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Lab 2: Basic Network Utilities

This lab introduces some basic network monitoring/analysis tools. There are a few exercises along the way. You should write up answers to the *ping* and *traceroute* exercises and turn them in next lab. (You should try out each tool, whether it is needed for an exercise or not!).

Prerequisite: Basic understanding of command line utilities of Linux Operating system.

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>
```

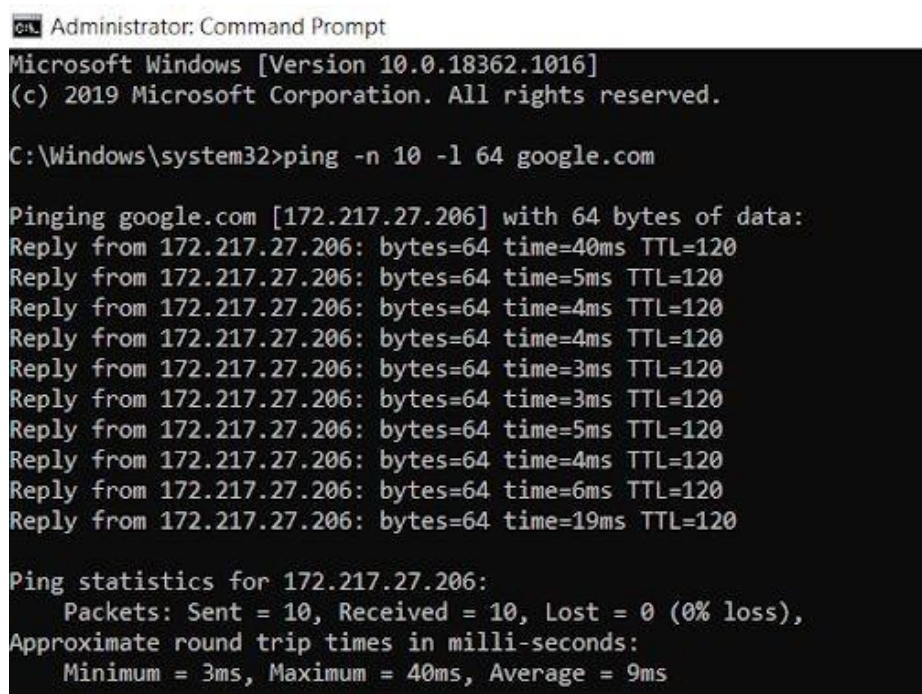
The default number of ICMP packets to send is either infinite (in Linux and Mac OS) or 4 (in Windows). The default packet size is either 64 bytes (in Linux) or 32 bytes (in Windows). You can specify either a hostname (e.g., `spit.ac.in`) or an IP address.

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
- ping -n 10 -l 64 google.com



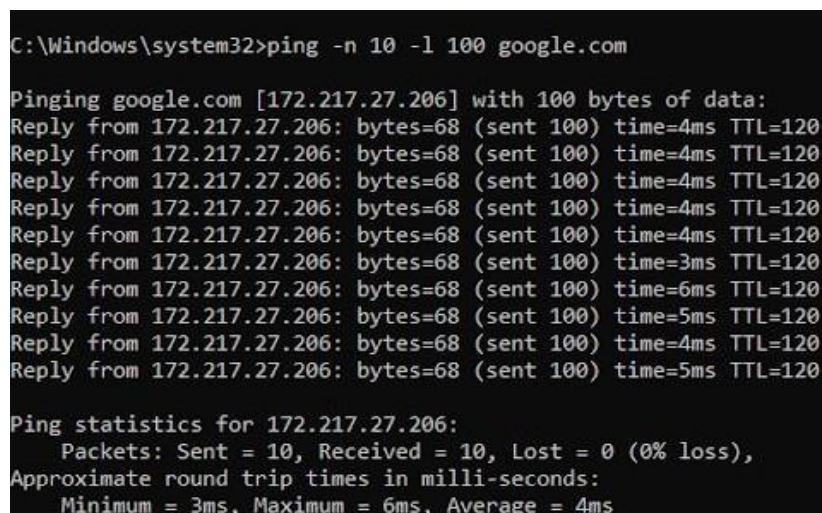
```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.18362.1016]
(c) 2019 Microsoft Corporation. All rights reserved.

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

Pinging google.com [172.217.27.206] with 64 bytes of data:
Reply from 172.217.27.206: bytes=64 time=40ms TTL=120
Reply from 172.217.27.206: bytes=64 time=5ms TTL=120
Reply from 172.217.27.206: bytes=64 time=4ms TTL=120
Reply from 172.217.27.206: bytes=64 time=4ms TTL=120
Reply from 172.217.27.206: bytes=64 time=3ms TTL=120
Reply from 172.217.27.206: bytes=64 time=3ms TTL=120
Reply from 172.217.27.206: bytes=64 time=5ms TTL=120
Reply from 172.217.27.206: bytes=64 time=4ms TTL=120
Reply from 172.217.27.206: bytes=64 time=6ms TTL=120
Reply from 172.217.27.206: bytes=64 time=19ms TTL=120

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 40ms, Average = 9ms
```

- ping -n 10 -l 100 google.com



```
C:\Windows\system32>ping -n 10 -l 100 google.com

Pinging google.com [172.217.27.206] with 100 bytes of data:
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=3ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=6ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=5ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=4ms TTL=120
Reply from 172.217.27.206: bytes=68 (sent 100) time=5ms TTL=120

Ping statistics for 172.217.27.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 6ms, Average = 4ms
```

- ping -n 10 -l 500 berkeley.edu

```
Command Prompt
C:\Users\Shobhit Verma>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=267ms TTL=36
Reply from 35.163.72.93: bytes=500 time=285ms TTL=36
Reply from 35.163.72.93: bytes=500 time=302ms TTL=36
Reply from 35.163.72.93: bytes=500 time=321ms TTL=36
Reply from 35.163.72.93: bytes=500 time=338ms TTL=36
Reply from 35.163.72.93: bytes=500 time=358ms TTL=36
Reply from 35.163.72.93: bytes=500 time=276ms TTL=36
Reply from 35.163.72.93: bytes=500 time=294ms TTL=36
Reply from 35.163.72.93: bytes=500 time=310ms TTL=36
Reply from 35.163.72.93: bytes=500 time=326ms TTL=36

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 = 358ms, Average = 307ms

C:\Users\Shobhit Verma>
```

- ping -n 10 -l 1000 google.com

```
Administrator: Command Prompt
Trace complete.

C:\Windows\system32>ping -n 10 -l 1400 google.com

Pinging google.com [172.217.160.206] with 1400 bytes of data:
Reply from 172.217.160.206: bytes=68 (sent 1400) time=5ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=5ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=7ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=11ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=4ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=5ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=24ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=5ms TTL=120
Reply from 172.217.160.206: bytes=68 (sent 1400) time=8ms TTL=120

Ping statistics for 172.217.160.206:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 24ms, Average = 7ms
```

- ping -n 10 -l 1400 www.ox.ac.uk

```
Command Prompt
Pinging www.ox.ac.uk [151.101.66.133] with 1400 bytes of data:
Reply from 151.101.66.133: bytes=1400 time=10ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=14ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=14ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=11ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=13ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=11ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=15ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=10ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=11ms TTL=55
Reply from 151.101.66.133: bytes=1400 time=145ms TTL=55

Ping statistics for 151.101.66.133:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 10ms, Maximum = 145ms, Average = 25ms

C:\Users\Shobhit Verma>
```

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?

Ans : RTT varies between different hosts. RTT depends on the distance of host, the medium, number of network hops, traffic levels in the network and server response time of the host. Propagation delay depends on distance. Transmission delay depends on the efficiency of medium.

Propagation and Transmission delay might have an impact in this case.

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 : RTT varies with packet size. RTT increases as packet size increases. Transmission delay depends on size of packet. So, transmission delay might have an impact on this.

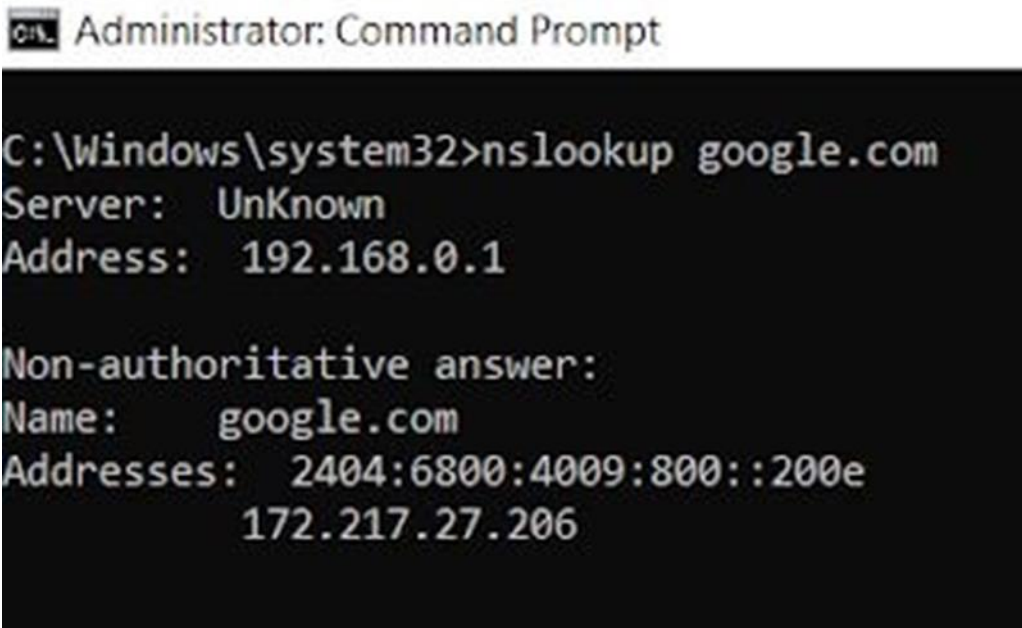
Exercise 1: Experiment with ping to find the round trip times to a variety of destinations. Write up any interesting observations, including in particular how the round trip time compares to the physical distance. Here are few places from who to get replies: www.uw.edu, www.cornell.edu, berkeley.edu, www.uchicago.edu, www.ox.ac.uk (England), www.u-tokyo.ac.jp (Japan).

Ans : From the images shown above, the following observations can be made :

- The length a signal has to travel correlates with the time taken for a request to reach a server and a response to reach a browser.
- 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

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:\Windows\system32>nslookup google.com
Server:      UnKnown
Address:     192.168.0.1

Non-authoritative answer:
Name:        google.com
Addresses:   2404:6800:4009:800::200e
             172.217.27.206
```

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:\Windows\system32>ipconfig

Windows IP Configuration

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  . :

Ethernet adapter Ethernet 2:

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

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix  . :
    Link-local IPv6 Address . . . . . : fe80::f8f9:6fe1:8feb:23e5%9
    IPv4 Address. . . . . : 192.168.0.105
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Ethernet adapter Bluetooth Network Connection:

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

```

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.)

```

Command Prompt
C:\Users\Shobhit Verma>netstat -t -n

Active Connections

Proto Local Address           Foreign Address         State       Offload State
TCP   127.0.0.1:49670          127.0.0.1:49671        ESTABLISHED InHost
TCP   127.0.0.1:49671          127.0.0.1:49670        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49697        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49698        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49699        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49700        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49703        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49708        ESTABLISHED InHost
TCP   127.0.0.1:49682          127.0.0.1:49713        ESTABLISHED InHost
TCP   127.0.0.1:49686          127.0.0.1:49687        ESTABLISHED InHost
TCP   127.0.0.1:49687          127.0.0.1:49686        ESTABLISHED InHost
TCP   127.0.0.1:49688          127.0.0.1:61900        ESTABLISHED InHost
TCP   127.0.0.1:49689          127.0.0.1:49690        ESTABLISHED InHost
TCP   127.0.0.1:49690          127.0.0.1:49689        ESTABLISHED InHost
TCP   127.0.0.1:49697          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49698          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49699          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49700          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49703          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49708          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49713          127.0.0.1:49682        ESTABLISHED InHost
TCP   127.0.0.1:49717          127.0.0.1:49718        ESTABLISHED InHost
TCP   127.0.0.1:49718          127.0.0.1:49717        ESTABLISHED InHost

```

```

Command Prompt
TCP 127.0.0.1:49718 127.0.0.1:49717 ESTABLISHED InHost
TCP 127.0.0.1:49813 127.0.0.1:49814 ESTABLISHED InHost
TCP 127.0.0.1:49814 127.0.0.1:49813 ESTABLISHED InHost
TCP 127.0.0.1:49883 127.0.0.1:49884 ESTABLISHED InHost
TCP 127.0.0.1:49884 127.0.0.1:49883 ESTABLISHED InHost
TCP 127.0.0.1:61900 127.0.0.1:49688 ESTABLISHED InHost
TCP 192.168.29.40:49781 52.139.250.253:443 ESTABLISHED InHost
TCP 192.168.29.40:49788 80.239.170.176:443 CLOSE_WAIT InHost
TCP 192.168.29.40:49815 82.202.185.205:443 ESTABLISHED InHost
TCP 192.168.29.40:49885 82.202.185.202:443 ESTABLISHED InHost
TCP 192.168.29.40:49890 23.37.43.27:80 ESTABLISHED InHost
TCP 192.168.29.40:49982 117.18.237.29:80 TIME_WAIT InHost
TCP 192.168.29.40:49984 62.67.238.151:443 CLOSE_WAIT InHost
TCP 192.168.29.40:49986 180.87.4.149:443 TIME_WAIT InHost
TCP 192.168.29.40:49987 180.87.4.214:443 SYN_SENT InHost
TCP [::1]:49672 [::1]:49673 ESTABLISHED InHost
TCP [::1]:49673 [::1]:49672 ESTABLISHED InHost
TCP [::1]:49674 [::1]:49675 ESTABLISHED InHost
TCP [::1]:49675 [::1]:49674 ESTABLISHED InHost
TCP [::1]:49678 [::1]:49679 ESTABLISHED InHost
TCP [::1]:49679 [::1]:49678 ESTABLISHED InHost
TCP [::1]:49680 [::1]:49681 ESTABLISHED InHost
TCP [::1]:49681 [::1]:49680 ESTABLISHED InHost
TCP [2405:201:804:47b7:a1af:7fab:db57:9321]:49847 [2405:200:1630:188a::4106]:443 ESTABLISHED InHost
TCP [2405:201:804:47b7:a1af:7fab:db57:9321]:49848 [2405:200:1630:188a::4106]:443 ESTABLISHED InHost
TCP [2405:201:804:47b7:a1af:7fab:db57:9321]:49849 [2405:200:1630:188a::4106]:443 ESTABLISHED InHost
TCP [2405:201:804:47b7:a1af:7fab:db57:9321]:49851 [2405:200:1630:18b4::3114]:80 ESTABLISHED InHost
C:\Users\Shobhit Verma>

```

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.

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`).

1) mscs.mu.edu

```
Command Prompt
C:\Users\Shobhit Verma>tracert www.mscs.mu.edu

Tracing route to turing.mscs.mu.edu [134.48.4.34]
over a maximum of 30 hops:

  0  0 ms  0 ms  0 ms  reliance.reliance [192.168.29.1]
  1  3 ms  2 ms  2 ms  100.70.208.1
  2  8 ms  7 ms  67 ms  172.26.40.5
  3  11 ms  6 ms  71 ms  172.26.40.5
  4  10 ms  7 ms  61 ms  172.26.40.5
  5  10 ms  7 ms  59 ms  172.17.1.46
  6  *      *      *      Request timed out.
  7  21 ms  16 ms  10 ms  103.198.140.58
  8  180 ms  317 ms  191 ms  103.198.140.27
  9  210 ms  198 ms  203 ms  103.198.140.27
 10  220 ms  202 ms  190 ms  37.49.232.13
 11  349 ms  203 ms  203 ms  100ge4-2.core1.par2.he.net [184.105.222.21]
 12  221 ms  203 ms  306 ms  100ge14-1.core1.nyc4.he.net [184.105.81.77]
 13  287 ms  306 ms  305 ms  184.105.223.161
 14  *      *      *      Request timed out.
 15  328 ms  306 ms  305 ms  r-222wwash-isp-ae6-3926.wiscnet.net [140.189.8.126]
 16  324 ms  305 ms  305 ms  r-milwaukee-ci-809-isp-ae3-0.wiscnet.net [140.189.8.230]
 17  322 ms  305 ms  305 ms  MarquetteUniv.site.wiscnet.net [216.56.1.202]
 18  314 ms  306 ms  306 ms  134.48.10.27
 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.
```

2) www.cs.grinnell.edu


```

C:\Users\Shobhit Verma>tracert www.cs.grinnell.edu
Unable to resolve target system name www.cs.grinnell.edu.

C:\Users\Shobhit Verma>tracert www.cs.grinnell.edu

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

  1    3 ms    2 ms    2 ms  reliance.reliance [192.168.29.1]
  2   12 ms    7 ms   56 ms  100.70.208.1
  3   13 ms    6 ms   47 ms  172.26.40.5
  4   13 ms    7 ms   43 ms  172.26.40.5
  5   11 ms    7 ms   36 ms  172.17.1.46
  6    *      *      *      Request timed out.
  7   12 ms    7 ms   79 ms  103.198.140.58
  8  197 ms   203 ms  203 ms  103.198.140.56
  9  213 ms   202 ms  205 ms  103.198.140.56
 10  116 ms   203 ms  204 ms  hurricane.mrs.franceix.net [37.49.232.13]
 11  222 ms   203 ms  202 ms  100ge4-2.core1.par2.he.net [184.105.222.21]
 12  212 ms   207 ms  203 ms  100ge14-1.core1.nyc4.he.net [184.105.81.77]
 13  219 ms   306 ms  305 ms  100ge9-1.core2.chi1.he.net [184.105.223.161]
 14  314 ms   305 ms  305 ms  100ge14-2.core1.msp1.he.net [184.105.223.178]
 15    *     220 ms  220 ms  216.66.77.218
 16  238 ms   221 ms  221 ms  peer-as5056.br02.msp1.tfbnw.net [157.240.76.37]
 17  234 ms   306 ms  292 ms  167.142.58.40
 18  227 ms   240 ms  253 ms  67.224.64.62
 19  265 ms   305 ms  305 ms  grinnellcollege1.desm.netins.net [167.142.65.43]
 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.

```

3) csail.mit.edu

```

C:\Users\Shobhit Verma>tracert csail.mit.edu

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

  1    3 ms    2 ms    2 ms  reliance.reliance [192.168.29.1]
  2   10 ms    7 ms  290 ms  100.70.208.1
  3   12 ms   37 ms   10 ms  172.26.40.5
  4   10 ms   69 ms    8 ms  172.26.40.5
  5   12 ms    8 ms    8 ms  172.17.1.46
  6    *      *      *      Request timed out.
  7    *      *      *      Request timed out.
  8    *      *      *      Request timed out.
  9    *      *      *      Request timed out.
 10    *      *      *      Request timed out.
 11  334 ms   252 ms   257 ms  49.45.4.86
 12  266 ms   305 ms   305 ms  4.7.26.61
 13    *      *      *      Request timed out.
 14  353 ms   517 ms   503 ms  MASSACHUSET.bear1.Boston1.Level3.net [4.53.48.98]
 15  417 ms   408 ms   408 ms  18.0.161.17
 16  303 ms   299 ms   302 ms  dmz-rtr-2-dmz-rtr-1-2.mit.edu [18.0.162.6]
 17  295 ms   322 ms   334 ms  18.4.7.65
 18    *     328 ms    *      core-1-ext.bdr.csail.mit.edu [128.30.13.26]
 19  377 ms   330 ms   408 ms  bdr.core-1.csail.mit.edu [128.30.0.246]
 20  323 ms   407 ms   408 ms  inquir-3ld.csail.mit.edu [128.30.2.109]

Trace complete.

```

4) cs.stanford.edu

```

C:\Users\Shobhit Verma>tracert cs.stanford.edu

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

  1    4 ms    3 ms    3 ms  reliance.reliance [192.168.29.1]
  2    8 ms    5 ms   64 ms  100.70.208.1
  3    9 ms    5 ms   66 ms  172.26.40.5
  4    8 ms    8 ms   60 ms  172.26.40.5
  5    8 ms    5 ms   64 ms  172.17.1.46
  6    *      *      *      Request timed out.
  7   10 ms   101 ms    7 ms  49.45.4.253
  8  187 ms   204 ms   202 ms  103.198.140.54
  9  215 ms   305 ms   203 ms  103.198.140.54
 10  221 ms   202 ms   203 ms  hurricane-electric.telecity2.nl-ix.net [193.239.116.14]
 11  215 ms   204 ms   205 ms  100ge8-1.core1.lon3.he.net [184.104.193.193]
 12  220 ms   305 ms   408 ms  100ge14-1.core1.lon2.he.net [184.105.64.237]
 13  216 ms   306 ms   298 ms  100ge13-2.core1.nyc4.he.net [72.52.92.166]
 14  323 ms   298 ms   305 ms  100ge8-1.core1.sjc2.he.net [184.105.81.218]
 15  322 ms   410 ms   303 ms  100ge1-1.core1.pao1.he.net [72.52.92.158]
 16  320 ms   304 ms   264 ms  stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
 17  269 ms   306 ms   304 ms  csee-west-rtr-vl3.SUNet [171.66.255.140]
 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.

```

5) cs.manchester.ac.uk

```

C:\Users\Shobhit Verma>tracert cs.manchester.ac.uk

Tracing route to cs.manchester.ac.uk [130.88.101.49]
over a maximum of 30 hops:

 1      6 ms      3 ms      3 ms  reliance.reliance [192.168.29.1]
 2      7 ms      5 ms      7 ms  100.70.208.1
 3     10 ms      7 ms      7 ms  172.16.92.147
 4     11 ms      6 ms     86 ms  172.16.92.147
 5     10 ms      6 ms     14 ms  172.17.1.46
 6      *        *        *    Request timed out.
 7      9 ms      7 ms     32 ms  49.45.4.253
 8    221 ms    202 ms    203 ms  103.198.140.45
 9    196 ms    199 ms    199 ms  103.198.140.54
10    133 ms    134 ms    137 ms  103.198.140.45
11    126 ms    130 ms    130 ms  hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
12    197 ms    199 ms    201 ms  be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
13    200 ms      *      159 ms  be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
14    127 ms    127 ms    153 ms  be2868.ccr21.lon01.atlas.cogentco.com [154.54.57.154]
15    129 ms    130 ms    131 ms  ldn-b1-link.telialia.net [62.115.9.28]
16    127 ms    131 ms    133 ms  ldn-bb3-link.telialia.net [62.115.120.74]
17      *      128 ms    129 ms  ldn-b2-link.telialia.net [62.115.122.189]
18    127 ms    130 ms    130 ms  jisc-ic-345131-ldn-b4.c.telialia.net [62.115.175.131]
19    127 ms    129 ms    127 ms  ae24.londhx-sbr1.ja.net [146.97.35.197]
20    157 ms    128 ms    131 ms  ae29.londpg-sbr2.ja.net [146.97.33.2]
21    135 ms    135 ms    135 ms  ae31.erdiss-sbr2.ja.net [146.97.33.22]
22    150 ms    151 ms    151 ms  ae29.manckh-sbr2.ja.net [146.97.33.42]
23    158 ms    202 ms    203 ms  ae23.mancrh-rbr1.ja.net [146.97.38.42]
24      *        *        *    Request timed out.
25    233 ms    204 ms    134 ms  130.88.249.194
26      *        *        *    Request timed out.
27      *        *        *    Request timed out.
28    236 ms    211 ms    195 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.

```
C:\Users\Shobhit Verma>tracert math.hws.edu
```

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

1	3 ms	3 ms	3 ms	reliance.reliance [192.168.29.1]
2	11 ms	5 ms	70 ms	100.70.208.1
3	10 ms	7 ms	19 ms	172.26.40.5
4	10 ms	7 ms	112 ms	172.26.40.5
5	7 ms	6 ms	29 ms	172.17.1.46
6	*	*	*	Request timed out.
7	11 ms	8 ms	8 ms	103.198.140.58
8	179 ms	202 ms	203 ms	103.198.140.45
9	194 ms	203 ms	205 ms	103.198.140.27
10	214 ms	203 ms	201 ms	103.198.140.107
11	213 ms	203 ms	203 ms	103.198.140.45
12	219 ms	202 ms	128 ms	hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
13	130 ms	132 ms	128 ms	be3671.ccr51.lhr01.atlas.cogentco.com [130.117.48.137]
14	125 ms	125 ms	124 ms	be3487.ccr41.lon13.atlas.cogentco.com [154.54.60.5]
15	137 ms	139 ms	139 ms	be2870.ccr22.lon01.atlas.cogentco.com [154.54.58.174]
16	126 ms	129 ms	124 ms	ae-7.edge7.London1.Level3.net [4.68.62.41]
17	128 ms	125 ms	127 ms	ae-228-3604.edge3.London15.Level3.net [4.69.167.102]
18	131 ms	128 ms	127 ms	ae-228-3604.edge3.London15.Level3.net [4.69.167.102]
19	126 ms	126 ms	128 ms	ae4.ar8.lon15.Level3.net [4.68.111.254]
20	260 ms	262 ms	266 ms	roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
21	376 ms	303 ms	306 ms	66-195-65-170.static.ct1.one [66.195.65.170]
22	324 ms	305 ms	305 ms	nat.hws.edu [64.89.144.100]
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\Shobhit Verma>tracert www.hws.edu

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

  1    3 ms    3 ms    3 ms  reliance.reliance [192.168.29.1]
  2    7 ms    5 ms   150 ms 100.70.208.1
  3   10 ms   11 ms   11 ms 172.26.40.5
  4    7 ms    6 ms   15 ms 172.26.40.5
  5    7 ms    7 ms    6 ms 172.17.1.46
  6    *      *      *    Request timed out.
  7   11 ms   10 ms   10 ms 103.198.140.58
  8  133 ms  183 ms  136 ms 103.198.140.45
  9  164 ms  145 ms  142 ms 103.198.140.56
 10  203 ms  203 ms  173 ms 103.198.140.107
 11  132 ms  130 ms  130 ms 103.198.140.45
 12  169 ms  199 ms  203 ms hu0-4-0-1.agr21.lhr01.atlas.cogentco.com [149.14.196.81]
 13  219 ms  205 ms  169 ms be3672.ccr52.lhr01.atlas.cogentco.com [130.117.48.145]
 14  136 ms  138 ms  134 ms be3488.ccr42.lon13.atlas.cogentco.com [154.54.60.13]
 15  130 ms  130 ms  130 ms be2871.ccr21.lon01.atlas.cogentco.com [154.54.58.186]
 16  137 ms  127 ms  125 ms ae-6.edge7.London1.Level3.net [4.68.62.5]
 17  128 ms  126 ms  125 ms ae-226-3602.edge3.London15.Level3.net [4.69.167.94]
 18  126 ms  126 ms  125 ms ae-226-3602.edge3.London15.Level3.net [4.69.167.94]
 19  125 ms  126 ms  124 ms ae4.ar8.lon15.Level3.net [4.68.111.254]
 20  261 ms  260 ms  259 ms roc1-ar5-xe-11-0-0-0.us.twtelecom.net [35.248.1.162]
 21  274 ms  267 ms  265 ms 66-195-65-170.static.ct1.one [66.195.65.170]
 22  270 ms  272 ms  272 ms nat.hws.edu [64.89.144.100]
 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.

```

The first row shows that the process of route tracing has started as the last column shows the Default Gateway of the user. The next three rows in both the cases are similar as the route is being traced starting from the ISP (Internet service provider) of the user. The next few rows, after which the tracing reaches the common IP address of 66.195.65.170 and then math.hws.edu [64.89.144.100], clearly show that the route is completely different after crossing the ISP for both the cases. A domain name might have multiple IP addresses associated. If this is the case, multiple traces may access two or more IP addresses. This will yield trace paths that differ from one another, even if the origin and destinations are the same. Domains may also use multiple servers for its subdomains. Tracing the path to the base domain might result in a completely different path when tracing to the subdomain. A URL with the **www** prefix is technically a subdomain, so it's possible that traces to **example.com** and **www.example.com** follow two very different paths.

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:\Windows\System32>tracert cs.stanford.edu

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

1	4 ms	4 ms	1 ms	192.168.0.1
2	3 ms	21 ms	25 ms	103.78.168.6
3	3 ms	5 ms	4 ms	103.78.168.1
4	3 ms	8 ms	5 ms	1.6.94.78
5	103 ms	99 ms	106 ms	100.67.110.97
6	100 ms	102 ms	108 ms	100.67.110.97
7	98 ms	121 ms	101 ms	hurricane.mrs.franceix.net [37.49.232.13]
8	141 ms	134 ms	126 ms	100ge4-2.core1.par2.he.net [184.105.222.21]
9	195 ms	195 ms	206 ms	100ge10-2.core1.ash1.he.net [184.105.213.173]
10	255 ms	255 ms	257 ms	100ge7-2.core1.pao1.he.net [184.105.222.41]
11	*	294 ms	257 ms	stanford-university.100gigabitethernet5-1.core1.pao1.he.net [184.105.177.238]
12	298 ms	297 ms	297 ms	csee-west-rtr-v13.SUNet [171.66.255.140]
13	315 ms	335 ms	301 ms	CS.stanford.edu [171.64.64.64]

Trace complete.

```

C:\Windows\System32>tracert csail.mit.edu

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

  1    2 ms    1 ms    1 ms  192.168.0.1
  2    3 ms    2 ms    9 ms  103.78.168.6
  3    3 ms    3 ms    2 ms  103.78.168.1
  4    4 ms    2 ms    4 ms  1.6.94.78
  5     *      *      *    Request timed out.
  6   106 ms   99 ms   100 ms 100.67.110.101
  7   100 ms   100 ms 100 ms mei-b2-link.telia.net [80.239.128.50]
  8   125 ms   125 ms 125 ms cogent-ic-344184-mei-b3.c.telia.net [62.115.179.97]
  9   126 ms   125 ms 128 ms be2346.ccr22.mrs01.atlas.cogentco.com [154.54.38.173]
 10   127 ms   125 ms 125 ms be3093.ccr42.par01.atlas.cogentco.com [130.117.50.165]
 11   127 ms   125 ms 125 ms be12489.ccr42.lon13.atlas.cogentco.com [154.54.57.69]
 12   190 ms   189 ms 190 ms be2101.ccr32.bos01.atlas.cogentco.com [154.54.82.38]
 13   306 ms   306 ms 305 ms 38.104.186.186
 14   304 ms   301 ms 303 ms dmz-rtr-1-external-rtr-3.mit.edu [18.0.161.13]
 15   285 ms   284 ms 306 ms dmz-rtr-2-dmz-rtr-1-2.mit.edu [18.0.162.6]
 16   292 ms   292 ms *     mitnet.core-1-ext.csail.mit.edu [18.4.7.65]
 17     *      *      *    Request timed out.
 18   349 ms   331 ms 306 ms bdr.core-1.csail.mit.edu [128.30.0.246]
 19   306 ms   299 ms 302 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?

Ans : The path from first hop to sixth hop is common for the six hosts for which traceroute is used.

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 : The number of nodes depends on the physical interface and is independent of the distance between the host and the website.

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 : RTT increases as the number of nodes increases. Thus, latency increases with increase in number of nodes due to increase in queuing delay. This is not true 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:\WhoIs>Whois google.com
```

```
Whois v1.21 - Domain information lookup  
Copyright (C) 2005-2019 Mark Russinovich  
Sysinternals - www.sysinternals.com
```

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

```
WHOIS Server: whois.markmonitor.com
```

```
Registrar URL: http://www.markmonitor.com
```

```
Updated Date: 2019-09-09T15:39:04Z
```

```
Creation Date: 1997-09-15T04:00:00Z
```

```
Registry Expiry Date: 2028-09-14T04:00:00Z
```

```
Registrar: MarkMonitor Inc.
```

```
Registrar IANA ID: 292
```

```
Registrar Abuse Contact Email: abusecomplaints@markmonitor.com
```

```
Registrar Abuse Contact Phone: +1.2083895740
```

```
Domain Status: clientDeleteProhibited https://icann.org/epp#clientDeleteProhibited
```

```
Domain Status: clientTransferProhibited https://icann.org/epp#clientTransferProhibited
```

```
Domain Status: clientUpdateProhibited https://icann.org/epp#clientUpdateProhibited
```

```
Domain Status: serverDeleteProhibited https://icann.org/epp#serverDeleteProhibited
```

```
Domain Status: serverTransferProhibited https://icann.org/epp#serverTransferProhibited
```

```
Domain Status: serverUpdateProhibited https://icann.org/epp#serverUpdateProhibited
```

```
Name Server: NS1.GOOGLE.COM
```

```
Name Server: NS2.GOOGLE.COM
```

```
Name Server: NS3.GOOGLE.COM
```

```
Name Server: NS4.GOOGLE.COM
```

```
DNSSEC: unsigned
```

```
URL of the ICANN Whois Inaccuracy Complaint Form: https://www.icann.org/wicf/
```

```
>>> Last update of whois database: 2020-08-25T08:00:06Z <<<
```

```
For more information on Whois status codes, please visit https://icann.org/epp
```

```
NOTICE: The expiration date displayed in this record is the date the  
registrar's sponsorship of the domain name registration in the registry is  
currently set to expire. This date does not necessarily reflect the expiration  
date of the domain name registrant's agreement with the sponsoring  
registrar. Users may consult the sponsoring registrar's Whois database to  
view the registrar's reported date of expiration for this registration.
```

```
TERMS OF USE: You are not authorized to access or query our Whois  
database through the use of electronic processes that are high-volume and  
automated except as reasonably necessary to register domain names or  
modify existing registrations; the Data in VeriSign Global Registry  
Services' ("VeriSign") Whois database is provided by VeriSign for  
information purposes only, and to assist persons in obtaining information  
about or related to a domain name registration record. VeriSign does not  
guarantee its accuracy. By submitting a Whois query, you agree to abide  
by the following terms of use: You agree that you may use this Data only  
for lawful purposes and that under no circumstances will you use this Data
```

Administrator: Command Prompt

Connecting to whois.markmonitor.com...

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: ns4.google.com
Name Server: ns2.google.com
Name Server: ns3.google.com
Name Server: ns1.google.com
DNSSEC: unsigned
URL of the ICANN WHOIS Data Problem Reporting System: <http://wdprs.internic.net/>
>>> Last update of WHOIS database: 2020-08-25T00:49:33-0700 <<<

For more information on WHOIS status codes, please visit:
<https://www.icann.org/resources/pages/epp-status-codes>

If you wish to contact this domain's Registrant, Administrative, or Technical contact, and such email address is not visible above, you may do so via our web form, pursuant to ICANN's Temporary Specification. To verify that you are not a robot, please enter your email address to receive a link to a page that facilitates email communication with the relevant contact(s).

Web-based WHOIS:
<https://domains.markmonitor.com/whois>


```

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: ns4.google.com
Name Server: ns2.google.com
Name Server: ns3.google.com
Name Server: ns1.google.com
DNSSEC: unsigned
URL of the ICANN WHOIS Data Problem Reporting System: http://wdprs.internic.net/
>>> Last update of WHOIS database: 2020-08-25T00:49:33-0700 <<<

For more information on WHOIS status codes, please visit:
  https://www.icann.org/resources/pages/epp-status-codes

If you wish to contact this domain's Registrant, Administrative, or Technical
contact, and such email address is not visible above, you may do so via our web
form, pursuant to ICANN's Temporary Specification. To verify that you are not a
robot, please enter your email address to receive a link to a page that
facilitates email communication with the relevant contact(s).

Web-based WHOIS:
  https://domains.markmonitor.com/whois

```

We find information like Domain Name, Domain ID, Registrar URL, Updated Date, Creation and Expiry Date, Registrar Contact details, IANA ID, Name Server and Domain Status.

Using *whois* we can get information about a specific ip address or we can get information regarding a registered domain.

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.

IP address can be found using ping, traceroute or nslookup.

Using the *nslookup* command we can find the ip address from domain name.

Administrator: Command Prompt

```
C:\Windows\system32>nslookup google.com
Server: UnKnown
Address: 192.168.0.1

Non-authoritative answer:
Name: google.com
Addresses: 2404:6800:4009:800::200e
           172.217.27.206
```

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 response. The following command uses *curl* to contact a public web service that will look up an IP address for you: `curl ipinfo.io/<IP-address>`. For a specific example:

`curl ipinfo.io/129.64.99.200` (As you can see, you get back more than just the location.)

```
C:\Users\Shobhit Verma>curl ipinfo.io/43.252.193.29
{
  "ip": "43.252.193.29",
  "city": "Mumbai",
  "region": "Maharashtra",
  "country": "IN",
  "loc": "19.0728,72.8826",
  "org": "AS17625 BlazeNet's Network",
  "postal": "400070",
  "timezone": "Asia/Kolkata",
  "readme": "https://ipinfo.io/missingauth"
}
```

Conclusion:

- Learnt about basic networking utilities.
- Learnt about RTT, Network Latency and factors affecting them.