44100113: COMPUTER NETWORKS
HOMEWORK 3: CHAPTER 4 Network Layer
SOLUTIONS

Notes: All exercises are in accordance with the 6th edition (International Edition). We change data values in some problems, which are highlighted.

Exercise 1 (R3)
Forwarding is about moving a packet from a router's input port to the appropriate output port. Routing is about determining the end-to-routes between sources and destinations.

Exercise 2 (R21)
Link state algorithms: Computes the least-cost path between source and destination using complete, global knowledge about the network. Distance-vector routing: The calculation of the least-cost path is carried out in an iterative, distributed manner. A node only knows the neighbor to which it should forward a packet in order to reach given destination along the least-cost path, and the cost of that path from itself to the destination.

Exercise 3 (P5)
(a). No VC number can be assigned to the new VC; thus the new VC cannot be established in the network.

(b). Each link has two available VC numbers. There are four links. So the number of combinations is $2^4 = 16$. One example combination is (10,00,00,10).

Exercise 4 (P10)
(a).

Prefix Match	Link Interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3

(b). Prefix match for first address is 5th entry: link interface 3
Prefix match for second address is 3nd entry: link interface 2
Prefix match for third address is 4th entry: link interface 3

Exercise 5 (P11)

Destination Address Range	Link Interface
00000000 through 00111111	0
01000000 through 01011111	1
01100000 through 01111111	2

10000000 through 10111111	2
11000000 through 11111111	3

number of addresses for interface $0 = 2^6 = 64$
number of addresses for interface $1 = 2^5 = 32$
number of addresses for interface $2 = 2^6 + 2^5 = 64 + 32 = 96$
number of addresses for interface $3 = 2^6 = 64$

Exercise 6 (P12)

Destination Address Range	Link Interface
11000000 through 11011111	0
10000000 through 10111111	1
11100000 through 11111111	2
00000000 through 01111111	3

number of addresses for interface $0 = 2^5 = 32$
number of addresses for interface $1 = 2^6 = 64$
number of addresses for interface $2 = 2^5 = 32$
number of addresses for interface $3 = 2^7 = 128$

Exercise 7 (P17)

From 214.97.254/23, possible assignments are
(a). Subnet A: 214.97.255/24 (256 addresses)
Subnet B: 214.97.254.0/25 - 214.97.254.0/29 (128-8 = 120 addresses)
Subnet C: 214.97.254.128/25 (128 addresses)
Subnet D: 214.97.254.0/31 (2 addresses)
Subnet E: 214.97.254.2/31 (2 addresses)
Subnet F: 214.97.254.4/30 (4 addresses)
(b). To simplify the solution, assume that no datagrams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upperleft interior subnets, respectively.

Router 1

Longest Prefix Match	Outgoing Interface
11010110 01100001 11111111	Subnet A
11010110 01100001 11111110 0000000	Subnet D
11010110 01100001 11111110 000001	Subnet F

Router 2

Longest Prefix Match	Outgoing Interface
11010110 01100001 11111111 0000000	Subnet D
11010110 01100001 11111110 0	Subnet B
11010110 01100001 11111110 0000001	Subnet E

Router 3

Longest Prefix Match	Outgoing Interface

11010110 01100001 11111111 000001	Subnet F
11010110 01100001 11111110 0000001	Subnet E
11010110 01100001 11111110 1	Subnet C

Exercise 8 (P19)

The maximum size of data field in each fragment = 680 (because there are 20 bytes IP header). Thus the number of required fragments $\left\lceil \frac{2400-20}{680} \right\rceil = 4$

Each fragment will have Identification number 422. Each fragment except the last one will be of size 700 bytes (including IP header). The last datagram will be of size 360 bytes (including IP header). The offsets of the 4 fragments will be 0, 85, 170, 255. Each of the first 3 fragments will have flag=1; the last fragment will have flag=0.

Exercise 9 (P28)

		Cost to				
		u	v	x	y	z
From	v	∞	∞	∞	∞	∞
	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

		Cost to				
		u	v	x	y	z
From	v	1	0	3	∞	6
	x	∞	3	0	3	2
	z	7	5	2	5	0

		Cost to				
		u	v	x	y	z
From	v	1	0	3	3	5
	x	4	3	0	3	2
	z	6	5	2	5	0

		Cost to				
		u	v	x	Y	z
From	v	1	0	3	3	5
	x	4	3	0	3	2
	z	6	5	2	5	0