Pre-Lab

[40 points] Unix Practice

1. [2.5pts] What commands can be used to find the PID(process identifier) of a process and kill that Process?

- ps aux command to find the PID

```
-bash-4.2$ ps aux
USER        PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root          1  0.0  0.0 128660  7432 ?        Ss   Sep28   1:42 /usr/lib/systemd/sys
root          2  0.0  0.0      0     0 ?        S    Sep28   0:00 [kthreadd]
root          4  0.0  0.0      0     0 ?        S<   Sep28   0:00 [kworker/0:0H]
root          6  0.0  0.0      0     0 ?        S    Sep28   0:03 [ksoftirqd/0]
root          7  0.0  0.0      0     0 ?        S    Sep28   0:02 [migration/0]
root          8  0.0  0.0      0     0 ?        S    Sep28   0:00 [rcu_bh]
root          9  0.0  0.0      0     0 ?        S    Sep28   0:37 [rcu_sched]
root         10  0.0  0.0      0     0 ?        S<   Sep28   0:00 [lru-add-drain]
root         11  0.0  0.0      0     0 ?        S    Sep28   0:00 [watchdog/0]
root         12  0.0  0.0      0     0 ?        S    Sep28   0:00 [watchdog/1]
root         13  0.0  0.0      0     0 ?        S    Sep28   0:02 [migration/1]
root         14  0.0  0.0      0     0 ?        S    Sep28   0:02 [ksoftirqd/1]
root         16  0.0  0.0      0     0 ?        S<   Sep28   0:00 [kworker/1:0H]
root         18  0.0  0.0      0     0 ?        S    Sep28   0:00 [kdevtmpfs]
root         19  0.0  0.0      0     0 ?        S<   Sep28   0:00 [netns]
root         20  0.0  0.0      0     0 ?        S    Sep28   0:00 [khungtaskd]
root         21  0.0  0.0      0     0 ?        S<   Sep28   0:00 [writeback]
root         22  0.0  0.0      0     0 ?        S<   Sep28   0:00 [kintegrityd]
root         23  0.0  0.0      0     0 ?        S<   Sep28   0:00 [bioset]
root         24  0.0  0.0      0     0 ?        S<   Sep28   0:00 [bioset]
root         25  0.0  0.0      0     0 ?        S<   Sep28   0:00 [bioset]
```

- Kill command to kill the process → kill SIGNAL PID
- To see avabilable kill signal → kill -l

```
-bash-4.2$ kill -l
 1) SIGHUP       2) SIGINT       3) SIGQUIT      4) SIGILL       5) SIGTRAP
 6) SIGABRT      7) SIGBUS       8) SIGFPE       9) SIGKILL     10) SIGUSR1
11) SIGSEGV     12) SIGUSR2     13) SIGPIPE     14) SIGALRM     15) SIGTERM
16) SIGSTKFLT   17) SIGCHLD     18) SIGCONT     19) SIGSTOP     20) SIGTSTP
21) SIGTTIN     22) SIGTTOU     23) SIGURG      24) SIGXCPU     25) SIGXFSZ
26) SIGVTALRM   27) SIGPROF     28) SIGWINCH    29) SIGIO       30) SIGPWR
31) SIGSYS      34) SIGRTMIN    35) SIGRTMIN+1  36) SIGRTMIN+2  37) SIGRTMIN+3
38) SIGRTMIN+4  39) SIGRTMIN+5  40) SIGRTMIN+6  41) SIGRTMIN+7  42) SIGRTMIN+8
43) SIGRTMIN+9  44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12 47) SIGRTMIN+13
48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14 51) SIGRTMAX-13 52) SIGRTMAX-12
53) SIGRTMAX-11 54) SIGRTMAX-10 55) SIGRTMAX-9  56) SIGRTMAX-8  57) SIGRTMAX-7
58) SIGRTMAX-6  59) SIGRTMAX-5  60) SIGRTMAX-4  61) SIGRTMAX-3  62) SIGRTMAX-2
63) SIGRTMAX-1  64) SIGRTMAX
```

2. [2.5pts] What command would you use to display your current directory and which one to change your current directory?

- pwd command to display output of the full path of the current directory

```
-bash-4.2$ pwd
/afs/cats.ucsc.edu/users/y/jbaek10/cse150
```

- cd to change directory (ex. cd directory_name)

```
-bash-4.2$ ls
OldFiles  backup  cse101  cse112  cse150  jbaek10.pub  public_html  welcome
-bash-4.2$ cd cse150
-bash-4.2$ ls
guide.txt  implement.txt
```

3. [2.5pts] What command would you use to access the user manual of any command and which one displays the help information?

- man
- man -help or -h

```
-bash-4.2$ man
What manual page do you want?
-bash-4.2$ man -h
Usage: man [OPTION...] [SECTION] PAGE...

  -C, --config-file=FILE     use this user configuration file
  -d, --debug                emit debugging messages
  -D, --default              reset all options to their default values
      --warnings[=WARNINGS]  enable warnings from groff

 Main modes of operation:
  -f, --whatis               equivalent to whatis
  -k, --apropos              equivalent to apropos
  -K, --global-apropos       search for text in all pages
  -l, --local-file           interpret PAGE argument(s) as local filename(s)
  -w, --where, --path, --location
                             print physical location of man page(s)
```

4. [2.5pts] What command would you use to find out the hostname of a machine? Connect to a Unix Timeshare server and then use that command to identify the hostname. Attach a screenshot with the information highlighted or circled.

- I used the command “hostname” and the output is unix1.lt.ucsc.edu

```
-bash-4.2$ hostname
unix1.lt.ucsc.edu
-bash-4.2$
```

5. [10pts] Given two scripts - guide.txt and implement.txt. Include the result of running your commands for a), b), and c) on these scripts.

a) What command would you use to display the contents of these two files?

- cat guide.txt

```
-bash-4.2$ cat guide.txt
Welcome to CSE150! Here is a sample text file, you may use for you linux commands and
 test it out.
Looking forward to seeing you all virtually during lab in the first two weeks!!
```

- cat implement.txt

```
-bash-4.2$ cat implement.txt
A paragraph is a series of related sentences developing a central idea, called the to
pic. Try to think about paragraphs in terms of thematic unity: a paragraph is a sente
nce or a group of sentences that supports one central, unified idea. Paragraphs add o
ne idea at a time to your broader argument.
12
34
51
Thank you! :)-bash-4.2$
```

b) What command would allow you to see the line-by-line differences between these two files?

- diff guide.txt, cat implement.txt

```
-bash-4.2$ diff guide.txt implement.txt
1,2c1,5
< Welcome to CSE150! Here is a sample text file, you may use for you linux commands a
nd test it out.
< Looking forward to seeing you all virtually during lab in the first two weeks!!
---
> A paragraph is a series of related sentences developing a central idea, called the
topic. Try to think about paragraphs in terms of thematic unity: a paragraph is a sen
tence or a group of sentences that supports one central, unified idea. Paragraphs add
 one idea at a time to your broader argument.
> 12
> 34
> 51
> Thank you! :)
\ No newline at end of file
-bash-4.2$
```

c) What command would you use to concatenate these two files?

- cat command

```
-bash-4.2$ cat guide.txt implement.txt
Welcome to CSE150! Here is a sample text file, you may use for you linux commands and
 test it out.
Looking forward to seeing you all virtually during lab in the first two weeks!!
A paragraph is a series of related sentences developing a central idea, called the to
pic. Try to think about paragraphs in terms of thematic unity: a paragraph is a sente
nce or a group of sentences that supports one central, unified idea. Paragraphs add o
ne idea at a time to your broader argument.
12
34
51
Thank you! :)-bash-4.2$
```

6. [5pts] What is the difference between running a command using "sudo [command]" and using "sudo -i"?

- sudo allows a permitted user to execute a command as the superuser or another user, as specified by the security policy.
- sudo -i Run the shell specified by the target user's password database entry as a login shell. This means that login-specific resource files such as .profile, .bash_profile or .login will be read by the shell.
- According to the man sudo

7. [5pts] What are the two commands to schedule a task? And what are the differences between them?

- cron and at command
- At is used to schedule something one time. Cron is used to scheduling something repeatedly - every day, hour, week, etc.

8. [5pts] What command would you use to copy all .txt files from a directory in the campus Unix server to your local machine?

- scp command
- Scp ~/*.txt username@host_name(or ip address):/C:/Users/jongb/Desktop

9. [5pts] What are two ways to write a given string to a program's stdin from the shell?

1. cat command
    - cat <<< " HELLO WORLD"
    - HELLO WORLD

```
-bash-4.2$ cat <<< "HELLO WORLD"
HELLO WORLD
```

2. Echo command
    - Echo "hello world"
    - hello world

```
-bash-4.2$ echo "hello world"
hello world
```

[5 points] Interfaces

10. [2.5pts] What is an interface on your computer? Look at your system settings, and find your WiFi interface. List the interface name, MAC address and IP Address. Attach a screenshot with the information highlighted or circled.

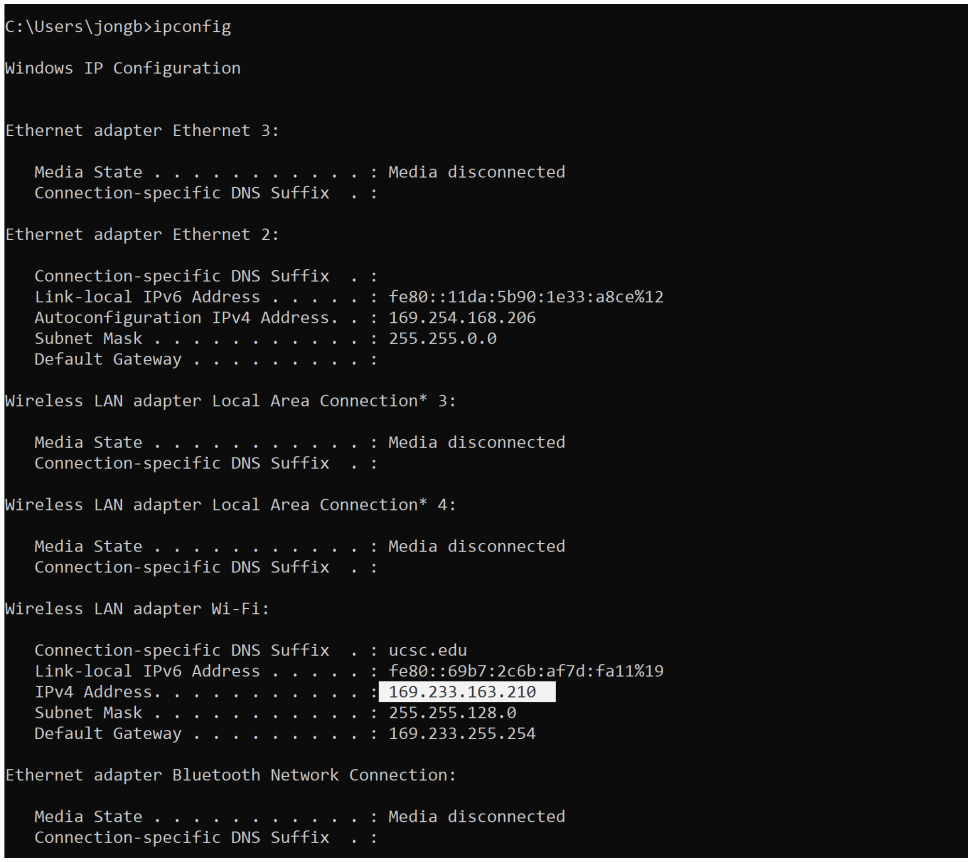
- The interface name

```
Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . : ucsc.edu
   Link-local IPv6 Address . . . . . : fe80::69b7:2c6b:af7d:fa11%19
   IPv4 Address. . . . . . . . . . . : 169.233.224.111
   Subnet Mask . . . . . . . . . . . : 255.255.128.0
   Default Gateway . . . . . . . . . : 169.233.255.254

Ethernet adapter Bluetooth Network Connection:

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



- WIFI Domain name: ucsc.edu
- It shows the IP address above.(169.233.163.210)

Name	[00000001] VirtualBox Host-O...
Adapter Type	Ethernet 802.3
Product Type	VirtualBox Host-Only Ethernet...
Installed	Yes
PNP Device...	ROOT\NET\0000
Last Reset	9/28/2022 6:12 PM
Index	1
Service Na...	VBoxNetAdp
IP Address	169.254.168.206, fe80::11da:5...
IP Subnet	255.255.0.0, 64
Default IP ...	Not Available
DHCP Enab...	No
DHCP Server	Not Available
DHCP Leas...	Not Available
DHCP Leas...	Not Available
MAC Addre...	0A:00:27:00:00:0C
Driver	C:\WINDOWS\SYSTEM32\DRI...

- This is going to be the MAC address seen above.(0A:00:27:00:00:0C)
- An interface allows a user to interact with the computer or the program.

11. [2.5 pts] What command can you use to assign an Ethernet interface eth0 the IP address 192.168.1.50?

- ipconfig eth0 192.168.1.50

[30 points] Traceroute

(Note: Take screenshots of the output of your results to justify your answers. Circle or highlight the round-trip delays in each screenshot. For credit, each screenshot must show the date and time of day – you can precede your commands with “date”)

12. [5 pts] Research the “traceroute” tool and write a very short description about what it does (in your own words - no copy/paste/Google will receive credit).

- In the lecture, we learned about how the data on the internet moves from the source terminal to the destination terminal. The Traceroute tool basically provides how the data moves when it moves from the source terminal to the destination terminal. It shows that the time, speed, ip address, and its name. Also, It helps to find if there is any network problem in that route.

13.[5 pts] Run Traceroute between a source and destination on the same continent at three different times during the day (and night if you're awake late!). Record your results in a table with a row for each run of Traceroute (time 1, time 2 and time 3) and 3 columns to record the reported RTT to the final destination. For example:

- traceroute command in linux(UDP port)
- tracert command in window(ICMP port) = tracert google.com
- 1st - 02:29:51

```
PS C:\Users\jongb> date
Fri Sep 30 02:29:51 PDT 2022
PS C:\Users\jongb> tracert google.com

Tracing route to google.com [2607:f8b0:4005:814::200e]
over a maximum of 30 hops:

  1     3 ms     6 ms     4 ms  2601:647:cb00:dd90:1e93:7cff:fe6d:5809
  2    11 ms    13 ms    14 ms  2001:558:4000:93::1
  3    10 ms    13 ms    10 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [2001:558:82:6805::1]
  4    11 ms    10 ms    10 ms  be-321-rar01.hayward.ca.sfba.comcast.net [2001:558:80:45a::1]
  5    21 ms    14 ms    18 ms  2001:558:80:42c::1
  6     *        *        *     Request timed out.
  7    17 ms    16 ms    15 ms  2001:558:fe0d:7::a
  8    15 ms    13 ms    13 ms  2607:f8b0:830f::1
  9    14 ms    18 ms    20 ms  2001:4860:0:1::5864
 10     *        *        *     Request timed out.
 11    17 ms    32 ms    32 ms  2001:4860::c:4001:e418
 12    15 ms    20 ms    13 ms  2001:4860::9:4003:18f
 13    21 ms    15 ms    17 ms  2001:4860:0:1005::1
 14    14 ms    14 ms    12 ms  2001:4860:0:1::69bf
 15    17 ms    15 ms    14 ms  sfo03s32-in-x0e.1e100.net [2607:f8b0:4005:814::200e]

Trace complete.
```

- 2nd - 10:04:20

```
PS C:\Users\jongb> date
Fri Sep 30 10:04:20 PDT 2022
PS C:\Users\jongb> tracert google.com

Tracing route to google.com [2607:f8b0:4005:812::200e]
over a maximum of 30 hops:

  1     4 ms     4 ms     3 ms  2601:647:cb00:dd90:1e93:7cff:fe6d:5809
  2    12 ms    13 ms    11 ms  2001:558:4000:93::1
  3    10 ms    14 ms    13 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [2001:558:82:6805::1]
  4    10 ms    10 ms    10 ms  be-321-rar01.hayward.ca.sfba.comcast.net [2001:558:80:45a::1]
  5    18 ms    16 ms    14 ms  2001:558:80:42c::1
  6     *        *        *     Request timed out.
  7    15 ms    14 ms    18 ms  2001:558:fe0d:7::12
  8    13 ms    14 ms     *     2607:f8b0:82fe::1
  9    23 ms    19 ms    21 ms  2001:4860:0:1::5cc6
 10    16 ms    16 ms    15 ms  2001:4860:0:1::6301
 11    13 ms    15 ms    11 ms  nuq04s45-in-x0e.1e100.net [2607:f8b0:4005:812::200e]

Trace complete.
```

- 3rd - 11:56:20

```
PS C:\Users\jongb> date
Fri Sep 30 11:56:20 PDT 2022
PS C:\Users\jongb> tracert google.com

Tracing route to google.com [2607:f8b0:4005:812::200e]
over a maximum of 30 hops:

  1    12 ms     4 ms     3 ms  2601:647:cb00:dd90:1e93:7cff:fe6d:5809
  2    19 ms    12 ms    11 ms  2001:558:4000:93::1
  3    10 ms    10 ms    15 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [2001:558:82:6805::1]
  4    10 ms    10 ms    13 ms  be-321-rar01.hayward.ca.sfba.comcast.net [2001:558:80:45a::1]
  5    28 ms    18 ms    25 ms  2001:558:80:42c::1
  6     *        *        *     Request timed out.
  7    19 ms    15 ms    13 ms  2001:558:fe0d:7::12
  8    23 ms     *        *     2607:f8b0:82fe::1
  9    17 ms    17 ms     *     2001:4860:0:1::5cc6
 10    14 ms    14 ms    14 ms  2001:4860:0:1::6301
 11    15 ms    15 ms    12 ms  nuq04s45-in-x0e.1e100.net [2607:f8b0:4005:812::200e]

Trace complete.
```

Time	RTT	RTT	RTT	# routers
Fri Sep 30 02:29:51 PDT 2022	17ms	15ms	14ms	#15
Fri Sep 30 10:04:20 PDT 2022	13ms	15ms	11ms	#11
Fri Sep 30 11:56:20 PDT 2022	15ms	15ms	12ms	#11

Determine the following:

a. The overall average and standard deviation of the overall round-trip delays
   i. Overall average:
      1. (17ms+15ms+14ms+13ms+15ms+11ms+15ms+15ms+12ms)/9 = 14.11ms
   ii. Deviation of the overall round-trip = √(((17ms-14.11ms)^2+(15ms-14.11ms)^2+(14ms-14.11ms)^2+(13ms-14.11ms)^2+(15ms-14.11ms)^2+(11ms-14.11)^2+(15ms-14.11)^2+(15ms-14.11)^2+(12ms-14.11)^2)/9) = √(8.35+0.79+0.01+1.23+0.79+9.67+0.79+0.79+4.45)/9 = √2.99 = 1.73ms

b. The number of routers in the path for each of the three hours. Did the path change during any of the runs?

i. The path changed.

ii. I ran the tracert command 02:29am with 15 router. However, when I ran the command again in the morning. I observed that it changed to 11 router.

Include a screenshot of your Traceroute output and circle all data used for your calculations.

Note: If Traceroute is hanging and doesn't complete, talk to your TA. Multiple lines with *** and no completion are not what we are looking for in this exercise.

14. [5 pts] Repeat the above exercise for a source and destination on different continents. Try to identify an overseas link with increased delay and highlight it in your Traceroute output. Include a screenshot of your Traceroute output and circle all data used for your calculations.

- tracert command in window(ICMP port) = tracert sih.hs.kr
- 1st

```
PS C:\Users\jongb> date
Fri Sep 30 02:24:02 PDT 2022
PS C:\Users\jongb> tracert sih.hs.kr

Tracing route to sih.hs.kr [218.38.234.235]
over a maximum of 30 hops:

  1     3 ms     3 ms     3 ms  10.0.0.1
  2    12 ms    28 ms    15 ms  96.120.89.121
  3    23 ms    12 ms    11 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [96.110.102.201]
  4    19 ms    11 ms    12 ms  po-2-rur01.scotts.ca.sfba.comcast.net [68.85.154.137]
  5    11 ms    11 ms    10 ms  be-221-rar01.santaclara.ca.sfba.comcast.net [69.139.199.205]
  6    12 ms    10 ms    11 ms  68.87.193.74
  7    15 ms    17 ms    15 ms  96.108.99.161
  8    19 ms    16 ms    15 ms  be-39911-cs01.9greatoaks.ca.ibone.comcast.net [68.86.93.241]
  9    16 ms    15 ms    15 ms  be-2101-pe01.9greatoaks.ca.ibone.comcast.net [96.110.36.218]
 10    15 ms    16 ms    16 ms  sl-mst50-sj2-ae3-0.sprintlink.net [144.232.6.77]
 11    19 ms    21 ms    22 ms  sl-crs1-pen-.sprintlink.net [144.232.2.103]
 12    19 ms    22 ms    23 ms  sl-crs2-stk-be3.sprintlink.net [144.232.22.179]
 13    23 ms    23 ms    28 ms  sl-crs2-oro-be2.sprintlink.net [144.232.15.238]
 14    33 ms    38 ms    38 ms  sl-crs2-tac-be1.sprintlink.net [144.232.15.91]
 15    34 ms    30 ms    32 ms  sl-mpe51-sea-ae14-0.sprintlink.net [144.232.8.154]
 16    32 ms    31 ms    33 ms  144.223.155.110
 17   150 ms   149 ms   147 ms  58.229.4.182
 18   155 ms   151 ms   147 ms  1.255.36.134
 19   178 ms   153 ms   145 ms  1.255.74.66
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22   151 ms   150 ms   154 ms  61.98.33.154
 23   147 ms   149 ms   146 ms  218.38.234.69
 24     *        *        *     Request timed out.
 25   151 ms   148 ms   164 ms  218.38.234.129
 26   150 ms   151 ms   150 ms  218.38.234.235

Trace complete.
```

- 2nd

```
PS C:\Users\jongb> date
Fri Sep 30 10:07:43 PDT 2022
PS C:\Users\jongb> tracert sih.hs.kr

Tracing route to sih.hs.kr [218.38.234.235]
over a maximum of 30 hops:

  1     2 ms     2 ms     2 ms  10.0.0.1
  2    12 ms    10 ms    11 ms  96.120.89.121
  3    12 ms    11 ms    11 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [96.110.102.201]
  4    12 ms    11 ms    12 ms  po-2-rur01.scotts.ca.sfba.comcast.net [68.85.154.137]
  5    10 ms    12 ms    11 ms  be-221-rar01.santaclara.ca.sfba.comcast.net [69.139.199.205]
  6    10 ms    10 ms     9 ms  68.87.193.74
  7    15 ms    20 ms    25 ms  96.108.99.161
  8    23 ms    17 ms    16 ms  be-39911-cs01.9greatoaks.ca.ibone.comcast.net [68.86.93.241]
  9    17 ms    16 ms    15 ms  be-2101-pe01.9greatoaks.ca.ibone.comcast.net [96.110.36.218]
 10    19 ms    22 ms    18 ms  sl-mst50-sj2-ae3-0.sprintlink.net [144.232.6.77]
 11    23 ms    23 ms    21 ms  sl-crs2-sj-be21.sprintlink.net [144.232.2.103]
 12    25 ms    22 ms    20 ms  sl-crs2-stk-be3.sprintlink.net [144.232.22.179]
 13    24 ms    22 ms    23 ms  sl-crs2-oro-be2.sprintlink.net [144.232.15.238]
 14    34 ms    38 ms    30 ms  sl-crs2-tac-be1.sprintlink.net [144.232.15.91]
 15    32 ms    31 ms    31 ms  sl-mpe51-sea-ae14-0.sprintlink.net [144.232.8.154]
 16    32 ms    42 ms    31 ms  144.223.155.110
 17   148 ms   147 ms   151 ms  58.229.4.182
 18   149 ms   148 ms   148 ms  1.255.36.134
 19   145 ms   146 ms   144 ms  1.255.74.66
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22   151 ms   151 ms   150 ms  61.98.33.154
 23   151 ms   146 ms   145 ms  218.38.234.69
 24     *        *        *     Request timed out.
 25   147 ms   160 ms   153 ms  218.38.234.129
 26   153 ms   153 ms   149 ms  218.38.234.235

Trace complete.
```

- 3rd

```
PS C:\Users\jongb> date
Fri Sep 30 12:02:05 PDT 2022
PS C:\Users\jongb> tracert sih.hs.kr

Tracing route to sih.hs.kr [218.38.234.235]
over a maximum of 30 hops:

  1     6 ms     2 ms     2 ms  10.0.0.1
  2    10 ms    12 ms    11 ms  96.120.89.121
  3    13 ms    11 ms    12 ms  po-303-1216-rur02.scotts.ca.sfba.comcast.net [96.110.102.201]
  4    20 ms    14 ms    11 ms  po-2-rur01.scotts.ca.sfba.comcast.net [68.85.154.137]
  5    25 ms    22 ms    11 ms  be-221-rar01.santaclara.ca.sfba.comcast.net [69.139.199.205]
  6    13 ms    10 ms     9 ms  68.87.193.74
  7    25 ms    15 ms    13 ms  96.108.99.161
  8    16 ms    18 ms    16 ms  be-39911-cs01.9greatoaks.ca.ibone.comcast.net [68.86.93.241]
  9    16 ms    18 ms    15 ms  be-2101-pe01.9greatoaks.ca.ibone.comcast.net [96.110.36.218]
 10    18 ms    16 ms    19 ms  sl-mst50-sj2-ae3-0.sprintlink.net [144.232.6.77]
 11    20 ms    20 ms    20 ms  sl-crs2-sj-be21.sprintlink.net [144.232.2.103]
 12    25 ms    23 ms    18 ms  sl-crs2-stk-be3.sprintlink.net [144.232.22.179]
 13    26 ms    28 ms    20 ms  sl-crs2-oro-be2.sprintlink.net [144.232.15.238]
 14    41 ms    38 ms    40 ms  sl-crs2-tac-be1.sprintlink.net [144.232.15.91]
 15    32 ms    33 ms    36 ms  sl-mpe51-sea-ae14-0.sprintlink.net [144.232.8.154]
 16    31 ms    34 ms    31 ms  144.223.155.110
 17   154 ms   152 ms   147 ms  58.229.4.182
 18   151 ms   149 ms   147 ms  1.255.36.134
 19   145 ms   148 ms   144 ms  1.255.74.66
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22   153 ms   151 ms   150 ms  61.98.33.154
 23   146 ms   145 ms   145 ms  218.38.234.69
 24     *        *        *     Request timed out.
 25   149 ms   150 ms   148 ms  218.38.234.129
 26   149 ms   150 ms   149 ms  218.38.234.235

Trace complete.
```

Time	RTT	RTT	RTT	# routers
Fri Sep 30 02:24:02 PDT 2022	150ms	151ms	150ms	#26
Fri Sep 30 10:07:43 PDT 2022	153ms	153ms	149ms	#26
Fri Sep 30 12:02:05 PDT 2022	149ms	150ms	149ms	#26

1. Overall average:
    a. (150ms+151ms+150ms+153ms+153ms+149ms+149ms+150ms+149ms)/9 = 150.4ms
2. Deviation of the overall round-trip:
    a. √(((150ms-150.4ms)^2+(151ms-150.4ms)^2+(150ms-150.4ms)^2+(153ms-150.4ms)^2+(153ms-150.4ms)^2+(149ms-150.4ms)^2+(149ms-150.4ms)^2+(150ms-150.4ms)^2+(149ms-150.4ms)^2)/9) = √(0.16+0.36+0.16+6.76+6.76+1.96+1.96+0.16+1.96)/9 = √2.99 = 2.25ms
3. The path did not change. I observed that the number of router stayed the same even in different time.

15. [15 pts] General questions about your experiment:

a. Compare the intra-continent and inter-continent results.

- The difference between intra-continent and inter-continent is speed. When I run the command traceroute, it traces all the routes to the destination IP. And if it is in the same continent like the intra-continent, it looks like it is much faster than tracing oversea like the inter-continent.
- If we compare these 2 in more details. We can simply see the difference by looking at the number of routers it uses. Intra-continent had much less number of router usage compare

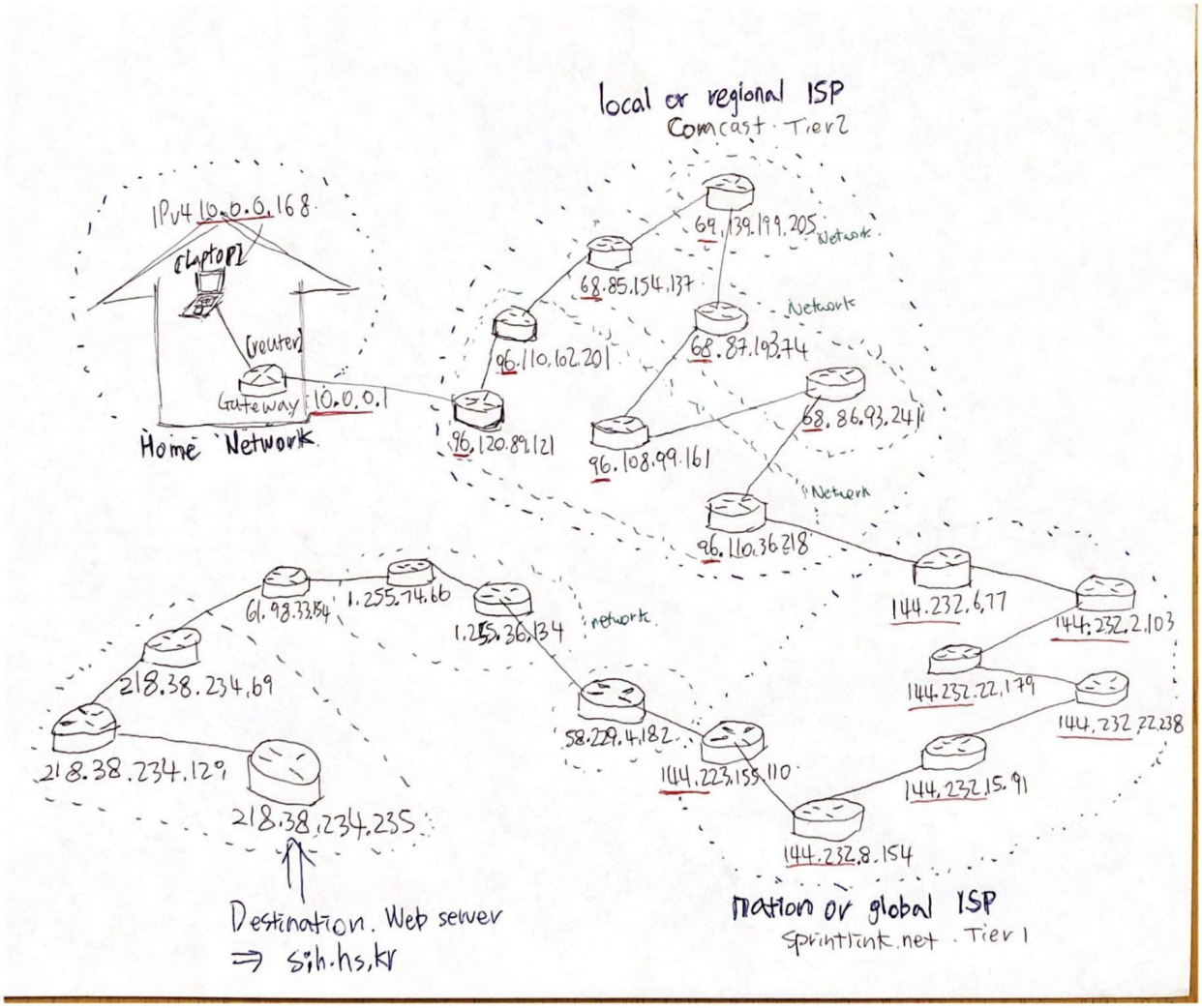
to the inter-continent results. Therefore, Intra-continent is much faster than the inter-continent.

b. Find a row in your table for which the reported RTT values are different. What could account for the difference in delay?

Time	RTT	RTT	RTT	# routers
Fri Sep 30 12:02:05 PDT 2022	149ms	150ms	149ms	#26

- For example, this row shows that the reported RTT values are different. The reason why there are three RTT(round trip time) is because tracert send 3 pockets for each to check if the network is working well or not. Because of that, it could give you different time as you see above.

c. Think about our "network drawing on paper" from the lecture and considering the traceroute output in #14 (inter-continent output), draw the network. Make sure your drawing uses nodes and edges (routers and links).



- **Routers with similar names and/or similar IP addresses can be considered as part of the same ISP. Put a dotted circle around any such groupings of nodes in your drawing to indicate these networks.**
- **How many ISPs have you identified that your packets traversed from the source to destination?**
    - I have two ISP like local ISP(comcast) and global ISP(sprintlink). In local ISP, it looks like I have 8 routers. In global ISP, it looks like I have 7 routers.
- **Have you identified your Access Network? Explain.**
    - According to the lecture, Access network is the network that physically connects an end system to the first router (“edge router”) such as Residential(Cable,

Telephone or fiber, Satellite if remote), Institutional or Enterprise (school, company), Mobile (WiFi, 4G/5G), Datacenter. In my example #14, we can see that the access network is going to be residential(DSL) since I ran the traceroute command at home.