4280-Information Theory (Spring 2011)

MATH 4280
Instructor
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Location Skiles 170 Tuesday-Thursday 3:05-4:25pm

Course MATH 4280 AG CRN 21784
MATH 4280 AU CRN 20599

Office Hours: Skiles 132 Monday 5-6pm & By appointement

Dates: January 11 *till* April 28, 2011

Monthly Calendar ⇨

(see Calendar)

- **Homework #4:** *CT Chap. 7, p.227-236 # 7.14, 7.15, 7.28*
  CT Chap. 8, p.256-258 # 8.1, 8.8, 8.9

  Due date: March 15th, 3pm
- March 15th & 17th: Gaussian Channels, *CT Chap. 9.1-9.3*
- March 29th & 31th: Gaussian Channels, *CT Chap. 9.4-9.6*
- April 5th & 7th: Rate Distorsion Theory, *CT Chap. 10.1-10.3*

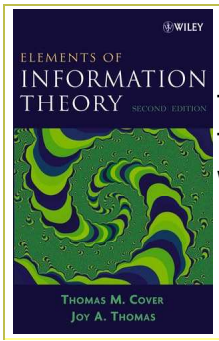
- **Homework #5:** *CT Chap. 9, p.290-292 # 9.1, 9.2, 9.3, 9.5, 9.10, 9.20 (long)*
  CT Chap. 10, p.336-338 # 10.1, 10.2, 10.6

  Due date: April 12th, 3pm
  Spring break: March 21-25

- April 12th & 14th: Rate Distorsion Theory, *CT Chap. 10.4-10.8*
- April 19th & 21th: Kolmogorov Complexity, *CT Chap. 14.1-14.3*
- April 26th & 28th: Kolmogorov Complexity, *CT Chap. 14.4-14.8*

- **Final Exam:** *May 5th, 2011, 11:30am-2:20pm, Skiles 170*

Prerequisites	Math 3215 or Math 3225

• ***Textbook***	 *Elements of Information Theory* , Second Edition Thomas M. Cover & Joy A. Thomas, Wiley, 2006 *(denoted by CT)*
• ***Homeworks***	A compulsory homework will be proposed once every two weeks. It will be graded and the total grade will be counted for 40% of the final grade. The due date must be respected by students.
• ***Final Exam***	*May 5th, 2011, 11:30am-2:20pm Skiles 170.* The final exam will count for 60% of the final grade.

Math 4280 (Intro to Information Theory) Spring 2012

- **Instructor:** Prasad Tetali, tetali@math.gatech.edu; 404-894-9238 (o)
- **Time/Location:** Skiles 170, Tue, Thurs. 3:05–4:25pm
- **Office hours:** Skiles 234 – Tuesday 4:30-6:00pm, Wed. 2:30-4:00pm
- **Prerequisites:** Undergrad Probability (at the level of Math 3215), Undergrad Linear Algebra (at the level of Math 2406) or Consent of Instructor

Course Objectives: To cover the basics of information theory and communication channels; to highlight the importance of (Shannon's) entropy and mutual information in quantifying, measuring, and transmitting information.

Suggested Textbooks:

* *Information and Coding Theory* by Gareth A. Jones and J. Mary Jones, Springer 2000.

* Reference 1: *Elements of Information Theory*: 2nd Edition by Thomas M. Cover and Joy A. Cover, Wiley 2006.

! Reference 2: *Information Theory, Inference and Learning Algorithms* by David J.C. MacKay, Cambridge University Press, 2003; available for free-download at the link http://www.inference.phy.cam.ac.uk/mackay/itila/

Additional material: Handouts or other sources will be distributed/mentioned as needed.

List of Topics:

The first six chapters of the textbook by Jones and Jones will be covered (not necessarily in that order), roughly at the rate of each chapter in 2 weeks. Important topics are as follows:

- Entropy and Information, Relative and Conditional Entropy, Fano's inequality
- Probability: Markov, Chebyshev inequalities, Chernoff bounds, and Weak Law of Large Numbers
- Asymptotic Equipartition Property (AEP)
- Markov chains and Entropy rate
- Source Coding (and Data Compression): Kraft, McMillan Inequalities
- Shannon and Huffman Codes, Ziv-Lempel Coding
- Information Channels: BSC, Erasure, Channel Capacity
- Shannon's theorem and its converse
- Error-correction codes: minimum distance, sphere-packing bound, Gilbert-Vershamov bound
- Hadamard matrices and codes

General grading policy: Quizzes (in-class) 15 % ; HWs 15% ; Two Tests (in-class) 35%; Final (in-class) 35%

Test 1 : Thursday, February 9th
Test 2 : Tuesday, March 13th

Final Exam: Thursday, May 3rd (11:30am – 2:20pm)

Homeworks will be assigned, collected and graded on a regular basis. You are strongly advised to solve all the homework problems. **Late submission of HWs is discouraged with a penalty of 20%.**

Grading Philosophy and Mechanism. In collaboration with Dr. Will Perkins (SoM Instructor of Math 3215), I am trying out a new technique in terms of reporting grade information on tests and quizzes. The primary intent is so you might come to the office hours and ask, "How can I improve my understanding of the basics and the technical material?" rather than the more commonly asked, "How can I go from a C to a B or ...?" etc.

So I will try to divide your grade on a test into some or all of the following categories, as pertinent:

1. Knowledge of the basic terms and definitions
2. Understanding of the fundamental and important concepts
3. Understanding of a method, an algorithm or technical analysis
4. Creativity and ability to solve somewhat challenging problems
5. Ability to apply methods and techniques to real questions and problems
6. Computations (and "plug and chug")

Suggestions:

- Please feel free to ask questions at any time: before, after or during the class.
- Please make use of my office hours.
- Class participation and discussion is highly encouraged.

Academic Dishonesty: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students. The institute honor code is available at http://www.deanofstudents.gatech.edu/Honor/honorcode.txt