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Homework 3

PART 1 - LAB

I am using the given trace for every question except question 3.

1.

The screenshot shows the Wireshark interface with the 'tcp-ethereal-trace-1' file open. The packet list pane on the left shows frame 199 selected, which is an HTTP POST request from 192.168.1.102 to 128.119.245.12. The packet details pane on the right shows the selected frame's structure: Ethernet II, Internet Protocol Version 4, and Transmission Control Protocol. The packet bytes pane at the bottom shows the raw data of the selected frame.

No.	Time	Source	Destination	Protocol	Length	Info
196	5.201150	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=162309 Ack=164091
197	5.202024	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163761 Ack=164091
198	5.297257	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=15931
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-rep
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16231
201	5.447887	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16401
202	5.455830	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16401
203	5.461175	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
204	5.598090	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
205	5.599082	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
206	5.651141	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=164091
207	6.101044	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1

Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 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, Dst: 128.119.245.12
> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 164041, Ack: 1, Len: 50
Source Port: 1161
Destination Port: 80

- a. Selecting HTTP at Frame 199 provides us with a client IP address of 192.168.1.102 and a TCP port number of 1161.

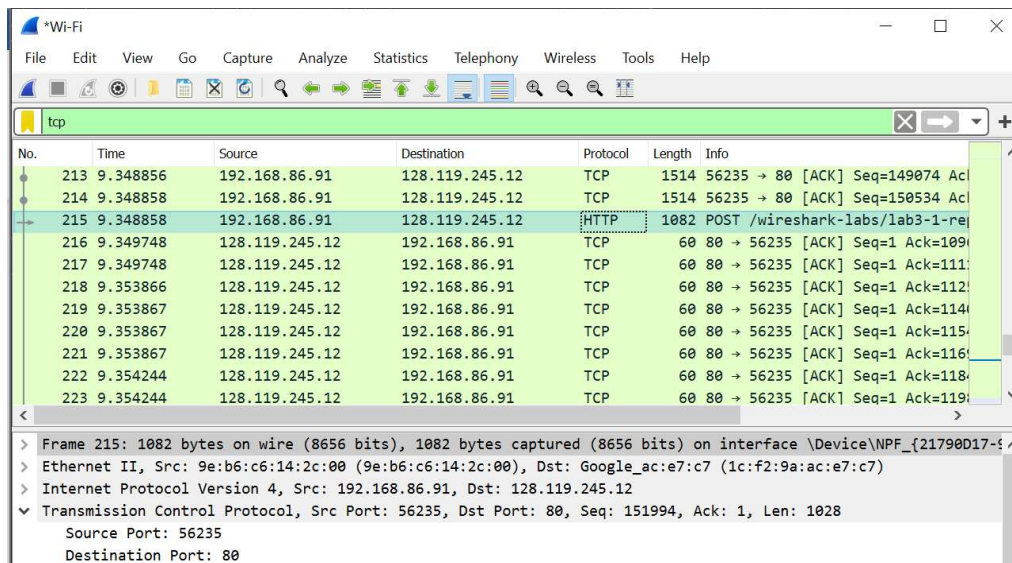
2.

The screenshot shows the Wireshark interface with the 'tcp-ethereal-trace-1' file open. The packet list pane on the left shows frame 203 selected, which is an HTTP 200 OK response from 128.119.245.12 to 192.168.1.102. The packet details pane on the right shows the selected frame's structure: Ethernet II, Internet Protocol Version 4, and Transmission Control Protocol. The packet bytes pane at the bottom shows the raw data of the selected frame.

No.	Time	Source	Destination	Protocol	Length	Info
196	5.201150	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=162309 Ack=164091
197	5.202024	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163761 Ack=164091
198	5.297257	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=15931
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-rep
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16231
201	5.447887	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16401
202	5.455830	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=16401
203	5.461175	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
204	5.598090	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
205	5.599082	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
206	5.651141	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=164091
207	6.101044	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1

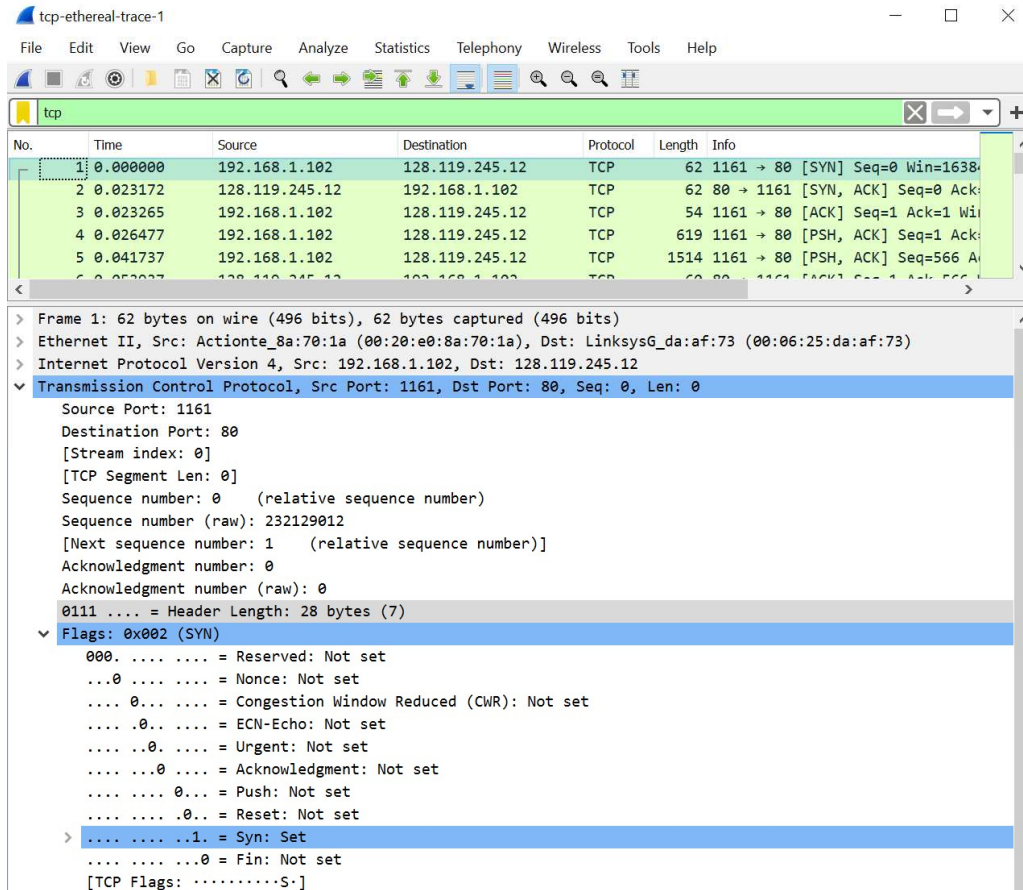
Frame 203: 784 bytes on wire (6272 bits), 784 bytes captured (6272 bits)
> Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
> Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 164091, Len: 730
Source Port: 80
Destination Port: 1161

- a. The IP address of gaia.cs.umass.edu is 128.119.245.12 and the TCP port number is 80.



3.

a. The IP address of my computer is 192.168.86.91 and the TCP port number is 56235.



4.

a. The sequence number of the TCP SYN segment is 0. The SYN flag is set to 1, identifying it as a SYN segment.

tcp-ethereal-trace-1

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tcp

No.	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=1638
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Wi
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 A

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)

> Ethernet II, Src: Linksys_G_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)

> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102

✓ Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 0 (relative sequence number)

Sequence number (raw): 883061785

[Next sequence number: 1 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

Acknowledgment number (raw): 232129013

0111 = Header Length: 28 bytes (7)

✓ Flags: 0x012 (SYN, 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

....0... = Push: Not set

....0.. = Reset: Not set

>1. = Syn: Set

....0 = Fin: Not set

[TCP Flags:A..S.]

5.

- The sequence number of the SYNACK segment is 0. The value of the Acknowledgement field is 1. This segment is identified as a SYNACK by the Acknowledgement and Syn flags both being set to 1.

tcp-ethereal-trace-1

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tcp

No.	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
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Len=565
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1

> 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, Dst: 128.119.245.12

▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 565]

Sequence number: 1 (relative sequence number)

Sequence number (raw): 232129013

[Next sequence number: 566 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

Acknowledgment number (raw): 883061786

0101 = Header Length: 20 bytes (5)

▼ Flags: 0x018 (PSH, ACK)

000. = Reserved: Not set

...0 = Nonce: Not set

.... 0... = Congestion Window Reduced (CWR): Not set

.... .0.. = ECN-Echo: Not set

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;

6. a. The sequence number of segment 4 which contains the HTTP POST command is 1.

No.	Time	Source	Destination	Protocol	Length	Info
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Len=565
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866
14	0.169118	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946
15	0.217299	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406
16	0.267802	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866
17	0.304807	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=9013
18	0.305040	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=9013 Ack=1

7. a. Segment Sequence Numbers:
- Segment 1: 1
 - Segment 2: 566

- iii. Segment 3: 2026
 - iv. Segment 4: 3486
 - v. Segment 5: 4946
 - vi. Segment 6: 6406
 - b. Sent Times in seconds
 - i. Segment 1: 0.026477
 - ii. Segment 2: 0.041737
 - iii. Segment 3: 0.053937
 - iv. Segment 4: 0.054026
 - v. Segment 5: 0.054690
 - vi. Segment 6: 0.077405
 - c. Ack Received Times in seconds
 - i. Segment 1: 0.053937
 - ii. Segment 2: 0.077294
 - iii. Segment 3: 0.124085
 - iv. Segment 4: 0.169118
 - v. Segment 5: 0.217229
 - vi. Segment 6: 0.267802
 - d. RTT in seconds
 - i. Segment 1: 0.02746
 - ii. Segment 2: 0.035557
 - iii. Segment 3: 0.070148
 - iv. Segment 4: 0.115092
 - v. Segment 5: 0.162539
 - vi. Segment 6: 0.190397
 - e. Estimated RTT in seconds
 - i. Segment 1: 0.02746
 - ii. Segment 2: $0.875 * 0.02746 + 0.125 * 0.035557 = 0.028472125$
 - iii. Segment 3: $0.875 * 0.028472125 + 0.125 * 0.070148 = 0.03368160937$
 - iv. Segment 4: $0.875 * 0.03368160937 + 0.125 * 0.115092 = 0.04385790819$
 - v. Segment 5: $0.875 * 0.04385790819 + 0.125 * 0.162539 = 0.05869304466$
 - vi. Segment 6: $0.875 * 0.05869304466 + 0.125 * 0.190397 = 0.07515603907$

8. Length of TCP Segments in bytes

a. Segment 1: 565

4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80	[PSH, ACK] Seq=1 Ack=	▼
< >								
> 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, Dst: 128.119.245.12 > Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565 ▼ Data (565 bytes)								

i.

b. Segment 2: 1460

5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[PSH, ACK] Seq=566 A	▼
< >								
> Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 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, Dst: 128.119.245.12 > Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460 ▼ Data (1460 bytes)								

i.

c. Segment 3: 1460

- d. Segment 4: 1460
- e. Segment 5: 1460
- f. Segment 6: 1460

1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80	[SYN, Seq=0 Win=16384, Len=0]
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161	[SYN, ACK, Seq=0 Ack=1, Len=0]
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80	[ACK, Seq=1 Ack=1 Win=0, Len=0]
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80	[PSH, ACK, Seq=1 Ack=1 Win=0, Len=0]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[PSH, ACK, Seq=566 Ack=1, Len=1460]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK, Seq=1 Ack=566 Win=0, Len=0]
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK, Seq=566 Ack=1 Win=0, Len=0]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK, Seq=566 Ack=1 Win=0, Len=0]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK, Seq=1 Ack=2026 Win=0, Len=0]
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK, Seq=4946 Ack=1 Win=0, Len=0]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK, Seq=6406 Ack=1 Win=0, Len=0]
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK, Seq=1 Ack=3486 Win=0, Len=0]


```

Sequence number: 0 (relative sequence number)
Sequence number (raw): 883061785
[Next sequence number: 1 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Acknowledgment number (raw): 232129013
0111 .... = Header Length: 28 bytes (7)
Flags: 0x012 (SYN, 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
.... ....0... = Push: Not set
.... ....0.. = Reset: Not set
> .... ....1. = Syn: Set
.... ....0 = Fin: Not set
[TCP Flags: .....A..S.]
Window size value: 5840
[Calculated window size: 5840]
Checksum: 0x774d [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0

```

9.
 - a. The minimum amount of buffer space is 5840 bytes.
 - b. The sender never gets throttled due to lack of receiver buffer space. It grows to 62780 bytes.
10. There are none. I checked for increasing sequence numbers in the Time-Sequence-Graph (Stevens).
11. The receiver typically acknowledges 1460 bytes in an ACK as most segments contain 1460 bytes of data. The only time the receiver seems to ACK every other received segment is before the POST segment is sent. It ACKS both the post segment in frame 4 and the segment in frame 3 together.
12. Average throughput is the total amount of data over the total transmission time.
 - a. Total amount of data: last TCP segment sequence number acknowledges minus the first TCP segment sequence number.
 - i. 164091 bytes – 1 byte = 164090 bytes
 - b. Total transmission time: time of last ACK minus time the first TCP segment is sent
 - i. 5.455830 s – 0.026477 s = 5.4294 seconds
 - c. Average throughput = 164090 bytes / 5.4294 seconds = 30.2224924 kbps