

# Description of Projects for CS 5713 – Computational Learning Theory Fall 2024

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## Abstract

This is a description of what is expected on the semester-long project. Information is provided both for theory-based projects as well as for implementation-based projects. Lengths of deliverables as well as deadlines for the various checkpoints as also discussed.

**Keywords:** Theory-based projects, implementation-based projects

## 1. General Description of the Projects

Students should form groups of 2 and work on the semester-long project. No group can be of 1 person, or of more than 2 persons. The work of the students will be presented near the end of the course and will also have a written component. Projects can be **implementation-based** or **theory-based**. In either case, the students will have to present what they read, and potentially the findings of an implementation, at the end of the semester.

Each team should read papers that are closely related to each other, so that it is easier to present the work and ultimately be able to identify similarities and differences between them. Furthermore, apart from the main papers, each student should cite in the related work section of their write-up, at least 3 more papers (other than the main papers). The description does not have to be more than 1-2 sentences in length, thus putting in perspective the main papers that the students read with respect to the rest of the literature.

### 1.1. Implementation-Based Projects

For implementation-based projects each student should read one separate main paper (i.e., each team should read two papers as main papers) and base their work on these two papers. In cases where the authors have made the code public, the students can try to verify the findings of the authors on the same as well as on different datasets and thus verify the claims in slightly broader settings. An alternative, or, in combination to the above, could be that the students study and contrast empirically properties of the proposed algorithms (e.g., running time, rate of convergence), thus complementing theoretical results that are provided for certain algorithms.

### 1.2. Theory-Based Projects

For theory-based projects each student should read two separate main papers (i.e., each team should read four papers as main papers) and base their work on these four papers. As these are theory-based projects, the students do not have to implement anything. However, they are meant to discuss advantages and disadvantages of the different methods from the main papers that they have read thus giving a better idea on how the papers fit in the literature and compare against each other.

### 1.3. Written Report

Each group should submit a written report that will be due near the Thanksgiving break.

**L<sup>A</sup>T<sub>E</sub>X Template.** For the written reports we should be using the template that is used in the International Conference on Algorithmic Learning Theory (ALT). Here is the template for ALT 2025:

<http://www.gautamkamath.com/alt2025-style.zip>

The project has to be written in L<sup>A</sup>T<sub>E</sub>X and you are not allowed to use any other template.

### 1.4. Poster Presentations at End of Semester

Each group should present their work as a poster at an end-of semester poster presentations day. For 2024, the day when the poster presentations will take place is

**Friday, December 6, 2024.**

*The presentations will take place at some point in the morning, between 9am and 2:30pm. If neither student shows up in the final presentations on that day, both students will receive a 0 (zero).*

**Grade:** 15% of the total grade (i.e., 3/8 of the project grade).

### 1.5. Outline

Below is a rough outline for the checkpoints of this course.

Table 1: The length of each deliverable corresponds to the total number of pages expected per group of two students. Each student is expected to contribute approximately equally to the final product.

Chkpt	Project Grade	Date	Deliverable
1	12.5%	(Week 6) Sat, Sep 28, 2024	up to 1 <sup>1</sup> / <sub>2</sub> -page of text
2	12.5%	(Week 9) Sat, Oct 19, 2024	about 3-4 pages of text; each student has done ~50% of their work
3	37.5%	(Week 14) Fri, Nov 22, 2024	6-8 pages of text (all) + code (implementation-based)
4	37.5%	(Week 16) Fri, Dec 6, 2024	poster presentation

## 2. List of Papers

Please click [here](#) to view a list of candidate papers.

**Remark 1 (Suitable Sources for Papers)** *Students should select at least half of the papers that they will present in their group from the list of papers provided above. For the rest of the papers*

*that the students select, these should come from top computer science, artificial intelligence, machine learning, evolutionary, and data mining conferences such as: STOC, FOCS, COLT, ALT, NeurIPS, ICML, AAAI, ECML/PKDD, ICLR, KDD, SDM, IJCAI, ISIT, ECAI, FOGA, GECCO, EuroGP, CVPR, ICCV, ECCV. In addition, one can look into top journals such as Machine Learning (ML), Journal of Machine Learning Research (JMLR), Proceedings of Machine Learning Research (these are conference papers but from good conferences – PMLR), Artificial Intelligence (AI), Journal of Artificial Intelligence Research (JAIR), Annals of Mathematics and Artificial Intelligence (AMAI), Journal of Field Robotics (JFR), Communications of the ACM (CACM). If the paper is not published in such a venue, you should discuss with me its suitability. Having said that, some papers coming from venues that are closely related to trustworthiness issues (e.g., some top computer security, or conferences on fairness and AI ethics) are also more than welcome for selections. However, please discuss with me the specific paper that you would like to work on. I will also be happy to include some of the proposed papers in the list of papers that I have compiled.*

### 3. Details on the Project Requirements

For the semester-long project we have the following checkpoints/important dates.

#### 3.1. Checkpoint 1: Paper Selection

By **September 28th** the students should identify the papers that they want to be working on as groups and submit one page with their selections, explaining how the papers are related to each other. For implementation-based projects suggestions on datasets should be made as well.

The length of checkpoint 1 reports should be no more than one and a half page, not including the references. Ideally, I would like these reports to be within one page.

**Grade:** 5% of the total grade (i.e., 1/8 of the project grade).

#### 3.2. Checkpoint 2: Mid-Semester Report

By **October 19th** the students should have skimmed **all the main papers** that they have selected to work on and **for at least half of them** the students should show significant understanding of the work as well as near-complete experiments and commentary on the results and the claims of the authors in these papers.

**Implementation-Based Projects.** This document for checkpoint 2 should summarize your experiments to date, show the learning curves or tables of results that you have so far, and discuss any difficulties that you are encountering. Please note that you should have results for at least one of the two papers and have at least some vague idea on the work and the difficulties for the implementation results that will be needed in the second paper. Last, outline the work left to finish. Results need to be presented graphically (e.g. learning curves or tables, not a long list of numbers or a screenshot). I will try to grade these documents as quickly as possible and try to suggest ways to help you overcome obstacles. Of course, if you are facing serious difficulties even earlier, please reach out to me so that we can find a solution earlier.

**Theory-Based Projects.** These projects do not have experiments. However, in the written report for checkpoint 2, at least two out of four papers should be described reasonably well and for the other two papers the students should have an idea of what the results are about and the extent to

which it will be easy to make comparisons with the two papers that they have devoted more time for reading and understanding their content.

**Length:** Due to the above, the length of this report should be a roughly half of the length of the final report (see below for page limits).

**Grade:** 5% of the total grade (i.e., 1/8 of the project grade).

### **3.3. Checkpoint 3: Final Written Report**

By **November 22** the students should submit the final written report.

**Length.** In the final written report each student should write **at least 3 pages** and **no more than 4 pages** for describing in text the papers that they read, their findings (either by comparing papers theoretically, or empirically via an implementation-based project), and potentially place their work compared to other related work (e.g., what gaps in the literature exist from prior work and how the particular papers address some of these gaps). **Therefore, the written report for a group of two students should have length between 6 and 8 pages. References should not be included in this page limit.** In addition, students may use additional pages for their report where they have figures, tables, and perhaps theorem statements, that further support their claims in the main text of their written report, but no further commentary on the results themselves is allowed beyond the 4-page limit that we have per person.

The students are encouraged to write conclusions and comment upon the results based on their understanding, so that we can distill the knowledge of the papers using different approaches.

**Grade:** 15% of the total grade (i.e., 3/8 of the project grade).

### **3.4. Checkpoint 4: Final Poster Presentation**

As explained earlier, all projects need to be defended on the “presentations day” at the end of the semester via a poster presentation. For 2024, this day will be **Friday, December 6, 2024**. If neither student shows up during the poster presentation, the whole group will receive a 0 (zero).

**Grade:** 15% of the total grade (i.e., 3/8 of the project grade).