

Final Project

B351 / Q351

1 Summary

- Work in groups of 2-3 to accomplish an engineering **or** research task in the field of artificial intelligence.
- Prepare a short technical or research paper summarizing your work.
- Prepare a professional poster along with a working demo to share with the class in a virtual symposium.

There are two tracks you and your teammates can choose between for your research project:

1.1 Engineering track

Use artificial intelligence techniques beyond those discussed in class to solve a task in a problem space of your choosing. Your technical paper should include a discussion of the problem space, an explanation of the algorithms implemented, and specifics about your solution's performance and limitations.

1.2 Research track

Compare different artificial intelligence algorithms or variants of algorithms to contribute to the understanding of the strengths and weaknesses of AI techniques. Your research paper should include a discussion of related research, a clear statement of your key question(s), and answer(s) based on your results.

2 Logistics

2.1 Timeline

1. **Team Formation Request Due** - Friday, Oct 22 @ 11:59PM
2. **Draft Proposals Due** - Friday, Oct 29 @ 11:59PM
3. **Project Proposal Meetings** - Monday, Nov 1 - Friday, Nov 5 (scheduled meeting)
4. **Final Proposals Due** - 24 hours after your Project Proposal Meeting
5. **Progress Check-in 1** - Monday, Nov 8 - Friday, Nov 12 (scheduled meeting)
6. **Progress Check-in 2** - Monday, Nov 15 - Friday, Nov 19 (scheduled meeting)
7. **Paper Drafts Due** - Friday, Dec 3 @ 11:59PM
8. **Paper Draft Meetings** - Monday, Dec 6 - Friday, Dec 10 (scheduled meeting)
9. **Posters Due** - Friday, Dec 10 @ 11:59PM
10. **Virtual Symposium** - Monday, Dec 13 @ 5:00PM (scheduled final exam time)
11. **Final Papers and Source Code Due** - Friday, Dec 17 @ 11:59PM
12. **Group Reflection Due** - Friday, Dec 17 @ 11:59PM

2.2 Teams

This project is intended to be a collaborative effort. After registering your preferences, you will be assigned a 2-3 person team to work with (no single-person projects will be allowed). We understand that smaller teams may have less time and combined expertise than larger teams, and will discuss expectations during your proposal meetings.

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

2.3 Mentors

Each team will be assigned one mentor who will help provide guidance for the final projects. You will be assigned the mentors based on overlapping availability, as your team will be responsible for meeting with your mentors four times throughout the final project timeline (once for the proposal, twice for progress check-ins, and once for the paper draft). If you have a preference for your mentors, please contact us to let us know, but be aware that our primary consideration is availability.

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.

2.4 Communications / Distance Learning

Team members are expected to be as professional and responsive as possible. The default expectation is that each team member will respond to communications from their teammates and mentors within 24 hours. Let your teammates and mentors know if this is not possible for you. If there is any way in which distance learning presents an issue for you, please contact the instruction team as soon as possible so we can help.

3 Project Scope

3.1 Engineering Track: Problem Space

You have free range to select any problem space. Historically, students have been successful in expanding upon the techniques covered in the course in new domains (e.g., building a Picross/nonogram solver) as well as learning new techniques for novel problems (e.g., handwriting recognition). The only absolute requirement is that your work must be your own and not utilize an existing implementation. In addition, you must be able to understand and explain the algorithms that you are implementing. In other words, you must implement the central logic of your project yourself without relying extensively on third-party libraries, technologies, or tutorials.

3.2 Research Track: Key Questions

You may address any research question of your interest, so long as your project involves implementing some algorithm modeling human intelligence. In the cognitive science realm, you may characterize the performance and flaws of modeling human decision-making in a certain way. In the computer science realm, you may compare different algorithms or different variants of algorithms for performance and efficiency. For example, you could compare Monte-Carlo tree search and minimax on a particular problem, or you could analyze a tradeoff between search depth and heuristic accuracy for the minimax algorithm. The only requirement is that you must address a clearly articulated, novel question that is related to themes discussed in class.

3.3 Projects involving Machine Learning Tasks

The focus of this class is on decision-making agents whose algorithms mirror human thought processes. Of course, machine learning is a very exciting field these days and we will not disallow teams from addressing problems that involve machine learning tasks. However, we expect a similar level of depth and mastery for

projects dealing with outside material as we do for projects dealing with topics covered in lecture, even if you have not been taught this outside subject matter.

In either case, your project must go beyond the level covered in homework assignments and tutorials; you must tackle a novel problem and apply advanced techniques. We will be happy to discuss whether or not your project is in scope and what our expectations are during our meetings with you.

If you do decide to focus on a machine learning task, please ensure that you adhere strictly to the data guidelines available on our Canvas page. Setting your test data aside until your source code has been finalized 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 model's real-world performance on novel data.

4 Project Requirements

4.1 Project Proposals

On Canvas, you will find additional documents outlining the information required for each track's project proposal. The most important features of the proposal are the description of your problem space / key questions and the rubric outlining your goals for each letter grade. 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 complete the draft proposal and attend this meeting will result in a 0 on the **entire project**.

With your mentors' feedback, you will compile a final proposal that will serve as a contract for your project overall. Successful students will make sure that they research an appropriate scope for their project before submitting the final proposal. Your final proposal must include a checklist of specific and appropriate criteria your project will meet for each grade level. This final proposal is due 24 hours after your feedback meeting with your team's mentors.

4.2 Check-ins

You will have a number of 10-15 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. Your check-in time will be assigned following a survey about your availability; your check-ins will repeat weekly for the duration of the project.

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. We assign a small number of points to ensure that students make appropriate use of our check-in sessions. **Team members who do not attend or are not prepared for a meeting will receive zero or half credit for that meeting.**

This semester check-ins will take place over Zoom and you will receive links for check-ins when your mentors are assigned; please contact us if this presents any issue for you.

4.3 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 the **entire project**. Along with this, your repository must contain a

README file with specific instructions on how to run your program along with any dependencies used in the 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 found in outside sources such as “Stack Overflow”, but **you must clearly mark any such code in your comments and attribute the authors**. When possible, such outside utility 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**. In extreme cases, we may assign a failing grade in the course.

Your source code will be based on the grading criteria we agree upon in your final project proposal.

4.3.1 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 strongly support the use of these technologies to enhance your final projects. Suitable technologies might include numpy, scipy, pandas, TensorFlow, MPI, CUDA, etc.

That 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. You must list any third-party tools in your proposal and describe how extensively you will use them.

If you want to add third-party technologies later on during your work, you **must** contact your mentors for approval. Failure to approve a third-party technology will result in a 0 on the source code section. You can find the project proposal amendment form on Canvas; you will present it to your mentors during one of your Zoom meetings.

4.3.2 User Interface

Your project must have an intuitive interface that you will present via screen-sharing at our virtual symposium. The interface can be as simple as a terminal input-output system to as complex as a rendering engine like Unity 3D or webpage connected to a backend server.

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

1. It must be presented via screen-sharing at our virtual 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 primary results or 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.

4.4 Technical/Research Paper

In addition to your source code, we expect a technical or research paper explaining the algorithms you implemented and the impact of your project. See the additional documentation files on Canvas for further details on each track's paper.

4.5 Group Reflection

After the project is finished, all team members will be required to fill out a form that describes what you and your teammates contributed to the project. This form also should share any thoughts about your group dynamics / what you've learned about working in teams. For each teammate, you are responsible for writing a short summary of the tasks they completed. Note that the members do not need to all complete the same number of items, but the overall workload should be roughly the same.

Along with this, you are allowed to bring up any instances where your partners did not communicate or accomplish tasks as promised. This is intended for extraordinary circumstances and not ordinary differences of opinion. All feedback will be taken into account by your mentors when deciding final grades.

5 Virtual Symposium

Instead of a final exam, we will be holding a virtual symposium for your group to display your project to your classmates, instructors, and the broader IU computer science and cognitive science community. This is a time for your team to show your peers all the hard work you've put into this assignment. Each team will submit a poster to our virtual symposium and hold a Zoom meeting room for interested peers, instructors, and faculty to try out a demo (as mentioned above) and ask questions.

5.1 Presentations

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

- Have all team members online in your Zoom meeting room until your mentors have arrived to grade your presentation.
- Always have at least one member of your team online in your Zoom meeting room and ready to present (the rest of your team members may explore the other projects).
- Have a **3-4 minute** presentation that has been prepared and rehearsed so that your team can present it clearly to instructors and students.
- Have a **1-2 minute** demonstration of your project ready to run on your laptop.
- Be prepared to intelligently answer any questions that the instructors or students may have about your project, research, or source code.

5.2 Posters

To advertise your virtual booth, you must submit a poster that meets the following requirements:

- Is a vector graphics format such as PDF or SVG
- Contains your project title and team member names
- Contains a description of your problem space / research questions
- Contains a description of the techniques you implemented
- **(Important)** Shows an empirical analysis of your algorithms' performance, either versus other algorithms or in different scenarios

Rubric

Item	Description	Points Possible
<i>Preparation</i>		
Draft Proposal	<i>Was the proposal turned in on time and was it of professional quality?</i>	5
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
Project Meetings (4)	<i>Did the team made significant progress and come prepared to demonstrate that progress to the instructors?</i>	10
<i>Virtual Symposium</i>		
Poster	<i>Did the team bring a poster that met all of the requirements set out in the assignment description?</i>	10
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
<i>Source Code</i>		
Project Success	<i>Graded according to the contract set out in the project proposal.</i>	100
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? Is a README.md included to explain how all of the parts work together?</i>	25
<i>Technical/Research Paper</i>		
Paper Draft	<i>Did the team submit a technical/research paper PDF that met all of the requirements set out in the assignment description?</i>	25
Final Paper	<i>Did the team submit a technical/research paper PDF that took into account the feedback given in the initial draft?</i>	50
TOTAL		250