CSCI 1440/2440 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 **Spectrum Auctions** or **Ad Exchange**), and then complete these theoretical, practical, and unifying tasks for your game. You should compile your theoretical results in a writeup (of length 3–5 pages), and your practical results in a fully operational agent. Before submitting your code, you should test it against other agents to see how well yours fares.

2 Tasks

This project comprises both theoretical and practical tasks.

2.1 Theoretical

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

You might want to begin this theory part of the project without regard for tractability. It is quite likely that any (relevant) optimal or equilibrium behavior you derive will be intractable. You should address this concern in a more refined theory, if possible, and certainly when designing and implementing 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.

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 game model that are violated by the actual game? Is there a way to relax them so that you can more accurately reason about the game? And likewise, for your assumptions about the other agents' behaviors. For this part of the project, you need not solve for (even approximately) optimal/equilibrium 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/equilibrium 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.

In addition to arguing about the correctness of your agent's strategy, be sure to also include in your write up complexity analyses (either theoretical or empirical) of any heuristics you implement.

[1] If 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 an ∼8[2] 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 that 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; that is, you must complete both final project options. You can partner with two different people for your two projects.

There is no difference in the final project requirements for CSCI 1440 students and CSCI 2440 students. Moreover, students enrolled in the two courses are welcome to partner with one another.

4 Deadlines

This project has several intermediate deadlines.

1. **Choose partner + project: Monday, November 3, 11:59 pm**
   By this deadline, you must choose which of the two projects you will complete, and finalize your partnership. You may work in groups of size 1 or 2. Please fill out this link 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.
2. **Friendly competition begins: Monday, November 10, 11:59 pm**
   You are invited to submit a working (though not necessarily particularly intelligent) version of your agent at this time. Participation in the friendly competition during this preliminary week is strictly voluntary, but highly recommended.
3. **First friendly competition deadline: Monday, November 17, 11:59 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.[3] You will have the entire duration of the project to improve your agent. You can view this submission as a "rough draft."
4. **Second friendly competition deadline: Monday, November 24, 11:59 pm**
   You should aim to submit a near-finished version of your agent to the class-wide competition by this deadline. Agents that finish at the top of these competitions will receive extra credit.
5. **Writeup and final agent due: Monday, December 8, 11:59 pm**
   The writeup is due on Gradescope at this time, while your agent must be submitted via the handin script. We will not accept submissions after this deadline.
6. **Oral presentations: Wednesday, December 10, 3:00 - 6:00 pm**
   Oral presentations are scheduled during our class' final exam slot. They will be held in room 368 in the CIT. **In-person attendance is mandatory. Note the three hour time slot.**

All deadlines listed are in Providence time (EDT).

[2] This precise number is subject to change, depending on the total number of student projects, since all must fit within our three-hour final exam block.

[3] If 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%)**