Randomized Algorithms (CSCI 6962)
Syllabus

Course Web Page:	http://www.cs.rpi.edu/∼drinep/random
Instructor:	Prof. Petros Drineas, Lally Hall 317
Lecture:	Mon and Thu 12:00-13:20
Office hours:	Monday 14:00-15:30 and by appointment
Required textbook:	*Randomized Algorithms*, by R. Motwani and P. Raghavan

We will also cover material from other sources (e.g. papers), that will be made available at the course web page.

Course Description

Randomized Algorithms are the state of the art in contemporary algorithm design. They are usually simple, sometimes even easy to analyze, and they work well in practice. They have found numerous applications in every field of Computer Science, and also in Mathematics, Physics, Economics, etc. Randomized Algorithms is an active and vibrant research area with many exciting new results every year.

Prerequisites

Some advanced algorithms course (covering basic graph algorithms, elementary data structures, etc.) as well as familiarity with basic calculus, probability theory, and elementary linear algebra. The instructor will cover most of the probability theory that is necessary for this course.

Course Learning Outcomes

At the end of the course, the student

1. is able to apply fundamental algorithmic ideas to design randomized algorithms,
2. is able to apply measure concentration results from probability theory in order to analyze randomized algorithms,
3. has developed a solid background on randomized algorithms for graph-theoretic, number theoretic, and linear algebraic problems,
4. is able to determine the running times, failure probabilities, and accuracy guarantees of the aforementioned algorithms,
5. is able to present material from published research in the area of randomized algorithms using field-specific language, and
6. is able to critique material from published research in the area of randomized algorithms.

Requirements and Grading

Semester requirements will include homeworks, a take-home final, and a student presentation. There will be five homework assignments, which will be made available via the course web site. Generally, they will have a two-week duration. Students will submit a paper copy of their assignment, preferably typed in LaTex. The take-home final will be given in the last lecture and will be due one week later. The student presentation will be a 75-minute lecture on a topic on randomized algorithms. Each student will choose a topic from a list of topics that the instructor will post at the course web site in the first few weeks of the semester. The weights in determining the semester average are:

Homeworks:	30%
Presentation:	30%
Take-home final:	40%

Letter grades will be computed from the semester average. Maximum lower bound cutoffs for A, B, C and D grades are 90%, 80%, 70%, and 60%, respectively. These bounds may be moved lower at the instructor's discretion.

Late Policy

Homework assignments must be submitted in class at the due date. Late assignments **will not be accepted** without a written excuse from Student Experience office (4th floor of Academy Hall, x8022, se@rpi.edu).

Academic Integrity

Unless the instructor has given explicit permission, copying and/or communicating solutions to homeworks and take-home or in-class exams is cheating. Any student caught cheating will receive an F in the course and will be reported to the appropriate academic authorities.

Preliminary Schedule

Here is a description of the material that will be covered in this course.

Week 1: Basic Probability Theory, Las Vegas and Monte Carlo Algorithms, Randomized Complexity Classes, and Randomized QuickSort.

Week 2: More Probability Theory: Markov and Chebyschev inequalities, randomized selection and the coupon collector problem, intro to Chernoff bounds.

Week 3: More Chernoff bounds, Randomized Rounding, and Martingales.

Week 4: The Probabilistic Method, the Max-SAT algorithm, Expanding Graphs, and Oblivious Routing.

Week 5: The Lovasz local lemma and the method of Conditional Probabilities.

Week 6: Basic notions in Markov Chains and Random Walks in Graphs (connectivity, ergodicity, stationary distributions, cover times, etc.).

Week 7: Algebraic Techniques: Freivald's technique, the Schwartz-Zippel Theorem, perfect matchings.

Week 8: Interactive Proof Systems.

Week 9: All pairs shortest paths, Min-Cut randomized algorithms.

Week 10: Minimum spanning Trees and the Max-Cut randomized algorithm.

Week 11: Parallel and Distributed Randomized Algorithms.

Week 12: Primality testing and Elementary number theory.

Week 13: Randomized Matrix Multiplication.

Week 14: Randomized regression algorithms.