Description

The design of efficient algorithms is a fundamental and important part of computer science. But the type of problem to be solved, the notion of what algorithms are "efficient," and even the model of computation can vary widely from area to area. This focus of this course will be on the most powerful paradigms and techniques that apply broadly in the design of efficient algorithms, and study their wide applications.

The goal for the class is to be broad rather than deep. Our plan is to touch upon the following areas. This is a tentative list of topics that might be covered in the class; we will select material adaptively based on the background, interests, and rate of progress of the students.

(Tentative) List of Topics

(1) Hash
Birthday paradox and coupon collector, bloom filters, load balancing, heavy hitters and count min sketch.

(2) Approximation algorithms
Scheduling, linear programming and duality, max cut and semi-definite programming.

(3) Randomized algorithms
Karger's min-cut, quick-sort, probabilistic method and random walk.

(4) Algorithms in data science
JL lemma, dimension reduction and spectral sparsification, sparse recovery and Fourier transform.

(5) Complexity theory
P vs NP, Hardness of approximation, derandomization and P=BPP

Grading

60% Homework and 40% final projects.
Policies

All coursework is to be done independently. Plagiarizing the homework will be penalized by maximum negative credit and cheating on the exam will earn you an F in the course. See the GMU Honor Code System and Policies at George Mason University Honor Code.

Collaboration policy: You are encouraged to discuss the material BEFORE you do the homework. However, you MUST write up your own solutions. You should also state the names of those you collaborated with on the first page of your submission.

Citation policy: Try to solve the problems without reading any published literature or websites, besides the class text. If, however, you do use a solution or part of a solution that you found in the literature or on the web, you must cite it.

Disability statement

If you have a learning or physical difference that may affect your academic work, you will need to furnish appropriate documentation to the Disability Resource Center. If you qualify for accommodation, the DRC staff will give you a form detailing appropriate accommodations for your instructor. In addition to providing your professors with the appropriate form, please take the initiative to discuss accommodation with them at the beginning of the semester and as needed during the term. Because of the range of learning differences, faculty members need to learn from you the most effective ways to assist you. If you have contacted the Disability Resource Center and are waiting to hear from a counselor, please tell me