

# INTRODUCTION TO CODING THEORY

## MATH 567

Winter 2007, MWF 10am-11pm, 213 DENNISON

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### ABOUT THE COURSE

Coding Theory is an area of mathematics that has important applications to digital communication (like satellite communication, CD players). The goal of coding theory is to encode a digital message such that most of the lost information can be retrieved after the message has been sent over a noisy channel.

Coding Theory was developed after Claude Shannon proved some important results about digital communication. Claude Shannon, who recently passed away, was born in Michigan and graduated at the University of Michigan. A statue in his honor can be found at the west entrance of the EECS building on North Campus. Shannon's theory will be one of the first things we will discuss in the course. His results were mostly theoretical, and it leaves open the question to come up with practical codes.

Some of the topics that we will discuss are: entropy (a measure for information), Huffman codes (for data compression), channels and channel capacity, Shannon's theorem, error correcting block codes, finite fields and constructions of various codes (Hamming codes, Golay codes, Reed-Muller codes, cyclic codes etc.), bounds for codes, weight distributions of codes and weight enumerators.

### BOOKS

We will use the book:

S. Roman, *Coding and Information Theory*, Graduate Texts in Mathematics **134**, Springer.

Other books are:

J.H. Van Lint, *Introduction to Coding Theory*, third edition, Graduate Texts in Mathematics **86**, Springer.

F. MacWilliams and N. Sloane, *The Theory of Error-Correcting Codes*, 1977.

Hoffman, Leonard, Lindner, Phelps, Rodger and Wall, *Coding Theory: the essentials*, Marcel Dekker, 1991.

J. Adamek, *Foundations of Coding Theory*, Wiley 1991.

#### PREREQUISITES

For this course, knowledge of linear algebra is needed (for example **math 217, 417, 419 or 513**). Some knowledge about probability and abstract algebra is useful, but these things will be reviewed as they show up.

#### OFFICE HOURS:

My office is:  
3067 East Hall  
phone: 763 2309  
email: [hderksen@umich.edu](mailto:hderksen@umich.edu)

Office hours will be posted on the webpage  
(or by appointment, call or email me)

#### WEBPAGE

There will be a webpage with all homework assignments, handouts etc.  
The webpage is:  
<http://www.math.lsa.umich.edu/~hderksen/math567.w07/index.html>

#### GRADING

There will be Homework assignments (50% of the grade), a midterm (25% of the grade) and a final (25% of the grade). Midterm and final may be take-home exams.