Chapter 7
Yavalath

The best games are not those in which all goes smoothly and steadily toward a certain conclusion, but those in which the outcome is always in doubt.

George B. Leonard

Abstract Yavalath is the most successful game evolved by the Ludi general game system. This chapter gives a complete description of the rules and analyses the forcing move mechanism that makes Yavalath so interesting. Some strong patterns and tactical tips are given, in addition to the solution of a puzzle and other aspects such as the first move advantage, draws and adding a third player. The publication of Yavalath and its reception by game players and designers is briefly discussed, as well as its general acceptance among the board game community and its possible role as an inspiration for subsequent games.

Keywords Yavalath · Forcing move · First move advantage · Swap rule · Three-player game · BoardGameGeek

7.1 Analysis

The simplicity of Yavalath's rules belie a tactical depth due to the potential for sequences of forcing moves. This section explores this forced move mechanism, including its use to solve the puzzle proposed in Chap. 1 and its prevalence in a number of strong patterns. It is demonstrated that the opening player has a strong (winning) advantage unless an additional rule is used to balance the game.

7.1.1 Rules

Yavalath is played on a hexagonal field of hexagons which is initially empty. The standard board size is five cells per side (Fig. 7.1).

Two players, White and Black, take turns adding a piece of their colour to an empty cell. A player wins by making 4-in-a-row of their colour (or more) but loses

C. Browne, *Evolutionary Game Design*, SpringerBriefs in Computer Science,
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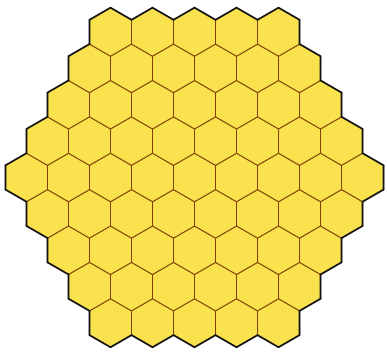
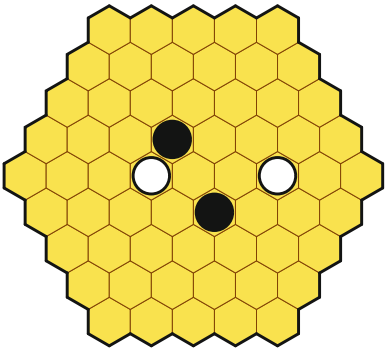
Fig. 7.1 The Yavalath board





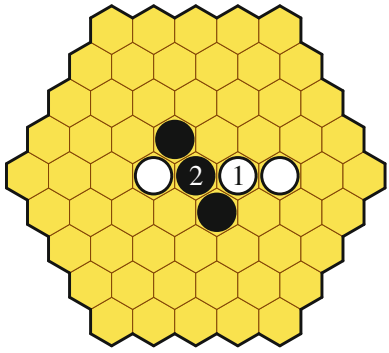


Fig. 7.2 A forcing move by White

by making 3-in-a-row of their colour without also making 4-in-a-row (or more). If the board fills without either player winning or losing, then the game is a draw.

Swap Rule: White makes the first move, then Black has the choice of either swapping colours—effectively stealing the first move—or continuing with their move as usual. This discourages White from making an overly strong opening move near the board centre.

7.1.2 Forcing Moves

The key tactical play in Yavalath is the *forcing move*, as shown in Fig. 7.2. White move **1** threatens to make a line of four white pieces next turn, hence Black is forced to play blocking move **2** to intervene. Unfortunately for Black, this forced blocking move completes a line of three black pieces to lose the game.

Games are typically won using sequences of such forcing moves to manipulate the opponent into disadvantageous and ultimately losing positions. Long sequences of forcing moves can be difficult to predict correctly, especially if forced replies by the opponent themselves trigger further forced replies from the mover,

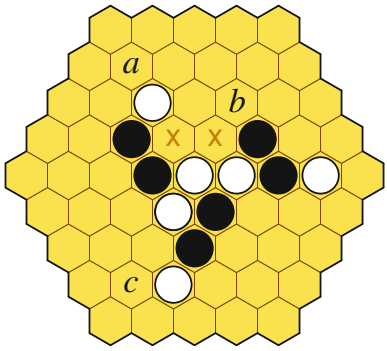


Fig. 7.3 White to play and win

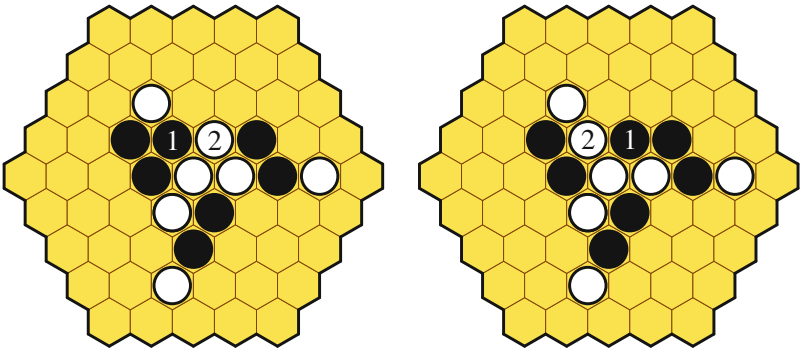


Fig. 7.4 Black can force a win with either move X

and so on. Players can therefore plan ahead with some degree of certainty, but must be careful of surprises that might lie in wait once a forced exchange is triggered.

7.1.3 Puzzle Solution

With this in mind, consider the simple puzzle presented in Chap. 1, with White to play and win (Fig. 7.3). A Black move **1** at either cell X will force a losing reply **2** from White, as shown in Fig. 7.4. Hence Black must not be allowed to make either of these moves, and the only way to achieve this is for White to go on the offensive with forcing moves of their own.

White has three forcing moves available to them, marked ***a***, ***b*** and ***c*** in Fig. 7.3. A move **1** at either ***a*** or ***b*** would force a reply **2** from Black as shown in Fig. 7.5, but each of these replies would in turn force a losing reply **3** from White. Such forcing moves that come back to hurt the mover are called *rebounds* (similar but opposite to the Go concept of "snap-backs").

The only non-losing choice available to White is therefore move **1** at ***c*** (Fig. 7.6). This forces a harmless reply **2** from Black and sets White up for move

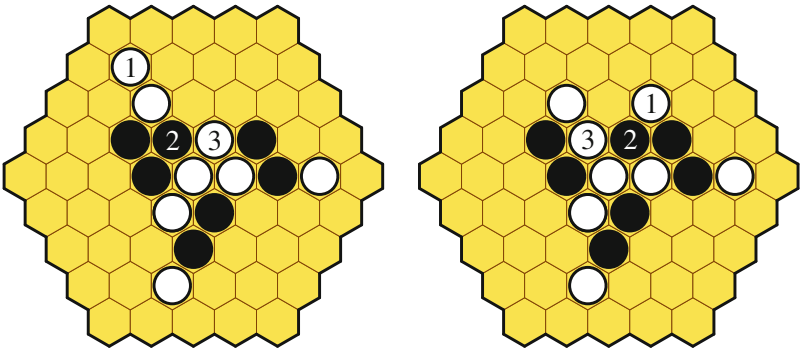


Fig. 7.5 Forcing moves ***a*** and ***b*** lose for White

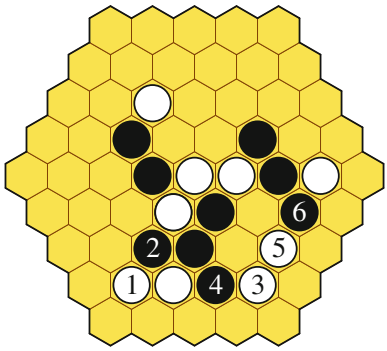


Fig. 7.6 Forcing move ***c*** is White's only winning play

3, which forces another harmless reply **4**. White can then play move **5** which forces the losing reply **6** from Black.

7.1.4 Strong Patterns

Triangular piece formations tend to be strong. For example, the small size-2 triangle shown in Fig. 7.7 allows White to launch a variety of winning attacks.

Figures 7.8 and 7.9 show forced winning sequences by White both above the triangle's apex (7.8) and below its base (7.9). Both of these attacks can be applied in each of three rotations and two reflections, hence it is difficult to block all possible attacks from all three sides of the small triangle. Players must therefore be wary of the opponent forming such patterns unless suitable precautions are taken.

Medium size-3 and large size-4 triangles (Figs. 7.10, 7.11) are also strong formations that allow forced wins, as shown. However, medium and large triangles are easier to block—it is usually sufficient to block one side—and hence do not present as much danger as small triangles.

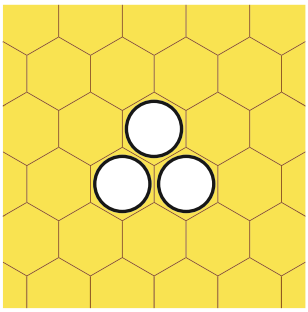


Fig. 7.7 The small size-2 triangle is a strong pattern

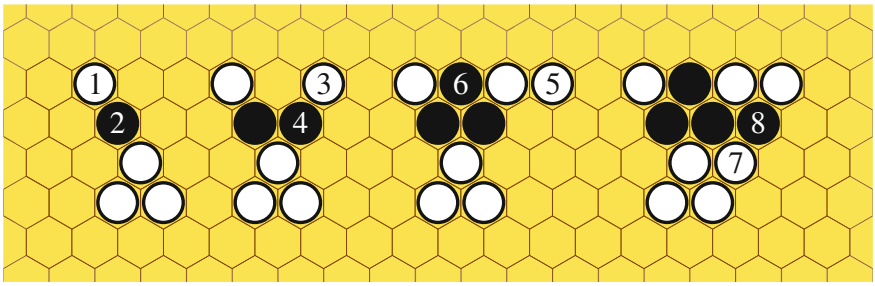


Fig. 7.8 White can force a win above the apex...

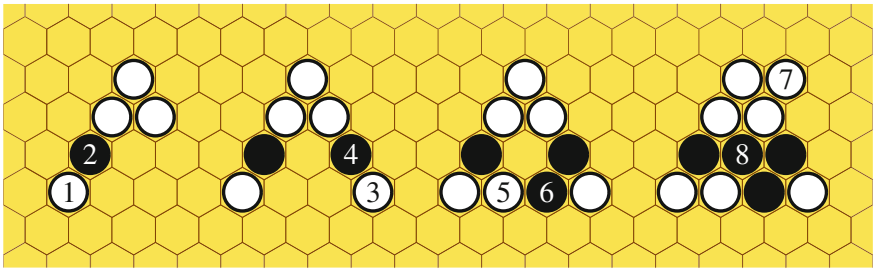


Fig. 7.9 …and can force a win below the base

7.1.5 First Move Advantage

White has a huge (winning) advantage if allowed an unconstrained opening move. Figure 7.12 shows how White can form a small triangle with their first three moves, which Black is helpless to defend against. This strong opening was first pointed out by Nestor Romeral Andrès in 2011.

Figure 7.13 shows how it is possible to block a small triangle on all three sides with only three pieces. However, White can choose which way to orient the triangle with their third piece to avoid this situation, so Black would have to catch White napping to achieve such a blockade.

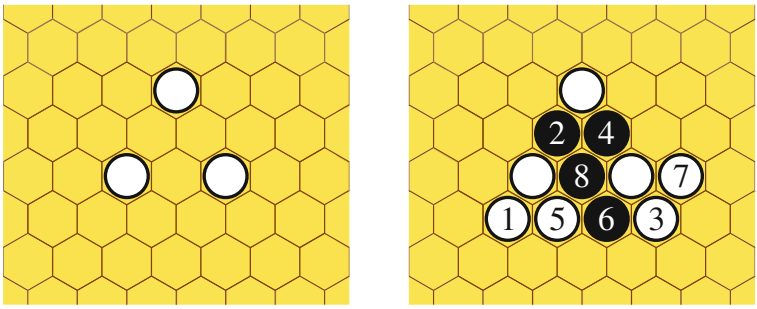


Fig. 7.10 Medium size-3 triangles allow a forced win

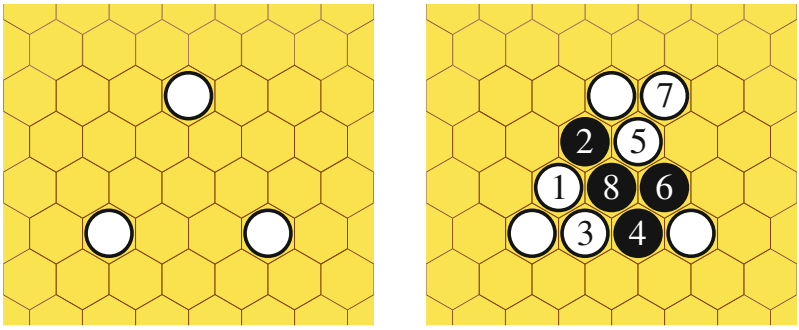


Fig. 7.11 Large size-4 triangles allow a forced win

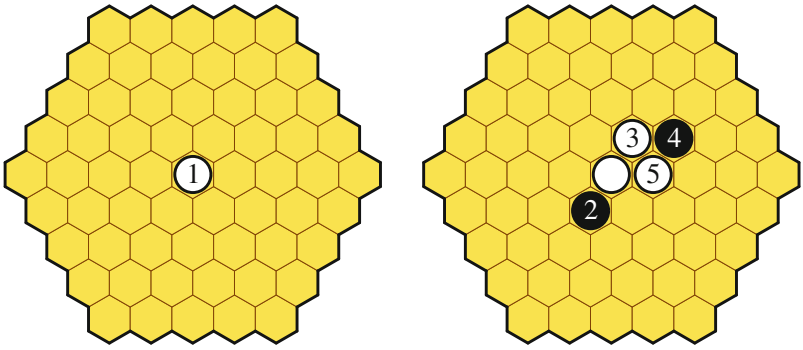
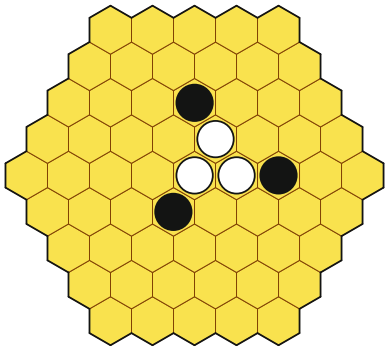


Fig. 7.12 A strong (winning) opening for White

The solution to this imbalance is the *swap rule*, which enables Black to swap colours in lieu of making their first move, to discourage White from making an overly strong opening move. This rule is used to successfully balance openings in a number of combinatorial games.

Fig. 7.13 Black foils White



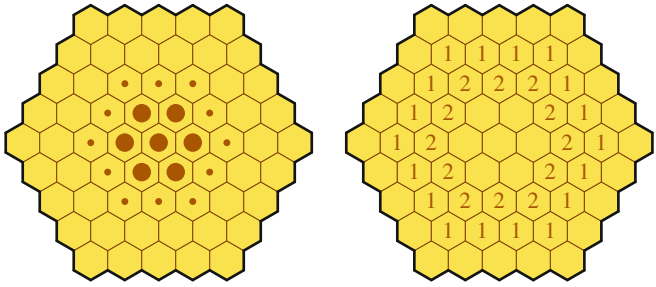


Fig. 7.14 Openings to swap (*left*) and openings to make (*right*)

Figure 7.14 (left) shows opening moves that Black should swap. The large dots represent moves that should undoubtedly be swapped, while the small dots represent moves that appear to be reasonably balanced. Opening moves in unmarked cells need not be swapped as their proximity to the board edge reduces the danger of the small triangle on that side. A general rule of thumb is: *swap any opening move that is three or more cells away from the board edge*.

Figure 7.14 (right) shows the best opening moves for White. Opening moves along the board edge are too weak to consider, while opening moves one cell away from the edge (marked "1") are weak but plausible. Opening moves two cells away from the edge (marked "2") are stronger and reasonably balanced; the opponent will not necessarily swap such a move.

Ludi did not discover the killer opening described above. It seems obvious in hindsight, but then again nor did any human player discover it until years and hundreds—possibly thousands—of games later. Its detection by exhaustive search would require a search depth of 13 involving over 10^{18} moves, and its detection by tactical analysis (centre → size-2 triangle → forced sequence) is beyond the capabilities of Ludi's simple advisor/policy AI model.

It has always been assumed that Yavalath suffered some degree of first move advantage so the swap rule has been used since its release, but the degree of this advantage has not been fully realised until now. This is possibly just as well,

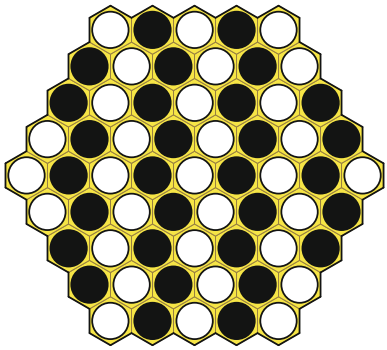


Fig. 7.15 A indecisive fill pattern

otherwise Ludi would have filtered out its rule set as being biased towards the first player and hence non-viable. An obvious next step for game design systems is the detection of such degenerate cases and their automated correction using remedial measures such as the swap rule, opening contract, piece balancing, initial movement restrictions, and so on.

7.1.6 Draws

Draws, although possible, are extremely rare. Players tend to make a fatal mistake due to the difficulty of correctly predicting forced sequences, or are forced into making a losing move as the number of available move choices dwindles in the end game.

Figure 7.15 shows a possible fill pattern that precludes a result, but which will not occur in actual play unless both players conspire for a draw.

7.1.7 Three Players

Yavalath works well as a three-player game. The standard two-player rules apply as specified by Ludi, with the following additions:

(a) Any player to make 3-in-a-row leaves the game (but their pieces remain).
(b) The mover must block the next player if possible.

Rule (a) allows the game to continue when a player loses but a winner is not yet decided between the remaining two players. Rule (b) removes a potential *king-maker effect*, which is the undesirable ability of a losing player to decide the outcome of a game [52]. The move order is: White, Black, Grey.

For example, Fig. 7.16 shows a three-player game with Grey to move. Grey *must* move at ***a*** to block White, then White *must* move at ***b*** to block Black and

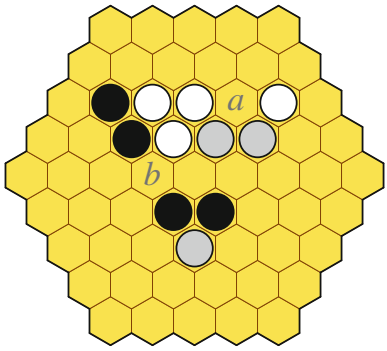


Fig. 7.16 Grey must block White at ***a***

hence lose the game. If rule (b) were not in effect, then Grey would be free to choose between a White loss (or a Black win) with move ***a*** or a White win with any other move, and the game would hence be decided by social factors rather than strategy. Example by Stephen Tavener.

The three-player version was devised as a natural extension of the two-player game shortly after its invention in 2007.

7.2 Impact

The rest of this chapter deals with the publication of Yavalath, its reception and impact on the broader game playing and game design communities.

7.2.1 Publication

Yavalath was invented by Ludi in November 2007 and published by Nestorgames in July 2009. No secret was made of the fact that this was the first computer-invented board game to be commercially published; this was in fact prominently stated as a marketing point. Yavalath was released in a twin pack with another Ludi game, Ndengrod, which was renamed as Pentalath and translated to the hexagonal Yavalath board for the occasion.

7.2.2 Reception

Yavalath has proven popular with new players as its rules are immediately accessible but their implications are not, making it quite addictive. One of the survey participants admitted to playing Yavalath repeatedly for over an hour, initially to beat the computer opponent but eventually to simply explore the game.

When new players are introduced to the game, there tends to be an "aha!" moment when they discover that forcing moves can make the opponent waste a turn, then shortly afterwards another "aha!" moment when they discover that these forcing moves can also be used to make the opponent play where they may not want to play. These forcing moves appear to be the key to the game, and once a sequence is triggered the result can be something of a surprise (unless the player has a good memory) which keeps the game interesting. There is also the aspect of better players being able to chunk forced sequences into conceptual units to facilitate strategic planning.

Publisher Nestor Romeral Andrès observes that Yavalath works well in attracting casual gamers at conventions and exhibitions due to its simple rules and addictive play. Casual gamers do not appear overly interested in the fact that the game is computer-generated, except to say that they would have expected such a game to be more complex and difficult to play. Hard-core gamers, on the other hand, tend to be very interested in the background of Yavalath, and are surprised that a computer can design such a "fun" game. There does not appear to be much concern within the game-playing community how a game is invented, provided that the game is good.

Game designers have also been surprisingly tolerant of the appearance of Yavalath and its ilk, most choosing to show interest in Ludi's potential as a collaborative tool rather than seeing it as a threat to their creative process (although this may change as automated game designers become more ambitious). Several have even stated that they find the creation of the game names as intriguing as the creation of the games themselves(!) There have been negative comments from designers who see in such automated systems not so much a threat but a challenge that must be risen to, but even in this sense Ludi could be said to inspire creativity in others.

7.2.3 Acceptance

BoardGameGeek (BGG) is a public web site that hosts an online database of almost all known board games (over 52,000) including descriptions, rules, reviews, classifications and player rankings from an international community of over 250,000 users [2]. BGG rankings generally provide a reliable indication of a game's quality, as the voting mechanism—unusually for social networking sites—is hidden such that casual users are unlikely to vote and most scores will therefore be informed decisions from educated users.

Yavalath was ranked #99 in the "Abstract Games" category out of 4,365 entries at the time of writing (August 2011). To put this in perspective, this places Yavalath in the top 2.5% of all abstract board games ever invented (as judged by BGG users) and above the following well-known titles:

- Backgammon (#112)
- Othello (#267)
- Halma (#426)
- Mastermind (#539)
- Chinese Checkers (#546)
- Checkers (#553)

This does not mean that Yavalath is as popular as any of these games (even remotely) but that those players who have tried Yavalath rate it on average more highly than those other games are rated by players who have tried them.

7.2.4 Inspiration

Yavalath's innovative "win with *N* but lose with (*N*-1)" mechanism has directly inspired the creation of related games by other designers, including Tritt, Cross, Tailath, Morro, Coffee and Epsilon. Some of these games have also been released by Nestorgames.

The Yavalath mechanism has been mapped to other rule contexts. For example, it has been placed in a connective context for Cross: *players win by connecting three non-adjacent sides with a chain of their pieces but lose by connecting two opposite sides beforehand*. Instead of winning with a line of *N* and losing with a line of *N*-1, players win with a 3-connection and lose with a 2-connection. This distinction between major and minor connections is reminiscent of the earlier game Unlur, but in this case both players share the same competing objectives and no extended opening contract is needed; Cross is a child of Yavalath.

In at least one known case Yavalath has inspired a designer not to invent a new game but to revisit a related idea, based on group size, that had been shelved years ago and forgotten. Yavalath could be said to have indirectly stimulated creativity by nudging this designer's memory and bringing this idea back into play for further development. It is interesting to note the surprising number of group size games that have emerged in the couple of years since then—more than the total number that had previously existed. Perhaps Ludi has served a wider role as a creative catalyst.