## Exercise1:

 $Q1. the\ IP\ address\ of\ gaia.cs. umass.edu: 128.119.245.12$ 

port number:80

the IP address and TCP port numbers used by the client computer (source):192.168.1.102;1161



## Q2. sequence number:232129013

1 0,000000		Destination		Levell' (sti-
	192.160.1.102	128.119.245.12	TCP	62 1161 + 88 [SYN] Seq=0 MIn=16388 Len+8 MSS=1460 SACK_PERN=1
2 8.025172	128.119.245.12	192,168,1,182	TCP	62 88 + 1161 [SYN, ACK] Seq-8 Ack-1 Win-SB48 Len-8 MSS-1468 SACK_PERM-1
3 0.021265	192-148-1-182	128.319.245.32	TCP .	5d 1161 + 88 [ACX] Seq=1 Ack=1 Win=17528 Len=8
4 9.926477	192.168.1.102	128,119,245,12	TCP	619 1161 + 88 [PSH, ACK] Seq-1 Ack-1 Win-17520 Len-565 [TOP segment of # _
5 0.041737	192.168.1.102	128,119,245,12	TCP	1514 1161 + 88 [FSH, ACK] Seq-566 Ack-1 Min-17520 Lam-1460 [TCP segment of,
6 8.053937	128-119-245-12	192,168,1,102	TCP	60 80 + 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 0.054026	192.168.1.182	128,119,245,12	TCP	1514 1161 + 88 [ACX] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a n_
E 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 + 88 [ACK] Seq=1486 Ack=1 Win=17520 Len=1460 [TCP segment of a r
9 8.077294	128.119.245.12	192,168,1,182	TCR	60 80 + 1161 [ACK] Seq-1 Ack-2026 WIn-8760 Len-0
18 8.877405	192,168,1,102	128.119.245.12	TCP	1514 1161 - 88 [ACK] Seq=4946 Ack+1 Win=17520 Len+1468 [TCP segment of a r. ]
Internet Protocol Fransmission Contr Source Port: 11 Destination Port [Stream Index: ( [Conversation or	Wersiam 4, Src: 192. ol Protocol, Src Por i : 80 il mpleteness: Incomple	168.1.182, Oxt: 128.1 t: 1161, Ost Port: 80	19.245.12	(_data=173 (00)=00.25:data=1733) ACK: 1, Len: 565
Internet Protocol Fransmission Contr Source Port Destination Por [Stream Index: ( [Convernation or [TCP Segment Les Sequence Mumber Sequence Mumber Sequence Mumber	Wersion 4, Sec: 192. ol Protocol, Sec Pord : 80 i] mplateness: Incompla : 965] 1 (relative sequ (row): 19212981)	108.1.102, Det: 128.1 t: 1161, Det Port: 89 ets, DATA (15)) wance number)	19.245.12 , Seq: 1, :	
Internet Protocol Transmission Contr Source Port: 11 Destination Port [Stream Index: 0 [Convernation or [TCP Segment Le Sequence Number Sequence Number [Next Sequence !	Wersiam 4, Src: 192.  ol Protocol, Src Por  i: 80  ji mpleteness: Incomple i: 965]  1 (relative seq: (rew): 23212981) ambter: 566 (relative	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sance number) Live sequence number)	19.245.12 , Seq: 1, :	
mternet Protocol renomission Contr source Port: 131 Destination Port (Stream Indox: ) (Conversation C: (TYP Segment Lm Sequence Number Sequence Number (Mext Sequence Indox Acknowledgment )	Wersian 4, Sec: 192. ol Protocol, Sec Pord i: 80 i) mpleteness: Incomple i: 946) I (relative sequ (row): 232129813 matter: 566 (relative tamber: 1 (relative tamber: 1 (relative	168.1.162, Dat: 228.1 ti 1161, Dat Port: 80 ets, DATA (15)] sance number) tive sequence number)] we ack number)	19.245.12 , Seq: 1, :	
nternet Protocol renomission Contr Source Purt: III Destination Port (Streen Index: (Conversation of (TCP Segment Les Sequence Number Requence Number (Next Sequence I Acknowledgment : Acknowledgment :	Wersiam 4, Src: 192.  ol Protocol, Src Por 5  i 90  pulsteness: Incomple  i 965] 1 (relative seq (red; 29212981)  amber: 566 (relative seq amber: 1 (relative seq sumber: 868 (relative seq	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sence ramber) tive sequence number)] na ack number) 766	19.245.12 , Seq: 1, :	
mternet Protocol ransmission Contr Source Purt: III Destination Port (Stream Index: c (TCP Segment Le Sequence Number (Mext Sequence ) Acknowledgment : Acknowledgment : displacement : Heat	Wersiam 4, Sec: 192. ol Protocol, Sec Por ii 90 ii) sepletemens: Incomple ii 966) I (relative seq (rew): 232129813 ambler: 566 (relative subter: 567 (relative incomplete in the sequence of the seq	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sence ramber) tive sequence number)] na ack number) 766	19.245.12 , Seq: 1, :	
Internet Protocol Franchission Contr Source Purt: 11 Destination Purt [Stream Index: 1 [Convernation or [TCP Segment Le Sequence Number Sequence Number Acknowledgment Acknowledgment stol Hoss Lings: 80.016 (P)	Wersiam 4, Sec: 192. ol Protocol, Sec Por ii 90 ii) sepletemens: Incomple ii 966) I (relative seq (rew): 232129813 ambler: 566 (relative subter: 567 (relative incomplete in the sequence of the seq	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sence ramber) tive sequence number)] na ack number) 766	19.245.12 , Seq: 1, :	
Internet Protocol Transmission Contr Source Purt: 11 Destination Purt (Stream Index: 6 [Corremation or [TYP Segment Le Soquence Number Sequence Number Acknowledgment to 1010 * Head Ilags: 80018 (P) Mindow: 17520	Wersiam 4, Sec: 192. ol Protocol, Sec Por i: 00 i: 00 ii) 10 iii) 10 iii) 10 iii) 10 iii) 10 iii) 10 iii) 11 iii) 10 iii) 11 i	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sence ramber) tive sequence number)] na ack number) 766	19.245.12 , Seq: 1, :	
internet Protocol renormission Contra- fource Purt: 110 Destination Port (Stroen Index: (Conversation of [TCP Segment Lin Sequence Number (Next Sequence Number (Next Sequence Activosidegment Activosidegment of etcl + Head Flags: 8x018 (Protocol 1752) (Calculated winn (Calculated winn	Wersiam 4, Sec: 192. oi Protocol, Sec Por di i 80 i 80 i 90 spleteness: Incomple i 9665 I (relative soq (rew): 23129013 ambier: (relative soq (rew): 23129013 ambier: (relative soq (rea): 880601 ambier: (relative soq (rea): 880601 ambier: (res): 880601 ambier: (res	108.1.102, Det 128.1 tr 1161, Det Portr 89 ets, DATA (15)] sance rumber) tive sequence number)] vs ack number) 126 (5)	19.245.12 , Seq: 1, /	
internet Protocol renormission Contra- fource Purt: 110 Destination Port (Stroen Index: (Conversation of [TCP Segment Lin Sequence Number (Next Sequence Number (Next Sequence Activosidegment Activosidegment of etcl + Head Flags: 8x018 (Protocol 1752) (Calculated winn (Calculated winn	Wersiam 4, Sec: 192.  10 Protocol, Sec Por  11 : 88 : 91  11 : 96 : (*elative seq.  12 (*ewe): 292129823  ausbers 566 (*elati  ausber (*ewe): 883961;  ausber 16 (*elati  ausber 183961;  be 182961;  be 182961;  be size: 17528]  ling factor: -2 (ne	108.1.102, Dat: 228.1 t: 3161, Dat Port: 80 ste, DATA (15)] sence ramber) tive sequence number)] na ack number) 766	19.245.12 , Seq: 1, /	

# Q3.

No	sequence	sent time	received	RTT	EstimatedRTT
	number		time		
1	232129013	0.026477	0.053937	0.027460	0.027460
2	232129578	0.041737	0.077294	0.035557	0.028472
3	232131038	0.054026	0.124085	0.070059	0.033670
4	232132498	0.054690	0.169118	0.114428	0.043765
5	232133958	0.077405	0.217299	0.139894	0.055781
6	232135418	0.078157	0.267802	0.189645	0.072514

No.	Time	Source	Destination	Protocol	Length Info
г	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
	2 0.023172	128.119.245.12	192.168.1.102	TCP	62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
	3 0.023265	192.168.1.102	128.119.245.12	TCP	54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
	4 0.026477	192.168.1.102	128.119.245.12	TCP	619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a
	5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 + 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of
	6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
	7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a r
	8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a r_
	9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
	10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a r
+	11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a r
	12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
	13 0.124185	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment o
	14 0.169118	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
	15 0.217299	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
	16 0.267802	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
	17 0.304807	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
	18 0.305040	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460 [TCP segment of a r

# Q4. 565,1460,1460,1460,1460,1460

Q5. 5840;No,5840>1460.

Q6.No, the sequence number never repeated.

Q7.1460, the server waits for a short time after receiving a packet. If consecutive new packets are received within this period of time, the server directly sends the ACK of the latter and ignores the ACK of the former.

Q8.Throughput=Total data transmission/The total time =(232293103-232129013)/(5.461175-0.026477)=164090/5.434698=30193.03

#### Eexrcise2:

No	Source IP	Destination IP	Protocol	Info
295	10.9.16.201	10.99.6.175	ТСР	50045 > 5000 [SYN] Seq=2818463618 win=8192 MSS=1460
296	10.99.6.175	10.9.16.201	ТСР	5000 > 50045 [SYN, ACK] Seq=1247095790 Ack=2818463619 win=262144 MSS=1460
297	10.9.16.201	10.99.6.175	ТСР	50045 > 5000 [ACK] Seq=2818463619 Ack=1247095791 win=65535
298	10.9.16.201	10.99.6.175	ТСР	50045 > 5000 [PSH, ACK] Seq=2818463619 Ack=1247095791 win=65535
301	10.99.6.175	10.9.16.201	ТСР	5000 > 50045 [ACK] Seg=1247095791 Ack=2818463652 win=262096
302	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [PSH, ACK] Seq=1247095791 Ack=2818463652 win=262144
303	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq =2818463652 Ack=1247095831 win=65535
304	10.9.16.201	10.99.6.175	ТСР	
				50045 > 5000 [FIN, ACK] Seq=2818463652 Ack=1247095831 win=65535
305	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [FIN, ACK] Seq=1247095831 Ack=2818463652 win=262144
306	10.9.16.201	10.99.6.175	TCP	50045 > 5000 [ACK] Seq=2818463652 Ack=1247095832 win=65535
308	10.99.6.175	10.9.16.201	TCP	5000 > 50045 [ACK] Seq=1247095831 Ack=2818463653 win=262144

Q1.2818463618

Q2.1247095790, 2818463619, seq+1

Q3. 2818463619, 1247095791,no

Q4. Client which first sent FIN in No.305; simultaneous close

Q5. client to server:2818463653-2818463618-2=33 server to client:1247095831-1247095790-2=39

data=final ACK-Initial Sequence Number-2