

EFFECTS OF GAME TOURNAMENTS ON LEARNING AND CLASSROOM CLIMATE

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Overview

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Introduction

- We had a game tournament in AI for at least ten years.
- Many students consider it the highlight of the course.
- Students are mostly male and mostly very competitive.
- It is our desire to create a classroom climate that encourages cooperation and welcomes students whether they enjoy competition or not.
- Office of Institutional Research, Planning and Assessment gathered appropriate data and evaluated it.

Game Tournament as a Motivating Factor

- Many students enjoy computer games.
- The MacArthur Foundation announced a \$2 Million competition to develop video games that teach science and math.
- Our students spend a good amount of time playing games.
- According to a survey we took, 64% of the students in our class play between 1-4 hours of video games **per day**.
- Can we use a game **tournaments** to maximally motivate students?

Game Tournament as a Motivating Factor

- Tournaments have a competitive aspect.
- However, competition does not have to be detrimental to classroom climate.
- John Shindler distinguishes between “healthy” and “unhealthy” competition
- He characterizes *healthy competition* as follows:
 - The goal is primarily fun.
 - The competitive goal is not “valuable/real.” And it is characterized that way.

Game Tournament as a Motivating Factor

- The learning and/or growth goal is conspicuously characterized as valuable.
- The competition has a short duration and is characterized by high energy.
- There is no long-term effect from the episode.
- All individuals or groups see a reasonable chance of winning.
- The students all firmly understand points 1-5 above.

Game Tournament as a Motivating Factor

- Shindler goes on to characterize *unhealthy competition* as follows:
- It feels real. The winners and losers will be affected.
- The competitive goal/reward is “valuable/real,” and is characterized that way.
- The learning task is characterized as a means to an end (winning the competition).
- Winners are able to use their victory as social or educational capital at a later time.

Game Tournament as a Motivating Factor

- Competition implicitly or explicitly rewards the advantaged students.
- Over time students develop an increasingly “competitive mindset.”

Game Tournament as a Motivating Factor

- Our goal was to examine the tournament and the way we run it to study its effect on competitiveness and classroom climate.
- In the past, the tournament was known as the “game competition.”
- We renamed it to “game tournament” so as to think about this assignment in the right frame of mind.

Term-long Project

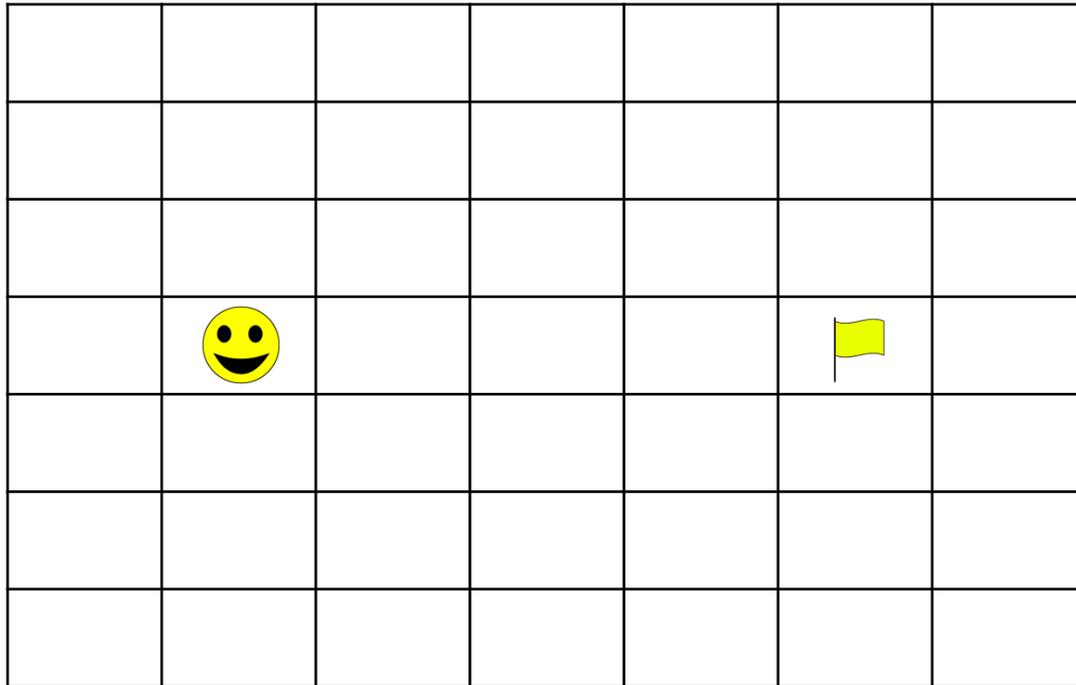
- We used to assign programming assignments covering basic NLP, heuristic search, theorem provers, and as final project the game tournament.
- We decided to integrate some of those assignments into the game tournament, making them milestones and avoiding start-up times across projects.
- The projects as found on the *MLeXAI* web-site are designed to last a semester and to feature Machine Learning techniques.
- Due to the short duration of our quarters, we decided to develop a project in which Machine Learning would be optional, but of benefit.

Stages of Implementation

- Uninformed Search
- Heuristic Search
- Alpha Beta Pruning
- Reasoning
- Tournament (4 weeks, short duration)
- Swiss style tournament ensures that all teams play all rounds. Ensures that comparable players play each other. (All individuals or groups see a reasonable chance of winning.)

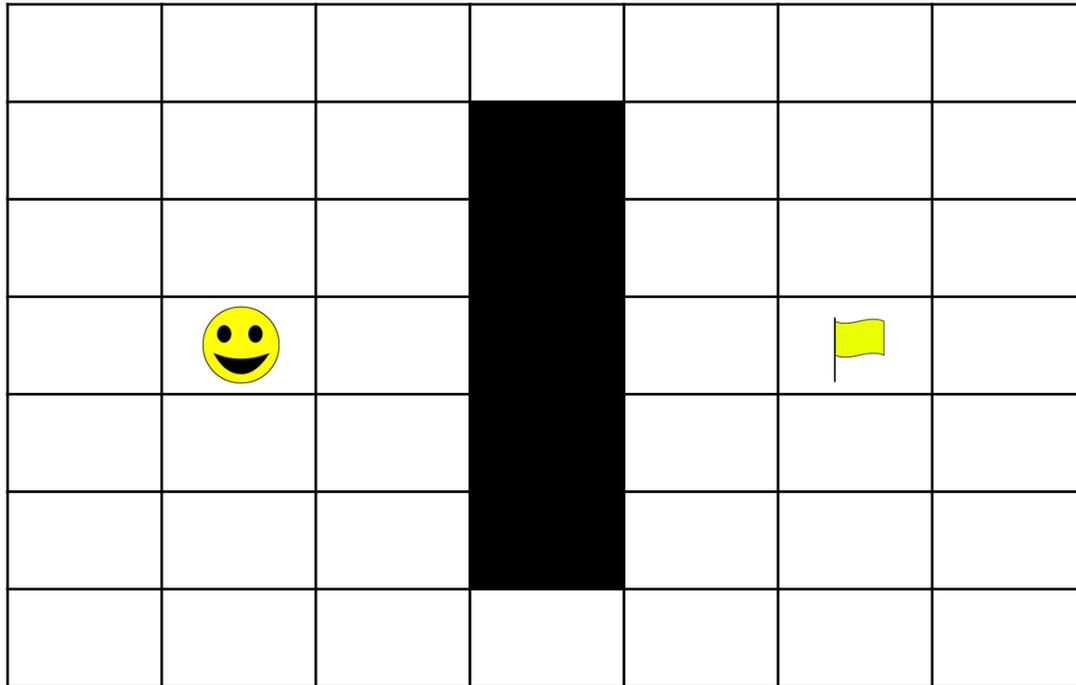
Capture the Flag

- The basic goal is for a player to reach a flag



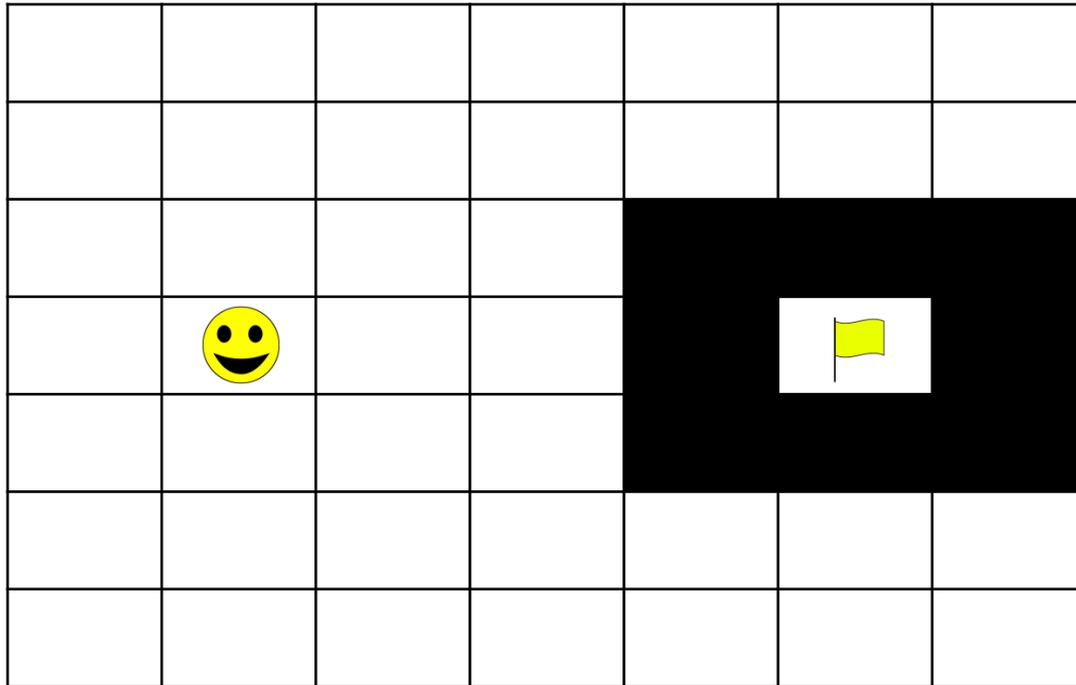
Capture the Flag

- Walls were added to increase branching



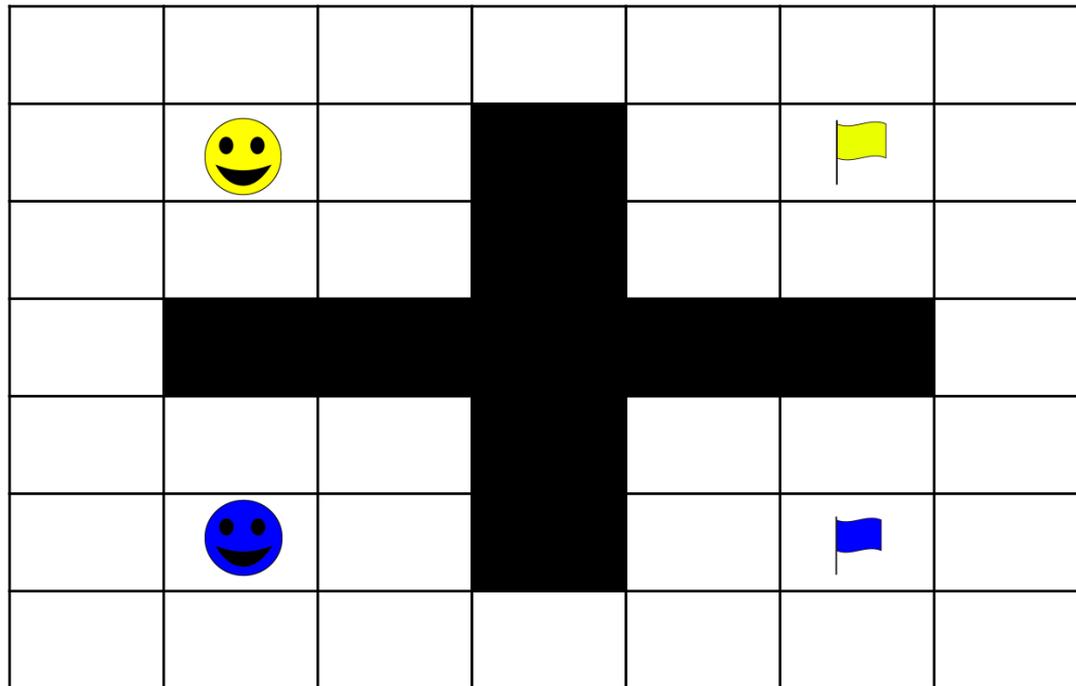
Capture the Flag

- Correctness check: some had no solution



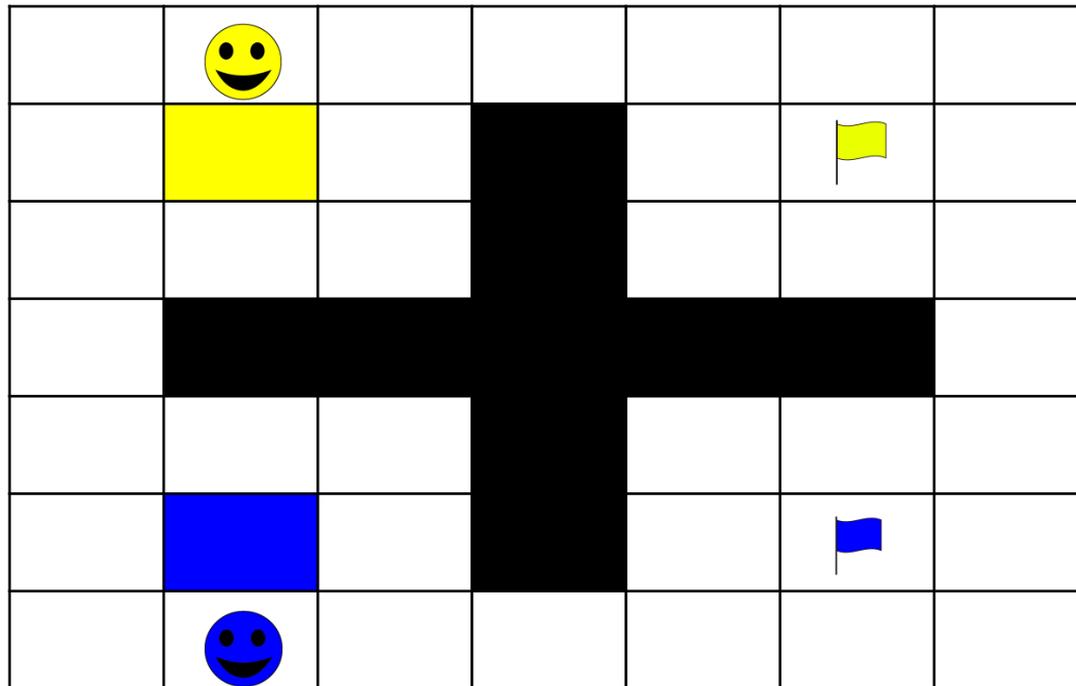
Capture the Flag

- For planning, multiple teams were introduced

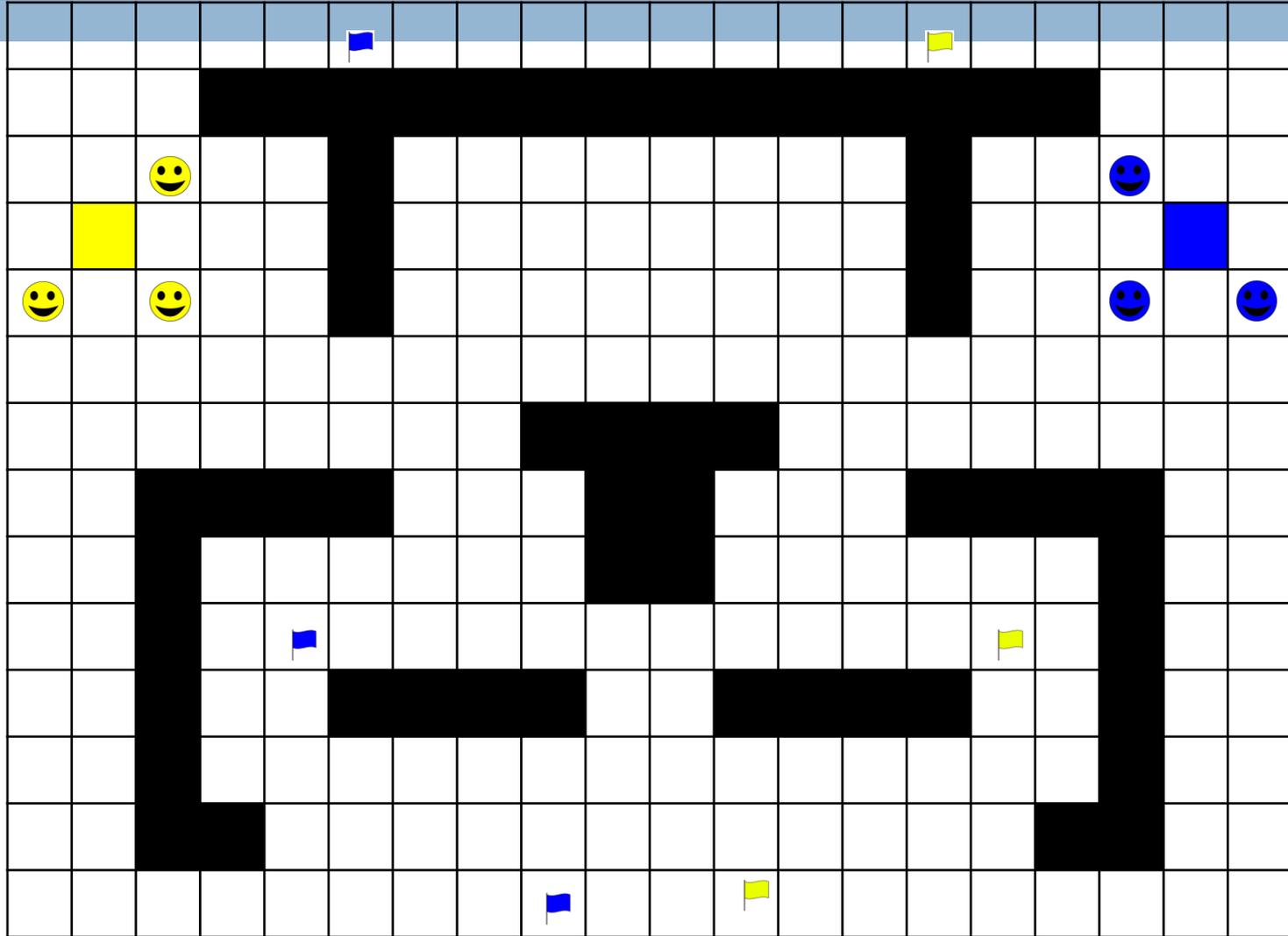


Capture the Flag

- Final tests added bases to return the flags to



Capture the Flag



Machine Learning in Capture the Flag

- If a flag gets returned to base, it re-spawns at its original spawn location.
- Each team gets a total of three minutes per game.
- Teams decide how much time they spend on a move.
- Re-spawning a flag and setting a time limit rather than a move limit gives students the opportunity to employ various forms of machine learning.
- Several groups did so.

Grading Scheme

- Past grading schemes favored good performance in the tournament.
- To foster healthy competition, we adding rubrics on teamwork and sportsmanship:
 - *Performance (35%)*: 15 percentage points, if software plays without crashing. 10 percentage points, if software has some strategy. 10 percentage points are based on the tournament performance.
 - *Teamwork (15%)*
 - *Sportsmanship (15%)*
 - *Features (35%)*: Interesting and non-standard features of the system.
 - *The last three support*: (The learning and/or growth goal is conspicuously characterized as valuable.)

Grading Scheme

- The 10 percentage points assigned to the performance in the tournament accounts for 2.5% of a student's course grade.
- As such, the performance in the tournament is mostly a symbolic reward when it comes to course grades.
- Without a doubt, there are bragging rights associated with doing well in the tournament.

Grading: Sportsmanship

- During past offerings of the course, some students helped other students to improve their software, partially to ensure that they had a good opponent to test their own software.
- More importantly, we wanted our students to contribute to a positive learning environment. It turned out that the addition of this category did exactly that as discussed later.

Data Gathered

- 18 students participated in the surveys.
- A survey designed and widely used to assess competitiveness was given.
- The survey consists of 20 true/false questions and is called the “Competitive Index” (CI).
- Scoring our students’ responses revealed that 46% of our students have a competitive index of **high**, 36% have one in the **middle** range and 5% are in the **low** range.

Data Gathered

- Near the end of the tournament, a second survey was conducted.
- We asked some specific questions about the tournament and gave our students the ability to provide us with feedback.
- All of them required a response of one of the following: Strongly agree, agree, disagree, and strongly disagree, scored on a scale of 4 to 1.

Responses

Survey Item	Mean
The game tournament for CSSE 413 encourages teamwork.	3.33
The game tournament for CSSE 413 encourages competition among classmates.	2.94
The game tournament challenges me to do my best academically.	3.11
Because of the tournament, I felt challenged to spend more effort on the final project than I otherwise would have.	2.72
The grading requirements for this tournament were clearly explained to me.	2.94
The grading requirements for this project are appropriate.	2.94

Discussion

- **Teamwork.** It is good to learn that the game tournament encourages teamwork.
- **Competition.** We were hoping that it would not encourage as much competition among students as the numeric responses indicate.
- Perhaps, students do not distinguish among healthy and unhealthy competition.
- Furthermore, as the software was indeed playing against each other, the tournament did create competition.
- In the future, we will rephrase this question so as to distinguish between competition and competitive behavior.

Discussion

- **Challenging.** The tournament seems to challenge our students to do their best academically.
- **Effort.** Apparently, the tournament in itself does not challenge students to exert more effort on the final project.
- A follow-up question should be asked to determine whether this is perhaps due to the fact that they would have put in a 100% anyway.
- **Grading requirements.** The grading requirements should be more explicitly spelled out, perhaps listing concrete examples of sportsmanship and desirable features.
- **Grading criteria.** When it comes to the appropriateness of the grading criteria, we should have invited out students to suggest what they consider more appropriate requirements.

Additional Data Gathered

- We went on to analyze the responses based on the overall project score, the scores of the four grading categories and our students' competitive index scores.

Results and Discussion

- “Students who had a higher standing in the game tournament believed that it encouraged competition among classmates more than students who had lower standings in the tournament.”

Results and Discussion

- “Students who found the game tournament assignment to be academically challenging also found it encouraged teamwork among classmates. They also reported putting more effort into their final project than students who did not see the game tournament assignment as academically challenging.”
- It is good to see that those students who found the tournament to be academically challenging put more effort into it.
- In the future, we need to advertise its academic challenges better.

Results and Discussion

- “Students who thought the game tournament assignment fostered competition reported putting more effort into their final project than students who did not see the game tournament assignment as competitive.”

Results and Discussion

- “There is no difference in tournament standing or attitude toward the tournament for students scoring mid or high on the competitiveness index. Their competitive predisposition does not seem to make a difference.”

Results and Discussion

- “There is a significant positive correlation between the game tournament project score and the sportsmanship score.”
- For future incarnations of the tournament, it would be useful to provide even more opportunities for students to contribute in this category.

Results and Discussion

- A positive correlation from the standpoint of the instructor is that the standing in the tournament is directly related to the effort put into the game project.

Data Gathered

- We closed the survey with three open ended questions:
 - ▣ How could the game tournament be improved?
 - ▣ What do you like best about the game tournament?
 - ▣ What do you like least about the game tournament?

Positive Aspects of Tournament

- Five out of 18 students explicitly mentioned that the tournament was fun.
- Several students indicated that it was interesting to see different kinds of AI perform when pitted against each other. Based on their response, they clearly saw the educational value of studying the performance of different kinds of AI in a real time environment.
- Some students indicated that they performed a good amount of research into an AI technique of their interest.

Positive Aspects of Tournament

- Some students felt a sense of accomplishment because their software was used rather than just graded and filed away. In that context, some students felt that they had to think outside the box and be concerned about efficiency.
- Some students liked the competitive aspect of the tournament, mentioning that it did indeed increase their desire to do well in it.
- Some students liked the teamwork that went into the final project.

Negative Aspects of Tournament

- Eleven out of 18 students explicitly stated that the issues we have had with the server was their least liked aspect of the tournament.
- Some students indicated that they did not have sufficient software development experience to implement their ideas or deal with the complexity of the software to be developed.

Improvements

- Almost all of the students stated that they would have liked a stable server from the time the tournament was assigned.
- Some students stated that they did not put as much effort into the tournament, because the server was unstable.
- Several students would have liked to know the rules of game play at the beginning of the term.

Conclusions

- From the general state of the responses, the concept of a tournament appeals to the students.
- Positive aspects included the ability to play against other students in the class, interactions between teams beyond simple competitiveness, the relatively open setup of the tournament and a sense of ownership in the project.
- Students seemed to enjoy the idea of competing against other students in their class, supporting the evidence that almost half of the class ranked “high” in the competitiveness index.

Conclusions

- As mentioned, the server was unstable, primarily because of adding some of the features rather late in the term.
- Students put a lot of effort into their software and want to see results.
- However, they did not get the satisfaction of this experience.

Conclusions

- Without a doubt, we were very excited about the tournament.
- We put a lot of thought and effort into the tournament
- However, as part of this excitement, we overreached, asking students to solve problems that they were not prepared to solve.
- For the next offering, we will draw out some of the milestones, simplify the game specification, and discuss implementation related issues in class.
- We will continue to collect data to get more reliable feedback and to improve the tournament.

Materials

- <http://www.rose-hulman.edu/class/csse/csse413/archive/CTF/>