

EE568: Information Theory
Spring 2009 Natalia A. Schmid

Syllabus
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1. Instructor Natalia Schmid

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(This web-page will contain important announcements and materials handed out in class)

2. Office Hours

TBA

3. Class time

12:30-1:45 pm. (Tu., Th.)

4. Class location

ESB 801

5. Prerequisites

EE513 or its equivalent; a course on optimization theory is useful

6. Description

Mathematical models for channels and sources; entropy, information, data compression, channel capacity, Shannon's theorems, rate-distortion theory.

7. My (Natalia Schmid's) expectations from Students

This is a second year graduate class. Lectures will provide the necessary basics. However, they will not cover all topics in depth. Students are expected to do their own independent work that will include reading papers distributed in class, performing additional literature research, and learning some concepts on their own. I expect you to work hard and be creative. If you are not familiar with some topic or with some fundamentals please ask me to prepare a handout for you with a brief introduction to the unknown topic.

The goal is to enable you to do your own independent research as well as learn about subjects on your own. This will be expected from you if you target an academic career and will be of great benefit to you if you follow a professional career path.

8. Textbook

T. M. Cover and J.A. Thomas, *Elements of Information Theory*, John Wiley & Sons, New York, 1991. (The second edition is published in 2006).

9. Collateral Textbook

The following textbook covers similar material. It is not required but may be useful as a second reference.

- R. G. Gallager, *Information Theory and Reliable Communication*, John Wiley & Sons, 1968.
- R. E. Blahut, *Principles and Practice of Information Theory*, Addison-Wesley, 1988.
- Kullback, *Information Theory and Statistics*, Dover, 1997.
- J. A. Bucklew, *Large Deviation Techniques in Decision, Simulation, and Estimation*, New York: Wiley, 1990.
- D. J. C. MacKay, *Information Theory, Inference, and Learning Algorithms*, Cambridge University Press, 2003. Available at: <http://www.inference.phy.cam.ac.uk/mackay/itila/>

10. Topics

We will cover material in Ch. 1-5, 8-10, 12, 13 of the book by Cover and Thomas (Ed.1991). Ch. 11, 14 will be covered as the time permits. The reference material from the text book is as follows (tentatively):

1. Measures of Information and Information inequalities (1.5-2 weeks)
2. Convergence of sequences of random variables. AEP (1 week)
3. Entropy rates of a stochastic process (1 week)
4. Lossless data compression (Huffman, Ziv-Lempel, Arithmetic, Shannon-Fano codes): Kraft inequality, Shannon's source coding theorem (2.5-3 weeks)
5. Channel capacity: jointly typical sequences, Fano's inequality, Shannon's channel coding theorem and its converse (2 weeks)
6. Differential entropy (0.5-1 weeks)
7. Gaussian channels (1.5 weeks)
8. Maximum entropy principle (as the time permits)
9. Testing Hypotheses (2 weeks)
10. Rate distortion (2 weeks)
11. Network information theory (as the time permits)

10. Examinations

There will be a midterm examination and a final examination. The dates of both exams will be announced in advance of it. An option to replace the final exam with a project will be considered.

11. Homework

There will be approximately 5-7 homework assignments. *No late homework will be accepted.* Three problems from each homework set will be selected at random and graded. The contribution of homework assignments towards the final grade will be based on the average of all homework grades, with one of the lowest homework grades not counted.

12. Computer Usage

Several homework problems may require computer usage. You may select any computer system and programming language to address these problems.

13. Ethics

Interaction among students in EE568 for the purpose of understanding concepts and developing solution strategies on homework assignments is permitted and very much encouraged, but submitted homework solutions should be your own effort.

14. Grade

The final grade for the EE568 will be based on the following factors, which will be weighted as indicated.

Midterm Examination	30%
Homework	40%
Final Examination	30%

Social Justice Statement:

West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment, based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700). If you feel that you are being treated inappropriately or unfairly in any way, please feel free to bring your concerns to my attention. Please be assured that doing so will not prejudice the grading process. In return, I expect you to behave professionally and ethically.