~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~LAB01~~~~~~

Exercise 1: nslookup

1. **Which is the IP address of the Google site (www.google.com)? In your opinion, what is the reason of having several IP addresses as an output?**

   The Google site: 216.58.196.132

   In interactive mode, we could know the details about various hosts and domains and non-interactive mode is just show the name and requested information. In my opinion, the reason of having several IP addresses as an output is that it helps the searchers to choose which IP address should be used.

2. **Find out name of the IP address 127.0.0.1. What is special about this IP address?**

   The name of the IP address 127.0.0.1 is localhost. In-addr.arpa is 1.0.0.127.

Exercise 2: Use ping to test host reachability

Website	ping	Why	website
• www.cse.unsw.edu.au	Reachable	-	Yes
• www.getfittest.com.au	Unreachable	It is not the legitimate website	Unreachable
• www.mit.edu	Reachable	-	Reachable
• www.intel.com.au	Reachable	-	Reachable
• www.tpg.com.au	Reachable	-	Reachable
• www.hola.hp	Unreachable	Unknown host link DNS could not be found	Unreachable
• www.amazon.com	Reachable	-	Reachable
• www.tsinghua.edu.cn	Reachable	-	Reachable
• www.kremlin.ru	Reachable	-	Reachable
• 8.8.8.8	Unreachable	-	Reachable
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Exercise 3: Use traceroute to understand network topology

1. **Run traceroute on your machine to www.columbia.edu .**

   - **How many routers are there between your workstation and www.columbia.edu ?**

     21

   - **How many routers along the path are part of the UNSW network?**

     4

   - **Between which two routers do packets cross the Pacific Ocean? Hint: compare the round trip times from your machine to the routers using ping.**

     Between number 9 and number 10. It still in Australia in number 9 and in United State.

2. **Run traceroute from your machine to the following destinations: (i) www.ucla.edu (ii) www.u-tokyo.ac.jpand (iii) www.lancaster.ac.uk .**

   a) **At which router do the paths from your machine to these three destinations diverge?**

      113.197.15.99

   b) **Find out further details about this router. (HINT: You can find out more about a router by running the whois command: whois router-IP-address).**

      The address is in Australia and it is AARNet Network Operation Center.

   c) **Is the number of hops on each path proportional the physical distance? HINT: You can find out geographical location of a server using the following tool - http://www.yougetsignal.com/tools/network-location/**

      ucla: 14 -> 43657.7km

      u-tokyo: 15 -> 34857.9km

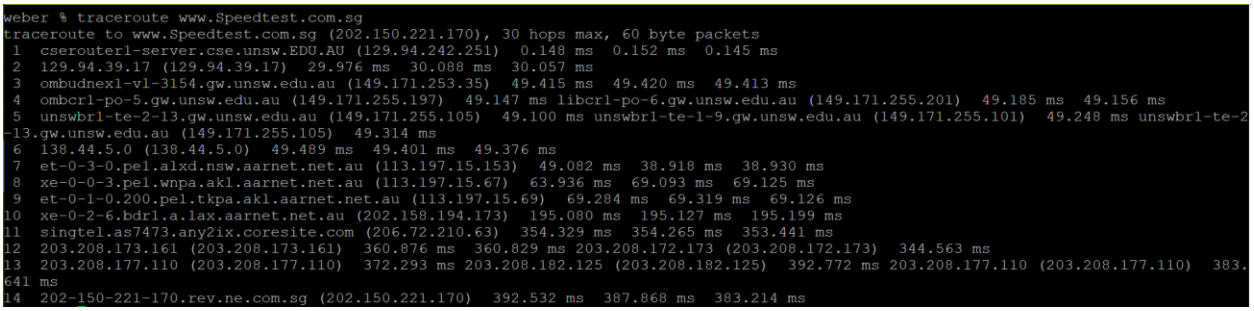
      lancaster: 26 -> 52098.5km

      At we can see, the number of hops on each path is not proportional the physical distance. U-tokyo has shortest distance from my location but its hops is 15, which is more than the hops to ucla.

3. **Several servers distributed around the world provide a web interface from which you can perform a traceroute to any other host in the Internet. Here are two examples: (i) http://www.speedtest.com.sg/tr.phpand (ii) https://www.telstra.net/cgi-bin/trace . Run traceroute from both these servers towards your machine and in the reverse direction (i.e. from your machine to these servers). You may also try other traceroute servers from the list at www.traceroute.org . What are the IP addresses of the two**

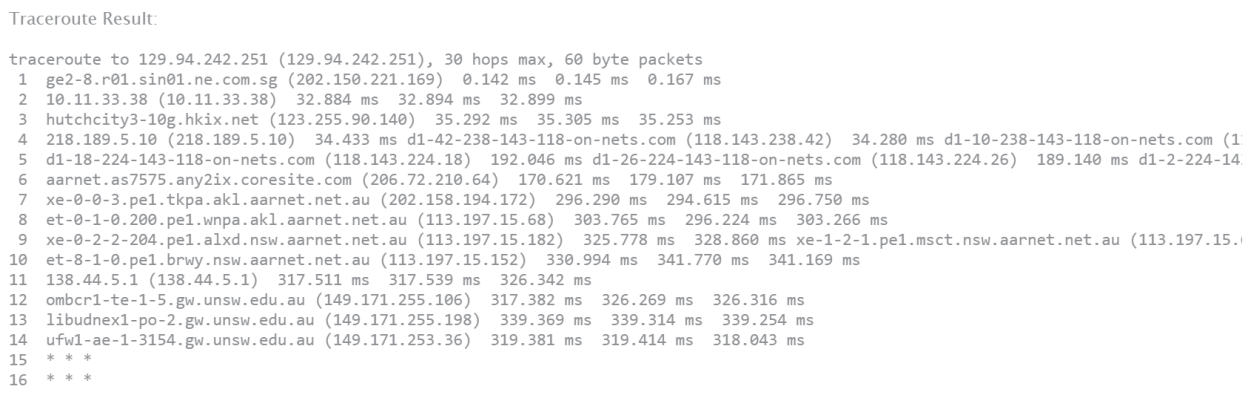
servers that you have chosen. Does the reverse path go through the same routers as the forward path? If you observe common routers between the forward and the reverse path, do you also observe the same IP addresses? Why or why not?

a) Trace from home to www.Speedtest.com.sg: 14 hops



```
weber % traceroute www.Speedtest.com.sg
traceroute to www.Speedtest.com.sg (202.150.221.170), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.148 ms  0.152 ms  0.145 ms
 2  129.94.39.17 (129.94.39.17)  29.976 ms  30.088 ms  30.057 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  49.415 ms  49.420 ms  49.413 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  49.147 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  49.185 ms  49.156 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  49.100 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  49.248 ms unswbr1-te-2
-13.gw.unsw.edu.au (149.171.255.105)  49.314 ms
 6  138.44.5.0 (138.44.5.0)  49.489 ms  49.401 ms  49.376 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  49.082 ms  38.918 ms  38.930 ms
 8  xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67)  63.936 ms  69.093 ms  69.125 ms
 9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69)  69.284 ms  69.319 ms  69.126 ms
10  xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173)  195.080 ms  195.127 ms  195.199 ms
11  singtel.as7473.any2ix.coresite.com (206.72.210.63)  354.329 ms  354.265 ms  353.441 ms
12  203.208.173.161 (203.208.173.161)  360.876 ms  360.829 ms 203.208.172.173 (203.208.172.173)  344.563 ms
13  203.208.177.110 (203.208.177.110)  372.293 ms 203.208.182.125 (203.208.182.125)  392.772 ms 203.208.177.110 (203.208.177.110)  383.
641 ms
14  202-150-221-170.rev.ne.com.sg (202.150.221.170)  392.532 ms  387.868 ms  383.214 ms
```

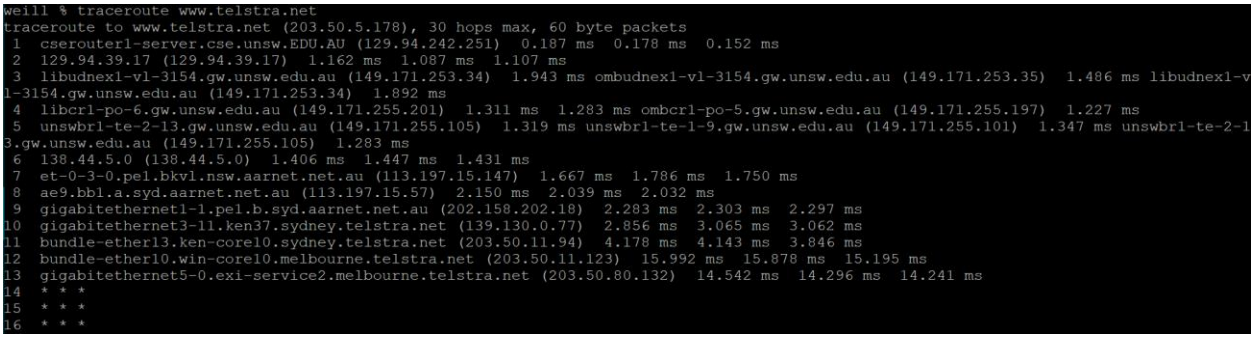
Trace from www.Speedtest.com.sg to home: 12 hops



```
Traceroute Result:

traceroute to 129.94.242.251 (129.94.242.251), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.142 ms  0.145 ms  0.167 ms
 2  10.11.33.38 (10.11.33.38)  32.884 ms  32.894 ms  32.899 ms
 3  hutchcity3-10g.hkix.net (123.255.90.140)  35.292 ms  35.305 ms  35.253 ms
 4  218.189.5.10 (218.189.5.10)  34.433 ms d1-42-238-143-118-on-nets.com (118.143.238.42)  34.280 ms d1-10-238-143-118-on-nets.com (11
 5  d1-18-224-143-118-on-nets.com (118.143.224.18)  192.046 ms d1-26-224-143-118-on-nets.com (118.143.224.26)  189.140 ms d1-2-224-14
 6  aarnet.as7575.any2ix.coresite.com (206.72.210.64)  170.621 ms  179.107 ms  171.865 ms
 7  xe-0-0-3.pe1.tkpa.akl.aarnet.net.au (202.158.194.172)  296.290 ms  294.615 ms  296.750 ms
 8  et-0-1-0.200.pe1.wnpa.akl.aarnet.net.au (113.197.15.68)  303.765 ms  296.224 ms  303.266 ms
 9  xe-0-2-2-204.pe1.alxd.nsw.aarnet.net.au (113.197.15.182)  325.778 ms  328.860 ms xe-1-2-1.pe1.msct.nsw.aarnet.net.au (113.197.15.
10  et-8-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.152)  330.994 ms  341.770 ms  341.169 ms
11  138.44.5.1 (138.44.5.1)  317.511 ms  317.539 ms  326.342 ms
12  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  317.382 ms  326.269 ms  326.316 ms
13  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  339.369 ms  339.314 ms  339.254 ms
14  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  319.381 ms  319.414 ms  318.043 ms
15  * * *
16  * * *
```

b) Trace from home to www.telstra.net : 13 hops



```
weill % traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.187 ms  0.178 ms  0.152 ms
 2  129.94.39.17 (129.94.39.17)  1.162 ms  1.087 ms  1.107 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.943 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.486 ms libudnex1-v
l-3154.gw.unsw.edu.au (149.171.253.34)  1.892 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.311 ms  1.283 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.227 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.319 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.347 ms unswbr1-te-2-1
3.gw.unsw.edu.au (149.171.255.105)  1.283 ms
 6  138.44.5.0 (138.44.5.0)  1.406 ms  1.447 ms  1.431 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.667 ms  1.786 ms  1.750 ms
 8  ae9.bb1.a.syd.aarnet.net.au (113.197.15.57)  2.150 ms  2.039 ms  2.032 ms
 9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  2.283 ms  2.303 ms  2.297 ms
10  gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  2.856 ms  3.065 ms  3.062 ms
11  bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94)  4.178 ms  4.143 ms  3.846 ms
12  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  15.992 ms  15.878 ms  15.195 ms
13  gigabitethernet5-0.exi-service2.melbourne.telstra.net (203.50.80.132)  14.542 ms  14.296 ms  14.241 ms
14  * * *
15  * * *
16  * * *
```

Trace from www.telstra.net to home: 12 hops

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.337 ms  0.206 ms  0.242 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.363 ms  1.602 ms  2.240 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.109 ms  12.232 ms  12.848 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  11.984 ms  11.971 ms  12.735 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.735 ms  11.597 ms  11.612 ms
 6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.864 ms  11.727 ms  11.862 ms
 7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  12.110 ms  12.103 ms  12.112 ms
 8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  12.360 ms  12.354 ms  12.362 ms
 9  138.44.5.1 (138.44.5.1)  12.609 ms  12.606 ms  12.611 ms
10  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  17.234 ms  13.980 ms  12.609 ms
11  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  13.483 ms  13.104 ms  13.112 ms
12  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  13.110 ms  13.229 ms  13.237 ms
```

From above, the reverse path does not the same routes as the forward path. This is because the routes are determined based on each router. For every route would have its own rules so the path forward is not the same path home. They determined by default routing, neighboring networks, metrics and so on.

Exercise 4: Use ping to gain insights into network performance

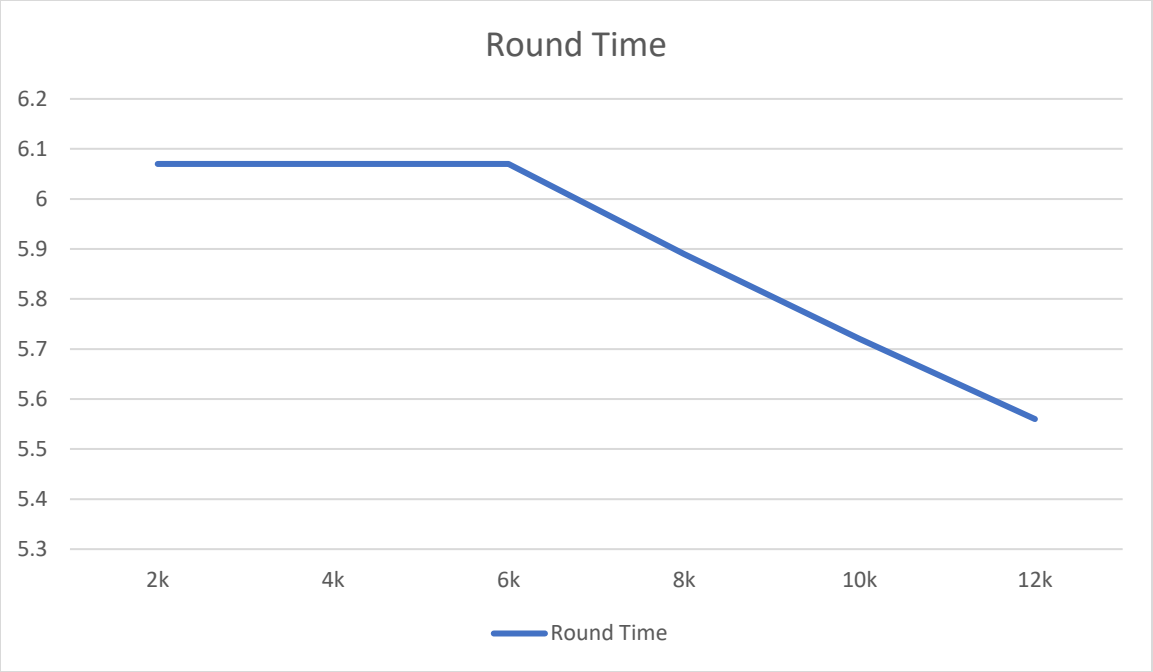
Assuming the propagation speed is the speed of light = 3*10^8 meter per second

Thus, speed of light = 3 * 10^8 / 1000 km per second = 300,000 km per second

Physical distance from UNSW(km)	Shortest Time(second / milliseconds)
University of Queensland: 892	T = ~0.0029 second / 2.9 milliseconds
National University of Singapore: 6458	T = ~0.0215 second / 21.5 milliseconds
Technical University of Berlin: 16294	T = ~0.0543 second / 54.3 milliseconds

Round Trip Time:

(i) www.uq.edu.au : 17.600 km / 2.9 ms = 6.069
(ii) www.nus.edu.sg : 152.134 km / 21.5 ms = 7.076
(iii) www.tu-berlin.de : 301.881 km / 54.3 ms = 5.560



Why are the y-axis values greater than 2?

Round-trip time counts the time required for a packet to travel from source to destination, and receives the response (again to the source). T is the shortest time to reach the destination, so RTT is at least two times the T., so the Y axis value will be greater than 2.

Is the delay to the destinations constant or does it vary over time? Why?

- As time goes on, the delay of destination seems to be constant except Singapore. In addition, there appeared to be a series of delays at some time.
- This is due to the use of packet switching, which makes use of statistical multiplexing. The resource flow is dynamically allocated and shared, so there will be no overload.

Transmission, Propagation, Processing and Queuing: Which of these delays depend on the packet size and which do not?

- Transmission delay depends on packet size, as it is the amount of time taken to transmit a whole pack of a certain size. It is calculated by L / R, where L = size of the whole packet and R = the link bandwidth
- Propagation, Processing and Queueing do NOT depend on the packet size.
    - Propagation relies on length of the physical link, divided by the propagation speed
    - Processing just checks for errors and processes the packet header
    - Queuing is just the time taken for the packet to wait at the output link for transmission