

Advanced Topics in Information Theory

Fall 2006/2007

Prof. Dr. Stefan M. Moser



Syllabus

<http://moser.cm.nctu.edu.tw/nctu/atit/>

1 Website

There is a website which is always kept up-to-date:

<http://moser.cm.nctu.edu.tw/nctu/atit/>

Note that any notes that are handed out during classes will also be available for download on this page. However, while the website is available worldwide, the documents can only be downloaded from within the National Chiao Tung University.

2 Instructor

Stefan M. Moser

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3 Time and Place

There are two lectures per week:

- Monday, 15:40–17:30, Engineering Building IV, Room 111 (ED111)
- Wednesday, 15:40–17:30, Engineering Building IV, Room 111 (ED111)

The course starts on Monday, September 11, and finishes on Wednesday, January 10. For more detailed program see the above mentioned website.

4 Course Objective

This course is an advanced course in information theory. Based on the theory we have learned in the course Information Theory we will continue to explore the most important results concerning data compression and reliable communication over a communication channel: mainly we will concentrate on multiple-user communication and lossy compression schemes. The course will cover approximately the following topics:

- Maximum entropy

- Methods of types
- Rate distortion theory (lossy compression)
- Multiple-users channels:
- Multiple-access channel
- Broadcast channel
- Relay channel
- Interference channel
- Gel'fand-Pinsker problem: channels with random parameters known at the transmitter
- Correlated source encoding (Slepian-Wolf)
- Information theory and the stock market

We hope that a student who finishes the course will be able to better understand the principles underlying all state-of-the-art communication systems and the difficulties encountered when designing and trying to improve them.

5 Prerequisites

The following lectures/topics are recommended:

- Probability
- Information Theory

6 Textbook

The course will mainly be based on

Thomas M. Cover and Joy A. Thomas: *Elements of Information Theory*, Wiley, 1991.

Further references and recommended readings:

- Robert G. Gallager: *Information Theory and Reliable Communication*, Wiley, 1968.
- Raymond W. Yeung: *A First Course in Information Theory*, Kluwer Academic Publishers, 2005.

7 Grading

The exercises are an essential part of this lecture and we will spend a considerable amount of time in discussing and solving them during class. There will be one exercise every week consisting of about four to six problems. The time in class will not be sufficient to solve all problems, i.e., the students are asked to finish the problems at home. For the understanding of the course and also as a preparation for the mid-term and final exam we highly recommend to solve the exercises! Since the material of this course is rather demanding by itself, we have decided not to further challenge the students with additional tasks like, e.g., a presentation of a paper. We hope that the saved time will be used instead for solving the exercises, going over the notes, and reading the textbook!

Your grade will be an average of

- your homework (15%),
- the midterm exam (35%), and
- the final exam (50%).

The grade of your homework will not be based on the correctness of your answers, but rather the effort you show in trying to solve them. To pass the course there is the additional condition that **at least 10 exercises have to be handed in.**

This course is worth 3 credits.

8 Special Remarks

The lecture will be held in English.