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# The Omniscient Play in Games

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This paper concerns the notion of "game solved" based on the definitions presented by Allis (1994). A new concept of so-called "ultra-strongly solved" is proposed. Then, the process from the "strongly solved" to the "ultra-strongly solved" is investigated with focus on the beauty of the initial position. It is also a changing process from a game to a puzzle, and a puzzle to an art, from the omniscient player's point of view. It results in the finding of the most reasonable initial position of a game. Moreover, the role of the omniscient play is considered.

## 1 Introduction

We have observed the change of research interests in the domain of computer strategic games for half a century. In the past history of computer games research, most investigations have mainly focused on the two challenges: building the over world champion level programs and solving the complex games like checkers and chess.

The building of strong game-playing programs has been involved with an expectation that it may be useful to witness the intelligence of computers. Moreover, the development of computer games technology, i.e., the synergy of software and hardware, have made it possible to win the human world champion (Hamilton and Garber 1997) and possibly establish the game-theoretical value of a game. The value is the outcome when all participants play optimally. It indicates whether a game is won or lost (or drawn if that possibility exists) from the perspective of the player who is to move first.

With respect to the solution of games, Allis presented, in his thesis (Allis 1994), the three definitions of "game solved". Here "ultra-weakly solved" means that the game-theoretical value of the initial position has been determined, "weakly solved" means that for the initial position a strategy has been determined to achieve the game-theoretical value against any opposition, and "strongly solved" is being used for a game for which such a strategy has been determined for all legal positions.

In this article we add another definition of so-called "ultra-strongly solved". It means that the game-theoretical value of any initial position is determined. An ordering

exists between the four definitions. Any ultra-strongly solved game is also strongly solved, while a strongly-solved game is also weakly solved. It must be interesting to investigate the process from the "strongly solved" to the "ultra-strongly solved" as well as the process from the "weakly solved" to the "strongly solved". However, very few attempts have been made with that focus. This is because the challenge to win the human champion is so high in most strategic games. It eventually arrived at drawing little attention to solving games or determining the game-theoretical value.

In this study we observe that the process from the "strongly solved" to the "ultra-strongly solved" is a glorious path, which is something like a victory run. This indeed runs from a game field to an art filed (Iida 2007). On the other hands, the process from just a good level to the world champion level is like a thorny path in strategic games such as Go and shogi. Moreover, the process from the "weakly solved" to the "strongly solved" is necessary to identify the principle variation. Thus a "game" changes into a "puzzle", for which an artistic value is required.

The present contribution concerns the process from the "strongly solved" to the "ultra-strongly solved" with focus on the notion of reasonable initial positions of a game. Here a question arises: "What are the necessary and sufficient conditions for a reasonable initial position?" Once we successfully developed the computer omniscient player, it becomes possible to respond or think seriously of the question. Moreover, the role of the omniscient play is discussed. Finally, concluding remarks are given.

## 2 Game Solved and Its Perspective

In this section, we first introduce a notion of so-called "ultra-strongly solved". For a strongly-solved game some changes of the rules are strongly required to retrieve the attractiveness. In particular, the replacement of the original initial position is discussed. Moreover, we consider some options after a game is ultra-strongly solved.

### 2.1 Ultra-strongly solved

If a two-person game like chess is strongly solved, then we know the game-theoretical value, and the principal variation. Note that the game-theoretical value means the outcome of a game such as win/loss/draw, whereas in other games like *reversi* the outcome includes the scores.

After a game is strongly solved, there might be several ways to follow. Here we mention two major options. (1) One is the change of the rules, e.g., a small change is the replacement of the initial position. (2) Another option is the movement to other more complex games while assuming the game was dead.

In the first option, regardless of the outcome of a game, the original initial position is to be changed, by which the outcome of the game may become uncertain. After all possible initial positions are examined, we then call the game is "ultra-strongly solved". During this process we expect to make some findings concerning an initial position and its various influences. Of which, the previous study (Kita and Iida 2006b) was done with focus on the relation between the game-theoretical value and the mobility in the initial position.

When following the second option, we might observe that the game considered was ultra-strongly solved. We notice that the initial position of classic games such as chess and shogi, which may have long history, must be well refined and no other initial positions are likely to be more reasonable than the original one. Even if exists such an initial position, it might not be accepted as a new one because of the historical reason. Here a question arises: How was such a reasonable initial position chosen long ago? It is our expectation that the mystery of the initial position of such classical games could be unveiled by building a computer omniscient player.

## 2.2 Changing the rules

Consider a two-person game that was strongly solved, and suppose that the outcome is the first player win. The interest of players would anyhow shift from the "winning strategy" to the "compensation" for the second player's disadvantage. It is just like *komi* in the game of Go. This indicates that creating an omniscient computer player might have a strong influence to the game considered. Once it happens, the rules of the game might be changed, or player's strategies could be improved. From this point of view it is the critical aspect of games to keep the fairness for all players. If the game is sufficiently fair for all players, that remains the improvements of playing skill.

Regardless of the outcome of a game, once the game-theoretical value is known, the attractiveness of most games would be going to lose. The rules of a game, which was strongly solved, are to be changed that it may be never solved. This process has been studied in the term of the "rebirth" of games (Cincotti and Iida 2006).

Moreover, changing the initial position is one of the most logical ways to keep the character of the game while eliminating a possibly undesirable characteristic, e.g., the explosion of opening theory. It is also the case where a game was ultra-strongly solved. In the domain of chess, "shuffle chess" is such an example, in which the set of eight pieces is aligned randomly on the back rank, and the black set of pieces will mirror the white one. In the shuffle chess the stochastic factor is introduced.

### 2.3 True figure of a game

The process from the "world-champion level" to the "weakly solved" is somewhat a crime path. It was stated (Donninger 2002). "I believe that solving a game is the same "achievement" as the extinction of a biological species. A solved game has completely lost its charm. It is dead for serious play". He continued; "Games are – like statues – important cultural goods and I see no principal difference between destroying a Buddha statue with a mortar and extincting a game with a supercomputer".

One is to continue the exploration of the mystery of a game perhaps with a supercomputer, moving from the "good level" to the "strongly solved", via the "world champion level" and the "weakly solved". Another one is to say "Do not kill the game" after a computer achieved the human world champion level. Then people are encouraged to work for other games. It is just like the natural movement from chess to shogi (Matsubara *et al.* 1996).

Although there is no strict definition of the "death of a game", the notion of the "weakly solved" may be equivalent to it. If so, it becomes more important to move forward from the "weakly or strongly solved" to "ultra-strongly solved". The finding of the most reasonable initial position would enable the game to retrieve the attractiveness. In this sense, the omniscient player might be a mortar to kill a game but also a rescuer to refine the game as well as possible, in other words, to find the true figure of the game.

## 3 The Initial Position and Its Alternative

By the omniscient player a game can be strongly solved. But it takes some more time to ultra-strongly solve. While changing the original initial position and trying to solve the other possible initial positions, there might be some possibilities of being unable even for the omniscient player to solve some initial positions.

### 3.1 Reasonable initial positions

Many games would be produced by changing the initial figuration while keeping the same rules otherwise. The point is to find reasonable initial positions. We here propose the following three aspects or steps to examine it based on the early studies (Majek and Iida 2004; Iida and Yoshimura 1999; Iida 2004).

1) Outcome uncertainty

Find an initial position where the game cannot be strongly solved. Namely, the outcome of the game must be uncertain.

2) Figuration beauty

Among positions found in (1), identify the initial positions which have in some way the

beautiful factors. The basic component is, for example in chess like games, the piece figuration and/or its symmetry: the line symmetry and point symmetry.

3) Fairness

The (nearly) same winning ratio for Black and White must be obtained statistically when playing many games starting from the initial position considered.

### 3.2 Examples

The initial position, shown in the Figure 1 (left), is an analogy from the 8x8 *reversi* and somehow looks beautiful due to the point symmetry at the centre of the board. However, it has already been strongly solved and the outcome is White win by four discs (Feinstein 1993).

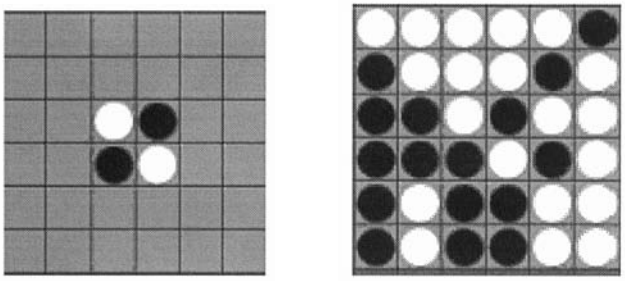

Figure 1: An initial position (left) and the terminal position solved (right).
White wins by four discs.

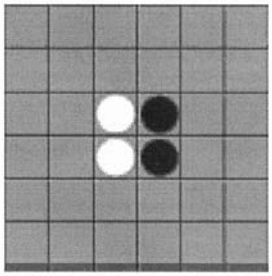

Figure 2: An example of possible alternative initial position.
White wins by two discs.

Let us show, in Figure 2, a possible alternative initial position. It has the line symmetric beauty. After longer time computation than for the initial position in Figure 1, the game was also strongly solved as White win by two discs. It is harder for our solver (simply alpha-beta algorithm implemented) to solve it and the outcome is closer to the draw than the original one. Any possible initial position, where there are four discs on

the board in some reasonable disc figuration and the outcome is drawn, has not yet been found.

The game of 6x6 *reversi* is being ultra-strongly solved. We found a possible alternative initial position that is more complex and closer to the draw than the original one. But it may be poorer in the sense of disc figuration, i.e., the point symmetry looks better than the line symmetry. Totally it may be concluded that the original initial position is slightly better than the alternative we found in this study. A question remains: How was the initial position chosen at that day without the omniscient player?

It is unfortunate that in this study the self-play experiments were not performed to obtain the statistics of the wining percentages for both initial positions shown in Figure 1 and Figure 2. However, we suspect that the initial position of Figure 2 makes the match more closely since its outcome is closer to the draw than the other position.

## 3 The Roles of the Omniscient Play

The omniscient play in a game would be informative for us to know something important. In the previous section the process from the weakly solved to the ultra-strongly solved was discussed, whereas it related to the role of the omniscient player. Here we discuss the roles of the omniscient player more widely.

### 3.1 Solving a game

One is, of course, to determine the solution of the game. The solution or the truth would sometimes surprise us with the strange move sequence or so. We shall observe: "Nothing is more boring than the truth". The truth is usually simple and therefore feels beautiful. However, it must let a game lose the charm as well.

The outcome of a game, i.e., the principle variation and the game-theoretical value, would suggest us something such as the design concept of the author of the game. Of which, the fairness or equality is an important aspect of a game. The notion of equality in a two-person game can be represented by the statistics on the winning ratio for Black and White when played by those who are at the (nearly) same level.

For example, in the game of Go they wish to know the game-theoretical value, by which the fair *komi* could be provided to the second player. They know through much experience that the exact *komi* is to be obtained from the game-theoretical value and such fair *komi* makes a serious play exciting more.

### 3.2 Seeking for a truly attractive game

In the sense of the forward game and backward game (Kita and Iida 2006a), the

omniscient play can open the door from the forward game to the backward game. Until a game is weakly or strongly solved, they play it as a forward game, in which they seek for the excitement or thrill that is caused by the accelerated change of the information on the game outcome (Iida *et al.* 2004). After a game is ultra-strongly solved or on-going for it, the game becomes a puzzle while changing the forward game into the backward game, and eventually would promote an art.

Any game is a puzzle from the omniscient player's point of view. Any artistic value is then explored in the puzzle world. One simple approach is to seek for the beautiful initial position. The beauty of the move sequence of the solution is also important (Iida 2007) as well as the ending position. Hence, it may be a great issue to find the most beautiful initial position as well as the ending position of the game.

Solving a game is, in some sense, a promotion process from a player to an author of the game. If we do not pay more attention to the process from the weakly solved to the ultra-weakly solved, solving a game means just putting it in a garbage box. In this sense we agree with the opinion by Donninger (2002). However, if we pay careful attention to that process, a game would enter an art museum in the form of the most beautiful figuration even after it is solved. In this sense, solving a game is not a crime, but a great achievement.

Is it true that a solved game loses the charm? No. Instead, some games, even after they were solved, would be still attractive for a serious play. It may become more interesting than before solving. Why? That would be the necessary and sufficient condition for being a truly attractive game. It is even without the proof, though.

## 4 Concluding Remarks

The omniscient play enables us to explore the true figure of a game and make other insights including its design concept and metaphor. A game with a long history and profound meaning is like a message to modern people. After such a game is ultra-strongly solved, i.e., building the computer omniscient player, we can start the serious study to understand the message. For essence, a great mystery is the question: How did people in the old time determine the so wonderful initial position of the intellectual games such as chess and shogi? In this direction this paper would remind us of the possibility to open a new dimension of computer games research.

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