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EXPERIMENT 2

AIM: To study the basic networking utilities.

IMPLEMENTATION: Given below are a few commands used in the networking.
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 milliseconds.
1.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.

i)64 bytes

```
Microsoft Windows [Version 10.0.18362.1016]
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C:\Users\HP>ping -n 10 -l 64 www.google.com

Pinging www.google.com [142.250.67.164] with 64 bytes of data:
Reply from 142.250.67.164: bytes=64 time=79ms TTL=117
Reply from 142.250.67.164: bytes=64 time=10ms TTL=117
Reply from 142.250.67.164: bytes=64 time=3ms TTL=117
Reply from 142.250.67.164: bytes=64 time=3ms TTL=117
Reply from 142.250.67.164: bytes=64 time=3ms TTL=117
Reply from 142.250.67.164: bytes=64 time=3ms TTL=117
Reply from 142.250.67.164: bytes=64 time=8ms TTL=117
Reply from 142.250.67.164: bytes=64 time=16ms TTL=117
Reply from 142.250.67.164: bytes=64 time=8ms TTL=117
Reply from 142.250.67.164: bytes=64 time=6ms TTL=117

Ping statistics for 142.250.67.164:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 79ms, Average = 13ms

C:\Users\HP>ping -n 10 -l 64 www.google.com > ping_n10_l64_google.log

C:\Users\HP>
```

ii)100 bytes

```
C:\Users\HP>ping -n 10 -l 100 www.google.com

Pinging www.google.com [142.250.67.164] with 100 bytes of data:
Reply from 142.250.67.164: bytes=68 (sent 100) time=4ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=6ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=3ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=7ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=3ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=3ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=5ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=11ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=3ms TTL=117
Reply from 142.250.67.164: bytes=68 (sent 100) time=3ms TTL=117

Ping statistics for 142.250.67.164:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 11ms, Average = 4ms

C:\Users\HP>ping -n 10 -l 100 www.google.com > ping_n10_l100_google.log

C:\Users\HP>
```

iii)500 bytes

```
C:\Users\HP>ping -n 10 -l 500 www.google.com

Pinging www.google.com [142.250.67.164] with 500 bytes of data:
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120
Request timed out.
Reply from 142.250.67.164: bytes=68 (sent 500) time=5ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=7ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=8ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 500) time=4ms TTL=120

Ping statistics for 142.250.67.164:
    Packets: Sent = 10, Received = 9, Lost = 1 (10% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 8ms, Average = 4ms

C:\Users\HP>ping -n 10 -l 500 www.google.com > ping_n10_l500_google.log

C:\Users\HP>
```

iv)1000 bytes

```
C:\Users\HP>ping -n 10 -l 1000 www.google.com

Pinging www.google.com [142.250.67.164] with 1000 bytes of data:
Reply from 142.250.67.164: bytes=68 (sent 1000) time=7ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=11ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=10ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=5ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120
Reply from 142.250.67.164: bytes=68 (sent 1000) time=4ms TTL=120

Ping statistics for 142.250.67.164:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 11ms, Average = 5ms
```

v)1400 bytes

```
C:\Users\HP>ping -n 10 -l 1400 www.google.com

Pinging www.google.com [172.217.166.68] with 1400 bytes of data:
Reply from 172.217.166.68: bytes=68 (sent 1400) time=290ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=5ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=7ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=11ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=7ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.166.68: bytes=68 (sent 1400) time=17ms TTL=120

Ping statistics for 172.217.166.68:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 290ms, Average = 35ms

C:\Users\HP>
```

Questions about latency:

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

Ans: Yes, the average RTT varies between different hosts. It is because of the following reasons:

a) Propagation delay: It is the time taken by the first bit to travel from sender to receiver end of the link. In other words, it is simply the time required for bits to reach the destination from the start point. Factors on which Propagation delay depends are

Distance and propagation speed. Different hosts can be situated at different locations

hence there can be difference in the distances.
b) Queuing delay: Queuing delay is the time a job waits in a queue until it can be executed. It depends on congestion. It is the time difference between when the packet
arrived Destination and when the packet data was processed or executed. It may be
caused by mainly three reasons i.e. originating switches, intermediate switches or call
receiver servicing switches. The processing time can be different for each host.

2. Does the average RTT vary with different packet sizes? What aspects of latency (transmit, propagation, and queueing delay) might impact this and why?
Ans: Yes, the average RTT varies with different packet sizes. It is because of the following reason:
Transmission delay: Time taken to put a packet onto link. In other words, it is simply time required to put data bits on the wire/communication medium. It depends on length of packet and bandwidth of network.

Exercise 1: 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. Here are few places from who to get replies: www.uw.edu, www.cornell.edu, berkeley.edu, www.uchicago.edu, www.ox.ac.uk (England), www.u-tokyo.ac.jp (Japan).

1.www.uw.edu

```
C:\Users\HP>ping www.uw.edu

Pinging www.washington.edu [128.95.155.197] with 32 bytes of data:
Reply from 128.95.155.197: bytes=32 time=283ms TTL=48
Reply from 128.95.155.197: bytes=32 time=225ms TTL=48
Reply from 128.95.155.197: bytes=32 time=226ms TTL=48
Reply from 128.95.155.197: bytes=32 time=227ms TTL=48

Ping statistics for 128.95.155.197:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 225ms, Maximum = 283ms, Average = 240ms

C:\Users\HP>
```

2.www.cornell.edu

```
C:\Users\HP>ping www.cornell.edu

Pinging ucomm-gw1.cornell.media3.us [20.42.25.107] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 20.42.25.107:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\HP>_
```

3.berkeley.edu

```
C:\Users\HP>ping berkeley.edu > ping_berkeley.log

C:\Users\HP>ping berkeley.edu

Pinging berkeley.edu [35.163.72.93] with 32 bytes of data:
Reply from 35.163.72.93: bytes=32 time=248ms TTL=34
Reply from 35.163.72.93: bytes=32 time=248ms TTL=34
Reply from 35.163.72.93: bytes=32 time=261ms TTL=34
Reply from 35.163.72.93: bytes=32 time=248ms TTL=34

Ping statistics for 35.163.72.93:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 248ms, Maximum = 261ms, Average = 251ms

C:\Users\HP>_
```

4.www.uchicago.edu

```
C:\Users\HP>ping uchicago.edu > ping_uchicago.log

C:\Users\HP>ping uchicago.edu

Pinging uchicago.edu [34.200.129.209] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 34.200.129.209:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\HP>
```

5.www.ox.ac.uk

```
C:\Users\HP>ping www.ox.ac.uk > ping_oxford.log

C:\Users\HP>ping www.ox.ac.uk

Pinging www.ox.ac.uk [151.101.66.133] with 32 bytes of data:
Reply from 151.101.66.133: bytes=32 time=3ms TTL=59
Reply from 151.101.66.133: bytes=32 time=3ms TTL=59
Reply from 151.101.66.133: bytes=32 time=5ms TTL=59
Reply from 151.101.66.133: bytes=32 time=5ms TTL=59

Ping statistics for 151.101.66.133:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 5ms, Average = 4ms

C:\Users\HP>
```

6.www.u-tokyo.ac.jp

```
C:\Users\HP>ping www.u-tokyo.ac.jp > ping_tokyo.log

C:\Users\HP>ping www.u-tokyo.ac.jp

Pinging www.u-tokyo.ac.jp [210.152.243.234] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 210.152.243.234:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\Users\HP>
```

Observations:
i)The RTT is dependent on the distance between the source and destination.
ii)The distance from India as a source to a destination like the U.S.A(ww.uw.edu) is more ie.240ms while with U.K as a destination(www.ox.ac.uk) ,it is 4ms.Hence,it be said that more the distance, higher is the RTT.

Nslookup (stands for “Name Server Lookup”) is a useful command for getting information from 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.

```
C:\Users\HP>nslookup www.google.com
Server:  UnKnown
Address:  192.168.0.1

Non-authoritative answer:
Name:    www.google.com
Addresses:  2404:6800:4009:80d::2004
          172.217.166.68


C:\Users\HP>nslookup www.wikipedia.org
Server:  UnKnown
Address:  192.168.0.1

Non-authoritative answer:
Name:    dyna.wikimedia.org
Addresses:  2001:df2:e500:ed1a::1
          103.102.166.224
Aliases:  www.wikipedia.org


C:\Users\HP>
```

Ifconfig (interface configuration) command is used to configure the kernel-resident network interfaces. It is used at the boot time to set up the interfaces as necessary. After that, it is usually used when needed during debugging or when you need system
tuning. Also, this command is used to assign the IP address and netmask to an interface or to enable or disable a given interface.

```
C:\Users\HP>ipconfig -all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : LAPTOP-A2V35EVV
   Primary Dns Suffix  . . . . . . . :
   Node Type . . . . . . . . . . . . : Hybrid
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Ethernet 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek PCIe GbE Family Controller #2
   Physical Address. . . . . . . . . : C8-D9-D2-81-C3-E6
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #3
   Physical Address. . . . . . . . . : 18-1D-EA-D4-99-CE
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 5:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #4
   Physical Address. . . . . . . . . : 1A-1D-EA-D4-99-CD
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
```

```
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Local Area Connection* 5:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #4
   Physical Address. . . . . . . . . : 1A-1D-EA-D4-99-CD
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

Wireless LAN adapter Wi-Fi 2:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) Wireless-AC 9560 160MHz #2
   Physical Address. . . . . . . . . : 18-1D-EA-D4-99-CD
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Link-local IPv6 Address . . . . . : fe80::9186:22c2:be9e:6fe0%23(Preferred)
   IPv4 Address. . . . . . . . . . . : 192.168.0.103(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : 17 August 2020 08:39:07
   Lease Expires . . . . . . . . . . : 17 August 2020 17:12:20
   Default Gateway . . . . . . . . . : 192.168.0.1
   DHCP Server . . . . . . . . . . . : 192.168.0.1
   DHCPv6 IAID . . . . . . . . . . . : 270015978
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-25-5F-C1-5C-C8-D9-D2-81-C3-E6
   DNS Servers . . . . . . . . . . . : 192.168.0.1
   NetBIOS over Tcpip. . . . . . . . : Enabled

Ethernet adapter Bluetooth Network Connection 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Bluetooth Device (Personal Area Network) #2
   Physical Address. . . . . . . . . : 18-1D-EA-D4-99-D1
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes

C:\Users\HP>
```

Netstat command displays various network related information such as network connections, routing tables, interface statistics, masquerade connections, multicast memberships etc.

```
C:\Users\HP>netstat -t -n

Active Connections

  Proto  Local Address          Foreign Address        State           Offload State

  TCP    127.0.0.1:49979        127.0.0.1:51446        ESTABLISHED     InHost
  TCP    127.0.0.1:51446        127.0.0.1:49979        ESTABLISHED     InHost
  TCP    192.168.0.103:50523    23.212.240.10:443      ESTABLISHED     InHost
  TCP    192.168.0.103:51437    34.226.252.211:443     ESTABLISHED     InHost
  TCP    192.168.0.103:51440    35.164.235.110:443     CLOSE_WAIT      InHost
  TCP    192.168.0.103:51441    161.69.226.16:443      ESTABLISHED     InHost
  TCP    192.168.0.103:51451    172.217.194.188:5228   ESTABLISHED     InHost
  TCP    192.168.0.103:51454    172.217.27.206:443     ESTABLISHED     InHost
  TCP    192.168.0.103:51457    172.217.26.238:443     ESTABLISHED     InHost
  TCP    192.168.0.103:51469    192.168.0.102:1026     CLOSE_WAIT      InHost
  TCP    192.168.0.103:51481    52.139.250.253:443     ESTABLISHED     InHost
  TCP    192.168.0.103:51482    54.249.0.244:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60857    104.26.7.154:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60863    13.227.234.36:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60864    34.210.241.6:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60866    172.217.26.238:443     TIME_WAIT       InHost
  TCP    192.168.0.103:60869    50.112.198.26:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60870    35.190.88.7:443        ESTABLISHED     InHost
  TCP    192.168.0.103:60875    50.112.198.26:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60876    50.112.198.26:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60879    35.186.205.6:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60921    3.211.211.45:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60931    5.62.53.133:443        CLOSE_WAIT      InHost
  TCP    192.168.0.103:60932    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60933    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60934    13.227.234.68:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60935    130.211.5.208:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60936    107.178.240.159:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60939    34.208.65.150:443      CLOSE_WAIT      InHost
  TCP    192.168.0.103:60940    34.208.65.150:443      CLOSE_WAIT      InHost
  TCP    192.168.0.103:60941    52.33.90.79:443        ESTABLISHED     InHost
  TCP    192.168.0.103:60942    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60943    54.148.69.131:443      ESTABLISHED     InHost
```

```
  TCP    192.168.0.103:60942    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60943    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60944    172.217.160.194:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60945    34.208.65.150:443      CLOSE_WAIT      InHost
  TCP    192.168.0.103:60946    172.217.160.194:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60947    216.58.196.66:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60948    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60949    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60950    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60951    172.217.160.194:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60952    172.217.167.161:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60953    172.217.174.225:443    ESTABLISHED     InHost
  TCP    192.168.0.103:60954    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60955    54.148.69.131:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60956    52.33.90.79:443        ESTABLISHED     InHost
  TCP    192.168.0.103:60957    52.108.236.4:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60958    23.50.253.178:443      CLOSE_WAIT      InHost
  TCP    192.168.0.103:60959    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60960    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60961    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60962    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60963    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60964    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60965    23.50.253.178:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60966    117.18.237.29:80       TIME_WAIT       InHost
  TCP    192.168.0.103:60967    23.50.253.178:443      CLOSE_WAIT      InHost
  TCP    192.168.0.103:60969    161.69.45.107:443      TIME_WAIT       InHost
  TCP    192.168.0.103:60970    52.114.132.22:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60975    204.79.197.200:443     ESTABLISHED     InHost
  TCP    192.168.0.103:60976    40.90.22.190:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60986    52.98.88.66:443        ESTABLISHED     InHost
  TCP    192.168.0.103:60987    40.100.140.2:443       ESTABLISHED     InHost
  TCP    192.168.0.103:60988    117.18.237.29:80       ESTABLISHED     InHost
  TCP    192.168.0.103:60989    13.107.19.254:443      ESTABLISHED     InHost
  TCP    192.168.0.103:60990    204.79.197.254:443     ESTABLISHED     InHost
  TCP    192.168.0.103:60991    117.18.232.200:443     ESTABLISHED     InHost
  TCP    192.168.0.103:60992    204.79.197.222:443     ESTABLISHED     InHost
  TCP    192.168.0.103:60998    35.160.226.115:80      SYN_SENT        InHost

C:\Users\HP>
```

Add the option "-l" (lower case ell) to list listening sockets, that is sockets that have been opened by server programs to wait for connection requests from clients.

```
Microsoft Windows [Version 10.0.18362.1016]
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C:\Users\HP>netstat -t -n -l

Displays protocol statistics and current TCP/IP network connections.

NETSTAT [-a] [-b] [-e] [-f] [-n] [-o] [-p proto] [-r] [-s] [-x] [-t] [interval]

  -a            Displays all connections and listening ports.
  -b            Displays the executable involved in creating each connection or
                listening port. In some cases well-known executables host
                multiple independent components, and in these cases the
                sequence of components involved in creating the connection
                or listening port is displayed. In this case the executable
                name is in [] at the bottom, on top is the component it called,
                and so forth until TCP/IP was reached. Note that this option
                can be time-consuming and will fail unless you have sufficient
                permissions.
  -e            Displays Ethernet statistics. This may be combined with the -s
                option.
  -f            Displays Fully Qualified Domain Names (FQDN) for foreign
                addresses.
  -n            Displays addresses and port numbers in numerical form.
  -o            Displays the owning process ID associated with each connection.
  -p proto      Shows connections for the protocol specified by proto; proto
                may be any of: TCP, UDP, TCPv6, or UDPv6.  If used with the -s
                option to display per-protocol statistics, proto may be any of:
                IP, IPv6, ICMP, ICMPv6, TCP, TCPv6, UDP, or UDPv6.
```

```
-p proto      Shows connections for the protocol specified by proto; proto
              may be any of: TCP, UDP, TCPv6, or UDPv6.  If used with the -s
              option to display per-protocol statistics, proto may be any of:
              IP, IPv6, ICMP, ICMPv6, TCP, TCPv6, UDP, or UDPv6.
-q            Displays all connections, listening ports, and bound
              nonlistening TCP ports. Bound nonlistening ports may or may not
              be associated with an active connection.
-r            Displays the routing table.
-s            Displays per-protocol statistics.  By default, statistics are
              shown for IP, IPv6, ICMP, ICMPv6, TCP, TCPv6, UDP, and UDPv6;
              the -p option may be used to specify a subset of the default.
-t            Displays the current connection offload state.
-x            Displays NetworkDirect connections, listeners, and shared
              endpoints.
-y            Displays the TCP connection template for all connections.
              Cannot be combined with the other options.
interval      Redisplays selected statistics, pausing interval seconds
              between each display.  Press CTRL+C to stop redisplaying
              statistics.  If omitted, netstat will print the current
              configuration information once.
```

Traceroute is a widely used command line utility available in almost all operating systems. It shows you the complete route to a destination address. It also shows the
time taken (or delays) between intermediate routers.

From your machine traceroute to the following hosts:

1.mscus.mu.edu

```
^C
C:\Users\HP>tracert mscs.mu.edu

Tracing route to mscs.mu.edu [134.48.4.5]
over a maximum of 30 hops:

  1    2 ms     1 ms     1 ms  192.168.0.1
  2    4 ms     2 ms     7 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3    2 ms     2 ms     2 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5    3 ms     3 ms     3 ms  103.42.160.13
  6  202 ms   204 ms   201 ms  182.79.222.233
  7  184 ms   183 ms   183 ms  core1.nyc4.he.net [198.32.118.57]
  8     *        *        *     Request timed out.
  9     *        *        *     Request timed out.
 10  246 ms   246 ms   256 ms  r-222wwash-isp-ae6-3926.wiscnet.net [140.189.8.126]
 11  246 ms   248 ms   247 ms  r-milwaukeeci-809-isp-ae3-0.wiscnet.net [140.189.8.230]
 12  241 ms   241 ms   241 ms  MarquetteUniv.site.wiscnet.net [216.56.1.202]
 13  247 ms   247 ms   250 ms  134.48.10.26
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.

C:\Users\HP>tracert mscs.mu.edu > traceroute_mscs.mu.edu.log
```

2.csail.mit.edu

```
C:\Users\HP>tracert www.csail.mit.edu

Tracing route to fe3.edge.pantheon.io [23.185.0.3]
over a maximum of 30 hops:

  1   313 ms     1 ms    12 ms  192.168.0.1
  2    40 ms    56 ms    17 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3    12 ms    29 ms    11 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     3 ms    11 ms     2 ms  103.27.170.25
  5    57 ms    15 ms    16 ms  aipl-49-65-179-202.ankhnet.net [202.179.65.49]
  6    11 ms    12 ms    14 ms  218.100.48.72
  7    10 ms     *        6 ms  100.66.8.20
  8     4 ms     4 ms     4 ms  100.66.8.5
  9    42 ms    38 ms    44 ms  1.6.7.35
 10    18 ms     3 ms     3 ms  23.185.0.3

Trace complete.
```

3.cs.standford.edu

```
C:\Users\HP>tracert www.cs.stanford.edu

Tracing route to cs.stanford.edu [171.64.64.64]
over a maximum of 30 hops:

  1   262 ms     1 ms     1 ms  192.168.0.1
  2     9 ms     8 ms     7 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3     2 ms     2 ms     5 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5    16 ms     5 ms     4 ms  103.42.160.13
  6   183 ms   183 ms   185 ms  116.119.52.163
  7   184 ms   183 ms   184 ms  core1.nyc4.he.net [198.32.118.57]
  8     *      244 ms     *     100ge8-1.core1.sjc2.he.net [184.105.81.218]
  9   236 ms   235 ms   235 ms  10ge4-5.core1.pao1.he.net [72.52.92.69]
 10   246 ms   246 ms   245 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 11   237 ms   238 ms   240 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 12   245 ms   253 ms   248 ms  CS.stanford.edu [171.64.64.64]

Trace complete.
```

4.cs.manchester.ac.uk

```
C:\Users\HP>tracert www.cs.manchester.ac.uk

Tracing route to cs2.eps.its.man.ac.uk [130.88.101.49]
over a maximum of 30 hops:

  1   184 ms     3 ms     3 ms  192.168.0.1
  2     5 ms     2 ms     2 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3     2 ms     2 ms     2 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5     5 ms     3 ms     4 ms  103.42.160.13
  6   134 ms   137 ms   135 ms  182.79.154.0
  7     *        *        *     Request timed out.
  8   134 ms   137 ms   141 ms  jisc-ic-345131-ldn-b4.c.telia.net [62.115.175.131]
  9   132 ms   133 ms   134 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
 10   136 ms   136 ms   134 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
 11   216 ms   208 ms   184 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
 12   148 ms   142 ms   142 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
 13   144 ms   146 ms   144 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
 14     *        *        *     Request timed out.
 15   140 ms   140 ms   140 ms  130.88.249.194
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18   143 ms   143 ms   143 ms  eps.its.man.ac.uk [130.88.101.49]

Trace complete.
```

Exercise 2: (Very short.) Use traceroute to trace the route from your computer to math.hws.edu and to www.hws.edu. Explain the difference in the results.

math.hws.edu

```
C:\Users\HP>tracert math.hws.edu

Tracing route to math.hws.edu [64.89.144.237]
over a maximum of 30 hops:

  1   279 ms     3 ms     1 ms  192.168.0.1
  2    17 ms    98 ms     3 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3     2 ms    42 ms     2 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5     3 ms     3 ms     9 ms  103.42.160.13
  6   235 ms   235 ms   240 ms  182.79.255.9
  7   293 ms   286 ms   249 ms  xe-9-1-0.edge1.LosAngeles6.Level3.net [4.26.0.61]
  8   233 ms   240 ms   233 ms  ae-2-52.ear3.LosAngeles1.Level3.net [4.69.207.49]
  9     *      234 ms     *     GBLX-level3-400G.LosAngeles1.Level3.net [4.68.73.189]
 10   310 ms   304 ms   302 ms  roc1-ar5-xe-0-0-0-0.us.twtelecom.net [35.248.1.158]
 11   310 ms   307 ms   307 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 12   297 ms   298 ms   297 ms  64.89.144.100
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

www.hws.edu

```
C:\Users\HP>tracert www.hws.edu

Tracing route to www.hws.edu [64.89.145.159]
over a maximum of 30 hops:

  1  1524 ms    74 ms   173 ms  192.168.0.1
  2     *       25 ms    17 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3     3 ms     8 ms     9 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5     7 ms     5 ms    95 ms  103.42.160.13
  6   234 ms   236 ms   266 ms  182.79.255.9
  7   252 ms   259 ms   270 ms  xe-9-1-0.edge1.LosAngeles6.Level3.net [4.26.0.61]
  8     *        *        *     Request timed out.
  9     *        *        *     Request timed out.
 10   305 ms   307 ms   321 ms  roc1-ar5-xe-0-0-0-0.us.twtelecom.net [35.248.1.158]
 11   316 ms   312 ms   317 ms  66-195-65-170.static.ctl.one [66.195.65.170]
 12   298 ms   301 ms   299 ms  64.89.144.100
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

In www.hws.edu, the 8th and 9th nodes were timed out as well along with the 4th node .

Exercise 3: Two packets sent from the same source to the same destination do not necessarily follow the same path through the net. Experiment with some sources that
are fairly far away. Can you find cases where packets sent to the same destination follow different paths? How likely does it seem to be? What about when the packets are sent at very different times? Save some of the outputs from traceroute. (You can
copy them from the Terminal window by highlighting and right-clicking, then paste into a text editor.) Come back sometime next week, try the same destinations again,
and compare the results with the results from today. Report your observations.

```
C:\Users\HP>tracert www.cs.stanford.edu

Tracing route to cs.stanford.edu [171.64.64.64]
over a maximum of 30 hops:

  1   262 ms     1 ms     1 ms  192.168.0.1
  2     9 ms     8 ms     7 ms  94-4-252-103.threesainfoway.com [103.252.4.94]
  3     2 ms     2 ms     5 ms  93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5    16 ms     5 ms     4 ms  103.42.160.13
  6   183 ms   183 ms   185 ms  116.119.52.163
  7   184 ms   183 ms   184 ms  core1.nyc4.he.net [198.32.118.57]
  8     *      244 ms     *     100ge8-1.core1.sjc2.he.net [184.105.81.218]
  9   236 ms   235 ms   235 ms  10ge4-5.core1.pao1.he.net [72.52.92.69]
 10   246 ms   246 ms   245 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 11   237 ms   238 ms   240 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 12   245 ms   253 ms   248 ms  CS.stanford.edu [171.64.64.64]

Trace complete.
```

```
C:\Users\HP>tracert www.cs.stanford.edu

Tracing route to cs.stanford.edu [171.64.64.64]
over a maximum of 30 hops:

  1     7 ms     1 ms     3 ms  192.168.0.1
  2    18 ms    54 ms     *     94-4-252-103.threesainfoway.com [103.252.4.94]
  3     3 ms    23 ms     *     93-4-252-103.threesainfoway.com [103.252.4.93]
  4     *        *        *     Request timed out.
  5     3 ms    20 ms    15 ms  103.42.160.13
  6   246 ms   243 ms   239 ms  182.79.222.237
  7   235 ms   220 ms   232 ms  core1.nyc4.he.net [198.32.118.57]
  8   283 ms   272 ms   272 ms  100ge8-1.core1.sjc2.he.net [184.105.81.218]
  9   274 ms   273 ms   273 ms  100ge1-1.core1.pao1.he.net [72.52.92.158]
 10   274 ms   287 ms   301 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 11   283 ms   337 ms   278 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 12   274 ms   301 ms   305 ms  CS.stanford.edu [171.64.64.64]

Trace complete.

C:\Users\HP>
```

There was no major difference found between the two.

Questions about path
Now look at the results you gathered and answer the following questions about the paths taken by your packets. Store your answers in a file named traceroute.txt.

1.Is any part of the path common for all hosts you tracerouted?
Ans: Yes, there are two common paths for all hosts. They are 94-4-252-103.threesainfoway .com [103.252.4.94] and 93-4-252-103.threesainfoway .com [103.252.4.93].

2. Is there a relationship between the number of nodes that show up in the traceroute and the location of the host? If so, what is this relationship?
Ans: No, there is no relationship between the number of nodes that show up in the traceroute and the location of the host.

3. Is there a relationship between the number of nodes that show up in the traceroute and latency of the host (from your ping results above)? Does the same relationship hold for all hosts?
Ans: Yes, there is a relationship between the number of nodes that show up in the traceroute and the latency of the host. The further apart the two nodes are, the more latency there is.

Exercise 4: (Short.) Use whois to investigate a well-known web site such as google.com or amazon.com, and write a couple of sentences about what you find out.

```
Domain Name: google.com
Registry Domain ID: 2138514_DOMAIN_COM-VRSN
Registrar WHOIS Server: whois.markmonitor.com
Registrar URL: http://www.markmonitor.com
Updated Date: 2019-09-09T08:39:04-0700
Creation Date: 1997-09-15T00:00:00-0700
Registrar Registration Expiration Date: 2028-09-13T00:00:00-0700
Registrar: MarkMonitor, Inc.
Registrar IANA ID: 292
Registrar Abuse Contact Email: abusecomplaints@markmonitor.com
Registrar Abuse Contact Phone: +1.2083895770
Domain Status: clientUpdateProhibited (https://www.icann.org/epp#clientUpdateProhibited)
Domain Status: clientTransferProhibited (https://www.icann.org/epp#clientTransferProhibited)
Domain Status: clientDeleteProhibited (https://www.icann.org/epp#clientDeleteProhibited)
Domain Status: serverUpdateProhibited (https://www.icann.org/epp#serverUpdateProhibited)
Domain Status: serverTransferProhibited (https://www.icann.org/epp#serverTransferProhibited)
Domain Status: serverDeleteProhibited (https://www.icann.org/epp#serverDeleteProhibited)
Registrant Organization: Google LLC
Registrant State/Province: CA
Registrant Country: US
Registrant Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Admin Organization: Google LLC
Admin State/Province: CA
Admin Country: US
Admin Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Tech Organization: Google LLC
Tech State/Province: CA
Tech Country: US
Tech Email: Select Request Email Form at https://domains.markmonitor.com/whois/google.com
Name Server: ns1.google.com
Name Server: ns3.google.com
Name Server: ns4.google.com
Name Server: ns2.google.com
```

The whois command is used to find out information about a domain, such as the owner of the domain, the owner's contact information, and the nameservers that the domain is using.
Here is a brief description of the most important fields:
• **Registrar:** MarkMonitor, Inc – the company that registered the domain on behalf of
the domain's owner.
• **Name Servers:** ns1.google.com, ns2.google.com, ns3.google.com, ns4.google.com
– the servers that control the domain's DNS.
• **Creation Date:** 1997-09-15 – the date the domain was originally registered.
• **Registrant Name, Address, City:** publicly accessible information of the domain owner.

Exercise 5: (Should be short.) Because of NAT, the domain name spit.ac.in has a different IP address outside of SPIT than it does on campus. Using information in this
lab and working on a home computer, find the outside IP address for spit.ac.in. Explain how you did it.

```
C:\Users\HP>nslookup spit.ac.in
Server:  UnKnown
Address:  192.168.0.1

Non-authoritative answer:
Name:    spit.ac.in
Address:  43.252.193.19


C:\Users\HP>
```

curl ipinfo.io/ip will get you the IP address list to find public IP addresses for your machine:

```
C:\Users\HP>curl ipinfo.io/129.64.99.200
{
  "ip": "129.64.99.200",
  "hostname": "websrv-prod.unet.brandeis.edu",
  "city": "Waltham",
  "region": "Massachusetts",
  "country": "US",
  "loc": "42.3765,-71.2356",
  "org": "AS10561 Brandeis University",
  "postal": "02453",
  "timezone": "America/New_York",
  "readme": "https://ipinfo.io/missingauth"
}
C:\Users\HP>
```

CONCLUSION: 1. In the above experiment, I learnt the basic commands of ipconfig,
ping, traceroute, etc.
2.I understood the implementation of basic networking utilities.

REFERENCES:

https://www.geeksforgeeks.org/linux-networking-tools/
https://opensource.com/article/18/5/how-find-ip-address-linux
https://www.educba.com/networking-commands/