Computer Networks PRACTICE SET

Short Practice Question:

1. Assume that you need to write and test a client-server application program on two hosts you have at home.

a. What is the range of port numbers you would choose for the client program?
b. What is the range of port numbers you would choose for the server program?
c. Can the two port numbers be the same?

2. Can you explain why some transport-layer packets may be lost in the Internet?
3.. Can you explain why some transport-layer packets may be duplicated in the Internet.
4. In the Go-Back-N protocol, the size of the send window can be $2m - 1$, while the size of the receive window is only 1. How can flow control be accomplished when there is a big difference between the size of the send and receive windows?
5. In the Selective-Repeat protocol, the size of the send and receive windows is the same. Does this mean that there are supposed to be no packets in transit?

6.. In a network with a fixed value for $m > 1$, we can either use the Go-Back-N or the Selective-Repeat protocol. Describe the advantage and disadvantage of using each. What other network criteria should be considered to select either of these protocols?
7. In TCP, can the sender window be smaller, larger, or the same size as the receiver window?
8. Can you mention some tasks that can be done by one or a combination of TCP segments?
9. What is the maximum size of the TCP header? What is the minimum size of the TCP header?
10 . In TCP, does a SYN segment open a connection in only one direction or in Both directions?
11. In TCP, does a FIN segment close a connection in only one direction or in Both directions?
12. In TCP, what type of flag can totally close the communication in both directions?
13. Assume that a client sends a SYN segment to a server. When the server checks the well-known port number, it finds that no process defined by the port number is running. What is the server supposed to do in this case?

13. Is the use of checksum for error control optional or mandatory in a. UDP? b. TCP?

14. Assume that a TCP server expects to receive byte 2001, but it receives a seg
ment with sequence number 2200. What is the reaction of the TCP server to
this event? Can you justify the reaction?

15. Assume that a TCP client expects to receive byte 2001, but it receives a seg-
ment with sequence number 1201. What is the reaction of the TCP client to this event? Can you justify the reaction?

16. A. Assume that a TCP server is missing bytes 2001 to 3000. The server receives a segment with sequence number 2001 that carries 400 bytes. What is the reaction of the TCP server to this event? Can you justify the reaction?

B. Suppose two hosts use a TCP connection to transfer a large file. Which of the following statements is/are False with respect to the TCP connection?

(i) If the sequence number of a segment is m, then the sequence number of the subsequent segment is always m+1.

(ii) If the estimated round-trip time (RTT) at any given point of time is t sec, the value of the retransmission timeout is always set to greater than or equal to t sec.

(iii) The size of the advertised window never changes during the course of the TCP connection.

(iv) The number of unacknowledged bytes at the sender is always less than or equal to the advertised window.

(a) iii only
(b) i and iii only
(c) i and iv only
(d) ii and iv only

17. The value of HLEN in TCP header is 1011 in binary. How many bytes of options are being carried by this packet?

(a) 11
(b) 20
(c) 24
(d) 34

18.Which of the following statement is incorrect related to

flow control?

(i) Opening, closing and shrinking of the send window is controlled by receiver TCP

(ii) Opening, closing and shrinking of the receiver window is controlled by sender TCP
(b)

(iii) When (new ackNo+new rwnd>last ackNo+last rwnd) window shrinks at sender TCP
(iv) When (new ackNo+new rwnd<last ackNo+last rwnd) window shrinks and sender TCP
(a) i and ii only
(b) ii and iii only
(c) iii and iv only
(d) I and iv only

19. Consider the figure below, with three links, each with the specified transmission rate and link length. The length of a the packet is 50000 bits. The speed of light propagation delay on each link is 2.5x10^8 m/sec.

In the transfer of file between PC and server, if the transmission rates along the path is 15Mbps, 50Mbps, and 16Mbps. The throughput is usually _____ (In case of no other traffic in the network).
(a) 15Mbps
(b) 50 Mbps
(c) 16 Mbps
(d) 27 Mbps

20.How long does it take a packet of length 1000 bytes to propagate over a link of distance 2500km, propagation speed 2.5x10^8 m/s, and transmission rate 2 Mbps?
(a) 10 ms
(b) 100 ms
(c) 0.1 ms
(d) 10 s
21.Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rate R1=1500Kbps, R2=2Mbps, and R3=1Mbps. Assuming no

other traffic in the network, what is the throughput for the file transfer?
Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
(a) 1 Mbps, 64 sec
(b) 2 Mbps, 16 sec
(c) 1500 Kbps, 48 sec
(d) 1 Mbps, 32 sec

22.Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rate R1=500kbps, R2=100Kbps, and R3=1Mbps.
Assuming no other traffic in the network, what is the
(a)throughput for the file transfer?
Suppose the file is 8 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
(a) 100 Kbps, 620 sec
(b) 2 Mbps, 16 sec
(c) 500 Kbps, 48 sec

23.What is the maximum size of data that the application layer can pass on to the TCP layer below?
(a) 1500 bytes
(b) 2^16 bytes - size of TCP header
(c) Any size
(d) 2^16 bytes

24..Let the size of the congestion window of a TCP connection be (b) 32 KB when a timeout occurs. The round-trip time of the connection is 100 msec and the maximum segment size used is 2 KB. The time taken (in msec) by the TCP connection to get back to 32 KB congestion window is ___.
(a) 800 to 1000
(b) 1100 to 1300
(c) 1500 to 1700
(d) 1400 to 1600

25. During the teardown of a TCP connection, which entity

enters into the TIME_WAIT state.
(a) TCP client
(b) TCP server
(c) who initiates the teardown process
(d) who receives the initial teardown request

26. In case of UDP, the “total length” field is set with a value of 500. What is the length of the application data present in the given segment?
(a) 500 bytes
(b) 492 bytes
(c) 492 bits
(d) 500 bits

27. In a data transfer using TCP, the complete data is sent as one segment which is of 200 bytes and the sequence number of the first byte is 1000. What is the value of the sequence number field in the segment during transit?
(a) 1000
(b) 1001
(c) 1200
(d) 1201

28.The contents of a UDP header send by the client in the hexadecimal format is BD050035101A0000. What type of service the client is requesting?
(a) Daytime
(b) DNS
(c) Web
(d) DHCP

29.If the value of HLEN field in TCP is 1110, how many bytes of options are included in the segment? If this value is used in total length field in UDP how much data in bytes the segment carries.

30. What is a Socket? How a socket is uniquely identified?
31.Compare and contrast flow control and Error control

32 . The value of HLEN in TCP header is 1011 in binary. How
many bytes of options are being carried by this packet?
(a) 11
(b) 20
(c) 24
(d) 34

33. How many sequence numbers are consumed in the SYN+ACK segment? Justify

Long Questions:

1. Short Notes:
    a. TCP Header
    b. Congestion control
    c. UDP
    d. State transition diagram of —--
    e. Half close & Full close in TCP Connection Termination with timeline diagram and state transition diagram.
    f. TCP Three-way Handshaking
    g. Checksum
    h. Utilization of stop and wait
    i. Piggybacking

2. Using 5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols?
a. Stop-and-Wait
b. Go-Back-N
c. Selective-Repeat

3. A sender sends a series of packets to the same destination using 5-bit sequence numbers. If the sequence numbers start with 0, what is the sequence number of the 100th packet?
4. In each of the following protocols, how many packets can have independent

sequence numbers before wraparound occurs (see the previous problems).
a. Stop-and-Wait
b. Go-Back-N with m = 8
c. Select-Repeat with m = 8
5. Create a scenario similar to Figure 3.22 (book) in which the sender sends three packets. The first and second packets arrive and are acknowledged. The third The packet is delayed and resent. The duplicate packet is received after the acknowledgement for the original is sent.
6. Answer the following questions related to the FSMs for the Stop-and-Wait protocol (Figure 3.21):
a. The sending machine is in the ready state and S = 0. What is the sequence a number of the next packet to send?
b. The sending machine is in the blocking state and S = 1. What is the the sequence number of the next packet to send if a timeout occurs?
c. The receiving machine is in the ready state and R = 1. A packet with the sequence number 1 arrives. What is the action in response to this event?
d. The receiving machine is in the ready state and R = 1. A packet with the sequence number 0 arrives. What is the action in response to this event?

7. Redraw Figure 3.29 (book)when the sender sends 5 packets (0, 1, 2, 3, and 4). Packets 0, 1, and 2 are sent and acknowledged in one 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 resend.

8. Assume that we need to design a Selective-Repeat sliding-window protocol for a network in which the bandwidth is 1 Gbps and the average distance between the sender and receiver is 5,000 Km. Assume that the average packet size is 50,000 bits and the propagation speed in the media is 2×108 m. Find the maximum size of the send and receive windows, the number of bits in the sequence number field (m), and an appropriate timeout value for the timer.

9. In a network using the Go-Back-N protocol with m = 3 and the sending window of size 7, the values of variables are Sf = 62, Sn = 66, and Rn = 64.
Assume that the network does not duplicate or reorder the packets.
a. What are the sequence numbers of data packets in transit?
b. What are the acknowledgement numbers of ACK packets in transit?

10. In a network using the Selective-Repeat protocol with m = 4 and the sending window of size 8, the value of variables are Sf = 62, Sn = 67, and Rn = 64.
Packet 65 has already been acknowledged at the sender site; packets 65 and 66

are received out-of-order at the receiver site. Assume that the network does not duplicate the packets.
a. What are the sequence numbers of pending data packets (in transit, corrupted, or lost)?

b. What are the acknowledgment numbers of pending ACK packets (in transit, corrupted, or lost)?

11. Answer the following questions related to the FSMs for the Selective-Repeat protocol with m = 7-bits. Assume that the window size is 64. (Figure 3.34):
a. The sending machine is in the ready state with Sf = 10 and Sn = 15. What is the sequence number of the next packet to be sent?
b. The sending machine is in the ready state with Sf = 10 and Sn = 15. The timer for packet 10 times out. How many packets are to be resend? What are their sequence numbers?
c. The sending machine is in the ready state with Sf = 10 and Sn = 15. An ACK with ackNo = 13 arrives. What are the next values of Sf and Sn? What is the action in response to this event?
d. The sending machine is in the blocking state with Sf = 14 and Sn = 21. What is it the size of the window?
e. The sending machine is in the blocking state with Sf= 14 and Sn = 21. An ACK with ackNo = 14 arrives. Packets 15 and 16 have already been acknowledged. What are the next values of Sf and Sn? What is the state of the sending machine?
f. The receiving machine is in the ready state with Rn = 16. The size of the window is 8. A packet with sequence number 16 arrives. What is the next value of Rn? What is the response of the machine to this event?

12. We can define the bandwidth-delay product in a network as the number of packets that can be in the pipe during the round-trip time (RTT). What is the bandwidth-delay product in each of the following situations?
a. Bandwidth: 1 Mbps, RTT: 20 ms, packet size: 1000-bits
b. Bandwidth: 10 Mbps, RTT: 20 ms, packet size: 2000-bits
c. Bandwidth: 1 Gbps, RTT: 4 ms, packet size: 10,000-bits

13. The following is a dump (contents) of a UDP header in hexadecimal format:

a. What is the source port number?
b. What is the destination port number?
c. What is the total length of the user datagram?
d. What is the length of the data?

e. Is the packet directed from a client to a server or vice versa?
f. What is the application-layer protocol?
g. Has the sender calculated a checksum for this packet?

14. Compare the TCP header and the UDP header. List the fields in the TCP header that are not part of the UDP header. Give reasons for each missing field.

15. Answer the following questions:
a. What is the minimum size of a UDP user datagram?
b. What is the maximum size of a UDP user datagram?
c. What is the minimum size of the application-layer payload data that can be encapsulated in a UDP user datagram?
d. What is the maximum size of the application-layer payload that can be encapsulated in a UDP user datagram?

16. Assume that we need to design a Go-Back-N sliding-window protocol for a network in which the bandwidth is 100 Mbps and the average distance between the sender and receiver is 10,000 Km. Assume the average packet size is 100,000-bits and the propagation speed in the media is 2×108 m/s. Find the maximum size of the send and receive windows, the number of bits in the sequence number field (m), and an appropriate timeout value for the timer.

17.A client uses UDP to send data to a server. The data length is 16 bytes. Calculate the efficiency of this transmission at the UDP level (ratio of useful bytes to total bytes).

18.In a TCP connection, the initial sequence number at the client site is 2,171. The client opens the connection, sends three segments, the second of which carries 1,000 bytes of data, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client?
a. The SYN segment
b. The data segment
c. The FIN segment

19.In a connection, the value of cwnd is 3000 and the value of rwnd is 5000. The host has sent 2000 bytes, which have not been acknowledged. How many more bytes can be sent?

20. In TCP, if the value of HLEN is 0111, how many bytes of options are included in the segment?

21.The ssthresh value for a Reno TCP station is set to 8 MSS. The station is now in the slow-start state with cwnd = 5 MSS and ssthresh = 8 MSS. Show the values of cwnd, sstresh, and the current and the next state of the station after the following events: three consecutive non duplicate ACKs arrived, followed by five duplicate ACKs, followed by two non duplicate ACKs, and followed by a timeout.

22. The ssthresh value for a Taho TCP station is set to 6 MSS. The station now is in the slow-start state with cwnd = 4 MSS. Show the values of cwnd, sstresh, and the state of the station before and after each of the following events: four consecutive non duplicate ACKs arrived followed by a timeout and followed by three non duplicate ACKs.

23. In a TCP connection, assume that maximum segment size (MSS) is 1000 bytes. The client process has 5400 bytes to send to the server process, which has no bytes to respond (unidirectional communication). The TCP server generates ACKs according to the rules we discussed in the text. Show the timeline for the transactions during the slow start phase, indicating the value of cwnd at the beginning, at the end, and after each change. Assume that each segment header is only 20 bytes.

24.Distinguish between a time-out and 3-duplicate ACKs event. Which one is a stronger sign of congestion in the network? Explain the reason behind the same through an appropriate example.

25.An HTTP client opens a TCP connection using an initial sequence number (ISN) of 14,534 and the ephemeral port number of 59,100. The server opens the connection with an ISN of 21,732. Show the three TCP segments during the connection establishment if the client defines the rwnd of 4000 and the server defines the rwnd of 5000. Ignore the calculation of the checksum field.

26. Let the slow start begin with cwnd=1 at time t=0 with a maximum segment size of 1500 Bytes. What is the RTT value when the cwnd is greater than 25KB?

27. List out five key differences between TCP and UDP. Specify the applications those are using TCP and UDP respectively. Draw and explain TCP and UDP header.

28. Following is the information for a TCP Client and a Server:
– The MSS (Maximum Segment Size) in both directions is 1000 bytes.
– The ISN (Initial Sequence Number) for Client is 50 and for Server is 81.

The Client sends 2000 bytes to the Server and the Server sends 3000 bytes to the client. Give the complete TCP message exchange between client and server. For each segment draw a vector showing the value of the SYN, ACK and FIN bits, with the value of the SEQ (Sequence Number) and the ACK (Acknowledgment Number). Assume no packets are lost and the application consumes the data as soon as it is received.?

29.A client is using a UDP socket 153.18.8.105:1087 to connect to a Daytime Server having socket 171.2.14.10:13. The UDP payload is "TESTING".
Given data: ASCII Values in Decimal: E = 69; G = 71; I = 73; N = 78; S = 83; T = 84.Calculate the UDP Checksum for the Segment with the above-mentioned details

30. Sequence Number: 5000 Urgent pointer value: 200 URG (Control Field) = 1 (Enabled) what is the first byte of urgent data and the last byte? How many bytes were urgent?

31. Key differences between TCP & UDP

32. Explain the three-way handshaking mechanism in TCP. What is the value of the

1. receiver window (rwnd) for host A if the receiver, host B, has a buffer size of 5000
2. bytes and 1000 bytes of received and unprocessed data?

33. In a TCP connection, the initial sequence number at the client site is 2,171. The client opens the connection, sends three segments, the second of which carries 1,000 bytes of data, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client?

a. The SYN segment
b. The data segment
c. The FIN segment

34. In the Go-back-N protocol with m=6, the sending machine is in the ready state with Sf=10 and Sn=15, An ACK with ACKNo =13 arrives, what are the next values of Sf, Sn, and Rn?

35. Explain the IPv4 header format

36. What is the difference between connectionless and connection oriented services? Why connectionless service is used though of connection oriented service is available.

37. Why the congestion control required in TCP. Why do we use 3 duplicate Ack to detect the congestion? Explain the working of slow start, congestion avoidance and fast recovery steps in details with a suitable graph

38. In sliding window protocols, what is the relationship among sequence numbers, sender window size and receiver window size. Explain why such a relationship is required and what happens if we don't follow it.

39.Compare the range of 16-bit addresses, 0 to 65,535 with the range of 32 bit addresses, 0 to 4, 294, 967, 295. Why do we need such a large number of IP addresses, but only a relatively small range of port numbers?
40. Explain why the size of the sender window must be less than 2^m for Go-Back-N ARQ
41. Four bits are used for sequence numbering in a sliding window protocol used in a computer network. What is the maximum window size?
42.In TCP, if the value of HLEN is 0111, how many bytes of [2 x 10 options are included in the segment?
43.In a TCP connection, the initial sequence number at the client site is 210. The client opens the connection, sends 1000 bytes of data successfully, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client? (2015 END-QS-NEW) (i) The SYN segment (ii) The FDN segment

44.Assume propagation delay is less than transmission delay on a link connecting host A to B. If host A starts transmission at t=0, at a time equal to transmission delay, where is the first bit of the packet?
45.Suppose you want to do a transaction from a remote client to a server as fast as possible. What transport layer protocol will you use and Why?
46.Explain the design of Go-back-to-N flow control protocol with the help of a diagram. How does Go-back-to-N protocol improve efficiency over StopandWaitprotocol?
47.What is the stop and wait protocol? A Stop and wait protocol has a frame size of 100 bits and transmission speed of 10 Mbps and ACK frame is 100 bits.Distance and Velocity of Propagation is 1OOkms and m/sec respectively. Calculate bandwidth utilization of the link
48.The distance from earth to a distant planet is approximately 9 x 10^10 m. What is the channel utilization if a stop-and-wait protocol is used for frame transmission on a 64 Mbps point-to-point link? Assume that the frame size is 32 KB and the speed of light is 3 x 10^8 m/s.
49.Sketch the TCP connection initiation and connection termination packet flows using a timing diagram and a state transition diagram.
50.Consider the use Of 10 K-bit size frames on a 10 Mbps satellite channel with 270 ms delay. What is the link utilization for stop-and-wait ARQ technique assuming P = 10-3
51.What are the flow and error control mechanisms used in the transport layer? Briefly explain. Suppose that the GBN protocol is used on a link with a bit rate of 64 kilobits per second and 20 milliseconds propagation delay. Assume that the transmission time for the acknowledgment and the processing time at nodes are negligible. What is the minimum frame size in bytes to achieve a link utilization of at least 100% for a window size of 7