

Final Project

B351 / Q351

1 Summary

- Work in groups of 2-3 to develop an AI implementation that makes non-trivial decisions over a problem space of your choosing;
- Prepare a short paper summarizing your AI, the techniques and technologies you utilized, and the lessons you learned along the way; and
- Prepare a working demo with an intuitive user-interface as well as a poster to present at a course symposium during the course's final exam time.

2 Background

2.1 Timeline

1. **Team Formation Requests Due** - Friday, October 26th @ 11:59PM
2. **Draft Project Proposals Due** - Sunday, November 4th @ 11:59PM
3. **Project Proposal Meetings** - Monday, November 5th - Friday, November 9th (scheduled meeting)
4. **Final Project Proposals Due** - 24 hours after your Project Proposal Meeting
5. **Check-in 1** - Monday, November 12th - Friday, November 16th (scheduled meeting)
6. **Check-in 2** - Monday, November 26th - Friday, November 30th (scheduled meeting)
7. **Course Symposium** - Monday, December 10th @ 2:45-4:45PM in Luddy Hall Lobby
8. **White Paper Due** - Tuesday, December 11th @ 7:00PM
9. **[Optional] Peer Assessment Due** - Tuesday, December 11th @ 11:59PM

2.2 Teams

This project is intended to be a collaborative effort. You **must** find a 2-3 person team to work with (no single-person projects will be allowed). You are allowed to choose your teams and submit a team formation request before the team formation deadline; we have constructed a Piazza thread that you may utilize if you would like assistance in finding teammates. That being said, we will pair any unpaired students randomly.

Larger teams will be expected to produce a more sophisticated project than smaller teams. For example, we would expect approximately 50% more from a 3-person team than a 2-person team.

A moderating factor in your grade for this project will be a peer assessment. If you receive a negative assessment from your teammates, you will lose points on your individual score.

2.3 Mentors

Each team will be assigned a pairing of two mentors who will help provide guidance for the final projects. You will be assigned the mentors based on overlapping availabilities, as your team will be responsible for meeting with your mentors three times throughout the final project timeline (once for the proposal and twice for progress check-ins). If you have a preference for your mentors, you may indicate that, but we have very little ability to ensure your assignments.

The mentors will moderate and approve the scope of your project, and they will also hold the primary responsibility for assigning your final project grades.

3 Project Requirements

You have free range to select any problem space. Historically, students have been successful in applying the techniques covered in the course to alternative domains (e.g., building a poker bot) as well as learning new techniques for novel problems (e.g., facial recognition). The only requirement is that your work must be your own and not utilize an existing implementation. In other words, you must implement the central logic of your project yourself without relying extensively on third-party libraries or technologies.

3.1 Project Proposals

On Canvas, you will find an additional document outlining the information required for each team's project proposal. Your project proposal is **critically** important as it will outline how your final project will be graded.

You will initially submit a draft proposal that will be reviewed by your team mentors. They will provide feedback and ensure that your project is challenging yet manageable. **You are responsible for working with your mentors to schedule your feedback meeting. Failure to schedule this meeting will result in a 0 on the project.**

With their feedback, you will compile a final proposal for which you will be accountable for achieving. Successful students will endeavor to make sure that they research an appropriate scope for their project before submitting the proposal.

3.2 Check-ins

You will have two 15-30 minute progress check-ins throughout the project timeline. These are opportunities for you to show your mentors what you have accomplished, ask for advice or assistance, and receive feedback on your current progress.

At each check-in you are expected to have made significant headway on your project. Additionally, teams should come to these meetings prepared to take advantage of the limited time window. **Teams failing to demonstrate either of these requirements will receive a 0 for that check-in.**

Additionally, your team is responsible for ensuring that you can make your scheduled check-in times. In the event that you cannot, you must reschedule with your mentors. (Rescheduling will only be allowed due to extenuating circumstances.) **Failure to attend a check-in will result in a 0 for the check-in.**

3.3 Peer Assessment

The peer assessment is **optional** and is intended to help address inequitable contribution to the final project. In the case that a teammate's performance did not meet agreed upon expectations, you may file a peer assessment form (found on Canvas). We will then take into account the information therein when assigning final project grades.

Note that this is not intended as an outlet to bemoan conflicts that occur naturally as a byproduct of teamwork (e.g., differences of opinion, differences of schedule, etc.). We will only take into consideration negative assessments that meet the following requirements:

1. Demonstrate that there were agreed upon contribution expectations for each team member;
2. Demonstrate that a team member did not meet their expected level of contribution; and
3. Demonstrate that good-faith attempts were made to address and rectify the inequitable contribution and that these attempts were unsuccessful.

Failure to meet any of these requirements or failure to submit the form by the deadline will mean that we cannot take any further action.

3.4 Source Code

You may use **any** language or combination of languages to implement your project. However, you **must** use IU's GitHub to store your source code. Your team should have a private repository for the project and all of the course instructors must be invited as collaborators (instructor usernames can be found on Canvas). **Failure to do so will result in a 0 for this project.**

The code you generate for this project should follow the best practices for the language of your choosing. Significant points will be allocated to the style, clarity, and efficacy of the code you produce (just as it would if you were an AI developer in industry).

The central logic of your project must be of your own design and implementation, and each member of your team will be expected to understand how every component works. There is nothing wrong with using utility functions written by outside sources and placed in the public domain, but **you must clearly mark any such code in your comments and attribute the authors.** When possible, such outside code should be placed in separate source code files. If during our examination of your code it becomes apparent that you have represented outside code as your own, **you will receive a 0 on the project and be reported for violating academic integrity.** Your team will be graded solely based on the merits of code that you have written yourselves.

3.5 Third-party Tools and Libraries

We want to encourage all students to explore the tools and libraries available to them in the artificial intelligence software ecosystem. If reasonable, we support the use of these technologies to enhance your final projects. Such technologies might include numpy, scipy, pandas, TensorFlow, MPI, OpenGL, etc.

That being said, in the past students have received lower than expected scores for relying too heavily on third-party code and not sufficiently demonstrating their own knowledge. **This semester, your mentors must approve your use of third-party tools before you can incorporate them into your project. Failure to approve a third-party technology will result in a 0 on the project.** You can find the request form on Canvas; you will submit it to your mentors during one of your three in-person meetings.

3.6 Projects involving Machine Learning Tasks

The focus of this class is on artificial intelligence solutions that make decisions. We will not disallow students from addressing problems that involve machine learning tasks, but we will require that they connect their machine learning task to a decision-making process and adhere to the data guidelines available on our Canvas page.

Only running on the test data once and reporting all of your results is a matter of academic integrity and it makes your results valid. It allows you to accurately represent your models real-world performance on novel data. If there is any evidence that you have revised or selected your models based on their performance on the test data, we will be forced to regard your final results as invalid indicators of real-world performance, and your score will be significantly affected.

3.7 User Interface

Your project must have an intuitive interface that you will present at the course symposium. The interface can be as simple as a terminal input-output system to as complex as a rendering engine like Unity3D or webpage connected to a backend server.

Regardless of what you choose, it must meet the following criteria:

1. It must be presented on a laptop that you bring to the course symposium;

2. It should afford users as much interactivity in as intuitive a way as possible (with explanatory comments to combat any ambiguity); and
3. It should take no longer than 1-2 minutes to demonstrate your AI's competency.

Note that developing the user-interface is **not** the core component of the project. Spectacular interfaces may be awarded some extra credit (and are good for your personal portfolio), but **they will in no way make up for a poor AI implementation.**

4 Course Symposium

Instead of a final exam, we will utilize our allotted exam timeslot to host a symposium where you can demonstrate to your classmates and the instructors what you accomplished in your project. Each team will get a small booth where you are expected to have a poster summarizing your accomplishments and a laptop running a demo of your AI agent (complete with the user interface described above).

4.1 Presentations

A significant part of your grade will depend on the presentation of your project to instructors who attend your booth. Please be sure to

1. Always have at least one member of your team present at your booth and ready to present (the rest of your team members may explore the other projects);
2. Have a **3-4 minute** presentation that has been prepared and rehearsed so that your team can present it to instructors (and students) who visit your booth;
3. Have a **1-2 minute** demonstration of your project ready to run on your laptop;
4. Be prepared to intelligently answer any questions that the instructors (or students) may have about your project, research, or source code.

4.2 Posters

To accompany your booth, you must develop a poster that meets the following requirements:

1. Is at least 2×3 ft. in size;
2. Contains your project title and team member names;
3. Contains a description of your problem space;
4. Contains a description of the techniques you implemented;
5. (**Important**) Shows an empirical analysis of your algorithms, either versus other algorithms or in different scenarios;
6. Is of professional quality (i.e., not handdrawn).

5 White Paper

In addition to presenting at the symposium, your team must also develop a white paper that summarizes your teams accomplishments. It should meet the following requirements:

1. Is 3-5 pages in length, double-spaced, 12 pt, Times New Roman, 1-inch margins;
2. Ideally is typeset in L^AT_EX (consider using TeXStudio or TeXMaker), but regardless of the source language, your final submission must be a PDF;

3. Contains your project title and team member names;
4. Contains a description of your problem space;
 - (a) What are the rules / constraints / objectives?
 - (b) What are the major challenges?
 - (c) What are the different variations that you might encounter?
 - (d) Any other pertinent information?
5. If your project primarily focuses on a machine learning task, briefly describe how your efforts on this task connect with a decision-making process. How should the information you are determining influence the behavior of an intelligent agent?
6. Contains a description of the techniques you implemented;
 - (a) What algorithms are you using?
 - (b) How do they work?
 - (c) What is the time / space complexity?
 - (d) What are the limitations?
 - (e) What were some alternatives?
7. Shows an empirical analysis of your algorithms, either versus other algorithms or in different scenarios (or, ideally, both);
 - (a) Present your findings in graphs and/or tables (NOT a giant paragraph of text).
 - (b) Why did you get these results?
 - (c) Were the results what you expected?
 - (d) What do the results imply about the problem space?
 - (e) Anything else of interest?
8. If you made use of outside code (from sources such as StackExchange, etc), includes a short explanation of the following for each code snippet **in addition to your in-code comments attributing sources**;
 - (a) Explains how the code snippet is used in your program;
 - (b) Explains, in your own words, how each code snippet works;
 - (c) Attributes the source of each code snippet, including author name (if possible, or username) and source URL;
9. Provides an explanation of how your work could have been expanded or improved
 - (a) What improvements would you make to the AI?
 - (b) What lessons did you learn?
 - (c) Anything else of interest?

Rubric

| Item | Description | Points Earned | Points Possible |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|
| Project Proposal | <i>Was the proposal turned in on time and was it of professional quality? Did it reflect the feedback from the mentors?</i> | | 5 |
| Check-in 1 | <i>Did the team made significant progress and come prepared to demonstrate that progress to the instructors?</i> | | 2.5 |
| Check-in 2 | <i>Did the team incorporate changes suggested during Check-in 1?</i> | | 2.5 |
| White Paper | <i>Did the team submit a white paper PDF that met all of the requirements set out in the assignment description?</i> | | 30 |
| Source Code | | | |
| Clarity and Style | <i>Is it easy to parse the source code and is it clear what each component is contributing to the overall project? If necessary, is a README.md included to explain how all of the parts work together?</i> | | 15 |
| Efficacy | <i>Does the source code accomplish what the team claimed? Does it do so in the most efficient way possible?</i> | | 15 |
| Symposium | | | |
| Presentation | <i>Did the team have a rehearsed and coherent 3-4 minute presentation describing their problem space, artificial intelligence solutions, and empirical results?</i> | | 10 |
| Demo | <i>Did the team have a working demo that met all of the requirements for the user interface set out in the assignment description?</i> | | 10 |
| Poster | <i>Did the team bring a poster that met all of the requirements set out in the assignment description?</i> | | 10 |
| TOTAL | | | 100 |