Competitive Modeling Symposium: PokerBot World Series

Christian Lebiere (clebiere@maad.com)
Micro Analysis and Design, Inc.
6800 Thomas Blvd., Pittsburgh, PA 15208 USA

Dan Bothell (db30+@andrew.cmu.edu)
Department of Psychology, Carnegie Mellon University
Baker Hall 446J, 5000 Forbes Ave, PA 15213 USA

The Cognitive Challenges in Poker

Game playing seems to satisfy a basic craving of human cognition by exercising its fundamental abilities in a competitive setting. Therefore, it provides an excellent benchmark to study and evaluate cognitive models in tractable yet naturalistic settings that are simple and formal yet reproduce much of the complexity of real life. Poker is probably the most widely played card game, with endless variations played by millions of adherents from casual players gambling pennies to professionals competing in million-dollar tournaments. Unlike other games that emphasize one particular aspect of cognition, poker involves a broad range of cognitive activities, including:

- Reasoning under uncertainty (opponents' cards)
- Dealing with probabilistic outcomes (future cards)
- Decision-making with multiple options (chips used for bets)
- Individual differences (different styles of play)
- Inference of intent (from opponents' bets)
- Intentional deception (bluffing, sandbagging)
- Pattern recognition (detecting trends from flow of game)
- Social and emotional aspects (dealing with winning and losing)
- Economic behavior (factoring impact of amount of bets)

Because of the range of cognitive activities involved, poker provides a broader and more challenging test for cognitive modeling than other games such as chess that focus on a more restricted range of mechanisms (e.g. search). Despite the complexity of aspects involved, it remains a highly tractable domain, partly because it abstracts away from computationally demanding perception and interaction problems. Poker is increasingly being played in online gaming communities where the need for challenging, cognitively plausible agents is increasing. Poker therefore provides a challenging domain at the intersection of fundamental research questions and potential mass application.

PokerBot at ICCM2004

Open competitions such as Robocup (http://www.robocup.org/) and the DARPA grand challenge (http://www.darpa.mil/grandchallenge/) have recently provided a promising mechanism to make progress on long-term research issues while focusing on a practical, measurable goal. To that end, a competitive modeling symposium took place at ICCM-2004 with the ultimate goal of producing a fully functional, human-like poker agent. The competition took place in two parts, emphasizing the dual aspects of cognitive modeling: the production of accurate models of human cognition that are not mere post-hoc descriptions of human performance but can perform actual tasks in a fully functional manner. The first part involved multiple runs of head-to-head, winner-take-all tournament play between models to test their functionality. The second part involved a live evaluation of the cognitive plausibility of the models during the conference. The best models were presented at a symposium during the conference where progress on research issues was discussed.

Tournament Rules

Because of the open-ended nature of the game that favors the exploration of the research issues, the variant of the game selected for the competition was No Limit Texas Hold'em a popular, fast-paced game that is the centerpiece of the World Series of Poker (http://www.harrahs.com/wsop/index.html).

The initial bankroll given each player at the start of the game was $10,000, with initial blinds of $10 and $20 that doubled every 100 hands to bring the game to a timely conclusion. To fairly distribute resources, the response time and memory space for each player was sharply limited. The winner of each tournament was the last player left, with as many tournament runs as possible played during the week between the submissions and the announcement of the results, with the players restarted to their initial state between each game. The complete logs of all games played were made available after the tournament to allow anyone to review them for fairness and accuracy and to serve as the basis for a database of games for further cognitive modeling.