

COMP9331 Lab1

Name: Jiachen Li

StudentID: z5184142

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 IP addresses of the Google site is 172.217.22.132.

```
[~bash-4.2$ nslookup www.google.com
Server:          129.94.242.2
Address:         129.94.242.2#53

Non-authoritative answer:
Name:   www.google.com
Address: 172.217.22.132
```

```
[~bash-4.2$ nslookup www.google.com
Server:          129.94.242.2
Address:         129.94.242.2#53

Non-authoritative answer:
Name:   www.google.com
Address: 216.58.196.132
```

The reason of having several IP addresses as an output is that Google is a search engine website, so the number of visitors per second is very huge, in order to not let one server work overload and keep the service working, then Google needs multiple servers to release the pressure and to ensure that the searching service is always available.

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

This IP address is the local address.

```
[~bash-4.2$ nslookup 127.0.0.1
Server:          129.94.242.2
Address:         129.94.242.2#53

1.0.0.127.in-addr.arpa name = localhost.
```

Exercise 2: Use ping to test host reachability

www.cse.unsw.edu.au connected

```
[bash-4.2$ ping www.cse.unsw.edu.au
PING www.cse.unsw.edu.au (129.94.242.51) 56(84) bytes of data.
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=1 ttl=64 time=0.165 ms
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=2 ttl=64 time=0.173 ms
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=3 ttl=64 time=0.146 ms
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=4 ttl=64 time=0.165 ms
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=5 ttl=64 time=0.163 ms
^C
--- www.cse.unsw.edu.au ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3997ms
rtt min/avg/max/mdev = 0.146/0.162/0.173/0.014 ms
```

www.getfittest.com.au unknown host

```
[bash-4.2$ ping www.getfittest.com.au
ping: unknown host www.getfittest.com.au
```

www.mit.edu connected

```
[bash-4.2$ ping www.mit.edu
PING e9566.dscb.akamaiedge.net (104.74.27.200) 56(84) bytes of data.
64 bytes from a104-74-27-200.deploy.static.akamaitechnologies.com (104.74.27.200): icmp_req=1 ttl=56 time=1.24 ms
64 bytes from a104-74-27-200.deploy.static.akamaitechnologies.com (104.74.27.200): icmp_req=2 ttl=56 time=1.70 ms
64 bytes from a104-74-27-200.deploy.static.akamaitechnologies.com (104.74.27.200): icmp_req=3 ttl=56 time=1.17 ms
64 bytes from a104-74-27-200.deploy.static.akamaitechnologies.com (104.74.27.200): icmp_req=4 ttl=56 time=1.25 ms
64 bytes from a104-74-27-200.deploy.static.akamaitechnologies.com (104.74.27.200): icmp_req=5 ttl=56 time=1.21 ms
^C
--- e9566.dscb.akamaiedge.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.175/1.317/1.701/0.198 ms
```

www.intel.com.au connected

```
[bash-4.2$ ping www.intel.com.au
PING e117.b.akamaiedge.net (104.74.39.239) 56(84) bytes of data.
64 bytes from a104-74-39-239.deploy.static.akamaitechnologies.com (104.74.39.239): icmp_req=1 ttl=56 time=1.19 ms
64 bytes from a104-74-39-239.deploy.static.akamaitechnologies.com (104.74.39.239): icmp_req=2 ttl=56 time=1.28 ms
64 bytes from a104-74-39-239.deploy.static.akamaitechnologies.com (104.74.39.239): icmp_req=3 ttl=56 time=1.17 ms
64 bytes from a104-74-39-239.deploy.static.akamaitechnologies.com (104.74.39.239): icmp_req=4 ttl=56 time=1.22 ms
64 bytes from a104-74-39-239.deploy.static.akamaitechnologies.com (104.74.39.239): icmp_req=5 ttl=56 time=1.15 ms
^C
--- e117.b.akamaiedge.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.155/1.205/1.281/0.054 ms
```


www.tpg.com.au connected

```
[~bash-4.2$ ping www.tpg.com.au
PING www.tpg.com.au (203.26.27.38) 56(84) bytes of data.
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=1 ttl=118 time=29.8 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=2 ttl=118 time=29.8 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=3 ttl=118 time=29.8 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=4 ttl=118 time=29.8 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=5 ttl=118 time=29.7 ms
^C
--- www.tpg.com.au ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4007ms
rtt min/avg/max/mdev = 29.726/29.833/29.887/0.055 ms
```

www.hola.hp unknown host

```
[~bash-4.2$ ping www.hola.hp
ping: unknown host www.hola.hp
```

www.amazon.com connected

```
[~bash-4.2$ ping www.amazon.com
PING d3ag4hukkh62yn.cloudfront.net (54.230.133.148) 56(84) bytes of data.
64 bytes from server-54-230-133-148.syd1.r.cloudfront.net (54.230.133.148): icmp_req=1 ttl=245 time=1.14 ms
64 bytes from server-54-230-133-148.syd1.r.cloudfront.net (54.230.133.148): icmp_req=2 ttl=245 time=1.17 ms
64 bytes from server-54-230-133-148.syd1.r.cloudfront.net (54.230.133.148): icmp_req=3 ttl=245 time=1.16 ms
64 bytes from server-54-230-133-148.syd1.r.cloudfront.net (54.230.133.148): icmp_req=4 ttl=245 time=1.20 ms
64 bytes from server-54-230-133-148.syd1.r.cloudfront.net (54.230.133.148): icmp_req=5 ttl=245 time=1.18 ms
^C
--- d3ag4hukkh62yn.cloudfront.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 1.141/1.173/1.200/0.020 ms
```

www.tsinghua.edu.cn connected

```
[~bash-4.2$ ping www.tsinghua.edu.cn
PING www.d.tsinghua.edu.cn (166.111.4.100) 56(84) bytes of data.
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=1 ttl=232 time=310 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=2 ttl=232 time=310 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=3 ttl=232 time=310 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=4 ttl=232 time=310 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=5 ttl=232 time=310 ms
^C
--- www.d.tsinghua.edu.cn ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 310.496/310.683/310.772/0.096 ms
```

www.kremlin.ru ping request can be sent but has no response

```

[-bash-4.2$ ping www.kremlin.ru
PING www.kremlin.ru (95.173.136.72) 56(84) bytes of data.
^C
--- www.kremlin.ru ping statistics ---
28 packets transmitted, 0 received, 100% packet loss, time 27215ms

```

8.8.8.8 connected

```

[-bash-4.2$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_req=1 ttl=120 time=1.37 ms
64 bytes from 8.8.8.8: icmp_req=2 ttl=120 time=1.15 ms
64 bytes from 8.8.8.8: icmp_req=3 ttl=120 time=1.26 ms
64 bytes from 8.8.8.8: icmp_req=4 ttl=120 time=1.19 ms
64 bytes from 8.8.8.8: icmp_req=5 ttl=120 time=1.20 ms
^C
--- 8.8.8.8 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.158/1.239/1.370/0.080 ms

```

Exercise 3: Use traceroute to understand network topology:

1. How many routers are there between your workstation and www.columbia.edu ?
21 routers. (from cse server to the website server)

```

[-bash-4.2$ traceroute www.columbia.edu
traceroute to www.columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.160 ms 0.144 ms 0.127 ms
 2 129.94.39.17 (129.94.39.17) 1.029 ms 1.035 ms 1.112 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.453 ms 1.734 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.646 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.291 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.126 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.424 ms 1.326 ms 1.400 ms
 6 138.44.5.0 (138.44.5.0) 1.630 ms 1.508 ms 1.457 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.249 ms 2.308 ms 2.321 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.461 ms 95.398 ms 95.337 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.475 ms 146.546 ms 146.438 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 150.966 ms 150.970 ms 150.976 ms
11 et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0) 157.631 ms 157.627 ms 157.655 ms
12 et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58) 180.735 ms 180.738 ms 180.809 ms
13 et-1-1-2.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 188.464 ms 188.605 ms 188.561 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 196.923 ms 196.995 ms 198.405 ms
15 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 201.293 ms 201.300 ms 201.260 ms
16 syr-9208-buf-9208.nysernet.net (199.109.7.193) 220.307 ms 213.604 ms 213.579 ms
17 nyc-9208-syr-9208.nysernet.net (199.109.7.162) 210.504 ms 210.328 ms 210.455 ms
18 columbia.nyc-9208.nysernet.net (199.109.4.14) 210.243 ms 210.319 ms 210.401 ms
19 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 210.699 ms 210.709 ms 210.722 ms
20 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.210) 210.896 ms 210.811 ms 210.831 ms
21 gutenber-e.org (128.59.105.24) 210.694 ms 210.731 ms 210.818 ms

```

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

The first five routers are part of the UNSW network.

Between which two routers do packets cross the Pacific Ocean?

Between the 7 and 8 routers, the packets cross the Pacific Ocean, because there is a huge increase in delay, which from almost 2.3ms to 95.4ms.

2. At which router do the paths from your machine to these three destinations diverge?
Find out further details about this router.

```
l-bash-4.2$ traceroute www.ucla.edu
traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.219 ms 0.213 ms 0.197 ms
 2 129.94.39.17 (129.94.39.17) 1.163 ms 1.172 ms 1.184 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 2.281 ms 2.255 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.656 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.423 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.460 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.423 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.545 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.463 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.545 ms
 6 138.44.5.0 (138.44.5.0) 1.684 ms 1.577 ms 1.545 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.367 ms 2.291 ms 2.293 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.330 ms 95.348 ms 95.401 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.576 ms 146.539 ms 146.549 ms
10 cenichpr-1-is-jmb-778.srvaca.pacificwave.net (207.231.245.129) 163.071 ms 163.109 ms 163.137 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73) 171.106 ms 171.076 ms 171.101 ms
12 * * *
13 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 171.185 ms bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 171.357 ms 171.325 ms
14 cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55) 171.228 ms 171.261 ms 171.231 ms
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

```
l-bash-4.2$ 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-server.cse.unsw.EDU.AU (129.94.242.251) 0.154 ms 0.134 ms 0.124 ms
 2 129.94.39.17 (129.94.39.17) 1.067 ms 1.021 ms 1.028 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.917 ms 1.943 ms 1.944 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.239 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.275 ms 1.347 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.364 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.460 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.380 ms
 6 138.44.5.0 (138.44.5.0) 1.733 ms 1.576 ms 1.605 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.958 ms 1.929 ms 1.912 ms
 8 ge-4-0-0.bb1.a.poo.aarnet.net.au (202.158.194.177) 156.900 ms 157.350 ms 157.344 ms
 9 paloolto0.iiij.net (198.32.176.24) 158.162 ms 158.286 ms 158.195 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 271.311 ms 271.249 ms osk004bb00.IIJ.Net (58.138.88.185) 289.017 ms
11 osk004ix51.IIJ.Net (58.138.106.130) 270.924 ms osk004ix51.IIJ.Net (58.138.106.126) 279.892 ms osk004ix51.IIJ.Net (58.138.106.130) 271.032 ms
12 210.130.135.130 (210.130.135.130) 272.894 ms 280.130 ms 272.881 ms
13 124.83.228.78 (124.83.228.78) 288.624 ms 285.139 ms 288.664 ms
14 124.83.252.250 (124.83.252.250) 286.345 ms 286.360 ms 286.357 ms
15 158.205.134.26 (158.205.134.26) 286.239 ms 286.339 ms 286.311 ms
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

```

-bash-4.2$ traceroute www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.edu.au (129.94.242.251) 0.203 ms 0.195 ms 0.188 ms
 2 129.94.39.17 (129.94.39.17) 1.063 ms 1.092 ms 1.064 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 2.075 ms 2.029 ms 2.273 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.454 ms 1.360 ms 1.360 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.500 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.506 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.649 ms
 6 138.44.5.0 (138.44.5.0) 1.689 ms 1.485 ms 1.508 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.356 ms 2.288 ms 2.333 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.240 ms 95.210 ms 95.297 ms
 9 et-2-1-0.bdri1.a.sea.aarnet.net.au (113.197.15.201) 148.329 ms 148.328 ms 148.369 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 146.550 ms 146.522 ms 146.483 ms
11 et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0) 157.392 ms 157.134 ms 157.101 ms
12 et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58) 180.450 ms 180.404 ms 180.467 ms
13 et-1-1-2.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 188.274 ms 188.386 ms 188.368 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 197.484 ms 197.189 ms 197.199 ms
15 et-2-0-0.4079.rtsw.ashb.net.internet2.edu (162.252.70.54) 204.755 ms 204.570 ms 204.583 ms
16 ae-2.4079.rtsw.wash.net.internet2.edu (162.252.70.136) 205.295 ms 205.267 ms 205.335 ms
17 ae-5.4079.rtsw.newy32aaa.net.internet2.edu (162.252.70.139) 210.181 ms 210.275 ms 210.254 ms
18 198.71.45.237 (198.71.45.237) 280.585 ms 280.760 ms 280.620 ms
19 ae1.mx1.lon2.uk.geant.net (62.40.98.76) 290.905 ms 282.736 ms 282.846 ms
20 ae3.mx1.lon.uk.geant.net.geant.net (62.40.98.78) 283.607 ms 283.621 ms 304.979 ms
21 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 283.613 ms 283.857 ms 284.156 ms
22 ae29.londpg-sbr2.ja.net (146.97.33.2) 284.251 ms 284.255 ms 284.423 ms
23 ae31.erdiss-sbr2.ja.net (146.97.33.22) 288.021 ms 287.995 ms 289.045 ms
24 ae29.manckh-sbr2.ja.net (146.97.33.42) 289.889 ms 289.857 ms 289.803 ms
25 ae24.lancu-rbr1.ja.net (146.97.38.58) 292.443 ms 292.118 ms 292.124 ms
26 * * *
27 ismx-issrx.rtr.lancs.ac.uk (148.88.255.17) 293.866 ms 293.787 ms 293.799 ms
28 dc.iss.srv.rtrcloud.lancs.ac.uk (148.88.253.3) 308.159 ms 304.538 ms 307.065 ms
29 www.lancs.ac.uk (148.88.65.80) 294.005 ms IX 293.983 ms IX 293.839 ms IX

```

Through the three pictures above, it can be seen that the paths diverge from the third routers.

Is the number of hops on each path proportional the physical distance?

Yes.

www.lancaster.ac.uk 10569.8 miles from Syd 29 jumps

www.u-tokyo.ac.jp 4908.7 miles from Syd 15 jumps

www.ucla.edu 7499.0 miles from Syd 14 jumps

- 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 to login.cse.unsw.edu.au (129.94.242.53), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.186 ms 0.185 ms 0.203 ms
 2 10.11.33.38 (10.11.33.38) 32.882 ms 32.890 ms 32.894 ms
 3 hutchcity3-10g.hkix.net (123.255.90.140) 34.473 ms 34.535 ms 34.480 ms
 4 dl-42-238-143-118-on-nets.com (118.143.238.42) 34.306 ms 34.357 ms 218.189.5.42 (218.189.5.42) 34.306 ms 34.357 ms 218.189.5.42 (218.189.5.42)
 5 dl-26-224-143-118-on-nets.com (118.143.224.26) 189.192 ms dl-2-224-143-118-on-nets.com (118.143.224.26) 189.192 ms dl-2-224-143-118-on-nets.com (118.143.224.26) 189.192 ms
 6 aarnet.as7575.any2ix.coresite.com (206.72.210.64) 172.445 ms 170.682 ms 170.717 ms
 7 xe-0-0-3.pe1.tkpa.akl.aarnet.net.au (202.158.194.172) 303.364 ms 303.136 ms 303.033 ms
 8 et-0-1-0.200.pe1.wnpa.akl.aarnet.net.au (113.197.15.68) 303.678 ms 294.959 ms 304.010 ms
 9 xe-0-2-2-204.pe1.alxd.nsw.aarnet.net.au (113.197.15.182) 335.351 ms 335.079 ms 324.473 ms
10 et-8-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.152) 331.380 ms 339.433 ms 330.958 ms
11 138.44.5.1 (138.44.5.1) 327.311 ms 326.373 ms 327.845 ms
12 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 326.474 ms 325.956 ms 318.724 ms
13 libudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 338.444 ms ombudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 338.444 ms ombudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 338.444 ms
14 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 319.356 ms 329.183 ms 326.994 ms
15 129.94.39.23 (129.94.39.23) 326.754 ms 329.001 ms 318.426 ms
16 * * *

```

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

```

1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.361 ms 0.332 ms 0.241 ms
2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 3.116 ms 1.352 ms 1.990 ms
3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.110 ms 12.099 ms 12.860 ms
4 bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95) 11.984 ms 11.849 ms 11.987 ms
5 aarnet6.lnk.telstra.net (139.130.0.78) 11.611 ms 11.602 ms 11.608 ms
6 ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17) 11.860 ms 11.725 ms 11.734 ms
7 ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56) 12.111 ms 12.099 ms 12.112 ms
8 et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146) 12.358 ms 12.348 ms 12.360 ms
9 138.44.5.1 (138.44.5.1) 12.609 ms 12.600 ms 12.608 ms
10 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 12.611 ms 12.600 ms 12.609 ms
11 libudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 12.863 ms
12 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 13.222 ms 13.225 ms 13.236 ms
13 129.94.39.23 (129.94.39.23) 13.357 ms 13.352 ms 13.359 ms

```

From my machine to www.speedtest.com,

```

-bash-4.2$ traceroute www.speedtest.com
traceroute to www.speedtest.com (209.15.13.134), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.187 ms 0.175 ms 0.164 ms
 2 129.94.39.17 (129.94.39.17) 1.175 ms 1.123 ms 1.133 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.727 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.769 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.356 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.411 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.369 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.438 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.399 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.462 ms
 6 138.44.5.0 (138.44.5.0) 1.865 ms 1.743 ms 1.710 ms
 7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.786 ms 1.782 ms 1.802 ms
 8 xe-0-2-1-204.pe1.wnmpa.alxd.aarnet.net.au (113.197.15.183) 24.269 ms xe-0-0-3.pe1.wnmpa.akl.aarnet.net.au (113.197.15.67) 24.243 ms xe-0-2-1-204.pe1.wnmpa.alxd.aarnet.net.au (113.197.15.183) 24.341 ms
 9 et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69) 27.354 ms 27.369 ms 27.390 ms
10 xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173) 148.164 ms 148.126 ms 148.014 ms
11 peer1network.as13768.any2ix.coresite.com (206.72.210.79) 148.133 ms 162.599 ms 162.534 ms
12 ***
13 ***
14 ***
15 ***
16 ***
17 ***
18 ***
19 ***
20 ***
21 ***
22 ***
23 ***
24 ***
25 ***
26 ***
27 ***
28 ***
29 ***
30 ***

```

From my machine to www.telstra.net,

```

-bash-4.2$ 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) 0.192 ms 0.177 ms 0.163 ms
 2 129.94.39.17 (129.94.39.17) 1.109 ms 1.105 ms 1.060 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.569 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 2.740 ms 2.744 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.465 ms 1.403 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.358 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 8.752 ms 8.642 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 8.688 ms
 6 138.44.5.0 (138.44.5.0) 1.793 ms 1.679 ms 1.657 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.695 ms 1.701 ms 1.700 ms
 8 ae9.bb1.a.syd.aarnet.net.au (113.197.15.57) 1.992 ms 2.077 ms 1.981 ms
 9 gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18) 2.202 ms 2.209 ms 2.144 ms
10 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 2.707 ms 4.262 ms 4.263 ms
11 bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94) 4.250 ms 4.208 ms 4.210 ms
12 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 15.784 ms 15.490 ms 15.462 ms
13 gigabitethernet5-0.exi-service2.melbourne.telstra.net (203.50.80.132) 13.832 ms 13.720 ms 13.868 ms
14 ***
15 ***
16 ***
17 ***
18 ***
19 ***
20 ***
21 ***
22 ***
23 ***
24 ***
25 ***
26 ***
27 ***
28 ***
29 ***
30 ***

```

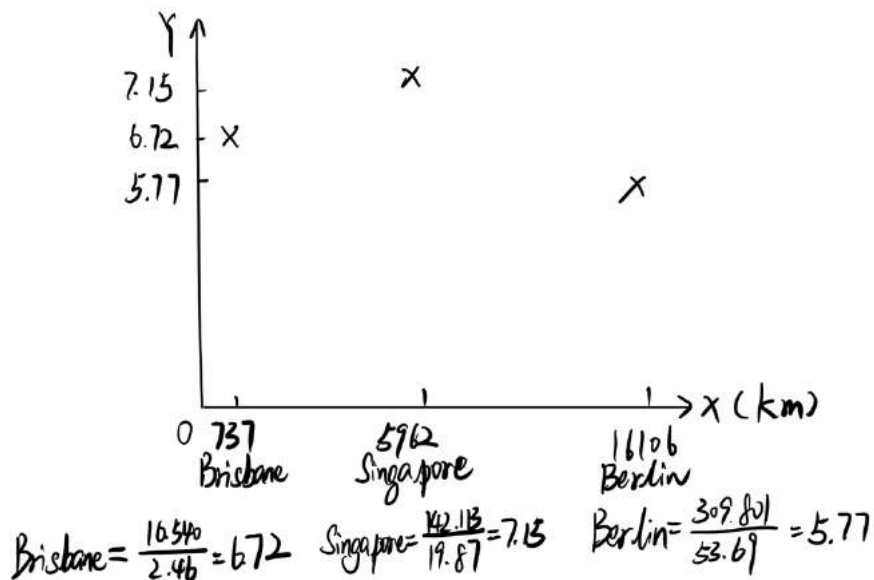
I have chosen <http://www.speedtest.com.sg/tr.php> and <https://www.telstra.net/cgi-bin/trace>. From the pictures above, it can be seen that the reverse path does not go through the same routers as the forward path. The IP address of the common routers between forward and the reverse path is also not the same. I think it is because the routing policy using on these routers or the best path is also changing.

Exercise 4: Use ping to gain insights into network performance

1. From UNSW to Brisbane, the direct physical distance is 737.25 kilometers.
 $T = 737.25 / \text{light speed} = 2.46\text{ms}$

From UNSW to Singapore, the direct physical distance is 5962.46 kilometers.
 $T = 5962.46 / \text{light speed} = 19.87\text{ms}$

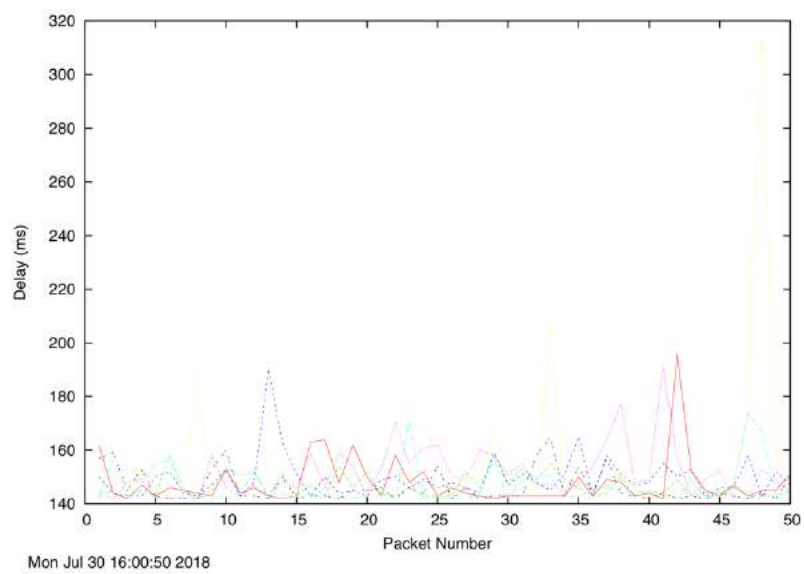
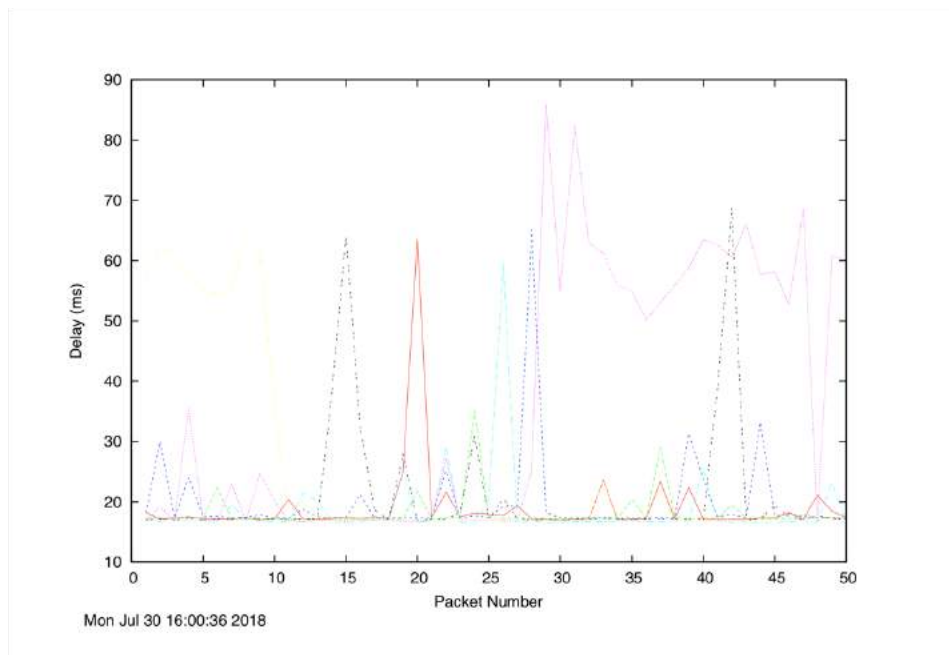
From UNSW to Berlin, the direct physical distance is 16106.19 kilometers.
 $T = 16106.19 / \text{light speed} = 53.69\text{ms}$

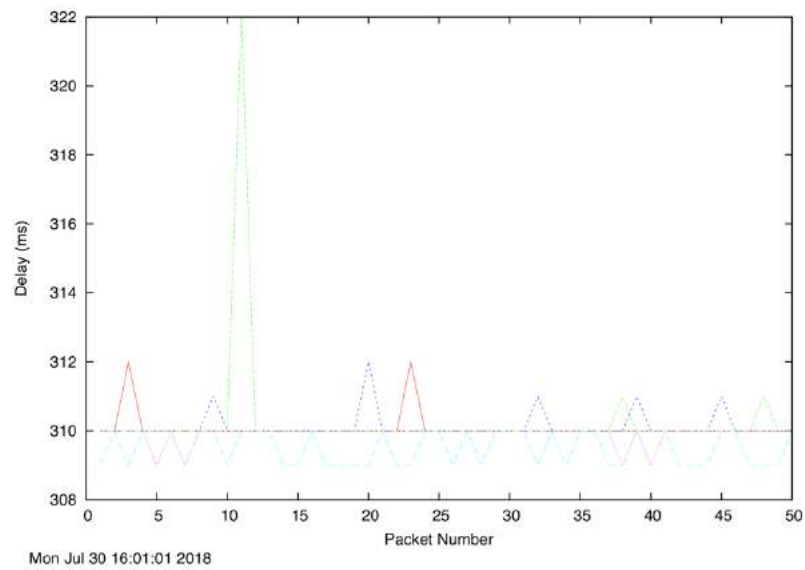


Can you think of at least two reasons why the y-axis values that you plot are greater than 2?

Because the packets could be affected by network congestion, switch-routing policy used on the routers (especially the quality of service policy), the bandwidth of the network and so on.

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





From the graphs above, the delay to the destinations varies over time. The reason why the delay to the destinations varies over time is that the environment of the network varies, such as the vary of the network traffic.

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?

Propagation delay, queuing delay and processing delay do not depend on the packet size.

Transmission delay depends on the packet size.