Exercise 1

Q1.

Server: 129.94.208.3

Several IP addresses could be used for load balancing/load distribution so that no single server bears too much demand (workload is spread evenly).

Q2.

Localhost (127.0.0.1) - your own computer and cannot be used to communicate with other computers

Exercise 2

yes www.unsw.edu.au

no www.getfittest.com.au

yes www.mit.edu

yes www.intel.com.au

yes www.tpg.com.au

no www.hola.hp

yes www.amazon.com

yes www.tsinghua.edu.cn

no www.kremlin.ru

yes 8.8.8.8

For getfittest and hola, these websites do not exist so their addresses are not accessable from using both the ping command and a Web browser. For kremlin.ru, the ping command cannot reach it but a web browser can because of security issues (the website is deemed unsafe by the browser).

Exercise 3

Q1.

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) 0.305 ms 0.255 ms 0.222 ms

2 129.94.39.17 (129.94.39.17) 0.988 ms 1.006 ms 0.907 ms

3 172.17.31.154 (172.17.31.154) 1.872 ms 1.895 ms 2.175 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.498 ms 1.401 ms 1.483 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.388 ms 1.302 ms 1.441 ms

6 138.44.5.0 (138.44.5.0) 1.472 ms 1.427 ms 1.361 ms

7 et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4) 1.907 ms 3.549 ms 3.547 ms

8 et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137) 71.947 ms 71.948 ms 71.919 ms

9 138.44.228.5 (138.44.228.5) 186.376 ms 186.386 ms 186.344 ms

10 fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115) 237.449 ms 237.369 ms 237.372 ms

11 fourhundredge-0-0-0-21.4079.core1.salt.net.internet2.edu (163.253.1.28) 237.335 ms fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168) 237.157 ms fourhundredge-0-0-0-22.4079.core1.salt.net.internet2.edu (163.253.1.30) 237.483 ms

12 fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251) 236.507 ms fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170) 236.987 ms fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251) 236.404 ms

13 fourhundredge-0-0-0-0.4079.core1.kans.net.internet2.edu (163.253.1.243) 237.734 ms 238.215 ms 238.174 ms

14 fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244) 236.473 ms 237.927 ms 237.865 ms

15 fourhundredge-0-0-0-3.4079.core2.eqch.net.internet2.edu (163.253.2.19) 237.794 ms 237.427 ms 237.383 ms

16 fourhundredge-0-0-0-0.4079.core2.clev.net.internet2.edu (163.253.2.16) 237.357 ms 237.316 ms 235.981 ms

17 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 238.616 ms 238.707 ms 238.664 ms

18 syr-55a1-buf-9208.nysernet.net (199.109.7.213) 242.322 ms 242.227 ms 242.237 ms

19 nyc32-55a1-syr-55a1.nysernet.net (199.109.7.206) 247.425 ms 247.411 ms 247.372 ms

20 nyc32-9208-nyc32-55a1.nysernet.net (199.109.7.201) 254.195 ms 247.096 ms 254.153 ms

21 columbia.nyc-9208.nysernet.net (199.109.4.14) 247.521 ms 247.863 ms 247.848 ms

22 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 247.843 ms 247.961 ms 247.837 ms

23 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 247.822 ms 247.512 ms 247.455 ms

24 www.neurotheory.columbia.edu (128.59.105.24) 247.374 ms 247.305 ms 247.139 ms

There are 23 routers between my workstation and www.columbia.edu

5 are part of the UNSW network

Packets cross the Pacific Ocean between routers 16 and 17 as 16 is in Brisbane and 17 is in New York.

Q2.

traceroute to www.ucla.edu (108.138.94.16), 30 hops max, 60 byte packets

1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.142 ms 0.114 ms 0.094 ms

2 129.94.39.17 (129.94.39.17) 0.878 ms 0.883 ms 0.873 ms

3 172.17.31.154 (172.17.31.154) 1.647 ms 1.636 ms 1.587 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.252 ms 1.264 ms 1.240 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.302 ms 1.276 ms 1.238 ms

6 138.44.5.0 (138.44.5.0) 2.539 ms 1.482 ms 1.462 ms

7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.763 ms 1.639 ms 1.748 ms

8 xe-0-2-5.bdr1.b.sea.aarnet.net.au (202.158.194.121) 143.724 ms 143.666 ms 143.685 ms

9 xe-4-1-1.mpr1.sea1.us.above.net (64.125.193.129) 143.887 ms 143.897 ms 143.799 ms

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11 ae27.mpr2.sea1.us.zip.zayo.com (64.125.29.3) 149.081 ms 148.521 ms 148.549 ms

12 99.82.182.102 (99.82.182.102) 143.897 ms 143.907 ms 143.865 ms

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17 150.222.214.200 (150.222.214.200) 143.937 ms 150.222.214.201 (150.222.214.201) 143.934 ms 144.010 ms

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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) 0.070 ms 0.068 ms 0.041 ms

2 129.94.39.17 (129.94.39.17) 0.899 ms 0.858 ms 1.019 ms

3 172.17.31.154 (172.17.31.154) 2.102 ms 1.563 ms 2.104 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.142 ms 1.195 ms 1.204 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.221 ms 1.174 ms 1.197 ms

6 138.44.5.0 (138.44.5.0) 1.290 ms 1.398 ms 1.397 ms

7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 3.884 ms 3.435 ms 3.424 ms

8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 155.918 ms 156.005 ms 155.963 ms

9 paloalto0.iij.net (198.32.176.24) 157.358 ms 157.289 ms 157.403 ms

10 osk011bb00.IIJ.Net (58.138.84.225) 275.534 ms osk004bb01.IIJ.Net (58.138.88.189) 267.449 ms 267.401 ms

11 osk004ip57.IIJ.Net (58.138.81.74) 275.520 ms osk004ip57.IIJ.Net (58.138.106.166) 267.490 ms osk004ip57.IIJ.Net (58.138.81.78) 271.711 ms

12 210.130.135.130 (210.130.135.130) 272.741 ms 272.894 ms 275.732 ms

13 124.83.228.58 (124.83.228.58) 275.311 ms 271.690 ms 267.717 ms

14 124.83.252.178 (124.83.252.178) 279.763 ms 279.180 ms 281.782 ms

15 158.205.134.26 (158.205.134.26) 277.673 ms 277.740 ms 281.592 ms

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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) 0.129 ms 0.123 ms 0.109 ms

2 129.94.39.17 (129.94.39.17) 0.942 ms 0.939 ms 0.945 ms

3 172.17.31.154 (172.17.31.154) 1.607 ms 1.974 ms 1.549 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.341 ms 1.348 ms 1.357 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.358 ms 1.391 ms 1.348 ms

6 138.44.5.0 (138.44.5.0) 1.567 ms 1.300 ms 1.312 ms

7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 98.242 ms 97.987 ms 97.960 ms

8 138.44.226.7 (138.44.226.7) 256.484 ms 256.524 ms 256.478 ms

9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 256.410 ms 256.366 ms 256.402 ms

10 ae29.londpg-sbr2.ja.net (146.97.33.2) 256.883 ms 256.788 ms 256.873 ms

11 ae31.erdiss-sbr2.ja.net (146.97.33.22) 260.703 ms 260.738 ms 260.662 ms

12 ae29.manckh-sbr2.ja.net (146.97.33.42) 262.470 ms 262.717 ms 262.663 ms

13 ae25.manckh-ban1.ja.net (146.97.35.50) 262.698 ms 262.563 ms 262.494 ms

14 lancaster-uni.ja.net (146.97.40.178) 276.490 ms 276.500 ms 276.432 ms

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The paths of the machines diverge at router 8 because it has the role of the AARNET network operations centre

From the traceroute results, the number of hops on each path is not proportional to the physical distance because Japan's distance is about 6848km but it has one more hop than London which is 16918km away from Australia.

Q3.

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) 0.087 ms 0.087 ms 0.080 ms

2 129.94.39.17 (129.94.39.17) 0.956 ms 0.996 ms 0.959 ms

3 172.17.31.154 (172.17.31.154) 1.776 ms 1.743 ms 1.782 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.369 ms 1.336 ms 1.374 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 15.212 ms 15.229 ms 15.233 ms

6 138.44.5.0 (138.44.5.0) 1.532 ms 3.763 ms 3.770 ms

7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.746 ms 1.710 ms 1.723 ms

8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.757 ms 147.677 ms 147.623 ms

9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.699 ms 147.666 ms 147.666 ms

10 203.208.171.117 (203.208.171.117) 147.955 ms 147.972 ms 203.208.172.153 (203.208.172.153) 324.720 ms

11 203.208.172.145 (203.208.172.145) 244.974 ms 244.968 ms 203.208.177.110 (203.208.177.110) 326.812 ms

12 203.208.182.253 (203.208.182.253) 308.185 ms 203.208.158.17 (203.208.158.17) 326.269 ms *

13 203.208.158.185 (203.208.158.185) 331.731 ms 202.150.221.170 (202.150.221.170) 200.863 ms 203.208.158.185 (203.208.158.185) 326.873 ms

traceroute to 129.94.242.118 (129.94.242.118), 30 hops max, 60 byte packets

1 202.150.221.169 (202.150.221.169) 0.195 ms 0.201 ms 0.226 ms

2 10.11.34.146 (10.11.34.146) 0.526 ms 0.677 ms 0.707 ms

3 aarnet.sgix.sg (103.16.102.67) 209.165 ms 209.131 ms 209.145 ms

4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232) 213.691 ms 213.644 ms 213.661 ms

5 138.44.5.1 (138.44.5.1) 199.997 ms 199.886 ms 199.959 ms

6 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 200.049 ms 199.944 ms 200.271 ms

7 irb-51901.kecd1-176q4-cbl-e1.gw.unsw.edu.au (129.94.24.10) 209.225 ms 209.236 ms *

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9 129.94.39.23 (129.94.39.23) 212.794 ms 212.888 ms 212.848 ms

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traceroute to portal.etsi.org (195.238.226.19), 30 hops max, 60 byte packets

1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.095 ms 0.083 ms 0.070 ms

2 129.94.39.17 (129.94.39.17) 0.839 ms 0.856 ms 0.879 ms

3 172.17.31.154 (172.17.31.154) 1.467 ms 1.899 ms 1.910 ms

4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20) 1.255 ms 1.130 ms 1.248 ms

5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.137 ms 1.161 ms 1.204 ms

6 138.44.5.0 (138.44.5.0) 2.358 ms 1.313 ms 1.310 ms

7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.889 ms 92.850 ms 92.855 ms

8 xe-0-0-6-2.a01.sngpsi03.sg.bb.gin.ntt.net (116.51.27.145) 92.803 ms 92.813 ms 92.830 ms

9 ae-15.r23.sngpsi07.sg.bb.gin.ntt.net (129.250.7.84) 97.284 ms ae-14.r22.sngpsi07.sg.bb.gin.ntt.net (129.250.7.82) 93.186 ms ae-15.r23.sngpsi07.sg.bb.gin.ntt.net (129.250.7.84) 97.287 ms

10 ae-0.a00.sngpsi07.sg.bb.gin.ntt.net (129.250.2.74) 93.320 ms 93.330 ms 93.321 ms

11 193.251.142.73 (193.251.142.73) 93.469 ms 93.592 ms 93.729 ms

12 81.52.166.55 (81.52.166.55) 251.484 ms 251.817 ms 251.535 ms

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portal.etsi.org did not run traceroute back to CSE machine.

IP address of www.speedtest.com.sg is 202.150.221.170 and portal.etsi.org is 195.238.226.19

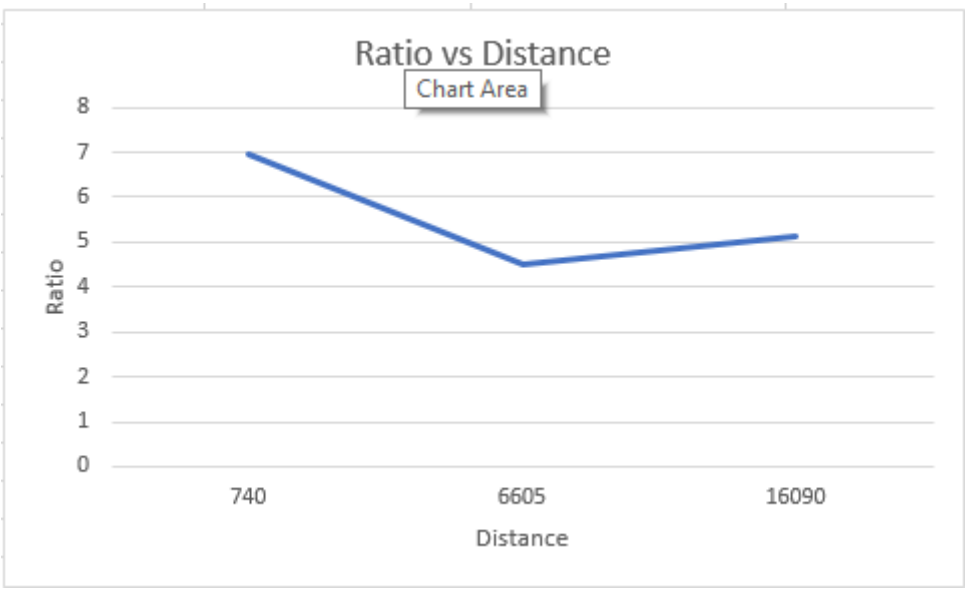
The reverse path for speedtest basically goes through the same routers as the forward path with a few less routers in between.

Routers are not the same on both paths but are very similar like unswbr1-te-2-13.gw.unsw.edu.au and libcr1-te-1-5.gw.unsw.edu.au as the packets don't have to follow the exact same path everytime.

Exercise 4

Q1.

Website	City	Physical Distance (km)	Shortest time T (ms)	Min_RTT (ms)	Ratio
www.uq.edu.au	Brisbane	740	2.47	17.116	6.938918919
www.upm.edu.au	Kuala Lumper	6605	22.02	99.642	4.525753217
www.tu-berline.de	Berlin	16090	53.63	274.335	5.115009323



Q2.

The delay to the destinations varies over time because for example, there can be many packets in the queue at one time and less packets at another which affects the delay time.

Q3.

Processing delay affected by packet size, but a small amount

Transmission delay affeced by packet size due to bandwidth

Queue delay only affected by traffic (no. of packets)

Propagation delay affected by distance/speed.