

Fall 2004 Course: Probabilistic Methods in Computer Engineering

Course Number: Cpr E 594, Section 1

Instructor: Srikanta Tirthapura

Email: *snt@iastate.edu*

Time: TR 12.40-2.00 (tentative)

Course website: <http://clue.eng.iastate.edu/~snt/594/>

For many applications in computer engineering, including network routing, hashing, string algorithms and computational biology, cryptography, massive data set algorithmics, and distributed peer-to-peer systems, a randomized algorithm is often the simplest and the most efficient solution. The above list of application areas is by no means exhaustive, and is growing everyday.

This course will introduce the student to a basic set of techniques for analyzing (mostly discrete) random variables and probabilistic processes, and will demonstrate their use in a broad range of applications, including sorting, hashing, graph problems, routing in parallel computers, and distributed systems.

Topics Covered

- **Discrete Random Variables, and their use in modeling algorithm behavior**
- **Tail Inequalities for the sums of Random Variables – Markov, Chebyshev and Chernoff Bounds**
- **Balls in Bins, Occupancy Problems**
- **Sorting and finding Quantiles**
- **Graph Algorithms - Minimum Spanning Trees, Min Cut, etc**
- **Routing in Parallel Computers and in Peer-to-peer Distributed Systems**
- **Hashing and Pattern matching**
- **Random Graphs**
- **Aggregate Computation over Massive Databases and Data Streams**
- **Data Location in Sensor Networks**

This course **does not cover Queuing Theory, or Statistics**. There are other excellent courses at Iowa State which deal with these topics.

Textbook

We will use the text *Probability and Computing: Randomized Algorithms and Probabilistic Analysis* by Michael Mitzenmacher and Eli Upfal. For some of the applications, we will distribute readings from research papers.

Workload

6-8 Homework Sets, Takehome exam. Some of the homeworks will involve programming.

Prerequisite

Computer Algorithms (Com S 311 or equivalent), Knowledge of Basic Probability