CS 791G - Randomized Algorithms - (Fall 2001)

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1 Preview

This course is intended for a graduate audience in the CSEE, Industrial Engineering and Mathematics Departments. It will serve as a thorough introduction to the fundamentals of design and analysis in the probabilistic realm. Although, the course is essentially theoretical, at appropriate junctures, we shall discuss real-world applications of the theory such as cryptography and computer security.

2 Pre-requisites

A course on Analysis of Algorithms; some exposure to probabibilty is preferred, but not required.

3 Syllabus sketch

1. Introduction - A Min-Cut Algorithm, Las Vegas and Monte Carlo, Binary Planar Partitions, A probabilistic recurrence, Computation Model and Complexity Classes.
2. Game-Theoretic techniques - Game Tree evaluation, The Minimax Principle, Randomness and Non-uniformity.
3. Moments and Deviations - Occupancy problems, The Markov and Chebyshev Inequalities, Randomized Selection, Two-point sampling, The Stable Marriage Problem, The Coupon Collector's Problem.
4. Tail Inequalities - The Chernoff bound, Routing in a Parallel Computer, A Wiring Problem, Martingales.
5. The Probabilistic Method - Overview of the Method, Maximum Satisfiability, Expanding Graphs, The Lovasz Local Lemma, The method of Conditional Probabilities.
6. Markov Chains and Random Walks - A $2-$SAT example, Markov Chains, Random Walks on graphs, Electrical Networks, Cover times, Graph Connectivity, Expanders and Rapidly mixing Random walks, Probability amplification by Random Walks on Expanders.

4 Material

All the material for this course will be based on the first six chapters of [MR95]. It would also help to refer [CLR92] and [Ros93].

5 Grading

1. Lecture Notes (30%)
2. Midterm (30%)
3. Final (40%)

References

[CLR92] T. H. Cormen, C. E. Leiserson, and R. L. Rivest. *Introduction to Algorithms.* MIT Press and McGraw-Hill Book Company, 6th edition, 1992.

[MR95] Rajeev Motwani and Prabhakar Raghavan. *Randomized Algorithms.* Cambridge University Press, Cambridge, England, June 1995.

[Ros93] Sheldon M. Ross. *Probability Models.* Academic Press, Inc., 5th edition, 1993.