Exercise 1: nslookup

1. Name: www.koala.com.au
   Address: 104.18.61.21
   Address: 104.18.60.21

   The reason of having several IP addresses because we don't want to much traffic in one address.

2. Name: localHost. LocalHost is the server of the computer that being used.

Exercise 2: Use ping to test host reachability

www.unsw.edu.au - reachable
www.getfittest.com.au – unreachable by ping and from web browser.
www.mit.edu - reachable
www.intel.com.au - reachable
www.tpg.com.au - reachable
www.hola.hp – unreachable by ping and from web browser
www.amazon.com - reachable
www.tsinghua.edu.cn - reachable
www.kremlin.ru - reachable
8.8.8.8 – reachable

Some host is not reachable because it is not a valid host.

Exercise 3: Use traceroute to understand network topology

1. There are 22 routers between my workstation and www.columbia.edu, 5 routers that part of the UNSW network, and the routers that do packets cross the pacific ocean are 113.197.15.149 and 113.197.15.99.

2. (i) 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) 0.209 ms 0.147 ms 0.114 ms
 2 129.94.39.17 (129.94.39.17) 0.921 ms 0.894 ms 0.838 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.530 ms 1.560 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.355 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.262 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.246 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.088 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.219 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.181 ms 1.282 ms
 6 138.44.5.0 (138.44.5.0) 1.307 ms 1.397 ms 1.359 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 1.996 ms 2.039 ms 2.020 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.170 ms 95.150 ms 95.121 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 147.060 ms 147.048 ms 147.019 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 164.149 ms 164.139 ms 163.485 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73) 160.170 ms 160.198 ms 160.835 ms
12 * * *

13 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 161.085 ms bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 160.549 ms bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 160.498 ms
14 cr00f2.csb1--rtr12f4.mathsci.ucla.net (169.232.8.183) 161.407 ms 160.709 ms 161.346 ms
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

(ii) 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) 0.178 ms 0.120 ms 0.123 ms
 2 129.94.39.17 (129.94.39.17) 0.827 ms 0.851 ms 0.796 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.895 ms 1.789 ms 1.770 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.147 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.124 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.129 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.153 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.180 ms 1.146 ms
 6 138.44.5.0 (138.44.5.0) 1.663 ms 1.842 ms 1.835 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 2.037 ms 1.778 ms 1.910 ms
 8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 155.133 ms 155.129 ms 155.101 ms
 9 paloalto0.iij.net (198.32.176.24) 156.430 ms 156.419 ms 156.476 ms
10 osk004bb00.IIJ.Net (58.138.88.185) 287.099 ms 287.090 ms 287.055 ms
11 osk004ip57.IIJ.Net (58.138.106.162) 278.211 ms 278.195 ms osk004ip57.IIJ.Net (58.138.106.166) 278.188 ms
12 210.130.135.130 (210.130.135.130) 287.054 ms 287.003 ms 286.993 ms
13 124.83.228.58 (124.83.228.58) 269.363 ms 269.651 ms 269.579 ms
14 124.83.252.178 (124.83.252.178) 311.366 ms 309.945 ms 309.917 ms
15 158.205.134.26 (158.205.134.26) 284.163 ms 293.033 ms 293.050 ms
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

(iii) www.lancaster.ac.uk

traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1 cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251) 0.226 ms 0.190 ms 0.160 ms
 2 129.94.39.17 (129.94.39.17) 0.905 ms 0.887 ms 0.859 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.422 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.393 ms 1.407 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.126 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.110 ms 1.113 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.147 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.108 ms 1.152 ms
 6 138.44.5.0 (138.44.5.0) 1.285 ms 1.355 ms 1.326 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.824 ms 92.654 ms 92.621 ms
 8 138.44.226.7 (138.44.226.7) 260.092 ms 260.037 ms 260.032 ms
 9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 260.215 ms 260.183 ms 260.155 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 260.574 ms 260.558 ms 260.520 ms
11 ae31.erdiss-sbr2.ja.net (146.97.33.22) 264.491 ms 264.485 ms 264.397 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 266.236 ms 266.403 ms 266.281 ms
13 ae24.lanclu-rbr1.ja.net (146.97.38.58) 268.587 ms 268.596 ms 268.565 ms
14 lancaster-university.ja.net (194.81.46.2) 328.618 ms 324.001 ms 323.944 ms
15 is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202) 268.923 ms 269.027 ms 268.992 ms
16 bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98) 274.633 ms 271.829 ms 271.864 ms
17 * * *
18 www.lancs.ac.uk (148.88.65.80) 269.230 ms !X 269.065 ms !X 269.221 ms !X

138.44.5.0 is the router where the paths from my machine to the three destinations diverge. The number of hops on each path is proportional the physical distance, the more the hoops, the further the distance.

3. (i) http://www.speedtest.com.sg/tr.php

From server to my machine

traceroute to 129.94.242.115 (129.94.242.115), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.142 ms 0.157 ms 0.159 ms
 2 10.15.62.210 (10.15.62.210) 0.275 ms 0.282 ms 0.287 ms
 3 aarnet.sgix.sg (103.16.102.67) 225.966 ms 225.978 ms 225.983 ms
 4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232) 208.129 ms 208.158 ms 208.082 ms
 5 138.44.5.1 (138.44.5.1) 209.330 ms 209.278 ms 209.244 ms
 6 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 209.256 ms 209.262 ms 209.224 ms
 7 libudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 213.430 ms ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202) 208.861 ms 208.939 ms
 8 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 212.211 ms 212.197 ms 212.267 ms
 9 129.94.39.23 (129.94.39.23) 210.096 ms 210.043 ms 210.051 ms
10 * * *
11 * * *
12 * * *
13 * * *
14 * * *
15 * * *

16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

From my machine to server

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) 0.105 ms 0.087 ms 0.067 ms
 2 129.94.39.17 (129.94.39.17) 0.854 ms 0.847 ms 0.828 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.538 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.313 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.460 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.143 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.169 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.147 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.218 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.232 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.191 ms
 6 138.44.5.0 (138.44.5.0) 5.924 ms 5.268 ms 5.215 ms
 7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.682 ms 1.737 ms 1.727 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.536 ms 147.484 ms 147.551 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.697 ms 147.696 ms 147.684 ms
10 203.208.171.9 (203.208.171.9) 324.224 ms 203.208.171.117 (203.208.171.117) 147.980 ms 148.009 ms
11 203.208.151.233 (203.208.151.233) 248.420 ms 203.208.172.145 (203.208.172.145) 249.641 ms 203.208.177.110 (203.208.177.110) 321.292 ms
12 203.208.182.253 (203.208.182.253) 335.991 ms 203.208.158.17 (203.208.158.17) 331.122 ms 331.100 ms
13 202-150-221-170.rev.ne.com.sg (202.150.221.170) 214.413 ms 205.658 ms 203.208.158.185 (203.208.158.185) 334.126 ms

(ii) https://www.telstra.net/cgi-bin/trace

From server to my machine

 1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.343 ms 0.205 ms 0.242 ms
 2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 1.616 ms 1.477 ms 2.241 ms
 3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.859 ms 12.348 ms 12.984 ms
 4 bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95) 31.601 ms 11.975 ms 12.733 ms
 5 aarnet6.lnk.telstra.net (139.130.0.78) 11.735 ms 11.599 ms 11.736 ms

6 xe-5-2-2.pe1.brwy.nsw.aarnet.net.au (113.197.15.32) 11.736 ms 11.848 ms 11.861 ms
7 138.44.5.1 (138.44.5.1) 11.983 ms 11.976 ms 11.987 ms
8 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 11.982 ms 12.098 ms 11.986 ms
9 ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202) 12.360 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.723 ms 12.599 ms 12.736 ms
11 129.94.39.23 (129.94.39.23) 12.861 ms 12.853 ms 12.860 ms

From my machine to server

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) 0.159 ms 0.134 ms 0.102 ms
2 129.94.39.17 (129.94.39.17) 0.864 ms 0.884 ms 0.833 ms
3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.353 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 10.484 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.452 ms
4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.080 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.084 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.045 ms
5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.094 ms 1.129 ms 1.127 ms
6 138.44.5.0 (138.44.5.0) 1.202 ms 1.261 ms 1.202 ms
7 xe-0-0-0.bdr1.rsby.nsw.aarnet.net.au (113.197.15.33) 1.418 ms 1.487 ms 1.468 ms
8 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 2.182 ms 2.062 ms 3.451 ms
9 bundle-ether2.chw-edge901.sydney.telstra.net (203.50.11.103) 2.207 ms 2.206 ms bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94) 2.549 ms
10 bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98) 2.131 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 13.440 ms 13.387 ms
11 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 13.280 ms 203.50.6.40 (203.50.6.40) 14.896 ms 14.894 ms
12 bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209) 13.199 ms 13.036 ms 13.143 ms
13 www.telstra.net (203.50.5.178) 12.773 ms 12.481 ms 12.611 ms

Both traceroute from the server to my machine did not reach my IP address but instead reach the unsw router and the reverse path take more hops to reach the destination than forward path.

For the common routers between the forward and reverse path, the IP addresses are different because one IP address for outgoing packets and the other for receiving packets.

Exercise 4: Use ping to gain insights into network performance

(i) www.uq.edu.au (University of Queensland)

Distance from UNSW : 733km.
Shortest possible time: $733*10^3 / 3*10^8 = 2.44$ms
Minimum delay = 16.590ms
Ratio between the minimum delay and shortest possible time = 6.80ms

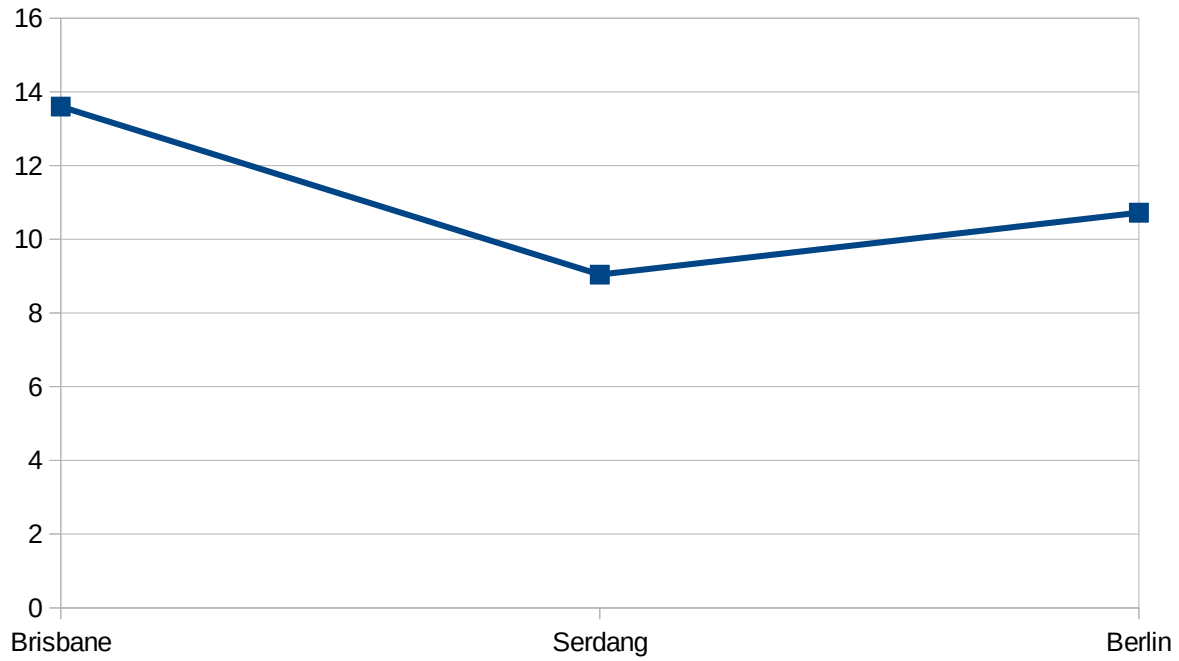
(ii) www.upm.edu.my(University Putra Malaysia)

Distance from UNSW : 6,602 km
Shortest possible time: $6{,}602*10^3 / 3*10^8 = 22.01$ ms
Minimum delay = 99.45 ms
Ratio between the minimum delay and shortest possible time = 4.52ms

(iii) www.tu-berlin.de (Berlin Institute of Technology)

Distance from UNSW: 16,095 km

Shortest possible time: $16{,}095*10^3/ 3*10^8$= 53.65 ms
Minimum delay = 287.524 ms
Ratio between the minimum delay and shortest possible time = 5.36 ms



Since shortest possible time won't be faster than Minimum delay. Therefore, the ratio will not be lower than 1 * 2.

2. The delay to the destinations is vary over the time because some destinations are more responsive than others.

3. Name: www.epfl.ch
   Address: 104.20.228.42
   Address: 104.20.229.42
   Location: Switzerland

4. Propagation delay - not depend on the packet size (depends on the speed of light)
   Transmission delay - depend on the packet size
   Processing delay - depend on the packet size
   Queuing delay – not depend on the packet size (depends on the number of packets).