MT4410/MT5441: Channels

COURSE DETAILS

First Term 2006/2007

Lecturer: Dr Christian Elsholtz
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Lecture times:
Monday 10 C325
Thursday 9 C325
Thursday 10 C325

Office hour:
I will decide about my office hour when all other tutorials are arranged.

Assessment:
A 2 hour examination.

Course work:
There will be weekly problem sheets. You will get your solutions marked, so that it this a good opportunity to get feedback. The homework does not count towards the exam, but you are strongly encouraged to do homework regularly. You are allowed to discuss homework with fellow students; but when you write it up, you should do it entirely on your own!
I intend to spend some time of the 2nd hour on Thursdays with discussing the problem sheets. Your active participation is very welcome.
Textbooks:
Codes and Cryptography - D Welsh (Oxford UP). Library Ref. 001.5436 WEL
Information Theory, Inference and Learning Algorithms D J C MacKay (Cambridge UP). Library Ref. 001.539 MAC

Note: Most of the course will follow Welsh's book. The library has a few copies. I have also put a copy of these books at the **restricted** bookshelf (behind the counter in the cage like zone). The advantage is that almost always you have access to it. But you can only borrow it for very shory periods only.

Course aims: To investigate the problems of data compression and information transmission in both noiseless and noisy environments.

Learning outcomes: On completion of the course, students should be able to:

- state and derive a range of information-theoretic equalities and inequalities;
- explain data-compression techniques for ergodic as well as memoryless sources;
- explain the asymptotic equipartition property of ergodic systems;
- understand the proof of the noiseless coding theorem;
- define and use the concept of channel capacity of a noisy channel;
- explain and apply the noisy channel coding theorem;
- evaluate and understand a range of further applications of the theory.

Content

- Entropy: Definition and mathematical properties of entropy, information and mutual information.
- Noiseless coding: Memoryless sources: proof of the Kraft inequality for uniquely decipherable codes, proof of the optimality of Huffman codes, typical sequences of a memoryless source, the fixed-length coding theorem.
- Ergodic sources: entropy rate, the asymptotic equipartition property, the noiseless coding theorem for ergodic sources.
- Lempel-Ziv coding.
- Noisy coding: Noisy channels, the noisy channel coding theorem, channel capacity.
- Further topics, such as hash codes, or the information-theoretic approach to cryptography and authentication.

Some background in probability theory/statistics is useful. You might like to revise your undergraduates notes, when necessary.

Some elementary background on coding theory is useful, even though I will try hard to avoid that you need it. A gentle reading are the first chapters of A First Course in Coding Theory, by R. Hill (OUP). Library Ref. 001.539 HIL
(Compare the course MT5461 in the second term).