Homework 3 Solutions

Chapter 4, problem 13

1. Any IP address in range 101.101.101.64 to 101.101.101.127

2. Since the original subnet block contains $2^{32-17} = 2^{15}$ IP addresses, thus each split subnet should contain 2^{13} IP addresses, which means each subnet should have prefix of x.x.x.x/19. The four equal size subnets are: 101.101.128.0/19, 101.101.160.0/19, 101.101.192.0/19, and 101.101.224.0/19

Chapter 4, Problem 21

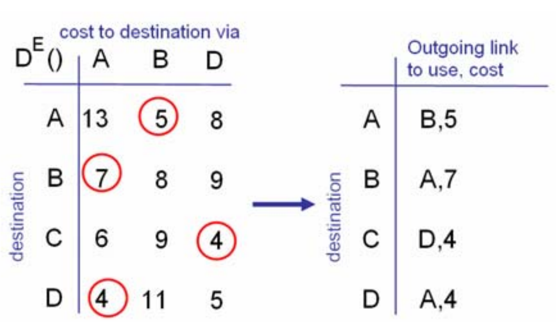
Step	*N'*	*D(s),p(s)*	*D(t),p(t)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
0	x	∞	∞	∞	3,x	1,x	6,x	∞
1	xw	∞	∞	4,w	2,w		6,x	∞
2	xwv	∞	11,v	3,v			3,v	∞
3	xwvu	7,u	5,u				3,v	∞
4	xwvuy	7,u	5,u					17,y
5	xwvuyt	6,t						7,t
6	xwvuyts							7,t
7	xwvuytsz							7,t

Note that in step 3, you can have "xwvy" since at this step the cost to "y" or to "u" has the same cost, so you can select either one of them.

Problem 3

See the example in lecture notes Chapter4-part2.ppt, Page 22.

a).



Distance vector table routing table

b). Router E directly connects to A, B, and D.

c). Cost from E to C via A is 6.

Problem 4

a). See the example shown in class notes Chapter4-part2.ppt, Page 26.

A()	B	C
B	1	12
C	6	7
D	4	9

B()	A	C	D
A	1	12	∞
C	8	5	5
D	∞	7	3

C()	A	B	D
A	7	6	∞
B	8	5	5
D	∞	8	2

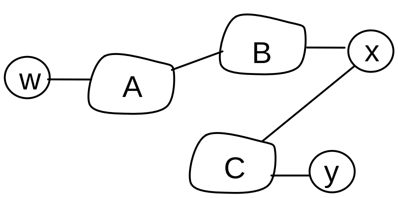
D()	B	C
A	4	9
B	3	7
C	8	2

b). A changes its route to C (via B), the original value is 7; route to D via B, original value is ∞
B does not change route since its diagonal values are still smallest;
C changes its route to A via B, the original value is 7;
D changes its route to A (via B), the original value is ∞.

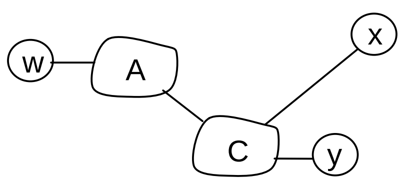
c). As explained in b), node A sends update to its neighboring node B and C. Node C sends update to A, B, and D; Node D sends its update to its neighboring node B and C.

Chapter 4, Problem 29

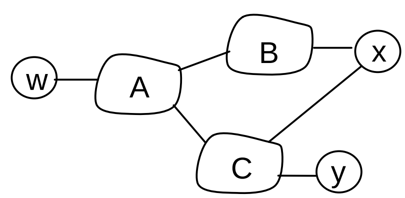
The topology view at X can be:



If C does not advertise to x of w

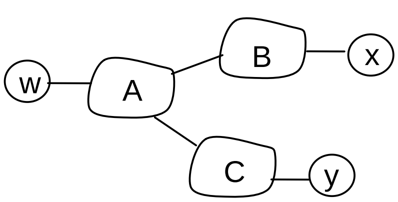


If B does not advertise to x of w

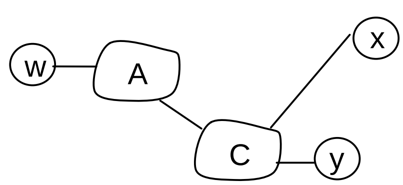


If both B and C advertise w to x

The topology view at W can be:



If A advertises route B to x



If A advertises route C to x

Network Y does not know the ISP B because the path route of traffic from W to Y goes through A, C; the path route of traffic from X to Y goes through C only. There is no traffic going through B then C to Y.

Problem 6:

a).

Ethernet MAC protocol is CSMA/CD – Carrier Sense Multiple Access with Collision Detection
802.11 wireless LAN is CSMA/CA – Carrier Sense Multiple Access with Collision Avoidance

b). It is because:

1> Ethernet protocol provides "listen before transmit", which makes a node to delay transmission if the channel is using by others. This can avoid destroying the current transmission.

2> Ethernet protocol can stop transmission once it detects collision, while slotted ALOHA does not stop upon collision. Thus Ethernet can quickly recover from a collision.

3> Ethernet uses an "exponentially back-off" mechanism in determining the time to retransmit, which can adjust the transmission speed according to the congestion situation. Slotted ALOHA always back-off with the same probability no matter how congested the network is.

c). Hub connects all LAN segments into one large Ethernet collision domain; Switch isolates LAN segments. In addition, Hub does not store packet while Switch does.

Problem 7:

a).

1 0 1 0 1 | 1
0 1 0 0 0 | 1
0 1 1 1 0 | 1
1 0 0 0 1 | 0
0 0 0 0 1 | 1

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0 0 0 1 1 | 0

b). second row, third column bit is wrong.

1 0 **1** 0 1 | 1
0 1 1 0 0 | 1
0 1 **1** 1 0 | 1
1 0 **0** 0 1 | 0
0 0 **0** 0 1 | 1

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0 0 **0** 1 1 | 0

We can find the error bit because the number of 1 bit in that row/column is not even.

Chapter 5, Problem 4:

Use the same procedure as show in Fig. 5.8 in textbook page 430, you can calculate the R equals to 101. Remember the minus operation in that example is XOR operation.

Chapter 5, Problem 5:

a). This is a standard single-variable optimization problem. For example, if you are required to find the min or max value of function f(x) where the variable is x, then the most straightforward way is to find x* such that x* makes df(x)/dx = 0.

For this question, the variable is p, the optimization function is $f(p)=Np(1-p)^{N-1}$. Therefore,

$$\frac{df(p)}{dp} = N(1-p)^{N-1} - N(N-1)p(1-p)^{N-2} = 0 \;\rightarrow\; p^* = 1/N$$

b). put p* into the slotted ALOHA efficiency formula f(p*), we have

$f(p^*) = (1-\frac{1}{N})^{N-1} = \frac{(1-1/N)^N}{1-1/N}$ since $\lim_{N\to\infty}(1-1/N)^N = 1/e$, so the slotted ALOHA efficiency as N goes to infinity is 1/e.

Problem 10:

802.11b: 2.4-2.485GHz, 11Mbps
802.11g: 2.4-2.485GHz, 54Mbps
802.11a: 5.1-5.8GHz, 54Mbps
Wireless LAN MAC protocol does not use "collision detection" because:
1). Difficult to detect collision signal due to weak received signal (fading).
2). Cannot sense all collisions in some case due to hidden terminal

Problem 11:

DIFS --- Distributed Inter-frame Space. After a channel is sensed idle, wait the short time interval (DIFS) to make sure the channel is really idle before transmitting a frame.

SIFS --- Short Inter-frame Spacing. When a destination station receives a frame that passes the CRC check, it waits the short time interval (SIFS) and then sends back an ack frame. SIFS is used to for the similar reason as the DIFS --- make sure the channel is really idle before transmitting.

RTS --- Request to Send. Use it to reserve access to channel.

CTS --- Clear to Send. When the receiver receives the RTS, it broadcasts a CTS to give the sender explicit permission to send frame and also instructs others not to send for the reserved duration requested in the RTS.

Wireless MAC protocol uses RTS/CTS because wireless protocol cannot detect collision. Thus if each node sends out a large frame and collides with others, the frame will keep going and waste a lot of bandwidth resource. RTS and CTS are very shot frame so the collision cost is relatively smaller.

Chapter 6, Problem 1:

Output corresponding to bit d_1 = [-1,1,-1,1,-1,1,-1,1]
Output corresponding to bit d_0 = [1,-1,1,-1,1,-1,1,-1]