CSE 848 Project Proposal:
Evolving an Intelligent Blackjack Agent

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Since its' inception in the early 18th century France, the card game Blackjack (also known as Twenty-One) has motivated gamblers to invent a variety of methods and algorithms to predict the probability of a successful hand. Using almost any of these methods while playing a one deck game of blackjack against a casino dealer usually results in a greater probability of victory for the casino player.

For each hand dealt (in which the deck is not reshuffled), the probability of a player's success is dependant upon which cards have already been dealt. Thus, by keeping track of which cards have already been played, a player (if they were quick witted enough) could evaluate the probability of going 'bust' on a hit.

In the version of Blackjack employed by this paper's authors' the only actions available to the agent will be "hit" or "stay"; for simplicity, the actions "double down", "split", and any others will not be available in this project.

Representation:

Using genetic algorithms, we hope to evolve a set of rules that will determine whether the agent will hit or stay. Each chromosome will be represented by an integer array of size 53; whereas the value in indices 0 through 51 will each represent a single card (from a full deck), and the contents of index 52 (the 53rd element in the array) contain either 0 or 1 (representing the actions hit/stay). The value of the each card in the deck (indices 0-51) can be one of 5 integer values representing that the card:

1) Has not been dealt yet
2) Has been dealt and discarded
3) Belongs to the agent's current hand
4) belongs to the dealer's current hand, and is visible to the agent

5) Belongs to the dealer's current hand, and is not visible to the agent.

Value	used	visDealer	hidDealer	agent	used	…….	……..	hit
Index	0	1	2	3	4	…….	……..	52

Figure 1.1: An example of an individual representation. In this case, the dealer has a 2 showing, and a 3 face.

Operators:

The authors' initial plan is to evolve X populations consisting of Y randomly generated individuals (where X<(Y/4)). After each generation, the lowest X_{bad}% of each population will be replaced by the child from a crossover operation involving an individual from the top X_{good}% and an individual from the lowest X_{bad}%. In addition to the crossover operations, the populations will be further changed by introducing small mutations to the top X_{good}% of each population with probability *p*.

Fitness Function:

After each generation, the agent will play a series of Blackjack games against the dealer (who will be following standard casino dealer rules, that is to say that the dealer will always hit if his hand is below 17, and stay if the hand is above 16) until the deck runs out. The average fitness of each individual will be decided based upon the set of known cards (which consists of cards that have been dealt and discarded, cards belonging to the agent's current hand, and the dealer's cards that are visible), a mathematical equation (dealing with the probability of beating the dealer and staying under 22), and how similar the individual is to the current hand being played. After the fitness function converges, we will gauge the success of our agent by the win ratio of Z 1-deck games of blackjack against a dealer agent (abiding by casino dealer rules).