Exercise 2

Domain	Reachable Ping	Reachable Web	Why Not?
www.google.co.uk	Yes	Yes	N/A
www.columbia.edu	Yes	Yes	N/A
www.wikipedia.org	Yes	Yes	N/A
ec.ho	No	No	possibly due to nonexistence, being blocked, or DNS resolution issues.
hhh.gs	Yes	Yes	N/A
defence.gov.au	No	Yes	possibly due to firewall configurations or network policy issues.
yes.no	Yes	Yes	N/A
one.one.one.one	Yes	Yes	N/A
theguardian.com	Yes	Yes	N/A
xn—i-7iq.ws	Yes	Yes	N/A

Exercise 3

```
z5504665@vx15:~$ traceroute usi.ch
traceroute to usi.ch (195.176.55.64), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.046 ms  0.052 ms  0.040 ms
 2  129.94.39.17 (129.94.39.17)  0.886 ms  0.855 ms  0.809 ms
 3  172.17.31.154 (172.17.31.154)  1.924 ms  1.567 ms  1.538 ms
 4  172.17.17.9 (172.17.17.9)  1.021 ms  1.044 ms  1.034 ms
 5  172.17.17.110 (172.17.17.110)  1.097 ms  1.203 ms 172.17.17.102 (172.17.17.102)  1.149 ms
 6  138.44.5.0 (138.44.5.0)  1.451 ms  1.322 ms  1.339 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.689 ms  1.533 ms  1.533 ms
 8  xe-1-1-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.199)  2.988 ms  3.035 ms  2.854 ms
 9  * et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  19.900 ms  19.982 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  46.001 ms  45.987 ms  46.021 ms
11  et-1_0_5.bdr1.sing.sin.aarnet.net.au (113.197.15.231)  92.348 ms  92.415 ms  92.405 ms
12  138.44.226.7 (138.44.226.7)  257.230 ms  257.130 ms  257.117 ms
13  ae2.mx1.lon2.uk.geant.net (62.40.98.65)  271.303 ms  271.321 ms  271.328 ms
14  ae8.mx1.par.fr.geant.net (62.40.98.107)  263.147 ms  263.192 ms  263.546 ms
15  ae7.mx1.gen.ch.geant.net (62.40.98.238)  270.428 ms  270.302 ms  270.899 ms
16  swice1-100ge-0-3-0-1.switch.ch (62.40.124.22)  270.799 ms  272.616 ms  272.263 ms
17  swiLG2-400GE-0-0-0-0.switch.ch (130.59.38.70)  278.178 ms  276.019 ms  275.941 ms
18  swiLG1-B1.switch.ch (130.59.36.77)  274.894 ms  274.745 ms  275.050 ms
19  lu-pop1-bkb02-100g-1-0-48.usi.ch (195.176.176.210)  274.662 ms  274.664 ms  275.149 ms
20  ma-pop1-dcfw01.net.ti-edu.ch (195.176.176.34)  274.955 ms  274.967 ms  275.355 ms
21  selenio.ti-edu.ch (195.176.55.64)  275.705 ms  275.554 ms  276.038 ms
```

1.

1)There are 20 routers between my workstation and usi.ch, cause the first one is local router. And first 6 routers belong to UNSW network, cause these 6 routers are passed through to all destinations.

2)The no.11 the domain name include sing, and the delay is much higher than before.

3) The no.13 cause the domain name include UK, and the delay is much higher than before 2.

```
z5504665@vx15:~$ traceroute  jhu.edu
traceroute to jhu.edu (128.220.192.230), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.044 ms  0.085 ms  0.075 ms
 2  129.94.39.17 (129.94.39.17)  0.830 ms  0.847 ms  0.836 ms
 3  172.17.31.154 (172.17.31.154)  1.552 ms  2.040 ms  2.012 ms
 4  172.17.17.45 (172.17.17.45)  1.057 ms 172.17.17.9 (172.17.17.9)  1.111 ms 172.17.17.45 (172.17.17.45)  1.061 ms
 5  * * *
 6  138.44.5.0 (138.44.5.0)  1.365 ms  1.293 ms  1.305 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.732 ms  3.760 ms  3.727 ms
 8  113.197.15.151 (113.197.15.151)  71.359 ms  71.363 ms  71.315 ms
 9  138.44.228.5 (138.44.228.5)  186.452 ms  186.211 ms  185.805 ms
10  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)  244.113 ms  244.058 ms  244.054 ms
11  fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168)  245.304 ms  245.322 ms  245.284 ms
12  fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251)  245.014 ms  245.003 ms  245.096 ms
13  fourhundredge-0-0-0-0.4079.core1.chic.net.internet2.edu (163.253.2.28)  243.701 ms  243.468 ms  245.084 ms
14  fourhundredge-0-0-0-0.4079.core1.eqch.net.internet2.edu (163.253.1.207)  244.381 ms  243.850 ms  243.000 ms
15  fourhundredge-0-0-0-0.4079.core1.clev.net.internet2.edu (163.253.1.210)  243.654 ms  245.437 ms  244.835 ms
16  fourhundredge-0-0-0-3.4079.core1.ashb.net.internet2.edu (163.253.1.122)  244.764 ms  244.933 ms  244.929 ms
17  et-0-1-8-1275.ashb-core.maxgigapop.net (206.196.177.2)  243.990 ms  243.461 ms  242.366 ms
18  206.196.178.141 (206.196.178.141)  242.219 ms  242.174 ms  242.260 ms
19  addr16212925332.testippl.jhmi.edu (162.129.253.32)  242.494 ms  242.489 ms addr16212925394.testippl.jhmi.edu (162.129.253.
94)  242.316 ms
20  162.129.255.245 (162.129.255.245)  244.596 ms  244.751 ms  244.622 ms
21  * * *
22  * * *
23  * * *
24  * * *
25  collaborate.johnshopkins.edu (128.220.192.230)  246.378 ms  246.223 ms  246.172 ms
```

```
z5504665@vx15:~$ traceroute usp.br
traceroute to usp.br (200.144.248.41), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.040 ms  0.056 ms  0.060 ms
 2  129.94.39.17 (129.94.39.17)  0.847 ms  0.786 ms  0.864 ms
 3  * * *
 4  172.17.17.9 (172.17.17.9)  1.200 ms  1.190 ms  1.153 ms
 5  172.17.17.102 (172.17.17.102)  1.209 ms  1.171 ms 172.17.17.110 (172.17.17.110)  1.151 ms
 6  138.44.5.0 (138.44.5.0)  17.189 ms  16.739 ms  16.696 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  2.872 ms  2.770 ms  3.511 ms
 8  et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137)  71.681 ms  71.691 ms  71.681 ms
 9  138.44.228.5 (138.44.228.5)  185.117 ms  187.147 ms  185.118 ms
10  fourhundredge-0-0-0-19.4079.core2.losa.net.internet2.edu (163.253.1.47)  232.060 ms  232.026 ms fourhundredge-0-0-0-20.407
9.core2.losa.net.internet2.edu (163.253.1.49)  231.996 ms
11  fourhundredge-0-0-0-0.4079.core2.elpa.net.internet2.edu (163.253.1.202)  231.500 ms  232.035 ms  232.123 ms
12  fourhundredge-0-0-0-21.4079.core1.elpa.net.internet2.edu (163.253.1.70)  233.172 ms fourhundredge-0-0-0-22.4079.core1.elpa
.net.internet2.edu (163.253.1.72)  233.000 ms fourhundredge-0-0-0-21.4079.core1.elpa.net.internet2.edu (163.253.1.70)  233.103
 ms
13  fourhundredge-0-0-0-23.4079.core1.hous.net.internet2.edu (163.253.1.62)  230.945 ms fourhundredge-0-0-0-0.4079.core1.hous.
net.internet2.edu (163.253.2.39)  233.276 ms  233.240 ms
14  fourhundredge-0-0-0-0.4079.core1.houh.net.internet2.edu (163.253.2.24)  232.409 ms  232.519 ms  232.470 ms
15  fourhundredge-0-0-0-0.4079.core1.pens.net.internet2.edu (163.253.2.35)  232.486 ms  231.965 ms  232.417 ms
16  fourhundredge-0-0-0-0.4079.core1.jack.net.internet2.edu (163.253.1.0)  233.585 ms  232.800 ms  231.298 ms
17  64.57.28.62 (64.57.28.62)  236.716 ms  236.834 ms  237.249 ms
18  mia2-mia1.bkb.rnp.br (200.143.252.26)  237.227 ms  237.009 ms  237.230 ms
19  cce2-mia2-monet.bkb.rnp.br (170.79.213.46)  301.438 ms  301.335 ms  301.494 ms
20  sp2-cce2-tisparkle.bkb.rnp.br (170.79.213.3)  341.579 ms  343.587 ms  341.670 ms
21  as28571.saopaulo.sp.ix.br (187.16.220.3)  344.835 ms  344.879 ms  344.940 ms
22  e72361-sp2-r06-nx-swc.uspnet.usp.br (143.107.249.38)  345.119 ms  345.193 ms  344.922 ms
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

```
z5504665@vx15:~$ traceroute ed.ac.uk
traceroute to ed.ac.uk (129.215.97.66), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.050 ms  0.052 ms  0.057 ms
 2  129.94.39.17 (129.94.39.17)  0.842 ms  0.855 ms  0.889 ms
 3  172.17.31.154 (172.17.31.154)  1.529 ms  1.932 ms  1.910 ms
 4  172.17.17.45 (172.17.17.45)  1.045 ms 172.17.17.9 (172.17.17.9)  1.014 ms  1.062 ms
 5  172.17.17.102 (172.17.17.102)  1.167 ms 172.17.17.110 (172.17.17.110)  1.221 ms 172.17.17.102 (172.17.17.102)  1.224 ms
 6  138.44.5.0 (138.44.5.0)  1.758 ms  1.368 ms  1.367 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.786 ms  1.681 ms  1.816 ms
 8  et-0-3-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.3)  3.234 ms  3.147 ms  3.023 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  19.919 ms  20.167 ms  20.201 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  46.596 ms  46.166 ms  46.267 ms
11  et-1_0_5.bdr1.sing.sin.aarnet.net.au (113.197.15.231)  92.547 ms  92.555 ms  92.566 ms
12  138.44.226.7 (138.44.226.7)  290.794 ms  290.739 ms  290.749 ms
13  ae2.mx1.lon2.uk.geant.net (62.40.98.65)  256.994 ms  256.965 ms  256.839 ms
14  janet-bckp-gw.mx1.lon2.uk.geant.net (62.40.125.58)  257.516 ms  257.596 ms  257.644 ms
15  ae31.erdiss-sbr2.ja.net (146.97.33.22)  261.565 ms  261.527 ms  261.580 ms
16  ae29.manckh-sbr2.ja.net (146.97.33.42)  263.123 ms  263.319 ms  263.319 ms
17  ae31.glasss-sbr1.ja.net (146.97.33.54)  271.282 ms  267.786 ms  267.725 ms
18  ae29.edinat-rbr2.ja.net (146.97.38.38)  268.939 ms  268.800 ms  268.916 ms
19  ae25.edinkb-rbr2.ja.net (146.97.74.34)  269.130 ms  275.564 ms  269.870 ms
20  university-of-edinburgh.ja.net (146.97.156.78)  269.668 ms  269.483 ms  269.526 ms
21  remote.net.ed.ac.uk (192.41.103.209)  269.148 ms  269.104 ms  269.115 ms
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

1)The no.6, and here are the further detail below:

```
% Information related to '138.44.5.0/24AS7575'

route:          138.44.5.0/24
origin:         AS7575
descr:          Australian Academic and Research Network
                Building 9
                Banks Street
mnt-by:         MAINT-AARNET-AP
last-modified:  2019-04-03T03:55:51Z
source:         APNIC

% This query was served by the APNIC Whois Service version 1.88.25 (WHOIS-AU2)
```

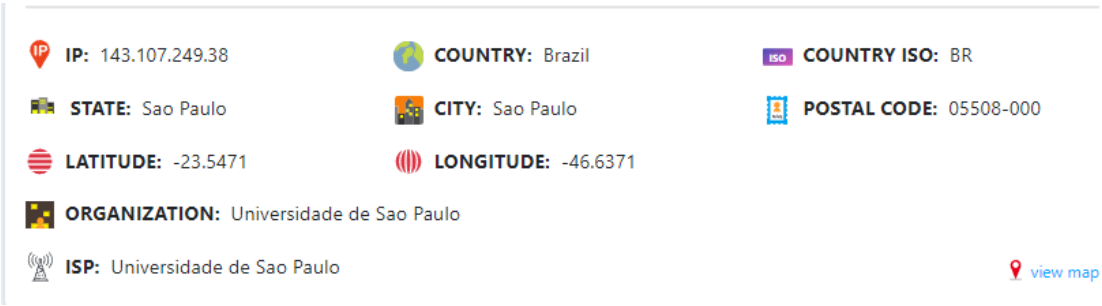
2)No, it is not.
Traceroute to ed.ac.uk, the ip geo location of destination is

IP: 192.41.103.209
COUNTRY: United Kingdom of Great Britain and Northern Ireland
COUNTRY ISO: GB
STATE: Scotland
CITY: Edinburgh
POSTAL CODE: EH2
LATITUDE: 55.9520
LONGITUDE: -3.1964
ORGANIZATION: The University of Edinburgh
ISP: The University of Edinburgh
view map

distance:16857km
hops:21

Traceroute to jnu.edu, the ip geo location of destination is

distance:15767km
hops:25
Traceroute to usp.br, the ip geo location of destination is



distance:13346km
hops:22

We can see the number of hops on each path is not proportional to the physical distance.

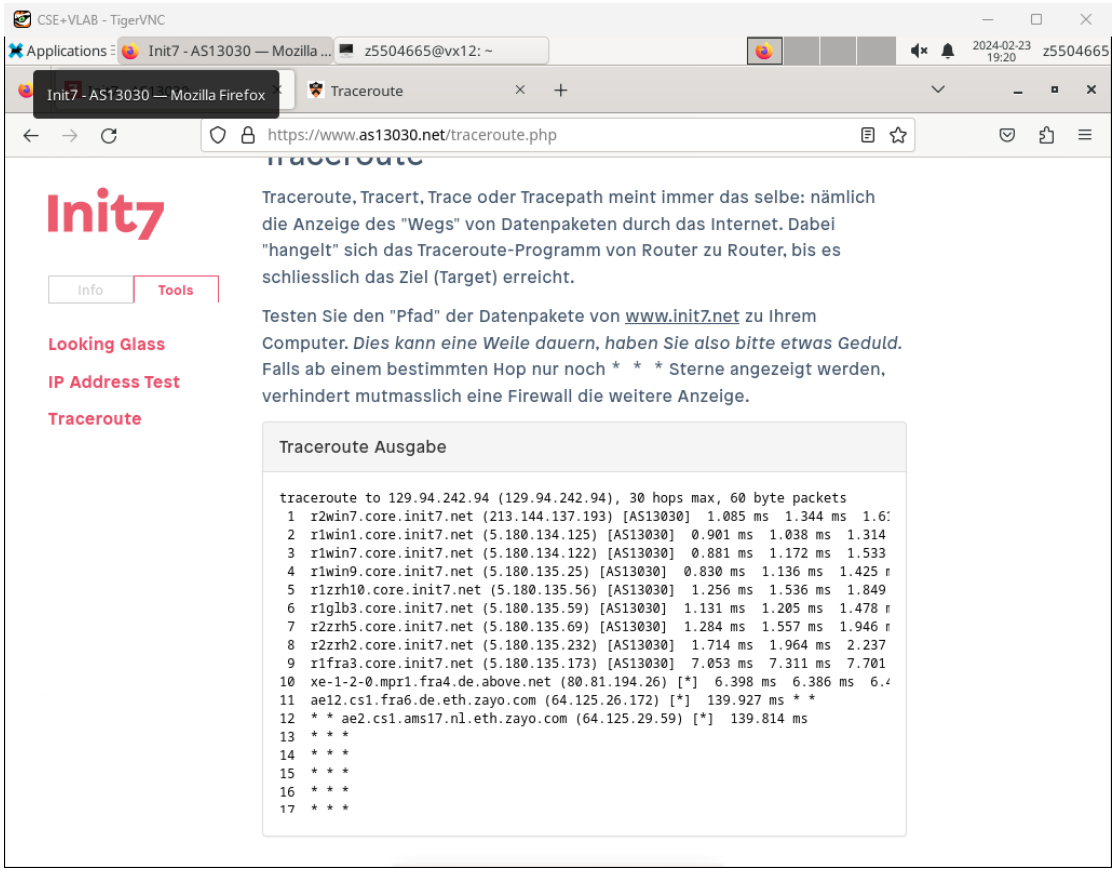
3.
1)
domain:www.as13030.net domain:www.net.princeton.edu
address:213.144.137.198 address:128.112.128.55

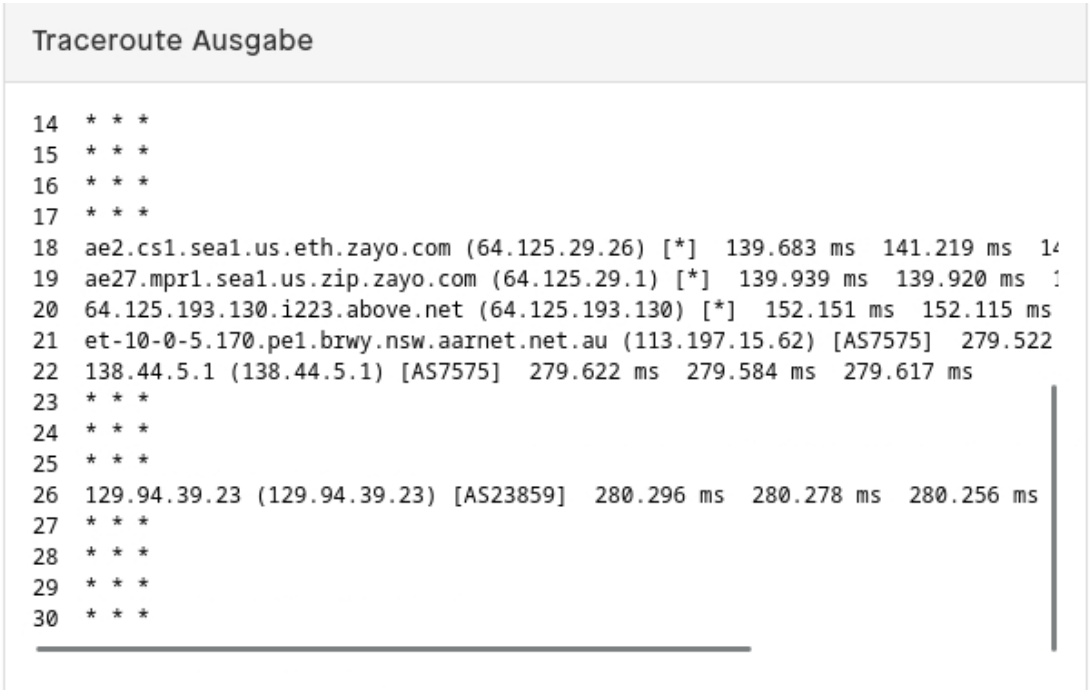
```
z5504665@vx12:~$ nslookup www.as13030.net
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
www.as13030.net canonical name = as13030.net.
Name:   as13030.net
Address: 213.144.137.198
Name:   as13030.net
Address: 2001:1620:2777:1a::2

z5504665@vx12:~$ nslookup www.net.princeton.edu
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
Name:   www.net.princeton.edu
Address: 128.112.128.55
```

2)

domain: www.as13030.net

hops of reverse path:





hops of forward path:

```
z5504665@vx12:~$ traceroute www.as13030.net
traceroute to www.as13030.net (213.144.137.198), 30 hops max, 60 byte pac
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.042 m
0 ms  0.040 ms
 2  129.94.39.17 (129.94.39.17)  0.849 ms  0.878 ms  0.835 ms
 3  172.17.31.154 (172.17.31.154)  1.777 ms  1.803 ms  2.040 ms
 4  172.17.17.45 (172.17.17.45)  1.247 ms  1.211 ms 172.17.17.9 (172.17.1
.096 ms
 5  172.17.17.102 (172.17.17.102)  22.140 ms  22.109 ms 172.17.17.110 (17
.110)  22.188 ms
 6  138.44.5.0 (138.44.5.0)  1.381 ms  1.423 ms  1.429 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  3.074 ms  3.321
230 ms
 8  xe-0-2-5.bdr1.b.sea.aarnet.net.au (202.158.194.121)  142.288 ms  142.
 142.329 ms
 9  xe-4-1-1.mpr1.sea1.us.above.net (64.125.193.129)  140.869 ms  140.864
0.655 ms
10  ae27.cs1.sea1.us.eth.zayo.com (64.125.29.0)  264.386 ms  264.490 ms
 ms
11  * * *
12  * * *
13  * * *
```

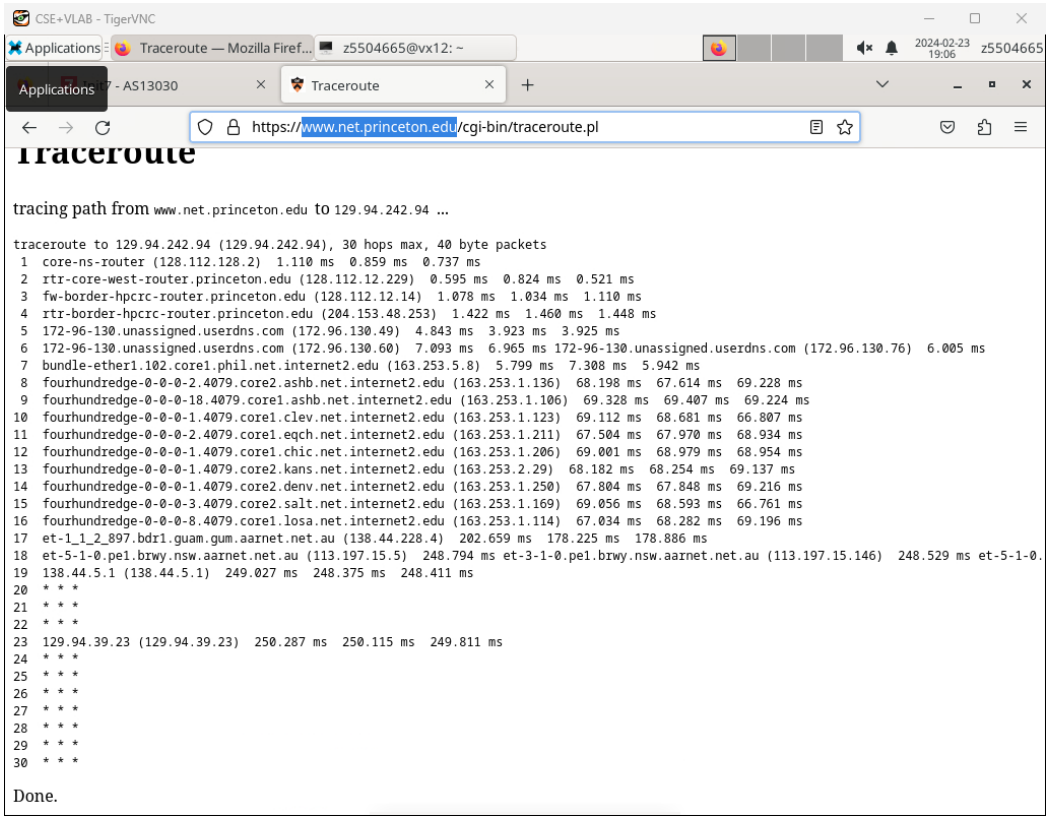
z5504665@vx12: ~

File Edit Tabs Help

```
10  ae27.cs1.sea1.us.eth.zayo.com (64.125.29.0)  264.386 ms  264.490 ms  264.499
 ms
11  * * *
12  * * *
13  * * *
14  ae4.mpr1.lhr15.uk.zip.zayo.com (64.125.28.195)  262.941 ms  263.013 ms  263.
101 ms
15  linx-1.init7.net (195.66.224.175)  263.775 ms  264.007 ms  264.277 ms
16  r2lon2.core.init7.net (5.180.135.248)  275.308 ms  278.285 ms  277.730 ms
17  r2fra3.core.init7.net (5.180.135.129)  275.034 ms  275.040 ms  275.122 ms
18  r1fra3.core.init7.net (80.81.192.67)  275.086 ms  274.996 ms  275.025 ms
19  r2zrh2.core.init7.net (5.180.135.172)  280.299 ms  280.380 ms  280.384 ms
20  r2zrh5.core.init7.net (5.180.135.233)  280.167 ms  280.224 ms  280.165 ms
21  r1glb3.core.init7.net (5.180.135.68)  280.633 ms  280.513 ms  280.499 ms
22  r1zrh10.core.init7.net (5.180.135.58)  281.020 ms  280.794 ms  280.819 ms
23  r1win9.core.init7.net (5.180.135.57)  280.732 ms  280.627 ms  280.599 ms
24  r1win7.core.init7.net (5.180.135.24)  280.787 ms  280.740 ms  280.960 ms
25  r1win1.core.init7.net (5.180.134.123)  280.809 ms  280.652 ms  280.715 ms
26  r2win7.core.init7.net (5.180.134.124)  280.919 ms  280.614 ms  280.702 ms
27  * * *
28  * * *
29  * * *
30  * * *
```

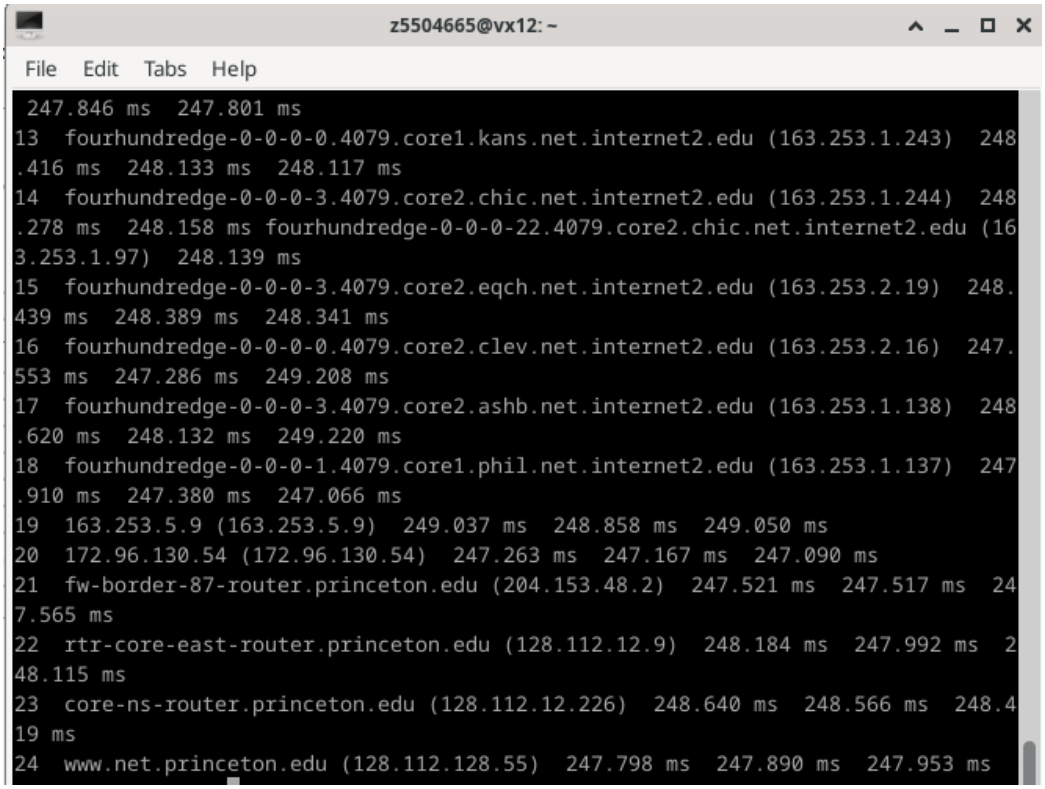
domain: www.net,princeton.edu

hops of reverse path:



hops of forward path:

```
z5504665@vx12:~$ traceroute www.net.princeton.edu
traceroute to www.net.princeton.edu (128.112.128.55), 30 hops max, 60 byte pack
ts
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.052 ms  0.0
2 ms  0.039 ms
 2  129.94.39.17 (129.94.39.17)  0.803 ms  0.832 ms  0.798 ms
 3  172.17.31.154 (172.17.31.154)  1.639 ms  1.931 ms  1.900 ms
 4  172.17.17.45 (172.17.17.45)  1.098 ms  1.109 ms 172.17.17.9 (172.17.17.9)
.020 ms
 5  * * *
 6  138.44.5.0 (138.44.5.0)  1.836 ms  1.614 ms  1.559 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.752 ms  1.905 ms  1.9
0 ms
 8  et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137)  71.371 ms  71.387 ms
 71.377 ms
 9  138.44.228.5 (138.44.228.5)  185.696 ms  184.924 ms  185.970 ms
10  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)  24
.076 ms  247.133 ms  247.144 ms
11  fourhundredge-0-0-0-21.4079.core1.salt.net.internet2.edu (163.253.1.28)  24
.795 ms fourhundredge-0-0-0-22.4079.core1.salt.net.internet2.edu (163.253.1.30)
 249.609 ms fourhundredge-0-0-0-21.4079.core1.salt.net.internet2.edu (163.253.1
28)  249.800 ms
12  fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251)  24
.284 ms fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170)
```



Answer:

I notice that some routers between forward path and reverse path are the same.

3)

Answer:

For paths of www.net,princeton.edu, we can find rtr-core-east-router.princeton.edu in both paths, but it has different ip address in these two paths.

This can occur due to Network Address Translation (NAT) or dynamic address allocation.

Exercise 4

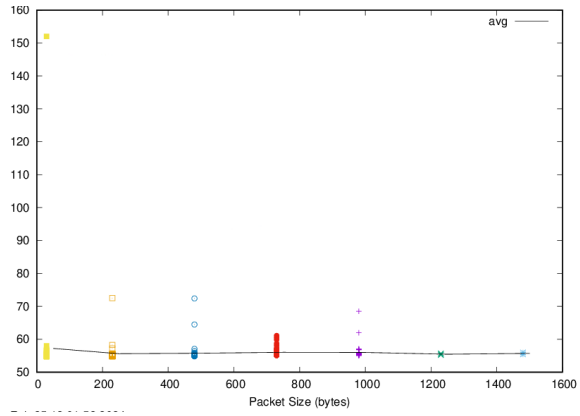
1.

Domain	Location	Distance from UNSW	Shortest possible time
cdu.edu.au	Charles Darwin University, Darwin, Australia	3148.98 km	10.4ms
usp.br	Universidade de São Paulo (USP),Sao Paulo,Brazil	13490.89 km	44.9ms
ed.ac.uk	The University of Edinburgh - Edinburgh, Scotland, UK	16880.66 km	56.2ms

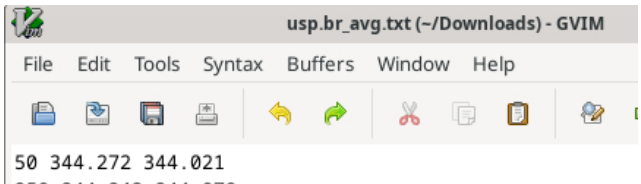
2.

cdu.edu.au RTT:54ms

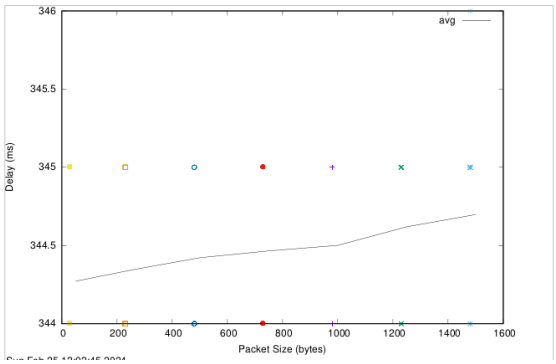

```
50 57.226 54.686
250 55.604 54.800
500 55.774 54.838
750 56.039 55.052
1000 56.006 55.039
1250 55.464 55.161
1500 55.703 55.389
~
```



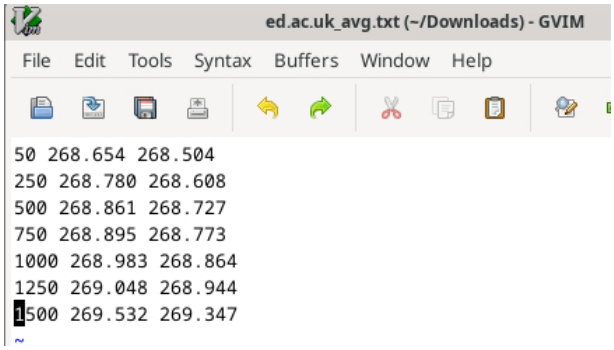
usp.br RTT:344ms

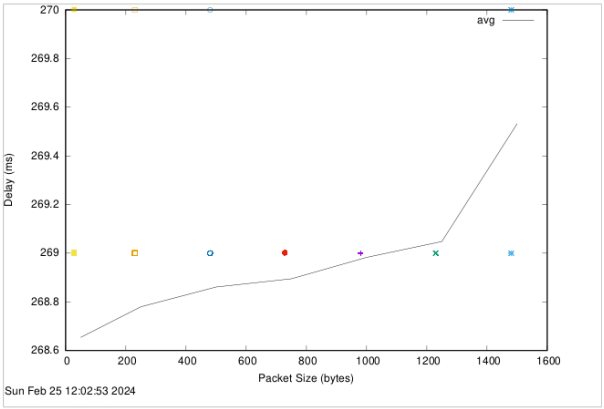


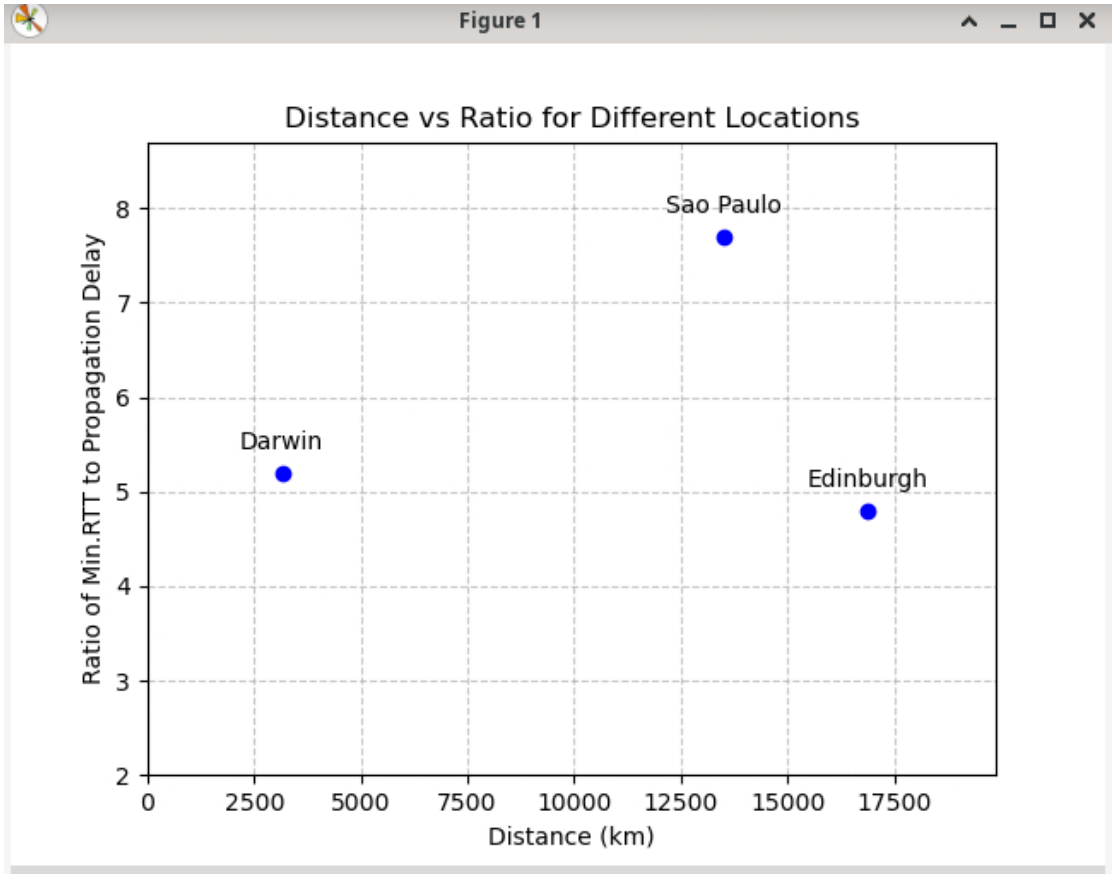

```
50 344.272 344.021
250 344.343 344.078
500 344.422 344.145
750 344.466 344.214
1000 344.501 344.321
1250 344.620 344.341
1500 344.698 344.464
```



ed.ac.uk RTT:269ms







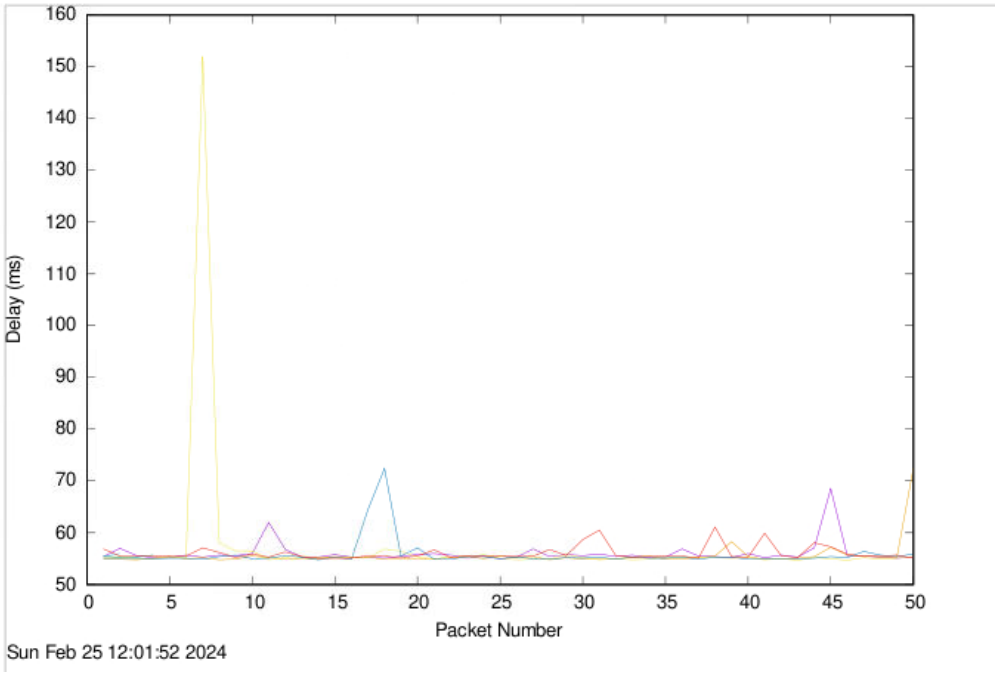
3.

Answer:

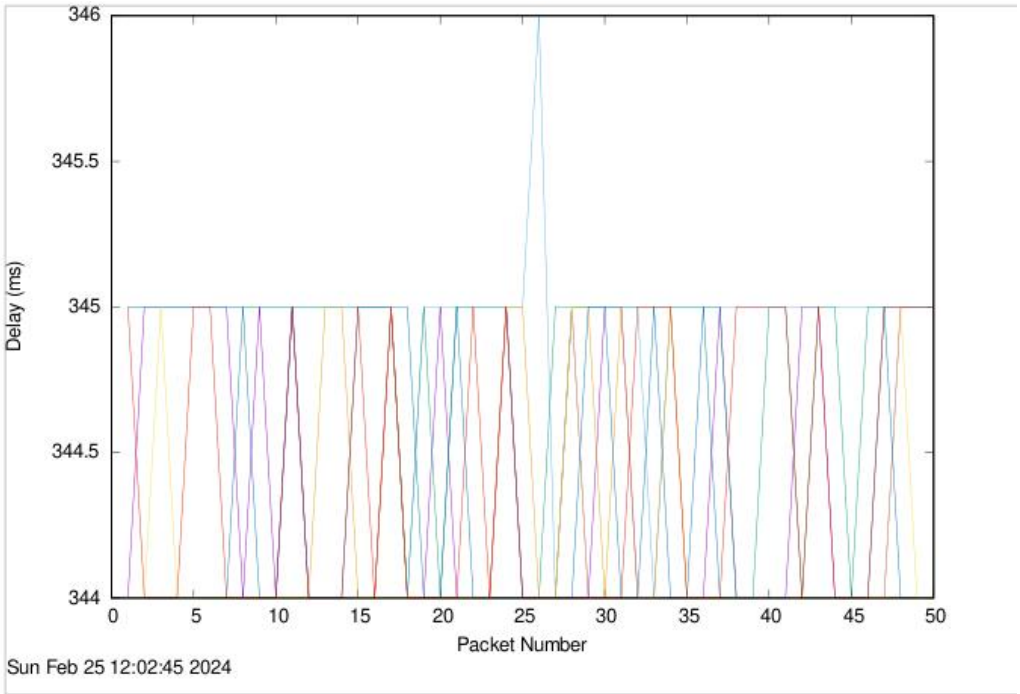
There has two possible reasons for why the y-axis values you plot are greater than 2

Network congestion: The actual RTT can be influenced by network congestion, routing inefficiencies, or other factors, causing it to be higher than the theoretical minimum.
Packet processing time: In addition to the time it takes for the packet to travel the distance, there's also packet processing time at routers and other network devices, which adds to the overall delay.

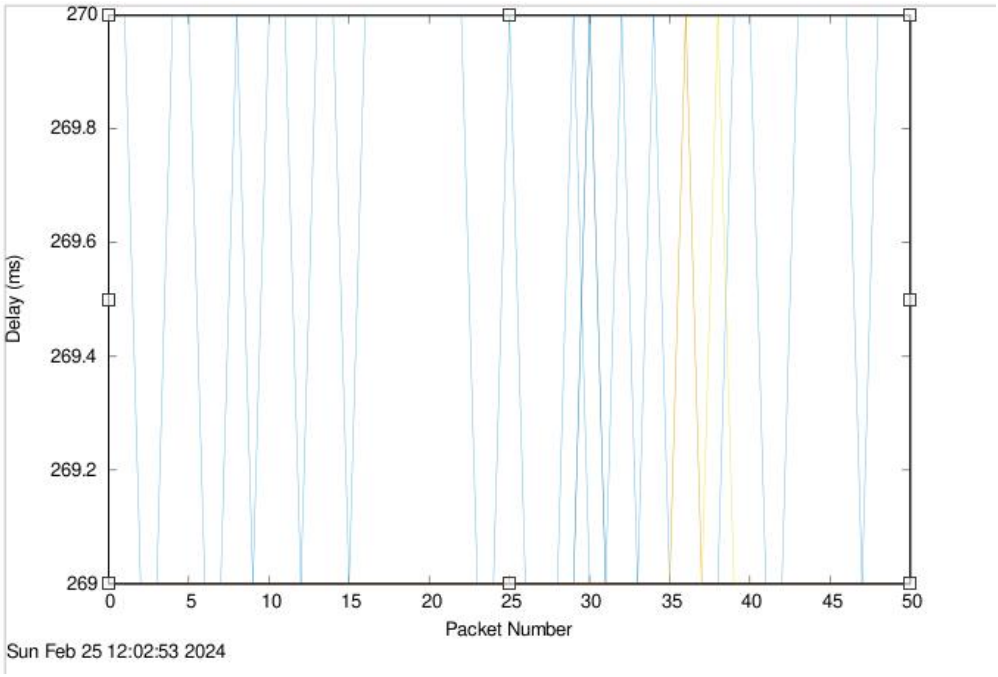
4.
cdu.edu.au_delay:



usp.br_delay:



ed.ac.uk_delay:



Answer:

From the pictures, We can see that the delay varies over time.

Because the delay in network communication is influenced by a complex interplay of factors, and variations over time are common due to the dynamic nature of network environments. For example, When there is a high volume of traffic on the network, routers and switches may become congested, causing delays as packets are queued up for transmission. This congestion can fluctuate throughout the day based on usage patterns and network conditions.

5.

Answer:

Propagation delay is independent of packet size, while transmission delay may vary with packet size due to the relationship between packet size and available bandwidth. Processing delay is generally not influenced by packet size, as it is more related to the internal operations of network devices. Queuing delay can be affected by packet size indirectly, as larger packets may contribute to congestion and longer wait times in network queues.