Name: _____ J#: _____

Jackson State University
CSC 435/CSC 524 Computer Networks, Spring 2020
Instructor: Dr. Natarajan Meghanathan
Exam 4
Due: April 17th, (Friday), 11.59 PM in Canvas Maximum Points: 100

Note: If I find that two or more students have copied the answers for even one question, everybody involved in this activity will get a ZERO for the ENTIRE EXAM. There should be strictly NO COPYING.

Note: You need to use this document and submit your answers in the space provided in one of the following ways.

Submission Options (choose one of the three): You can either
(a) Print this exam, write the solutions in the space provided, scan and upload as a PDF file or
(b) Use the space provided to type the solutions, save the file to a word or PDF and upload or
(c) Write the solutions for some questions by hand and type the solutions for some other questions. In this case, you should scan the written text to a PDF file, merge it with the PDF file for the typed content and submit everything together as a single PDF file.

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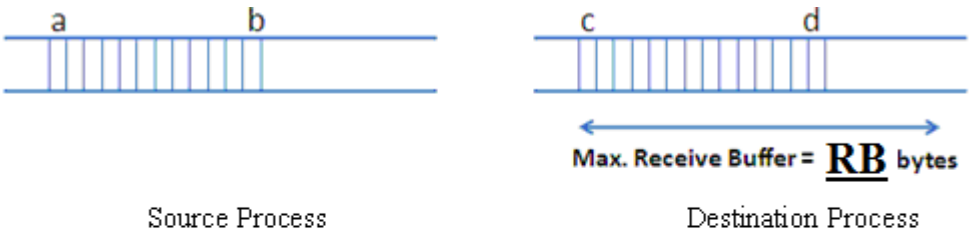
Q1 - 20 pts) Consider the status of a TCP connection at the source and destination as shown in the Figure and Table below. Let the Congestion Window size be **CW** bytes and Maximum Receiver Buffer Size be **RB** bytes. What would be the Effective Window Size (the amount of data that can be sent) by the source considering:



Notation	Description
a	Last Byte Acknowledged
b	Last Byte Sent
c	Last Byte Read
d	Last Byte Received

(a) Only Congestion Control (b) Only Flow Control (c) Both Flow Control and Congestion Control

		Byte Sequence Number				CW	RB
		a	b	c	d	bytes	bytes
1	Addy, James	9933	12957	5209	10582	11536	19919
2	Boyd, Ronnal	10072	14150	7113	11314	11511	22985
3	Collins, Deunta	10522	11752	6176	11253	11173	18905
4	Dave, Hitanshu	8035	12839	3536	8706	12787	19497
5	Deanes, Marcus	7526	10250	3564	8025	11698	20563
6	Gomes, Anthony	9112	11115	5604	8701	11950	21841
7	Holmes, Shaquan	7350	13851	5466	8604	12617	18012
8	Jackson, Cameron	9437	11953	5749	8435	10037	22517
9	Lewis, Devario	8885	14099	5884	10051	11393	18603
10	McBride, Tony	9928	11238	5285	10988	12465	21477
11	Sims, Kandice	10702	14272	3412	10369	11357	18490
12	Smith, Morgan	9660	13009	4078	10947	12446	19597
13	Valliappan, Vallimanalan	8430	13406	7331	11117	10147	19197
14	Ward, Craig	10908	11540	6716	10442	10111	19365
15	Whitfield, Nicholas	10549	12436	5737	8637	12787	19888
1	Brown, Demetrius	8486	12231	7266	10829	10771	22483
2	Cato, Jahelle	10342	11081	6491	10511	10756	18525
3	Ereyimwen, Enoma	9981	11003	3584	8142	12154	19452
4	Ford, Kalil-Dan	10575	11532	6701	11224	12021	19528
5	Hall, Dwayne	9204	12105	4911	9537	10118	18790
6	Horner, Ashly	10275	11278	6968	10413	11400	18825
7	Nathaniel, Jonathan	9605	12987	6643	10352	12193	21914
8	Roberts, Cambria	8293	11127	7577	10653	12870	22340
9	Tchounwoy, Hervey	7126	11528	4094	9504	11597	22216
10	Walk, Malerie	10663	13479	4486	9331	10794	19557
11	Washington, Daren	8761	11194	6776	10539	11117	20424
12	Wynn, Marcus	10296	14784	5187	10299	10057	19989

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Q2 - 20 pts) The following are the sample round-trip times (Sample RTTs) for the acknowledgments or timeouts for a sequence of packet transmissions at the sender side: S1, S2, S3, S4, S5, S6 and S7. Compute the estimated RTT and estimated timeout values at the end of each acknowledgment received or timeout incurred. Use Karl's simple retransmission algorithm (for an α value assigned to you).

#	Name	S1, ms	S2, ms	S3, ms	S4, ms	S5, ms	S6, ms	S7, ms	α
1	Addy, James	379	timeout	418	188	50	timeout	424	0.4
2	Boyd, Ronnal	10	timeout	15	385	51	timeout	45	0.7
3	Collins, Deunta	303	timeout	132	timeout	408	53	435	0.8
4	Dave, Hitanshu	180	timeout	59	428	197	timeout	178	0.3
5	Deanes, Marcus	184	356	timeout	478	timeout	50	75	0.7
6	Gomes, Anthony	452	190	354	timeout	483	timeout	360	0.6
7	Holmes, Shaquan	341	146	412	timeout	292	480	timeout	0.2
8	Jackson, Cameron	45	227	timeout	157	timeout	154	480	0.7
9	Lewis, Devario	480	timeout	293	60	96	timeout	24	0.5
10	McBride, Tony	25	timeout	85	326	173	timeout	358	0.9
11	Sims, Kandice	217	463	229	timeout	373	169	timeout	0.8
12	Smith, Morgan	318	67	timeout	63	337	timeout	479	0.3
13	Valliappan, Vallimanalan	178	timeout	440	timeout	211	434	260	0.4
14	Ward, Craig	253	timeout	243	367	496	timeout	64	0.3
15	Whitfield, Nicholas	453	185	timeout	483	timeout	412	222	0.6
1	Brown, Demetrius	345	431	282	timeout	337	timeout	333	0.9
2	Cato, Jahelle	329	354	timeout	406	7	timeout	83	0.6
3	Ereyimwen, Enoma	380	timeout	394	445	timeout	31	178	0.7
4	Ford, Kalil-Dan	151	timeout	369	timeout	497	368	303	0.4
5	Hall, Dwayne	342	127	331	timeout	51	timeout	370	0.9
6	Horner, Ashly	493	261	357	234	timeout	127	timeout	0.5
7	Nathaniel, Jonathan	446	timeout	376	timeout	252	320	415	0.8
8	Roberts, Cambria	448	121	110	timeout	timeout	242	438	0.8
9	Tchounwoy, Hervey	491	timeout	193	timeout	149	412	287	0.8
10	Walk, Malerie	175	timeout	324	timeout	200	35	115	0.5
11	Washington, Daren	414	timeout	400	152	243	5	timeout	0.5
12	Wynn, Marcus	466	367	timeout	timeout	52	277	158	0.9

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Q3 - 60 pts) Consider each of the three congestion control algorithms (AIMD, Slow Start, Fast Recovery) that work in units of packets and that start each connection with a congestion window equal to one packet. The lost packet and the subsequent packets have to be retransmitted by the sender.

For simplicity, assume a perfect timeout mechanism that detects a lost packet exactly 1 RTT after it is transmitted. Also, assume the congestion window is always less than or equal to the advertised window, so flow control need not be considered.
Consider the loss of packets with sequence numbers **S1, S2, S3, S4** in their first transmission attempt. Assume these packets are delivered successfully in their first retransmission attempt.

For each of the three congestion control algorithms, set up a table to indicate the RTTs and the sequence numbers of the packets sent. The sequence numbers of the packets sent range from 1 to **P**.
Also, compute the effective throughput achieved by this connection to send packets with sequence numbers 1 to **P**, each packet holds **1 KB** of data and that the RTT = **150** ms.

Show all the work.

		Sequence numbers of packets lost in the first transmission attempt				Number of Packets, P
#	Name	S1	S2	S3	S4	
1	Addy, James	5	17	36	45	60
2	Boyd, Ronnal	6	16	32	50	55
3	Collins, Deunta	8	16	35	53	61
4	Dave, Hitanshu	7	22	35	49	59
5	Deanes, Marcus	13	20	33	51	55
6	Gomes, Anthony	13	16	36	53	53
7	Holmes, Shaquan	5	24	31	51	57
8	Jackson, Cameron	7	19	35	48	67
9	Lewis, Devario	12	23	35	47	66
10	McBride, Tony	10	21	31	51	50
11	Sims, Kandice	8	20	39	54	68
12	Smith, Morgan	7	21	39	53	67
13	Valliappan, Vallimanalan	14	18	39	49	66
14	Ward, Craig	12	23	38	55	60
15	Whitfield, Nicholas	12	21	38	45	58
1	Brown, Demetrius	11	16	31	41	50
2	Cato, Jahelle	10	18	37	47	70
3	Ereyimwen, Enoma	14	24	35	50	61
4	Ford, Kalil-Dan	13	19	36	45	57
5	Hall, Dwayne	6	22	37	48	51
6	Horner, Ashly	11	24	38	54	59
7	Nathaniel, Jonathan	10	18	38	54	65
8	Roberts, Cambria	12	18	34	47	54
9	Tchounwoy, Hervey	7	16	37	48	53
10	Walk, Malerie	14	16	33	54	64
11	Washington, Daren	9	15	36	48	61
12	Wynn, Marcus	8	20	30	51	65

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