    185.255.84.150.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62301    185.255.84.150.443     ESTABLISHED
tcp4       0      0  192.168.0.101.62300    195.244.31.10.443      ESTABLISHED
tcp4      31      0  192.168.0.101.62298    66.225.223.63.443      CLOSE_WAIT
tcp4       0      0  192.168.0.101.62297    64.38.119.27.443       ESTABLISHED
tcp4       0      0  192.168.0.101.62296    64.38.119.27.443       ESTABLISHED
tcp4       0      0  192.168.0.101.62295    103.43.90.55.443       ESTABLISHED
```

- **Telnet: (reff :**
  https://www.geeksforgeeks.org/protocols-application-layer/#:~:text=It%20allows%20Telnet%20client%20to,a%20remote%20device%20or%20system.
  https://osxdaily.com/2018/07/18/get-telnet-macos/
)
  Telnet stands for the TELecommunications NETwork. It helps in terminal emulation. It allows Telnet client to access the resources of the Telnet server. It is used for managing the files on the internet. It is used for initial set up of devices like switches. The telnet command is a command that uses the Telnet protocol to communicate with a remote device or system. Port number of telnet is 23.



- **Tracert / Traceroute: (reff :**
  https://www.geeksforgeeks.org/traceroute-command-in-linux-with-examples/
  https://mediatemple.net/community/products/dv/204643870/using-the-traceroute-command
  https://www.hostingmanual.net/domain-traceroute-instructions/**)**
  The traceroute command, as the name implies, traces the route that packets takes to reach the host. It will show you how many hops it takes to reach the host and how long it took between each hop. This allows you to diagnose potential networking bottlenecks. The example below shows the traceroute command output from a local machine to Google's public DNS. Alternatively, you can use our traceroute tool which will display the hops required for a particular domain from 10 different locations.
  EXPERIMENTS WITH TRACEROUTE
  From your machine traceroute to the following hosts:
  1. ee.iitb.ac.in

Store the output of each traceroute command in a separate file named traceroute_HOSTNAME.log, replacing HOSTNAME with the hostname for end-host you pinged

```
 1  192.168.0.1 (192.168.0.1)  1.767 ms  1.212 ms  1.159 ms
 2  139.5.237.132 (139.5.237.132)  1.258 ms  1.533 ms  1.847 ms
 3  172.169.2.185 (172.169.2.185)  2.741 ms  9.246 ms  11.389 ms
 4  * * *
 5  103.88.220.233 (103.88.220.233)  6.138 ms  2.729 ms  2.875 ms
 6  undefined.hostname.localhost (103.214.130.129)  3.213 ms  3.158 ms  3.097 ms
 7  219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  3.067 ms  3.563 ms  4.144 ms
 8  172.23.78.233 (172.23.78.233)  3.848 ms  3.531 ms  3.931 ms
 9  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  5.644 ms  3.057 ms  4.510 ms
10  if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  124.740 ms *  126.277 ms
11  * * if-ae-21-2.tcore1.pye-paris.as6453.net (80.231.154.208)  123.379 ms
12  if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49)  132.473 ms  124.849 ms  125.762 ms
13  80.231.153.66 (80.231.153.66)  125.207 ms * *
14  * * *
15  janet.bear1.manchester1.level3.net (212.187.174.238)  134.148 ms  138.508 ms  127.993 ms
16  ae22.manckh-sbr2.ja.net (146.97.35.189)  138.264 ms  132.141 ms  139.092 ms
17  ae23.mancrh-rbr1.ja.net (146.97.38.42)  131.183 ms  131.497 ms *
18  universityofmanchester.ja.net (146.97.169.2)  132.236 ms * *
19  130.88.249.194 (130.88.249.194)  134.448 ms  133.610 ms  164.019 ms
20  * * *
21  gw-jh.its.manchester.ac.uk (130.88.250.32)  132.495 ms  132.682 ms  132.820 ms
22  eps.its.man.ac.uk (130.88.101.49)  132.431 ms  133.795 ms  142.043 ms
```

2. mscs.mu.edu

```
 1  192.168.0.1 (192.168.0.1)  5.580 ms  1.219 ms  1.166 ms
 2  139.5.237.132 (139.5.237.132)  2.049 ms  1.948 ms  1.895 ms
 3  172.169.2.185 (172.169.2.185)  13.305 ms  2.909 ms  2.841 ms
 4  103.88.220.234 (103.88.220.234)  2.797 ms * *
 5  103.88.220.233 (103.88.220.233)  10.100 ms  7.284 ms  8.969 ms
 6  undefined.hostname.localhost (103.214.130.129)  3.258 ms  3.193 ms  2.913 ms
 7  219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  7.171 ms  5.370 ms  4.055 ms
 8  * * 172.23.78.233 (172.23.78.233)  12.961 ms
 9  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  13.304 ms  41.024 ms  47.340
ms
10  if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  128.543 ms * *
11  * * *
12  if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49)  124.950 ms  125.035 ms
124.865 ms
13  * * *
14  * * *
15  marquette-u.ear3.chicago2.level3.net (4.16.38.70)  221.370 ms  219.022 ms  218.605 ms
16  134.48.10.26 (134.48.10.26)  230.893 ms  343.018 ms  230.339 ms
17  * * *
18  * * *
19  euclid.mscs.mu.edu (134.48.4.5)  230.517 ms  241.360 ms  307.463 ms
```

3. www.cs.grinnell.edu

```
 1  192.168.0.1 (192.168.0.1)  3.190 ms  4.403 ms  9.691 ms
 2  139.5.237.132 (139.5.237.132)  3.716 ms  6.784 ms  5.218 ms
 3  172.169.2.185 (172.169.2.185)  5.693 ms  2.412 ms  2.797 ms
 4  103.88.220.234 (103.88.220.234)  2.457 ms *  3.342 ms
 5  103.88.220.233 (103.88.220.233)  6.129 ms  3.000 ms  3.115 ms
 6  undefined.hostname.localhost (103.214.130.129)  3.779 ms  3.297 ms  6.210 ms
 7  219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  22.287 ms  3.721 ms  3.719 ms
 8  * 172.23.78.233 (172.23.78.233)  4.575 ms  3.319 ms
 9  172.31.244.45 (172.31.244.45)  26.032 ms  20.649 ms  28.649 ms
10  ix-ae-4-2.tcore2.cxr-chennai.as6453.net (180.87.37.1)  33.753 ms  32.846 ms  30.468 ms
11  if-ae-10-4.tcore2.svw-singapore.as6453.net (180.87.67.16)  306.407 ms * *
12  if-ae-7-2.tcore2.lvw-losangeles.as6453.net (180.87.15.26)  245.513 ms  232.448 ms  236.922
ms
13  if-ae-2-2.tcore1.lvw-losangeles.as6453.net (66.110.59.1)  250.930 ms *  232.334 ms
14  * las-b24-link.telia.net (80.239.128.214)  384.211 ms  344.960 ms
15  palo-b24-link.telia.net (62.115.119.90)  365.462 ms  364.410 ms  358.621 ms
16  * palo-b1-link.telia.net (62.115.122.169)  361.842 ms  358.569 ms
17  hurricane-ic-308019-palo-b1.c.telia.net (80.239.167.174)  366.966 ms  360.452 ms  362.831
ms
18  stanford-university.100gigabitethernet5-1.core1.pao1.he.net (184.105.177.238)  364.802 ms
356.704 ms  361.299 ms
19  csee-west-rtr-vl3.sunet (171.66.255.140)  241.923 ms  348.737 ms  255.122 ms
20  171.64.64.64 (171.64.64.64)  358.460 ms  346.527 ms  306.808 ms
```

4. csail.mit.edu

```
 1  192.168.0.1 (192.168.0.1)  1.528 ms  0.981 ms  1.668 ms
 2  139.5.237.132 (139.5.237.132)  2.123 ms  1.522 ms  2.083 ms
 3  172.169.2.185 (172.169.2.185)  3.010 ms  2.959 ms  3.337 ms
 4  * 103.88.220.234 (103.88.220.234)  3.354 ms  2.124 ms
 5  103.88.220.233 (103.88.220.233)  6.845 ms  3.200 ms  2.922 ms
 6  undefined.hostname.localhost (103.214.130.129)  3.008 ms  3.039 ms  3.182 ms
 7  219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  3.035 ms  3.164 ms  4.061 ms
 8  172.23.78.233 (172.23.78.233)  3.976 ms  3.927 ms  3.687 ms
 9  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  3.800 ms  6.438 ms  3.507 ms
10  if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  318.956 ms
    if-ae-2-2.tcore2.mlv-mumbai.as6453.net (180.87.38.2)  203.390 ms
    if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  303.290 ms
11  if-ae-12-2.tcore1.l78-london.as6453.net (180.87.39.21)  306.891 ms
    if-ae-2-2.tcore2.wyn-marseille.as6453.net (80.231.217.2)  277.149 ms  237.577 ms
12  * * *
13  if-ae-12-2.tcore1.n75-newyork.as6453.net (66.110.96.5)  245.999 ms
    if-ae-15-2.tcore2.ldn-london.as6453.net (80.231.131.118)  200.012 ms  196.387 ms
14  63.243.216.22 (63.243.216.22)  200.547 ms
    66.110.96.146 (66.110.96.146)  209.181 ms
    if-ae-32-3.tcore2.nto-newyork.as6453.net (80.231.20.107)  199.963 ms
15  if-ae-12-2.tcore1.n75-newyork.as6453.net (66.110.96.5)  200.858 ms  213.011 ms
    be-10390-cr02.newyork.ny.ibone.comcast.net (68.86.83.89)  208.383 ms
16  66.110.96.130 (66.110.96.130)  205.186 ms  208.504 ms
    66.110.96.142 (66.110.96.142)  207.311 ms
17  be-10390-cr02.newyork.ny.ibone.comcast.net (68.86.83.89)  207.640 ms  214.563 ms  226.222 ms
18  be-1202-cs02.newyork.ny.ibone.comcast.net (96.110.38.37)  208.924 ms  203.320 ms  213.270 ms
19  96.110.42.6 (96.110.42.6)  213.765 ms  217.897 ms *
20  ae0-0-eg-bstpmall74w.boston.ma.boston.comcast.net (68.86.238.34)  213.457 ms  212.656 ms  224.279 ms
21  50-201-57-174-static.hfc.comcastbusiness.net (50.201.57.174)  204.405 ms
    dmz-rtr-2-dmz-rtr-1-1.mit.edu (18.0.161.6)  318.452 ms
    50-201-57-174-static.hfc.comcastbusiness.net (50.201.57.174)  307.024 ms
22  mitnet.core-1-ext.csail.mit.edu (18.4.7.65)  306.189 ms
    dmz-rtr-1-external-rtr-3.mit.edu (18.0.161.13)  313.788 ms  242.245 ms
23  dmz-rtr-2-dmz-rtr-1-1.mit.edu (18.0.161.6)  306.268 ms
    dmz-rtr-2-dmz-rtr-1-2.mit.edu (18.0.162.6)  306.518 ms
    dmz-rtr-2-dmz-rtr-1-1.mit.edu (18.0.161.6)  239.384 ms
24  mitnet.core-1-ext.csail.mit.edu (18.4.7.65)  323.452 ms  213.597 ms
    bdr.core-1.csail.mit.edu (128.30.0.246)  214.272 ms
25  * * *
26  bdr.core-1.csail.mit.edu (128.30.0.246)  235.309 ms  306.412 ms *
27  * * *
28  * * *
29  * * *
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```

5. cs.manchester.ac.uk

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 1  192.168.0.1 (192.168.0.1)  11.247 ms  1.261 ms  0.988 ms
 2  139.5.237.132 (139.5.237.132)  2.405 ms  1.825 ms  1.885 ms
 3  172.169.2.185 (172.169.2.185)  5.300 ms  7.617 ms  9.457 ms
 4  103.88.220.234 (103.88.220.234)  2.181 ms  2.060 ms  3.013 ms
 5  103.88.220.233 (103.88.220.233)  3.564 ms  9.472 ms  11.453 ms
 6  undefined.hostname.localhost (103.214.130.129)  3.267 ms  3.707 ms  3.377 ms
 7  219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  3.265 ms  3.234 ms  4.126 ms
 8  172.23.78.233 (172.23.78.233)  8.528 ms  4.245 ms  3.493 ms
 9  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  4.030 ms  3.974 ms  4.012 ms
10  if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  128.136 ms  125.199 ms  125.023 ms
11  if-ae-21-2.tcore1.pye-paris.as6453.net (80.231.154.208)  117.981 ms
    if-ae-8-1600.tcore1.pye-paris.as6453.net (80.231.217.6)  125.239 ms *
12  if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49)  126.362 ms  125.320 ms  125.636 ms
13  be6453.agr21.par04.atlas.cogentco.com (130.117.15.69)  143.128 ms  133.731 ms  146.703 ms
14  be3169.ccr31.par04.atlas.cogentco.com (154.54.37.237)  147.716 ms  135.684 ms  144.661 ms
15  be3183.ccr41.par01.atlas.cogentco.com (154.54.38.65)  133.911 ms
    be2103.ccr42.par01.atlas.cogentco.com (154.54.61.21)  127.159 ms
    be3184.ccr42.par01.atlas.cogentco.com (154.54.38.157)  127.516 ms
16  be12489.ccr42.lon13.atlas.cogentco.com (154.54.57.69)  129.058 ms  125.546 ms
    be12497.ccr41.lon13.atlas.cogentco.com (154.54.56.129)  127.943 ms
17  be2099.ccr31.bos01.atlas.cogentco.com (154.54.82.34)  198.612 ms  199.347 ms
    be2101.ccr32.bos01.atlas.cogentco.com (154.54.82.38)  386.555 ms
18  be3599.ccr21.alb02.atlas.cogentco.com (66.28.4.237)  508.519 ms
    be3600.ccr22.alb02.atlas.cogentco.com (154.54.0.221)  200.197 ms  200.055 ms
19  be2878.ccr21.cle04.atlas.cogentco.com (154.54.26.129)  208.440 ms
    be2879.ccr22.cle04.atlas.cogentco.com (154.54.29.173)  291.952 ms
    be2878.ccr21.cle04.atlas.cogentco.com (154.54.26.129)  303.146 ms
20  be2718.ccr42.ord01.atlas.cogentco.com (154.54.7.129)  306.418 ms
    be2717.ccr41.ord01.atlas.cogentco.com (154.54.6.221)  221.937 ms  281.335 ms
21  be2639.rcr21.dsm01.atlas.cogentco.com (154.54.29.50)  307.850 ms
    be2640.rcr21.dsm01.atlas.cogentco.com (154.54.29.126)  308.407 ms  288.991 ms
22  38.104.184.50 (38.104.184.50)  230.072 ms  238.055 ms  236.492 ms
23  167.142.58.40 (167.142.58.40)  235.398 ms  233.725 ms *
24  67.224.64.62 (67.224.64.62)  231.588 ms  307.592 ms  232.748 ms
25  grinnellcollege1.desm.netins.net (167.142.65.43)  287.967 ms  333.870 ms  310.047 ms
26  * * *
27  * * *
28  * * *
```

- **Exercise 2:**

  Use traceroute to trace the route from your computer to math.hws.edu and to www.hws.edu. Explain the difference in the results.

```
192.168.0.1 (192.168.0.1)  1.469 ms  0.976 ms  1.035 ms
139.5.237.132 (139.5.237.132)  1.584 ms  1.410 ms  1.899 ms
172.169.2.185 (172.169.2.185)  2.709 ms  3.493 ms  10.561 ms
* 103.88.220.234 (103.88.220.234)  2.028 ms *
103.88.220.233 (103.88.220.233)  5.112 ms  11.511 ms  6.380 ms
undefined.hostname.localhost (103.214.130.129)  4.109 ms  5.821 ms  6.082 ms
219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  10.002 ms  8.308 ms  7.451 ms
* * *
ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  4.837 ms  4.028 ms  3.897 ms
if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  137.549 ms *  124.736 ms
if-ae-8-1600.tcore1.pye-paris.as6453.net (80.231.217.6)  127.875 ms  126.010 ms *
if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49)  125.144 ms  125.141 ms  125.541 ms
* * *
ae-2-3204.edge3.paris1.level3.net (4.69.161.114)  125.499 ms  132.123 ms  127.740 ms
global-crossing-xe-level3.paris1.level3.net (4.68.63.230)  117.579 ms  138.607 ms  119.701

roc1-ar5-xe-11-0-0-0.us.twtelecom.net (35.248.1.162)  208.955 ms  205.789 ms  205.786 ms
66-195-65-170.static.ctl.one (66.195.65.170)  206.850 ms  207.196 ms  213.639 ms
nat.hws.edu (64.89.144.100)  216.768 ms  223.902 ms  209.738 ms
* * *
* * *
* * *
```

```
192.168.0.1 (192.168.0.1)  2.002 ms  8.221 ms  1.401 ms
139.5.237.132 (139.5.237.132)  2.464 ms  2.029 ms  1.904 ms
172.169.2.185 (172.169.2.185)  10.837 ms  8.704 ms  10.391 ms
103.88.220.234 (103.88.220.234)  4.670 ms * *
103.88.220.233 (103.88.220.233)  3.921 ms  3.051 ms  3.278 ms
undefined.hostname.localhost (103.214.130.129)  2.997 ms  40.426 ms  3.299 ms
219.65.79.57.static-mumbai.vsnl.net.in (219.65.79.57)  3.345 ms  3.457 ms  3.744 ms
172.23.78.233 (172.23.78.233)  45.810 ms  5.551 ms *
ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5)  4.003 ms  4.739 ms  4.761 ms
if-ae-5-2.tcore1.wyn-marseille.as6453.net (80.231.217.29)  140.966 ms  127.622 ms *
if-ae-21-2.tcore1.pye-paris.as6453.net (80.231.154.208)  117.745 ms * *
if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49)  126.746 ms  125.678 ms  125.170 ms
* * *
ae-2-3204.edge3.paris1.level3.net (4.69.161.114)  126.274 ms
ae-1-3104.edge3.paris1.level3.net (4.69.161.110)  120.023 ms  117.595 ms
* global-crossing-xe-level3.paris1.level3.net (4.68.63.230)  118.140 ms  117.944 ms
roc1-ar5-xe-11-0-0-0.us.twtelecom.net (35.248.1.162)  205.660 ms  205.644 ms  206.079 ms
66-195-65-170.static.ctl.one (66.195.65.170)  263.291 ms  306.396 ms  307.155 ms
nat.hws.edu (64.89.144.100)  307.127 ms  207.675 ms  207.642 ms
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Route tracing is started in both of them . In some of the rows route tracing is done and it shows the Default Gateway of the user. Then the route is being traced starting from the ISP of the user. And after some time it reaches the common IP address of 66.195.65.170 and then nat.hws.edu [64.89.144.100] . A domain name might have multiple IP addresses associated.Many domains use separate hosting for email. If you try to trace the domain, you'll get data for the website server, not the email server