King Fahd University of Petroleum & Minerals

College of Computer Science and Engineering

ICS 343: Fundamentals of Computer Networks [Term 162]

<u>Major Exam 2</u>

<u>Date & Time: Wednesday, Apr. 26, 2017 [6:30 -8:30 PM]</u>

<u>Duration: 120 Minutes</u>

Ref. Book Chapters 18, 19, 29, 24 & Lecture slides

KEY

Name	

Question	Max. Grade	Grade	CLO
1	25		1 and 2
2	40		1 and 2
3	20		1 and 2
4	15		1 and 2
Total	**100**		

Notes:

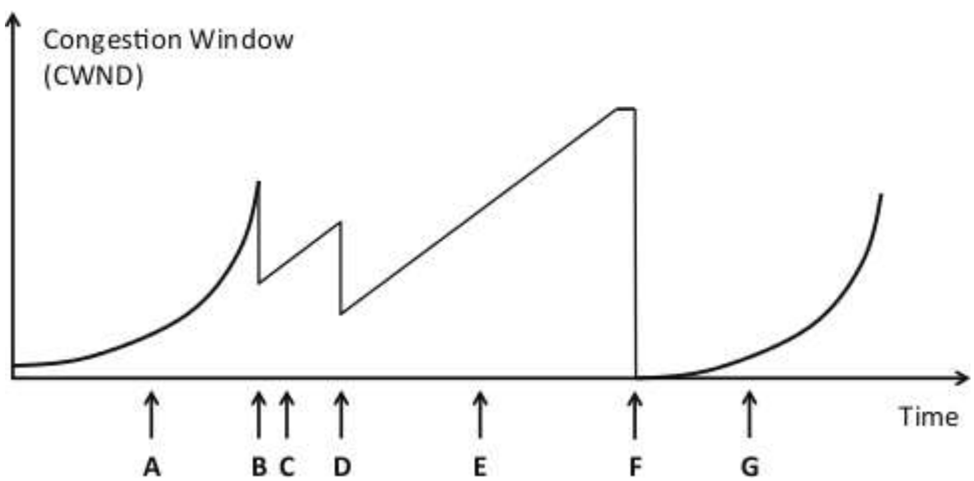
1. Make sure you have <u>**Six**</u> different pages (including the cover page)
2. This is a *closed book and notes* exam
3. Write clearly, briefly and precisely
4. Cheating will result in a *DN* grade

Question 1 [25 Points].

a) [10 Points] Consider a **Taho TCP** connection using the slow-start congestion control scheme with an initial THRESHOLD value of 64 KB and a Maximum Segment Size (MSS) of 4 KB. The receiver's advertised window is initially 24 KB. The first transmission attempt is numbered 0, and all transmission attempts are successful except for Timeouts on transmission #4. Find the size in KB of the sender's congestion window for the transmission attempts from #1 to #10.

Transmission Number	Sender's Congestion Window (KB)	Threshold (KB)
0	4	64
1	8	64
2	16	64
3	24	64
4	24	64
5	4	12
6	8	12
7	12	12
8	16	12
9	20	12
10	20	12

b) [15 Points] Consider this plot of ***cwnd*** versus Time for a **Reno TCP** connection:



At each of the marked points A through G along the timeline, indicate what event has happened, or what phase of congestion control TCP is in (as appropriate), from the following options: Slow-Start (SS), Congestion-Avoidance (CA), Fast-Recovery (FR) and Timeout.

Point	Description
A	Slow Start
B	Fast Recovery
C	Congestion Avoidance
D	Fast Recovery
E	Congestion Avoidance
F	Time out
G	Slow Start

Question 2 [40 Points].

a) [5 Points] Explain the difference between ***Subnetting*** and ***Supernetting*** in the context of Classful IP addressing

The answer is available in Section 18.4.2 page 531 of the textbook.

b) [10 Points] What is the network address if one of the addresses is 167.199.170.82/27?
Solution: The prefix length is 27, which means that must keep the first 27 bits as it is and change the remaining bits (5) to 0s. This 5-bits change affects only the last byte (01010010). Changing the last 5 bits to 0s, we get 01000000 or 64. The network address is 167.199.170.64/27.

c) [10 Points] A small organization is given a block with the beginning address and the prefix length 205.16.37.24/29 (in slash notation). What is the range of the block?
Note: 205.16.37.24 = 11001111 00010000 00100101 00011000
Solution:
The beginning address is 205.16.37.24. To find the last address we keep the first 29 bits and change the last 3 bits to 1s. Beginning: 11001111 00010000 00100101 00011000
Ending: 11001111 00010000 00100101 00011111 There are only 8 addresses in this block.

d) [15 Points] An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP needs to distribute these addresses to three groups of customers as follows: 1. The first group has 64 customers; each needs 256 addresses. 2. The second group has 128 customers; each needs 128 addresses. 3. The third group has 128 customers; each needs 64 addresses. Design the subblocks and give the slash notation for each subblock. Find out how m any addresses are still available after these allocations.

Solution:

Group 1:

For this group, each customer needs 256 addresses. This m eans the suffix length is 8 (2^8 = 256). The prefix length is then 32 − 8 = 24.

01: 190.100.0.0/24 -> 190.100.0.255/24

02: 190.100.1.0/24 -> 190.100.1.255/24

……………………………………..

64: 190.100.63.0/24 -> 190.100.63.255/24

Total = 64 × 256 = 16,384

Group 2:

For this group, each customer needs 128 addresses. This means the suffix length is 7 (2^7 = 128). The prefix length is then 32 − 7 = 25.

The addresses are:

001: 190.100.64.0/25 -> 190.100.64.127/25

002: 190.100.64.128/25 -> 190.100.64.255/25

003: 190.100.127.128/25 -> 190.100.127.255/25

Total = 128 × 128 = 16,384

Group 3:

For this group, each customer needs 64 addresses. This means the suffix length is 6 (2^6 = 64). The prefix length is then 32 − 6 = 26.

001:190.100.128.0/26 -> 190.100.128.63/26

002:190.100.128.64/26 -> 190.100.128.127/26

…………………………

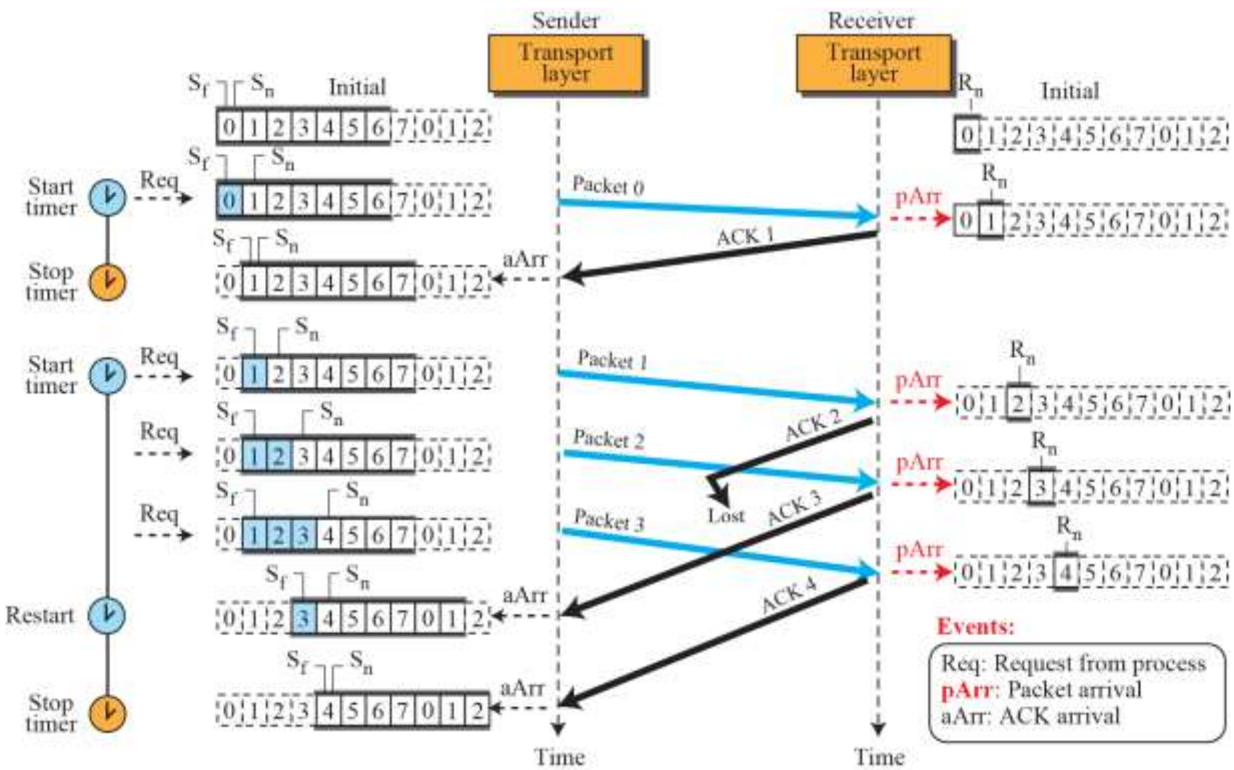
128:190.100.159.192/26 -> 190.100.159.255/26

Total = 128 × 64 = 8,192

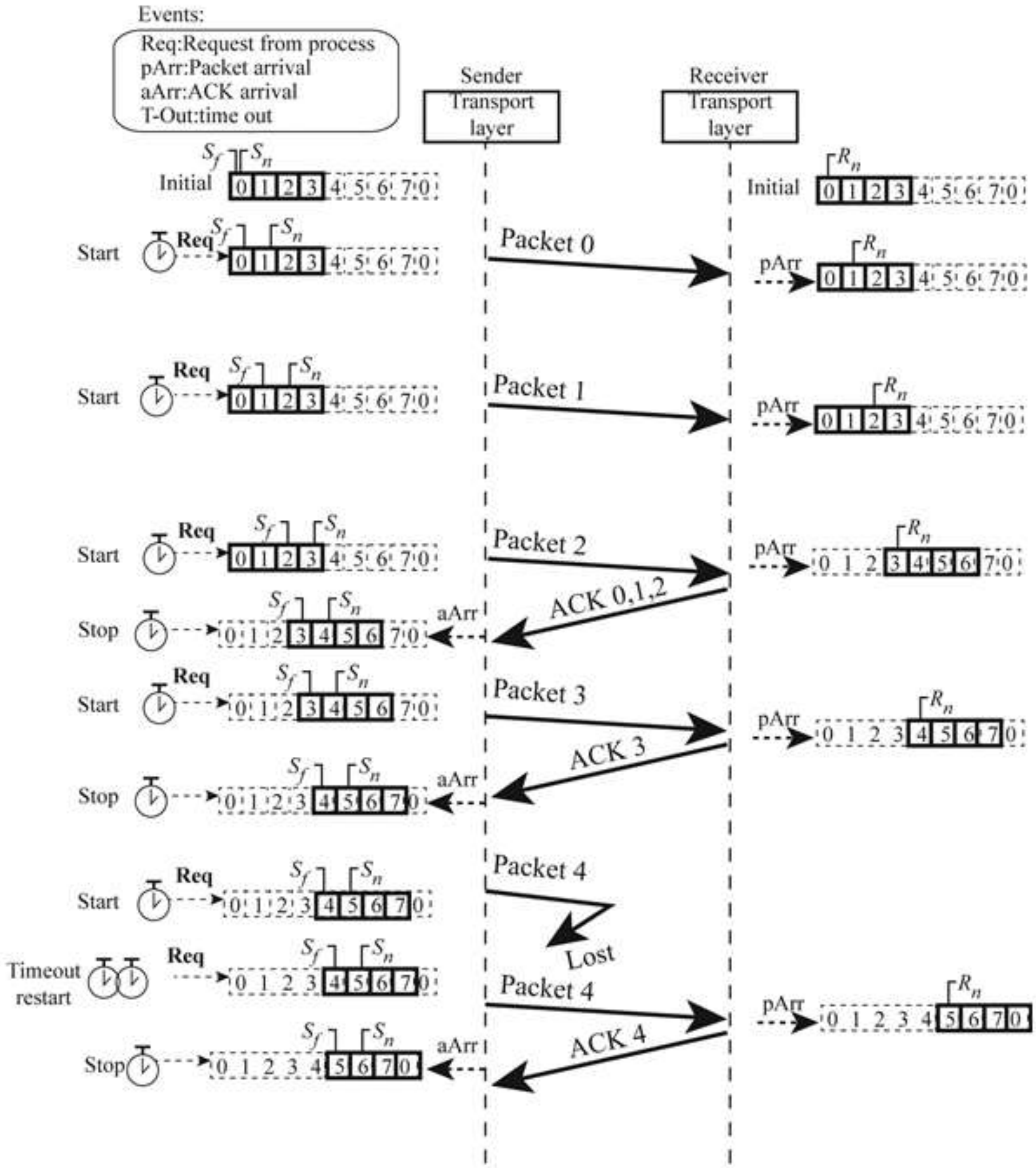
- Number of granted addresses : 65,536
- Number of allocated addresses: 40,960
- Number of available addresses: 24,576

Question 3 [20 Points].

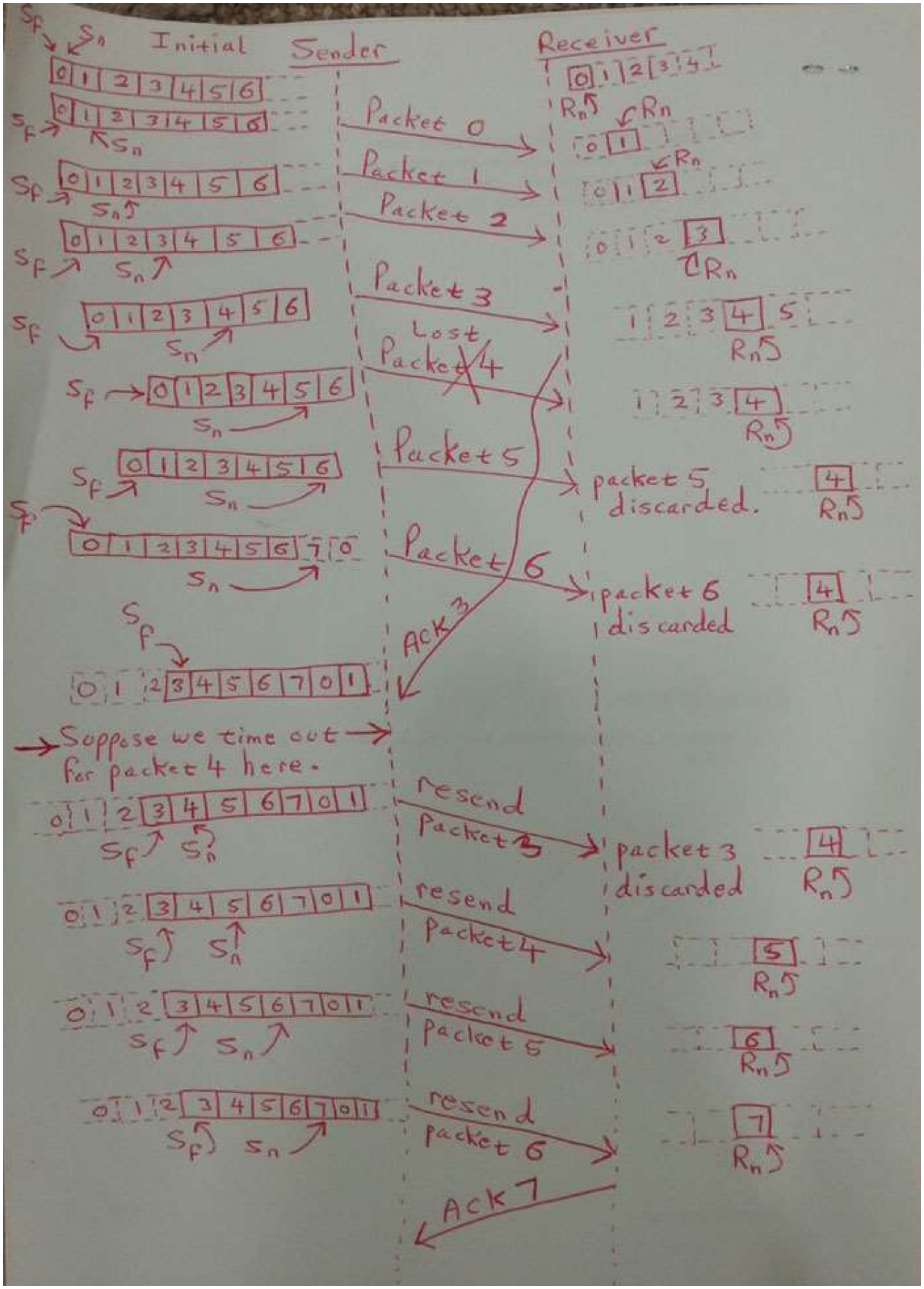
Redraw the following figure when the sender sends 5 packets (0, 1, 2, 3, 4) such that:
Packets 0, 1, 2 are sent and acknowledged in a single ACK, which arrives at the sender site after **all** packets have been sent. Packet 3 is received and acknowledged in a single ACK. Packet 4 is lost and resent.



Solution is on next page..

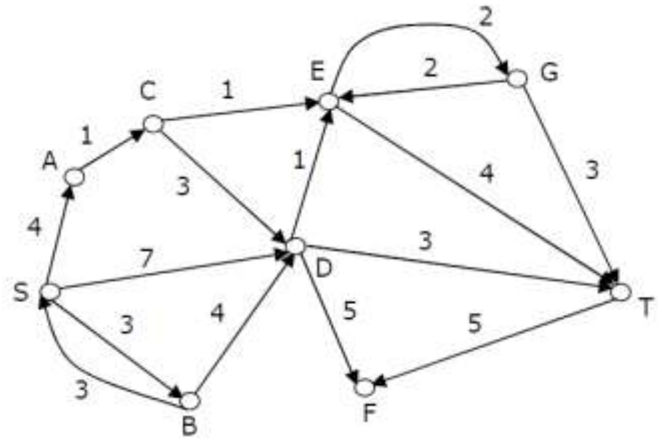

Events:
Req:Request from process
pArr:Packet arrival
aArr:ACK arrival
T-Out:time out
Sender Transport layer
Receiver Transport layer
Initial
Start
Req
Packet 0
pArr
Packet 1
Packet 2
ACK 0,1,2
Stop
aArr
Packet 3
ACK 3
Packet 4
Lost
Timeout restart
ACK 4

Alternative Solution:



Question 4 [15 Points].

a) [10 points] Consider the directed graph shown in the figure below. There are multiple shortest paths between vertices *S* and *T*.



Which one will be reported by the Dijkstra's algorithm? **Select** the correct answer and ***explain*** your selection:

(A) *SDT*

(B) *SBDT*

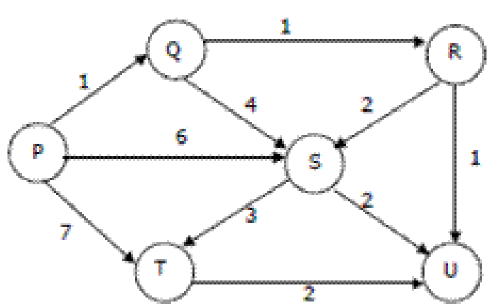
(C) *SACDT*

(D) *SACET*

Answer: (D)

When the algorithm reaches vertex 'C', the distance values of 'D' and 'E' would be 7 and 6 respectively. So the next picked vertex would be 'E'.

b) [5 Points] Suppose we run Dijkstra's single source shortest-path algorithm on the following edge weighted directed graph with vertex *P* as the source.



In what **order** do the nodes get included into the set of vertices for which the shortest path distances are finalized?

(A) P, Q, R, S, T, U

(B) P, Q, R, U, S, T

(C) P, Q, R, U, T, S

(D) P, Q, T, R, U, S