Tutorial questions for Chapter 5.

Network Layer: The control plane

Expected time to complete: 1 week.

Simple questions: Pease answer the following questions:

1. Briefly define/explain the following terms/concepts:
    a. Routing protocols

        ~ determine good paths (equivalently, routes), from sending hosts to receiving hosts, through network of routers.

    b. Routing algorithms

        ~ is an algorithm that calculates the least cost path/route that a packet can take from a sending host to a receiving host through a network of routers.

    c. The differences between link state and distance vector routing protocols

Link state routing protocols	Distance vector routing protocols
All routers have complete topology, link cost information	Routers know only physically connected neighbours and the link cost to them
The link costs are broadcast to all the routers in the network from a single controller	Requires an iterative process of computation, exchange of information with neighbours

    d. The differences between intra-AS routing and inter-AS routing

Intra-AS Routing	Inter-AS routing
Routing among hosts, routers in the same Autonomous System (AS)	Routing among AS'es

    e. Count to infinity

        ~ An important issue in distance vector routing that occurs when a connecting interface goes down or link cost increases. This results in a loop that is unnecessarily expensive (what would take 2 iterations will take orders more).

    f. BGP (Border Gateway Protocol):

        ~ the de facto inter-domain routing protocol

    g. OSPF (Open Shortest Path First):

        ~ it is the de facto intra-AS routing protocol that uses a link state routing algorithm.

    h. RIP (Routing Information Protocol):

        ~ it is intra-AS protocol that precedes OSPF, using a distance vector routing algorithm instead.

i. What is ICMP?

~ (Internet Control Message Protocol): it is used to send messages between routers, typically in case of errors.

j. What is SNMP?

~ (Simple Network Management Protocol): it is an Internet Standard protocol for collection and organizing information about managed devices on IP networks and for modifying that information to change device behaviour.

2. Routing algorithms

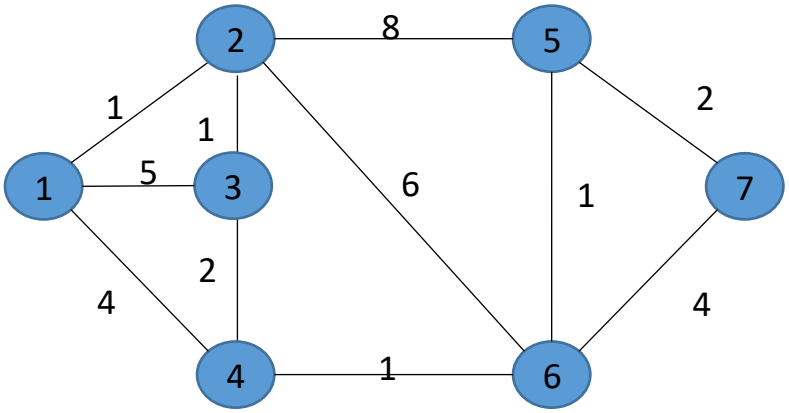

Figure 1. An example network 1

2-1. Apply the Bellman-Ford algorithm on the example network 1 given in Figure 1 to find the minimum-cost routes from station 1 to all other stations. Please make a table containing all the values. Please use "inf" to specify an infinite cost and "-" to specify no next hop respectively.

Step dest	1 (cost, next hop)	2	3	4
1	0, 1	0, 1	0, 1	0, 1
2	1, 2	1, 2	1, 2	1, 2
3	5, 3	2, 2	2, 2	2, 2
4	4, 4	4, 4	4, 4	4, 4
5	∞, -	9, 2	6, 4	6, 4
6	∞, -	5, 4	5, 4	5, 4
7	∞, -	∞, -	9, 4	8, 4

2-2. Apply the Dijkstra algorithm on the example network 1 in Figure 1 to find the minimum-cost routes from station 1 to all other stations. Please make a table for the final value. S is the set of stations whose least-cost path is known; D(v) is the current cost of path from source (i.e., station 1) to station v; p(v) is the predecessor station along path from source to v, that is next to v. Please use "inf" to specify an infinite cost and "-' to specify no predecessor respectively.

Step	D(1), p(1)	D(2) ,p(2)	D(3) ,p(3)	D(4) ,p(4)	D(5) ,p(5)	D(6) ,p(6)	D(7) ,p(7)	S
0	0, -	Inf, -	Inf, -	Inf, -	Inf, -	Inf, -	Inf, -	-
1	0, -	1, 1	5, 1	4, 1	Inf, -	Inf, -	Inf, -	1
2	0, -	1, 1	2, 2	4, 1	9, 2	7, 2	Inf, -	1,2
3	0, -	1, 1	2, 2	4, 1	9, 2	7, 2	Inf, -	1,2,3
4	0, -	1, 1	2, 2	4, 1	9, 2	5, 4	Inf, -	1,2,3,4
5	0, -	1, 1	2, 2	4, 1	6, 6	5, 4	9, 6	1,2,3,4,6
6	0, -	1, 1	2, 2	4, 1	6, 6	5, 4	8, 5	1,2,3,4,6,5
7	0, -	1, 1	2, 2	4, 1	6, 6	5, 4	8, 5	1,2,3,4,6,5,7