CS 599: Rounding Techniques in Approximation Algorithms
Syllabus
Fall 2024

1 General Information

Instructor: Nathan Klein (nklei1@bu.edu)

Webpage: https://nathan-klein.github.io/rounding

Lectures: Tuesday and Thursday, 3:30 - 4:45 in CDS 701

Office Hours: Tuesday 1:30 - 3:30, Thursday 2:30 - 3:30, and by appointment in CDS 1026

Course Description: We will survey a simple but powerful framework for designing approximation algorithms known as "Relax and Round." Given a (possibly NP-Hard) discrete optimization problem, this framework first relaxes it into a polynomial time solvable one over a continuous domain. It then solves this easier problem, whose solution can have fractional coordinates: for example, it could assign a variable to be half true and half false in a SAT formula. In the final step, we round this fractional solution to an integer one.

Our goal will be to find a rounding procedure that, like a good translator, finds an integer solution that approximately preserves the key properties of the fractional one such as cost. There are many beautiful methods known for performing this rounding step, which will be our main focus. We will discuss many of them, such as the use of integral polytopes, iterative rounding, iterative relaxation, and independent and dependent randomized rounding. The course will emphasize graph problems as well as results from the past decade with exciting open directions.

Prerequisites: Strong undergraduate-level knowledge of algorithms, linear algebra, and probability. Some familiarity with linear programming and at least one of CS 530, 531, or 537 is recommended but not required. Motivated, mathematically mature undergraduate students who have excelled in CS 237 and CS 330 are also welcome.

2 Coursework

Grade Calculation: Four homework sets (15% each, lowest dropped), scribe (10%), participation and quizzes (15%), and a final project (30%)

Homework: Group work is encouraged, however please list your group members on every homework. Furthermore, when working with a group, you may not write down solutions and consult them later. All homework write-ups must be completed alone and without the aid of notes from group work. Please print out homework and bring it to class. If this is not possible due to special circumstances on the day of, it can be emailed to me, but please limit your use of this option.

Late Homework: You have four late days to use as you'd like over all assignments for turning in late homework. A late day is considered used if you end up turning in the homework: remember, I will drop the lowest homework score. After these days are used up, I will not accept late homework unless there are extenuating circumstances.

Scribe: Each student will be assigned one or two classes to scribe for, depending on the number of registered students. This will involve (i) writing LaTeX notes of the course content on that day, and (ii) asking questions on the day of their scribe to help ensure all students present are able to understand the lecture. If this second component makes you uncomfortable, please let me know and we can figure out an alternative!

Participation and Quizzes: As long as you come to class engaged, you should receive essentially full points. You can also receive participation points from posting on Piazza (see below). The quizzes will be based on a flash-card deck that I post online and will contain basic definitions from the course. They will involve briefly explaining concepts from the flashcard deck. This is designed to help students follow lectures. In some ways learning math is like learning a language, and it is important to know the basic building blocks by heart.

Final Project: The final project will involve either undertaking an original research project or reading a paper in the field. There will be both a written component and a presentation at the end of the course. Projects may be done alone or in small groups. Students will need to discuss and clear their final project topic with me. If students want to continue working after the course to develop a project into a paper, I am happy to help make this happen in any way I can.

3 Additional Information

Piazza: We will be using Piazza: https://piazza.com/bu/fall2024/ce15. A code to join will be emailed to all students. Consider posting questions here instead of emailing me, as this way all students can benefit.

Anki: I will post Anki flashcards each week on the course website of definitions to know for the quizzes and, more importantly, to know so that it is easier to follow lectures. Many of the flashcards will be posted the first week, and the number will decrease in subsequent weeks.

Health: Please let me know if you are struggling at all with health issues and I am more than happy to help make the course more manageable for you. For mental health, consider Student Health Services as a resource: they provide free assessments and can help connect you to a therapist covered by your healthcare. They also run meditation sessions and support groups, with one explicitly aimed at graduate students.