17/06/2019

# Lecture 07 tutorial: Routing

**During tutorials prepare a short report of your activities and show it to your tutor.**
Study the following **questions** and verify the correctness of the **answers** if given.
Be aware that the exam question might be directly related to the tutorial questions

**Additional Instructions:** Where a **group number** is indicated, please discuss this particular question with other members of your group, prepare a short written answer and email this to your tutor before the end of the day (you may wish to verify the correctness of your answer first). This will be used to produce a set of sample answers for the class for study purposes. *Note:* You should work through all questions in the tutorials, not just ones assigned to your group.

## PART 1 : Questions relating to lecture slides and related materials

Group 1

**Question 1.**
Read http://www.think-like-a-computer.com/2011/08/24/the-routing-table/
and explain what you see in your own routing table.
You need to see your configuration table first.

Group 2

**Question 2.**
What are routing tables?

Group 3

**Question 3.**
Consider a network as in slide 4. Compile the routing table for nodes B and F. Mark the alternative paths.

Group 4

**Question 4.**
Re-write the routing table from slide 6 using the slash notation

Group 5

**Question 5.**

a. How does static routing differ from dynamic routing?
b. When would you use static routing?

Group 6

**Question 6.**
Explain the principles of the hierarchical routing
Group 7

**Question 7.**
Is it necessary that every autonomous system use the same intra-AS routing algorithm? Why or why not?

Group 8

**Question 8.** Taxonomy

a) Name three most popular routing protocols.
b) Where are they used?
c) What routing algorithms the employ?

Group 9

**Question 9.** DV

a) Explain the concept of the distance vector routing.
b) Explain the difference between the concept and practical implementation

Group 10

**Question 10.** RIP

a) Describe fundamental features of the RIP including timers used.
b) Demonstrate how the routing table in the router C is updated

Group 1

**Question 11.** OSPF

Describe OSPF routing protocol.
Improve this question by itemizing it.

Group 2

**Question 12.** BGP

Describe BGPF routing protocol.
Improve this question by itemizing it.

**PART 2 : Additional Text Book Problems - Try to complete at at least 2 each**

Group 3

P l. Looking at Figure 5.3, enumerate the paths from y to u that do not contain any loops.

P2. Repeat Problem Pl for paths from x to z, z to u, and z tow.

Group 4

P3. 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 by computing a table similar to Table 5. I .

Group 5

P4. Consider the network shown in Problem P3. Using Dijkstra' s algorithm, and showing your work using a table similar to Table 5.1, do the following: a. Compute the shortest path from t to all network nodes. b. Compute the shortest path from u to all network nodes. c. Compute the shortest path from v to all network nodes. d. Compute the shortest path from w to all network nodes. e. Compute the shortest path from y to all network nodes. f. Compute the shortest path from z to all network nodes.

~~P5. Consider the network shown below, and assume that each node initially knows the costs to each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node z. 2 3 3 PROBLEMS 457 VideoNote Dijkstra's algorithm: discussion and example~~

Group 6

P6. Consider a general topology (that is, not the specific network shown above) and a synchronous version of the distance-vector algorithm. Suppose that at each iteration, a node exchanges its distance vectors with its neighbors and receives their distance vectors. Assuming that the algorithm begins with each node knowing only the costs to its immediate neighbors, what is the maximum number of iterations required before the dist1ibuted algorithm converges? Justify your answer.

Group 7

P7. Consider the network fragment shown below. x has only two attached neighbors, wand y. w has a minimum-cost path to destination u (not shown) of 5 , and y has a minimum-cost path to u of 6. The complete paths from wand y to u (and between wand y) are not shown. AU link costs in the network have strictly positive integer values. a. Give x's distance vector for destinations w, y, and u. b. Give a link-cost change for either c(x, w) or c(x,y) such that x will inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm. c. Give a link-cost change for either c(x, w) or c(x,y) such that x will not inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm.

Group 8

P8. Consider the three-node topology shown in Figure 5.6. Rather than having the link costs shown in Figure 5.6, the link costs are c(x,y) = 3, c(y,z) = 6, c(z,x) = 4. Compute the distance tables after the initialization step and after each iteration of a synchronous version of the distance-vector algorithm (as we did in our earlier discussion of Figure 5.6).

Group 9

P9. Can the poisoned reverse solve the general count-to-infinity problem? Justify your answer.

Group 10

P 10. Argue that for the distance-vector algorithm in Figure 5.6, each value in the distance vector D(x) is non-increasing and will eventually stabilize in a finite number of steps.

Group 1

P 11. Consider Figure 5. 7. Suppose there is another router w, connected to router y and z. The costs of all links are given as follows: c(x,y) = 4, c(x,z) = SO, c(y, w) = l , c(z, w) = 1, c(y,z) = 3. Suppose that poisoned reverse is used in the distance-vector routing algorithm. a. When the distance vector routing is stabilized, router w, y, and z inform their distances to x to each other. What distance values do they tell each other? b. Now suppose that the link cost between x and y increases to 60. Will there be a count-to-infinity problem even if poisoned reverse is used? Why or why not? lf there is a count-to-infinity problem, then how many iterations are needed for the distance-vector routing to reach a stable state again? Justify your answer. c. How do you modify c(y,z) such that there is no count-to-infinity problem at all if c(y,x) changes from 4 to 60?

Group 2

P 12. What is the message complexity of LS routing algorithm?

Group 3

P 13. Will a BGP router always choose the loop-free route with the shortest AS path length? Justify your answer.

Group 4

P 14. Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS l and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4. a. Router 3c learns about prefix x from which routing protocol: OSPF, RIP, eBGP, or iBGP? b. Router 3a learns about x from which routing protocol? c. Router learns about x from which routing protocol? d. Router Id learns about x from which routing protocol? 4b X 2c AS3 AS1

Group 5

PI5. Referring to the previous problem, once router learns about x it will put an entry (x, I) in its forwarding table. a. Will I be equal to /1 or h for this entry? Explain why in one sentence. b. Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router learns that xis accessible via AS2 as well as via AS3. Will be set to /1 or 12? Explain why in one sentence. c. Now suppose there is another AS, called ASS, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router Id learns that xis accessible via AS2 ASS AS4 as well as via AS3 AS4. Will/ be set to 11 or 12? Explain why in one sentence.

Group 6

P16. Consider the following network. ISP B provides national backbone service to regional ISP A . ISP C provides national backbone serv ice to regional ISP D. Each ISP consists of one AS. B and C peer with each other in two places using BGP. Consider traffic going from A to D. B would prefer to hand that traffic over to Con the West Coast (so that C would have to absorb the cost of carrying the traffic cross-country), while C would prefer to get the traffic via its East Coast peering point with B (so that B would have carried the traffic across the country). What BGP mechanism might C use, so that B would hand over A-to-D traffic at its East Coast peering point? To answer this question, you will need to dig into the BGP specification.