



Reversi: Adapting intelligence in a traditional board game.

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Abstract—This paper talks about a simple board game called reversi and the history of this game. Moreover, it provides a detail background of the game, an understanding of how this game is played and what are the rules that must be followed by the players. The paper will also include how artificial intelligence can be introduced in this game which makes it possible for the player to play against a machine who thinks and reacts fast by the help of some artificial intelligence concepts.

Keywords: *Reversi, Othello, artificial intelligence.*

I. INTRODUCTION

Artificial intelligence is a concept in which the computer machines imitate and simulate the human intelligence or even exceed the level of intelligence where they tend to perform various processes such as learning and adapting to the environment that is surrounding those machines. Moreover, by learning and capturing the knowledge, it allows the computer machines to make the most strategic decision making, prediction and self-correction. According to Schalkoff, "Artificial intelligence is a field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990).

However, in today's world artificial intelligence has dominated the gaming industry where new AI solutions are constantly being created for the purpose of challenging the capabilities of the human intelligence.

Furthermore, games like chess have been in the subject of intelligence for a long time and that's because they are less complicated, and the rules are well defined. The purpose of these games is to evolve by the help of using the human knowledge and accomplish a game playing behavior that is seen to be intelligent to the human players.

II. BACKGROUND OF REVERSI

Reversi or also known as Othello is a strategic board game that is considered traditional and very popular in Japan where it has been played for many centuries. The game was first introduced in 1883 and because of its popularity it was later introduced in America and most of the European countries in 1970. Moreover, the game contains simple rules for the players to understand but it has many other complex strategies that would take years and a lot of practice for the players to master.

III. RULES OF REVERSI

Reversi is a strategic based board game that is played between two players in an unchecked of a size 8 X 8 board. The game contains 64 identical pieces for each player that are called disks. The disks can be distinguished between both players by the color it where it can either be black or white. The duration of the game depends on how fast the players are playing where sometimes they tend to take time to think before making a move, but normally the game will be played between 5 to 60 minutes. Its very simple to set up the game where at first only 4 pieces of the disks that are from different colors will be placed diagonally from each other before the game can start and always the black disk starts the first move of the game. As you can observe in figure 1 below how the board and disks of the game look like.

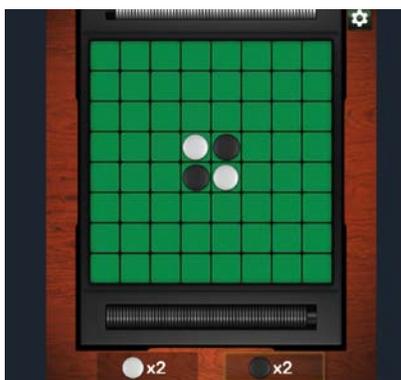


Figure 1- The start of the game.

The main objective of the game is to secure the spaces around the board by placing the disk of the colored player. However, the rules of the game states that, the only way a player can secure that specific space is to have two disks surrounding the opponent's disk from both sides that can either be front and back, left and right or even in a diagonal perspective. Furthermore, even if the opponent secured a specific space it can still be taken if the player surrounds both his disks around the opponent's disk.



Figure 2- space secured by player 1.

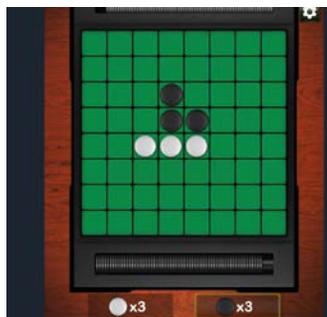


Figure 3- space captured by the opponent again.

As you can observe in figure 2, the player has secured the space of the opponent after moving the black disk on top of the opponents white disk which will result in the white disk in the middle being transformed into black disk now and that means that space has been captured. Moreover, also notice in figure 3, the opponent has also captured the space and replace the black disk in the middle by trapping the black disk from both sides which results in the space to be captured. Notice that whenever the spaces are being captured by the players the score keeps on increasing and that's because the

main goal of the game is to capture as many spaces and remove the opponent's disk.

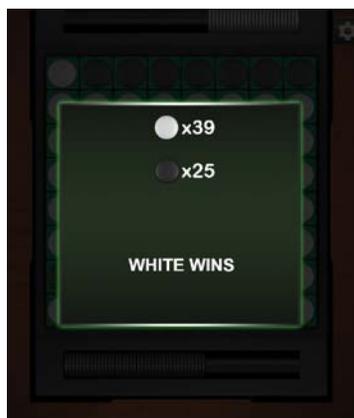


Figure 4- game ends.

Once the entire spaces are captured in the game and there is no more place for a move to be made by both of the players the game ends and the player with the most disks that are captured in the spaces on the board, is declared as the winner of the game. Moreover, the game can also end if there was a timer that was set and if the time ends then the same concept is applied where the player with the most discs that is secured is declared as the winner.

Since the proposed game is going to be an intelligent based board game and the player is going to be playing against the computer machine, the game must contain several difficulties and they are called:

- Beginner mode: This mode is mostly recommended for people who have never played reverse before and aren't very familiar with the rules and how the game is played. It is the most ideal mode for people to get used to the game which will be completely easy, and the machine will not be determined to find the most possible way to win the game.
- Regular mode: This mode is mostly recommended for people who got used to the game and completely familiar with the rules of the game and how it can be played. Moreover, this will be little challenging for the players since the computer might respond a bit faster and better than the easy mode.
- Expert mode: This mode is highly recommended for players that are fully aware of the game and are feeling the need to challenge the machine will be behaving completely differently and will make sure to find the most applicable chance of victory. Furthermore, the machine will be performing various principle of artificial intelligence like constantly monitoring the movements of the player by making predictions and calculations that will make sure it gives the players a difficult time and blocks them from ensuring a victory.

IV. LITREATURE REVIEW

Without a shadow of a doubt, artificial intelligence is becoming a very popular implementation in information technology industry and specially in games where it tends to challenge the human intelligence. For example; computer chess program has been introduced by IBM which was called "Deep blue ", where it managed to defeat a world chess champion Garry Kasparov in a game of six matches on 10th of February 1996. The deep blue program was the first step in the history of humanity where a human was defeated by our own creation which proved that it can adapt, predict and react faster than the human being. However, this computer chess program had a logic behind its intelligence and that's by using a large search possible tree of states and where the program relies on its database which retrieved the knowledge that it has learned and evaluates the positions of the search tress. Moreover, it today's world the modern chess computer programs has evolved since 1996, where it can analyze millions of the possible positions of the chess pieces in a fraction of seconds.

Moreover, by the help of machine learning which is considered one of the techniques in artificial intelligence, the games can achieve a far greater behavior than what they used to be. There are other concepts that help artificial intelligence achieve the required results for most machines and those concepts are neural networks for example which allows the network on that machine to learn and improve itself on its own. Moreover, the machine keeps on updating itself of the knowledge that it has learnt during the gameplay. Other concepts are there like decision tree which makes the machine make the best choices of decisions and allows them to predict the future outcomes that may arise. There are just some few examples of artificial intelligence implementations and by applying them, games tend to evolve and surpass our expectations.

V. PROPOSED SOLUTION

Intelligence can be added in the board game reversi according to its rules in which the computer machine must be completely aware of, where it has to understand the basic concepts like where it can move, how it can capture the space and block the players by securing its disks at the corner of the board. Moreover, prediction and decision making are an important factor which can be achieved by the help of an algorithm called search algorithm. There are different types of search algorithms that are applied and one of the main problems is if random searching algorithm is used and that's because it will be placing things at a random space without thinking. For example, the proposed game reverse, if this algorithm is used then the game will not be challenging, and it will make things easier for the player to defeat the machine. The most appropriate solution to make the game intelligent and challenging is by introducing the second type of searching algorithm that is called Mini-Max searching. This algorithm is used in such a way where it gives the machine program and

advantage where it has a huge possibility of beating the player, the machine can consider the moves of the player beforehand in advanced and prepare for the comeback to ensure that it can defeat that player without any issues. The algorithm should allow the machine to secure the corner spaces to make it difficult for the player to attempt to surround the machines disks to secure that specific space.

VI. CONCLUSION

In conclusion I would like to conclude that artificial intelligence without a doubt has opened many possible opportunities in which we as human can learn from the machines that we have created. It can teach us to think faster and make better decisions, but that can be done with practice. However, in reversi with the most appropriate artificial intelligence algorithms its possible for the machine to defeat a human being player and this report contains the necessary explanations of how these algorithms can be introduced and applied in the ancient board game. Furthermore, the development of the game can be improved slowly until it reaches a point where it can fully become an intelligent game and apply the best strategic movements to defeat perhaps the best players who are used to playing this game. For future references it would be without a doubt an interesting thing to discover whether the principles can be applied in the board game to get the most significant performance.

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