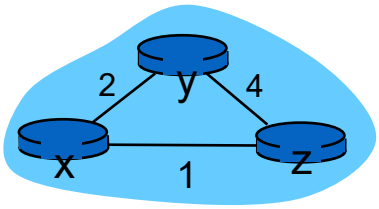
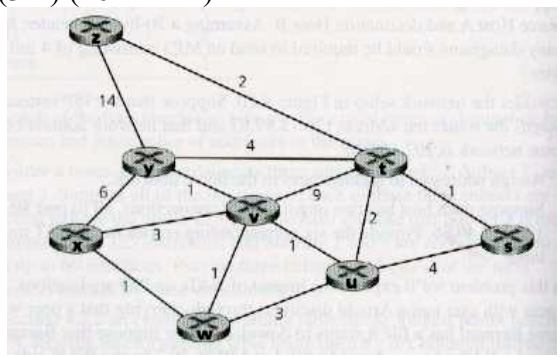
Computer Networks midterm (108/4)

只寫答案而沒有解釋說明，扣一半分數

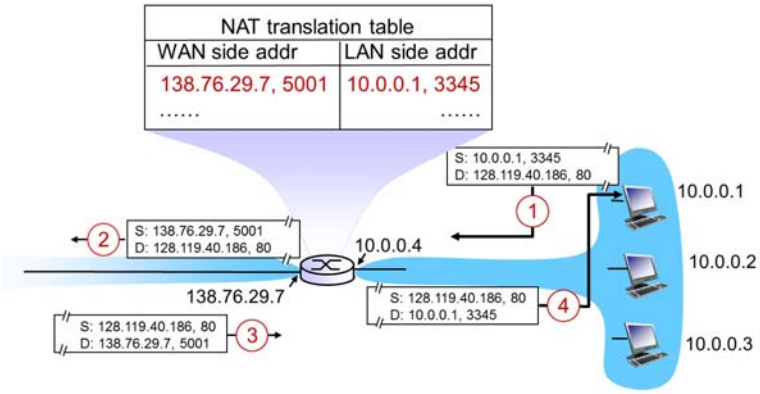
1. Consider a router that interconnects two subnets: S1 and S2. Suppose all of the interfaces in each of these three subnets are required to have the prefix 120.107.17/24. Also suppose S1 is required to support up to 120 interfaces and S2 up to 30 interfaces. Provide two network addresses (of the form a.b.c.d/x) that satisfy these constraints. （要解釋原因, 4% each, 8% total）
2. List three tables of node X, Y and Z with the distance vector algorithm, from the time when three nodes are initialized to the time three tables are stabilized. (table 一行 3% (x, y, z 各看自己那列 1%),共 6%。數值有變動時，要寫出公式 2%, 共 4% => 10% total)



3. Use Dijkstra's shortest-path algorithm to compute the shortest path from z to all network nodes. (a) Show how the algorithm works by computing a table. (數值相同時，優先選字母順序較前者, 公式 1% each, 表格每列(含箭頭)1%, 16%) (b) show the forwarding table of z. (7%) (c) What is the count-to-infinity problem? (3%) (26% total)



4. 針對 IPv4 Class B 網路（以十進位表示，要寫完整過程） (20%)
   a. 求出最後一個 Class B 網路的網路表示法為何？(2%) 可用 IP 範圍？ (4%) 共有幾個 IP 可用？(2%) mask 的值為何？(2%)
   b. 將最後一個 Class B 網路分成 14 個 subnet，subnet mask 的值為何？(2%) 請列出第一個 subnet 的網路表示法 (2%) 可用 IP 範圍？(4%) 共有幾個 IP 可用？(2%)
5. Suppose datagrams are limited to 1000 bytes (including header) between source host A and destination host B. Assuming a 20-byte IP header and 20-byte TCP header, (a) How many datagrams would be required to send an MP3 consisting of 4 million bytes? (4%) (b) How many bytes (including header) are each datagram? (Two answers: 2%) (8% total)
6. (a) How are routing algorithms classified by global and decentralized information? (b) What are these two routing algorithms? (10%)
7. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)
8. Explain four NAT operations with this figure (用圖上的數值說明 8%)



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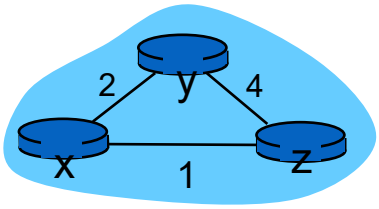
Ans:

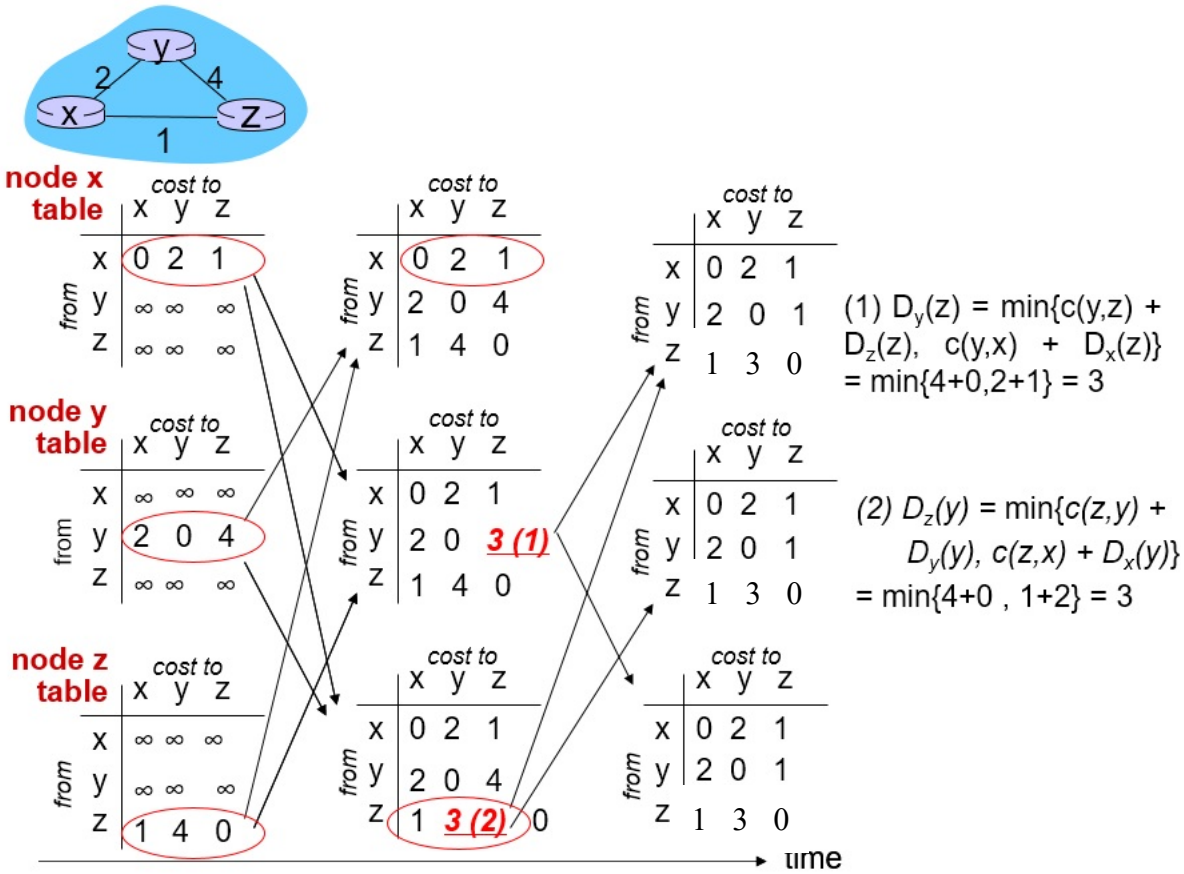
S1: 120 < 128 = 2^7, 32-7=25, 設為120.107.17.0…….(2)/25=120.107.17.0/25 (4%)

S2: 30 < 32 = 2^5, 32-5=27, 設為120.107.17.100….. (2)/25=120.107.17.128/27 (4%)

2. List three tables of node X, Y and Z with the distance vector algorithm, from the time when three nodes are initialized to the time three tables are stabilized. (table 一行 3% (x, y, z 各看自己那列 1%),共 6%。數值有變動時，要寫出公式 2%, 共 4% => 10% total)

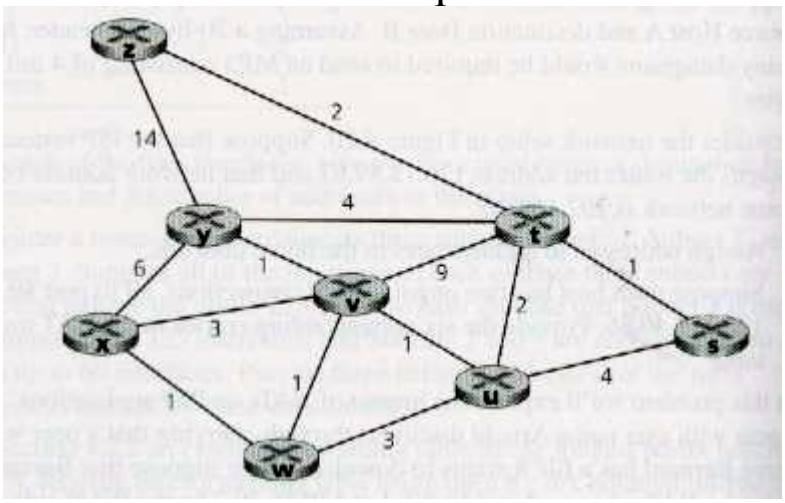


Ans:



3. Use Dijkstra's shortest-path algorithm to compute the shortest path from z to all network nodes. (a) Show how the algorithm works by computing a table. (數值相同時，優先選字母順序較前者, 公式 1% each, 表格每列(含箭頭)1%, 16%) (b) show the forwarding table of z. (7%) (c) What is the count-to-infinity problem? (3%) (26% total)

Computer Networks midterm (108/4)



Ans: (1% each, 7% total)

N'	D(s),p(s)	D(t),p(t)	D(u),p(u)	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)
z	∞	2, z	∞	∞	∞	∞	14, z
zt	a)3, t		b) 4, t	c) 11, t	∞	∞	d) 6, t
zts			4, t	11, t	∞	∞	6, t
ztsu				e) 5, u	f) 7, u	∞	6, t
ztsuv					g) 6, v	h) 8, v	6, t
ztsuvw						~~i) 7, w~~	6,t
ztsuvwy						7, w	
ztsuvwyx							

(1% each, 9% total)

a). D(s) = min{D(s), D(t) + C(t, s)} = min{∞, 2 + 1} = 3

b). D(u) = min{D(u), D(t) + C(t, u)} = min{∞, 2 + 2} = 4

c). D(v) = min{D(v), D(t) + C(t, v)} = min{∞, 2 + 9} = 11

d). D(y) = min{D(y), D(t) + C(t, y)} = min{14, 2 + 4} = 6

e). D(v) = min{D(v), D(u) + C(u, v)} = min{11, 4 + 1} = 5

f). D(w) = min{D(w), D(u) + C(u, w)} = min{∞, 4 + 3} = 7

g). D(w) = min{D(w), D(v) + C(v, w)} = min{7, 5+1} = 6

h). D(x) = min{D(x), D(v) + C(v, x)} = min{∞, 5 + 3} = 8

i). D(x) = min{D(x), D(w) + C(w, x)} = min{8, 6 + 1} = 7

(b) Forwarding table of z: (1% each, 7% total)

Destination	Next hop (output link)
s	t
t	t
u	t
v	t
w	t
x	t
y	t

(c) The count-to-infinity problem means that it takes a long time for a distance vector routing algorithm to converge when there is a link cost increase. (3%)

4. 針對 IPv4 Class B 網路（以十進位表示，要寫完整過程） (20%)

a. 求出最後一個 Class B 網路的網路表示法為何？(2%) 可用 IP 範圍？ (4%) 共有幾個 IP 可用？

(2%) mask 的值為何？(2%)

b. 將最後一個 Class B 網路分成 14 個 subnet，subnet mask 的值為何？(2%) 請列出第一個 subnet 的網路表示法 (2%) 可用 IP 範圍？(4%) 共有幾個 IP 可用？(2%)

Ans:

a.

最後一個 class B 的 Network ID 表示為 10111111. 11111110. XXXXXXXX. XXXXXXXX，十進位為為 191.254.0.0 (2%)

所有 16 個 bit 的 X 不可以全為 0 或 1，

因此第一個可用 Host ID 為 10111111. 11111110. 00000000.00000001 = 191.254.0.1 (2%)

最後一個可用 Host ID 為 10111111. 11111110. 11111111.11111110 = 191.254.255.254 (2%)

->共有 2^{16}-2 個可用 Host ID (2%)

Mask: 255.255.0.0 (2%)

b.

將最後一個 Class B 網路分成 14 個 subnet，最少需要 Host ID 的前 4 ($14<2^4$)個 bits 當作 subnet ID。所以新的 subnet mask 是由原本 Class B 的 default subnet mask 255.255.0.0 來改，改成 11111111. 11111111. 11110000.00000000 => 255.255.240.0 (2%)

subnet 的 ID 要從最後一個 Class B Network ID 10111111. 11111110. 00000000.00000000 來改，需要 Host ID 的前 4 個 bits 當作 subnet ID。因此第一個 subnet ID 為 10111111. 11111110. 00000000.00000000 => 191.254.0.0 (2%)

因此第一個可用 Host ID 為 10111111. 11111110. 00000000. 00000001 = 191.254.0.1 (2%)

最後一個可用 Host ID 為 10111111. 11111110.00001111. 11111110 = 191.254.15.254 (2%)

->共有 2^{12}-2=4094 個可用 Host ID (2%)

5. Suppose datagrams are limited to 1000 bytes (including header) between source host A and destination host B. Assuming a 20-byte IP header and 20-byte TCP header, (a) How many datagrams would be required to send an MP3 consisting of 4 million bytes? (4%) (b) How many bytes (including header) are each datagram? (two answers: 2%) (8% total)

Ans:

MP3 file size = 4 million bytes. Assume the data is carried in TCP segments, with each TCP segment also having 20 bytes of header. Then each datagram can carry 1000-40=960 bytes of the MP3 file

Number of datagrams required Ceiling ($4x10^6/960$) = 4167 (4%)

= All but the last datagram will be 1,000 bytes (2%); the last datagram will be 640+40 = 680 bytes. (2%)

6. (a) How are routing algorithms classified by global and decentralized information? (b) What are these two routing algorithms? (10%)

Ans:

(a) Global:

all routers have complete topology, link cost info (2%)

Decentralized:

router knows physically-connected neighbors, link costs to neighbors (2%)

iterative process of computation, exchange of info with neighbors (2%)

(b) "link state" algorithms and "distance vector" algorithms (4%)

7. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

Ans:

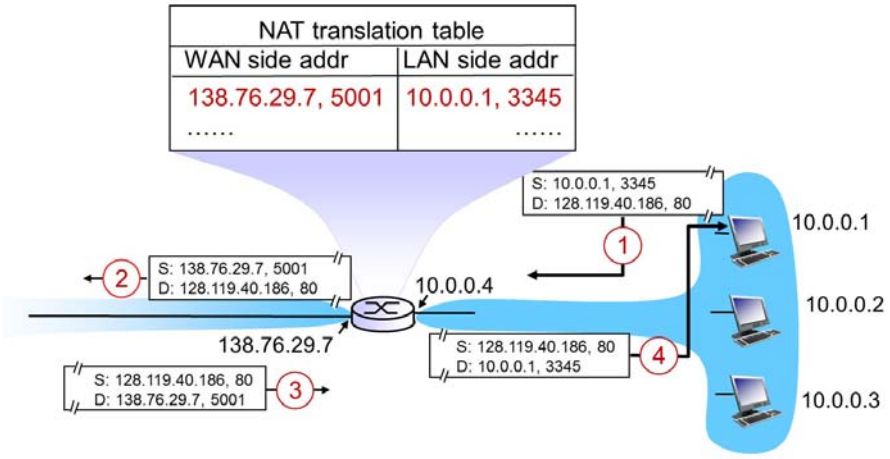
(a) Goal: allow host to *dynamically* obtain its IP address from network server when it joins network (2%)

Computer Networks midterm (108/4)

(b) Flow: (8%)

- host broadcasts "DHCP discover" msg (2%)
- DHCP server responds with "DHCP offer" msg (2%)
- host requests IP address: "DHCP request" msg (2%)
- DHCP server sends address: "DHCP ack" msg (2%)

8. Explain four NAT operations with this figure (用圖上的數值說明 8%)



Ans:

NAT router must: (8%)

- *outgoing datagrams: replace* (source IP address, port #)=(10.0.0.1, 3345) (1%) of every outgoing datagram to (NAT IP address, new port #)=(138.76.29.7, 5001) (1%)
- *remember (in NAT translation table)* every (source IP address, port #)=(10.0.0.1, 3345) (2%) to (NAT IP address, new port #)=(138.76.29.7, 5001) translation pair (2%)
- *incoming datagrams: replace* (NAT IP address, new port #)=(138.76.29.7, 5001) (1%) in dest fields of every incoming datagram with corresponding (source IP address, port #)=(10.0.0.1, 3345) (1%) stored in NAT table