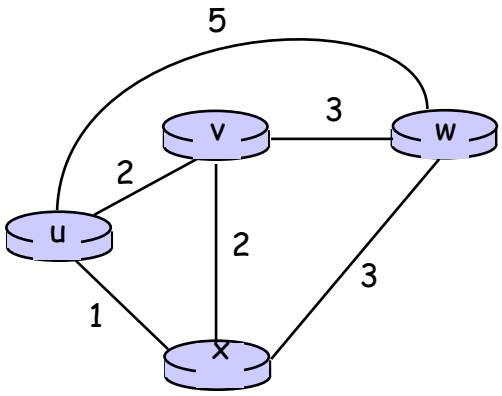
Computer Networks midterm (109/4)

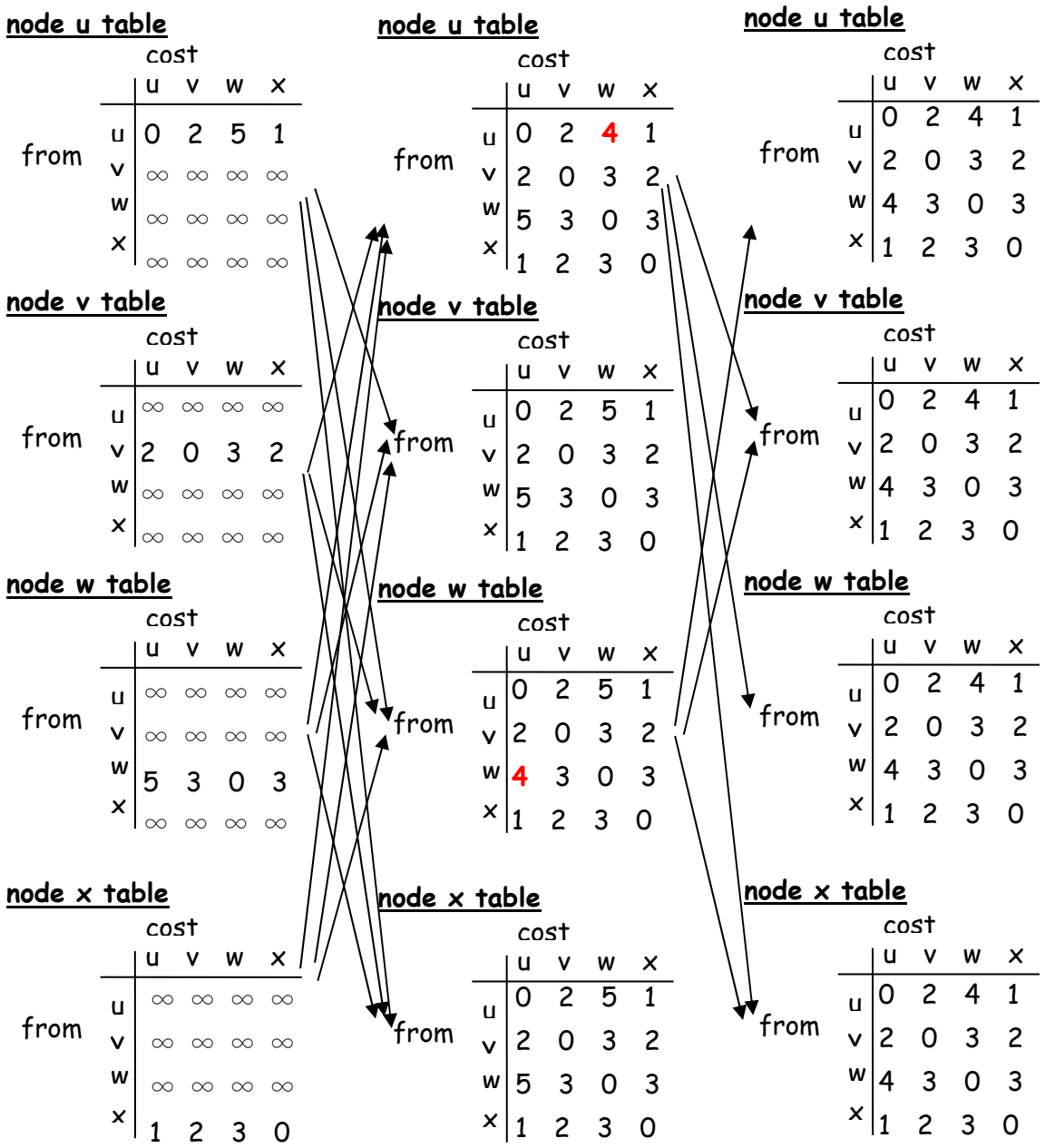
只寫答案而沒有解釋說明，扣一半分數

1. List four tables of node u, v, w and x with the distance vector algorithm, from the time <u>when four nodes are initialized</u> to the time <u>four tables are stabilized</u>. (table 一列 2%，u, v, w and x 各看自己那列 8%。寫出從初始化步驟到第二步驟時每個 node 到其他 node 之 distance vector 計算的三條公式，如 u 為 $D_u(v)$, $D_u(w)$, $D_u(x)$ 6%，畫出傳送 distance vector 的箭頭 2%，16% total)



Ans:

Computer Networks midterm (109/4)



U:

$D_u(v) = \min\{c(u,x) + D_x(v), c(u,w) + D_w(v), c(u,v) + D_v(v)\}$

$= \min\{1+2 , 5+3, 2+0\} = 2$

$D_u(w) = \min\{c(u,x) + D_x(w), c(u,w) + D_w(w), c(u,v) + D_v(w)\}$

$= \min\{1+3 , 5+0, 2+3\} = 4$

$D_u(x) = \min\{c(u,x) + D_x(x), c(u,w) + D_w(x), c(u,v) + D_v(x)\}$

$= \min\{1+0 , 5+3, 2+2\} = 1$

u's Forwarding table

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

Computer Networks midterm (109/4)

V:

$D_v(u) = \min\{c(v,u) + D_u(u), c(v,w) + D_w(u), c(v,x) + D_x(u)\}$

$= \min\{2+0 , 3+5, 2+1\} = 2$

$D_v(w) = \min\{c(v,x) + D_x(w), c(v,w) + D_w(w), c(v,u) + D_u(w)\}$

$= \min\{2+3 , 3+0, 2+5\} = 3$

$D_v(x) = \min\{c(v,x) + D_x(x), c(v,w) + D_w(x), c(v,u) + D_u(x)\}$

$= \min\{2+0 , 3+3, 2+1\} = 2$

v's Forwarding table

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

W:

$D_w(u) = \min\{c(w,u) + D_u(u), c(w,v) + D_v(u), c(w,x) + D_x(u)\}$

$= \min\{5+0 , 3+2, 3+1\} = 4$

$D_w(v) = \min\{c(w,v) + D_v(v), c(w,x) + D_x(v), c(w,u) + D_u(v)\}$

$= \min\{3+0 , 3+2, 5+2\} = 3$

$D_w(x) = \min\{c(w,x) + D_x(x), c(w,v) + D_v(x), c(w,u) + D_u(x)\}$

$= \min\{3+0 , 3+2, 5+1\} = 3$

w's Forwarding table

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

X:

$D_x(u) = \min\{c(x,u) + D_u(u), c(x,v) + D_v(u), c(x,w) + D_w(u)\}$

$= \min\{1+0 , 2+2, 3+5\} = 1$

$D_x(v) = \min\{c(x,v) + D_v(v), c(x,w) + D_w(v), c(x,u) + D_u(v)\}$

$= \min\{2+0 , 3+3, 1+2\} = 2$

$D_x(w) = \min\{c(x,w) + D_w(w), c(x,v) + D_v(w), c(x,u) + D_u(w)\}$

$= \min\{3+0 , 2+3, 1+5\} = 3$

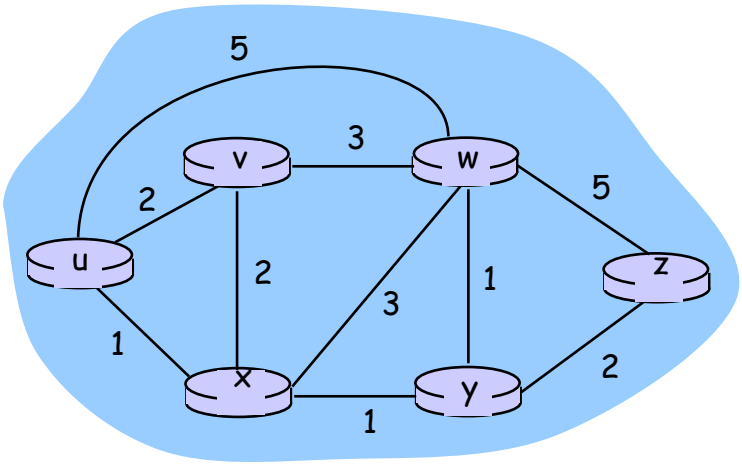
x's Forwarding table

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

2. 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

Computer Networks midterm (109/4)

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

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					

Computer Networks midterm (109/4)

#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

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

Computer Networks midterm (109/4)

#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	
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. 針對 163.107.172.1 這個 IP address，(以十進位表示，要寫完整過程) (19%)
   a. 這一個 IP 屬於那個 Class 的網路？以二進位說明(1%) 其所屬的 IP 網路表示法為何？(2%) 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 6 subnets，subnet mask 的值為何？(2%) 請列出第 6 個 subnet 的網路表示法 (2%) 可用 IP 範圍？(4%) 共有幾個 IP 可用？(1%)
   c.手動設定電腦的網路時，至少要設定哪三個項目的資訊，才可以上網？(3%)

Ans:

a.

163.107.172.1 的二進位表示法為 10100011.01101011.XXXXXXXX.XXXXXXXX，由前兩個 bits 10 可判斷為 Class B 的 IP。(1%)

Computer Networks midterm (109/4)

此 IP 所屬於的 Class B 的網路表示法為 163.107.0.0 (2%)
所有 host ID 部分的 16 個 bit 的 X 不可以全為 0 或 1，
因此第一個可用 Host ID 為 10100011.01101011.00000000. 00000001 = 163.107.0.1 (1%)
最後一個可用 Host ID 為 10100011.01101011.11111111.11111110 = 163.107.255.254 (1%)
->共有 2^{16}-2=65534 個可用 Host ID (1%)
Mask: 255.255.0.0 (1%)

b.

將此 Class B 網路分成 6 個 subnet，最少需要 6 <= 2^3, subnet mask 的值 => 需要 Host ID 的前 3 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 255.255.11100000.00000000=> 255.255.224.0 (2%)

subnet 的 ID 要從此 Class B Network ID 10100011.01101011. XXXXXXXX.XXXXXXXX 來改，需要 Host ID 的前 3 個 bits 當作 subnet ID。因此第 6 個 subnet ID (從 000 開始，第六個是 101)為 10100011.01101011.10100000.00000000 => 163.107.160.0 (2%)
因此第一個可用 Host ID 為 10100011.01101011. 10100000. 00000001 = 163.107.160.1 (2%)
最後一個可用 Host ID 為 10100011.01101011. 10111111. 11111110 = 163.107.191.254 (2%)
->共有 2^{13}-2=8190 個可用 Host ID (1%)

c. IP address, subnet mask, default gateway (3%)

4. Consider sending a 2480-byte datagram into a link that has an MTU of 820bytes, 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 1 分。沒有解釋或不清楚，視狀況扣分，8%)

fragment	data lengths	ID	offset	flag
1				
…..				

Ans:

820 Bytes 內 IP data=820–20=800Bytes. 2480 byte-20 byte (datagram IP data)=2460Bytes,分為 800, 800, 800, 60, 共 4 個 fragments, 加上 20bytes IP header 後，data length 為 820, 820, 820, 80.

fragment	data lengths	ID	offset	flag
1st	820 (1%)	1	0 (1%)	1
2nd	820 (1%)	1	800/8=100 (1%)	1
3rd	820 (1%)	1	100*2=200 (1%)	1
4th	80 (1%)	1	100*3=300 (1%)	0

(data length, offset,每列 1 分。沒有解釋或不清楚，視狀況扣分，8%)

5. (a) Explain two network-layer functions (功能 1%,說明 1%，2% each, 4% total)
(b) What is the longest prefix matching? (2%)
(c) Explain four scheduling mechanisms used in router. (名稱1%,說明1%，2% each, 8% total)
(d) What four items can be returned from the DHCP server? (2% each, 8% total)
(e) What is the major motivation of NAT? (2%)
(f) Which field is used by NAT to support simultaneous connections with a single LAN-side address? (2%)
(g) How many addresses do IPv4 have? (2%) How many addresses do IPv6 have? (2%)
(h) Which network layer protocol does the traceroute program use? (2%) (32% total)

Ans:

Computer Networks midterm (109/4)

(a) forwarding: move packets from router's input to appropriate router output (1%, 1%)
routing: determine route taken by packets from source to destination

(b) when looking for forwarding table entry for given destination address, use longest address prefix that matches destination address. (2%)

(c) FIFO (first in first out) scheduling: send in order of arrival to queue (1%, 1%)
Priority scheduling: send highest priority queued packet
Round Robin (RR) scheduling: cyclically scan class queues, sending one complete packet from each class (if available)
Weighted Fair Queuing (WFQ): each class gets weighted amount of service in each cycle (2%)

(d) allocated IP address on subnet (2%)
address of first-hop router for client
name and IP address of DNS sever
network mask

(e) range of addresses not needed from ISP: just one IP address for all devices (2%)

(f) 16-bit port-number in IP header (2%)

(g) 2^{32} IPv4 addresses; (2%)
2^{128} IPv6 addresses (2%)

(h) ICMP (2%)

6. (a) Which command is used to release your current IP address? (2%)
(b) Which command is used to instruct your host to obtain a network configuration, including a new IP address? (2%)
(c) To see only the DHCP packets in Wireshark, which protocol is entered into the filter field? (2%)
(d) Which transport protocol are DHCP messages sent over? (2%)
(e) Before offering an IP address to a client, why should the DHCP server issues an ARP request for the offered IP? (2%) (10% total)

Ans:

(a) ipconfig /release (2%)

(b) ipconfig /renew (2%)

(c) bootp (2%)

(d) UDP (2%)

(e) make sure the IP address is not already in use by another workstation. (2%)