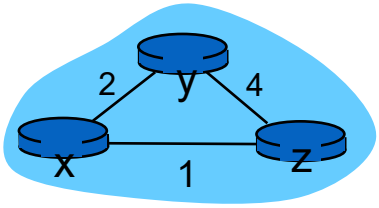
Advanced Computer Networks midterm (110/4)

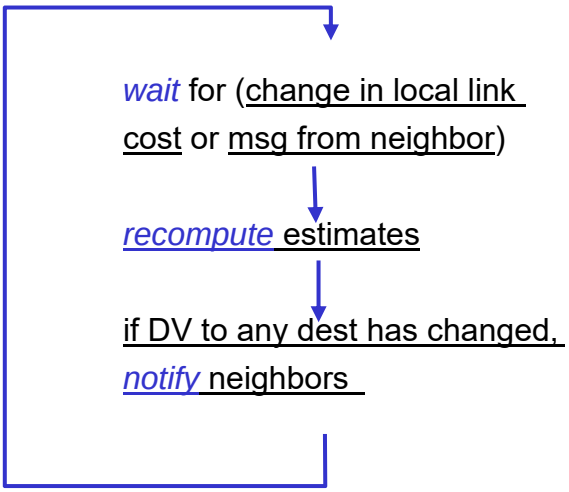
只寫答案而沒有解釋說明，扣一半分數

1. (a) Describe the flow of distance vector routing algorithm. (6%)
   (b) 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%, 16% total)



Ans:

(a)



(2% per item)

(b)

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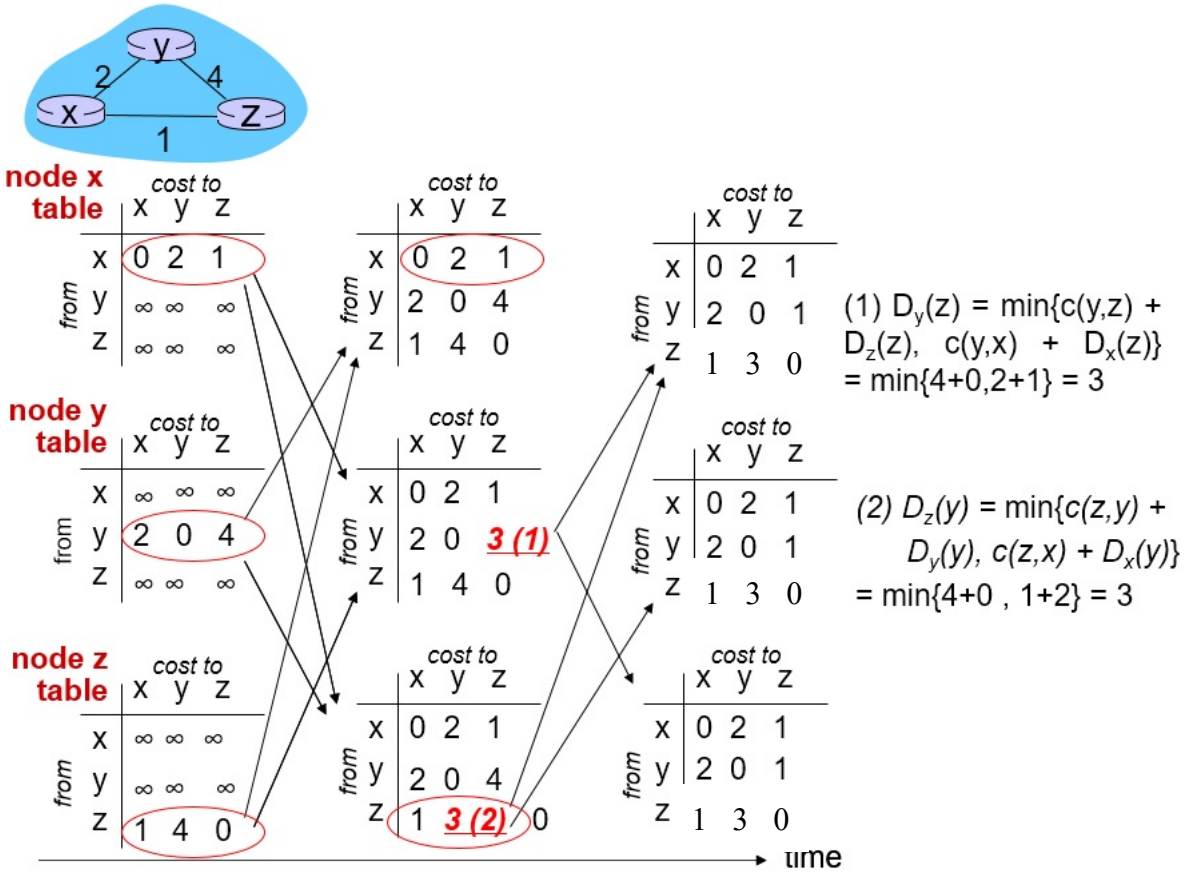


2. What kind of routing algorithm does OSPF use? List its three steps. (8%)

Ans:

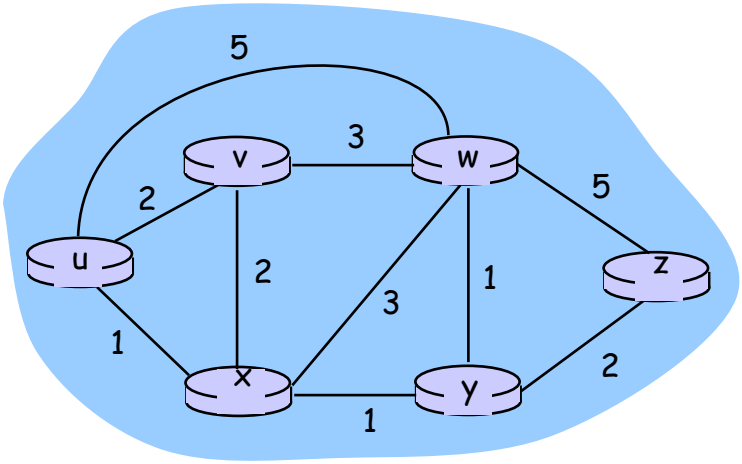
uses Link State algorithm (2%)

LS packet dissemination (2%)

topology map at each node (2%)

route computation using Dijkstra's algorithm (2%)

3. Use Dijkstra's shortest-path algorithm to compute the shortest path from the source node to all other network nodes. (a) Show how the algorithm works by computing a table. (公式錯一個扣 1%，含過程的表格共 10%，扣完為止) (b) Show the forwarding table of the source node. (5%) (note: the source node 選法：學號最後一位除以 5 的餘數：0=>z, 1=>y, 2=>x, 3=>w, 4=>v, 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) (15% total)



Ans: (除 step 之外，一欄 1 分)

以 v 為起點

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Step	N'	D(u), p(u)	D(w), p(w)	D(x), p(x)	D(y), p(y)	D(z), p(z)
0	v	2, v	3, v	2, v	∞	∞
1	vu		3, v	2, v	∞	∞
2	vux		3, v		3, x #1	∞
3	vuxw				3, x	8, w #2
4	vuxwy					5, y #3
5	vuxwyz					

#1.D(y)=min(D(y),D(x)+c(x,y))=min(∞, 2+1)=3 (1%)
#2.D(z)=min(D(z),D(w)+c(w,z))=min(∞, 3+5)=8
#3.D(z)=min(D(z),D(y)+c(y,z))=min(∞, 3+2)=5

Forwarding table （一列 1 分）

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

以 w 為起點

Step	N'	D(u), p(u)	D(v), p(v)	D(x), p(x)	D(y), p(y)	D(z), p(z)
0	w	5, w	3, w	3, w	1, w	5, w
1	wy	5, w	3, w	2, y #1		3, y #2
2	wyx	3, x #3	3, w			3, y
3	wyxu		3, w			3, y
4	wyxuv					3, y
5	wyxuvz					

#1.D(x)=min(D(x),D(y)+c(y,x))=min(3, 1+1)=2
#2.D(z)=min(D(z),D(y)+c(y,z))=min(5, 1+2)=3
#3.D(u)=min(D(u),D(x)+c(x,u))=min(5, 2+1)=3

Forwarding table

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

以 x 為起點

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	2, x	3, x	1, x	∞

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1	xu		2, x	3, x	1, x	∞
2	xuy		2, x	2, y #1		3, y #2
3	xuyv			2, y		3, y
4	xuyvw					3, y
5	xuyvwz					

#1.D(w)=min(D(w),D(y)+c(y,w))=min(3, 1+1)=2
#2.D(z)=min(D(z),D(y)+c(y,z))=min(∞, 1+2)=3

Forwarding table

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

以 y 為起點

Step	N'	D(u), p(u)	D(v), p(v)	D(w), p(w)	D(x), p(x)	D(z), p(z)
0	y	∞	∞	1, y	1, y	2, y
1	yw	6, w #1	4, w #2		1, y	2, y
2	ywx	2, x #3	3, x #4			2, y
3	ywxu		3, x			2, y
4	ywxuz		3, x			
5	ywxuzv					

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

Forwarding table

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

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	

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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

4. 針對 192.1.2.1 這個 IP address，(以十進位表示，要寫完整)

a. 這一個 IP 屬於哪個 Class 的網路？以二進位說明(1%)其所屬的 IP 網路表示為何? (1%) 可用 IP 範圍? (2%) 共有幾個 IP 可用? (1%) mask 的值為何?(1%)

b. 將此 IP 網路分成 9 個 subnet，subnet mask 的值為何?(1%) 請列出第 6 個 subnet 的網路表示法為何?(1%) 可用 IP 範圍?(2%) 共有幾個 IP 可用?(1%) (11% total)

Ans:

a.

192.1.2.1 的二進位表示法為 **110**00000.00000001.00000010.xxxxxxxx，由前三個 bits 110 可判斷為 **Class C** 的 IP (2%)
此 IP 所屬於的 Class C 的網路表示為 **192.1.2.0** (2%)
所有 host ID 部分的 8 個 bit 的 x 不可以全為 0 或 1，因此第一個可用 host ID 為 **11000000.00000001.00000010.00000001** = **192.1.2.1** (2%)
最後一個可用 host ID 為 **11000000.00000001.00000010.11111110** = **192.1.2.254** (2%)，共有 **2^8-2=254** 個可用 host ID (2%)
Mask：**255.255.255.0** (2%)

b.

將此 Class C 網路分成為 9 個 subnet，最少需要 $9<=2^4$，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 C 的 default subnet mask 255.255.255.0 來改，改成 **255.255.255.11110000 = 255.255.255.240** (2%)
subnet 的 ID 要從此 Class C Network ID 11000000.00000001.00000010.xxxxxxxx 來改，需要 ID 的前 4 個 bits 當作 subnet ID。因此第 6 個 subnet ID (從 000 開始，第六個是 0101)為 **11000000.00000001.00000010.01010000→192.1.2.80** (2%)，因此第一個可用 host ID 為 **11000000.00000001.00000010.01010001** = **192.1.2.81** (2%)
最後一個可用 host ID 為 **11000000.00000001.00000010.01011110** = **192.1.2.94** (2%)，共有 **2^4-2=14** 個可用 host ID (2%)

5. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (4%) (c) 使用 DHCP 自動設定 IP 時，會取得哪四項資訊，電腦可以上網？(4%) (10% total)

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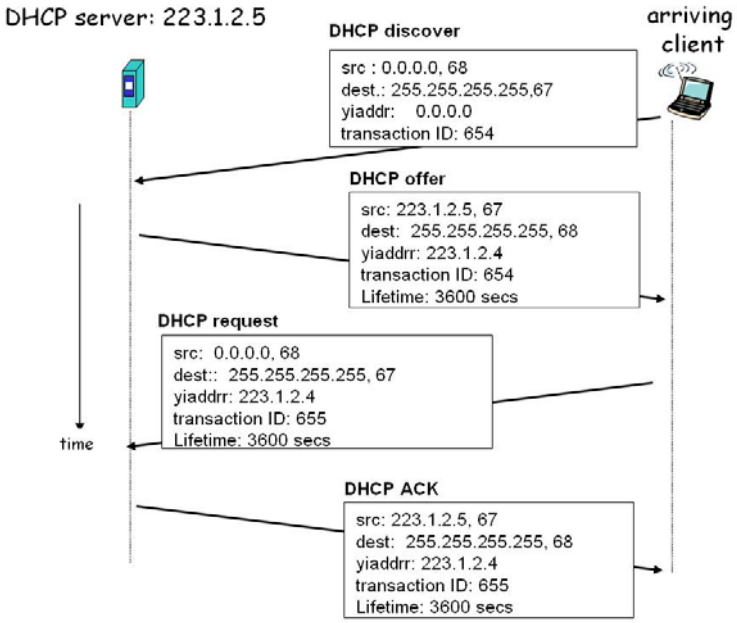
Ans:

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

(b) Flow: (4%)

- host broadcasts "DHCP discover" msg (1%)
- DHCP server responds with "DHCP offer" msg (1%)
- host requests IP address: "DHCP request" msg (1%)
- DHCP server sends address: "DHCP ack" msg (1%)



(c) IP address, subnet mask, default gateway, DNS server (4%)

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%)

(b) Channel Partitioning: FDMA; (2%)
Random Access: CSMA/CD (2%)

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"Taking turns": Token Passing (2%)

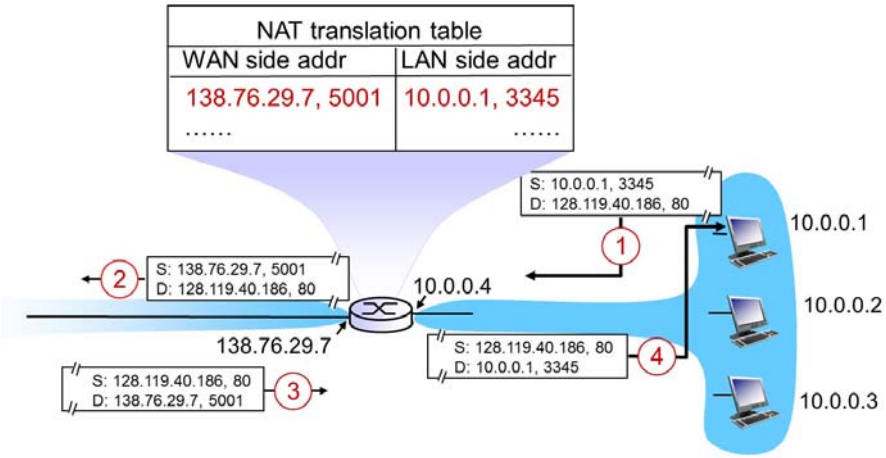
8. Consider the CRC generator, G=1001, and suppose that D has the value 10101010000. What is the value of R? (要寫出運算過程 6%, 8% total)

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
```

9. Explain four NAT operations with this figure (用圖上的數值說明 5%)



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) to (NAT IP address, new port #)=(138.76.29.7, 5001) translation pair (1%)
- *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