50.012 Networks (2020 Term 6)

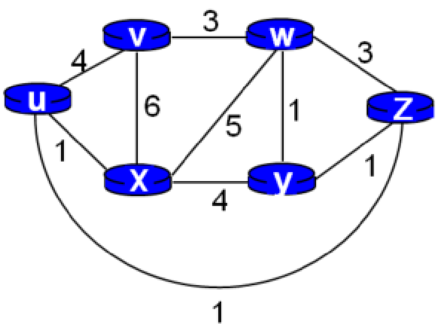
Homework 4

Hand-out: 24 Nov

Due: 4 Dec 23:59

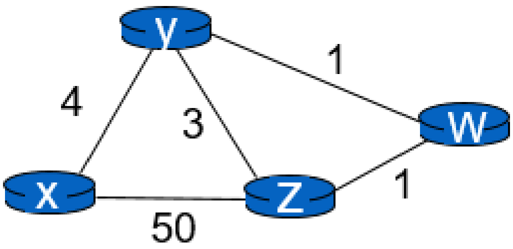
Name: ________________ Student ID: _________________

1. (Adapted from last year's final exam) Consider the network in the Figure below (noticed that there is a direct link between node u and z), where the numbers show the symmetrical link costs. Assume a link state routing protocol is used. **Node x** applies Dijkstra's algorithm to compute the best route to every other node. Step 0 of Dijkstra's algorithm (i.e., immediately after initialization) is shown below. Write down **all** the rows after step 0 until the algorithm completes.



Step	N'	D(u), p(u)	D(v),p(v)	D(w), p(w)	D(y),p(y)	D(z),p(z)
0	X	1,x	6,x	5,x	4,x	∞
1	xu		5,u	5,x	4,x	2,u
2	xuz		5,u	5,x	3,z	
3	xuzy		5,u	4,y		
4	xuzyw		5,u			
5	xuzywv					

2. (textbook chapter 5, problem P11): Consider the network below and 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? If there is a count-to-infinity problem, show the first three rounds of message exchanged among w, y, and z and how their DV change.

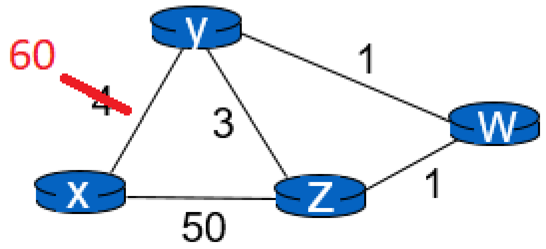
Suggested solution: a)

Router z	Informs w, $D_z(x)=\infty$
	Informs y, $D_z(x)=6$
Router w	Informs y, $D_w(x)=\infty$
	Informs z, $D_w(x)=5$
Router y	Informs w, $D_y(x)=4$
	Informs z, $D_y(x)=4$

b) Yes, there will be a count-to-infinity problem. The following table shows the routing converging process. Assume that at time t0, link cost change happens. At time t1, y updates its distance vector and informs neighbors w and z. In the following table, "→" stands for "informs".

	t0	Round 1	Round 2	Round 3	Round 4
Z			No change	→ w, $D_z(x)=\infty$ → y, $D_z(x)=11$	
W			→ y, $D_w(x)=\infty$ → z, $D_w(x)=10$		No change
Y	Y detects change of c(x,y), $D_y(x)= D_z(x) + c(y,z) =9$	→ w, $D_y(x)=9$ → z, $D_y(x)= \infty$		No change	→ w, $D_y(x)=14$ → z, $D_y(x)= \infty$

We see that w, y, z form a loop in their computation of the costs to router x. If we continue the iterations, then we will see that, at round 27 (r27), z detects that its least cost to x is 50, via its direct link with x. At r29, w learns its least cost to x is 51 via z. At r30, y updates its least cost to x to be 52 (via w). Finally, at r31, no updating, and the routing is stabilized.



	r27	r28	r29	R30	r31
Z	→ w, $D_z(x)=50$ → y, $D_z(x)=50$				
W		No change: still go through y to x, with $D_w(x)=50$	→ y, $D_w(x)=51$ → z, $D_w(x)=\infty$		
Y		→ w, $D_y(x)=53$ → z, $D_y(x)=\infty$		→ w, $D_y(x)=\infty$ → z, $D_y(x)=52$	