

Solution of homework #4

Problem 1.

The routing table using Dijkstra's algorithm.

Step	N	D(A),p(A)	D(B),p(B)	D(C),p(C)	D(D),p(D)	D(E),p(E)	D(G),p(G)	D(H),p(H)
0	F	Inf.	Inf.	Inf.	3, F	1, F	6, F	Inf.
1	FE	Inf.	Inf.	4, E	2, E		6, F	Inf.
2	FED	Inf.	11, D	3, D			3, D	Inf.
3	FEDG	Inf.	7, G	3, D				17, G
4	FEDGC	7, C	5, C					17, G
5	FEDGCB	6, B						7, B
6	FEDGCBA							7, B
7	FEDGCBAH							

Destination	Next Hop	Cost	Shortest Path
A	B	6	FEDCBA
B	C	5	FEDCB
C	D	3	FEDC
D	E	2	FED
E	F	1	FE
G	D	3	FEDG
H	B	7	FEDCBH

// 3points for each step in table1, 6 points for table 2, 30 points in total //

Problem 2.

(a) Initial distance table at node E.

D^E	B	C	D
A	Inf.	Inf.	Inf.
B	5	Inf.	Inf.
C	Inf.	2	Inf.
D	Inf.	Inf.	10

(b) Initial distance table at node C.

D^C	A	D	E
A	2	Inf.	Inf.
B	Inf.	Inf.	Inf.
D	Inf.	1	Inf.
E	Inf.	Inf.	2

(c) The distance table after the first iteration.

Node E.

D^E	B	C	D
A	6	4	Inf.
B	5	Inf.	25
C	Inf.	2	11
D	20	3	10

Node C.

D^C	A	D	E
A	2	Inf.	Inf.
B	3	16	7
D	Inf.	1	12
E	Inf.	11	2

(d) The update message from node C to node E in iteration 1 is

$$\text{Min}_w D^C(B, w) = 3;$$

(e) The new distance table at node E after processing information from node C sent in iteration 1.

D^E	B	C	D
A	6	4	Inf.
B	5	5	25
C	Inf.	2	11
D	20	3	10

// 4 points for each part, 30 points in total //

Problem 3.

(a). The original addressing scheme that had multiple classes is very inefficient in network address space utilization. It required that the network portion of the IP address be exactly one, two, or three bytes long, which turned out to be problematic for supporting the rapidly growing number of organizations with small and medium-sized networks. For example, 2000 hosts is typically allocated a class B network address, leaving more than 63000 unused addresses that could not be used by other organizations.

(b)The CIDR address this problem by allowing the network part of an IP address can be any number of bits long. In this case, the organizations needing to support 2000 hosts could be allocated a block of only 2048 host addresses of the form a.b.c.d/21, which improves the utilization of the address space significantly.

(c). Subnet masks are used to split the network address into smaller segments with fewer hosts in each segments. With subnet masking, the administrator of the network can break the host part of the network address into even smaller fragments, which can be used to identify a particular geographic or department location.

(d)The Dynamic Host Configuration Protocol (DHCP) is designed to provide a centralized approach to the configuration and maintenance of IP address space. DHCP improves the efficiency of address space utilization by allowing the network administrator to configure various clients on the network from a single location.

//four parts, 5 points each//

Problem 4.

(a) When the source (A) and the destination (B) are in the same subnet, A knows that the B can be reached directly via its outgoing interface without the need for any intervening routers by consulting its routing table. A then passes the IP datagram to the link-layer protocol for the interface, which then has the responsibility of transporting the datagram to B. //10 points//

(b) When the source (A) and the destination (B) are not in the same subnet, A first consults its routing table. The routing table tells A that A should first send the datagram to router 1 in order to send the datagram to B. A then send the datagram to the link layer and indicates to the link layer that it should send the datagram to the IP address of router 1 interface to A. Next, it is the job of the routers to move the datagram to destination B. Router1 will consult its routing table and then forwarded the datagram to the IP address of the interface of router 2 to router 1 using the link-layer protocol. Router 2 then will forward the datagram to router 3. Finally, router 3 will forward the datagram to the IP address of the interface of router 3 to destination B.

In the whole process, the routing tables in the routers play a central role in routing datagrams. //10points//

Additional problem for 6000 level students

Problem 1.

Initiation:

Node A.

D^A	B	C
B	1	Inf.
C	Inf.	2
D	Inf.	Inf.
E	Inf.	Inf.

Node B

D^B	A	D	E
A	1	Inf.	Inf.
C	Inf.	Inf.	Inf.
D	Inf.	15	Inf.
E	Inf.	Inf.	5

Node C.

D^C	A	D	E
A	2	Inf.	Inf.
B	Inf.	Inf.	Inf.
D	Inf.	1	Inf.
E	Inf.	Inf.	2

Node D

D^D	B	C	E
A	Inf.	Inf.	Inf.
B	15	Inf.	Inf.
C	Inf.	1	Inf.
E	Inf.	Inf.	10

Node E

D^E	B	C	D
A	Inf.	Inf.	Inf.
B	5	Inf.	Inf.
C	Inf.	2	Inf.
D	Inf.	Inf.	10

Iteration 1.

Node A.

D^A	B	C
B	1	Inf.
C	Inf.	2
D	16	3
E	6	4

Node B.

D^B	A	D	E
A	1	Inf.	Inf.
C	3	16	7
D	Inf.	15	15
E	Inf.	25	5

Node C.

D^C	A	D	E
A	2	Inf.	Inf.
B	3	16	7
D	Inf.	1	12
E	Inf.	11	2

Node D

D^D	B	C	E
A	16	3	Inf.
B	15	Inf.	15
C	Inf.	1	12
E	20	3	10

Node E.

D^E	B	C	D
A	6	4	Inf.
B	5	Inf.	25
C	Inf.	2	11
D	20	3	10

Iteration 2.

Node A.

D^A	B	C
B	1	5
C	4	2
D	16	3
E	6	4

Node B.

D^B	A	D	E
A	1	18	9
C	3	16	7
D	4	15	8
E	5	18	5

Node C.

D^C	A	D	E
A	2	4	6
B	3	16	7
D	5	1	5
E	6	4	2

Node D

D^D	B	C	E
A	16	3	14
B	15	4	15
C	18	1	12
E	20	3	10

Node E.

D^E	B	C	D
A	6	4	13
B	5	5	25
C	8	2	11
D	20	3	10

Iteration 3.

Node A.

D ^A	B	C
B	1	5
C	4	2
D	5	3
E	6	4

Node B.(No change after iteration 3).

D ^B	A	D	E
A	1	18	9
C	3	16	7
D	4	15	8
E	5	18	5

Node C.

D ^C	A	D	E
A	2	4	6
B	3	5	7
D	5	1	5
E	6	4	2

Node D (No change after iteration 3).

D ^D	B	C	E
A	16	3	14
B	15	4	15
C	18	1	12
E	20	3	10

Node E.

D^E	B	C	D
A	6	4	13
B	5	5	14
C	8	2	11
D	9	3	10

Iteration 4. (Final distance tables)

Node A. (No change after iteration 3)

D^A	B	C
B	1	5
C	4	2
D	5	3
E	6	4

Node B.(No change after iteration 3).

D^B	A	D	E
A	1	18	9
C	3	16	7
D	4	15	8
E	5	18	5

Node C. (no change after iteration 3)

D^C	A	D	E
A	2	4	6
B	3	5	7
D	5	1	5
E	6	4	2

Node D (No change after iteration 3).

D ^D	B	C	E
A	16	3	14
B	15	4	15
C	18	1	12
E	20	3	10

Node E. (No change after iteration 3).

D ^E	B	C	D
A	6	4	13
B	5	5	14
C	8	2	11
D	9	3	10

The distance tables take three iterations to converge.

There are several factors that are affecting the number of iterations before convergence.

- (a) The number of vertexes in the graph. Generally, the more vertexes, the larger the number of iterations.
- (b) The relative link costs. The greater the difference among the link costs, the larger the number of iterations will be.
- (c) The connectivity of the graph. The effect is hard to determine.

// Initiation: 8 Points. 4 Iterations: 8 Points each. Comments about the number of iterations, 10 points//