50.005 Computer System Engineering - Lab 5

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**Part 1: ping**

Q1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Host | Success | Min RTT | Average RTT | Max RTT |
| www.csail.mit.edu | 100% | 6.629 | 9.378 | 14.808 |
| www.berkeley.edu | 100% | 206.690 | 220.564 | 258.607 |
| www.usyd.edu.au | 100% | 146.466 | 153.037 | 172.515 |
| www.kyoto-u.ac.jp | 100% | 90.630 | 94.716 | 112.555 |

Q2

According to iplocation.net and google maps, the locations and straight-line distance to the hosts are:

csail.mit.edu (128.30.2.121) is located in Boston, US (15,124.38 km away)

www.csail.mit.edu (23.185.0.3) is located in SF, US (13,583.74 km away)

berkeley.edu (52.26.125.248) is located in Oregon, US (13,093.17km away)

usyd.edu.au (129.78.5.11) is located in NSW, AUS (6,316.7km away)

kyoto-u.ac.jp (133.3.250.141) is located in Kyoto, JP (4,996.18km away)

Apart from www.csail, the min RTT is a function of geographical distance. While pinging csail.mit.edu (128.30.2.121) takes ~240ms (16 hops on traceroute, hosted at mit.edu in Boston), which is expected based on the distance, pinging [www.csail.mit.edu](http://www.csail.mit.edu) (23.185.0.3) takes ~6ms (9 hops, hosted on Pantheon in SF). Additionally, Pantheon offers high-performance servers and is known for extremely low response times.

Q3

Approach: for each host ping <host> -c 10 -s $x -i 5 | grep -e “rtt” -e “packet loss” where x is 56/512/1024 bytes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Host | Packet size | RTT Min | RTT Avg | RTT Max | Success | Shell output |
| [www.csail.mit.edu](http://www.csail.mit.edu) | 56 | 6.629 | 9.378 | 14.808 | 100% | ------------------------------  starting to ping www.csail.mit.edu  ------------------------------  pinging csail.mit.edu 10 times with 56 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45046ms  rtt min/avg/max/mdev = 6.629/9.378/14.808/2.465 ms    pinging csail.mit.edu 10 times with 512 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45045ms  rtt min/avg/max/mdev = 7.101/12.622/32.793/7.192 ms    pinging csail.mit.edu 10 times with 1024 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45047ms  rtt min/avg/max/mdev = 8.427/15.761/49.700/11.535 ms |
| 512 | 7.101 | 12.622 | 32.793 | 100% |
| 1024 | 8.427 | 15.761 | 49.700 | 100% |
| [www.berkeley.edu](http://www.berkeley.edu) | 56 | 206.690 | 220.564 | 258.607 | 100% | ------------------------------  starting to ping www.berkeley.edu  ------------------------------  pinging berkeley.edu 10 times with 56 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45037ms  rtt min/avg/max/mdev = 206.690/220.564/258.607/17.936 ms    pinging berkeley.edu 10 times with 512 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45035ms  rtt min/avg/max/mdev = 209.106/229.268/328.019/39.380 ms    pinging berkeley.edu 10 times with 1024 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45044ms  rtt min/avg/max/mdev = 209.597/215.184/234.341/7.186 ms |
| 512 | 209.106 | 229.268 | 328.019 | 100% |
| 1024 | 209.567 | 215.184 | 234.341 | 100% |
| [www.usyd.edu.au](http://www.usyd.edu.au) | 56 | 146.466 | 153.037 | 172.515 | 100% | ------------------------------  starting to ping www.usyd.edu.au  ------------------------------  pinging usyd.edu.au 10 times with 56 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45049ms  rtt min/avg/max/mdev = 146.466/153.037/172.515/7.731 ms    pinging usyd.edu.au 10 times with 512 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45035ms  rtt min/avg/max/mdev = 146.396/158.615/185.209/12.081 ms    pinging usyd.edu.au 10 times with 1024 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45043ms  rtt min/avg/max/mdev = 148.225/158.603/173.055/8.411 ms |
| 512 | 146.396 | 158.615 | 185.209 | 100% |
| 1024 | 148.225 | 158.603 | 173.055 | 100% |
| [www.kyoto-u.ac.jp](http://www.kyoto-u.ac.jp) | 56 | 90.630 | 94.716 | 112.555 | 100% | ------------------------------  starting to ping www.kyoto-u.ac.jp  ------------------------------  pinging kyoto-u.ac.jp 10 times with 56 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45044ms  rtt min/avg/max/mdev = 90.630/94.716/112.555/6.111 ms    pinging kyoto-u.ac.jp 10 times with 512 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45044ms  rtt min/avg/max/mdev = 91.421/95.855/119.764/8.173 ms    pinging kyoto-u.ac.jp 10 times with 1024 bytes, 5s interval  10 packets transmitted, 10 received, 0% packet loss, time 45043ms  rtt min/avg/max/mdev = 91.420/101.139/132.032/11.574 ms |
| 512 | 91.421 | 95.855 | 119.764 | 100% |
| 1024 | 91.420 | 101.139 | 132.032 | 100% |

Q4

Of 100 packets sent, none were returned. Some possible reasons are: the host has blocked ICMP through a firewall to increase security or utilize its resources handling other requests, the network might be dropping packets because of congestion, or the server is down. The latter possibilities are probably not the cause for me as the host was reachable through a browser.

**Part 2: traceroute**

Q5

1. A TTL value (hop limit) is set
2. Traceroute sends packets with increasing TTL values.
3. Routers decrease TTL values and drop packets where TTL = 0.
4. Hence, the sender receives no reply until the correct number of hops, equal to the TTL value, is reached.
5. A list of routers is built through this knowledge.

Example:

* Traceroute: send packet, TTL = 1
* Packet reaches first hop, TTL = 0, dropped
* Traceroute: send packet, TTL = 2
* Packet reaches first hop, TTL = 1
* Packet reaches second hop, TTL = 0, dropped
* Traceroute: send packet, TTL = 3
* Packet reaches first hop, TTL = 2
* Packet reaches second hop, TTL = 1
* Packet reaches third hop, destination is reached!
* Route: Traceroute > first hop > second hop > third hop

Q6

|  |  |  |
| --- | --- | --- |
| Remote Location | Remote > Local | Local > Remote |
| New York | 1 <1 <1 <1 72-9-99-137-cust-gw.reverse.ezzi.net 72.9.99.137  2 1 2 1 ads-psc-cr01.ezzi.net 96.45.77.1  3 1 <1 <1 ads-psc-ir01-v261.ezzi.net 72.9.111.109  4 2 1 1 72-9-111-177.reverse.ezzi.net 72.9.111.177  5 2 1 1 nyk-b5-link.telia.net 213.248.104.110  6 89 89 89 nyk-bb4-link.telia.net 80.91.254.15  7 117 102 89 las-b24-link.telia.net 62.115.116.96  8 88 88 88 m1limited-ic-308155-las-b3.c.telia.net 62.115.48.230  9 249 249 249 18.246.65.202.unknown.m1.com.sg 202.65.246.18  10 249 249 249 49.246.65.202.unknown.m1.com.sg 202.65.246.49  11 249 249 259 178.246.65.202.unknown.m1.com.sg 202.65.246.178 | 1 1 ms 1 ms 1 ms router.asus.com [192.168.1.1]  2 19 ms 4 ms 4 ms 175.156.240.1  3 4 ms 4 ms 7 ms 254.246.65.202.unknown.m1.com.sg [202.65.246.254]  4 6 ms 6 ms 4 ms 253.246.65.202.unknown.m1.com.sg [202.65.246.253]  5 8 ms 4 ms 4 ms 9.246.65.202.unknown.m1.com.sg [202.65.246.9]  6 6 ms 6 ms 4 ms 37.246.65.202.unknown.m1.com.sg [202.65.246.37]  7 8 ms 5 ms 5 ms 21.246.65.202.unknown.m1.com.sg [202.65.246.21]  8 180 ms 167 ms 165 ms 13.246.65.202.unknown.m1.com.sg [202.65.246.13]  9 165 ms 173 ms 171 ms las-b3-link.telia.net [62.115.48.229]  10 254 ms 256 ms 253 ms nyk-bb4-link.telia.net [62.115.116.97]  11 253 ms 254 ms 260 ms nyk-b5-link.telia.net [80.91.254.14]  12 254 ms 254 ms 252 ms coretech-ic-322321-nyk-b5.c.telia.net [213.248.104.111]  13 257 ms 253 ms 256 ms 72-9-111-178.reverse.ezzi.net [72.9.111.178]  14 397 ms 307 ms 275 ms 72-9-111-247.reverse.ezzi.net [72.9.111.247] |
| Amsterdam | 1 <1 <1 <1 213.214.121.210  2 <1 <1 <1 213.214.116.98  3 <1 <1 <1 213.214.116.2  4 6 <1 <1 30gigabitethernet1-3.core1.ams1.he.net 80.249.209.150  5 43 17 10 100ge9-2.core1.par2.he.net 184.105.81.109  6 20 42 20 100ge6-1.core2.mrs1.he.net 184.105.222.22  7 157 157 163 100ge10-1.core1.sin1.he.net 184.105.65.13  8 197 200 199 100ge14-2.core1.hkg1.he.net 184.105.222.101  9 206 206 206 starhubinternet-as-as4657.10gigabitethernet7-20.core1.hkg1.he.net 74.82.46.54  10 206 206 206 203.118.15.6  11 206 206 206 203.118.2.26  12 206 206 206 an-atl-loc11.starhub.net.sg 203.118.15.174  13 206 206 206 203.116.245.218  14 272 272 271 49.246.65.202.unknown.m1.com.sg 202.65.246.49  15 271 271 271 178.246.65.202.unknown.m1.com.sg 202.65.246.178 | 1 6 ms 1 ms 3 ms router.asus.com [192.168.1.1]  2 7 ms 7 ms 4 ms 175.156.240.1  3 8 ms 5 ms 7 ms 242.246.65.202.unknown.m1.com.sg [202.65.246.242]  4 6 ms 5 ms 5 ms 241.246.65.202.unknown.m1.com.sg [202.65.246.241]  5 8 ms 6 ms 5 ms 37.246.65.202.unknown.m1.com.sg [202.65.246.37]  6 9 ms 6 ms 9 ms 134.246.65.202.unknown.m1.com.sg [202.65.246.134]  7 44 ms 53 ms 56 ms 6939.sgw.equinix.com [27.111.228.81]  8 212 ms 213 ms 178 ms 100ge6-2.core2.mrs1.he.net [184.105.65.14]  9 197 ms 202 ms 196 ms 100ge9-2.core1.par2.he.net [184.105.81.109] |
| Tokyo | 1 <1 <1 <1 hosted-by.i3d.net 31.204.145.129  2 <1 <1 <1 hosted-by.i3d.net 31.204.145.250  3 7 2 <1 ix-xe-4-2-3-0.tcore2.TV2-Tokyo.as6453.net 180.87.181.69  4 66 66 66 if-ae-2-2.tcore1.TV2-Tokyo.as6453.net 180.87.180.1  5 66 66 67 if-ae-31-2.tcore2.SVW-Singapore.as6453.net 180.87.15.40  6 66 66 81 if-ae-2-2.tcore1.SVW-Singapore.as6453.net 180.87.12.1  7 67 67 67 180.87.12.162  8 67 67 67 w118012041.w118012.starhub.net.sg 203.118.12.41  9 67 67 67 an-atl-loc11.starhub.net.sg 203.118.15.174  10 66 66 66 203.116.245.218  11 67 67 67 49.246.65.202.unknown.m1.com.sg 202.65.246.49  12 67 67 67 178.246.65.202.unknown.m1.com.sg 202.65.246.178 | 1 2 ms 2 ms 3 ms router.asus.com [192.168.1.1]  2 5 ms 5 ms 11 ms 175.156.240.1  3 7 ms 12 ms 6 ms 242.246.65.202.unknown.m1.com.sg [202.65.246.242]  4 7 ms 8 ms 4 ms 241.246.65.202.unknown.m1.com.sg [202.65.246.241]  5 5 ms 6 ms 5 ms 162.246.65.202.unknown.m1.com.sg [202.65.246.162]  6 5 ms 6 ms 11 ms ix-xe-2-1-2-601.tcore1.SVW-Singapore.as6453.net [180.87.12.145]  7 5 ms 6 ms 6 ms if-ae-2-2.tcore2.SVW-Singapore.as6453.net [180.87.12.2]  8 72 ms 79 ms 75 ms if-ae-2-2.tcore1.TV2-Tokyo.as6453.net [180.87.180.1] |

Q7

The routes are not necessarily the same. When a packet is received by a router, the router tries to send it to the next hop as quickly as possible. This is decided using the routing table and is dependent on prevalent network conditions. Routes change based on the traffic of the network, causing the non-deterministic behaviour of traceroute even in both directions.