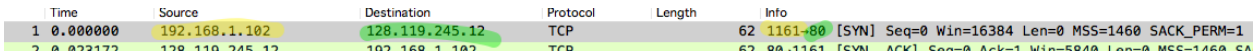
1.

A. From the provided trace, their ip address is 192.168.1.102, port 1161



	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161→80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1

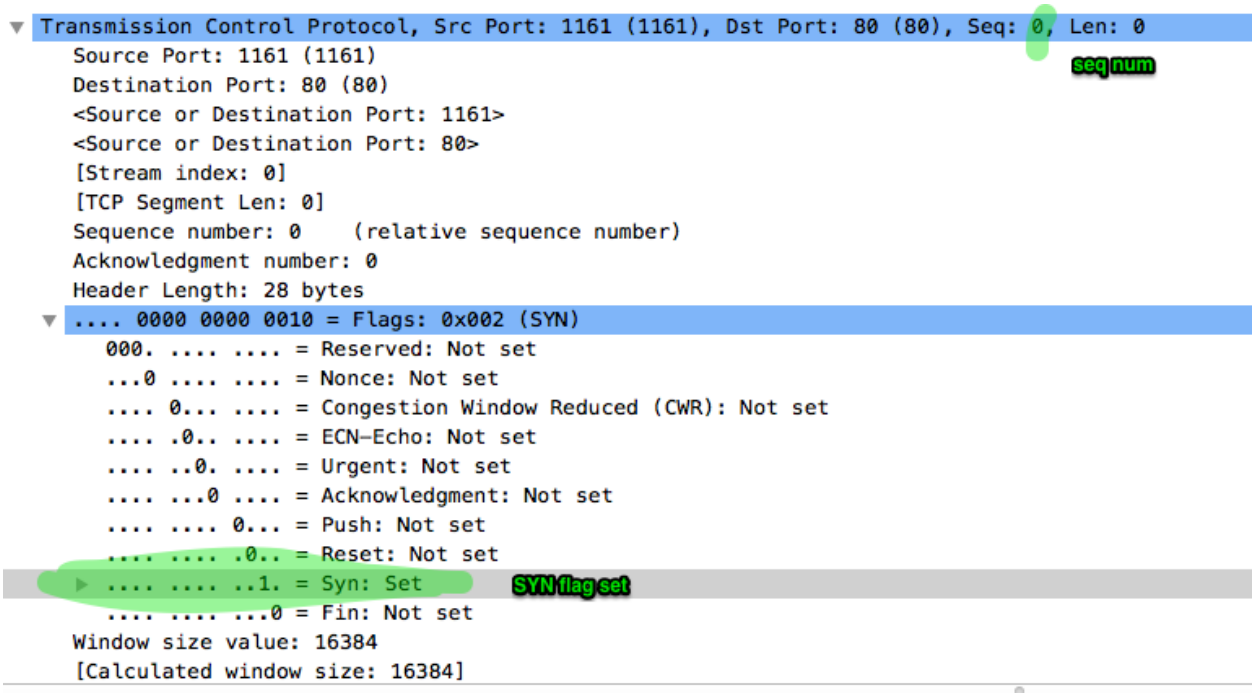
B. Gaia ip address is 128.119.245.12 using port 80

C. my ip address is 12.0.0.108 and I'm using port 50228.

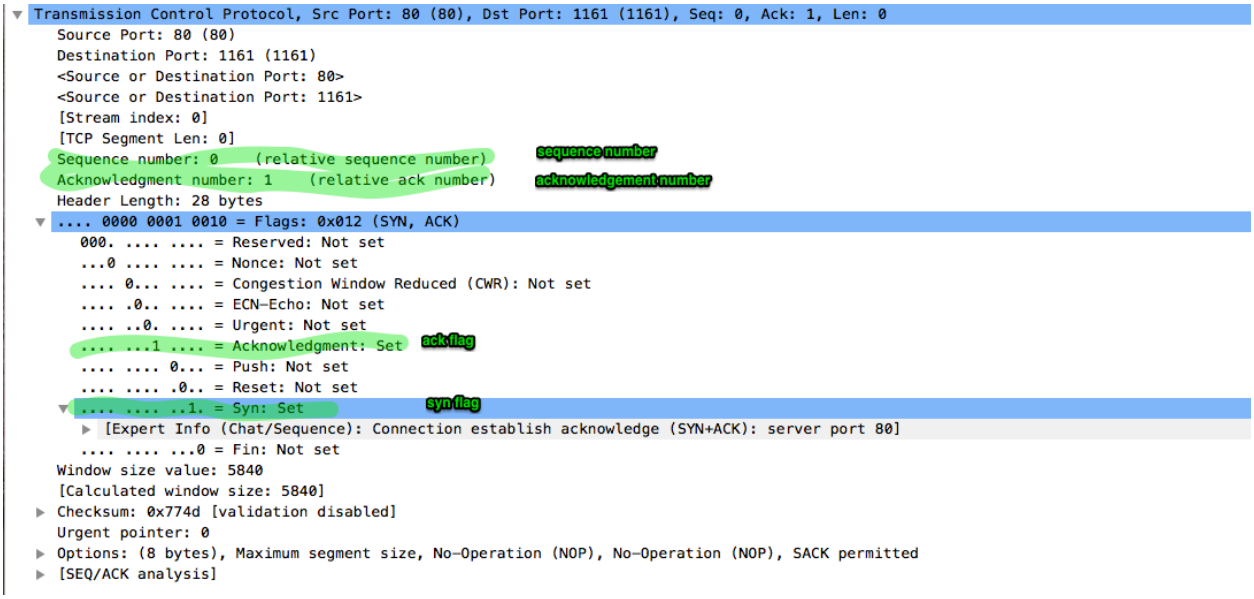
```
/Users/erouse/Documents/CS372/lab3/upload capture.pcapng 181 total packets, 181 shown

                                  gaia ip address          my ip address
    169 3.749565       128.119.245.12        12.0.0.108            HTTP     785    HTTP/1.1 200
OK\r
Frame 169: 785 bytes on wire (6280 bits), 785 bytes captured (6280 bits) on interface 0
Ethernet II, Src: AsustekC_5b:f4:88 (40:16:7e:5b:f4:88), Dst: Apple_e2:80:2e (3c:
15:c2:e2:80:2e)
Internet Protocol Version 4, Src: 128.119.245.12 (128.119.245.12), Dst: 12.0.0.108 (12.0.0.108)
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 50228 (50228), Seq: 1, Ack: 152901,
Len: 719                                  gaia port                 my port
Hypertext Transfer Protocol
    HTTP/1.1 200 OK\r\n
    Date: Sat, 08 Nov
    [HTTP response 1/1]
    Data (685 bytes)
0000  20 32 30 31 34 20 31 38 3a 31 37 3a 35 38 20 47    2014 18:17:58 G
0010  4d 54 0d 0a 53 65 72 76 65 72 3a 20 41 70 61 63   MT..Server: Apac
0020  68 65 2f 32 2e 32 2e 33 20 28 43 65 6e 74 4f 53   he/2.2.3 (CentOS
0030  29 0d 0a 4c 61 73 74 2d 4d 6f 64 69 66 69 65 64   )..Last-Modified
0040  3a 20 53 61 74 2c 20 32 33 20 4f 63 74 20 32 30   : Sat, 23 Oct 20
0050  31 30 20 31 31 3a 33 38 3a 35 38 20 47 4d 54 0d   10 11:38:58 GMT.
0060  0a 45 54 61 67 3a 20 22 64 36 66 36 61 2d 31 61   .ETag: "d6f6a-1a
0070  32 2d 33 34 36 37 37 38 38 30 22 0d 0a 41 63 63   2-34677880"..Acc
0080  65 70 74 2d 52 61 6e 67 65 73 3a 20 62 79 74 65   ept-Ranges: byte
0090  73 0d 0a 43 6f 6e 74 65 6e 74 2d 4c 65 6e 67 74   s..Content-Lengt
00a0  68 3a 20 34 31 38 0d 0a 4b 65 65 70 2d 41 6c 69   h: 418..Keep-Ali
00b0  76 65 3a 20 74 69 6d 65 6f 75 74 3d 31 30 2c 20   ve: timeout=10,
00c0  6d 61 78 3d 31 30 30 0d 0a 43 6f 6e 6e 65 63 74   max=100..Connect
00d0  69 6f 6e 3a 20 4b 65 65 70 2d 41 6c 69 76 65 0d   ion: Keep-Alive.
00e0  0a 43 6f 6e 74 65 6e 74 2d 54 79 70 65 3a 20 74   .Content-Type: t
00f0  65 78 74 2f 68 74 6d 6c 3b 20 63 68 61 72 73 65   ext/html; charse
0100  74 3d 55 54 46 2d 38 0d 0a 0d 0a 3c 54 49 54 4c   t=UTF-8....<TITL
0110  45 3e 55 70 6c 6f 61 64 20 70 61 67 65 20 66 6f   E>Upload page fo
0120  72 20 54 43 50 20 45 74 68 65 72 65 61 6c 20 4c   r TCP Ethereal L
0130  61 62 3c 2f 54 49 54 4c 45 3e 0a 3c 62 6f 64 79   ab</TITLE>.<body
0140  20 62 67 63 6f 6c 6f 72 3d 22 23 46 46 46 46 46    bgcolor="#FFFFF
0150  46 22 3e 0a 3c 70 3e 3c 66 6f 6e 74 20 66 61 63   F">.<p><font fac
0160  65 3d 22 41 72 69 61 6c 2c 20 48 65 6c 76 65 74   e="Arial, Helvet
0170  69 63 61 2c 20 73 61 6e 73 2d 73 65 72 69 66 22   ica, sans-serif"
0180  20 73 69 7a 65 3d 22 34 22 3e 20 43 6f 6e 67 72    size="4"> Congr
0190  61 74 75 6c 61 74 69 6f 6e 73 21 20 3c 62 72 3e   atulations! <br>
01a0  20 3c 2f 66 6f 6e 74 3e 0a 0a 3c 50 3e 3c 66 6f    </font>..<P><fo
01b0  6e 74 20 66 61 63 65 3d 22 41 72 69 61 6c 2c 20   nt face="Arial,
01c0  48 65 6c 76 65 74 69 63 61 2c 20 73 61 6e 73 2d   Helvetica, sans-
01d0  73 65 72 69 66 22 3e 20 59 6f 75 27 76 65 20 6e   serif"> You've n
01e0  6f 77 20 74 72 61 6e 73 66 65 72 72 65 64 20 61   ow transferred a
01f0  20 63 6f 70 79 20 6f 66 20 61 6c 69 63 65 2e 74    copy of alice.t
0200  78 74 20 66 66 72 6f 6d 0a 79 6f 75 72 20 63 6f   xt ffrom.your co
0210  6d 70 75 74 65 72 20 74 6f 20 0a 67 61 69 61 2e   mputer to .gaia.
0220  63 73 2e 75 6d 61 73 73 2e 65 64 75 2e 20 20 59   cs.umass.edu.  Y
0230  6f 75 20 73 68 6f 75 6c 64 20 6e 6f 77 20 73 74   ou should now st
0240  6f 70 20 57 69 72 65 73 68 61 72 6b 20 70 61 63   op Wireshark pac
0250  6b 65 74 20 63 61 70 74 75 72 65 2e 20 49 74 27   ket capture. It'
0260  73 20 74 69 6d 65 20 74 6f 20 73 74 61 72 74 20   s time to start
0270  61 6e 61 6c 79 7a 69 6e 67 20 74 68 65 20 63 61   analyzing the ca
0280  70 74 75 72 65 64 20 57 69 72 65 73 68 61 72 6b   ptured Wireshark
0290  20 70 61 63 6b 65 74 73 21 20 3c 2f 66 6f 6e 74    packets! </font
02a0  3e 0a 0a 3c 2f 46 4f 52 4d 3e 0a 0a 0a           >..</FORM>...
```

2. Sequence number is 0, knows it is SYN because the SYN flag is set.



3. Sequence number is still 0. Acknowledgement number is 1. Gaia determined this by adding 1 to the sequence number, this is the next expected byte. the SYN flag is set and the ACK flag is set.



4. Sequence number: 1.

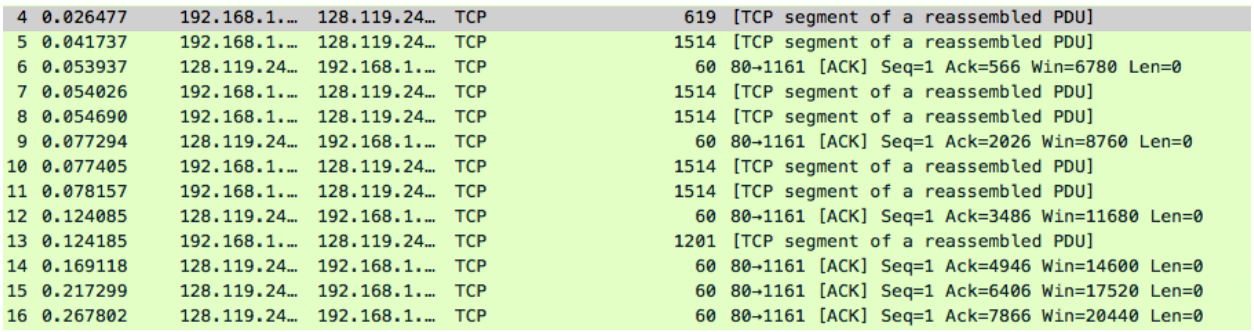
/Users/erouse/Documents/CS372/lab3/tcp-ethereal-trace-1.pcapng 213 total packets, 213 shown

```
      4 0.026477       192.168.1.102         128.119.245.12        TCP      619    [TCP segment
of a reassembled PDU]
Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73
(00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102 (192.168.1.102), Dst: 128.119.245.12
(128.119.245.12)
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 1, Ack: 1, Len:
565
    Source Port: 1161 (1161)
    Destination Port: 80 (80)
    [Stream index: 0]
    [TCP Segment Len: 565]
    Sequence number: 1    (relative sequence number)
    [Next sequence number: 566    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Header Length: 20 bytes
    .... 0000 0001 1000 = Flags: 0x018 (PSH, ACK)
        000. .... .... = Reserved: Not set
        ...0 .... .... = Nonce: Not set
        .... 0... .... = Congestion Window Reduced (CWR): Not set
        .... .0.. .... = ECN-Echo: Not set
        .... ..0. .... = Urgent: Not set
        .... ...1 .... = Acknowledgment: Set
        .... .... 1... = Push: Set
        .... .... .0.. = Reset: Not set
        .... .... ..0. = Syn: Not set
        .... .... ...0 = Fin: Not set
    Window size value: 17520
    [Calculated window size: 17520]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x1fbd [validation disabled]
    Urgent pointer: 0
    [SEQ/ACK analysis]
    TCP segment data (565 bytes)
0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00   ..%..s. ..p...E.
0010  02 5d 1e 21 40 00 80 06 a2 e7 c0 a8 01 66 80 77   .].!@.....f.w
0020  f5 0c 04 89 00 50 0d d6 01 f5 34 a2 74 1a 50 18   .....P.. ..4.t.P.
0030  44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65   Dp....PO ST /ethe
0040  72 65 61 6c 2d 6c 61 62 73 2f 6c 61 62 33 2d 31   real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f   -reply.htm HTTP/
0060  31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e   1.1..Host: gaia.
0070  63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 55 73   cs.umass.edu..Us
0080  65 72 2d 41 67 65 6e 74 3a 20 4d 6f 7a 69 6c 6c   er-Agent: Mozill
0090  61 2f 35 2e 30 20 28 57 69 6e 64 6f 77 73 3b 20   a/5.0 (Windows;
00a0  55 3b 20 57 69 6e 64 6f 77 73 20 4e 54 20 35 2e   U; Windows NT 5.
00b0  31 3b 20 65 6e 2d 55 53 3b 20 72 76 3a 31 2e 30   1; en-US; rv:1.0
00c0  2e 32 29 20 47 65 63 6b 6f 2f 32 30 30 33 30 32   .2) Gecko/200302
00d0  30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32   08 Netscape/7.02
00e0  0d 0a 41 63 63 65 70 74 3a 20 74 65 78 74 2f 78   ..Accept: text/x
00f0  6d 6c 2c 61 70 70 6c 69 63 61 74 69 6f 6e 2f 78   ml,application/x
0100  6d 6c 2c 61 70 70 6c 69 63 61 74 69 6f 6e 2f 78   ml,application/x
0110  68 74 6d 6c 2b 78 6d 6c 2c 74 65 78 74 2f 68 74   html+xml,text/ht
0120  6d 6c 3b 71 3d 30 2e 39 2c 74 65 78 74 2f 70 6c   ml;q=0.9,text/pl
0130  61 69 6e 3b 71 3d 30 2e 38 2c 76 69 64 65 6f 2f   ain;q=0.8,video/
0140  78 2d 6d 6e 67 2c 69 6d 61 67 65 2f 70 6e 67 2c   x-mng,image/png,
0150  69 6d 61 67 65 2f 6a 70 65 67 2c 69 6d 61 67 65   image/jpeg,image
0160  2f 67 69 66 3b 71 3d 30 2e 32 2c 74 65 78 74 2f   /gif;q=0.2,text/
0170  63 73 73 2c 2a 2f 2a 3b 71 3d 30 2e 31 0d 0a 41   css,*/*;q=0.1..A
0180  63 63 65 70 74 2d 4c 61 6e 67 75 61 67 65 3a 20   ccept-Language:
0190  65 6e 2d 75 73 2c 20 65 6e 3b 71 3d 30 2e 35 30   en-us, en;q=0.50
01a0  0d 0a 41 63 63 65 70 74 2d 45 6e 63 6f 64 69 6e   ..Accept-Encodin
01b0  67 3a 20 67 7a 69 70 2c 20 64 65 66 6c 61 74 65   g: gzip, deflate
01c0  2c 20 63 6f 6d 70 72 65 73 73 3b 71 3d 30 2e 39   , compress;q=0.9
01d0  0d 0a 41 63 63 65 70 74 2d 43 68 61 72 73 65 74   ..Accept-Charset
01e0  3a 20 49 53 4f 2d 38 38 35 39 2d 31 2c 20 75 74   : ISO-8859-1, ut
```

5 and 6:

Table 1

Seqment	Sequence Number	Time Sent	ACK Rec'd	RTT	EstimatedRTT .875*estRTT + 0.125*SmplRTT	Segment Length
1	1	0.026477	0.053937	0.02746	0.02746	619
2	565	0.026477	0.077294	0.050817	0.030379625	1514
3	2026	0.054026	0.124085	0.070059	0.035339546875	1514
4	3486	0.054690	0.169118	0.114428	0.045225603515	1514
5	4946	0.077405	0.217299	0.139894	0.057059153076	1514
6	6406	0.078157	0.267802	0.189645	0.073632383941	1514



4	0.026477	192.168.1.…	128.119.24…	TCP	619	[TCP segment of a reassembled PDU]
5	0.041737	192.168.1.…	128.119.24…	TCP	1514	[TCP segment of a reassembled PDU]
6	0.053937	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.…	128.119.24…	TCP	1514	[TCP segment of a reassembled PDU]
8	0.054690	192.168.1.…	128.119.24…	TCP	1514	[TCP segment of a reassembled PDU]
9	0.077294	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.…	128.119.24…	TCP	1514	[TCP segment of a reassembled PDU]
11	0.078157	192.168.1.…	128.119.24…	TCP	1514	[TCP segment of a reassembled PDU]
12	0.124085	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.…	128.119.24…	TCP	1201	[TCP segment of a reassembled PDU]
14	0.169118	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.24…	192.168.1.…	TCP	60	80→1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

7. The windw size holds steady at 17520. We never fill the buffer, we receive ACKs in order, so calculated window never shrinks below 17520.

8. Nope. I followed the ACKs and they all sequence in order, as they should.

9. The length of an ACK is usually 60 bytes. It starts out ACKing each 1514 bytes, but then starts ACKing after two segments (3028 bytes).

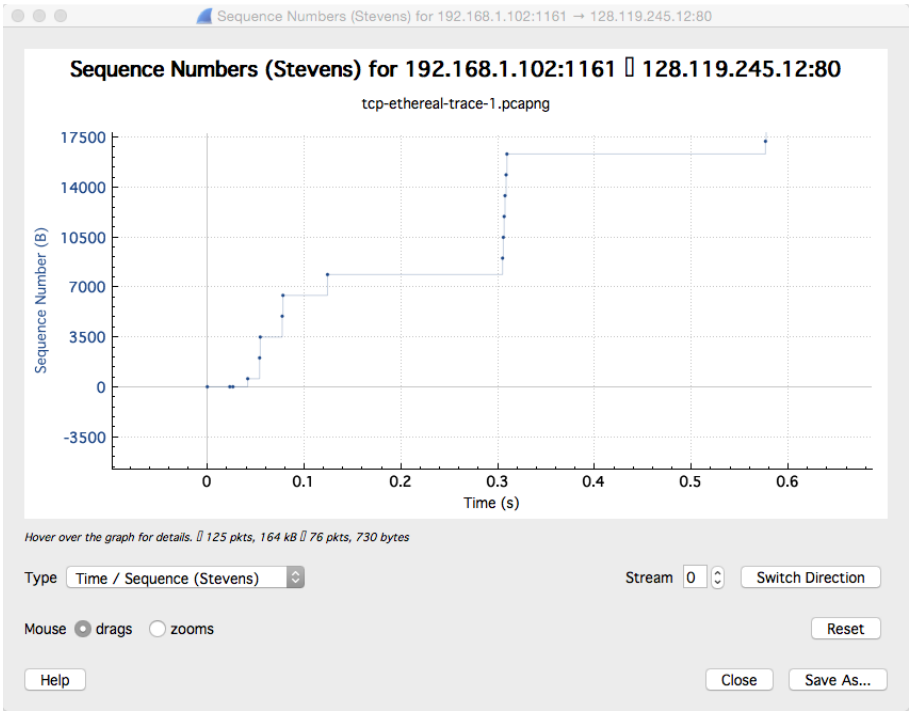
99	2.476801	192.168.1.…	128.119.24…	TCP	msg 1	1514	1161→80 [ACK] Seq=74549 Ack=1 Win=17520 Len=1460
100	2.477515	192.168.1.…	128.119.24…	TCP	msg 2	1514	1161→80 [ACK] Seq=76009 Ack=1 Win=17520 Len=1460
101	2.478415	192.168.1.…	128.119.24…	TCP	msg 3	1514	1161→80 [ACK] Seq=77469 Ack=1 Win=17520 Len=1460
102	2.479341	192.168.1.…	128.119.24…	TCP	msg 4	1514	1161→80 [ACK] Seq=78929 Ack=1 Win=17520 Len=1460
103	2.480356	192.168.1.…	128.119.24…	TCP	msg 5	1514	1161→80 [ACK] Seq=80389 Ack=1 Win=17520 Len=1460
104	2.481218	192.168.1.…	128.119.24…	TCP	a push!!??? wierd	946	1161→80 [PSH, ACK] Seq=81849 Ack=1 Win=17520 Len=892
105	2.576633	128.119.24…	192.168.1.…	TCP	ACK for 1 and 2	60	80→1161 [ACK] Seq=1 Ack=77469 Win=62780 Len=0
106	2.672045	128.119.24…	192.168.1.…	TCP	ACK for 3 and 4	60	80→1161 [ACK] Seq=1 Ack=80389 Win=62780 Len=0
107	2.747257	128.119.24…	192.168.1.…	TCP		60	80→1161 [ACK] Seq=1 Ack=82741 Win=62780 Len=0

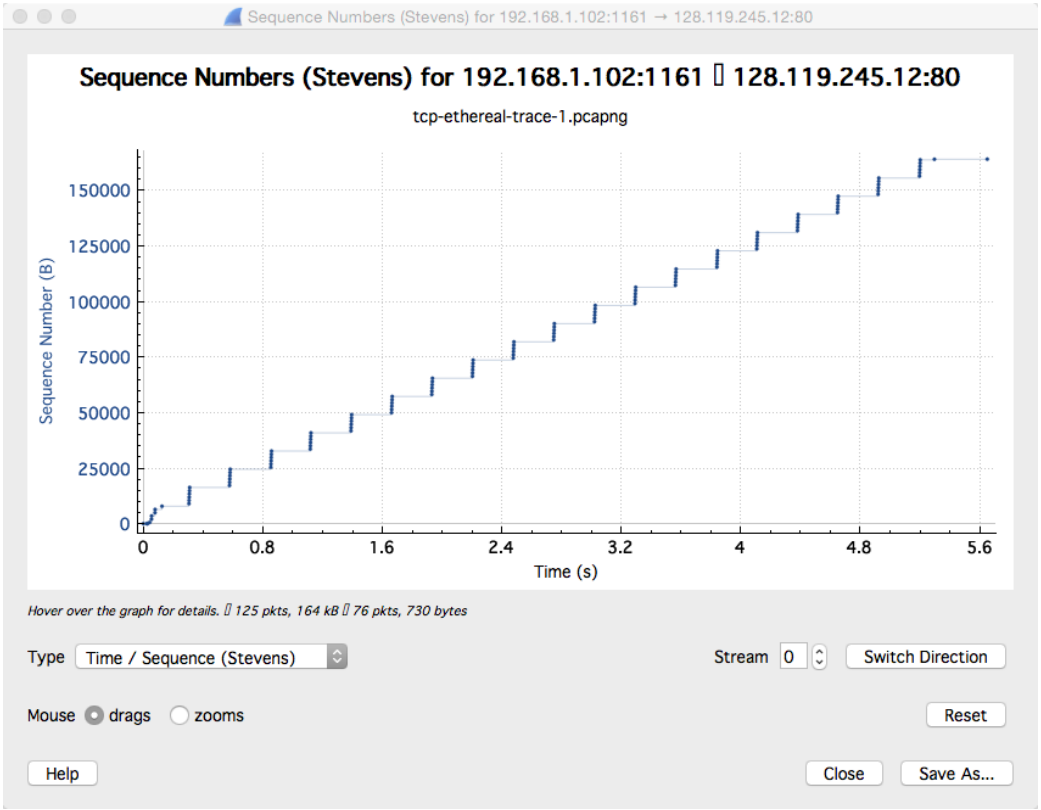
10. According to segment 199, the total bytes sent were 164090. Total time was 5.27s. Therefore 1664090/5.27 = 31131 bytes/second.

199	5.297341	192.168.1.…	128.119.24…	TCP	104	1161→80 [PSH, ACK] Seq=164041 Ack=1 Win=17520 Len=50

```
▼ Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 164041, Ack: 1, Len: 50
    Source Port: 1161 (1161)
    Destination Port: 80 (80)
    <Source or Destination Port: 1161>
    <Source or Destination Port: 80>
    [Stream index: 0]
    [TCP Segment Len: 50]
    Sequence number: 164041    (relative sequence number)
    [Next sequence number: 164091    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Header Length: 20 bytes
```

11. Slow start begins at t=0 and ends at about t=0.3 where congestion avoidance takes over. Measured data is more erratic than idealized behavior.





12. Slow start begins at t=0 and ends at about t=0.2 where congestion avoidance takes over. Measured data is more erratic than idealized behavior.