

Advanced Topics in Information Theory

Fall 2009/2010

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/>

You will find there all necessary information and current announcements about this course. All handouts and exercises that are handed out during classes will also be available for download on this page. Note that while the website is available worldwide, the documents can only be downloaded from within the National Chiao Tung University (NCTU) and the National Tsing Hua University (NTHU).

2 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. We will talk about multiple-user communication and lossy compression schemes. The course will cover approximately the following topics:

- 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.

3 Prerequisites

The following lectures/topics are recommended:

- Probability
- Information Theory

4 Instructor

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5 Time and Place

There are two lectures per week:

- Wednesday, 15:40–17:30 (GH), Engineering Building IV, Room 303 (ED303)
- Friday, 9:00–9:50, Engineering Building IV, Room 303 (ED303)

The course starts on Wednesday, 16 September, and finishes on Friday, 15 January. For more detailed program see the above mentioned website.

6 Office Hours

NCTU requests that every teacher offers two hours per week where students may come to ask questions:

- Tuesday, 13:30–15:30, Engineering Building IV, Office 727

However, we would like to encourage you to show up in the teacher's or teaching assistant's office at any time in case you have questions about the class or related subjects. Moreover, we are always available during and after classes.

7 Textbook

The course will mainly be based on

- Thomas M. Cover and Joy A. Thomas: *Elements of Information Theory*, second edition, Wiley, 2006.

For certain topics there will be additional handouts during classes.

Further references and recommended readings:

- Robert G. Gallager: *Information Theory and Reliable Communication*, Wiley, 1968.
- Imre Csiszár, János Körner: *Information Theory: Coding Theorems for Discrete Memoryless Systems*, 3rd edition, Akadémiai Kiado, Budapest.
- Po-Ning Chen and Fady Alajaji: "Lecture Notes in Information Theory," Volume I & II, National Chiao Tung University (NCTU), Hsinchu, Taiwan.

- James L. Massey: “Applied Digital Information Theory I and II,” lecture notes, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.
- Raymond W. Yeung: *A First Course in Information Theory*, Kluwer Academic Publishers, 2005.

8 Exercises

Every week, an exercise will be distributed in class. This exercise will consist of several problems that need to be solved at home and handed in during the class of the following week. A model solution will be handed out afterwards.

We believe the exercises to be extremely important and crucial to the understanding of the course. They also serve as a preparation for the mid-term and final exams and we therefore highly recommend to solve them. **To pass the course you need to hand in at least 10 exercises.**

9 Exams

There will be one mid-term and one final exam. Both exams are going to last three hours and be open-book. Details about the covered material will be published in due time.

10 Grading

The grade will be an average of

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

The grade of the homework will not be based on the correctness of the answers, but rather on the effort the student shows in trying to solve them. This course is worth 3 credits.

11 Special Remarks

The lecture will be held in English.