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Invention of Othello AIs for player-level adaptation and various features

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Game Information is gradually improving year by year as one of the Artificial Intelligence field. Recent game AIs can be stronger than human player such as Deep Blue, Logistello and so on. On the other hand, amateur players can't win the game against AI which has higher skill than them. Because of this circumstance, players can generally adjust AI's difficulty in config of the software. However, there are many cases that AIs equal to general human player's level can't be created suitably. Moreover, AI's unnatural action is happened if Strong AI weaken by special operation such as changing parameters dynamic. Another problem is that the AIs' actions are monotonous and discouraging since their parameters are also fixed and constant.

Because of the background, many fields such as variety, level automation, natural action and education are required for the good relationship between human player and Game AI. The goal of this research is to create multiple featured "rival AIs" which have the same strength as human players, especially Beginners or a little bit stronger people, with genetic algorithm. I expect that they can maintain human's motivation and improve their skill. The elements of rival are (1)the same level or higher rank, (2)equivalent opponent and (3)similar strength but different features. To implement three points of them, I considered three elemental technologies((1)estimate

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player's strength, (2)I/O model avoiding unnatural moves, (3)adaptive algorithm to human's level) and experimented under them. Othello(Reversi) is determined as the target game for research and the reasons are because the rule is simple, the population of this game is huger than the other games and almost all Othello AIs can be set up stronger than all human players. The AI system of this research consists of two phases. The first phase is the part to create an Agent AI which has the same strength as the human player and the second one is the part to create a group of various AIs with Genetic Algorithm. I implemented the elemental technology (1) into the first phase and the technology (2) and (3) into the second phase.

About the first phase, it is very difficult to mimic whole human players' action. Therefore, I want to extract only the strength of them and focused on the best move for strong AI and the actual move for the player. The method is that Tester AI(stronger than human) evaluates each move of the player in the record and picks up subtract of evaluation score between the best move and the actual move. After checking the records, average of the values for each move becomes the index of player's strength. To create the Agent AI, the stable action of AI is required. The idea is that AI put the move which is close to the index of strength as the target value. AI compares the average of subtract of the evaluation values(each candidate of the next move and the past ones) and the target value, then the closest move from it becomes the next one. The result is that winning rate of the AI with the method against the base AI is close to 0.5(the same strength) and AI put the move which is along the target value(stable action). Therefore, I expect that the AI can be used as the Agent AI by implementing the method.

On the other hand, I/O model to avoid unnatural moves in the second phase is decided by heuristic evaluation under the move that most people would like to get or not. Questionnaires said that Beginners usually and absolutely want to get the corners if they can put a piece there, and they never put a piece on the spaces around the corners in the case of opponent's getting there in the next turn.

Genetic Algorithm is utilized as adaptive algorithm for the same strength as human and various strategies, and I used MGG-best2(a kind of GA model) and BLX-α(the crossover for keeping child individual's variety).

About the fitness calculation for the same strength and various features, I focused on the winning rate of each Individual against the Agent AI and the distance of tactical parameters among whole Individuals. the fitness value to get Individuals that have the same strength as the Agent AI is determined by whether winning rate is close to 0.5. About the fitness value for different strategies, if a Individual's parameter is close to others, fitness is gradually larger(as a bigger penalty) because close parameters leads Individuals to have the same characteristics. There are three tactical parameters for Othello, mobility, frontier and stability. Using these parameters as the GA's chromosome, some Individual AIs having the close strength to the Agent AI and different features each other could be appeared.

Combining these systems, I experimented whether AIs are optimized and adapted to human strength with various features. Result of the experiment with testees said that the evaluation for strength and unnatural move reached the goal of this research even though there are a little bias. However, the evaluation of variety was different and far from what I hoped. The reason might be because three tactical features(mobility, frontier, stability) as chromosome are difficult to determine for Beginners, so the solution is adding chromosome information such as count of pieces, favorite places, favorite actions and so on. Implement this solution, the problem might be cleared.