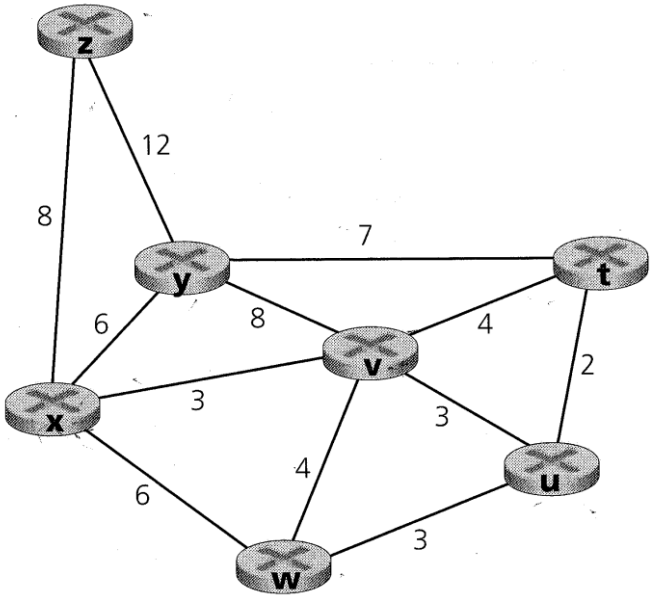
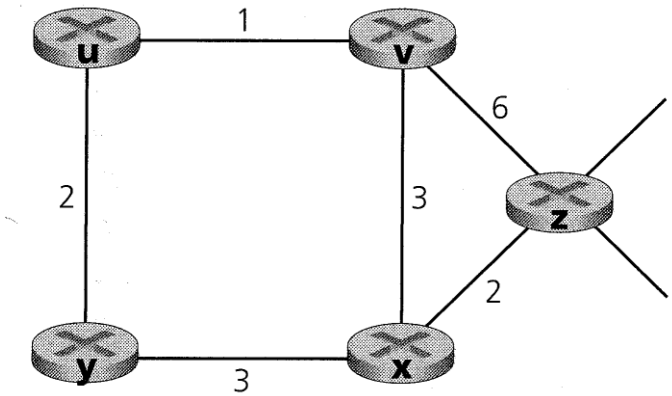
**NET2201 COMPUTER NETWORKS**
**Tutorial 2**

**TUTORIAL QUESTIONS FOR CHAPTERS 4 AND 5: NETWORK LAYER**

1. Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from *x* to all network nodes. Show how the algorithm works in a table. (7 marks)




2. Consider the network shown below, and assume that each node initially knows the costs of each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node *z*. (8 marks)



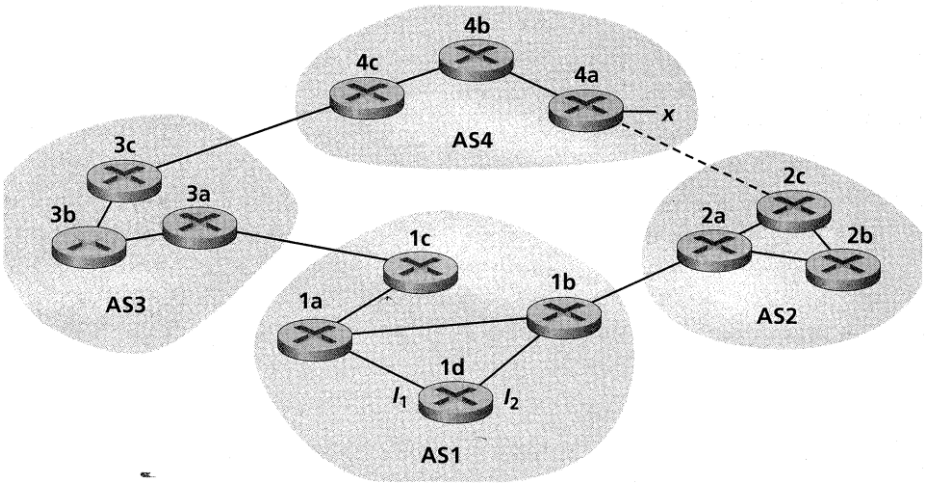

3. Consider the network shown below. Suppose, RIP is used for intra-AS protocol, and BGP is used for inter-AS protocol. Initially suppose there is no physical link between AS2 and AS4.

   a. Router 3c learns about prefix *x* from which routing protocol? (1 mark)

   b. Router 3a learns about prefix *x* from which routing protocol? (1 mark)

c. Router 1c learns about prefix *x* from which routing protocol? (1 mark)

d. Router 1d learns about prefix *x* from which routing protocol? (1 mark)




4. Referring to the previous problem, once router 1d learns about *x* it will put an entry (*x*,*I*) in its forwarding table.

   a. Will *I* be equal to $I_1$ or $I_2$ for this entry? Explain why in one sentence. (2 marks)

   b. Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that *x* is accessible via AS2 as well as via AS3. Will *I* be set to $I_1$ or $I_2$? Explain why in one sentence. (2 marks)

   c. Now suppose that there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that *x* is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will *I* be set to $I_1$ or $I_2$? Explain why in one sentence. (2 marks)

Source: Chapter 4 and 5, Computer Networking – A Top-Down Approach, Kurose and Ross.

## TUTORIAL QUESTIONS FOR CHAPTER 6: LINK LAYER

1. Suppose the information content of a packet is the bit pattern as shown below, and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? (2 marks)

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

2. Consider the following two-dimensional even parity matrix.

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

   Give an example of a double bit error that can be detected but cannot be corrected. Explain your answer. (6 marks)

3. Consider the generator, G = 10011, and suppose that D has the value 1010101010, and number of CRC bits is $r = 4$. What is the value R? (4 marks)

4. Consider two nodes, A and B, that use the slotted ALOHA protocol to contend for a channel. Suppose node A has more data to transmit than node B, and node A's retransmission probability $P_A$ is greater than node B's retransmission probability, $P_B$.

   a. Provide a formula for node A's average throughput. What is the total efficiency of the protocol with these two nodes? (3 marks)

   b. If $P_A = 2P_B$, is node A's average throughput twice as large as that of node B? Why or why not? If not, how can you choose $P_A$ and $P_B$ to make that happen? Explain your answer. (4 marks)

   c. In general, suppose there are $N$ nodes, among which node A has retransmission probability $2p$ and all other nodes have retransmission probability $p$. Provide expressions to compute the average throughputs of node A and of any other node. Explain your answer. (4 marks)

5. Suppose four active nodes: node A, B, C, and D, are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

   a. What is the probability that node A succeeds for the first time in slot 5? Explain your answer. (3 marks)

   b. What is the probability that some node (either A, B, C or D) succeeds n slot 4? Explain your answer. (3 marks)

c. What is the probability that the first success occurs in slot 3? Explain your answer. (3 marks)

d. What is the efficiency of this four-node system? Explain your answer. (3 marks)

6. Let's consider the operation of a learning switch in the context of a network in which 6 nodes labeled A through F are star connected into a switch. Suppose that (1) B sends a frame to E, (2) E replied with a frame to B, (3) A sends a frame to B and (4) B replied with a frame to A. The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers. (8 marks)

7. Why is token-passing protocol difficult to implement? (4 marks)

8. What are the three categories of medium access control protocols? Compare and contrast them. (7 marks)

9. Each host has a unique IP address. Do you agree that MAC address can be omitted? Justify your answer. (4 marks)

10. Provide an example of how link and network layers can cooperate. (5 marks)

Source: Chapter 6, Computer Networking – A Top-Down Approach, Kurose and Ross.