CSCI 466 Final   **Name: _____**
Networks
Fall 2012

This exam consists of 8 problems on the following 8 pages.

You may use your single-sided hand-written 8 ½ x 11 note sheet and a calculator during the exam.
No computers or communication devices of any kind are permitted.

If you have a question, raise your hand and I will stop by. Since partial credit is possible, **please write legibly and show your work**.

Problem	Points	Score
1	10	
2	21	
3	10	
4	9	
5	8	
6	10	
7	9	
8	12	
Total	89	

1) Multiple choice (10 points total, 2 points each). Circle the **_best_** single answer.

   I.   Which of the following most accurately describes a SYN flood denial of service attack?
     a) Attacker sends a large number of TCP SYN segments but does not finish the TCP connection setup.
     b) Attacker sets a SYN cookie in the initial setup request causing the server to slow down due to computation of an excessive number of cryptographic hashes.
     c) Attacker establishes (via all steps of the 3-way handshake process) a large number of connections but never sends any data and never closes the TCP connections.
     d) Attacker sends TCP SYN segments to the target's broadcast address causing a broadcast storm inside the target's network.

   II. The diagram below is an example of which of the following?
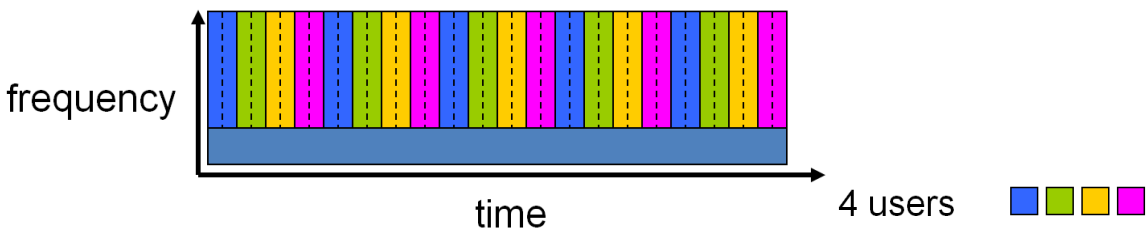
     a) Active Queue Management (AQM)
     b) Code Division Multiple Access (CDMA)
     c) Frequency Division Multiplexing (FDM)
     d) Time Division Multiplexing (TDM)

   III. Which of the following is a key advantage SSH provides over Telnet?
     a) Faster response times access due to pipelining.
     b) Faster response times since it is not subject to Nagle's algorithm.
     c) Traffic is encrypted.
     d) Fewer retransmissions due to the use of TCP instead of UDP.

   IV. All the following are subject to link-layer network collisions **_EXCEPT_**:
     a) Upstream channel on a cable modem
     b) 802.11 WiFi
     c) Ethernet using a switch
     d) Ethernet using a hub

   V. All the following help with the problem IP address space exhaustion **_EXCEPT_**:
     e) IPv6
     f) Network Address Translation (NAT)
     g) Virtual Local Area Networks (VLANs)
     h) Classless Inter-Domain Routing (CIDR) addresses

2) Matching (21 points total, 1 points each). For each networking protocol/concept on the left, match it with the letter on the right that _**best**_ describes it. Each letter will be used _**exactly once**_.

	File Transfer Protocol (FTP)	**A.**	Protocol used for error reporting and signaling in the network layer, e.g. traceroute and ping
	Virtual Local Area Network (VLAN)	**B.**	Policy implemented by a router in which packets are dropped _before_ buffer space is actually exceeded.
	MAC address	**C.**	Used to unique identify a target process running on a host.
	IP address	**D.**	Unique address that operates at the network layer, used by routers on the Internet.
	Hub	**E.**	Results if broadcast is implemented via uncontrolled flooding and the network has cycles.
	Router	**F.**	Unique address that operates at the link layer, used to forward traffic on Ethernet switches.
	Network Address Translation (NAT)	**G.**	Allows a single network switch to behave as if it were multiple independent switches.
	Internet Control Message Protocol (ICMP)	**H.**	Rule used by routers to decide output port when multiple entries match a given destination IP address.
	Head Of Line (HOL) blocking	**I.**	Occurs when all the packets in one of a router's input queues has to wait due to contention on a specific output queue.
	Random Early Detection (RED)	**J.**	Routing protocol used to route between autonomous systems, including implementing policy (business) rules.
	Longest prefix matching	**K.**	Piece of network hardware, accepts cat-5 Ethernet cables, implements only the physical layer
	Classless Inter-Domain Routing (CIDR) addresses	**L.**	Piece of network hardware, accepts cat-5 Ethernet cables, implements only the physical and link layers
	Switch	**M.**	Piece of network hardware, accepts cat-5 Ethernet cables, implements only the physical, link, and network layers
	Socket port number	**N.**	Type of address used by a router that aggregates many possible destinations into a single forwarding table entry.
	Distance vector	**O.**	Allows multiple hosts with private IP addresses to share a single public IP address.
	Broadcast storm	**P.**	Contains every node in a network graph, but may not contain every edge, contains no cycles.
	Virtual circuit	**Q.**	Protocol that runs on two separate TCP connections, one for control and one for transferring data.
	Link state	**R.**	Routing protocol in which nodes only exchange information with their neighbors.
	Border Gateway Protocol (BGP)	**S.**	Routing protocol in which nodes exchange information with all other nodes in the network.
	Spanning tree	**T.**	The first random access protocol to allow multiple access to a shared communication link.
	ALOHA	**U.**	Network-layer connections that require pre-configuring or signaling to establish a route through the network.

3) Media Access Control (10 points)

a) Ethernet is a Carrier Sense, Multiple Access with Collision Detect (CSMA/CD) technology. Explain what is meant by "Carrier Sense", "Multiple Access", and "Collision Detect".

b) Ethernet makes use of binary exponential backoff. Assume host A and B have just collided for the first time trying to send a frame. Explain the process A and B undertake to determine when to resend. Now assume in their 2nd attempt, A and B collide for a second time. Explain what happens now.

c) Assume 802.11 (WiFi) network cards could both send and listen for collisions at the same time (similar to wired Ethernet). Host A and B are both trying to send frames to access point C at the same time. Draw a diagram showing a situation in which A and B cannot detect the collision despite their ability to listen for collisions while they are sending. Provide a short caption explaining what the problem is.

4) Error detection and correction (9 points)

a) Assume a link-layer protocol is doing error detection/correction using two-dimensional even parity. You have four 7-bit words of data to send (given below). Show the five 8-bit words you put on the wire.

0	1	1	0	0	0	1
1	1	1	1	1	1	1
0	0	1	0	1	0	0
0	0	0	0	0	0	0

b) You have received the follow five 8-bit words using two-dimensional even parity. There is a single one-bit error in the transmission. Circle the bit that is in error.

1	1	0	0	0	0	1	1
0	1	0	1	0	1	0	0
0	0	0	0	1	1	0	0
0	1	1	1	0	0	0	1
1	1	0	0	1	0	1	0

c) The 802.11 WiFi protocol computes the CRC of each frame and supports link-layer retransmission. What problem could occur in the transport-layer if retransmission were not performed for 802.11 frames?
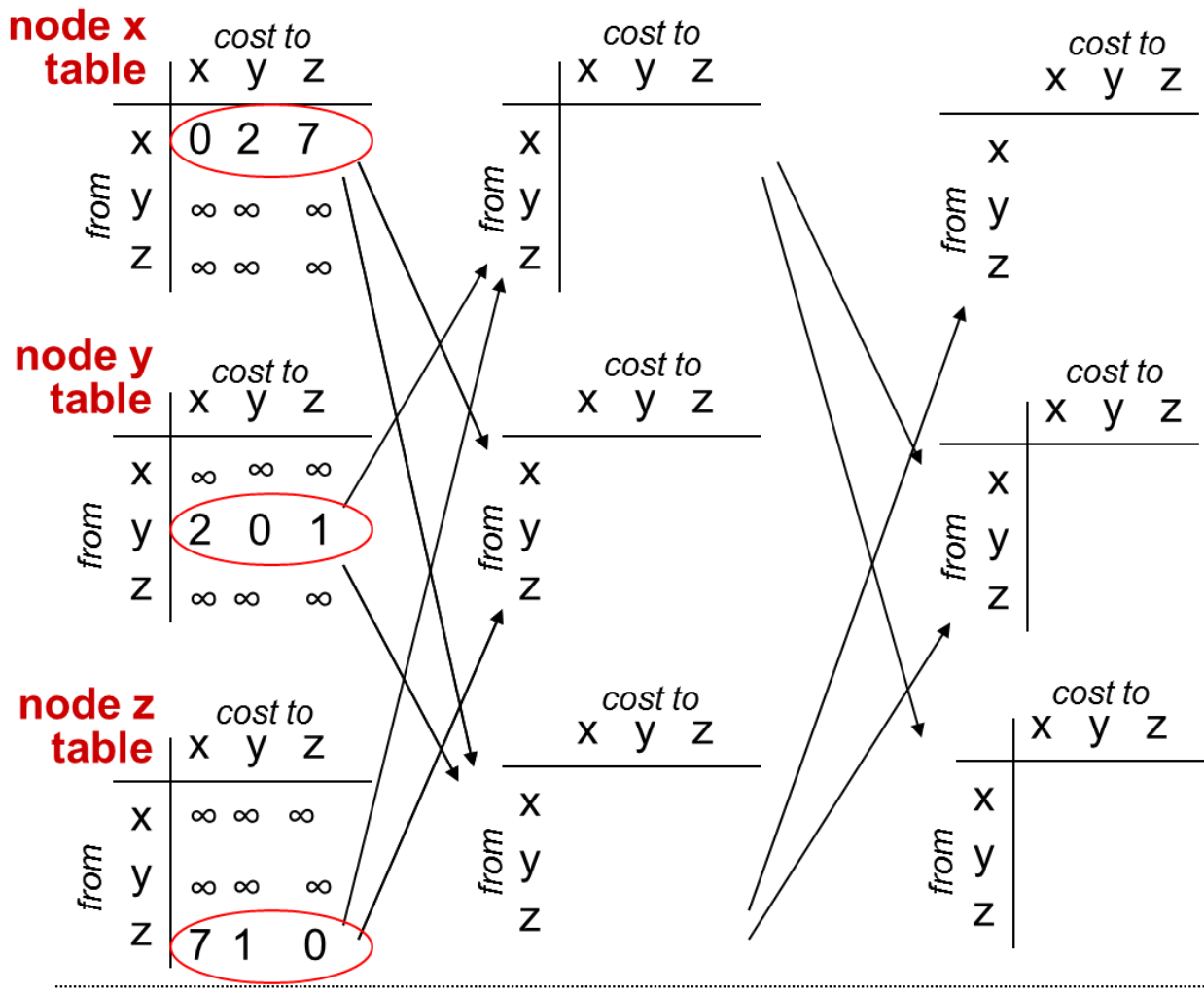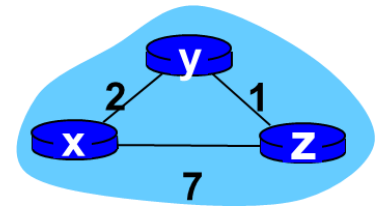
5) Transport layer (8 points)

a) The TCP protocol has mechanism for both congestion control and flow control. Explain the difference. In your description, include the signal each might use to determine their behavior.

b) The UDP protocol is connectionless and unreliable just like IP. Besides providing an checksum over the header and payload, what key capability does UDP add over just sending your data in an IP packet?
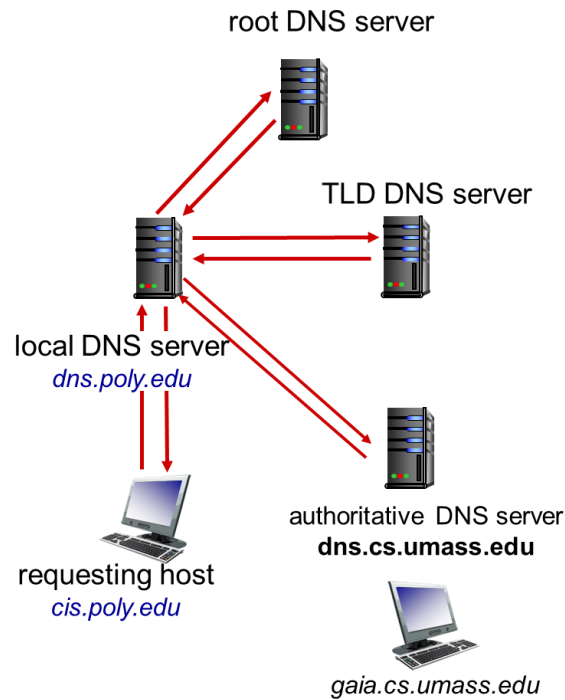
6) Routing (10 points)

a) What is the difference between routing and forwarding?

b) The network below uses a distance vector routing protocol. The initial table in each router is given. Show the new contents of all three tables after each round of the distance vector protocol. Continue until convergence.


node x table

cost to

from	x	y	z
x	0	2	7
y	∞	∞	∞
z	∞	∞	∞

cost to

	x	y	z
x			
y			
z			

cost to

	x	y	z
x			
y			
z			

node y table

cost to

from	x	y	z
x	∞	∞	∞
y	2	0	1
z	∞	∞	∞

cost to

	x	y	z
x			
y			
z			

cost to

	x	y	z
x			
y			
z			

node z table

cost to

from	x	y	z
x	∞	∞	∞
y	∞	∞	∞
z	7	1	0

cost to

	x	y	z
x			
y			
z			

cost to

	x	y	z
x			
y			
z			

→ time

7) DNS (9 points)

a) `cis.poly.edu` wants to know the IP address of `gaia.cs.umass.edu`. Assume all DNS servers start with an empty cache. Assume the DNS request from `cis.poly.edu` to `dns.poly.edu` is a recursive query and all other DNS queries are iterative. Label the directed red edges showing the order of communications.

root DNS server

TLD DNS server

local DNS server
dns.poly.edu

authoritative DNS server
dns.cs.umass.edu

requesting host
*cis.poly.edu*

gaia.cs.umass.edu

b) Assume another host `foo.poly.edu` is on the same LAN as `cis.poly.edu` and `dns.poly.edu`. A few seconds after `cis.poly.edu` gets a DNS reply for its query, `foo.poly.edu` also makes a DNS query for `gaia.cs.umass.edu`. Assume the TTL on the reply received at `cis.poly.edu` was 3600. Describe how `foo.poly.edu`'s DNS query proceeds.

b) Assume the cis.poly.edu is connected to his local DNS server via a wired Ethernet switch. The diagram below shows the DNS query fully-encapsulated before for sending it on the wire. Label each header section with the name of the three protocols being used to carry the DNS query.

Header			
	Header		
		Header	Payload: DNS query
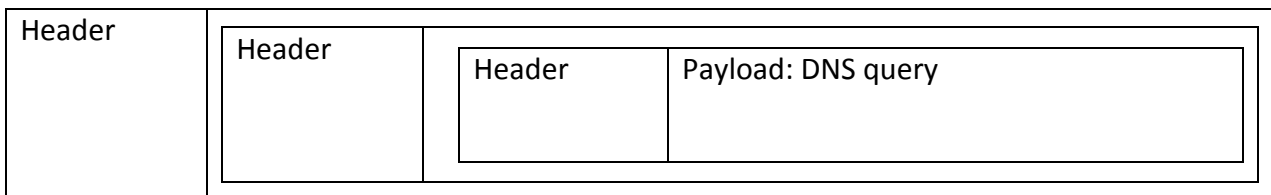
8) IP prefixes and forwarding (12 points). Consider the following three routers where router R has outgoing interfaces A, B, and C:
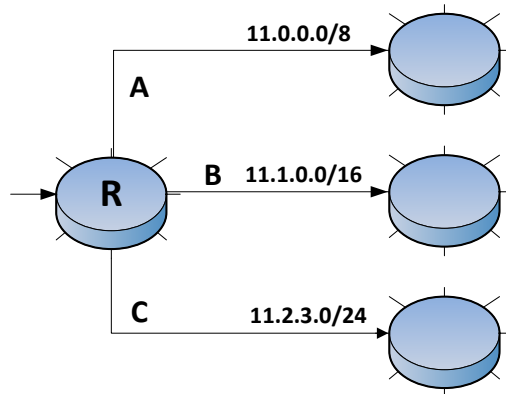
a) How many IP addresses does the prefix 11.2.3.0/24 represent?

b) List the forwarding table entries for router R. A new packet has just arrived at R. Describe how R uses its forwarding table to decide what to do with the packet.

c) Which outgoing interface does R use for a packet with destination 11.2.3.1?

d) Which outgoing interface does R use for a packet with destination 11.1.2.3?

e) Which outgoing interface does R use for a packet with destination 11.2.4.5?