



# SC727 - Advanced Coding Theory

Professor Ari Trachtenberg  
[trachten@bu.edu](mailto:trachten@bu.edu)

**Time:** Fall 2004. Mondays and Wednesdays 2-4pm.

**Description:** Error-correcting codes have been employed in a wide variety of applications, primarily protecting information over unreliable communications or computational channels. As such, error-correcting codes are employed in storage media (e.g. RAM, CDs, DVDs, hard disks), over communications lines (e.g. telephone modems, deep-space communications), and to solve related problems (e.g. data synchronization, location detection, sphere packing).



This course will cover advanced topics in coding theory up to and including the current state of the art. The course will begin with a review of the relevant fundamentals in coding theory and information theory, including classical code constructions and newer algebraic-geometry constructions. The course will continue with an investigation of trellis-based and iterative coding and decoding, including design of codes for optimum performance. Throughout, our emphasis will be on decoding properties and algorithms of these codes and on applications from computer engineering, computer science, and mathematics.

## Selected Tentative Topics:

- **classical:** Hamming, Golay, Convolutional, Cyclic, BCH, Reed-Solomon (decoding: Forney, Berlekamp-Massey, Euclidean alg), Reed-Muller, Lexicode
- **graph-based decoding:** trellis design and coding (Viterbi algorithm, tail-biting, minimality), iterative decoding (greedy, belief-propagation, turbo-codes, Low Density Parity-Check codes)
- **algebraic-geometry:** Hermitian, Goppa
- **applications:** tilings, covering codes, sphere packing, McEliece's cryptosystem, data reconciliation, identifying codes

## Prerequisites:

sc561 or consent of instructor (experience with *algebra/number theory* should be sufficient – please e-mail [trachten@bu.edu](mailto:trachten@bu.edu) with questions)

**PART OF ENG COMMUNICATIONS & NETWORKS CONCENTRATION**

PICTURES COPYRIGHTED BY MICROSOFT (2004?)