

CSCE 669-601 Computational Optimization

Spring 2024

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Office Hours: MW 11:30 am–1:00 pm

Course Research Project (Due April 29)

You can take one of the two options below for your course research project.

A. Paper reading. you pick a research paper on optimization problems that was published no earlier than 2015 in one of the following journals and conference proceedings:

- *Journal of the ACM* (JACM)
- *SIAM Journal on Computing* (SICOMP)
- *ACM Transactions on Algorithms* (TALG)
- *ACM Symposium on Theory of Computing* (STOC)
- *IEEE Symposium on Foundations of Computer Science* (FOCS)
- *ACM-SIAM Symposium on Discrete Algorithms* (SODA)

You should discuss with the instructor on the paper of your choice. After reading the paper, you should give a 15-minute presentation on the paper (prepared using PowerPoint) to the class, and write a report of at least 8 pages on the paper. Note that most papers in the conference proceedings are preliminary versions and with many details missing. You should re-write the main analysis (including the proofs of the key lemmas and theorems) and fill the missing details.

B. Mini-research project. In this option, you will pick a research problem. The problem can be one questioned in an existing research paper, or one that is closely related to your own research, or one suggested by the instructor in class. After discussing with the instructor and having instructor's permission, you will read related research work in the area and try to solve the problem. You can expect to gain further direction and advice from the instructor during the research. With the instructor's permission, students may also work on research problems proposed and suggested by themselves. A project report of at least 10 pages should be submitted that summarizes the new findings during your research.

Project proposal. A written project proposal should be submitted by March 25. The instructor will review your proposal, provide advice and suggestions to your research project, and grant his permission to your proposed research.

Suggested Research Projects

Some suggested research projects are given here. The projects are either extensions of the results we discussed in class, or research topics that the instructor feels proper for a course research project. The list will be updated dynamically when the class progresses.

1. Maximal set of vertex-disjoint shortest augmenting paths. Without translating into the MAXIMUM FLOW problem, develop a linear-time algorithm that finds a maximal set of vertex-disjoint shortest augmenting paths for a given matching in a bipartite graph.

2. Recent breakthrough in MAXIMUM FLOW algorithms. Read the following paper that presented a breakthrough in the study of MAXIMUM FLOW algorithms:

- L. Chen, R. Kyng, Y. Liu, R. Peng, M. Gutenberg, and S. Sachdeva: Maximum flow and minimum-cost flow in almost-linear time, *Proc. 2022 IEEE 63rd Annual Symposium on Foundations of Computer Science (FOCS)*, pp. 612-623 (2022).

3. Algorithms for KNAPSACK with improved space complexity. Design a dynamic programming algorithm that solves the KNAPSACK problem with improved space complexity $O(V_0)$, while keeping the same time complexity.