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EXPERIMENT 2

AIM: To study the basic command line networking utilities.

THEORY:

Some Basic command line Networking utilities

Start with a few of the most basic command line tools. These commands are available on Unix, including Linux (and the first two, at least, are also for Windows). Some parameters or options might differ on different operating systems. Remember that you can use `man <command>` to get information about a command and its options.

ping — The command `ping <host>` sends a series of packets and expects to receive a response to each packet. When a return packet is received, ping reports the round trip time (the time between sending the packet and receiving the response). Some routers and firewalls block ping requests, so you might get no response at all. Ping can be used to check whether a computer is up and running, to measure network delay time, and to check for dropped packets indicating network congestion. Note that `<host>` can be either a domain name or an IP address. By default, ping will send a packet every second indefinitely; stop it with Control-C

Network latency, specifically round trip time (RTT), can be measured using `ping`, which sends ICMP packets. The syntax for the command in Linux or Mac OS is:

```
ping [-c <count>] [-s <packetsize>] <hostname>
```

The syntax in Windows is:

```
ping [-n <count>] [-l <packetsize>] <hostname>
```

The default number of ICMP packets to send is either infinite (in Linux and Mac OS) or 4 (in Windows). The default packet size is either 64 bytes (in Linux) or 32 bytes (in Windows). You can specify either a hostname (e.g., `spit.ac.in`) or an IP address.

To save the output from `ping` to a file, include a greater than symbol and a file name at the end of the command. For example:

```
ping -c 10 google.com > ping_c10_s64_google.log
```

EXPERIMENTS WITH PING

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

Microsoft Windows [Version 10.0.18363.1016]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Ankeet>ping -n 10 -l 64 www.google.com

Pinging www.google.com [172.217.174.228] with 64 bytes of data:

Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=7ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117
Reply from 172.217.174.228: bytes=64 time=4ms TTL=117

Ping statistics for 172.217.174.228:

Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 4ms, Maximum = 7ms, Average = 4ms

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

Pinging www.google.com [172.217.174.228] with 100 bytes of data:

Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117
Reply from 172.217.174.228: bytes=68 (sent 100) time=4ms TTL=117

Ping statistics for 172.217.174.228:

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

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

```
Pinging www.google.com [172.217.174.228] with 500 bytes of data:
```

```
Reply from 172.217.174.228: bytes=68 (sent 500) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 500) time=5ms TTL=117
```

```
Ping statistics for 172.217.174.228:
```

```
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
```

```
    Minimum = 4ms, Maximum = 5ms, Average = 4ms
```

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

```
Pinging www.google.com [172.217.174.228] with 1000 bytes of data:
```

```
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=5ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=4ms TTL=117  
Reply from 172.217.174.228: bytes=68 (sent 1000) time=5ms TTL=117
```

```
Ping statistics for 172.217.174.228:
```

```
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
```

```
    Minimum = 4ms, Maximum = 5ms, Average = 4ms
```

QUESTIONS ABOUT LATENCY

Now look at the results you gathered and answer the following questions about latency. Store your answers in a file named `ping.txt`.

1. 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 varies between different hosts.
Processing delay – time it takes a router to process the packet header, depends on the processing speed of the switch.
Queueing delay – time the packet spends in routing queues depends on the number of packets, size of the packet and bandwidth
Transmission delay – time it takes to push the packet's bits onto the link depends on size of the packet and bandwidth
Propagation delay – time for a signal to reach its destination depends on size of the packet and the bandwidth
2. 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 varies with different packet sizes. The differences are likely caused by transmit delay

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).

>> Infrastructure components, network traffic, and physical distance along the path between a source and a destination are all potential factors that can affect RTT.

Physical distance – although a connection optimized by a CDN can often reduce the number of hops required to reach a destination, there is no way of getting around the limitation imposed by the speed of light; the distance between a start and end point is a limiting factor in network connectivity that can only be reduced by moving content closer to the requesting users. To overcome this obstacle, a CDN will cache content closer to the requesting users, thereby reducing RTT.

nslookup — The command `nslookup <host>` will do a DNS query to find and report the IP address (or addresses) for a domain name or the domain name corresponding to an IP address. To do this, it contacts a "DNS server." Default DNS servers are part of a computer's network configuration. (For a static IP address in Linux, they are configured in the file `/etc/network/interfaces` that you encountered in the last lab.) You can specify a different DNS server to be used by `nslookup` by adding the server name or IP address to the command:
`nslookup <host> <server>`

```
C:\Users\Ankeet>nslookup youtube.com
Server: beetel-04177
Address: 192.168.1.1

Non-authoritative answer:
Name:     youtube.com
Addresses: 2404:6800:4009:80c::200e
          172.217.166.46
```

ifconfig — You used ifconfig in the previous lab. When used with no parameters, ifconfig reports some information about the computer's network interfaces. This usually includes lo which stands for localhost; it can be used for communication between programs running on the same computer. Linux often has an interface named eth0, which is the first ethernet card. The information is different on Mac OS and Linux, but includes the IP or "inet" address and ethernet or "hardware" address for an ethernet card. On Linux, you get the number of packets received (RX) and sent (TX), as well as the number of bytes transmitted and received. (A better place to monitor network bytes on our Linux computers is in the GUI program System Monitor, if it is installed!!!.)

```
C:\Users\Ankeet>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 1:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix  . :
    Link-local IPv6 Address . . . . . : fe80::5cb8:126f:e31c:fe6a%21
    IPv4 Address. . . . . : 192.168.1.2
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Ethernet adapter Bluetooth Network Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

C:\Users\Ankeet>
```

netstat — The netstat command gives information about network connections. I often use netstat -t -n which lists currently open TCP connections (that's the "-t" option) by IP address rather than domain name (that's the "-n" option). 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: netstat -t -n -l. (On Mac, use netstat -p tcp to list tcp connections, and add "-a" to include listening sockets in the list.)

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

Active Connections

Proto	Local Address	Foreign Address	State	Offload State
TCP	127.0.0.1:49679	127.0.0.1:49914	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49709	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49710	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49711	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49713	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49727	ESTABLISHED	InHost
TCP	127.0.0.1:49698	127.0.0.1:49748	ESTABLISHED	InHost
TCP	127.0.0.1:49709	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49710	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49711	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49713	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49715	127.0.0.1:49802	ESTABLISHED	InHost
TCP	127.0.0.1:49715	127.0.0.1:49858	ESTABLISHED	InHost
TCP	127.0.0.1:49716	127.0.0.1:49717	ESTABLISHED	InHost
TCP	127.0.0.1:49717	127.0.0.1:49716	ESTABLISHED	InHost
TCP	127.0.0.1:49727	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49729	127.0.0.1:49730	ESTABLISHED	InHost
TCP	127.0.0.1:49730	127.0.0.1:49729	ESTABLISHED	InHost
TCP	127.0.0.1:49737	127.0.0.1:49738	ESTABLISHED	InHost
TCP	127.0.0.1:49738	127.0.0.1:49737	ESTABLISHED	InHost
TCP	127.0.0.1:49739	127.0.0.1:61900	ESTABLISHED	InHost
TCP	127.0.0.1:49740	127.0.0.1:49741	ESTABLISHED	InHost
TCP	127.0.0.1:49741	127.0.0.1:49740	ESTABLISHED	InHost
TCP	127.0.0.1:49748	127.0.0.1:49698	ESTABLISHED	InHost
TCP	127.0.0.1:49755	127.0.0.1:49756	ESTABLISHED	InHost
TCP	127.0.0.1:49756	127.0.0.1:49755	ESTABLISHED	InHost
TCP	127.0.0.1:49758	127.0.0.1:61900	ESTABLISHED	InHost
TCP	127.0.0.1:49761	127.0.0.1:49762	ESTABLISHED	InHost
TCP	127.0.0.1:49762	127.0.0.1:49761	ESTABLISHED	InHost
TCP	127.0.0.1:49800	127.0.0.1:49801	ESTABLISHED	InHost
TCP	127.0.0.1:49801	127.0.0.1:49800	ESTABLISHED	InHost
TCP	127.0.0.1:49802	127.0.0.1:49715	ESTABLISHED	InHost
TCP	127.0.0.1:49803	127.0.0.1:49804	ESTABLISHED	InHost
TCP	127.0.0.1:49804	127.0.0.1:49803	ESTABLISHED	InHost
TCP	127.0.0.1:49856	127.0.0.1:49857	ESTABLISHED	InHost
TCP	127.0.0.1:49857	127.0.0.1:49856	ESTABLISHED	InHost
TCP	127.0.0.1:49858	127.0.0.1:49715	ESTABLISHED	InHost
TCP	127.0.0.1:49859	127.0.0.1:49860	ESTABLISHED	InHost

telnet — Telnet is an old program for remote login. It's not used so much for that any more, since it has no security features. But basically, all it does is open a connection to a server and allow server and client to send lines of plain text to each other. It can be used to check that it's possible to connect to a server and, if the server communicates in plain text, even to interact with the server by hand. Since the Web uses a plain text protocol, you can use telnet to connect to a web client and play the part of the web browser. I will suggest that you to do this with your own web server when you write it, but you might want to try it now. When you use telnet in this way, you need to specify both the host and the port number to which you want to connect: telnet <host> <port>. For example, to connect to the web server on www.spit.ac.in: telnet spit.ac.in 80

traceroute — Traceroute is discussed in man utility. The command traceroute <host> will show routers encountered by packets on their way from your computer to a specified <host>. For each $n = 1, 2, 3, \dots$, traceroute sends a packet with "time-to-live" (ttl) equal to n . Every time a router forwards a packet, it decreases the ttl of the packet by one. If the ttl drops to zero, the router discards the packet and sends an error message back to the sender of the packet. (Again, as with ping, the packets might be blocked or might not even be sent, so that the error messages will never be received.) The sender gets the identity of the router from the source of the error message. Traceroute will send packets until n reaches some set upper bound or until a packet actually gets through to the destination. It actually does this three times for each n . In this way, it identifies routers that are one step, two steps, three steps, ... away from the source computer. A packet for which no response is received is indicated in the output as a *.

Traceroute is installed on the computers. If was not installed in your virtual server last week, but you can install it with the command `sudo apt-get install traceroute`

The path taken through a network, can be measured using `traceroute`. The syntax for the command in Linux is:

```
traceroute <hostname>
```

The syntax in Windows is:

```
tracert <hostname>
```

You can specify either a hostname (e.g., `cs.iitb.ac.in`) or an IP address (e.g., `128.105.2.6`).

1.2.1 EXPERIMENTS WITH TRACEROUTE

From **your machine** traceroute to the following hosts:

1. ee.iitb.ac.in
2. mscs.mu.edu
3. www.cs.grinnell.edu
4. csail.mit.edu
5. cs.stanford.edu
6. cs.manchester.ac.uk

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(e.g., `traceroute_ee.iitb.ac.in.log`).


```
C:\Users\Ankeet>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	2 ms	beetel-04177 [192.168.1.1]
2	2 ms	1 ms	1 ms	csp1.zte.com.cn [192.168.5.1]
3	4 ms	2 ms	2 ms	172.22.1.194 [172.22.1.194]
4	*	*	*	Request timed out.
5	84 ms	33 ms	107 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	15 ms	15 ms	14 ms	46-97-87-183.mysipl.com [183.87.97.46]
7	105 ms	23 ms	20 ms	172.23.78.233 [172.23.78.233]
8	23 ms	22 ms	22 ms	ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
9	*	174 ms	170 ms	if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
10	168 ms	166 ms	167 ms	if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
11	186 ms	174 ms	168 ms	if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
12	169 ms	177 ms	178 ms	80.231.153.66
13	*	*	236 ms	ae-2-3603.ear3.Chicago2.Level3.net [4.69.159.186]
14	237 ms	*	237 ms	MARQUETTE-U.ear3.Chicago2.Level3.net [4.16.38.70]
15	237 ms	238 ms	237 ms	134.48.10.26
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\Ankeet>tracert www.cs.grinnell.edu
```

```
Tracing route to www.cs.grinnell.edu [132.161.132.159]  
over a maximum of 30 hops:
```

1	4 ms	13 ms	1 ms	beetel-04177 [192.168.1.1]
2	2 ms	1 ms	1 ms	csp3.zte.com.cn [192.168.5.1]
3	3 ms	2 ms	2 ms	172.22.1.194 [172.22.1.194]
4	*	*	*	Request timed out.
5	6 ms	4 ms	81 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	21 ms	17 ms	14 ms	46-97-87-183.mysipl.com [183.87.97.46]
7	32 ms	13 ms	14 ms	172.23.78.233 [172.23.78.233]
8	44 ms	41 ms	41 ms	172.31.244.45 [172.31.244.45]
9	43 ms	43 ms	46 ms	ix-ae-4-2.tcore2.cxr-chennai.as6453.net [180.87.37.1]
10	282 ms	302 ms	296 ms	if-ae-9-2.tcore2.mlv-mumbai.as6453.net [180.87.37.10]
11	306 ms	285 ms	282 ms	if-ae-2-2.tcore1.mlv-mumbai.as6453.net [180.87.38.1]
12	301 ms	301 ms	*	if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
13	297 ms	280 ms	281 ms	if-ae-2-2.tcore2.wyn-marseille.as6453.net [80.231.217.2]
14	301 ms	*	317 ms	if-ae-9-2.tcore2.l78-london.as6453.net [80.231.200.14]
15	312 ms	300 ms	300 ms	if-ae-15-2.tcore2.ldn-london.as6453.net [80.231.131.118]
16	305 ms	306 ms	362 ms	if-ae-32-3.tcore2.nto-newyork.as6453.net [80.231.20.107]
17	321 ms	311 ms	335 ms	if-ae-26-2.tcore1.ct8-chicago.as6453.net [216.6.81.29]
18	302 ms	306 ms	307 ms	63.243.129.121
19	*	*	*	Request timed out.
20	311 ms	301 ms	297 ms	et3-1-0-0.agr03.desm01-ia.us.windstream.net [40.128.250.43]
21	324 ms	309 ms	305 ms	ae4-0.pe04.grnl01-ia.us.windstream.net [40.128.248.35]
22	316 ms	315 ms	304 ms	ae7-0.pe05.grnl01-ia.us.windstream.net [40.138.127.29]
23	293 ms	280 ms	277 ms	grnl-static-grinnellcollege0-0001.flex.iowatelecom.net [69.66.111.181]
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\Ankeet>tracert csail.mit.edu
```

```
Tracing route to csail.mit.edu [128.30.2.109]  
over a maximum of 30 hops:
```

1	1 ms	1 ms	1 ms	beetel-04177 [192.168.1.1]
2	3 ms	7 ms	1 ms	csp1.zte.com.cn [192.168.5.1]
3	4 ms	3 ms	2 ms	172.22.1.194 [172.22.1.194]
4	*	4 ms	*	172.22.1.193 [172.22.1.193]
5	52 ms	103 ms	13 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	16 ms	12 ms	11 ms	46-97-87-183.mysipl.com [183.87.97.46]
7	6 ms	5 ms	9 ms	172.23.78.233 [172.23.78.233]
8	5 ms	5 ms	5 ms	ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
9	268 ms	264 ms	*	if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
10	266 ms	*	263 ms	if-ae-2-2.tcore2.wyn-marseille.as6453.net [80.231.217.2]
11	248 ms	*	262 ms	if-ae-9-2.tcore2.l78-london.as6453.net [80.231.200.14]
12	276 ms	282 ms	271 ms	if-ae-15-2.tcore2.ldn-london.as6453.net [80.231.131.118]
13	260 ms	251 ms	251 ms	if-ae-32-2.tcore2.nto-newyork.as6453.net [63.243.216.22]
14	278 ms	268 ms	280 ms	if-ae-12-2.tcore1.n75-newyork.as6453.net [66.110.96.5]
15	269 ms	258 ms	256 ms	66.110.96.150
16	270 ms	264 ms	263 ms	be-10390-cr02.newyork.ny.ibone.comcast.net [68.86.83.89]
17	251 ms	254 ms	253 ms	be-1302-cs03.newyork.ny.ibone.comcast.net [96.110.38.41]
18	266 ms	225 ms	225 ms	96.110.42.10
19	225 ms	312 ms	225 ms	ae0-0-eg-bstpmall74w.boston.ma.boston.comcast.net [68.86.238.34]
20	274 ms	269 ms	281 ms	50-201-57-174-static.hfc.comcastbusiness.net [50.201.57.174]
21	294 ms	281 ms	276 ms	dmz-rtr-1-external-rtr-3.mit.edu [18.0.161.13]
22	344 ms	267 ms	275 ms	dmz-rtr-2-dmz-rtr-1-1.mit.edu [18.0.161.6]
23	265 ms	264 ms	281 ms	mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
24	*	*	*	Request timed out.
25	271 ms	282 ms	281 ms	bdr.core-1.csail.mit.edu [128.30.0.246]
26	273 ms	274 ms	275 ms	inquir-3ld.csail.mit.edu [128.30.2.109]

```
Trace complete.
```

```
C:\Users\Ankeet>tracert cs.stanford.edu
```

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

1	1 ms	1 ms	1 ms	beetel-04177 [192.168.1.1]
2	4 ms	1 ms	1 ms	csp3.zte.com.cn [192.168.5.1]
3	4 ms	2 ms	2 ms	172.22.1.194 [172.22.1.194]
4	*	*	4 ms	172.22.1.193 [172.22.1.193]
5	4 ms	15 ms	5 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	6 ms	4 ms	5 ms	38-97-87-183.mysipl.com [183.87.97.38]
7	19 ms	18 ms	17 ms	172.23.78.237 [172.23.78.237]
8	24 ms	26 ms	25 ms	172.31.244.45 [172.31.244.45]
9	30 ms	29 ms	30 ms	ix-ae-4-2.tcore2.cxr-chennai.as6453.net [180.87.37.1]
10	245 ms	241 ms	240 ms	if-ae-10-4.tcore2.svw-singapore.as6453.net [180.87.67.16]
11	252 ms	242 ms	236 ms	if-ae-7-2.tcore2.lvw-losangeles.as6453.net [180.87.15.26]
12	228 ms	226 ms	228 ms	if-ae-2-2.tcore1.lvw-losangeles.as6453.net [66.110.59.1]
13	261 ms	266 ms	266 ms	las-b24-link.telina.net [80.239.128.214]
14	261 ms	256 ms	262 ms	palo-b24-link.telina.net [62.115.119.90]
15	269 ms	267 ms	274 ms	palo-b1-link.telina.net [62.115.122.169]
16	254 ms	270 ms	274 ms	hurricane-ic-308019-palo-b1.c.telina.net [80.239.167.174]
17	269 ms	263 ms	260 ms	stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
18	274 ms	273 ms	273 ms	csee-west-rtr-vl3.SUNet [171.66.255.140]
19	267 ms	283 ms	273 ms	CS.stanford.edu [171.64.64.64]

```
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.

>> There is difference in the 12th hop in the above mentioned sites

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

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

1	3 ms	1 ms	1 ms	beetel-04177 [192.168.1.1]
2	2 ms	3 ms	2 ms	csp1.zte.com.cn [192.168.5.1]
3	*	3 ms	5 ms	172.22.1.194 [172.22.1.194]
4	*	14 ms	9 ms	172.22.1.193 [172.22.1.193]
5	270 ms	199 ms	99 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	6 ms	24 ms	21 ms	46-97-87-183.mysipl.com [183.87.97.46]
7	17 ms	12 ms	18 ms	172.23.78.233 [172.23.78.233]
8	5 ms	7 ms	7 ms	ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
9	160 ms	162 ms	181 ms	if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
10	169 ms	164 ms	165 ms	if-ae-21-2.tcore1.pye-paris.as6453.net [80.231.154.208]
11	163 ms	161 ms	162 ms	if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
12	164 ms	163 ms	164 ms	80.231.153.66
13	163 ms	164 ms	164 ms	ae-2-3204.edge3.Paris1.Level3.net [4.69.161.114]
14	169 ms	171 ms	166 ms	global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
15	252 ms	257 ms	260 ms	roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
16	254 ms	254 ms	254 ms	66-195-65-170.static.ctl.one [66.195.65.170]
17	268 ms	265 ms	267 ms	nat.hws.edu [64.89.144.100]
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\Ankeet>tracert www.hws.edu
```

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

1	11 ms	4 ms	3 ms	beetel-04177 [192.168.1.1]
2	5 ms	2 ms	1 ms	csp3.zte.com.cn [192.168.5.1]
3	5 ms	3 ms	2 ms	172.22.1.194 [172.22.1.194]
4	*	4 ms	*	172.22.1.193 [172.22.1.193]
5	5 ms	4 ms	9 ms	73-192-119-111.mysipl.com [111.119.192.73]
6	17 ms	5 ms	9 ms	42-97-87-183.mysipl.com [183.87.97.42]
7	8 ms	5 ms	6 ms	172.23.78.237 [172.23.78.237]
8	5 ms	5 ms	5 ms	ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
9	166 ms	161 ms	160 ms	if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
10	161 ms	161 ms	175 ms	if-ae-8-1600.tcore1.pye-paris.as6453.net [80.231.217.6]
11	166 ms	162 ms	164 ms	if-ae-11-2.tcore1.pvu-paris.as6453.net [80.231.153.49]
12	*	*	*	Request timed out.
13	169 ms	*	163 ms	114.161.69.4.in-addr.arpa [4.69.161.114]
14	164 ms	164 ms	164 ms	global-crossing-xe-level3.paris1.level3.net [4.68.63.230]
15	255 ms	256 ms	257 ms	roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
16	261 ms	261 ms	264 ms	66-195-65-170.static.ctl.one [66.195.65.170]
17	261 ms	263 ms	260 ms	nat.hws.edu [64.89.144.100]
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.
```

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.

20th August 2020:

```
C:\Users\Ankeet>tracert csail.mit.edu

Tracing route to csail.mit.edu [128.30.2.109]
over a maximum of 30 hops:

  1    1 ms    1 ms    1 ms  beetel-04177 [192.168.1.1]
  2    3 ms    7 ms    1 ms  csp1.zte.com.cn [192.168.5.1]
  3    4 ms    3 ms    2 ms  172.22.1.194 [172.22.1.194]
  4    *      4 ms    *     172.22.1.193 [172.22.1.193]
  5   52 ms   103 ms   13 ms  73-192-119-111.mysipl.com [111.119.192.73]
  6   16 ms   12 ms   11 ms  46-97-87-183.mysipl.com [183.87.97.46]
  7    6 ms    5 ms    9 ms  172.23.78.233 [172.23.78.233]
  8    5 ms    5 ms    5 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  9  268 ms   264 ms    *     if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
 10  266 ms    *     263 ms  if-ae-2-2.tcore2.wyn-marseille.as6453.net [80.231.217.2]
 11  248 ms    *     262 ms  if-ae-9-2.tcore2.l78-london.as6453.net [80.231.200.14]
 12  276 ms   282 ms   271 ms  if-ae-15-2.tcore2.ldn-london.as6453.net [80.231.131.118]
 13  260 ms   251 ms   251 ms  if-ae-32-2.tcore2.nto-newyork.as6453.net [63.243.216.22]
 14  278 ms   268 ms   280 ms  if-ae-12-2.tcore1.n75-newyork.as6453.net [66.110.96.5]
 15  269 ms   258 ms   256 ms  66.110.96.150
 16  270 ms   264 ms   263 ms  be-10390-cr02.newyork.ny.ibone.comcast.net [68.86.83.89]
 17  251 ms   254 ms   253 ms  be-1302-cs03.newyork.ny.ibone.comcast.net [96.110.38.41]
 18  266 ms   225 ms   225 ms  96.110.42.10
 19  225 ms   312 ms   225 ms  ae0-0-eg-bstpmall74w.boston.ma.boston.comcast.net [68.86.238.34]
 20  274 ms   269 ms   281 ms  50-201-57-174-static.hfc.comcastbusiness.net [50.201.57.174]
 21  294 ms   281 ms   276 ms  dmz-rtr-1-external-rtr-3.mit.edu [18.0.161.13]
 22  344 ms   267 ms   275 ms  dmz-rtr-2-dmz-rtr-1-1.mit.edu [18.0.161.6]
 23  265 ms   264 ms   281 ms  mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
 24    *      *      *     Request timed out.
 25  271 ms   282 ms   281 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 26  273 ms   274 ms   275 ms  inquire-3ld.csail.mit.edu [128.30.2.109]

Trace complete.
```

27th August 2020:

```
C:\Users\Ankeet>tracert csail.mit.edu

Tracing route to csail.mit.edu [128.30.2.109]
over a maximum of 30 hops:

  1    1 ms    1 ms    1 ms  beetel-04177 [192.168.1.1]
  2    2 ms    *        2 ms  csp3.zte.com.cn [192.168.5.1]
  3    *        6 ms    2 ms  172.22.1.194 [172.22.1.194]
  4    *        *        8 ms  172.22.1.193 [172.22.1.193]
  5   53 ms    7 ms    5 ms  73-192-119-111.mysipl.com [111.119.192.73]
  6    5 ms    5 ms    5 ms  46-97-87-183.mysipl.com [183.87.97.46]
  7    5 ms    5 ms    4 ms  172.23.78.233 [172.23.78.233]
  8    5 ms    5 ms    5 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  9  256 ms   254 ms   254 ms  if-ae-5-2.tcore1.wyn-marseille.as6453.net [80.231.217.29]
 10  246 ms   244 ms   245 ms  if-ae-2-2.tcore2.wyn-marseille.as6453.net [80.231.217.2]
 11  247 ms   247 ms    *    if-ae-9-2.tcore2.178-london.as6453.net [80.231.200.14]
 12  245 ms   244 ms   244 ms  if-ae-15-2.tcore2.ldn-london.as6453.net [80.231.131.118]
 13  254 ms   253 ms   252 ms  if-ae-32-2.tcore2.nto-newyork.as6453.net [63.243.216.22]
 14  252 ms   252 ms   253 ms  if-ae-12-2.tcore1.n75-newyork.as6453.net [66.110.96.5]
 15  254 ms   253 ms   253 ms  66.110.96.150
 16  255 ms   255 ms   254 ms  be-10390-cr02.newyork.ny.ibone.comcast.net [68.86.83.89]
 17  255 ms   255 ms   256 ms  be-1302-cs03.newyork.ny.ibone.comcast.net [96.110.38.41]
 18  210 ms   209 ms   209 ms  96.110.42.10
 19  270 ms   209 ms   209 ms  ae0-0-eg-bstpmall74w.boston.ma.boston.comcast.net [68.86.238.34]
 20  257 ms   256 ms   257 ms  50-201-57-174-static.hfc.comcastbusiness.net [50.201.57.174]
 21    *        *        *    Request timed out.
 22    *        *       261 ms  dmz-rtr-2-dmz-rtr-1-1.mit.edu [18.0.161.6]
 23  262 ms   264 ms   262 ms  mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
 24    *        *        *    Request timed out.
 25  265 ms   264 ms   265 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 26  265 ms   265 ms   265 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

Trace complete.
```

QUESTIONS ABOUT PATHS

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?
>> Yes some part of the path is common for all hosts that I tracerouted.
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?
>> No there is no relationship between number of nodes and location.
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?
>> Number of nodes has direct relationship to the latency for all hosts.

Whois — The *whois* command can give detailed information about domain names and IP addresses. If it is not installed on the computers then install it with command `sudo apt-get install whois`. *Whois* can tell you what organization owns or is responsible for the name or address and where to contact them. It often includes a list of domain name servers for the organization.

When using *whois* to look up a domain name, use the simple two-part network name, not an individual computer name (for example, *whois spit.ac.in*).

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.

```
c:\tools> whois techbuzzonline.com

Whois v1.14 - Domain information lookup
Copyright (C) 2005-2016 Mark Russinovich
Sysinternals - www.sysinternals.com

Connecting to COM.whois-servers.net...

Domain ID: 1663819488_DOMAIN_COM-VRSN
  Registrar WHOIS Server: whois.godaddy.com
  Registrar URL: http://www.godaddy.com
  Updated Date: 2017-10-26T16:55:43Z
  Creation Date: 2011-06-26T05:36:06Z
  Registry Expiry Date: 2022-06-26T05:36:06Z
  Registrar: GoDaddy.com, LLC
  Registrar IANA ID: 146
  Registrar Abuse Contact Email: abuse@godaddy.com
  Registrar Abuse Contact Phone: 480-624-2505
  Domain Status: clientDeleteProhibited https://icann.org/epp#clientDeleteProhibited
  Domain Status: clientRenewProhibited https://icann.org/epp#clientRenewProhibited
  Domain Status: clientTransferProhibited https://icann.org/epp#clientTransferProhibited
  Domain Status: clientUpdateProhibited https://icann.org/epp#clientUpdateProhibited
  Name Server: JIM.NS.CLOUDFLARE.COM
  Name Server: MARY.NS.CLOUDFLARE.COM
  DNSSEC: unsigned
  URL of the ICANN Whois Inaccuracy Complaint Form: https://www.icann.org/wicf/
>>> Last update of whois database: 2017-11-20T07:52:52Z <<<
```

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.

Geolocation — A geolocation service tries to tell, approximately, where a given IP address is located physically. They can't be completely accurate—but they probably get at least the country right most of the time.

This geolocation program is not installed on our computers, but you can access one on the command line using the *curl* command, which can send HTTP requests and display the

```
Microsoft Windows [Version 10.0.18363.1016]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Ankeet>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\Ankeet>
```

CONCLUSION:

Got to learn about different types of IP addresses in my laptop and some of the basic network commands like ping, ipconfig, tracert.

REFERENCES:

- 1) cloudflare.com/learning/cdn/glossary/round-trip-time-rtt/
- 2) <https://www.geeksforgeeks.org/traceroute-in-network-layer/>