# Advanced Computer Networks midterm (111/4)

只寫答案而沒有解釋說明，扣一半分數

1. (a) What is the longest prefix matching? (2%)
   (h) Explain four scheduling mechanisms used in router. (名稱1%,說明1%，2% each, 8% total)
   (i) What four items can be returned from the DHCP server? (2% each, 8% total)
   (j) What is the major motivation of NAT? (2%)
   (k) (a) Which command is used to release your current IP address? (2%)
   (l) Which command is used to instruct your host to obtain a network configuration, including a new IP address? (2%)
   (m) What is the DHCP goal? (2%) (26% total)

Ans:

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

(b) 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%)

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

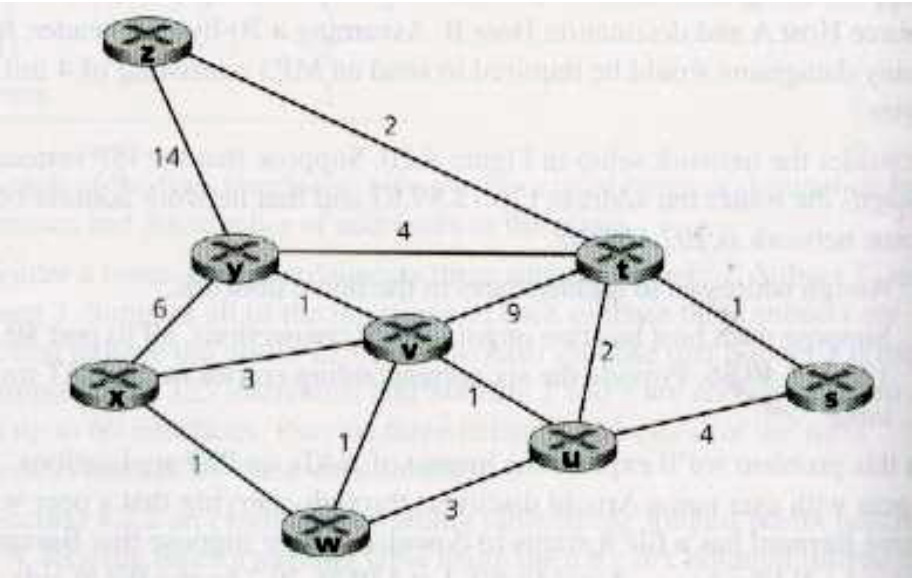
(d) range of addresses not needed from ISP: just one IP address for all devices (2%)

(e) ipconfig /release (2%)

(f) ipconfig /renew (2%)

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

2. 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. (一格 0.5%，共 4%) (20% total)



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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: (0.5% each, 4% total)

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

3. 針對 163.107.172.1 這個 IP address，(以十進位表示，要寫完整過程) (9%)
   a. 將此 IP 網路分成 11 subnets，subnet mask 的值為何？(2%) 請列出第 5 個 subnet 的網路表示法 (2%) 可用 IP 範圍？(4%) 共有幾個 IP 可用？(1%)

Ans:

a.

將此 Class B 網路分成 11 個 subnet，最少需要 11<= $2^4$, 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。因此第 5 個 subnet ID (從 0000 開始，第 5 個是 0100) 為 10100011.01101011.01000000.00000000 => 163.107.64.0 (2%)

因此第一個可用 Host ID 為 10100011.01101011. 01000000. 00000001 = 163.107.64.1 (2%)

最後一個可用 Host ID 為 10100011.01101011. 01001111. 11111110 = 163.107.79.254 (2%)

->共有 $2^{12}$-2=4094 個可用 Host ID (1%)

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

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(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%)

5. (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:

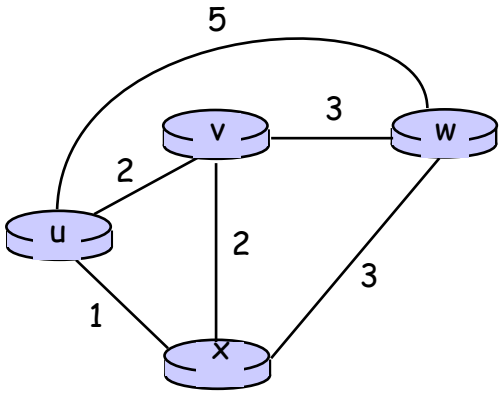
a. Channel Partitioning (2%)
   - divide channel into smaller "pieces" (time slots, frequency, code) to node for exclusive use (1%)

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%)
"Taking turns": Token Passing (2%)

6. 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 1%，u, v, w and x 各看自己那列 4%。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 $D_u(v)$, $D_u(w)$, $D_u(x)$ 0.5%，共 6%，畫出傳送 distance vector 的箭頭 2%，寫出各節點的 Forwarding table 一格 0.5%, 共 6%, 18% total)




Ans:

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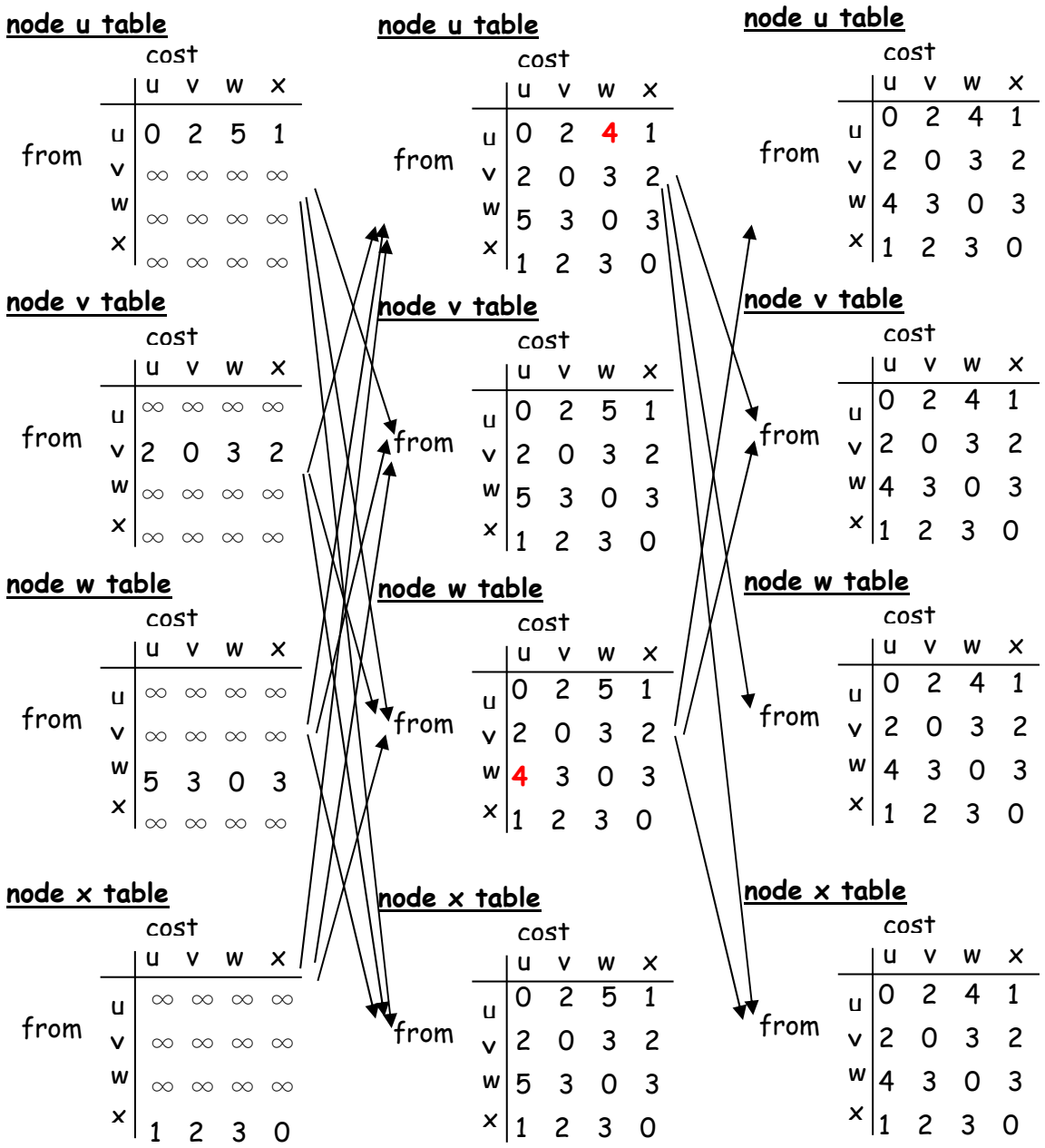


U:

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

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

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

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

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

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

u's Forwarding table

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

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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 |