Detailed Course Plan for Part-I

Saif K. Mohammed and Erik G. Larsson

I. Lecture-1: Typical Sequences and Entropy of DMS (SM)

Time and Venue: 1 Feb. 2012, 9:00 - 12:00 (Algorithmen)

Contents:

1) Typical sequences, AEP (Chap. 2 [2], Chap. 1 [4], Chap. 3 [1])

2) Entropy of a discrete memoryless source (DMS) (Chap. 2 [2], Chap. 2 [1])

Scribe: Reza Moosavi

II. Lecture-2: Jointly Typical Sequences (SM)

Time and Venue: 8 Feb. 2012, 9:00 - 12:00 (Algorithmen)

Contents:

1) Discrete Memoryless Channel (DMC)

2) Jointly typical sequences (Chap. 2 [2], Chap. 1 [4], Chap. 7.6 [1])

Scribe: T. V. K. Chaitanya

III. Lecture-3: Conditional typicality, channel coding theorem for DMC (SM)

Time and Venue: 15 Feb. 2012, (9:00-12:00) (Algorithmen)

1) Conditionally typical sequences, conditional entropy (Chap. 2 [2], Chap. 1 [4])

2) Basic properties of the entropy function (Chap. 2 [1], Chap. 2 [2])

3) Channel coding theorem (achievability, using the maximal code approach) (Chap. 3 [2], Chap. 4 [3], Chap. 7.7 [1])

4) Mutual Information (Chap. 2 [1])

Scribe: Hien Ngo

IV. Lecture-4: Converse to the Channel Coding Theorem for DMC (SM)

Time and Venue: 23 Feb. 2012 (9:00-12:00) (Algorithmen)

Contents:

1) Strong converse to the channel coding theorem (Chap. 3 [2])

2) Weak converse to the channel coding theorem (Chap. 7 [2])

Scribe: A. Pitarokoilis

V. Lecture-5: Channel Capacity of DMC (SM)

Time and Venue: 6 Mar. 2012, 9:00 - 12:00 (Signalen)

Contents:

1) Proof of the weak converse to the channel coding theorem (Chap. 7 [2])

2) Discussion on the weak and strong converse and definition of channel capacity for the DMC (Chap. 7 [2])

3) Capacity of discrete-time semi-continuous memoryless channel (SCMC).

Scribe: Johannes Lindblom

VI. Lecture-6: Problem solving class for Homework-I (SM)

Time and Venue: 7 Mar. 2012, 9:00 - 12:00 (Signalen)

Contents:

1) Homework-I has been handed out on 22 Feb. 2012.

VII. Lecture-7: Channel coding theorem for discrete-time continuous memoryless channel (SM)

Time and Venue: 16 Mar., 9:00 - 12:00 (Signalen)

Contents:

1) Channel coding theorem for the continuous memoryless channel with input cost: Random coding argument with typical set decoding (Chap. 9 [1])

2) Achievable rates for the discrete-time AWGN channel with an average power constraint (Chap. 9 [1])

Scribe: Mirsad

VIII. Lecture-8: Channel capacity of waveform channels (EL)

Time and Venue: 20 Mar., 9:00 - 12:00 (Signalen)

Contents:

1) Degrees of freedom of almost time and bandwidth limited signals (Chap. 8 [3])

2) Decomposing a band-limited ISI channel with coloured additive Gaussian noise into parallel channels.

3) Capacity of waveform channels (waterfilling over parallel channels)

4) Power-limited and bandwidth-limited regime

Scribe: Reza Moosavi

IX. Lecture-9: Converse to the channel coding theorem for discrete-time continuous memoryless channels (SM)

Time and Venue: 21 Mar., 9:00 - 12:00 (Signalen)

Contents:

1) Converse to the channel coding theorem for discrete-time continuous memoryless channels, using Fano's inequality (Chap. 9 [1])

2) Miscellaneous results in information theory (e.g. data processing inequality)

Scribe: T. V. K. Chaitanya

X. Lecture-10: Problem solving class for Homework-II (EL, SM)

Time and Venue: 18 Apr. 2012, 9:00 - 12:00 (Signalen)

Contents:

1) Homework-II will be handed out on 23 Mar. 2012.

XI. Lecture-11: Capacity of single-user fading channels (SM)

Time and Venue: 19 Apr. 2012, 9:00 - 12:00 (Signalen)

Contents:

1) Capacity of time-invariant (deterministic) single-user frequency-flat Gaussian channels

SIMO (Rx combining)

MISO (Tx Beamforming)

(Chap. 5 [5])

2) Capacity of time-invariant single-user frequency-selective Gaussian channels

(OFDM, Chap. 5 [5])

3) Capacity of fading channels (Chap. 5 [5])

Slow fading (Tx, Rx diversity, space-time codes)

Fast fading (capacity with CSIR only, with CSIT and CSIR, power allocation strategies)

Scribe: Johannes Lindblom

XII. Lecture-12,13: Single-antenna multi-user uplink channel (SM)

Time and Venue: 25 Apr., 2 May 2012 9:00 - 12:00 (Signalen)

Contents:

1) Channel coding theorem and converse for the non-fading AWGN multi-user uplink (MAC) channel (Chap. 15.3 [1], Chap. 8 [4], [6])

2) Optimal multi-access strategy: Successive interference cancellation (comparison with orthogonal access)

3) Multi-access strategies for multi-user single-antenna fading channels

Suggested reading:

Chap. 15.3 [1], Chap. 8 [4], [6], Chap. 6 [5].

Scribe: Hien Ngo (Lecture 12), Mirsad Cirkic (Lecture 13)

XIII. Lecture-14: Problem solving class for Homework-III (SM)

Time and Venue: 19 June 2012, 9:00 - 12:00 (Signalen)

Contents:

1) Homework-III will be handed out on 2 May 2012.

REFERENCES

[1] T. M. Cover and J. A. Thomas, ”Elements of Information Theory, *Wiley*, 2nd Ed. 2006.
[2] J. Wolfowitz, “Coding Theorems of Information Theory,” *Ergebnisse Der Mathematik Und Ihrer Grenzgebiete*, 2nd Ed. 1964.
[3] R. G. Gallager, ”Information Theory and Reliable Communication, *Wiley*, 1968.
[4] G. Kramer, ”Topics in Multi-User Information Theory, *Now Publishers*, vol. 4, no.4-5, 2008.
[5] D. N. C. Tse and P. Vishwanath, ”Fundamentals of Wireless Communication,*Cambridge University Press*, 2005.
[6] A. E. Gamal and Y. Kim, ”Network Information Theory,*Cambridge University Press*, 2012.