The Game Theory of Reversi

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I: Introduction and Background

Reversi is a game that was invented in England circa 1880. There are at least two men who claim to have invented the game, Lewis Waterman and James Mollett, but it is unclear as to who copied who, although James Mollett did publish a very similar game ten years earlier. Reversi began to be marketed in 1888 by Jaques and Sons of London, and quickly grew in popularity at the end of the 19th century. More recently, Reversi was rebranded and registered under the new name Othello by Tsukuda Original, a Japanese game company. This was clearly a reference to the Shakespearean play *The Tragedy of Othello, the Moor of Venice*, which stars the Venetian general Othello, who is black, and his beautiful wife Desdemona, who is white. Since the rebranding, Reversi has grown in popularity around the world, perhaps most of all in Japan. In fact, there have even been annual Reversi World Championships, held every year since 1977, with Japan being one of the most decorated countries in both the individual and team rounds (Chen).

II: Rules and Terminology

Reversi is a turn-based strategy game played by two people on a eight-by-eight grid board, similar to chess, except that the Reversi board is uncheckered. Players use pieces called discs, each with one side black and one side white, corresponding to their respective players. The game starts off with two black pieces and two white pieces diagonally adjacent to each other in the center of the 8x8 grid, as shown below:
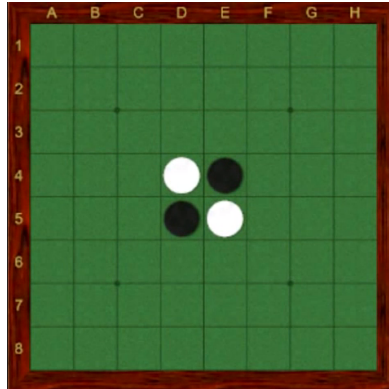
From this initial position, each player will take turns, starting with black, by placing one disc onto the

board with their own color facing up; however, the only way to place a new disc on the board is to

"sandwich" one of the other player's discs between your new disc and one of your discs that is already

on the board in the same vertical, horizontal, or diagonal line. After you put down a new disc, each of

the opponent's discs that were "sandwiched" must be flipped over to your own color side. For

example, in the initial starting position as shown above, black starts out and may only place a new disc

in squares C4, D3, E6, or F5, thereby capturing one of the two white discs already on the board. Then

the tally after the first move goes from Black--2 pieces vs White--2 pieces to Black--4 pieces vs

White--1 piece. If a move sandwiches your opponent's discs in more than one direction, all the

opponent's discs that were sandwiched must be flipped over as well. If it gets to a player's turn and

they have no possible moves on the board, the player must pass his turn and let his opponent continue

to make more moves until the player can make another legal move again. The game continues until every

single square is filled (most common), or there are no more possible moves left (rarer), or one player

flips over all of their opponent's pieces (rarest). The player with the most pieces on the board then wins.

Reversi is mathematically unsolved, meaning that there has not yet been an algorithm developed that

determines the perfect way to play this game. It is undetermined whether or not going first gives any

advantage, but computer analysis so far suggests a likely draw anyways.

Reversi, like most other games, also has its own terminology, particularly when referring to

places on the board. First and foremost are the corners and edges of the board, which are exactly what

they sound like. These positions will be further elaborated on later in the paper, but for now it is simply

important to know that corners cannot be flipped. Edge squares can further be broken down into

several categories. The two centermost squares on each edge are known as the B squares. On either

side of the B squares on each edge are the A squares. Finally, the slightly more important C squares are

the eight edge squares that are adjacent to a diagonal. Another common term within the game is called

the sweet sixteen, which refers to the sixteen squares in the center of the board, as shown below:
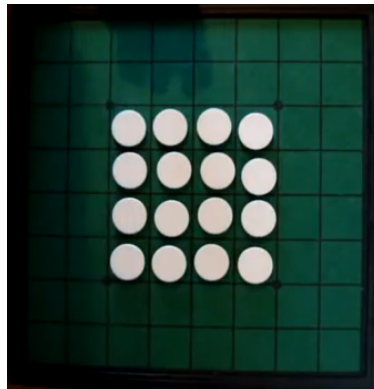
These squares are generally the first squares that you play on in the opening of the game, simply based

on proximity to the starting position. They also are not adjacent to any corner or edge, meaning that

playing there does not give your opponent access to an edge or corner. Finally, perhaps the most

important non-edge squares are called the X squares, which are located diagonally adjacent from each

corner. These X squares can be dangerous to play on, as they usually lead to an immediate loss of the

corresponding corner (Fang). The figure below gives a summary of the B, A, C, and X squares:

III: Basic Strategy of Reversi

At its core, the basic goal of Reversi is to capture as many of your opponents discs as you can, while at the same time preventing your opponent from flipping too many of your own discs. However, Reversi can be a very volatile and elastic game, because pieces can easily change from one color to another from turn to turn. Hence, a key strategy of this game is to look for ways to stabilize your position in such a way that once you flip a disc, it will stay your color for the rest of the game--in other words, you're trying to lock in pieces as your color. It is here that corners come into play, because corners are the only squares on the board that may not be flipped once taken. In fact, to actually flip a corner, a player would have to play a piece off of the board, which of course is not a legal move. So once a player has taken a corner, they can then go about expanding outwards, because having a disc of the same color next to a corner will in turn lock those pieces in as well. Basically, if you control a corner and some adjacent edge pieces on the same side as the corner, those pieces are locked in as well. All of this also implies that if we want to take corners for ourselves, it would stand to reason that we would want to avoid giving them away to our opponent. This means that we try not to play on the squares adjacent to the corners--either the C squares or the X squares. Sometimes, C squares can't be avoided, so a player will have no option but to play the C square. This can be okay though; it just may give your opponent leverage later on in the game. X squares, however, are generally to be avoided at all

costs, because they generally give your opponent instant access to the corner. All your opponent would need is a single disc along the board's diagonal to swoop in and steal the corner from you, before wreaking havoc on the rest of the board. So if both players have the aim of reaching the corners without playing the X squares, this typically means that the areas around the corners are the last few squares to be played in a game (Hobo). The game basically boils down to biding your time, waiting for your opponent to make a mistake before you, such as playing an X square, thereby allowing you to reach a corner and build from there. This is where the counter-intuitive concept of minimalism comes into play.

IV: Minimalism and Mobility

The idea of minimalism is rather than take as many pieces as you can, try to take as few pieces as you can per turn, at least through the mid game. This may seem to fly in the face of all logic and reason, given the objective is to end up with more discs on the board than your opponent, but it has been proven to be the best strategy, and the one that is used by the world champions of Reversi. It is the reason why simply taking the most number of discs per turn will almost guarantee a loss every time. The reason is that taking more pieces will reduce your mobility, or the number of moves available to you each turn. By taking more and more of your opponent's discs, you leave less options for yourself in your next turn, while giving your opponent more move options to choose from. You want to maintain your mobility in at least the first half of the game because that is how you avoid making a bad move, such as playing the X square, and at the same time limiting your opponent's moves until they are forced to make a bad move themselves. Because it is possible to flip many pieces on just a single turn in Reversi, it is easy to catch up to your opponent at the end of the game, especially when you have all the moves and they have none. For instance, take a look at the following (slightly exaggerated) example, where white has only one disc and black has every other disc except the corners:
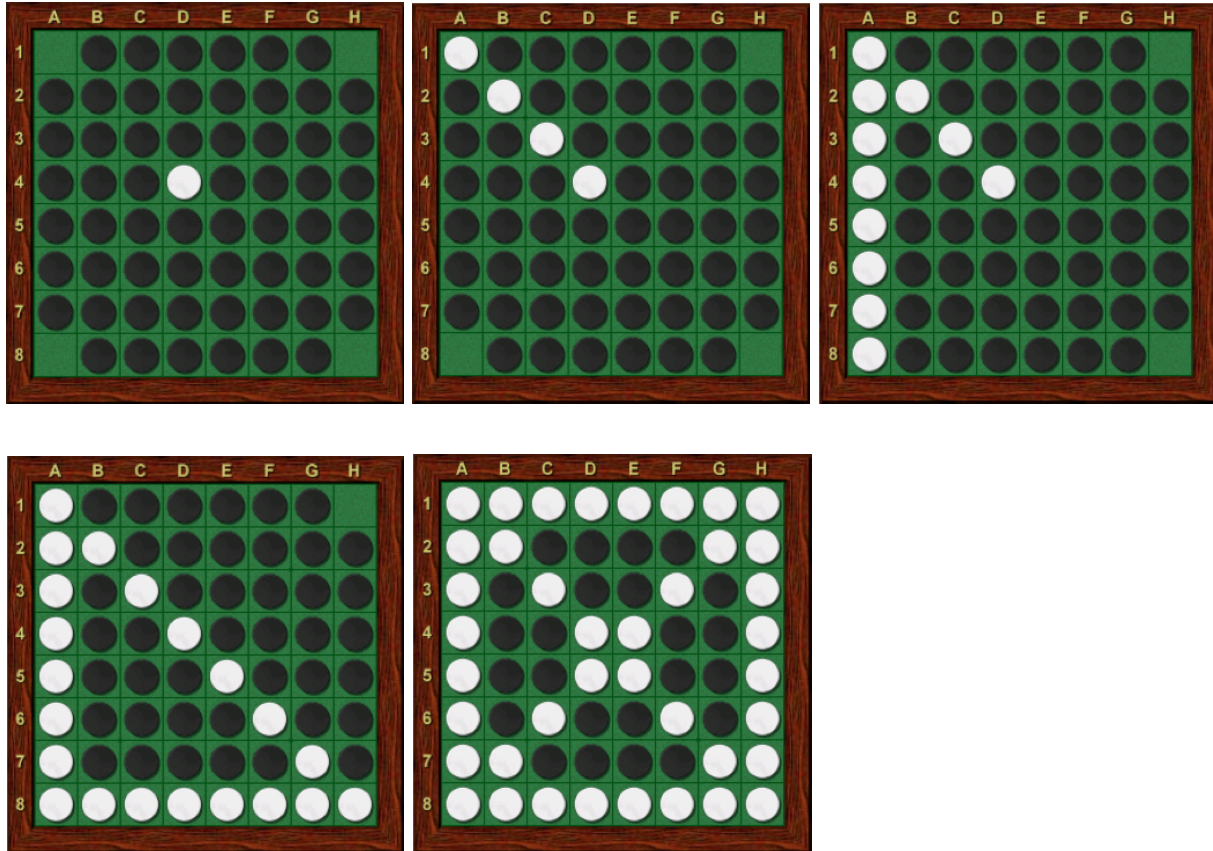
This example demonstrates the importance of both corners and mobility. With only one disc on D4, white seems to be guaranteed a loss. But actually, because of minimalism, black has no moves to make and therefore must pass, leaving the last four moves for white. So white proceeds to take all four corners, sweeping across the board, and ends up the winner 40-24 (Fang).

V: Conclusion

Growing up, I played a lot of board games with my father, including checkers, chess, Connect 4, backgammon, and Reversi, among others. These moments are some of my favorite childhood memories of bonding with my father, despite the fact that for most of the games, I rarely won. Reversi was the one exception, especially after I started picking up the tricks and strategies mentioned above

(all of which I learned through experience, rather than through the internet). Eventually, I almost came to

rival my father, and each game always came down to the last few moves. For this, Reversi will always

hold a special, nostalgic place in the back of my mind, and it most certainly lives up to it's tagline: "A

minute to learn...a lifetime to master."

Summary

Reversi was a board game invented in England in the late 19th century, and then re-introduced as Othello in the 1970's, where it quickly grew into a popular game around the world. Players take turns sandwiching each other's discs to flip them to their own colors, and the objective is to finish the game with more than half of the discs as your own color. Corners are impossible to flip, and therefore are the best ways to anchor and protect the rest of your discs. But because of this, it is important to avoid playing next to corners in order to not give access to them to your opponent. Particularly in the first half of the game, it is important to bide your time and take fewer pieces rather than more pieces in order to maintain your mobility and wait for your opponent to make a bad move to capitalize on yourself. Most of all, remember that Reversi is only a board game in the end--happy flipping!

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