CS 8803 Syllabus

Special Topics: Counting and Sampling

Fall 2026

Instructor Information

Instructor: Zongchen Chen

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General Course Information

Description

We study problems of generating random elements from a large combinatorial set (sampling) and of estimating the size of the set (counting), such as sampling spanning trees, independent sets, or proper colorings of a given graph, and counting their numbers. We mostly focus on Markov Chain Monte Carlo (MCMC) methods, which are simple and popular algorithms for such tasks. We discuss mathematical tools for analyzing the convergence rate of Markov chains, as well as recent developments in obtaining optimal mixing times. This is a theoretical course for graduate students with backgrounds in combinatorics, probability theory, and the analysis of algorithms.

Course Learning Outcomes

Upon successful completion of this course, you should be able to formulate Markov Chain Monte Carlo (MCMC) algorithms to efficiently solve sampling and counting problems within large combinatorial sets. Additionally, you will be prepared to apply advanced mathematical and probabilistic tools to rigorously analyze the convergence rates and mixing times of specific Markov chains. Furthermore, you should be able to evaluate recent theoretical advancements in algorithm design to establish optimal mixing bounds and clearly articulate the theoretical relationship between approximate counting and uniform sampling across various combinatorial structures.

Required Course Materials

We will not follow one particular textbook. The lecture notes will be available.

Grading Policy

Participation: 20%; Problem sets: 50%; Final project: 30%.

Letter grades are computed according to the usual brackets: A[90, 100]; B[80, 90); C[70, 80); D[60, 70); F [0, 60).

Description of Graded Components

There will be four problem sets and one final project.

Course Policies

Attendance and/or Participation

Attendance will be counted in determining your final grade.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.