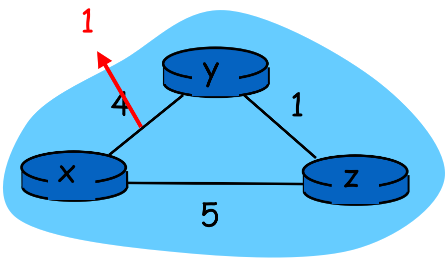
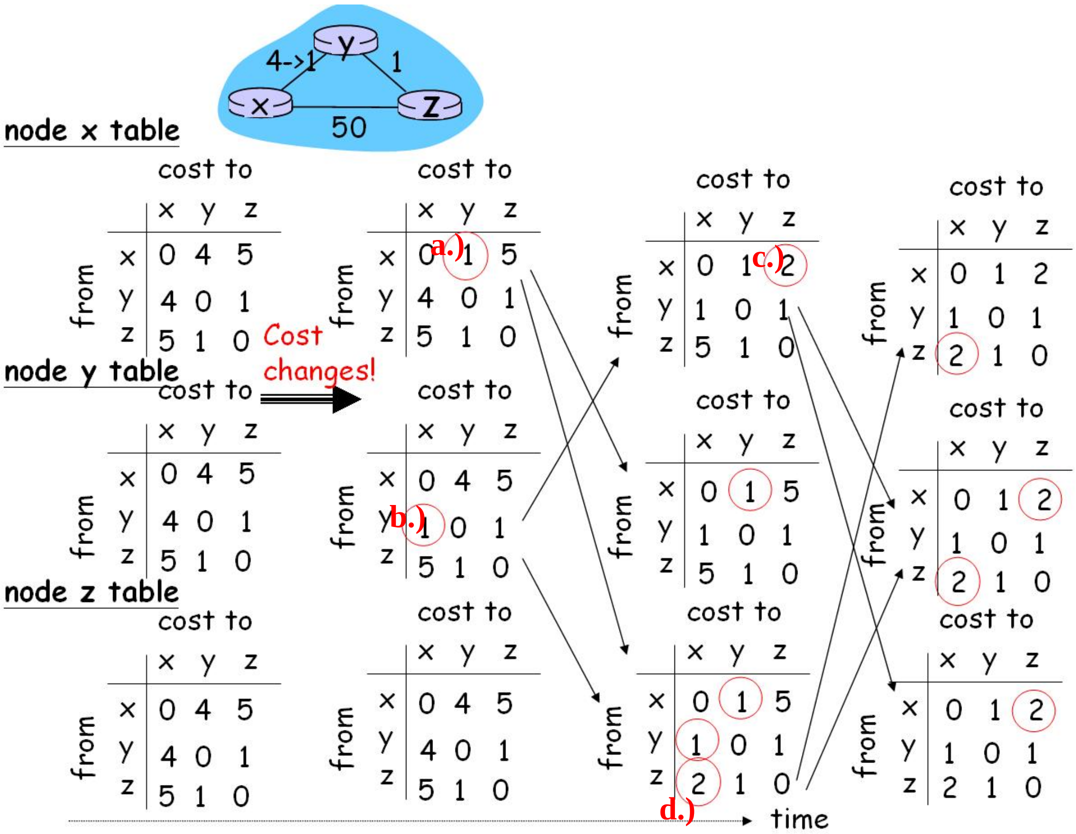
Computer Networks midterm (105/4)

只寫答案而沒有解釋說明，扣一半分數

1. 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:



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

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

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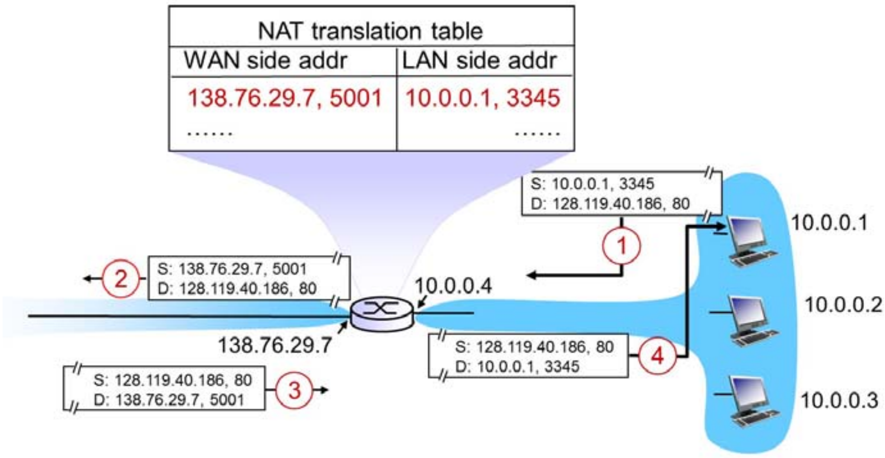
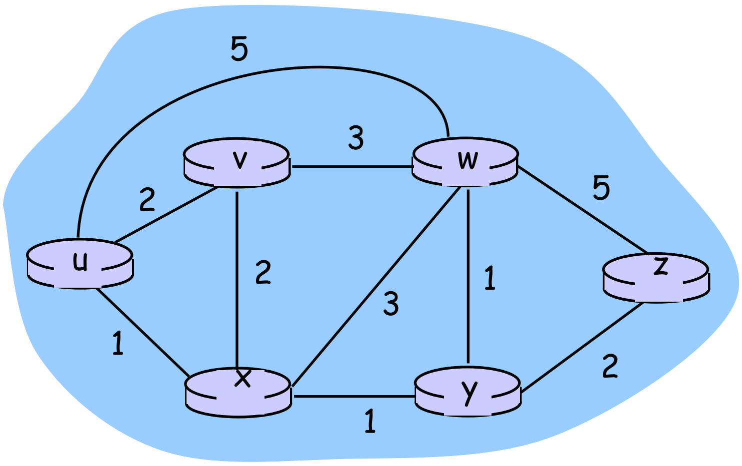


Ans:

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

3. Use Dijkstra's shortest-path algorithm to compute the shortest path from the source node to all other network nodes. (6%) (a) Show how the algorithm works by computing a table. (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))



Ans: (除 step 之外，一欄 1 分)

以 v 為起點

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					

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

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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	∞	∞	<u>1, y</u>	1, y	2, y
1	yw	6, w #1	4, w #2		<u>1, y</u>	2, y
2	ywx	<u>2, x</u> #3	3, x #4			2, y
3	ywxu		3, x			<u>2, y</u>
4	ywxuz		<u>3, x</u>			
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	∞	<u>2, z</u>
1	zy	∞	∞	<u>3, y</u> #1	3, y #2	
2	zyw	8, w #3	6, w #4		<u>3, y</u>	
3	zywx	<u>4, x</u> #5	5, x #6			
4	zywxu		<u>5, x</u>			
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

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#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 IPv4 Class C 網路（以十進位表示，要寫完整過程） (10% total)
   將第一個 Class C 網路分成 15 subnets，subnet mask 的值為何？(2%) 請列出第 15 個 subnet 的網路表示法 (2%) 可用 IP 範圍？(4%) 共有幾個 IP 可用？(2%)

Ans:

將第一個 Class C 網路分成 15 個 subnet，加上全為 0 與全為 1 的兩個不能用的 subnet ID，最少需要 15+2=17 < 2^5,需要 Host ID 的前 5 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 11111111. 11111111. 11111111. 11111000 => 255. 255. 255.248 (2%)

subnet 的 ID 要從第一個 Class C Network ID 11000000. 00000000. 00000001.00000000 來改，需要 Host ID 的前 5 個 bits 當作 subnet ID，不可全為 0 或 1。因此第 15 個 subnet ID 為 11000000. 00000000. 00000001. 01111000 => 192.0.1.120 (2%)
因此第一個可用 Host ID 為 11000000. 00000000. 00000001. 01111001 = 192.0.1.121 (2%)
最後一個可用 Host ID 為 11000000. 00000000. 00000001. 01111110 = 192.0.1.126 (2%)
->共有 2^3-2=6 個可用 Host ID (2%)

5. (a) What are two main functions of ICMP to communicate network-level information by hosts & routers? (6%) (b) How does the traceroute program run with ICMP? (10%, 14% total)

Ans:

(a)

- error reporting: unreachable host, network, port, protocol (2%)
- echo request/reply (used by ping) (2%)

(b)

- Source sends series of UDP segments to dest (2%)
  First has TTL =1
  Second has TTL=2, etc.
- When nth datagram arrives to nth router:
  Router discards datagram (2%)
  And sends to source an ICMP message (type 11, code 0) (2%)
- When ICMP message arrives, source calculates RTT (2%)
- Stopping criterion
  UDP segment eventually arrives at destination host. Destination returns ICMP “host unreachable” packet (type 3, code 3) (2%)

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6. Consider sending a 5580-byte datagram into a link that has an MTU of 980bytes, including 20-byte IP header. Suppose the original datagram is stamped with the identification number 1. List these segments in a table with their data lengths, IDs, flags and offsets. (表格中 data length, offset 每列 0.5 分，ID, flag 全部一分。沒有解釋或不清楚，視狀況扣分，8%)

fragment	data lengths	ID	offset	flag
1				
…..				

Ans:

IP data=980–20=960Bytes. 980 Bytes 內 IP data=960Bytes, 5580 byte-20 byte datagram IP data=5560Bytes,分為 960, 960, 960, 960, 960, 760 共 6 個 fragments, 加上 20bytes IP header 後，data length 為 980, 980, 980, 980, 980, 780.

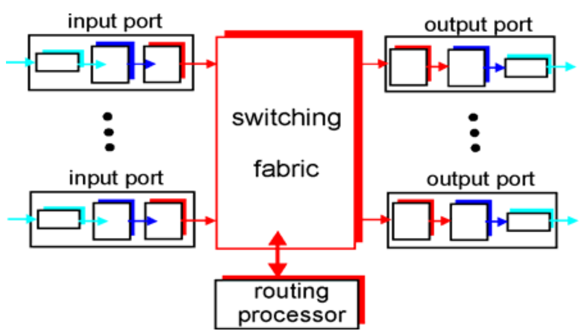
fragment	data lengths	ID	offset	flag
1st	980	1	0	1
2nd	980	1	960/8=120	1
3rd	980	1	120*2=240	1
4th	980	1	120*3=360	1
5th	980	1	120*4=480	1
6th	780	1	120*5=600	0

(data length, offset,每列 0.5 分，flag、ID 全部一分。沒有解釋或不清楚，視狀況扣分，8%)

7. (a) Draw a figure to show four components of a router (8%) (b) Draw three types of switching fabrics with their names. (2% each, 14% total)

Ans:

(a) (2% each, 8% total)

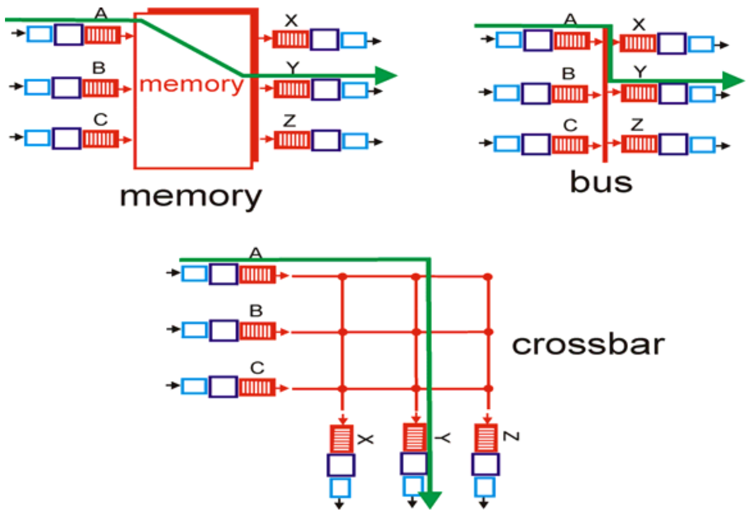


(b) (6%)

switching via memory; (2%)

switching via a bus; (2%)

switching via an interconnection network (2%)



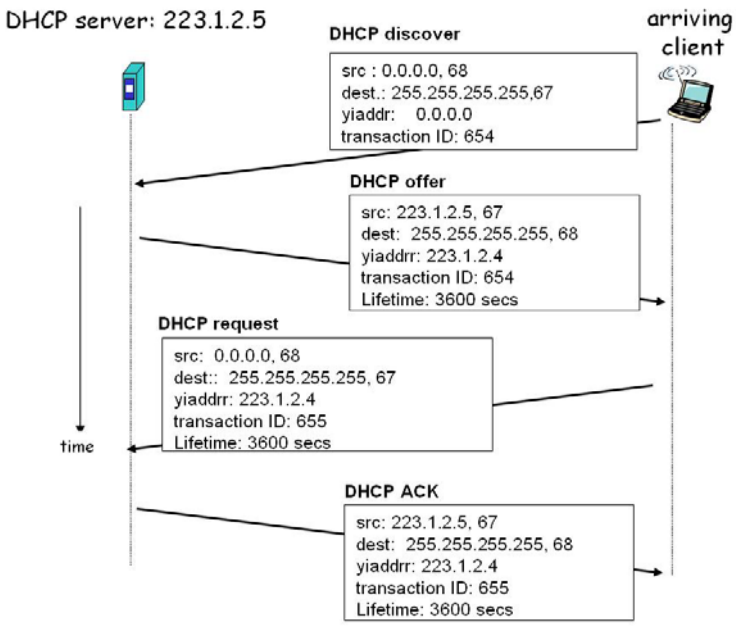
8. (a) What is the goal of DHCP? (2%) (b) List four steps of DHCP (8%) (10% total)

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%)



9. (a) How many addresses do IPv4 have? (2%) How many addresses do IPv6 have? (2%) (b) Draw a figure to explain how to tunnel IPv6 datagrams between two IPv4 routers? (8%,要說明過程, 12% total)

Ans:

(a) (2% each)

2^{32} IPv4 addresses;

2^{128} IPv6 addresses

(b)

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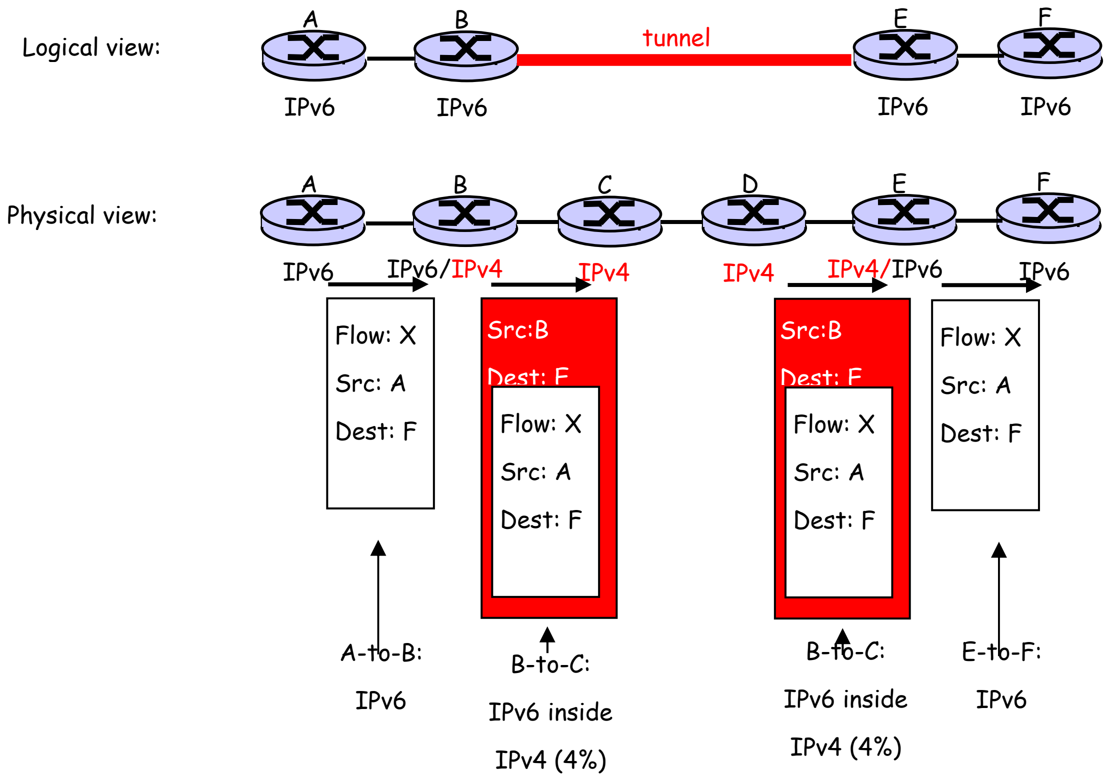

- <u>the source IPv4 router encapsulates the new IPv4 datagram by including the original IPv6 datagram as its payload</u> (2%) and <u>IPv4 addresses of the two IPv4 routers as the new source and destination IP addresses in the new IPv4 header</u>. (2%) (包含在圖上左邊的 4%內)
- <u>the new IPv4 datagram is decapsulated in the destination IPv4 router</u> (2%) and the <u>original IPv6 datagram is further transmitted through IPv6</u>. (2%) (包含在圖上右邊的 4%內)