Homework 6

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1.选做5道题

P1. Suppose the information content of a packet is the bit pattern 1010 0111 0101 1001 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme?
Your answer should be such that a minimum-length checksum field is used.

Answer:
1 1 1 0 1
0 1 1 0 0
1 0 0 1 0
1 1 0 1 1
1 1 0 0 0

P2. Show (give an example other than the one in Figure 6.5) that two-dimensional parity checks can correct and detect a single bit error. Show (give an example of) a double-bit error that can be detected but not corrected.

Answer:
Suppose we begin with the initial two-dimensional parity matrix:
0 0 0 0
1 1 1 1
0 1 0 1
1 0 1 0
With a bit error in row 2, column 3, the parity of row 2 and column 3 is now wrong in the matrix below:
0 0 0 0
1 1 0 1
0 1 0 1
1 0 1 0
Now suppose there is a bit error in row 2, column 2 and column 3. The parity of row 2 is now correct! The parity of columns 2 and 3 is wrong, but we can't detect in which rows the error occurred!
0 0 0 0
1 0 0 1
0 1 0 1
1 0 1 0
The above example shows that a double bit error can be detected (if not corrected).

P5. Consider the generator, G 5 1001, and suppose that D has the value 11000111010. What is the value of R?

Answer:
If we divide 10011 into 1010101010 0000, we get 1011011100, with a remainder of R=0100. Note that, G=10011 is CRC-4-ITU standard.

P6. Rework the previous problem, but suppose that D has the value
a. 01101010101.
b. 11111010101.
c. 10001100001.

Answer:
a) we get 1000110000, with a remainder of R=0000.
b) we get 0101010101, with a remainder of R=1111.
c) we get 1011010111, with a remainder of R=1001.

P 10. Consider two nodes, A and B, that use the slotted ALOHA protocol to contend for a channel. Suppose node A has more data to transmit than node B, and node A's retransmission probability pA is greater than node B's retransmission probability, pB.
a. Provide a formula for node A's average throughput. What is the total efficiency of the protocol with these two nodes?
b. If pA = 2pB, is node A's average throughput twice as large as that of node B? Why or why not? If not, how can you choose pA and pB to make that happen?

c. In general, suppose there are N nodes, among which node A has retransmission probability 2p and all other nodes have retransmission probability p. Provide expressions to compute the average throughputs of node A and of any other node.

Answer:

a) A's average throughput is given by $p_A(1-p_B)$.

Total efficiency is $p_A(1-p_B) + p_B(1-p_A)$.

b) A's throughput is $p_A(1-p_B)=2p_B(1-p_B)= 2p_B- 2(p_B)^2$.

B's throughput is $p_B(1-p_A)=p_B(1-2p_B)= p_B- 2(p_B)^2$.

Clearly, A's throughput is not twice as large as B's.

In order to make $p_A(1-p_B)= 2\, p_B(1-p_A)$, we need that $p_A= 2 – (p_A / p_B)$.

c) A's throughput is $2p(1-p)^{N-1}$, and any other node has throughput $p(1-p)^{N-2}(1-2p)$.