CSE 123: Computer Networks

Homework 3 Solutions

Out: 5/11, Due: 5/18

Total Points = 27

Problems

1. **Distance-Vector Routing [9 points]**
   For the network shown below, give the global distance-vector tables like those in Tables 3.10 and 3.13 on pages 244 and 246 in the book (P&D) when
   a. Each node knows only the distances to its immediate neighbors.

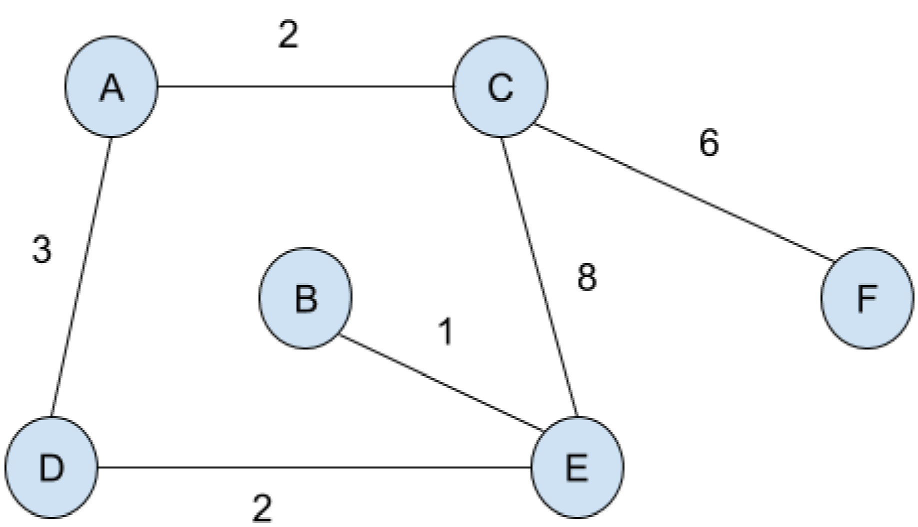
	A	B	C	D	E	F
A	0	Inf	2	3	Inf	Inf
B	Inf	0	Inf	Inf	1	Inf
C	2	Inf	0	Inf	8	6
D	3	Inf	Inf	0	2	Inf
E	Inf	1	8	2	0	Inf
F	Inf	Inf	6	Inf	Inf	0

   b. Each node has reported the information it had in the previous step to its immediate neighbors.

	A	B	C	D	E	F
A	0	Inf	2	3	5	8
B	Inf	0	9	3	1	Inf
C	2	9	0	5	8	6
D	3	3	5	0	2	Inf
E	5	1	8	2	0	14
F	8	Inf	6	Inf	14	0

c. Step "b." happens a second time.

	A	B	C	D	E	F
A	0	6	2	3	5	8
B	6	0	9	3	1	15
C	2	9	0	5	7	6
D	3	3	5	0	2	11
E	5	1	7	2	0	14
F	8	15	6	11	14	0



3 pts for each of a, b, and c (9 pts total)

- -0.5 pts for each incorrect row in the tables

Blank table entries will be treated as Infinity

2. **Link-State Routing [6 points]**
   Using the same network topology as in the figure in problem 4, draw the table like Table 3.14 on page 258 in the book (P&D) that shows the steps for building the routing table of node C.

Confirmed	**Tentative**	**Comments**
(C,0,-)		Initial node
(C,0,-)	(A,2,A) (E,8,E) (F,6,F)	C Neighbors
(C,0,-) (A,2,A)	(E,8,E) (F,6,F)	Added A
(C,0,-) (A,2,A)	(E,8,E) (F,6,F) (D,5,A)	A Neighbors
(C,0,-) (A,2,A) (D,5,A)	(E,8,E) (F,6,F)	Added D
(C,0,-) (A,2,A) (D,5,A)	(E,7,A) (F,6,F)	D Neighbors; cheaper path found for E
(C,0,-) (A,2,A) (D,5,A) (F,6,F)	(E,7,A)	Added F
(C,0,-) (A,2,A) (D,5,A) (F,6,F)	(E,7,A)	F has no new Neighbors
(C,0,-) (A,2,A) (D,5,A) (F,6,F) (E,7,A)		Added E
(C,0,-) (A,2,A) (D,5,A) (F,6,F) (E,7,A)	(B,8,A)	E Neighbors
(C,0,-) (A,2,A) (D,5,A) (F,6,F) (E,7,A) (B,8,A)		Added B; done

6 pts total

- 0.5 pts for each of the initial and added nodes steps (3 pts total)
- 0.5 pts for each updating tentative nodes steps (2.5 pts total)
- 0.5 pts for having all correct confirmed entries

3. **AS Routers [7 points]**
Suppose P, Q, and R are network service providers with respective CIDR address allocations 211.0.0.0/8, 212.0.0.0/8, and 213.0.0.0/8. Each provider's customers initially receive address allocations that are a subset of the provider's.
P has the following customers:
PA, with allocation 211.163.0.0/16
PB, with allocation 211.176.0.0/12.
Q has the following customers:
QA, with allocation 212.10.16.0/20
QB, with allocation 212.11.0.0/16.

*Note: For each routing table below you only need two columns; one for the CIDR prefix to match and the other being the next hop (ex. R, PA, QB, etc.).

a. Give routing tables for P, Q, and R assuming each provider connects to both of the others.

P's Table

address	nexthop
212.0.0.0/8	Q
213.0.0.0/8	R
211.163.0.0/16	PA
211.176.0.0/12	PB

Q's Table

address	nexthop
211.0.0.0/8	P
213.0.0.0/8	R
212.10.16.0/20	QA
212.11.0.0/16	QB

R’s Table

address	nexthop
211.0.0.0/8	P
212.0.0.0/8	Q

b. Now assume P is connected to Q and Q is connected to R, but P and R are not directly connected. Give tables for P and R.

Only 2 changes, one in each table:

P’s Table

address	nexthop
212.0.0.0/8	Q
213.0.0.0/8	Q
211.163.0.0/16	PA
211.176.0.0/12	PB

R’s Table

address	nexthop
211.0.0.0/8	Q
212.0.0.0/8	Q

c. Suppose R is removed. Then customer PA acquires a direct link to Q, and QA acquires a direct link to P, in addition to the other existing links. Give tables for P and Q (should no longer include R).

P’s Table

address	nexthop
212.0.0.0/8	Q
212.10.16.0/20	QA
211.163.0.0/16	PA
211.176.0.0/12	PB

Q’s Table

address	nexthop
211.0.0.0/8	P
211.163.0.0/16	PA
212.10.16.0/20	QA
212.11.0.0/16	QB

3 pts for part a

- 1 pt for having a table for each of P, Q, and R (3 pts total)
- -0.5 pts for each incorrect or unnecessary entry up to -1 pt per table

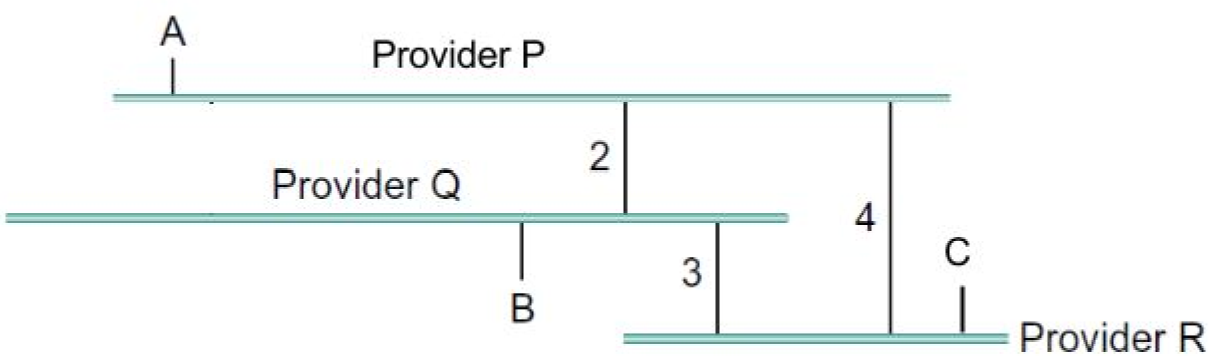
2 pts for part b

- Same general break down as part a

2 pts for part c

- Same general break down as part a

4. **BGP Routing [5 points]**
Consider the network shown below, in which horizontal lines represent transit providers and numbered vertical lines are inter-provider links. A, B, and C are networks connected to a particular provider below. The numbered links 2, 3, and 4 just show the links between the providers. For the purposes of this problem, a route can be written as a comma separated path from one provider to another. Ie. the route from B to A through R would be A:<Q,R, P>.



a. Suppose that P, Q, and R are all peer autonomous systems. List the paths that provider P knows to get to network C. If there are none, say so.

Only <P, R> because Q isn't advertising a path/ route to R through itself

b. Similarly, list the paths that provider R has to get to network B. If there are none, say so.

Only <R, Q> because P isn't advertising a path/ route to Q through itself

c. Now suppose providers P, Q, and R adopt the policy that outbound traffic is routed to the "closest" inter-provider link that it knows has a path to the destination, thus minimizing their own cost (e.g., P is "closer" to network C than Q as far as R is concerned because link 4 is closer to C than link 3). If P and Q are customers of R, and P and Q are peers, what routes will traffic from network A to network C follow? What about traffic from network C to network B? A to B?

A->C : <P, R>
C->B : <R, Q>
A->B : <P, Q>

d. Suppose the same as part c above except that now P and R are customers of Q, and P and R are peers. What paths will traffic from network A to network C take? What about from network C to network B? C to A?

A->C : <P, Q, R>
C->B : <R, Q>
C->A : <R, P>

1 pt for part a for correctness
1 pt for part b for correctness
1.5 pts for part c

- 0.5 pts for each correct path (1.5 pts total)

1.5 pts for part d

- 0.5 pts for each correct path (1.5 pts total)