TAC
A Trading Agent Competition

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This paper is a report of the Trading Agent Competition (TAC) held during the Fourth International Conference on Multiagent System (ICMAS-00) in Boston on July, 8th of this year (2000).

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1. THE CHALLENGE

The ICMAS-00 Trading Agent Competition (TAC) was organized by Michael Wellman of the University of Michigan and Peter Wurman from North Carolina State University. The purpose of the competition was to stimulate research in trading agents with an emphasize on developing a successful strategy for maximizing profits in a constrained environment.

Market games were executed on the Michigan Internet AuctionBot ([Wurman et al. (1998)]). Each game ran for 15 minutes and consisted of eight players; each of which were given a set of preferences for customers wishing to purchase travel arrangements. The preferences specified the desired travel days, bonus for hotel quality, and values for entertainment events. Players participated in auctions to try to acquire the necessary resources. The auctions had predefined bidding rules and three types of clearing rules ([University of Michigan 2000]). A player's score was the sum of the utility it created for its clients minus the cost of acquiring the goods. A penalty of $100 per day was imposed for changes in the travel dates.

2. THE COMPETITION

Participates in TAC represented 6 countries and 18 unique affiliations, including InterTrust Technologies, Artifical Life, Industilogik as well as educational institutions such as Swedish Institute of Computer Science, University of Maryland,

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and Stockholm University. This diverse mixture led to an interesting competition. Qualifying rounds ran for approximately 7 days. Twelve semi-finalists qualified and met in Boston to compete for the championship. Preliminary rounds narrowed the field to the top eight players. The winner was "ATTac" from AT&T Labs - Research with an average score of 3398.26, and was closely followed by "RoxyBot" from Brown University and NASA Ames Research Center with a score of 3283.24. These scores represent an average over the thirteen games played that day. Interestly, the top three teams had very low standard deviations, suggesting that their strategy had a consistent behavior.

3. THE STRATEGIES

There were some common strategies amongst a majority of the players. Most players recognized that the hotels were the most constraining resource (limited to 32 available rooms per night). As such, competitors based their strategy around obtaining hotel rooms. One team devised a price prediction algorithm to determine the rate at which hotel bids were increasing and used this information to determine the cost versus benefit of a room. Another team created models of the hotel auction and managed their sunk costs to determine an upper limit for resources. Yet another team decided to place travelers seeking longer stays in a cheaper hotel to minimize overall costs.

There were other solutions which obtained resources based upon individual customer preferences instead of trying to make aggregate purchases. An interesting example of this used an allocator and completor to represent current costs and possible travel arrangements. The agent made a purchase decision near the end of the auctions based upon the current travel options and costs. This solution consistently provided positive results. Another approach used a linear programming solution to find an optimal purchase. One team observed that hotel bidders tended to place a high bid near the end of the hotel auction to ensure a purchase. Their agent used this information and a greedy algorithm to win hotel rooms at a reasonable price. Another solution examined the risk involved in making a purchase. The agent modeled failure to purchase a hotel room as a catastrophic event.

To maximize profits, one team lengthened travel stays if the customer preferences showed a higher score for attending entertainment events. Another team decided to shorten the travel arrangements if the cost of the hotel exceeded the penalty for deviating from the desired preferences.

Several contestants found that network delay and server performance impacted their agents performance. At least two teams added features to determine the expected response time and used this information to enhance their agents performance. All games were run on the Internet and subject to normal delays which can occur.

After a player had acquired all the necessary resources, such as hotel rooms and airline flights, they had to either report an allocation of the goods to the server within four minutes or the server would construct an allocation for the agent. The server used a greedy non-optimal strategy so most players provided their own allocation. Providing an optimal distribution of goods is a known NP-complete problem. The two top scoring finalists, however, always reported an optimal solution to the server for the games involved in the finals.

Other players reported optimum solutions some of the time and near-optimum solutions most of the time.

4. CONCLUSIONS

No two teams solved the problem in the same manner but all teams agreed that the competition was both fun and challenging. Everyone hoped that the contest would become a yearly event. Some teams enjoyed the competition so much that they are still playing games on the AuctionBot server. Anyone can create a userid and run their agent on the AuctionBot server so you should give it a try and see how your solution would perform.

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