EECE 7374 – Fall 2023
Homework #4 Solution

1) **Dijkstra's algorithm**

Step	*N'*	*D(t),p(t)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
0	x	∞	∞	3,x	6,x	6,x	8,x
1	xv	7,v	6,v	3,x	6,x	6,x	8,x
2	xvu	7,v	6,v	3,x	6,x	6,x	8,x
3	xvuw	7,v	6,v	3,x	6,x	6,x	8,x
4	xvuwy	7,v	6,v	3,x	6,x	6,x	8,x
5	xvuwyt	7,v	6,v	3,x	6,x	6,x	8,x
6	xvuwytz	7,v	6,v	3,x	6,x	6,x	8,x

2) **Distance vector algorithm**

a)

	Destination					
Node	A	B	C	D	E	F
A	0	2	2	3	7	6
B	2	0	4	5	6	4
C	2	4	0	1	5	7
D	3	5	1	0	4	6
E	7	6	5	4	0	2
F	6	4	7	6	2	0

b) From its neighbors A, B, D.

c) C's cost to E through B: 8 + 6 = 14
C's cost to E through A: 2 + 7 = 9
C's cost to E through D: 1 + 4 = 5
Path through D has minimum cost.

d) From its neighbors B, D, F.

e) E's cost to B through B: 10
E's cost to B through D: 4 + 5 = 9
E's cost to B through F: 2 + 4 = 6
Path through F has minimum cost.

3) **BGP**

a) A will advertise that it can reach w and y, since x needs to know which networks its provider can reach. It may also advertise that it can reach B and C. However, if B and C are only transit networks (that is, only providing service to/from their customers networks), then A would not have to advertise B and C to x.

b) X will not advertise any routes to A, since otherwise A might try to route through x, and x is a customer network, not a transit network.

c) A will advertise that it can reach w and x. Note that since C is a peer network, A will only advertise its customers to C. In particular, A wouldn't advertise y to C, since that might cause C to route to y via A.

Bonus problem

a) Since all IP packets are sent outside, we can use a packet sniffer to record all IP packets generated by the hosts behind a NAT. As each host generates a sequence of IP packets with sequential numbers and a distinct (very likely, as they are randomly chosen from a large space) initial identification number (ID), we can group IP packets with consecutive IDs into a cluster. The number of clusters is the number of hosts behind the NAT.

   For more practical algorithms, see the following papers.

   "A Technique for Counting NATted Hosts", by Steven M. Bellovin, appeared in IMW'02, Nov. 6-8, 2002, Marseille, France.
   "Exploiting the IPID field to infer network path and end-system characteristics."
   Weifeng Chen, Yong Huang, Bruno F. Ribeiro, Kyoungwon Suh, Honggang Zhang, Edmundo de Souza e Silva, Jim Kurose, and Don Towsley.
   PAM'05 Workshop, March 31 - April 01, 2005. Boston, MA, USA.

b) If those identification numbers are not sequentially assigned but randomly assigned, the technique suggested in part (a) won't work, as there won't be clusters in sniffed data.