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Birzeit University
Computer Systems Engineering Department

ENCS 535 – Computer Networks
2nd Exam, First Semester 2008/2009

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Student's name: _____

Student's ID #: _____

Instructions:

- **You have 90 minutes** to complete the exam.
- There are 5 questions, and 8 pages (including this cover page)
- The exam is closed book. Textbooks, notes, laptops, personal digital assistants, and cellular phones are **NOT** allowed. However, **calculators are permitted**.
- Answer all questions in the space provided on the exam paper. Use the back of pages if it is necessary.
- Question marks are listed by the question.
- Please, do not separate the pages, and indicate your Student ID at the top of every page.
- No questions will be answered during the exam. If there is an ambiguity, state your assumptions and proceed.
- Please, fill out the exam attendance sheet when provided by the proctor after the exam starts.
- The total number of points for each question is given in parenthesis. There are 100 points total.

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Question 1: Multiple Choice -- Choose the best answer from the choices given. And fill the table below with the letter of the correct answer to corresponding question number. [40 marks total, 2 marks each]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----|----|----|----|----|----|----|----|----|----|
| | | | | | | | | | |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| | | | | | | | | | |

- The appropriate TCP socket at the destination host is identified by:
 - The destination IP address
 - The destination port number
 - Both the destination IP and the destination port number
 - None of the above**
- In the Selective-Repeat protocol, when the last in order packet re-acknowledged, this may indicate that:
 - A sent packet has been lost in transit
 - An out-of-order packet has been received
 - At least one packet will have to be retransmitted
 - All of the above.**
 - a & c
- Which of the following is a reasonable solution to the selective repeat dilemma?
 - The window size should be equal to the size of sequence number space
 - The window size should be greater than or equal to half size of sequence number space
 - The window size should be less than or equal to half size of sequence number space**
 - The sequence number space should be unlimited.
- The primary advantage of a sliding window protocol over a stop-and-wait protocol is:
 - It decreases the number of frames retransmitted
 - It increases the effective utilization of the link via pipelining**
 - It decreases the error rate of the link
 - It complicates buffer management for error recovery
 - None of the above
- The process of delivering the received segment to the correct socket is called:
 - Multiplexing
 - Demultiplexing**
 - Forwarding
 - Routing
 -
- If Host A sends Host B a TCP segment with 20 bytes of data and with sequence number 50 and ACK number 40, then the next in-order packet from host B to Host A should have:
 - A sequence number 41 and ACK number 51
 - A sequence number 70 and ACK number 51
 - A sequence number 51 and ACK number 40
 - A sequence number 40 and ACK number 70**

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7. Which of the following is true about “cumulative acknowledgement” with sequence number Q in sliding window protocols?
 - a. When received by the sender, it retransmits all the packets in the window up to sequence number Q
 - b. When sent by the receiver, this mean that all the packets up to sequence number Q have been correctly delivered
 - c. When delivered by the sender, it slides its window such that the send base become equal to Q
 - d. **b & c**
 - e. a & c

8. UDP has which of the following characteristics:
 - a. Three-way handshake for connection establishment.
 - b. Connection state at the server.
 - c. Regulated send rate.
 - d. **Checksum for error detection**
 - e. None of the above.

9. Which of the following protocols is not pipelined:
 - a. **Stop and wait.**
 - b. Go-Back-N.
 - c. Selective repeat.
 - d. TCP.
 - e. None of the above.

10. Virtual circuit network provide:
 - a. Process- to- process connection services
 - b. Process- to- process connectionless services
 - c. **Host- to- host connection services**
 - d. Host- to- host connectionless services

11. In a datagram-oriented packet-switched network:
 - a. Host-to-host connection setup is required at the network layer
 - b. End-to-end connection setup is required at the network layer
 - c. Host-to-host connection setup is required at the transport layer
 - d. End-to-end connection setup is required at the transport layer
 - e. **none of the above**

12. When a router input or output queue is full, the packet to be dropped is:
 - a. The new incoming packet.
 - b. The first packet in queue
 - c. The last packet in queue
 - d. **Based on the queue management algorithm**

13. Assume that a router has 3 input and 5 output ports, of which the processing, the line speed, and the transmission speeds are all identical. The speed of the switching fabric is equal to the speed of the input ports combined. Where can the queuing occur inside the router?
 - a. At the input ports
 - b. At the output ports
 - c. **Both at the input and output ports**
 - d. Queuing will never occur

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14. The IP address of the datagram is 11001000.11001000.11001000.11001000. Which of the following router link interface prefixes would best match the IP address of the datagram?
- 11001000.11001000.1100100**
 - 11001000.11001000.110010
 - 11001000.11001000.11001
 - They all are the same
15. One purpose of Network Address Translation (NAT) is to conceal private network information from the rest of the Internet. A NAT device achieves this purpose by:
- Changing the source IP address in all outgoing packets
 - Changing the destination IP address in all outgoing packets
 - Changing the source IP address and port in all outgoing packets**
 - Changing the destination IP address and port in all outgoing packets
 - All of the above
16. The Open Shortest Path First (OSPF) protocol is an example of:
- A distance-vector routing protocol used within an Autonomous System
 - A distance-vector routing protocol used between Autonomous Systems
 - A link-state routing protocol used within an Autonomous System**
 - A link-state routing protocol used between Autonomous Systems
 - All of the above
17. The Routing Interfacing (RIP) protocol is an example of:
- A distance-vector routing protocol used within an Autonomous System**
 - A distance-vector routing protocol used between Autonomous Systems
 - A link-state routing protocol used within an Autonomous System
 - A link-state routing protocol used between Autonomous Systems
 - All of the above
18. What is the result of using a hierarchical addressing scheme?
- Increased number of addresses**
 - Decreased amount of routers needed
 - Increased memory usage on routers
 - No routing tables needed on routers
19. Which of the following is true about IP RIP based networks?
- The default update time is 30 seconds.**
 - The default update time is 90 seconds.
 - Only changes to the routing tables are sent during updates.
 - Complete routing table are sent during updates.
20. The BGP protocol is an example of:
- Inter- AS routing protocol used between Autonomous Systems**
 - Intra- AS routing protocol used between Autonomous Systems
 - Inter- AS routing protocol used within Autonomous Systems
 - Intra- AS routing protocol used within Autonomous Systems

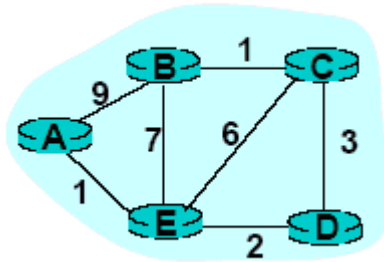
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Question 2: Answer the following True/False questions by writing either T or F beside the each sentence.
[30 marks total, 1.5 marks each]

| | | |
|----|---|----------|
| 1 | The TCP protocol may not retransmit a segment until the timer expires. | T |
| 2 | The size of the TCP RcvWindow never changes throughout the duration of the connection | F |
| 3 | In reliable data transfer protocols, when the receiver timer expires, this is an indication of an ACK error. | F |
| 4 | TCP use flow control to its applications to eliminate the possibility of the sender overflowing the router's buffer. | F |
| 5 | Using Fast Retransmission, TCP sender retransmits the packet if it receives three acknowledgements for the same data. | F |
| 6 | In the Selective-Repeat protocol, the packets that are received out-of- order are discarded by the receiver. | F |
| 7 | In the Go-Back-N protocols, the sender and receiver sliding windows must have the same size. | F |
| 8 | Connection-based services can be offered as host-to-host and/or process-to-process. | T |
| 9 | Maximum Transmission Unit (MTU) is the maximum amount of data that a transport- layer segment can carry. | F |
| 10 | In VC (Virtual Circuit) networks, the VC number of each connection must be the same for all links along the path. | F |
| 11 | Head-of-Line (HOL) blocking may occurs in the router's input ports. | T |
| 12 | The packet loss can occur in the router's input and output ports. | T |
| 13 | DHCP allow host to dynamically obtain its IP address from network server when it joins network. | T |
| 14 | DHCP client send "DHCP discover" message to a specific DHCP server. | F |
| 15 | NAT is a possible solution for IP address Shortage problem. | T |
| 16 | ICMP messages are carried in UDP segment. | F |
| 17 | The only improvement for IPv6 over IPv4 is the address space expansion from 32 into 128 bit. | F |
| 18 | An IP address has two components, the network address and the host address. | T |
| 19 | Subnet mask used to determine what host an IP address belongs to. | F |
| 20 | Dijkstra's algorithm computes the least cost path for each node in a network to every other node. | T |

Question 3: [16 Marks]

1. [6 marks] in the network below, the initial distance vector (DV) for **A** is $[0 \ 9 \ \infty \ \infty \ 1]$. Complete the table below by finding the values of the DV after *every* iteration of the Bellman-Ford algorithm till it does not change anymore (i.e. the algorithm terminates). You need NOT write out the DVs of other nodes.



| | A | B | C | D | E |
|--------------------|----------|----------|----------|----------|----------|
| Initial | 0 | 9 | ∞ | ∞ | 1 |
| Iteration 1 | | | | | |
| Iteration 2 | | | | | |
| ⋮ | | | | | |
| ⋮ | | | | | |

Solution

| | A | B | C | D | E |
|--------------------|----------|----------|----------|----------|----------|
| Initial | 0 | 9 | ∞ | ∞ | 1 |
| Iteration 1 | 0 | 8 | 7 | 3 | 1 |
| Iteration 2 | 0 | 8 | 6 | 3 | 1 |
| Iteration 3 | 0 | 7 | 6 | 3 | 1 |

2. [4 marks] What is poison reverse? How it works?

It is a possible solution for the “count-to-infinity” problem that may occur in running the distance- vector protocol.

It works as a following:

If Z routes through Y to get to X, Z tells Y its (Z’s) distance to X is infinite (so Y won’t route to X via Z)

3. [6 marks] What are the three main classes of the Classful IP Addressing, and what is the number of hosts that can be used for each class

Class A: 8 bits reserved for the subnet, therefore the number of addresses = $2^{(32-8)} = 2^{(24)}$ address
Class B: 16 bits reserved for the subnet, therefore the number of addresses = $2^{(32-16)} = 2^{(16)}$ address
Class C: 24 bits reserved for the subnet, therefore the number of addresses = $2^{(32-24)} = 2^{(8)}$ address

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Question 4: [8 Marks] Suppose that a TCP packet is about to deliver to following 64-bit data message represented in hexadecimal: BD04 85A4 C4D1 E296.

a. [4 Marks] Determine the content of the checksum field of the packet. **Show all the details.**

Solution

| | | OR | |
|---|-----------------------------------|-----------------|--------------------------------------|
| BD04 | 1011 1101 0000 0100 | BD04 | 1011 1101 0000 0100 |
| | | 85A4 | 1000 0101 1010 0100 |
| 85A4 | <u>1000 0101 1010 0100</u> | C4D1 | 1100 0100 1101 0001 + |
| | 0100 0010 1010 1000 | E296 | <u>1110 0010 1001 0110</u> |
| | 1 | | 10 1110 1010 0000 1111 |
| | <u>0100 0010 1010 1001</u> | | 10 |
| | | Sum | 1110 1010 0001 0001 |
| | | checksum | 0001 0101 1110 1110 |
| | + | | |
| C4D1 | <u>1100 0100 1101 0001</u> | | |
| | 0000 0111 0111 1010 | | |
| | 1 | | |
| | <u>0000 0111 0111 1011</u> | | |
| | | | |
| | + | | |
| E296 | <u>1110 0010 1001 0110</u> | | |
| The sum | 1110 1010 0001 0001 | | |
| Checksum(1's complement of the sum)= | 0001 0101 1110 1110 | | |

b. [4 Marks] Now assume that the received data represented in hexadecimal was BD04 84A4 C4D1 E396. Would the receiver detect the errors? Explain.

Sum of all 16 bit words + checksum field = 1111 1111 1111 1111

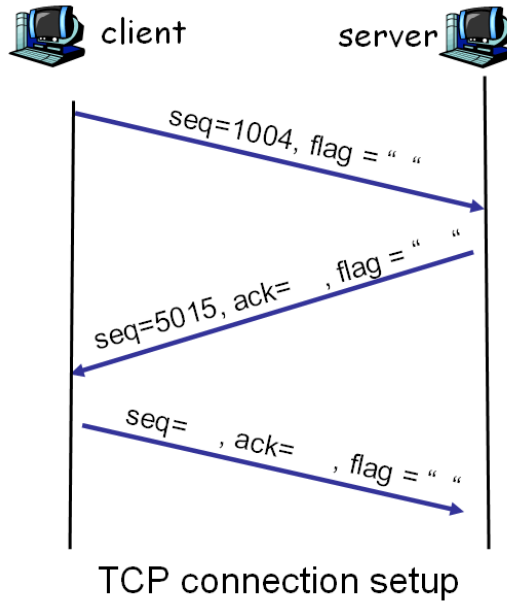
The error is not detected. The reason is that the two bit errors cancelled the effect of each other.

| | | OR | |
|---|--|-------------|--------------------------------------|
| BD04 | 1011 1101 0000 0100 | BD04 | 1011 1101 0000 0100 |
| | | 84A4 | 1000 0100 1010 0100 |
| 84A4 | <u>1000 0100 1010 0100</u> | C4D1 | 1100 0100 1101 0001 |
| | 0100 0010 1010 1000 | E396 | <u>1110 0010 1001 0110</u> |
| | 1 | | 10 1110 1010 0000 1111 |
| | <u>0100 0010 1010 1001</u> | | 10 |
| | | | 1110 1010 0001 0001 |
| | + | | |
| C4D1 | <u>1100 0100 1101 0001</u> | | |
| | 0000 0111 0111 1010 | | |
| | 1 | | |
| | <u>0000 0111 0111 1011</u> | | |
| | | | |
| | + | | |
| E396 | <u>1110 0010 1001 0110</u> | | |
| The sum | 1110 1010 0001 0001 | | |
| Sum of all 16 bit words + checksum field | 1110 1010 0001 0001 + 0001 0101 1110 1110 | | |
| | = 1111 1111 1111 1111 | | |

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| | |
|--|--|
| | |
|--|--|

Question 5: [6 Marks] Suppose the TCP connection setup between client and server, fill in the missing sequence number and ack number.



The first packet: flag="SYN".

The second packet: ack=1005, flag="SYN+ACK" (or write "SYN/ACK").

The third packet: seq=1005, ack=5016, flag="ACK"

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