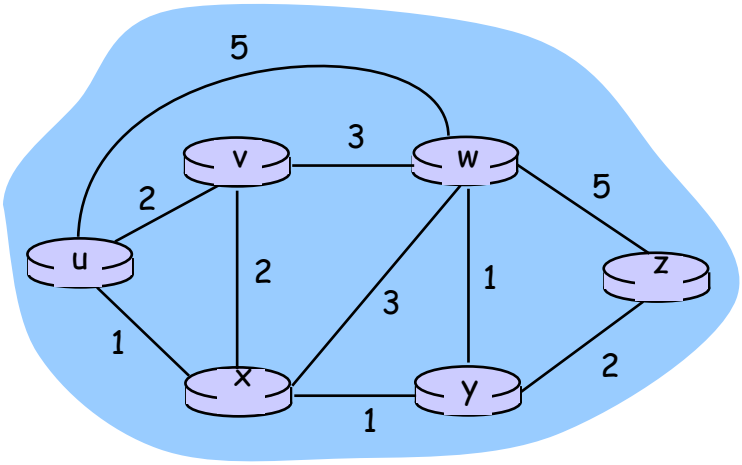
Computer Networks midterm (104/4)

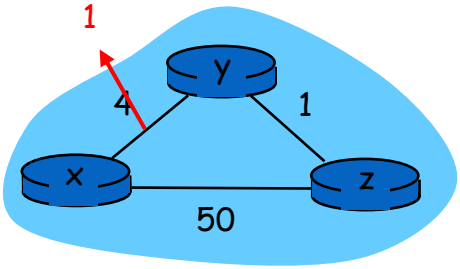
只寫答案而沒有解釋說明，扣一半分數

1. 針對 163.107.172.1 這個 IP address，將此 IP 網路分成 7 subnets，subnet mask 的值為何？(2%) 請列出第 7 個 subnet 的網路表示法 (2%) 可用 IP 範圍？(2%) 共有幾個 IP 可用？(1%) （以十進位表示，要寫完整過程, 7% total）

2. Use Dijkstra's shortest-path algorithm to compute the shortest path from the source node **Z** to all other network nodes. (a) Show how the algorithm works by computing a table. (6%) (b) Show the forwarding table of the source node Z. (5%, 11% total) (cost 數值相同時，優先選字母順序較前者; 數值有變動時，要寫出公式)



3. List changing processes of three tables of node X, Y and Z with the distance vector algorithm, from the time before the X-Y link cost is changed from 4 to 1 to the time three tables are stabilized. (第 1 行 table 是未變動前的穩定狀況，後 3 行 table 一行 3% (x, y, z 各看自己那列 1%),共 9%。數值有變動時，要寫出公式，各 1%共 4% => total 13%)



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

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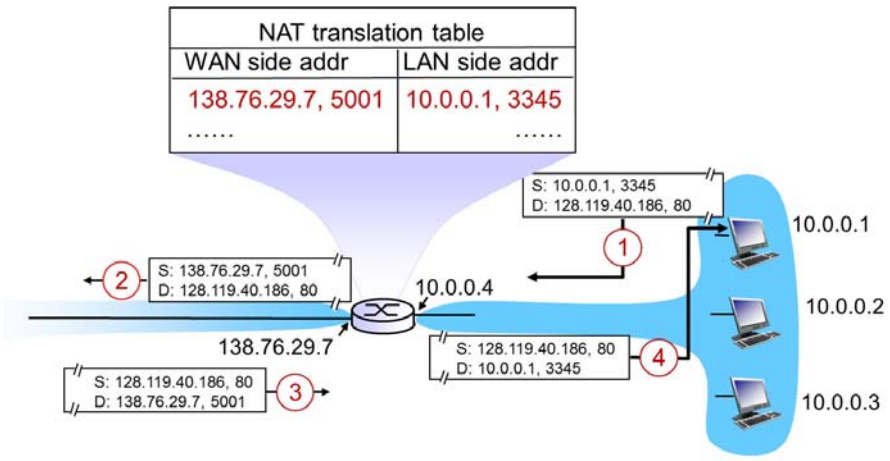

5. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

6. Describe how Ethernet uses CSMA/CD with exponential backoff (要寫出碰撞後如何動作) in detail (12%)

7. (a) List three types of multiple access protocols and describe how they work briefly. (9%) (b) Classify FDMA, Token Passing and CSMA/CD into one of the type to whom they belong. (6%) (15% total)

8. (a) List a distance vector routing protocol. (2%) (b) List a Link State routing protocol. (2%) (c) Which protocol in (b) and (c) has the Security feature? (2%) (6% total)

9. Compare and contrast link state and distance vector routing algorithms. (10%)

10. Consider the CRC generator, G=1001, and suppose that D has the value 10101010000. What is the value of R? (要寫出運算過程 6%, 8% total)

Computer Networks midterm (104/4)

只寫答案而沒有解釋說明，扣一半分數

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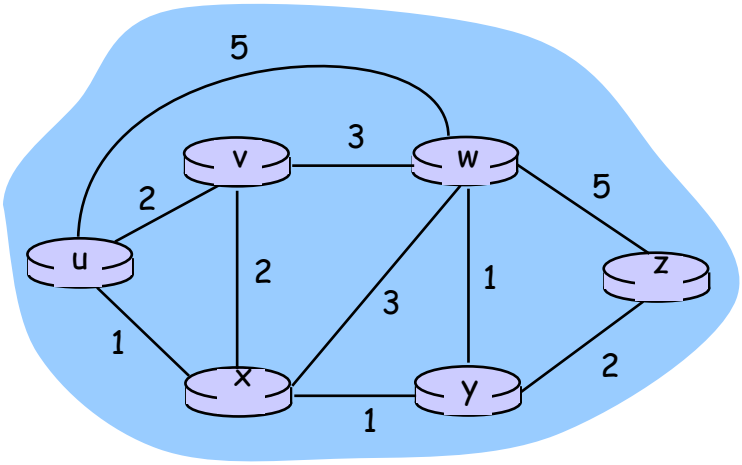
Ans:

將此 Class B 網路分成 7 個 subnet，加上全為 0 與全為 1 的兩個不能用的 subnet ID，最少需要 7+2=9 <= 2^4, subnet mask 的值 => 需要 Host ID 的前 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 255.255.11110000.00000000=> 255.255.240.0 (2%)

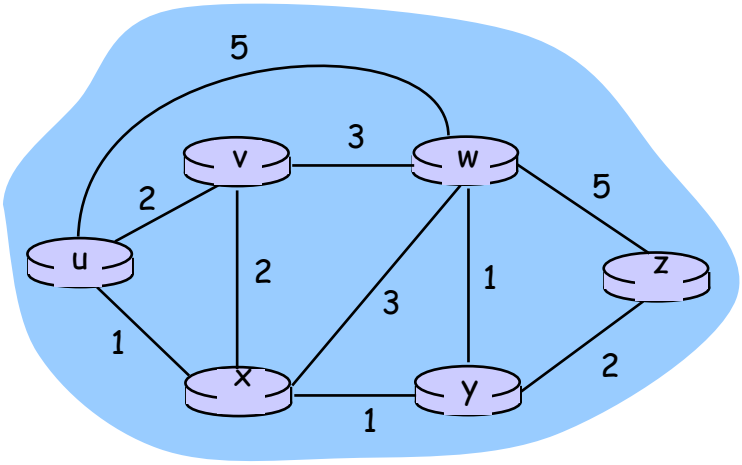
subnet 的 ID 要從此 Class B Network ID 10100011.01101011. XXXXXXXX.XXXXXXXX 來改，需要 Host ID 的前 4 個 bits 當作 subnet ID，不可全為 0 或 1。因此第 7 個 subnet ID 為 10100011.01101011.01110000.00000000 => 163.107.112.0(2%)
因此第一個可用 Host ID 為 10100011.01101011.01110000. 00000001 = 163.107.112.1 (1%)
最後一個可用 Host ID 為 10100011.01101011.01111111. 11111110 = 163.107.127.254 (1%)
->共有 2^{12}-2=4094 個可用 Host ID (1%)

2. Use Dijkstra's shortest-path algorithm to compute the shortest path from the source node Z to all other network nodes. (a) Show how the algorithm works by computing a table. (6%) (b) Show the forwarding table of the source node Z. (5%, 11% total) (cost 數值相同時，優先選字母順序較前者; 數值有變動時，要寫出公式)



1.

Ans: (除 step 之外，一欄 1 分)



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以 z 為起點

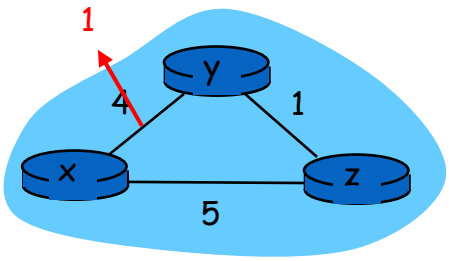
Step	N'	D(u), p(u)	D(v), p(v)	D(w), p(w)	D(x), p(x)	D(y), p(y)
0	z	∞	∞	5, z	∞	2, z
1	zy	∞	∞	3, y #1	3, y #2	
2	zyw	8, w #3	6, w #4		3, y	
3	zywx	4, x #5	5, x #6			
4	zywxu		5, x			
5	zywxuv					

#1.D(w)=min(D(w),D(y)+c(y,w))=min(5, 2+1)=3
#2.D(x)=min(D(x),D(y)+c(y,x))=min(∞, 2+1)=3
#3.D(u)=min(D(u),D(w)+c(w,u))=min(∞, 3+5)=8
#4.D(v)=min(D(v),D(w)+c(w,v))=min(∞, 3+3)=6
#5.D(u)=min(D(u),D(x)+c(x,u))=min(∞, 3+1)=4
#6.D(v)=min(D(v),D(x)+c(x,v))=min(∞, 3+2)=5

Forwarding table

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

3. List changing processes of three tables of node X, Y and Z with the distance vector algorithm, from the time before the X-Y link cost is changed from 4 to 1 to the time three tables are stabilized. (第 1 行 table 是未變動前的穩定狀況，後 3 行 table 一行 3% (x, y, z 各看自己那列 1%),共 9%。數值有變動時，要寫出公式，各 1%共 4% => total 13%)



Ans:

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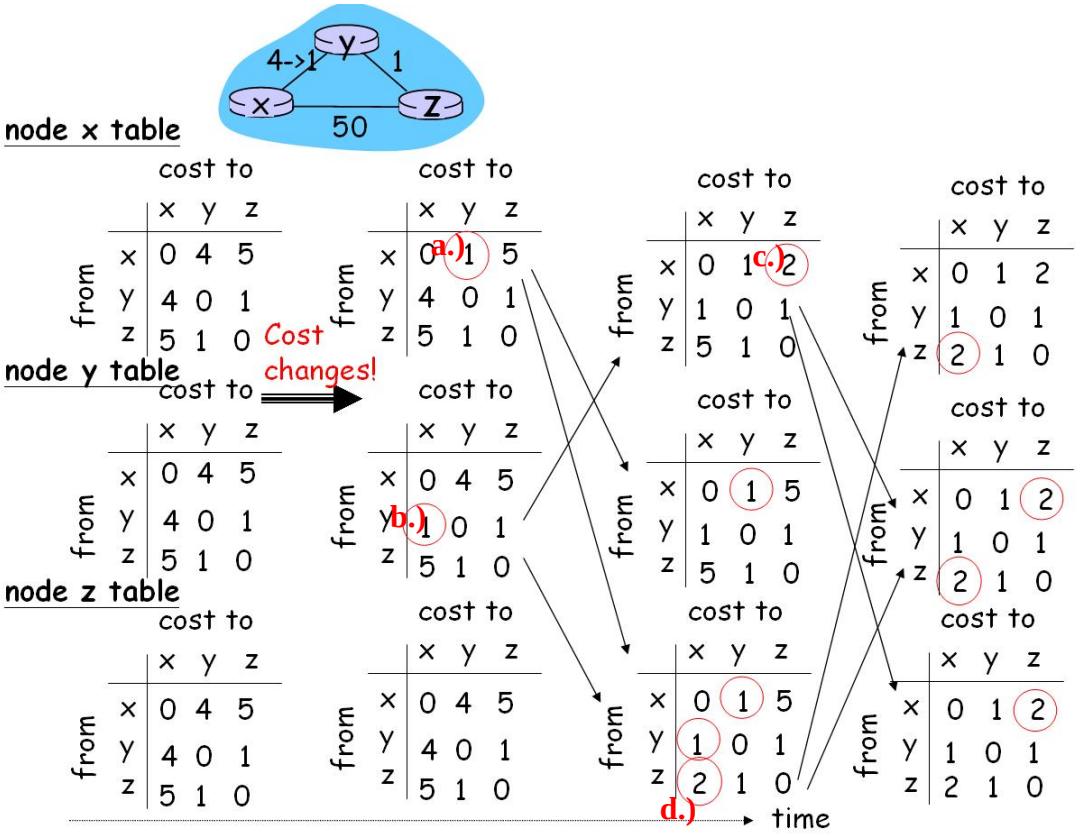


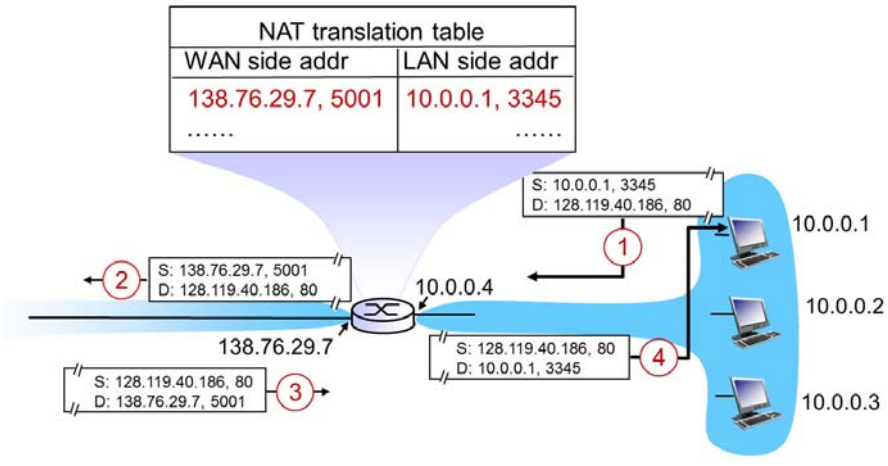
a). $D_x(y) = \min\{C(x,y) + D_y(y), C(x,z) + D_z(y)\} = \min\{1+0, 50+1\} = 1$

b). $D_y(x) = \min\{C(y,x) + D_x(x), C(y,z) + D_z(x)\} = \min\{1+0, 1+50\} = 1$

c). $D_x(z) = \min\{C(x,z) + D_z(z), C(x,y) + D_y(z)\} = \min\{50+0, 1+1\} = 2$

d). $D_z(x) = \min\{C(z,x) + D_x(x), C(z,y) + D_y(z)\} = \min\{50+0, 1+1\} = 2$

4. 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

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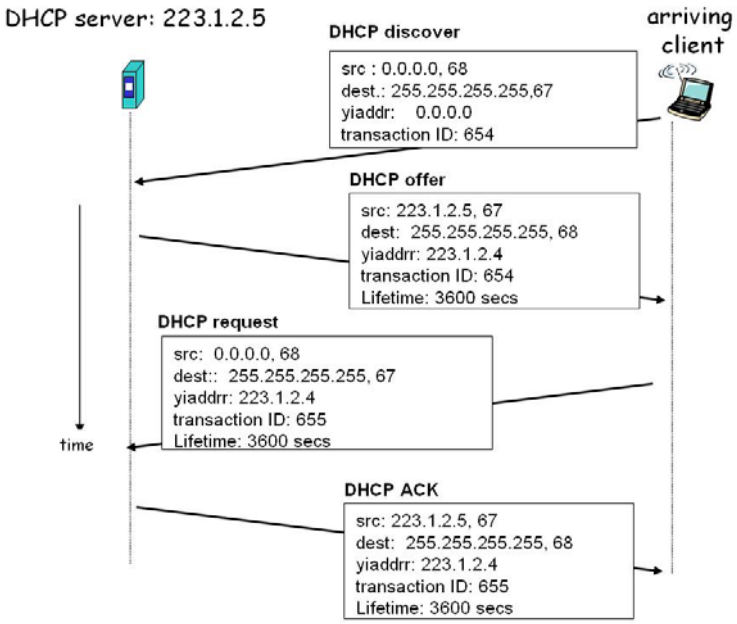
5. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

Ans:

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

(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%)



6. Describe how Ethernet uses CSMA/CD with exponential backoff (要寫出碰撞後如何動作) in detail (12%)

Ans:

- adapter doesn't transmit if it senses that some other adapter is transmitting, that is, carrier sense (2%)
- transmitting adapter aborts when it senses that another adapter is transmitting, that is, collision detection (2%)
- Before attempting a retransmission, adapter waits a random time, that is, random access with Exponential Backoff. (2%)
  - first collision: choose K from {0,1}; delay is K· 512 bit transmission times (2%)
    after second collision: choose K from {0,1,2,3}…(2%)
    after m collisions, choose K from {0,1,2,3,4,…,2^m-1} (2%)

7. (a) List three types of multiple access protocols and describe how they work briefly. (9%) (b) Classify FDMA, Token Passing and CSMA/CD into one of the type to whom they belong. (6%) (15% total)

Ans:

(a)Three broad classes:

a. Channel Partitioning (2%)
   - divide channel into smaller "pieces" (time slots, frequency, code) to node for exclusive use (1%)

b. Random Access (2%)
   - channel not divided, allow collisions (1%)

c. "Taking turns" (2%)
   - Nodes take turns, but nodes with more to send can take longer turns (1%)

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(b) Channel Partitioning: FDMA; (2%)
Random Access: CSMA/CD (2%)
"Taking turns": Token Passing (2%)

8.
(a) List a distance vector routing protocol. (2%) (b) List a Link State routing protocol. (2%) (c) Which protocol in (b) and (c) has the Security feature? (2%) (6% total)

Ans:
(a) RIP.
(b) OSPF
(c) OSPF

9. Compare and contrast link state and distance vector routing algorithms. (10%)

Ans:
- Link state algorithms:
  - Computes the least-cost path between source and destination (2%) using complete, global knowledge about the network. (2%)
- Distance-vector routing:
  - The calculation of the least-cost path is carried out in an iterative, distributed manner. (2%)
  - A node only knows the neighbor to which it should forward a packet in order to reach given destination along the least-cost path (2%), and the cost of that path from itself to the destination (2%)

10. Consider the CRC generator, G=1001, and suppose that D has the value 10101010000. What is the value of R? (要寫出運算過程 6%, 8% total)

Ans:
If we divide 1001 into 10101010000, we get 10111101(過程 6%), with a remainder of R = 101 (2%).

```
          10111101
      ____________
1001 ) 10101010000
       1001
       ----
        1110
        1001
        ----
         1111
         1001
         ----
          1100
          1001
          ----
           1010
           1001
           ----
            1100
            1001
            ----
             101
```