EE/Ma 127a Error-Correcting Codes R. J. McEliece
draft of October 18, 2000 162 Moore

Homework Assignment 3 (**FINAL VERSION**)
Due (in class) 9am October 20, 2000

Reading: Handouts "TI ECC chip data sheet," and "MacWilliams Identities." Wicker, pp. 74–76.

Problems to Hand In:

Problem 1. In the handout data sheet describing the TI ECC chip, on page 7-467, we read "... two of the check bits, bits `CB0` and `CB1`, are inverted to ensure that the gross-error condition of all lows and all highs is detected." Explain this remark.

Problem 2. In class on Oct. 13, I derived lower bounds on the redundancy r for a single-error correcting ($d = 3$) and a single error correcting, double error detecting ($d = 4$) linear code, in terms of the dimension k. In this problem you are supposed to derived similar (but more complicated) for the cases $d = 5$ and $d = 6$.

(a) Derive such a lower bound for $d = 5$ codes.

(b) Derive such a lower bound for $d = 6$ codes.

(c) Apply your bounds to estimate the least redundancy needed for a $k = 32$ code if $d = 5$ or $d = 6$.

Problem 3. Find the weight enumerator for the so-called "simplex" code, i.e., the $(2^m - 1, m)$ code which is dual to the $(2^m - 1, 2^m - 1 - m)$ Hamming code. [Hint: Use the fact that the columns for the $m \times (2^m - 1)$ generator matrix for the code are all the distinct nonzero vectors of length m.]

Problem 4. Using the result of Problem 3, and the MacWilliams identies, find a formula for the number of words of weight 3 and 4 in the general $(2^m - 1, 2^m - 1 - m)$ Hamming code.

Problem 5. It is now noon on Wednesday.

(a) What time of day will it be a million hours from now? What day of the week?

(b) Same question, a million hours *ago*?