Second Midterm Exam  
CMPSCI 290nw: A Networked World  
Fall 2013  
Prof. Jim Kurose

Instructions:

- There are 4 questions on this exam.  
- Put your name and student number on the exam books NOW!  
- The exam is closed book.  
- You have 80 minutes to complete the exam. Be a smart exam taker - if you get stuck on one problem go on to another problem. Also, don't waste your time giving irrelevant (or not requested) details.  
- The total number of points for each question is given in parenthesis. There are 100 points total. An approximate amount of time that would be reasonable to spend on each question is also given; if you follow the suggested time guidelines, you should finish with 10 minutes to spare. The exam is 80 minutes long.  
- Show all your work. Partial credit is possible for an answer, but only if you show the intermediate steps in obtaining the answer.  
- Good luck.

PLEASE  
(PLEASE, PLEASE, PLEASE, PLEASE, PLEASE!!)  
WRITE NEATLY  
I need to be able to read your answers!
Question 1: "Quickies" (25 points (5 each), 20 minutes)

Answer each of the following questions briefly, i.e., in at most a few sentences.

a) What is meant by router-assisted congestion control? Answer: in router-assisted congestion control, a router may mark a packet or directly send a congestion indication response to a sending node.

b) What is the purpose of the DHCP protocol? Answer: to get an IP address. The IP address will be in the same subnetwork (LAN) as the router to which it is attached via the LAN.

c) In class we said that BGP be considered a “policy-based” routing protocol. In what sense does BGP allow for policy-based routing? Answer: BGP allows a network to choose which paths it will use to reach a destination, and also allow a network to decide which paths that it advertise to its neighbors, thus controlling how the neighbors can choose to route through its network.

d) Would you prefer to use a CSMA protocol in light traffic (when almost no node will have a message to send) or in heavy traffic (when almost all nodes have a message to send)? Briefly explain your choice. Answer: CSMA works very well in light traffic – a node wanting to send will sense the channel idle and just send, with a low probability of a collision. In TDMA and in taking-turns protocols, the node would have to wait its turn before sending, even when there are no nodes with a packet to send.

e) In the distance vector protocol, suppose that node $x$ routes through node $y$ to get to a destination node $z$. Is it possible for $y$’s cost to get to $z$ to be more than $x$’s cost to get to $z$? Explain briefly. Answer: No. Since $x$ routes through $y$ (i.e., its minimum cost to destination $z$ is through $y$), $x$’s cost to $z$ will be the sum of the cost of the $x,y$ link plus $y$’s cost to $z$. Thus $x$’s cost to $z$ must be greater than $y$’s cost to $z$.

Question 2: Dijkstra’s Link State Algorithm (25 points, 15 minutes)

Consider the 6-node network shown below, with the given link costs.

![Diagram of a 6-node network with link costs]

Using Dijkstra's algorithm, find the least cost path from source node $u$ to all other destinations. Show your work in tabular format, as we did in class, homeworks and in the text.
**Answer:**

<table>
<thead>
<tr>
<th>Nprime</th>
<th>D(u),p(u)</th>
<th>D(v),p(v)</th>
<th>D(w),p(w)</th>
<th>D(x),p(x)</th>
<th>D(y),p(y)</th>
<th>D(z),p(z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>–</td>
<td>6,u</td>
<td>5,u</td>
<td>6,u</td>
<td>infty</td>
<td>infty</td>
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<tr>
<td>u w</td>
<td>–</td>
<td>6,u</td>
<td>–</td>
<td>6,u</td>
<td>14,w</td>
<td>6,w</td>
</tr>
<tr>
<td>u w v</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>6,u</td>
<td>14,w</td>
<td>6,w</td>
</tr>
<tr>
<td>u w v x</td>
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<td>–</td>
<td>12,x</td>
<td>6,w</td>
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<td>u w v x z</td>
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<td>7,z</td>
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<td>u w v x z y</td>
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</tbody>
</table>

The links in the least cost routing tree from node u to all destinations are:
- u-to-v, u-to-w, u-to-x, z-to-y, w-to-z.

**Question 3: LAN Addressing, and Learning Switches. (26 points 20 minutes)** Consider the scenario below in which two LANs are connected by a router. Suppose that A is in the process of sending a IP datagram from itself (A) to B.

Answer the following questions:

a) Consider the MAC frame (containing the A-to-B datagram being sent by A) as it arrives to the left interface of router R. What are the MAC addresses on this frame? What are the IP addresses on the datagram encapsulated inside this frame? *Answer: the MAC source address is the MAC address of A, 74-29-9c-e8-ff-55, and destination MAC address is the MAC address of the left interface of the router, e6-e9-00-17-bb-4b. The IP source address is 111.111.111.111 and the destination IP address is 222.222.222.222.*

b) How did A learn (i.e., what protocol did it use to find out) what destination address MAC address to use on this frame? *It used ARP to learn the MAC address of the router’s left interface.*

c) Now consider the MAC frame (containing the A-to-B datagram being sent by A) as it arrives to node B. What are the MAC address on this frame? What are the IP addresses on the datagram encapsulated inside this frame? *Answer: the MAC source address is the MAC address of the right interface of R, 1a-23-f9-cd-06-9b, and destination MAC address is the MAC address of B, 49-bd-d2-c7-56-2a. The IP source address is 111.111.111.111 and the destination IP address is 222.222.222.222.*
d) After the frame has been received by the router, what is the content of the switch table at S1. (Hint: in answering this question, take into account your answer to b) above as well as the fact that a frame containing the A-to-B IP datagram has also passed through this switch). 

**Answer:** The router knows that host A is reachable via the top left interface (since A sent the MAC frame containing the IP datagram, its source MAC address is on that frame, as well as having sent an ARP request packet. The switch also knows that the MAC address of the left interface of the router, e6-e9-00-17-bb-4b, is reachable via the switch’s right interface since the router replied to an earlier ARP request with an ARP reply in an Ethernet frame that contained the router’s interface MAC address as the source address in that frame.

**Question 4: Who can touch your Internet traffic?** (24 points, 15 minutes)

a) Suppose that your ISP notices that its network is frequently congested in the evenings due to a large number of its customers streaming video, causing all user applications get receive severely degraded performance. Your ISP decides that it will drop packets from any and all streaming video applications/providers when its network becomes congested. Discuss whether or not your ISP’s behavior violates network neutrality principles. **Answer:** Your ISP is allowed to perform “reasonable network management”. In times of overload, dropping traffic would be a reasonable way to manage the overload. Also and importantly, as long as the ISP is not discriminating against one video service provider/application then the ISP is also not violating fair competition among the video providers that want to use the network. Perhaps an open question is whether or not an ISP can discriminate one class of traffic versus another (e.g., drop video packets but not web traffic); I would guess that I can, particularly in times of overload.

b) Suppose there was a website inside the US that published web pages about how to make improvised bombs. What do you think would be the NSA’s position on whether or not it could record when you access this web site? What law/act/amendment might the NSA claim allows or prevents them from doing so. **Answer:** This information would be considered call metadata (i.e., the source and destination of the web request, but not the specific content downloaded), which is a business data record rather than personal data, and would not require a warrant under the Patriot Act.

c) Suppose you know a non-US-citizen living outside the US. What do you think would be the NSA’s position on whether or not it could record a conversation that you place to that person. What law/act/amendment might the NSA claim allows or prevents them from doing so. **Answer:** the NSA might claim that FISA (amended) allows it to collect information on any non-US person.