Research Project: Experimental Study of an Amazing Algorithm

CMSC-641 Algorithms, fall 2017, Alan Sherman, UMBC

Overview

Each student must complete a research project on a focused topic related to this course, subject to the requirements listed below. The project must aim to accomplish new, significant results (survey papers are not acceptable). Each student must communicate his or her findings in an oral presentation to the class and in a written report in the format of a computer science technical report (at most 10 pages). Each aspect of the project (including proposals, reviews, reports, and presentations) is intended to match the process that professional computer science researchers follow in carrying out original research.

This project has several purposes: (1) to gain experience performing research in algorithms, (2) to learn how to read research papers in algorithms, (3) to gain insights through comparing theoretical and experimental analyses of algorithms, (4) to gain experience writing a computer science technical report, (5) to gain experience presenting a technical talk, (6) to explore an amazing algorithm deeply, and (7) to gain experience working in groups.

This documents describes the special requirements of this project. See the accompanying handout for more general specifications and advice about writing proposals, drafts, reports, and reviews, and about giving presentations.

Special Requirements

Each team will study some amazing algorithm approved by the instructor. The project will ask and answer some focused research question about this algorithm. The answer to this question must include some experimental results (including time and space measurements), which must compare two related algorithms or two variations of an algorithms. The project should focus sharply on the team's new and significant work answering their research question. Keep the project as focused as reasonably possible.

Where appropriate, demonstrate the knowledge and skills you have learned in 641, including analyzing time and space usage, analyzing special properties of algorithms, proving correctness, using asymptotic notations correctly, designing algorithms, and reasoning precisely about algorithms.

The proposal must include (among other elements) a focused research question, a review of background and previous work, and two high-quality research papers: an "introductory paper" (possibly a survey) that provides a useful introduction to the algorithm, and a "reference paper" that serves as a launching pad for the project. Typically, the reference paper would be a specialized research paper that closely matches what the group is trying to do. The group might build from, extend, modify, or improve (however modestly) this reference paper. Good places to look for such papers include the top algorithms conferences (FOCS, STOC, SODA) and the transaction-level journals of the major professional societies (ACM, IEEE, SIAM). *(FOCS = IEEE Foundations of Computer Science, SODA = SIAM Symposium on Discrete Algorithms, STOC = ACM Symposium on Theory of Computation)*

Deliverables and their due dates (all due on Fridays)

October 6	Proposal
October 27	Progress report
November 22	Complete draft report and draft presentation slides for review
November 27	Oral presentations begin
December 8	Final report, slides, and confidential evaluations of group members

Note: For each deliverable, bring two hard copies to class, and email an electronic version to sherman@umbc.edu with 641 in the subject line. One copy is for the instructor; the other is for a student reviewer. Always hand in deliverables on 8.5in × 11in one-sided paper, with one staple in the upper-left corner, without any covers or folders.

Group Work
Students must work in small groups of two to four members (ideally three). Learning how to work in groups is a valuable experience. By leveraging complementary strengths of their members, groups have the potential to achieve better results than can individuals working alone. Typically, but not necessarily, everyone in each group will receive the same grade. The teams must be approved by the instructor.

Peer Review
Each group will be paired with another group. The paired group will provide a peer review of the other group's proposal, draft report, and draft slides.

Grading Policy
The project will count for 25% of the semester grade. Each report will be evaluated on the following three criteria: appropriateness for assignment (have you satisfied the specifications?), scientific merit (correctness, significance, novelty, non-triviality, scientific completeness), and effective presentation (clarity, organization, English usage, appropriate style). Each project will be evaluated on the basis of the final report (70%), oral presentation (15%), source code (5%), proposal (5%), and progress report (5%).

Confidential Evaluation of Group Members (at most 1 page)
Only for groups with more than one member, each member must evaluate the performance and contribution of each group member (including yourself) to the project. What did each person do and how well did they do his or her task? How well did the group function as a team? This evaluation will be read only by the instructor.