

**Computer Networks**  
Spring 2002  
**Assignment 9**

**Problem 28** (4 points):

Suppose the information content of a packet is the bit pattern 1001110010011001.

- (a) Show the outcome when applying the even parity scheme to this pattern. (1 point)
- (b) What would be the outcome when using the 2-dimensional parity scheme on this bit pattern when organized in a  $4 \times 4$  matrix? (1 point)
- (c) Give a set of rules that would allow to detect and correct a single bit error in *any* place of a bit matrix resulting from the 2-dimensional parity scheme. (1 point)
- (d) Show by counterexample that a double bit error cannot always be corrected. (1 point)

**Problem 29** (2 points):

What is the CRC code resulting from the bit pattern  $D = 11111$  when using the generator  $G = 1010$ ? Show all work. If you run into problems, you can find a much better explanation of CRC codes than in the book in the html file associated with chapter 5a in the syllabus list on the course web page.

**Problem 30** (4 points):

Consider the CDMA scheme. Suppose we have a sender 1 that uses the code

$$c = (1, 1, -1, 1, -1, -1, -1, 1).$$

- (a) What would be the channel output if sender 1 wants to transmit the bit pattern 101? (1 point)
- (b) Find a code  $c'$  for another sender 2 that is orthogonal to  $c$  (i.e. that does not cause interference problems on the receiver side). Recall that for this the dot product of  $c$  and  $c'$  has to be 0. (1 point)
- (c) Compute the channel output for the case that sender 1 wants to transmit the bits 0 and 1 and at the same time sender 2 wants to transmit the bits 1 and 0. (2 points)