# CS 4701: Practicum in Artificial Intelligence
# Spring 2020
# Project Description

CS 4701 involves the creation of one semester-long programming project. The goal is to exercise knowledge you acquired from one of your AI courses (CS 4700 or others in our curriculum) through the development of a large-scale system. The major effort of the project should involve AI, as opposed to user-interface design, client-server software, etc. These can certainly be part of your system, but it should not be where most of the work takes place – beware, it is very easy to get sucked into programming effort that is not central to the goal of 4701.

Students should work in teams of 3. Any variance from this number requires prior permission and is **rarely** granted.

Nearly the entirety of your grade is based on your project. Your overall grade is determined as follows:

- 10%: Completing all milestones as requested.
- 10%: Short presentation at the end of the semester.
- 80%: Your overall project, computed as follows:
    - 50%: Effort
    - 20%: Clarity of writing
    - 30%: Evaluation

These are discussed further below.

Your project will have the following milestones/assignments.

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## MILESTONE 1: Teammate Selection
## Due: Thursday, February 6, 11:59pm

ONE MEMBER of your team should go to CMS and do the following:

- Upload a file containing your **Team Agreement**.
- Group with your team members.

If you are unfamiliar with grouping on CMS, follow the below instructions:

1. You should set your CMS notifications so as to receive emails about group invitations (Instructions: http://www.cs.cornell.edu/Projects/CMS/userdoc/notifications.html)
2. One person issues a request on CMS, from the relevant assignment page (Project 1 Proposal, in this case).
3. The invitees must accept on CMS. (Any other pending invitations to the invitee are automatically declined.)

You have *not completed this Milestone* if you have not fully grouped (sent and accepted invitations) on CMS.

**TEAM AGREEMENT INSTRUCTIONS**

Working together as a team with an entire course grade depending on it is a serious commitment to your teammates. To reflect this commitment, I am asking that you take a moment to reflect on it by submitting a "Team Agreement". It may be copied verbatim from what follows, or even better it can be adapted to reflect your further thoughts on working together as a team. You should print out the agreement together with your names and each team member should sign it, indicating acceptance of these expectations and your intention to fulfill them.

*We all show equal commitment to our objective.*
*We will all take part in deciding how work should be allocated.*
*We are committed to helping each other learn.*
*We will acknowledge good contributions from team members.*
*We will handle disagreements and conflicts constructively within the team.*
*We will give constructive feedback to one another, and will receive feedback in that light.*
*We will attend all planned team meetings and stay for their full duration.*
*We will keep each other fully informed about what's going on.*
*When one of us is under pressure, we will offer to help that teammate.*
*We will support each other both inside and outside the group.*

If you do choose to modify this agreement, make sure the expectations that you list are thoughtful and realistic. For example, "We will get a perfect score on the project" would not be meaningful as a principle to follow for working together. If you'd like further thoughts on writing your team agreement, please consult the CS3110 Fall 2018 Teams materials prepared by Prof. Michael Clarkson.

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MILESTONE 2: Project Proposal
Due: Thursday, February 13, 11:59pm

ONE MEMBER of your team should upload a copy of the proposal to CMS. Your CMS group will automatically transfer from the Team Selection assignment.

Your proposal should have the following information, in the order specified:

- **Title** of your project
- Team member **names** with Cornell **NetIDs**
- **AI Keywords:** What area of AI does your project involve? For example, reinforcement learning, natural language processing, game playing, etc.
- **Application setting:** To the extent relevant you should specify the "application" task you are attempting. For example, for a game playing program this would be the name of the game, for a chatbot it would be the setting it would be in, etc.
- **A clear and concise description** of what you plan to do:
  - Section 1: (1-2 paragraphs) What you want to do. Give us the big picture.
  - Section 2: (2-3 paragraphs) What specific aspect of AI will you be developing in your project? Show us that you've thought more than superficially about how you would go about doing what you just described in Section 1.

- Section 4: (2-3 paragraphs) How will you evaluate your system? Make sure you have thought about this carefully. For example:
  - How will you know if you were successful in what you attempted? For example, if you're going to build a game-playing system, how will you know how good it is? Is there an existing program you will go head-to-head against? (And if so, think about this carefully – it is easier to go head-to-head with an open-source game playing program that you can download and run locally than to do so with a game that you can only play via, say, an iPhone.) Or will you have it play against humans? (And if so, think carefully about this – how will you know how good the human players are, to calibrate your results?)
  - If you plan to explore different solution approaches, how will you determine their relative merits? Or if you had different design options for some facets of your system and you explored the various options, how did you settle on the ones you ultimately use?

  **One special word of warning:** If your evaluation involves people interacting with your system you should recruit people other than yourselves, such as other 4701 students. Plan for evaluation, and include it in the next item, the project timeline.
- Section 5: A timeline for your project, spanning implementation, evaluation, and writing. This should be a list of milestones that shows that you've thought about the steps you'll need to accomplish along the way. It should include dates for each. Think about how you will break up your project into pieces, how long each piece should take, which things can be done in parallel versus must be done sequentially, who will do which parts, etc.
- Section 6: Any existing resources (software, data, etc.) you are thinking of relying on. You do not need to reinvent the wheel. If there are software or data resources that you want to use in your project that's ok. It is the work you do beyond these that is graded. Thus, for example, if you propose a project that involves machine learning this is where you would demonstrate that you've thought about where you will find data. Finding existing data is fine, just as is creating your own data resource if need be, depending on the nature of your project. Please include separate subsections, as relevant, for software versus data resources.
- Section 7 (If relevant) Is your project related to anything else members of your team are doing? How? Your project can be connected to something else you are currently doing. The only requirements are that (1) the work for the project must be disjoint from what you are doing elsewhere, (2) you disclose that this is the case, and (3) all parties (both this project's teammates as well as those involved in whatever else it is connecting to) are aware of its use in this fashion. **It is extremely important that you are clear what is distinct in this project compared to the work you would be doing otherwise.** Make sure to be specific.
- Section 8 (If relevant): List any references (technical papers, websites, etc.) you used in formulating your project.

Your proposal is not a contract. We expect your project to evolve over the semester. It's purpose is to make you think carefully about your project – so you scope out the scale well, assess whether your team has the necessary skills for the proposed project, divide up the work among the people and over the semester thoughtfully, etc.

Take the space that you need to provide all the requested information. There is no explicit page limit for this, but as a rough guideline 1 page will probably be on the short side, 4 pages on the long side. If you feel some figures are necessary to explain something, your proposal might go longer. The same if your project is related to something else you're doing and you need space to describe it, or if you need to describe existing software or data resources that you hope to use. All this is fine.

You will receive feedback on your proposal. We want you to succeed with your project and the feedback is to help you do so. It will fall into one of three general categories:

- Move ahead as you planned (potentially addressing the feedback you were given).
- Submit a revised proposal. This is sometimes because the feedback was sufficiently large that we want to make sure that you addressed it all effectively, and sometimes it's simply that we need some additional information to be sure we understand your project and can give you helpful feedback.
- Discuss your project with the TAs. This typically happens if we either don't feel we understand the proposed project sufficiently or if we feel there is some significant amount of retooling that might be necessary.

On rare occasions, circumstances have arisen that made a team want to change projects midstream. **You cannot do so without permission.** Should that wind up the case you would need to prepare a replacement proposal following the guidelines above.

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MILESTONE 3: Status Report
Due: Tuesday, March 24, 11:59pm

ONE MEMBER of your team should upload a copy of your status report to CMS. Your CMS group will automatically transfer from the Project Proposal assignment.

It is natural for your project to morph over time. The goal of the status report is to (1) make sure you have been working on your project, (2) give details about project elements that weren't apparent at the time of the project proposal, and (3) give you a chance to explain how what you're hoping to do has changed. It also gives us a chance to provide feedback to help you along.

Your status report should start verbatim with the project proposal that you originally submitted and **directly add to it**. Please make it easy to see what was in the original proposal versus what is new text. One good way to show what is new versus what was already there is to use a **different colored font** for your new text to distinguish it from the earlier proposal text.

The best-case scenario is that things are going exactly as you planned, which would make your status report trivial to prepare. But things *never* go exactly as planned. It is totally OK if things have changed or there's more that you didn't think of at the time of the proposal. This update will most typically include things like the following:

- We didn't realize that doing part X was so hard, so it's taking us longer to do it and we had to scale back some other part Y.

- We said we would do X but it doesn't seem to be working so we decided to instead do some modified version of X.
- We discovered this great software/data resource which simplifies X, which means we're now going to try to do something bigger, X+Y.
- We learned that the great software/data resource X that we expected to use wasn't available, so we're instead using Y.
- We thought more about how to evaluate the project, and instead of doing X we now realize that it will be better to do Y.

Please also provide an updated timeline. It should say which items in the original timeline have been done, and what (if anything) you are changing in the timeline given what you've learned about the project thus far. Similarly, if the planned division of labor has changed, say so. Please also add any additional references to technical papers or websites if relevant.

We expect to have seen substantive work by this point in the semester, and it is a component of the effort portion of your grade.

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MILESTONE 4: Project Presentation
Due: TBD, Last week of classes/finals

You will give a 15-20 minute oral presentation that gives an overview of your project. Its primary goal is to have you give us some help in understanding your project when reviewing your project report. Don't try to present all your work. Do try to present the big picture of what you were trying to do, what you accomplished, and how you assessed it. More details will be given later in the semester.

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MILESTONE 5: Final Submissions
Due: TBD, Last week of classes/finals

You will need to submit **three things:**

1. A final report
2. Your code
3. An individual report

**MILESTONE 5a: Project Report (Group)**: This is the main report for your project.

ONE MEMBER of your team should upload a copy of the proposal to CMS. Your CMS group will automatically transfer from the Status Report assignment.

Your final submission should be a roughly 10-page paper. As with the proposal, this is a guideline that you might very well vary from. For example, your report might be longer if you require many figures. To help you calibrate this guideline, a 5 page paper would likely be too short whereas a 15 page paper would likely be too long.

Your report should include the following, in the specified order:

- Title page:
  - Title of your project
  - Team member names with Cornell NetIDs
  - AI keywords
  - Application setting
  - List the names and NetIDs of any other students who played a role in your submitted project
    - For example, did others proofread your paper or serve as user study participants for your evaluation?

- The body of your report will have two main sections of equal importance:
  - Part 1: Project description
    - Say what you had planned to do, then explain what your project wound up being.
    - Explain what were the key aspects of AI that were the core of your project.
  - Part 2: Evaluation
    - Explain what assessment you conducted concerning your project. How well did you do? Be clear about (1) what *questions* you asked, (2) *how* you went about answering them, and (3) what specific answers you got. This will likely be quantitative. Your question(s) might be about how well your system worked (perhaps along multiple dimensions), or it might be about how different elements of the system design contributed to overall success. **Your project is not complete if you have not thought about how you can evaluate your accomplishments**; the nature of this evaluation is part of the design of your project. Be clear why you think you were successful, or not, or in what circumstances. Sloppy or hand-wavy discussions of performance will significantly negatively impact your grade.

- References (as relevant):
  - Technical papers, books, websites, etc., that played a role in the formulation and execution of your project
  - Software resources
  - Data resources

- Relationship to other work by team members (if relevant): If you project was connected to other work any members of your team were involved, please summarize how this project was distinct from it.

Note what this **DOES NOT** include: code listings, software architectures, etc. If you're discussing the different modules of your system your report is at the wrong level. Your report should be about the ideas. At this point in your studies I'm presuming that you can architect and code software, and what heft there is in your hacking should be apparent through the ideas and evaluation you conducted.

**MILESTONE 5b: Code**:

ONE MEMBER of your team should upload a copy of the code to CMS as a .zip file; this is part of the same CMS assignment as your final project report.

You will NOT be graded on the quality of your code. It doesn't even matter what programming language(s) you use. However, we do want to have your code as a record of your work. This will allow us to check, for example, that your team implemented the code and that it does what you reported it does.

**MILESTONE 5c: Project Report (Individual)**: Each team member should submit on CMS a short (1-2 page) personal report on the project. This is an individual assignment. This report should have three brief sections:

- Section 1: Outline your individual contributions to the project.
- Section 2: Describe what personal lessons were learned from doing the project.
- Section 3: (If relevant) If you played a role in the project of another team, such as serving as a test user or reading their report, you should document this here.

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## BE AMBITIOUS!

Glorious failure is better than timid success

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List of sample projects from recent past offerings of CS 4701

- Adversarial facial recognition data transfer
- Assassins AI
- Atari video game AI
- Brick Breaker AI
- Bughouse chess AI
- Capture Go AI
- Crossword puzzle scan and solve
- Customer volume prediction
- Daily Fantasy Football advisor
- Electronic dance music composer
- Eye-swipe user interface
- Five-card Draw Poker AI
- Generic card game AI
- Handwritten Japanese transcription
- Houseplant care advisor
- Machi Koro AI
- Manga translation and character recognition
- Multi-cuisine recipe creator
- Onitama AI
- Pentago AI
- Physical therapy exercise assessment
- Pokemon battle
- Poster design advisor
- QWOP AI
- Rap rhyming analyzer
- Rendering images geometrically
- Risk (boardgame) AI
- Sign language interpreter
- Skin disease advisor
- Song lyric generation
- Super Smash Brothers Melee AI
- Texas Hold-em AI
- Tool for predicting cryptocurrency pricing based on Twitter
- Two-player Tetris AI
- "Ultimate Tic-Tac-Toe" AI
- Video style transfer
- Wikipedia chatbot
- Wikipedia game AI