CAT Game and JCAT Platform

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Background

- **Market Design Competition (CAT)** [Gerding et al., 2007]
  - A CAT game has multiple players, each as a market, and includes trading agents that move between these markets and exchange some sort of virtual goods.
  - Under the umbrella of Trading Agent Competition (TAC).
  - CAT is an abbreviation of catallactics, the science of economic exchange, and a reverse of prior TAC competitions.
- **Motivations**
  - Experimental approaches in the literature with different assumptions and criteria make the results incomparable.
  - Markets are not isolated in the real world and usually compete against each other as the traders in a market do.

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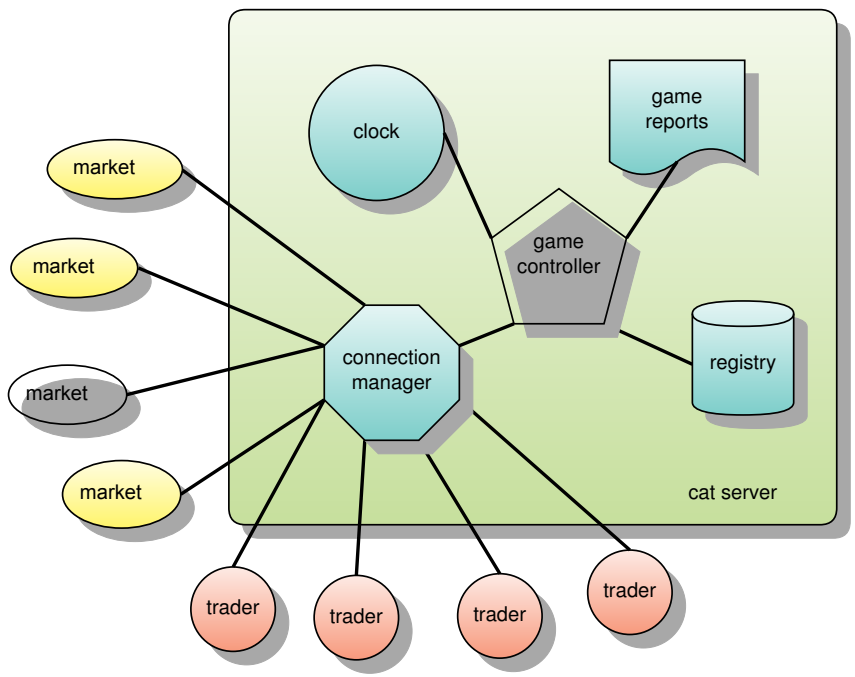
CAT games
An overview

- A typical CAT game consists of a CAT server and several CAT clients, which may be markets or traders.
- JCAT [Niu et al., 2008c]: the server platform in Java for CAT games, extending the single-market simulator JASA [Phelps, 2007]



CAT games
Outline

- Game rules
- How trading agents behave
- How markets behave

CAT game rules (I)

- A CAT game lasts a certain number of days, each day consists of rounds, and each round lasts a certain number of ticks, or milliseconds.
- (game starting) the game server broadcasts the list of markets and traders.
- (day opening) markets post their price lists, specifying fees on 1. registration 2. information 3. shout 4. transaction 5. profit
- (day opening) the game server assigns each trader a private value, all of which determines the supply and demand schedules of the global market.
- (day opening) traders select a market to do business to maximize their profits based on their experience with the markets and fees the markets charge.

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CAT game rules (II)

- (day opening) both trader and market may optionally subscribe with a set of markets to receive additional information about shouts and transactions in those markets.
- (trading) a trader has a chance each round to make a new shout or modify its existing shout; at most one active shout is allowed at any moment for a trader; and a shout persists until it is matched or modified, or the trading day closes.
- (trading) a market may allow or reject the placement of a new shout or a modifying one, and match an active ask and an active bid at any time as long as the bid price is no lower than the ask price and the transaction price falls in between.

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CAT game rules (III)

- (day closed) a daily score is calculated for each market according to the following rule

  $$Daily\ Score = Market\ Share + Profit\ Share + Transaction\ Success\ Rate$$
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Trading agents
Market selection strategy

- **random**: the trader randomly picks a market;
- ϵ**-greedy**: the trader treats the choice of market as an n-armed bandit problem which it solves using an ϵ-greedy exploration policy [Sutton and Barto, 1998]
- **softmax**: similar to ϵ-greedy, but using a softmax exploration policy [Sutton and Barto, 1998]

Trading agents
Trading strategy

- **ZI-C (Zero Intelligence with Constraint) [Gode and Sunder, 1993]**
  picks offers randomly but ensures at no loss.
- **ZIP (Zero Intelligence Plus) [Cliff and Bruten, 1997]**
  adapts its profit margin by using a simple heuristic rule to remain competitive in the market based upon information about shouts and transactions.
- **RE [Roth and Erev, 1995]**
  uses the profit earned through the previous shout as a reward signal and learns the best profit margin level to set.
- **GD [Gjerstad and Dickhaut, 1998]**
  estimates the probability of an offer being accepted from the distribution of past offers, and chooses the offer that maximizes its expected utility.

Parameterized market mechanism framework

[Niu et al., 2008b]

- **shout accepting policy**
  - whether a shout from a trader should be allowed to place
- **matching policy**
  - how to match placed shouts
- **pricing policy**
  - how to determine transaction prices for matched shouts
- **clearing policy**
  - when to clear the market, i.e., finding matchable shouts and executing transactions
- **quoting policy**
  - how to determine the market quotes
- **charging policy**
  - how to determine the fees

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Parameterized market mechanism framework

Policies implemented in JCAT

- **shout accepting policy**
  - Always (AA), Quote-beating (AQ), Transaction-based (AT), ...
- **matching policy**
  - Equilibrium-based (ME), MaxVolume (MV)
- **pricing policy**
  - Discriminatory (PD), Unanimous (PU), Biased (PB), ...
- **clearing policy**
  - Continuous (CC), Roundwise (CR), Probabilistic (CP)
- **quoting policy**
  - One-sided (QO), Two-sided (QT)
- **charging policy**
  - Fixed (GF), Bait-and-switch (GB), Cutting-price (GC), ...

Where to download?

http://jcat.sourceforge.net/

- JCAT version 0.12
- Overview of CAT: A Market Design Competition [Gerding et al., 2007]
- CAT Protocol (CATP) Specification [Niu et al., 2007b]
- JCAT Tutorial [Niu, 2008]

http://jcat.sourceforge.net/api/

- JCAT API Doc

How to compile and run?

- **Prerequisites**
  - Sun Java 1.6+
  - Apache ant 1.6.2
- **Download and decompress**
  - `jcat-0.12.tar.gz`
- **Compile and execute**
  - `ant jar|doc|tar|applet|...`
  - `ant run|server|servertraders`
  - `ant traders|markets`
- **Configuration file**

Where to start?

- **To extend the existing policies in JCAT**
- **Papers on the official CAT Competition website**
  - AAMAS 2008 paper [Niu et al., 2008b]
  - IAT 2008 paper [Niu et al., 2008a]
  - AMEC 2008 paper [Cai et al., 2008]
  - TADA 2007 paper [Niu et al., 2007a]
  - papers that entrants wrote on their designs.

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