

Exercise 1: nslookup

Use the nslookup command from the "Tools of the Trade" and answer the following questions:

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?

Non-authoritative answer:

Name: www.google.com

Address: 216.58.196.132

The reason of having several IP addresses as an output maybe the sites might be run on different servers and each server has different IP addresses.

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

Server: 129.94.208.3

Address: 129.94.208.3#53

1.0.0.127.in-addr.arpa name = localhost.

The name of the IP address 127.0.0.1 is localhost. It is the loopback address used in almost all cases.

Exercise 2: Use ping to test host reachability

Host Name	Reachability	Reason
www.cse.unsw.edu.au	Yes	
www.getfittest.com.au	No	DNS address could not be found
www.mit.edu	Yes	
www.intel.com.au	Yes	
www.tpg.com.au	Yes	
www.hola.hp		DNS address could not be found
www.amazon.com	Yes	
www.tsinghua.edu.cn	Yes	
www.kremlin.ru	No	The firewall of the target prevent ICMP protocol message to reach the target.
8.8.8.8	Yes	

Exercise 3: Use traceroute to understand network topology

Note: Include all traceroute outputs in your report.

1. Run traceroute on your machine to www.columbia.edu. How many routers are there between your workstation and www.columbia.edu? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean? Hint: compare the round trip times from your machine to the routers using ping.

```
z5092212@tabla17:~/Desktop/cs3331$ traceroute www.columbia.edu
traceroute to www.columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.218 ms 0.178 ms 0.147 ms
 2 129.94.39.17 (129.94.39.17) 1.092 ms 1.098 ms 1.012 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.954 ms libudnex1-vl-
3154.gw.unsw.edu.au (149.171.253.34) 1.673 ms ombudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.35) 1.953 ms
```

4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.247 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.231 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.252 ms

5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.280 ms 1.259 ms 1.287 ms

6 138.44.5.0 (138.44.5.0) 1.455 ms 1.469 ms 1.423 ms

7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.215 ms 2.500 ms 2.422 ms

8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.628 ms 95.619 ms 95.578 ms

9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.710 ms 146.641 ms 146.661 ms

10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 146.639 ms 146.624 ms 146.589 ms

11 et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0) 157.474 ms 157.409 ms 157.426 ms

12 et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58) 180.500 ms 180.511 ms 180.505 ms

13 et-1-1-2.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 188.294 ms 188.836 ms 188.816 ms

14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 197.263 ms 197.247 ms 197.231 ms

15 buf-9208-l2-CLEV.nysernet.net (199.109.11.33) 201.526 ms 201.461 ms 201.477 ms

16 syr-9208-buf-9208.nysernet.net (199.109.7.193) 205.313 ms 205.430 ms 205.404 ms

17 nyc-9208-syr-9208.nysernet.net (199.109.7.162) 210.768 ms 210.647 ms 210.601 ms

18 columbia.nyc-9208.nysernet.net (199.109.4.14) 210.476 ms 210.491 ms 210.543 ms

19 nyser111-gw-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.10) 493.051 ms 483.492 ms 432.811 ms

20 phi-core-1-x-nyser111-gw-1.net.columbia.edu (128.59.255.13) 210.847 ms 210.755 ms 210.659 ms

21 cc-conc-1-x-phi-core-1.net.columbia.edu (128.59.255.214) 210.754 ms 210.809 ms 210.986 ms

22 neurotheory.columbia.edu (128.59.105.24) 210.949 ms 211.047 ms 211.044 ms

There are 22 routers between my workstation and www.columbia.com .

UNSW network: from the 1st to the 5th routers are belong to UNSW. So there are 5 of them.

The routers that cross the pacific ocean might be the 7th router:

```
7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)
```

and the 9th router:

```
9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)
```

since the ping time dramatically increased in the total time.

2. Run traceroute from your machine to the following destinations:
(i) www.ucla.edu (ii) www.u-tokyo.ac.jp and (iii) www.lancaster.ac.uk. At which router do the paths from your machine to these three destinations diverge? 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`). Is the number of hops on each path proportional to the physical distance? HINT: You can find out geographical location of a server using the following tool - <http://www.yougetsignal.com/tools/network-location/>

tracing to www.ucla.edu :

```
z5092212@tabla17:~/Desktop/cs3331$ traceroute www.ucla.edu
traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.213 ms 0.175 ms 0.150 ms
 2 129.94.39.17 (129.94.39.17) 1.126 ms 1.124 ms 1.089 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.500 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 3.112 ms 3.201 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.273 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.268 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.235 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.311 ms 1.293 ms 1.268 ms
 6 138.44.5.0 (138.44.5.0) 1.392 ms 1.425 ms 1.497 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.268 ms 2.449 ms 2.407 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.475 ms 95.341 ms 95.315 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.739 ms 146.750 ms 146.731 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.391 ms 163.406 ms 163.371 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73) 171.363 ms 171.304 ms 171.159 ms
12 * * *
13 bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 171.382 ms 171.618 ms bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 171.567 ms
```

```
14 cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55) 171.465 ms 171.545 ms  
cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53) 171.528 ms
```

tracing to www.u-tokyo.ac.jp:

```
z5092212@tabla17:~/Desktop/cs3331$ traceroute www.u-tokyo.ac.jp  
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets  
1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.218 ms 0.177 ms 0.150 ms  
2 129.94.39.17 (129.94.39.17) 1.202 ms 1.210 ms 1.189 ms  
3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.562 ms libudnex1-vl-  
3154.gw.unsw.edu.au (149.171.253.34) 1.446 ms ombudnex1-vl-3154.gw.unsw.edu.au  
(149.171.253.35) 1.565 ms  
4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.367 ms 1.390 ms libcr1-po-  
5.gw.unsw.edu.au (149.171.255.165) 1.367 ms  
5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.391 ms 1.427 ms 1.401 ms  
6 138.44.5.0 (138.44.5.0) 1.419 ms 1.385 ms 1.415 ms  
7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.923 ms 2.058 ms 2.021 ms  
8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 156.420 ms 157.372 ms 157.357 ms  
9 paloalto0.iij.net (198.32.176.24) 158.162 ms 158.051 ms 158.097 ms  
10 osk004bb00.IIJ.Net (58.138.88.185) 289.237 ms 289.372 ms 289.525 ms  
11 osk004ix51.IIJ.Net (58.138.106.126) 288.961 ms osk004ix51.IIJ.Net (58.138.106.130)  
271.131 ms osk004ix51.IIJ.Net (58.138.106.126) 288.912 ms  
12 210.130.135.130 (210.130.135.130) 288.897 ms 280.006 ms 288.771 ms  
13 124.83.228.78 (124.83.228.78) 288.686 ms 288.907 ms 280.088 ms  
14 124.83.252.250 (124.83.252.250) 295.406 ms 295.246 ms 286.516 ms  
15 158.205.134.26 (158.205.134.26) 286.429 ms 295.359 ms 286.403 ms
```

tracing to www.lancaster.ac.uk:

```
z5092212@tabla17:~/Desktop/cs3331$ traceroute www.lancaster.au.uk  
traceroute to www.lancaster.au.uk (185.53.179.6), 30 hops max, 60 byte packets  
1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.224 ms 0.155 ms 0.123 ms  
2 129.94.39.17 (129.94.39.17) 1.102 ms 1.102 ms 1.017 ms
```

3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.564 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.651 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.843 ms

4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.242 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.308 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.341 ms

5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.258 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.352 ms 1.329 ms

6 138.44.5.0 (138.44.5.0) 1.427 ms 1.396 ms 1.463 ms

7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.890 ms 2.002 ms 1.959 ms

8 xe-0-2-5.bdr1.b.sea.aarnet.net.au (202.158.194.121) 143.958 ms 143.953 ms 143.917 ms

9 xe-0-0-23-2.a01.sttlwa01.us.bb.gin.ntt.net (198.104.202.61) 152.238 ms 152.173 ms 152.188 ms

10 be3048.ccr21.sea02.atlas.cogentco.com (154.54.11.9) 144.200 ms 144.110 ms 144.135 ms

11 be2085.ccr21.slc01.atlas.cogentco.com (154.54.2.198) 165.334 ms 165.335 ms 165.314 ms

12 be3037.ccr21.den01.atlas.cogentco.com (154.54.41.146) 185.623 ms
be3038.ccr22.den01.atlas.cogentco.com (154.54.42.98) 186.005 ms 185.977 ms

13 be3035.ccr21.mci01.atlas.cogentco.com (154.54.5.90) 185.915 ms
be3036.ccr22.mci01.atlas.cogentco.com (154.54.31.90) 186.041 ms
be3035.ccr21.mci01.atlas.cogentco.com (154.54.5.90) 185.957 ms

14 be2832.ccr42.ord01.atlas.cogentco.com (154.54.44.170) 207.102 ms
be2831.ccr41.ord01.atlas.cogentco.com (154.54.42.166) 207.037 ms
be2832.ccr42.ord01.atlas.cogentco.com (154.54.44.170) 207.028 ms

15 be2717.ccr21.cle04.atlas.cogentco.com (154.54.6.222) 214.605 ms
be2718.ccr22.cle04.atlas.cogentco.com (154.54.7.130) 214.610 ms 214.579 ms

16 be2994.ccr32.yyz02.atlas.cogentco.com (154.54.31.234) 221.620 ms 221.411 ms 221.331 ms

17 be3260.ccr22.ymq01.atlas.cogentco.com (154.54.42.90) 222.518 ms
be3259.ccr21.ymq01.atlas.cogentco.com (154.54.41.206) 222.984 ms 222.986 ms

18 be3043.ccr22.lpl01.atlas.cogentco.com (154.54.44.165) 291.978 ms 292.263 ms
be3042.ccr21.lpl01.atlas.cogentco.com (154.54.44.161) 293.042 ms

19 be2183.ccr42.ams03.atlas.cogentco.com (154.54.58.70) 295.314 ms
be2182.ccr41.ams03.atlas.cogentco.com (154.54.77.245) 298.752 ms
be2183.ccr42.ams03.atlas.cogentco.com (154.54.58.70) 294.858 ms

```
20 be2813.ccr41.fra03.atlas.cogentco.com (130.117.0.122) 302.633 ms 303.558 ms
303.107 ms

21 be2960.ccr22.muc03.atlas.cogentco.com (154.54.36.254) 308.379 ms 308.753 ms
308.109 ms

22 te0-0-0-2.agr11.muc03.atlas.cogentco.com (154.54.56.206) 308.732 ms te0-0-1-
2.agr12.muc03.atlas.cogentco.com (154.54.56.230) 308.767 ms te0-0-1-
2.agr11.muc03.atlas.cogentco.com (154.54.56.226) 308.161 ms

23 te0-0-2-3.nr11.b015933-1.muc03.atlas.cogentco.com (154.25.6.162) 307.733 ms 307.664
ms te0-0-2-1.nr11.b015933-1.muc03.atlas.cogentco.com (154.25.8.22) 308.776 ms
```

They diverge at the router

```
6 138.44.5.0 (138.44.5.0)
```

The number of hops on each path is not proportional the physical distance.

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.php> and (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?

From <http://www.speedtest.com.sg/tr.php> to my machine:

Traceroute Result:

traceroute to 129.94.209.117 (129.94.209.117), 30 hops max, 60 byte packets

```
1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.159 ms 0.196 ms 0.207 ms
```

```

2 10.11.33.38 (10.11.33.38) 32.917 ms 32.971 ms 32.996 ms
3 hutchcity3-10g.hkix.net (123.255.90.140) 34.518 ms 34.500 ms 34.541 ms
4 d1-42-238-143-118-on-nets.com (118.143.238.42) 34.469 ms 218.189.5.42 (218.189.5.42)
34.478 ms 34.380 ms
5 d1-26-224-143-118-on-nets.com (118.143.224.26) 189.252 ms d1-2-224-143-118-on-
nets.com (118.143.224.2) 183.165 ms d1-18-224-143-118-on-nets.com (118.143.224.18)
192.625 ms
6 aarnet.as7575.any2ix.coresite.com (206.72.210.64) 179.196 ms 179.082 ms 170.761 ms
7 xe-0-0-3.pe1.tkpa.akl.aarnet.net.au (202.158.194.172) 305.315 ms 303.393 ms 302.998
ms
8 et-0-1-0.200.pe1.wnpp.akl.aarnet.net.au (113.197.15.68) 304.481 ms 296.607 ms
303.238 ms
9 xe-0-2-2-204.pe1.alxd.nsw.aarnet.net.au (113.197.15.182) 324.491 ms 324.427 ms
333.202 ms
10 et-8-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.152) 339.795 ms 341.428 ms 332.264
ms
11 138.44.5.1 (138.44.5.1) 325.953 ms 317.678 ms 317.460 ms
12 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 328.103 ms 498.898 ms 326.329 ms
13 libudnex1-po-2.gw.unsw.edu.au (149.171.255.198) 395.949 ms 395.568 ms 395.299 ms
14 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 326.545 ms 328.723 ms 318.324 ms
15 129.94.39.23 (129.94.39.23) 327.098 ms 327.167 ms 327.102 ms

```

In reverse direction(from my machine to <http://www.speedtest.com.sg>) :

```

z5092212@tabla17:~/Desktop/cs3331$ traceroute www.speedtest.com.sg
traceroute to www.speedtest.com.sg (202.150.221.170), 30 hops max, 60 byte packets
1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.140 ms 0.098 ms 0.096 ms
2 129.94.39.17 (129.94.39.17) 1.094 ms 1.122 ms 1.059 ms
3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.847 ms 1.826 ms ombudnex1-vl-
3154.gw.unsw.edu.au (149.171.253.35) 1.520 ms
4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.364 ms 1.278 ms 1.313 ms

```


5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.292 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.325 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.291 ms

6 138.44.5.0 (138.44.5.0) 1.460 ms 1.480 ms 1.451 ms

7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.780 ms 1.927 ms 1.801 ms

8 xe-0-2-1-204.pe1.wnpa.alxd.aarnet.net.au (113.197.15.183) 24.319 ms 24.251 ms xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67) 24.264 ms

9 et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69) 26.731 ms 26.719 ms 26.669 ms

10 xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173) 148.204 ms 148.156 ms 148.128 ms

11 singtel.as7473.any2ix.coresite.com (206.72.210.63) 306.068 ms 306.074 ms 305.990 ms

12 203.208.172.173 (203.208.172.173) 314.979 ms 310.847 ms 203.208.151.181 (203.208.151.181) 328.673 ms

13 203.208.177.110 (203.208.177.110) 333.546 ms 331.751 ms 331.841 ms

14 203.208.182.45 (203.208.182.45) 339.071 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170) 336.606 ms 336.593 ms

From <https://www.telstra.net/cgi-bin/trace> to my machine:

1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.416 ms 0.325 ms 0.241 ms

2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 1.366 ms 1.478 ms 2.117 ms

3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 12.983 ms 12.098 ms 13.111 ms

4 bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95) 11.986 ms 11.850 ms 11.859 ms

5 aarnet6.lnk.telstra.net (139.130.0.78) 11.735 ms 11.599 ms 11.611 ms

6 ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17) 11.736 ms 11.848 ms 11.736 ms

7 ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56) 11.983 ms 12.098 ms 11.986 ms

```
8 et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146) 12.360 ms 12.473 ms 12.359 ms
9 138.44.5.1 (138.44.5.1) 12.612 ms 12.601 ms 12.612 ms
10 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 12.608 ms 12.597 ms 12.610 ms
11 ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202) 12.988 ms 12.849 ms 12.733 ms
12 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 13.236 ms 13.224 ms 13.233 ms
13 129.94.39.23 (129.94.39.23) 13.360 ms 13.351 ms 13.359 ms
```

In reverse direction(from my machine to <https://www.telstra.net/cgi-bin/trace>) :

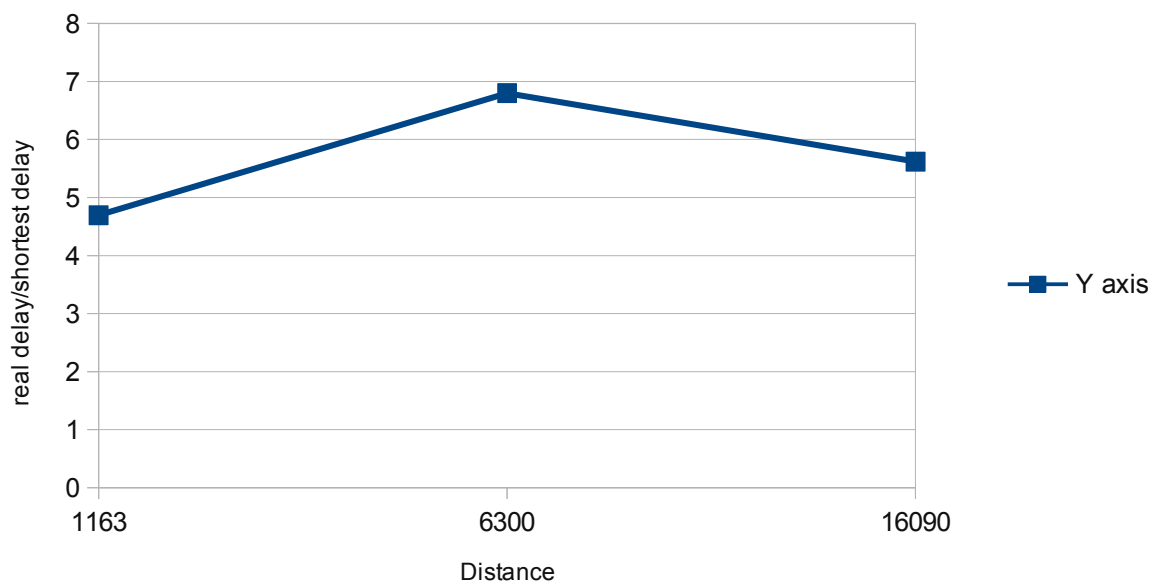
```
z5092212@tabla17:~/Desktop/cs3331$ traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
 1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.222 ms 0.183 ms 0.150 ms
 2 129.94.39.17 (129.94.39.17) 1.067 ms 1.064 ms 1.027 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.829 ms 1.692 ms 2.047 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.294 ms 1.211 ms ombcr1-po-
6.gw.unsw.edu.au (149.171.255.169) 1.200 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.212 ms unswbr1-te-1-
9.gw.unsw.edu.au (149.171.255.101) 1.235 ms 1.258 ms
 6 138.44.5.0 (138.44.5.0) 2.485 ms 2.247 ms 2.214 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.727 ms 1.771 ms 1.821 ms
 8 ae9.bb1.a.syd.aarnet.net.au (113.197.15.57) 2.105 ms 2.163 ms 2.136 ms
 9 gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18) 2.238 ms 2.263 ms 2.295
ms
10 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 2.896 ms 3.016 ms 3.066
ms
11 bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94) 4.710 ms 4.714 ms 4.685
ms
12 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 15.269 ms 15.252 ms
14.475 ms
13 gigabitethernet5-0.exi-service2.melbourne.telstra.net (203.50.80.132) 14.422 ms 14.357
ms 13.737 ms
```

The traceroute does not show the exactly same IP address even if they have the same name between forward and reverse paths. This is because the names that traceroute shows are router interface instead of routers.

Exercise 4: Use ping to gain insights into network performance

1. For each of these locations find the (approximate) physical distance from UNSW using Google Maps and compute the shortest possible time T for a packet to reach that location from UNSW. You should assume that the packet moves (i.e. propagates) at the speed of light, 3×10^8 m/s. Note that the shortest possible time will simply be the distance divided by the propagation speed. Plot a graph where the x-axis represents the distance to each city (i.e. Adelaide, Singapore and Berlin), and the y-axis represents the ratio between the minimum delay (i.e. RTT) as measured by the ping program (select the values for 50 byte packets) and the shortest possible time T to reach that city from UNSW. (Note that the y-values are no smaller than 2 since it takes at least $2 \cdot T$ time for any packet to reach the destination from UNSW and get back). Can you think of at least two reasons why the y-axis values that you plot are greater than 2?

from UNSW to	Shortest Distance(km)	Shortest Time(ms)
Adelaide	1163	3.8
Singapore	6300	21
Berlin	16090	53



from UNSW to	X axis (distance)	Y axis
Adelaide	1163	4.7
Singapore	6300	6.8
Berlin	16090	5.62

The y axis is always greater than 2 is because that:

1. the ping is the time where it counts both the forward time and the backward time.
2. The real time delay is the total amount of propagation delay, transmission delay, processing delay and queuing delay. The shortest time we calculate is the best case in propagation delay which is almost impossible to reach.

2. Is the delay to the destinations constant or does it vary over time? Explain why.

The delay varies over time. This is because that the internet is like a highway and it can get congested.

3. The measured delay (i.e., the delay you can see in the graphs) is composed of propagation delay, transmission delay, processing delay and queuing delay. Which of these delays depend on the packet size and which do not?

The delays that depend on the packet size is transmission delay. It is calculate by L/R where L is the size of the package and R is the bandwidth.

The other delay does not depend on the packet size.

Processing delay: check the error of the packet header.

Propagation delay: it relies on the length of the physical link and the propagation speed.

Queuing delay: The time that the packets wait for the other packets to transmit before them.