

CS3205: ASSIGNMENT REPORT

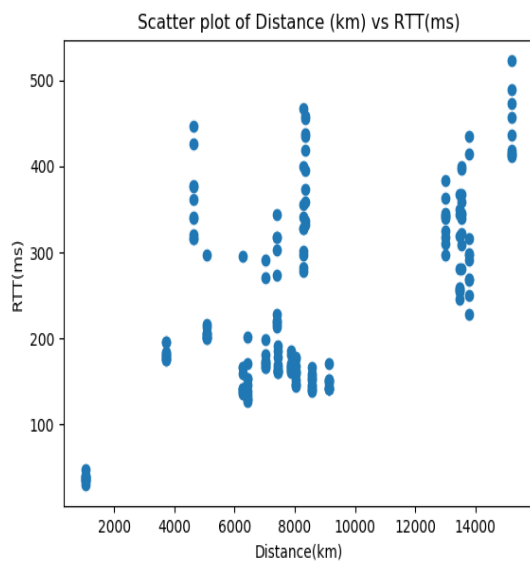
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1 Q1

Parts (a), (b), (c): Code in `Q1.py` file in folder Q1. Distances stored in `distances.txt` file and RTT stored in `rtt_log.csv` file in folder Q1.

Scatter plot: Average speed is 8.02 times slower than speed of light



Part (d):

```
Jeffins-MacBook-Air:~ jeffinbiju$ traceroute 139.130.4.5
traceroute to 139.130.4.5 (139.130.4.5), 64 hops max, 52 byte packets
 1 192.168.1.1 (192.168.1.1)  4.201 ms  14.341 ms  1.102 ms
 2 abts-kk-dynamic-001.64.172.122.airtelbroadband.in (122.172.64.1)  18.864 ms  11.849 ms  8.415 ms
 3 182.79.20.201 (182.79.20.201)  9.425 ms
   125.18.238.133 (125.18.238.133)  28.656 ms  18.724 ms
 4 116.119.57.158 (116.119.57.158)  68.796 ms
   116.119.68.223 (116.119.68.223)  54.008 ms
   182.79.135.24 (182.79.135.24)  77.492 ms
 5 unknown.telstraglobal.net (202.127.73.101)  45.752 ms  43.797 ms  53.759 ms
 6 * i-91.sgcncore01.telstraglobal.net (202.84.224.198)  47.230 ms *
 7 i-15350.pthp-core02.telstraglobal.net (202.84.140.37)  95.429 ms
   i-91.sgcncore01.telstraglobal.net (202.84.224.198)  109.599 ms  117.876 ms
 8 bundle-ether5.pie-core10.perth.telstra.net (203.50.9.1)  122.643 ms  97.742 ms
   i-25451.pthw-core02.telstraglobal.net (202.84.141.238)  113.711 ms
 9 bundle-ether5.wel-core10.perth.telstra.net (203.50.9.5)  102.268 ms
   bundle-ether3.way-core10.adelaide.telstra.net (203.50.6.234)  132.189 ms
   bundle-ether5.wel-core10.perth.telstra.net (203.50.9.5)  95.851 ms
10 bundle-ether16.exi-core10.melbourne.telstra.net (203.50.6.231)  139.145 ms
   bundle-ether3.fli-core10.adelaide.telstra.net (203.50.6.232)  122.255 ms
   bundle-ether16.exi-core10.melbourne.telstra.net (203.50.6.231)  144.471 ms
11 bundle-ether16.win-core10.melbourne.telstra.net (203.50.6.229)  152.568 ms
   bundle-ether12.chw-core10.sydney.telstra.net (203.50.11.124)  175.723 ms
   bundle-ether16.win-core10.melbourne.telstra.net (203.50.6.229)  132.473 ms
12 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  148.613 ms  138.743 ms
   bundle-ether4-3.ken-core10.sydney.telstra.net (203.50.6.226)  145.331 ms
13 203.50.11.221 (203.50.11.221)  161.593 ms  140.991 ms  141.578 ms
14 139.130.4.5 (139.130.4.5)  156.865 ms  163.441 ms  143.650 ms
Jeffins-MacBook-Air:~ jeffinbiju$
```

- 1) Number of hops = 14
- 2) Using ip-api.com, we can find that the IP address of router that forwards packet to foreign router is 116.119.57.158, the foreign router that receives this packet has ip address 202.127.73.101 which is located in Hong Kong.
- 3) Hong Kong

2 Q2

Part (a)

Ping -c4 output on terminal:

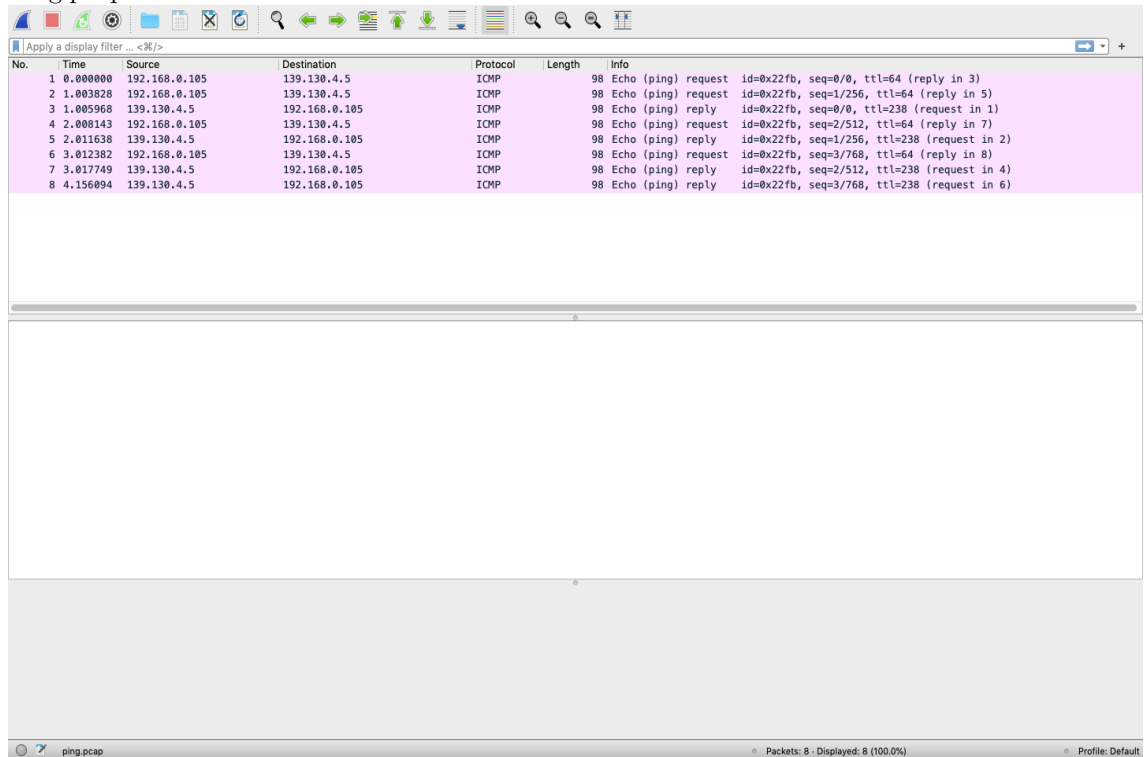
```

[Jeffins-MacBook-Air:~ jeffinbiju$ ping -c4 139.130.4.5
PING 139.130.4.5 (139.130.4.5): 56 data bytes
Request timeout for icmp_seq 0
64 bytes from 139.130.4.5: icmp_seq=0 ttl=238 time=1006.033 ms
64 bytes from 139.130.4.5: icmp_seq=1 ttl=238 time=1007.889 ms
64 bytes from 139.130.4.5: icmp_seq=2 ttl=238 time=1009.672 ms
64 bytes from 139.130.4.5: icmp_seq=3 ttl=238 time=1143.788 ms

--- 139.130.4.5 ping statistics ---
4 packets transmitted, 4 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 1006.033/1041.845/1143.788/58.871 ms

```

Ping.pcap file on wireshark



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.0.105	139.130.4.5	ICMP	98	Echo (ping) request id=0x22fb, seq=0/0, ttl=64 (reply in 3)
2	1.003828	192.168.0.105	139.130.4.5	ICMP	98	Echo (ping) request id=0x22fb, seq=1/256, ttl=64 (reply in 5)
3	1.005968	139.130.4.5	192.168.0.105	ICMP	98	Echo (ping) reply id=0x22fb, seq=0/0, ttl=238 (request in 1)
4	2.008143	192.168.0.105	139.130.4.5	ICMP	98	Echo (ping) request id=0x22fb, seq=2/512, ttl=64 (reply in 7)
5	2.011638	139.130.4.5	192.168.0.105	ICMP	98	Echo (ping) reply id=0x22fb, seq=1/256, ttl=238 (request in 2)
6	3.012382	192.168.0.105	139.130.4.5	ICMP	98	Echo (ping) request id=0x22fb, seq=3/768, ttl=64 (reply in 8)
7	3.017749	139.130.4.5	192.168.0.105	ICMP	98	Echo (ping) reply id=0x22fb, seq=2/512, ttl=238 (request in 4)
8	4.156894	139.130.4.5	192.168.0.105	ICMP	98	Echo (ping) reply id=0x22fb, seq=3/768, ttl=238 (request in 6)

We can see that 8 packets were exchanged. We can also see that the RTT we get from ping is almost equal to the RTT observed by opening the pcap file in wireshark as shown in the above images. For example, the second ping gives an $RTT = 2.008143 - 1.005968 = 1.002175$ which is approximately equal to 1007.889.

Part (b)

We can see that the server ip address is 128.30.52.100 and my ip address is 192.168.0.105.

ip.src == 192.168.0.105 and ip.dst == 128.30.52.100

No.	Time	Source	Destination	Protocol	Length	Info
54	*REF*	192.168.0.105	128.30.52.100	TCP	78	56465 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=841888972 TSecr=0 SACK_P...
55	0.168610	192.168.0.105	128.30.52.100	TCP	78	56466 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=841889139 TSecr=0 SACK_P...
57	0.324993	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1 Ack=1 Win=131712 Len=0 TSval=841889294 TSecr=561523976
58	0.325323	192.168.0.105	128.30.52.100	TLSv1.3	583	Client Hello
60	0.480877	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=1 Ack=1 Win=131712 Len=0 TSval=841889458 TSecr=561524142
61	0.490888	192.168.0.105	128.30.52.100	TLSv1.3	583	Client Hello
65	0.664192	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=518 Ack=2897 Win=129600 Len=0 TSval=841889632 TSecr=561524315
66	0.664192	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=518 Ack=4097 Win=128384 Len=0 TSval=841889632 TSecr=561524315
69	0.666908	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=518 Ack=5549 Win=129600 Len=0 TSval=841889634 TSecr=561524318
70	0.679806	192.168.0.105	128.30.52.100	TLSv1.3	130	Change Cipher Spec, Application Data
71	0.679974	192.168.0.105	128.30.52.100	TLSv1.3	158	Application Data
72	0.680124	192.168.0.105	128.30.52.100	TLSv1.3	554	Application Data
78	0.805093	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=518 Ack=2897 Win=128832 Len=0 TSval=841889770 TSecr=561524453
79	0.805094	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=518 Ack=4097 Win=129856 Len=0 TSval=841889770 TSecr=561524453
80	0.805094	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=518 Ack=5549 Win=128384 Len=0 TSval=841889770 TSecr=561524457
81	0.806210	192.168.0.105	128.30.52.100	TLSv1.3	130	Change Cipher Spec, Application Data
85	0.985828	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1162 Ack=5628 Win=130944 Len=0 TSval=841889950 TSecr=561524637
86	0.985828	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1162 Ack=5707 Win=130880 Len=0 TSval=841889950 TSecr=561524637
87	0.985829	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1162 Ack=5759 Win=130816 Len=0 TSval=841889950 TSecr=561524637
88	0.986066	192.168.0.105	128.30.52.100	TLSv1.3	97	Application Data
91	0.995031	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1193 Ack=7771 Win=129024 Len=0 TSval=841889959 TSecr=561524641
94	1.141580	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=582 Ack=5628 Win=130944 Len=0 TSval=841890104 TSecr=561524794
95	1.141580	192.168.0.105	128.30.52.100	TCP	66	56466 → 443 [ACK] Seq=582 Ack=5707 Win=130880 Len=0 TSval=841890104 TSecr=561524794
96	1.143283	192.168.0.105	128.30.52.100	TLSv1.3	232	Application Data
98	1.976128	192.168.0.105	128.30.52.100	TCP	232	[TCP Retransmission] 56465 → 443 [PSH, ACK] Seq=1193 Ack=7771 Win=131072 Len=166 TSva...
103	1.978592	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1359 Ack=10667 Win=129600 Len=0 TSval=841890939 TSecr=561525103
104	1.978668	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1359 Ack=12115 Win=131072 Len=0 TSval=841890939 TSecr=561525103
107	1.981013	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1359 Ack=13563 Win=129600 Len=0 TSval=841890941 TSecr=561525103
108	1.981013	192.168.0.105	128.30.52.100	TCP	66	56465 → 443 [ACK] Seq=1359 Ack=14653 Win=128512 Len=0 TSval=841890941 TSecr=561525103
110	2.106870	192.168.0.105	128.30.52.100	TCP	78	[TCP Window Update] 56465 → 443 [ACK] Seq=1359 Ack=14653 Win=131072 Len=0 TSval=84189...

▶ Frame 110: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface en0, id 0
 ▶ Ethernet II, Src: Apple_Id:0f:8a (94:f6:d6:1d:0f:8a), Dst: D-LinkIn_41:a6:54 (c4:e9:0a:41:a6:54)
 ▶ Internet Protocol Version 4, Src: 192.168.0.105, Dst: 128.30.52.100

```

0000  c4 e9 0a 41 a6 54 94 f6 d6 1d 0f 8a 00 00 45 00  ...A.T.....E-
0010  00 00 00 00 00 00 00 c5 24 c0 a8 00 69 00 1e    @..@..$.i..
0020  34 64 dc 91 01 bb 7e d1 b1 ac ab f6 df 13 b0 10  4d.....
0030  00 00 52 ce 00 00 01 01 00 0a 32 2e 3c f9 21 78  -R.....2,<ix
0040  33 fc 01 01 05 0a ab f6 da d1 ab f6 df 13      3.....
  
```

Destination Address: IPv4 address Packets: 139 · Displayed: 30 (21.6%) · Dropped: 0 (0.0%) Profile: Default

No.	Time	Source	Destination	Protocol	Length	Info
54	*REF*	192.168.0.105	128.30.52.100	TCP	78	56465 → 443 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=84188972 TSecr=0 SACK_P...
56	0.324882	128.30.52.100	192.168.0.105	TCP	74	443 → 56465 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 SACK_PERM=1 TSval=5615239...
59	0.489803	128.30.52.100	192.168.0.105	TCP	74	443 → 56466 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 SACK_PERM=1 TSval=5615241...
62	0.663997	128.30.52.100	192.168.0.105	TLSv1.3	1514	Server Hello, Change Cipher Spec, Application Data
63	0.664120	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [PSH, ACK] Seq=1449 Ack=518 Win=69632 Len=1448 TSval=561524315 TSecr=8418...
64	0.664123	128.30.52.100	192.168.0.105	TCP	1266	443 → 56465 [PSH, ACK] Seq=2897 Ack=518 Win=69632 Len=1200 TSval=561524315 TSecr=8418...
67	0.666820	128.30.52.100	192.168.0.105	TLSv1.3	1514	Application Data, Application Data
68	0.666826	128.30.52.100	192.168.0.105	TLSv1.3	70	Application Data
73	0.804867	128.30.52.100	192.168.0.105	TLSv1.3	1514	Server Hello, Change Cipher Spec, Application Data
74	0.804875	128.30.52.100	192.168.0.105	TCP	1514	443 → 56466 [PSH, ACK] Seq=1449 Ack=518 Win=69632 Len=1448 TSval=561524453 TSecr=8418...
75	0.805018	128.30.52.100	192.168.0.105	TCP	1266	443 → 56466 [PSH, ACK] Seq=2897 Ack=518 Win=69632 Len=1200 TSval=561524453 TSecr=8418...
76	0.805024	128.30.52.100	192.168.0.105	TLSv1.3	1514	Application Data, Application Data
77	0.805026	128.30.52.100	192.168.0.105	TLSv1.3	70	Application Data
82	0.985728	128.30.52.100	192.168.0.105	TLSv1.3	145	Application Data
83	0.985735	128.30.52.100	192.168.0.105	TLSv1.3	145	Application Data
84	0.985736	128.30.52.100	192.168.0.105	TLSv1.3	118	Application Data
89	0.994902	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [ACK] Seq=5759 Ack=1162 Win=69632 Len=1448 TSval=561524641 TSecr=84188964...
90	0.994910	128.30.52.100	192.168.0.105	TLSv1.3	630	Application Data
92	1.141474	128.30.52.100	192.168.0.105	TLSv1.3	145	Application Data
93	1.141477	128.30.52.100	192.168.0.105	TLSv1.3	145	Application Data
97	1.372444	128.30.52.100	192.168.0.105	TCP	66	443 → 56465 [ACK] Seq=7771 Ack=1359 Win=69632 Len=0 TSval=561525020 TSecr=841889950
99	1.978180	128.30.52.100	192.168.0.105	TCP	66	443 → 56465 [ACK] Seq=7771 Ack=1359 Win=69632 Len=0 TSval=561525100 TSecr=841890105
100	1.978187	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [ACK] Seq=7771 Ack=1359 Win=69632 Len=1448 TSval=561525103 TSecr=84189010...
101	1.978512	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [PSH, ACK] Seq=9219 Ack=1359 Win=69632 Len=1448 TSval=561525103 TSecr=841...
102	1.978517	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [ACK] Seq=10667 Ack=1359 Win=69632 Len=1448 TSval=561525103 TSecr=8418901...
105	1.980896	128.30.52.100	192.168.0.105	TCP	1514	443 → 56465 [PSH, ACK] Seq=12115 Ack=1359 Win=69632 Len=1448 TSval=561525103 TSecr=84...
106	1.980950	128.30.52.100	192.168.0.105	TLSv1.3	1156	Application Data
109	2.106793	128.30.52.100	192.168.0.105	TCP	1156	[TCP Spurious Retransmission] 443 → 56465 [PSH, ACK] Seq=13563 Ack=1359 Win=69632 Len...
111	2.286146	128.30.52.100	192.168.0.105	TCP	78	[TCP Dup ACK 99#1] 443 → 56465 [ACK] Seq=14653 Ack=1359 Win=69632 Len=0 TSval=56152529...

Frame 111: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface en0, id 0
 Ethernet II, Src: D-LinkIn_41:a6:54 (c4:e9:0a:41:a6:54), Dst: Apple_Id:0f:8a (94:f6:d6:1d:0f:8a)
 Internet Protocol Version 4, Src: 128.30.52.100, Dst: 192.168.0.105

0000 94 f6 d6 1d 0f 8a c4 e9 0a 41 a6 54 08 00 45 00A.T.E.
 0010 00 40 a1 ce 40 00 2d 06 36 56 80 1e 34 64 c0 a8 @.@- 6V-4d-
 0020 00 69 01 bb dc 91 ab f6 df 13 7e d1 b1 ac b0 10 .i.....
 0030 00 11 0c 04 00 00 01 01 08 0a 21 78 34 b2 32 2e:x4.2.
 0040 3c 79 01 01 05 0a 7e d1 b1 06 7e d1 b1 ac cy.....

Number of outgoing packets = 30, Number of incoming packets = 28.

Number of outgoing packets in 1st second = 21, 2nd second = 8, 3rd second = 1.

Number of incoming packets in 1st second = 17, 2nd second = 9, 3rd second = 2.

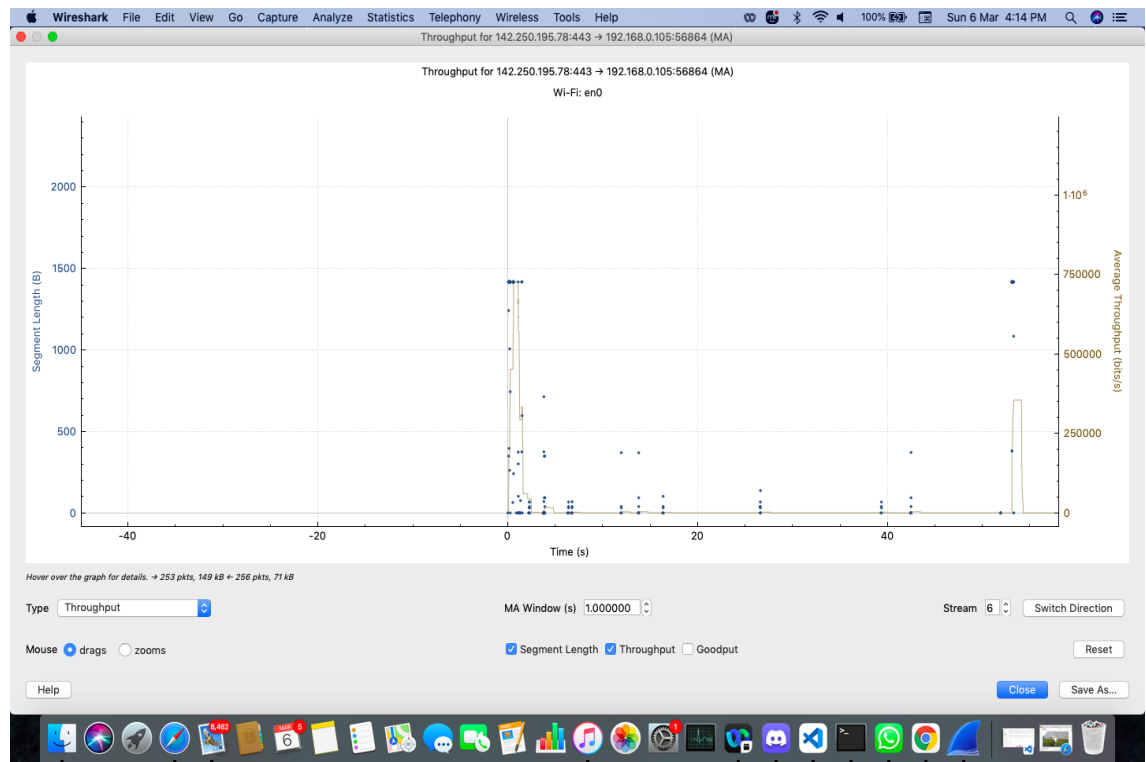
Size of outgoing data = sum of lengths of outgoing packets as seen in wireshark length column = 78+78+66+583.....=4121 bytes

Similarly size of incoming data = sum of lengths of incoming packets as seen in wireshark length column = 74+74+1514+1514+.....=23324 bytes



Part (c) Plot of throughput in TCP stream:

We can see that the throughput is high initially since youtube prefetches most of the content before starting to play the video so as to prevent buffering during the video.



3 Q3

See code in Q3.py file in folder Q3.

Answer: It was a bright cold day in February, and the clocks were striking thirteen.