

# Project

CS 421: Natural Language Processing

Due: December 2, 2019 (12 p.m.)

## 1 Introduction

All graduate students enrolled in CS 421 are required to complete a semester-long project. Undergraduate students may optionally choose to complete a semester-long project, in which case their course grade can be determined according to the graduate student grade breakdown (20% project, 40% exams, 40% assignments) rather than the undergraduate grade breakdown (50% exams, 50% assignments); however, it is not mandatory for them to do so. Projects can be selected from one of the following topics: (a) build your own chatbot, (b) build your own essay grader, or (c) custom project. Regardless of which topic you select, you will be responsible for three deliverables:

1. Implementation (30%)
2. Report (40%)
3. Presentation (30%)

You may complete your project individually or in pairs. If the latter, you must include a signed statement (scanned copies are fine) in your project submission detailing each partner's contributions. Please make note of the following dates regarding final project deliverables (additional details can be found in subsequent sections of this document). All deadlines are at noon.

Deliverable	% Course Grade	Due Date
Proposal for Custom Project	0	10/29/2019
Notification of Partner and Undergraduate Notification of Participation	0	11/12/2019
Project Implementation	6	12/2/2019
Project Report	8	12/2/2019
Project Presentation	6	12/3/2019 or 12/5/2019

## 2 Project Topics

Further guidelines for each project topic are provided below. Those interested in pursuing a custom project are encouraged to discuss their plans with the Professor and/or TA early in the semester.

### 2.1 Build Your Own Chatbot

Conversational agents have quickly pervaded everyday life, materializing in devices ranging from the expected (e.g., cell phones) to the quite unexpected (e.g., chatbot-enabled microwaves). These agents can be utilized for a variety of purposes, some strictly task-based and others less structured. This project will focus on the latter.

Specifically, you will be tasked with creating a conversational agent with whom the Professor or TA can converse for a minimum of 20 dialogue turns under the same expectations that they might hold when conversing with a stranger at a social event. For the purposes of this exercise, you may pretend that both the Professor and TA have normal social skills. That is, in the span of 20 dialogue turns with a stranger they might want to:

- Discuss a couple different, but relatively generic, topics (e.g., the weather, sports, TV shows, or music)
- Ask some questions, but not feel as if they are interviewing the other party
- Answer some questions, but not feel as if they are being interviewed
- Engage only in dialogue that does not require extensive prior context

They will probably not want to involve themselves in technical discussions or those that involve polarizing topics (e.g., politics), nor will they want to spend too much time on one specific topic. In case of misunderstandings (in either direction), they will want to be able to avoid awkwardness by quickly recovering and moving to another topic. Finally, they will want to be able to easily exit the conversation when they decide that they have talked for long enough.

You may build your chatbot using rule-based methods, statistical and/or neural models, or a combination of the two. You are encouraged, although certainly not required, to take advantage of third-party dialogue system frameworks to aid in the creation of your agent. Some of these frameworks include:

- DialogFlow: <https://dialogflow.com/>
- Wit.ai: <https://wit.ai/>
- Microsoft Bot Framework: <https://dev.botframework.com/>
- ChatScript: <https://github.com/ChatScript/ChatScript>

Your chatbot should be able to converse about at least three different topics, which you may choose at your discretion while keeping in mind the general project guidelines. You will probably need to store information about these topics in some sort of knowledge base. You should indicate what the topics are in your submission, and provide at least 10 sample inputs to lend some guidance to the Professor and TA. However, they will also provide their own inputs to test the system. At least one of their test inputs will be a string of random letters (gibberish), one will be purposely off-topic, one will ask an on-topic question, and one will provide an on-topic answer.

## 2.2 Build Your Own Essay Grader

In light of teacher shortages and the growing prevalence of standardized testing in K-12 and higher education, it is increasingly impractical to assume the availability of human graders for essay questions.<sup>1</sup> Some educational assessment companies have instead begun to focus their efforts on developing automated approaches for essay scoring. These approaches combine many NLP subtasks, including but not limited to checking grammar, measuring language complexity, and assessing textual coherence.

You will be tasked with creating a system that automatically scores essays written by 7<sup>th</sup>-10<sup>th</sup> grade students. The system should be trained and evaluated using the ASAP-AES essay dataset (<https://www.kaggle.com/c/asap-aes/data>), which contains responses to eight different prompts. Essays corresponding to these prompts were manually graded using different score ranges, so your system will need to somehow adapt its own predictions accordingly (either by training separate models for each prompt, training a single model and scaling the predicted score to different ranges, or employing more advanced domain adaptation techniques). You should evaluate your system's performance overall and for each subset of test essays using quadratic weighted kappa (<https://www.kaggle.com/c/asap-aes/overview/evaluation>).

You may use any statistical, classical machine learning, or deep learning model that you would like to train your essay grader, and may extract any features from the data that you think would aid in the model's performance. You must extract a minimum of three different types of features. Some characteristics that you may want to encode as features when building your essay grader include (but are certainly not limited to):

- Essay length
- Word order
- Spelling mistakes
- Subject-verb agreement

---

<sup>1</sup>This is not a commentary on CS 421; your project reports will be graded manually.

- Topic coherence
- N-gram frequency

You are welcome to use third-party libraries to aid in data preprocessing, feature extraction, and model training and evaluation. You should compare the performance of your model to (at least) a baseline that predicts a random class for each test essay. You are encouraged to compare to other alternative approaches, such as versions of your model with some types of features removed, as well.

## 2.3 Custom Project

If you already have a different project idea in mind, or if you find yourself unexcited about building a chatbot or essay grader, you are welcome to propose a custom project. Custom projects must be approved by the Professor and TA by Tuesday, October 29th; if you do not have your custom project approved by that date, you must choose between one of the other two project topics.

When proposing your project, you should keep the following guidelines in mind:

- Projects should seek to explore a new idea—if you hope to simply replicate an existing project from some external source, you should very clearly state your motivations for doing so.
- Projects should be achievable within the span of a single semester.
- Projects should not require computing resources to which you do not currently have access.
- Projects should not involve human subjects unless you already have IRB approval.

To submit a custom project proposal, write up a short (less than one page) document indicating your goals, planned methods, and estimated timeline, and email it to [hshahi6@uic.edu](mailto:hshahi6@uic.edu) in advance of the stated deadline. You may view this proposal somewhat like a contract—if it is approved and you meet (most of) your stated objectives, you will probably receive a high score for your implementation. If, on the other hand, you do not meet any of your stated objectives, you will probably receive a lower score. Do not feel obligated to cram an unreasonable number of goals into your proposal; the project is only worth 20% of your overall course grade, and should require a proportional amount of work (assuming each assignment is worth 8% of the overall course grade, roughly the workload of 2-3 assignments).

## 3 Implementation

Regardless of your project topic, you are required to include your implementation in the project submission. If you use third-party code for any portion of

the implementation, make sure to document it! The inclusion of undocumented third-party code will be considered plagiarism.

Include a README file with your submission that clearly describes how to run your implementation, complete with suggested input and expected output if applicable. The Professor and TA will use this file to figure out how to run it; if they are unable to run the code based on the instructions given, they will assume that a working version is not available.

In the event that your implementation is too large or complex to reasonably expect the Professor or TA to run it, schedule a meeting with one of them to demo the implementation and then submit the source code so that they are still able to run their plagiarism checks. If you need to demo your implementation, you must do so prior to the December 2<sup>nd</sup> project deadline; otherwise, it will be considered late.

## 4 Report

A central component of your project submission (and the component worth the largest share of points) will be your final report. Your final report should be between 2200-2800 words, and should be formatted similarly to a standard conference paper, containing the following components:

- **Introduction:** The general problem statement, the motivations for solving the problem, and your key contributions.
- **Related Work:** An overview of prior relevant work towards solving the problem. You should make sure to point out how your approach compares to or differs from other related approaches. Readers should come away from the related work section with a clear idea of how your research builds upon that which has been done already.
- **Methods:** A description of the methods you used to complete your project. This section should include, but is not limited to: dataset descriptions, feature descriptions, design overview(s), model parameters, and external tools and libraries used.
- **Evaluation:** The alternative method(s) to which your project was compared (those building their own chatbots may need to get creative with this), the evaluation metrics, and the results of your evaluation.
- **Discussion:** A more qualitative evaluation of the project, detailing what worked well, what didn't, and why that might be the case. It is often useful to include specific examples of good and bad performance in this section.

- **Conclusion:** A summary of the key contributions and findings resulting from the project, optionally followed by a brief discussion of plans for future improvement.

If this is one of your first exposures to scientific writing, or if you would simply like to view a selection of sample project reports to gain a better understanding of what is expected, contact the Professor and/or TA and they will gladly provide those for you.

## 5 Presentation

During the last week of class, you will give a short presentation about your completed project. The exact time limit will be determined once the Professor knows (a) how many students are working in pairs vs. individually, and (b) how many undergraduates, if any, are choosing to complete projects. Your presentation should include the following components:

- Your goals and any hypotheses you made prior to completing the work
- The methods you implemented
- Your evaluation procedures
- Your results
- A brief discussion of the results
- A final summary of your contributions and key takeaway points

If you are working with a partner, the two of you should present your work together unless some other arrangement has been pre-approved by the Professor.

## 6 Individual vs. Pair Projects

Students may choose to work either individually or in pairs, depending on their preference. Although projects are expected to contain the same key components regardless of whether one or two people are completing them, grading may be more rigorous for those working in pairs since (in theory) there is room for twice as much work. Partners may also receive different grades for the same project submission if the Professor and/or TA determine that one partner contributed significantly more to the project than the other. To facilitate a fair assessment of the individual contributions of project partners, all projects completed in pairs must be accompanied by a statement explaining the distribution of work across the project, signed by both partners.

If you are interested in working with a partner but do not have a specific partner in mind, feel free to post on Piazza to see if any of your classmates are also

searching for partners.

If you are currently working with a partner but no longer wish to (either because you do not like your partner anymore or you simply decided you'd prefer to work alone), email the Professor and TA to let them know, and preferably CC your partner when doing so.

## 7 Deadlines

The project is due on **December 2<sup>nd</sup> at noon**, and final presentations will be scheduled for **December 3<sup>rd</sup>** and **December 5<sup>th</sup>**.

If you would like to work on a custom project, you must submit your project proposal via email by no later than **October 29<sup>th</sup> at noon**. For record-keeping purposes, you must submit a short written proposal (less than one page) even if you have already had your project verbally approved by the Professor or TA.

If you will be working with a partner on your project, the two of you must notify the TA by **November 12<sup>th</sup> at noon** (if you will be working with a partner on a custom project, this should be mentioned in the project proposal). If you are an undergraduate who plans to complete a project, you should also notify the TA by this date, regardless of whether or not you will be working with a partner. If you are a graduate student and do not email the TA by this date, it will be assumed that you will be completing the project on your own. If you are undergraduate student and do not email the TA by this date, it will be assumed that you will not be completing the project.

If you have any further questions regarding the project requirements or deadlines, feel free to post them on Piazza.

Happy researching!