SARTRE: a Case-Based Poker Web App

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ABSTRACT

In this paper, we present a web implementation of a poker bot, called SARTRE, which uses case-based reasoning to play Texas Hold'em poker. SARTRE uses a memory-based approach to create a betting strategy for two-player, limit Texas Hold'em. Hand histories from strong poker players are observed and encapsulated as cases that capture specific game state information. Betting decisions are generalised by retrieving and re-using solutions from previous similar situations. SARTRE participated in the 2009, 2010 and 2011 IJCAI Computer Poker Competition's where the system was thoroughly evaluated by challenging a range of other computerised opponents. SARTRE can now be challenged online.

Categories and Subject Descriptors

I.2 Artificial Intelligence, I.2.1 Applications and Expert Systems, Games

General Terms

Algorithms

Keywords

Game AI, Case-Based Reasoning, Poker

1. WHY TEXAS HOLD'EM POKER

Chess is a game of perfect information; each player can look at the board and obtain all information necessary to make playing decisions. Poker, however, is a game of imperfect information: poker players have cards that only they see, therefore players must make decisions based on hidden information. Games may be further classified as either deterministic or stochastic. If a game contains chance elements, such as the roll of a die, this introduces randomness into the game. These types of games are known as stochastic games: e.g. bridge, backgammon and poker. The absence of chance elements ensures the game is deterministic: e.g. chess, checkers and go. Poker is a stochastic game with imperfect information. It is stochastic because shuffling cards introduces randomness into the game. It is a game of imperfect information because players cannot see their opponents' cards. Given the relatively simple rules of the game there are an enormous amount of subtle and sophisticated scenarios that can occur during a hand of play - this is particularly true of the Texas Hold'em variation [1]. An annual competition for computer poker has been held since 2006 in conjunction with AAAI and IJCAI.

2. POKER STRATEGY

There are two types of strategies that a poker agent may employ: a Nash equilibrium strategy, or an exploitive strategy. A strategy is a mapping between game states and the actions that an agent will take at that game state. An agent's strategy consists of specifying a probability triple at every game state, which specifies the proportion of the time an agent will either fold, check/call or bet/raise at a particular point in the game. A Nash equilibrium is a robust, static strategy that attempts to limit its exploitability against a worst-case opponent [2]. An exploitive strategy seeks to construct a model of an opponent, using it to inform future actions. A consequence of an exploitive strategy is that it no longer plays near the equilibrium and hence is vulnerable to exploitation itself, especially if the model of the opponent is incorrect [3].

3. SARTRE OVERVIEW

To implement its case-based approach SARTRE uses a database of cases built by observing actual poker hands. Each case consists of a collection of attribute-value pairs that encapsulate game state information. Separate case-bases are constructed for each round of play (pre-flop, flop, turn, river). When SARTRE is required to make a betting decision, a target case is created to describe the current state of the game and the appropriate case-base (collection of source cases) is searched to locate similar cases using a k-nearest neighbour algorithm. A betting decision is made by employing one of three solution re-use policies: probabilistic, majority-rules or best-outcome [1].

Various versions of SARTRE have used case-bases from hand history logs of Hyperborean-Eqm, a winner of the 2008 computer poker competition and MANZANA, a winner of the 2009 competition. SARTRE assumes the strategy of the poker bot from which its case-base derives. In 2011 SARTRE placed 2nd in four events, 4th in one event and 1st place in the multi-player, limit Hold'em competition. The SARTRE web app can be challenged at: www.cs.auckland.ac.nz/poker/

4. REFERENCES

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