

CS294-180 Partition Functions: Algorithms & Complexity

Course Project: Fall 2023

1. General

The goal of the project is to give you an opportunity to investigate part of the course material (or a closely related topic) in greater depth, by reading, digesting and presenting (in oral and written form) one or more original research papers. Exceptionally, and subject to approval, you may substitute for this some creative work on an existing open problem mentioned in class or a problem of your own choosing.

I would like you to work in pairs on this. If you are having trouble finding a partner, please send me email and I will try to act as a matchmaker. A list of suggested topics can be found on the class web page. In most cases a topic appears with two or three references; choosing a topic **does not** entail digesting all of these references in detail—typically you might focus mainly on one of them and use the others as context or background. Moreover, your chosen paper will typically contain several results, and you will likely focus on one or two main ones.

The deliverables for all projects are:

- A presentation of approximately 70 minutes duration (i.e., a normal lecture slot, allowing time for questions and a break). The presentation should be didactic and accessible to the class: think of it as an additional stand-alone “guest” lecture extending the class in some direction. You may choose to prepare slides for this, or to use the whiteboards. (Slides will help with timing and efficiency, but you should be careful not to over-load the lecture with too much material.)
- A short written report of 4–5 pages (11pt L^AT_EX, standard margins). [Note: The page limit is intentional: It is harder and arguably more useful to be able to write a report of 4 pages than one of 10 pages.]

The presentation and the report are intended to complement one another, and should be prepared in parallel. The assessment will be based on both. The deadline for the report will be Friday December 15th (last day of the semester). The presentations will be scheduled during class times, beginning no earlier than November 14th and continuing through the end of the semester; we will need to use RRR week and possibly one additional day during finals week. A schedule will be posted once topics have been chosen; less technically challenging topics will go earlier.

2. Choosing a project

You should choose a project and have it approved by me no later than **Tuesday October 31st**. If you want to choose a project from the list, you should email your choice to me together with at least one, and preferably two alternatives in decreasing order of preference. First choices will be allocated on a first-come, first-served basis. Topics from the list will be marked as they are allocated.

If you want to propose a creative project, or any other project not on the list, you *must* discuss it with me well before the above date.

3. More on reading projects

The idea is that you should read, understand and digest one or two papers on a topic related to those discussed in class. You should understand the work well enough to give an intuitive explanation of it, answer questions about it, and assess its strengths and limitations. Your written report should consist of:

- Sufficient background to explain the results.
- Statement of the results.

- Assessment of how the results relate to other work in the area (and, in particular, work discussed in class).
- Indication of the key ideas used in the proofs or technical development, distinguishing between novel and standard steps.

Your lecture presentation should contain the same ingredients; however, you should use the different medium to complement your written presentation, e.g., by presenting examples, drawing pictures, sketching one or more proofs.

4. More on other projects

These projects are inherently more open-ended and harder to describe in general terms. Possible examples are:

- Make some non-trivial progress on an existing open problem (either mentioned in class, or stated in a paper).
- Perform a rigorous and well informed experimental evaluation of theoretical results proved in class, with a view to illuminating the underlying theory.
- Apply some ideas or techniques from the class to a problem from your own research area.

Such a project may involve an experimental component, but should include at least some application of the analytical techniques we have discussed (e.g., analysis of a simple special case, or a precise heuristic discussion). *A mere implementation of some algorithm without reference to theoretical analysis is not sufficient.* Before embarking on such a project, it is essential that you specify your goals clearly and discuss them with me first.

The nature of the report and presentation for this type of project will depend on the material, but the essential ingredients should be similar to those listed above for reading projects. In addition, it may be appropriate to attach an appendix giving technical proofs and/or experimental results.