

CS1951k/CS2951z Final Project

1 Introduction

This course has focused on both the theory and practice of algorithmic game theory, particularly with regard to auctions. To that end, the final project has both a theoretical and practical component, as described below. Your job is to pick a game (either the [Spectrum Auction](#) or the [Ad Exchange](#)), and then complete these theoretical, practical, and unifying tasks for your game. You should compile your theoretical results in a writeup (no more than 5 pages), and your practical results in a fully operational agent. Before you submit your code, you will have a chance to test it out against other agents to see how well yours fares.

2 Tasks

2.1 Theoretical

Construct a model for a simplified version of both the game and the behavior of other bidders. Compute, and describe intuitively, an optimal strategy in your simplified version of the game. We leave the particular simplifications up to you, but ideally they would be simple enough that you can derive optimal behavior, but complicated enough that it bears enough of a relationship to the original game that your ideas will be meaningful when implemented in your agent.

Note: If you try out a model and it turns out not to be useful, feel free to include that in your writeup! We are interested to see (at least some of) your process, not just your conclusions.

Note also: You might want to complete this theory part of the project without regard for tractability. It is quite likely that any optimal behavior you derive will be intractable. You must, however, address this concern when designing and implementing your agent.

2.2 Practical

Construct an autonomous agent to participate in the game, using your theory to shape its design. Describe your agent's strategy by answering the following questions: What assumptions did you make in constructing your model that are violated in the game? Is there a way to relax them slightly so that you can more accurately reason about behavior in the game? For this part of the project, you are not required to solve for (even approximately) optimal behavior.¹

Describe how your theoretical model combined with your answers to the practical questions led you to your agent's design. For everything that your agent does, you should tell us whether doing so was a direct result of the optimal strategy you derived in your simplified game, or why you were forced to diverge from that strategy, and how any heuristics you implemented are intended to compensate for its deficiencies.

All of the above was concerned with the "correctness" of your agent's strategy. You should also include in your write up complexity analyses (either theoretical or empirical) of any heuristics you implement.

¹If you manage to do so, then you should iterate on your solution to the project. That is, your response to this part should become part of your theory story, and you should have another go at this question!

2.3 Oral Presentation

You should prepare a 7–8 minute oral presentation of your final agent design, with supporting slides, to be presented to the class. In this presentation, you should describe your model, and any theoretical analyses of your model you were able to complete, however simple. You should also explain your agent design, and how you came to this design based on your model. Your presentations should be engaging; they will be scored by your peers as well as by the course staff. (We will provide a Google Form for submitting peer feedback as you watch the presentations.) You should also be prepared to answer any questions that arise.

3 Capstone & Grad Course

If you are taking this course as a capstone, you must do this assignment twice: once for the Spectrum Auction game, and again for the AdX game. You can partner with two different people for your two projects.

There is no difference in the final project requirements for CS1951k students and CS2951z students. Moreover, students enrolled in the two courses are welcome to partner with one another.

4 Deadlines

This project will have several intermediate deadlines. All deadlines listed below are in Providence time (EDT).

1. Choose partner + project: Sunday, April 12, 10:00 pm

By this deadline, you must choose which of the two projects you will complete, and finalize your partnership. We allow groups of 1 or 2.

Please fill out [this form](#) by the deadline. Please fill out only one form per group. If you are doing both projects, please fill it out twice, but again, only one form per group.

The stencil code will be released on Friday, April 10, so you will have a couple of days to look it over, alongside the game specs, to help make your decision.

2. Friendly competition begins: Saturday, April 25, 5:00 pm

You must submit a working version of your agent by this deadline. At this time, the TAs will begin running your agents in a continuous class-wide competition.² You will have the entire duration of the project to improve your agent; this submission can be just a “rough draft.”

3. Second friendly competition deadline: Saturday, May 2, 5:00 pm

You should aim to submit a near-finished version of your agent to the class-wide competition by this deadline. Agents that finish in first place in the next day of competitions will receive extra credit.

4. Writeup and final agent due: Friday, May 8, 10:00 pm

We will not accept submissions after this deadline. The writeup is due on Gradescope at this time, while your agent must be submitted via the handin script.

5. Oral Presentations via Zoom: Saturday, May 9, 8:00 am to 12:00 pm

Our “final exam” slot is from 9:00 am to noon on Saturday May 9. You will present your agent to the class during this time. As of now, we plan to begin early (8:00 am) to accommodate students in Asia. If you absolutely cannot be available for an oral presentation during this time period, please let us know as soon as possible, and no later than Monday, May 4.

²If there are enough earlier submissions, we may start the competitions earlier, just for fun, but this deadline won’t change.

5 Grading

- **Writeup (50%)**
 - **25%** Model and analysis of simplified game
 - **25%** A description of any principles / theory, etc. that guided your agent design
- **Agent (25%)**
 - **5%** Submit a beta version of your agent for the first friendly competition
 - * Winners of the second friendly competition will receive extra credit
 - **20%** Performance of your final agent against the TAs' agents
 - * **10%** Released Tier 1 Agent
 - * **10%** Unreleased Tier 2 Agent
- **Presentation (25%)**
 - **15%** Oral Presentation
 - **10%** Attendance & Participation