CS5100
foundations of AI

Final Project Guidelines and Requirements

Khoury College, Northeastern University

1 Key Logistics

All deadlines 6:00 pm Eastern

- Submit topic preferences [here] by Jan 25
- Groups assigned by Jan 27
- **Proposal:** due Feb 7, expect feedback & TA assignment by Feb 10 (3%)
- **Check-in 1:** Preferably during lecture time on Feb 24, 26, or 27. (1%)
  By appointment with assigned TA - can be virtual.
- **Check-in 2:** Between Mar 21–Mar 28. Significant progress expected. (1%)
  By appointment with assigned TA - can be virtual.
- **In-class presentations:** (15%)
  - **Slides Due:** Apr 11
  - **Presentations:** Apr 16-24, during lecture time.
    In-person attendance mandatory on all days.
- **Final report, peer evaluations and source code:** (20%)
  - **Report, GitHub repository, peer review form due:** Apr 18

2 Overview

The aim of the final project is to allow you to pick one topic in AI to pursue in more depth than course assignments permit and build something cool related to it from the ground up. The project should be interesting (and hopefully useful to someone) - but you should also consider feasibility when proposing a project. You might start looking for ideas in your daily life - look for problems that you might want to solve using techniques covered in this course. If you can turn your solution into something that lasts and is used actively beyond the final project deadline, that would be a fantastic outcome!

I encourage you to be ambitious. There are no[1] restrictions on the topic of the project (as long as it is relevant to AI). That said, I strongly advise against projects that will rely on LLMs/transformer architectures as a core feature of the pipeline - for several reasons: a) in most projects of this nature, the LLM/transformer ends up doing most of the heavy lifting and does not contribute meaningfully to the intended learning outcomes in this course, b) training these models from scratch is infeasible with available compute infrastructure, and fine-tuning existing models is not considered sufficient work for a group project, and c) most projects involving LLMs/transformers tend to be highly contrived, repetitive or derivative, and add little to no value to one's résumé. I would much rather have students pick an 'easier' topic, but build the AI infrastructure from scratch in order to gain a solid understanding of foundational methods.

The best projects are often those that arise organically - think not about what solution you would like to implement, but simply start by identifying a problem that you would like to apply AI towards. Tackling a problem that you personally face in your day-to-day life will lead to a much more motivated project, and lead to much higher satisfaction. A common mistake I see students make is looking for datasets on Kaggle, etc., and then designing a project idea that conveniently fits this dataset. Such projects end up being limited in scope, and not faring well in evaluations. Similarly, projects that are proposed by identifying an approach - say, a specific idea/technique a student has prior experience with - and then fitting a problem around this technique tend to fail at a significantly higher rate.

Think ahead of what we've already covered in class, and feel free to talk to me about your ideas! Projects involving *creative* use of LLMs (not as the central aspect of the project, but perhaps as a data generator, etc.), deep learning, and reinforcement learning are particularly fun - and pose unique challenges that make them a worthwhile learning experience. The next few sections detail what is expected from you at each stage of the project throughout the semester, and include some examples of excellent projects from past versions of this course.

[1] within reason, subject to ethical considerations

2.1 Project Proposal

The first step is a 1-page write-up of your project idea. It should contain a brief overview of what you're planning to do, and why. Identify a problem that you think can reasonably be tackled within a semester, and motivate it sufficiently. Identify and summarize existing approaches that have tried solving the same problem, with references/links as appropriate. It is absolutely okay to not know which AI approach would be the best solution at this point in the semester (especially since many of you are new to the field). In our feedback, we will make concrete suggestions for how to go about solving the problem of your choice. You should then start to read ahead of lecture content and build an understanding of the suggested technique(s) as a group. The proposal counts for 3% out of the 40% of your grade assigned to the project. Some cool past project ideas are listed below:

- Playing the NYT Connections game
- Combine existing instrumental music into novel tracks
- Translating ASL using webcam input
- Assist veterans in dealing with VA paperwork
- Optimizing city layouts to minimize travel time
- Equitable dynamic loan pricing

2.2 Check-in 1

Each group will be assigned a TA, whom they are required to meet with between the dates specified on page 1. All team members must be present. The week before Spring break, lectures are canceled on account of my unavoidable international travel, and instead, material will be covered through video recordings provided to you. The lecture meeting times should instead be used to complete your first check-in with the TA team. You should also use these lecture slots as an opportunity to work with your group on your project's initial codebase setup, etc. - since everyone is guaranteed to be available at the same time.

The goal of this first check-in is to assist you in finalizing your project direction, based on both provided feedback on your proposal, and your research thereafter. Teams are expected to come to the meeting having looked into the suggested approaches, produced a rough timeline of deliverables, and drafted a split of work and responsibilities. Any questions you may have for us are most welcome! This check-in accounts for 1% out of the 40% of your grade assigned to the project.

2.3 Check-in 2

The second check-in will be a 10-15 minute chat with the same TA about how your project is coming along, and will help us identify any shortcomings or hurdles that need to be dealt with before the final presentations and report are due. This check-in will be scheduled **outside** lecture hours, and by appointment. Ideally, all group members should be present for this check-in as well. This also gives us a chance to ensure that all members in the group contributed equally to the project (more on this in later sections). This check-in counts for 1% out of the 40% project component of your grade.

2.4 Final Presentation (dates on page 1, attendance mandatory)

Each group will present their work through an in-class presentation, lasting no longer than 9 minutes, with an additional 2-3 minutes for questions. Presentations with live demos are highly encouraged; this gives you a chance to impress the audience and show off your work. In the interest of minimizing turnaround time, all demos must be pre-recorded and embedded in your presentation. To do so, upload your demo videos privately to YouTube (or another similar service) and embed the web-hosted video into your presentation - this will minimize both the submission file size for your PPT, as well as the probability of things going wrong during the presentation. All group members must be present and are expected to participate equally in the presentation. Points will be assigned on the basis of clarity of presentation (both visual and content-related), formatting of results, ability to answer relevant questions, and adherence to the time limit. A more detailed rubric will be shared with you closer to the presentations.

2.5 Final Deliverables (due dates on page 1)

2.5.1 Final Report

The final project write-up should be a comprehensive technical report consisting of a **maximum** of 6 pages including references. You may use double-column research paper formats (optional), and the use of LaTeX is highly encouraged, but not mandatory. Please typeset algorithms, equations, and other mathematical operators as appropriate. A general outline of a project report would include some subset of the following sections (choose as appropriate for your project): a) Abstract, b) Introduction, c) Related Work, d) Problem Statement and Methods, e) Experiments and Results, f) Discussion and Conclusion.

The reader should be able to follow the problem you tried to solve, why it was interesting and relevant today, and what AI method(s) you attempted to use to do so. You should assume the reader is unfamiliar with the specific AI technique you used but is aware of basic computational concepts (such as your colleagues who may not yet have taken this course, but may have taken CS3500 and some introductory mathematics courses). You should report and discuss empirical results along with details about your experimental setup. Make sure that results are visualized or presented appropriately, and are easy to follow. Think about how you can make it easy for a reader to reproduce your work - report hyperparameters and architecture choices where appropriate. Choosing the right format for your results is half the battle. You should conclude by addressing any potential limitations and discussing ways of improving or extending your work beyond the course.

[LINK] Here is a sample project report, from when I took advanced AI as a first-year graduate student. This should give you a sense of my expectations with respect to the writing, level of detail, and presentation of results. Here are two of the best-written project reports from last semester: 1) [LINK] Equiloan, 2) [LINK] City Layout Optimization.

2.5.2 GitHub Repository

The implementation of your course project should be submitted as a public GitHub repository, which should be well-organized with modular, re-usable, and properly commented code. **Throughout the semester, each student must commit their work to this repository to establish a history of contributions, which will be a factor in your final grade.** All repositories must also include a detailed Read-Me file with instructions to recreate an appropriate environment and any necessary packages, and a walkthrough on how to run your code. Jupyter notebooks are not an acceptable submission format for the final project, but may be used solely for any data cleaning and preprocessing steps. If so, include the notebook and detailed documentation for the user in your GitHub repository. Here are some examples of well-formatted repositories from past semesters: 1) [LINK] Market Reader, 2) [LINK] AI City Architect

2.5.3 Group Member Ratings, Contributions

Throughout the semester, students may raise concerns about underperforming team members through Canvas ("Project Team Concern Report" in the Navigation sidebar). These reports may be filed as information only, or request direct intervention from me or the TA team. If concerns about a student are raised repeatedly, and performance does not improve despite intervention, they will be forced to switch to the research-intensive pathway instead in order to avoid failing the course. At the end of the semester, each student will also be required to submit final peer ratings for all of their group members. This rating will be submitted individually and will only be visible to the instructor and TAs. Consistent negative ratings from the rest of your group will have consequences on your project grade. All students are also expected to contribute directly to the actual implementation in terms of code, which will be evaluated through git history.

Working in teams can be challenging; however, it is a vital skill to gain at University. Be it academia or industry, most work with any real-world impact is the result of a collaboration. To track your team's progress, and to keep each other accountable, I highly recommend the use of project management tools, such as this progress tracker on Notion. Having an objective source of contribution history can be an effective tool in conflict resolution, should the need arise. Please also use the TA team's expertise to your advantage, and feel free to reach out if we can help with anything!

3 Grading

Grading will be based on the clarity of the writing, the novelty of the project, general interest in the topic, the suitability of the approach selected and applied, and the execution of the methods proposed. A detailed rubric will be shared closer to the presentation dates. The presentation will account for 15% out of the 40% project component, and the final report, your individual contributions, and source code repository together will make up the remaining 20% of your grade.