Randomized Algorithms (2019)

Instructors:

László Kozma (lectures), Katharina Klost (tutorials)

References:

Letters refer to author initials, numbers to chapter/section.

[MR] R. Motwani, P. Raghavan. Randomized Algorithms. Cambridge University Press, 1995
This is the main textbook, very nice and readable, some parts a bit outdated.

[MU] M. Mitzenmacher, E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis. Second Edition. Cambridge University Press, 2017.
Used to complement [MR] where applicable. First Edition (2005) is also fine, section numbers may not match.

[AS] N. Alon, J. Spencer. The Probabilistic Method. Fourth Edition. Wiley, 2016.
Used for Part III, to complement MR and MU. Not essential reading for the course, but beautiful book, highly recommended.

[CLRS] T. H. Cormen, C. Leiserson, R. Rivest, C. Stein. Introduction to Algorithms, MIT Press 2009
[KT] J. Kleinberg, E. Tardos. Algorithm Design, Addison-Wesley 2005.
[M] J. Matoušek. Lectures in Discrete Geometry. Springer Verlag, 2002

(Planned) Topics:

Date	Topic	Reference/additional reading
Apr. 9. - Apr. 25.	**0.** Administrative stuff. **Part I.** Motivating examples. - Min-Cut - Smallest enclosing disk - Ski rental - Prediction with Experts - Color-coding - Primality Testing	 MR 1.1, MR 10.2, MU 1.5 notes (Welzl paper) notes notes (Arora-Hazan-Kale survey) notes (Alon-Yuster-Zwick paper) MR 14.6
Apr. 30. - May 2. May 7.	**Part II.** Basics of probability theory and randomized algorithms. - Events and probabilities - Possible uses of randomness - Tail inequalities - Las Vegas and Monte Carlo - Complexity classes	MR 1-4,A-C, MU 1-4
May 7. May 9.	**Part III.** The probabilistic method. - Probabilistic arguments - Random graphs	MR 5, MU 5,6, AS
May 14. - June 4.	**Part IV.** Problems and randomized algorithmic techniques. - Fingerprinting, polynomial identity testing - Satisfiability, Schöning’s algorithm - Random walks, gambler’s ruin, graph traversal - MaxSAT - Linear Programming relaxation	 MR 7, MU 1.1, 1.3 notes

June 6. - July 10.	**Part V.** Data structures. - Hashing, Universal hashing - Perfect hashing - Count-Min Sketch and Bloom filter - Load balancing - Streaming algorithms - Randomized treaps	MR, MU, notes
June 18.- June 20.	**Part VI.** Selected further topics. - Randomized MST - Chan’s optimization technique	MR, MU, notes