ICSI516 Homework 4 – Network Layer
20 points
Due date: Monday 12/03 at 11:59PM as a single PDF file via Blackboard

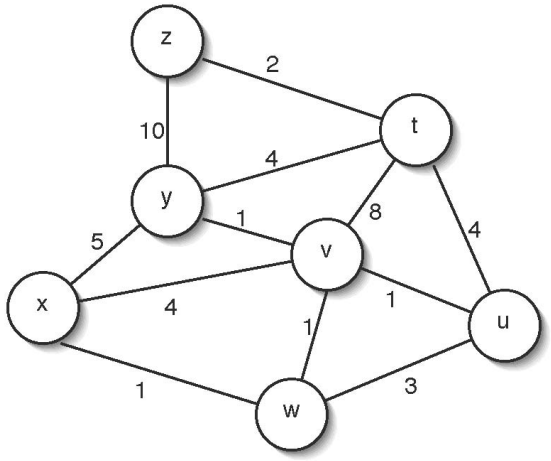
All parts of the assignment are to be completed independently. Submission of the same text by multiple students will be considered cheating. Students caught cheating will receive 0 points for the assignment and will be reported.

1. [2 points] Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11010000 00000000 00000000 00000000 through 11010000 11111111 11111111 11111111	0
11010001 00000000 00000000 00000000 through 11010001 00000000 11111111 11111111	1
11010001 00000000 00000000 00000000 through 11010001 11111111 11111111 11111111	2
Otherwise	3

   a. What is the correct interface to use for each of the following addresses:
      - 10011000 10010001 01010001 01010101
      - 11010001 00000000 11000011 00111100
      - 11010001 10000000 00010001 01110111
   b. Rewrite the forwarding table you created for part (a) using the a.b.c.d/x notation instead of the binary string notation.
2. [3 points] Consider the network in Figure 4.22 of your textbook(6th edition), which covers an example of Network Address Translation. Suppose that the ISP instead assigns the router the address 128.111.52.100 and that the network address of the home network is 192.168.1/24.
   a. Assign addresses to all interfaces in the home network.
   b. Suppose each host has two ongoing TCP connections, all to port 80 at host 112.33.200.11. Provide the six corresponding entries in the NAT translation table in the router.
3. [2 points] Calculate the byte overhead (in terms of number of Bytes) introduced by IP fragmentation when a packet of size 7000 Bytes traverses a network with MTU 1200 Bytes. What can the source network do to avoid fragmentation?
4. [3 points] Consider the following prefix 169.220.2.0/28.
   a. Write down the network mask in dotted-decimal notation.
   b. Calculate the corresponding network address.
   c. Calculate the corresponding broadcast address.
   d. How many host addresses are there in this prefix?
   e. How many IP addresses in total are there in this prefix?

5. [3 points] Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from z to all network nodes. Show how the algorithm works by computing a table similar to Table 4.3 in your book (6th edition).



6. [2 point] Consider the three node topology shown in Figure 4.30 in your book. Rather than having the link costs as shown in the figure, use the link costs of c(x,y)=5, c(y,z)=9, and c(x,z)=3. Compute the distance tables after the initialization step and after each iteration of a synchronous version of the distance-vector algorithm (as shown in the book for Figure 4.30).
7. [1 point] Compare and contrast the advertisements used by RIP and OSPF. In what networks is RIP more appropriate?
8. [1 point] Why does the Internet need to use different intra-AS and inter-AS protocols?
9. [3 points] *Scheduling* and *buffer management* are two key functions that a router performs on its queues.
    a. What is each of these techniques concerned with?
    b. Describe how First-In-First-Out (FIFO) scheduling can be detrimental to application performance and discuss advanced techniques to solve this problem following our discussion of [Demers+98, Fair Queueing].
    c. Describe how Tail Drop buffer management can be detrimental to application performance and discuss advanced techniques to solve this problem following our discussion of [Floyd+93, Random Early Detection].