Coding Theory

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Recommended Reading:
A first course in coding theory. Raymond Hill, 1986, Oxford Applied Mathematics and Computing Science Series. (Highly recommended.)

Combinatorics: Topics, Techniques, Algorithms. Peter J. Cameron, CUP, 1994. (Chapter 17 gives a concise account of coding theory.)
Coding and Information Theory. Richard W. Hamming, Prentice-Hall, 1980. (Chapters 2, 3 and 11 are relevant to this course.)
Coding Theory: A First Course. San Ling and Chaoping Xing, CUP, 2004.
The Theory of Error-Correcting Codes. F. J. MacWilliams and N. J. A. Sloane, North-Holland, 1977. (For reference.)
Hammings original paper, *Error Detecting and Error Correcting Codes*, Bell Systems Technical Journal **2** (1950) 147-160, is beautifully written and, for a mathematics paper, very easy to read. It is available from `www.lee.eng.uerj.br/~gil/redesII/hamming.pdf`.

Prereq: (MATH 20580) or (MATH 20610) or (MATH 20810) or (ACMS 20620).

Course Content: Error-correcting codes are used to correct errors when messages are transmitted through a noisy communication channel. The messages can be binary data (a stream of 0s and 1s). The channels can be a telephone line, a high frequency radio link, a satellite communication link. The noise may be human error, lightning, thermal noise imperfection in the equipment, and may result in errors so that the data received is different from sent data. The object of error-correcting code is to encode the data, by adding a certain amount of redundancy to the message, so that the original message can be recovered if not too many errors have occurred.

Error-correcting codes are now widely used in applications such as returning pictures from deep space, design of registration numbers and storage of data on magnetic tape. It is also of great mathematical interest, relying largely on ideas from pure mathematics and in particular illustrating the power and beauty of algebra.

This course provides an elementary treatment of the theory of error-correcting codes. Topics include an introduction to finite fields and vectors over finite fields, linear codes, encoding

and decoding with a linear code, Hamming codes, perfect codes, codes based on latin squares, cyclic codes, MDS codes, weight enumerators.

Homework and Projects: On a regular basis there will be homework assignments. There will also be one (or more small) projects to be done by each student. To do well you must keep up with the homework. You are allowed and encouraged to discuss the problems, however, the work you hand in should be formulated by yourself only and should not be merely copied.

Examination Schedule: There will be 2 midterms, project work and a final exam.
Test 1: Friday, Oct. 11, 2013 or Wednesday, Oct. 9, 2013 (the week before fall break).
Test 2: Friday, November 15, 2013 (roughly).
Final: Thursday, December 19, 2013, 8:00-10:00am.

Grading Policy: Each of the 2 midterms and the project work will be worth 100 points. The final exam will be worth 150 points. The homework will account for 50 points total. Letter grades will be based on total points out of the 500.