# TWILIGHT CHESS

## A Chess Variant Designed to Rehabilitate Human vs. Computer Challenge

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ABSTRACT

We advocate the study of a very straightforward variant of chess. Twilight chess can be defined in a single sentence: pieces may be removed from the board and replaced later. The idea is to consider a variant rather close to standard chess, but at the same time more difficult (due to combinatorial explosion) for computers. The idea is to stimulate research of new programing techniques. there are two advantages. First, only slight modifications are needed to adapt existing chess engines. Second, twilight chess is easily learnt by human players who can reuse most of their chess knowledge to master this variant. Twilight chess is thus a good candidate for a strategic game, closely related to chess, in which humans could be ahead of computers. Preliminary studies, based on the adaptation of FRUIT 2.1 to twilight chess, tend to support this idea.

### 1. MOTIVATIONS

As witnessed by the loss of two matches by V. Kramnik and G. Kasparov, world champions at the time, the strength of computer chess is largely above the human level. Moreover, Elo rankings of computer chess, see (Swedish Chess Computer Association, 2009; Computer Chess Rating Lists, 2009), of spring 2009 show more than 10 entries above the 3000 mark. By comparison, the best player of the FIDE's list, V. Topalov, is ranked 2812. On the light of these facts is it fair to say that there is no longer a real challenge on the sportive issue of computer chess vs. human chess.

We propose the study of a variant of chess to set up a new challenge in which the human holds his chances vs. the machine. Twilight chess can be seen as an alternative approach to the challenge set by O. Syed with Arimaa (Syed, 2003).

Moreover, an interesting point in favour of twilight chess lies in its high closeness to standard chess. It makes the adaptation of existing chess software trivial. It is the same for the human chess players who can reuse much of their chess knowledge to master this variant. Also the study of the relative impact, in terms of quality of play, of the new rules for both humans and computers is interesting in itself. Twilight chess could lead to new programming approaches.

### 2. RULES

Twilight chess can be basically defined in a single line. It is standard chess with two extra kinds of moves allowed: any piece, except the King, can be removed from the board (it can be seen as a move towards a twilight zone), and any piece previously removed from the board can be placed on any empty square of the board (this can be seen as a move from the twilight zone to the chessboard), except for the Pawns onto the last rank. More precisely, in a twilight chess game:

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- All classical laws of chess apply.
- Warp move: any piece, except the King, can be removed from the board.
- Drop move: any piece previously removed can be moved to any free square of the board, except for a Pawn into the last rank (eighth rank for white player, first rank for black player).
- Warp and drop moves are considered as standard moves with relation to classical laws of chess.

In order to cope with classical laws of chess, warp and drop moves are considered as moves from, and towards, a special 65th square: the twilight square.

Following this philosophy we have natural answers for the two-square pawn-moves ability, the castling rights, and the 50-move rules.

- *If a Pawn is dropped on the second rank (as a white player), can it afterwards be moved two squares forward?* The answer is no since it has already moved (back and forth to the twilight square), and moving two squares forward only applies to Pawns that have not moved.
- *If a rook is warped and later dropped to its original square can I castle on this side ?* The answer is no because the Rook has moved.
- A player can claim a draw by the fifty-move rule if no capture has been made and no Pawn has been moved in the last fifty consecutive moves. Since drop and warp moves are considered as moves, moving a Pawn to, or from, the twilight square restart the count. Moving a piece to, or from, the twilight square is not a capture and does not restart the count.

Regarding the threefold repetition rule we stick to the classical definition, mutatis mutandi. A player can claim a draw if the same position will appear for the third time after the next move. In order for a position to be considered the same, each player must have the same set of legal moves each time, including the possible rights to castle, capture en passant, and make two-square pawn moves.

While all changes are straightforward, this variant has great repercussions on the game. Notably, the number of legal moves is many times bigger than in classical chess. Assume, there is an average number of 30 legal moves in classical chess that has to be compared to $30 + 12 + 3 * 38 = 156$ for a twilight chess game in which a player has 3 pieces (of different kind) outside the board: each classical chess move is also a twilight chess move (30), and each piece on the board can be removed (12), each piece outside the board can be dropped in a free square (3*38). Moreover it is clear that as the game unfolds, and pieces are exchanged, the number of free squares increases, thus multiplying possibilities for pieces outside the board.

It seems fair to estimate the number of legal moves in a typical twilight chess game as 100 very conservatively. Thus, after two plies about $10^4$ different positions can be reached instead of $10^3$ for classical chess. Therefore twilight chess introduces a significant rise of the order of magnitude of the search tree for a single move.

## 3. STRATEGIC CONSIDERATIONS AND RELATION WITH OTHER CHESS VARIANTS

Several other chess variants include drop moves as well: Shogi, Bughouse Chess, and Crazyhouse Chess to name a few, see Wikipedia (2003a) for further informations on these variants. Though, in all these variants, it is through piece captures that pieces can be dropped later. Twilight chess warp move initiates totally new strategic issues.

Warp moves are strategic by their very nature. Except for rare cases (such as discovered attacks or square freeing), warp moves do not create immediate threats. Moreover, a piece in the twilight zone has no direct influence on the board. Thus, warping a piece, from a static point of view, weakens the position. It can be viewed as both a temporal (since it takes a tempo to drop the piece back into play) and a spatial gambit (since a warped piece weakens the control of the board) as opposed to traditional material gambits.

In contrast, a warped piece has a greater potential than the same piece on the board since it enjoys a greater mobility. Therefore, it has an impact on the relative strengths of pieces: it is clear that Knights benefit more from this feature than Queens. A second aspect on which warped pieces have an impact is quiescence search, since no

position in which there are pieces in the twilight zone can be considered as quiescent (think at all possible forks when dropping a Knight for instance).

To the best of knowledge of the author, a warp move is a singularity of twilight chess with no counterparts on the other chess variants (at least the variants cited). This singularity, by its strategic nature, is quite challenging from a computer programming point of view. Moreover, if we combine this remark with the combinatorial explosion of legal moves in twilight chess, it is arguable that cleverer evaluation functions are more worthy of study than in classical chess.

## 4. PUNICA: A COMPUTER TWILIGHT CHESS PROGRAM

As a preliminary study we have adapted the open source Fruit 2.1 chess engine (Letouzey, 2005) to Twilight chess. The software is named Punica after the scientific name of pomegranate tree, due to the combinatorial explosion of moves. We have also adapted winboard interface (Mann, 1994). An executable program can be downloaded from the Twilight chess website (Frédéric Prost, 2008).

The adaptation is, purposely, not clever at all: basically we have just introduced the possibility of warp and drop moves and we have not modified at all the evaluation fuction (warp and drop moves are considered as neutral).

Fruit is a good candidate for twilight chess engine for several reasons. It is a very strong chess engine (ranked around 2700 elo). It has a robust search procedure and very simple evaluation fuction; clever evaluation functions could be seen as over specific when moving to twilight chess (in twilight chess there are no such things as pawn structure for instance, while notions like king safety are crucial). The sceptical playing style of Fruit makes it a good defender. This is especially important in twilight chess, as early experiments have shown.

## 5. CONCLUSION

Twilight chess appears to be a very interesting strategic game from a programming point of view for several reasons. First, the combinatorial explosion of moves (with relation to classical chess) together with new strategic issues introduced by warp moves and also the fact that standard programming techniques have, at the least, to be adapted, if not found inappropriate for this game, (e.g. quiescent search), makes twilight chess a game in which the human could hold his own versus a computer. And we believe that there is no such thing as a human vs. computer challenge to liven up research in strategic game programming. Second, the extreme closeness of twilight chess to classical chess on the one hand allows the use of already existing chess engines as strong starting points for twilight chess programming, and on the other hand ensures a large pool of very strong human competitors. Thus, from a programming point a view, twilight chess is the continuation of human vs. compter challenge by other means (to paraphrase Clausewitz).

We hope that further studies on this variant will lead to new programming techniques that could benefit to strategic game programming.

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## 7. APPENDICES

## APPENDIX A: SAMPLE TWILIGHT CHESS GAMES

We present two games of twilight chess to give the flavor of this variant. The first one is a game in which the author succeeded in defeating Punica, and the second one is a game of the engine vs. itself. We use an extension of `pgn` notation, see (Wikipedia, 2003b) for a formal definition of classical `pgn`.

We use the following symetric notation for warp an drop moves:

- Warp moves: first the coordinate of the square followed by `@`, then the symbol of the warped piece. Hence, `b8@N` means that the Knight on `b8` is warped.
- Drop moves: first the symbol of the piece to be dropped followed by `@`, then the coordinate of the square on which the piece is dropped. Hence, `Q@h7` means that a Queen is dropped on square `h7`

[Date ”2009.06.06”] [White ”Prost, F.”] [Black ”Punica”] [Result ”1-0”] [TimeControl ”180+15”] [Variant ”Twilight Chess”]

1. Nf3 h7@P 2. b1@N d5 3. d2@P Nf6 4. f1@B P@e4 5. Ng5 f8@B 6. P@g6 Rf8 7. gxf7+ Rxf7 8. B@g6 B@e6 9. N@e5 Qd6 10. a1@R d5@P 11. Qxd6 exd6 12. Nexf7 Ke7 13. f7@N b8@N 14. Nxe4 N@h4 15. Nxf6 Kxf6 16. Be4 a8@R 17. O-O P@f5 18. e4@B R@g4 19. R@g3 Rxg3 20. hxg3 Ng6 21. B@d8+ Kf7 22. N@g5+ Ke8 23. Bxc7 b7@P 24. Bxd6 Bxa2 25. b3 Bxb3 26. cxb3 P@c2 27. Bb2 f5@P 28. Bb4 P@a3 29. B2xa3 a7@P 30. e2@P g7@P 31. Re1+ Kd7 32. P@g7 P@g8 33. g3@P P@h2+ 34. Kxh2 Ne5 35. Rxe5 c8@B 36. Re7+ Kc6 37. b4@B B@c7+ 38. B@g3 Bxg3+ 39. Kxg3 c1=Q 40. Bxc1 Kd6 41. Re8 Kc7 42. Rxg8 Kb7 43. g8@R Kc7 44. g8=Q Kb7 45. R@b8+ Kc7 46. Qd8+ Kc6 47. Rb6+ Kc5 48. Qd6 1-0

In the following game the evaluation of the position by the engine is given in commentary . Note that the evaluation of the position is very chaotic (much more than in classical chess).

[Date ”2009.06.08”] [White ”Punica”] [Black ”Punica”] [Result ”0-1”] [TimeControl ”900+15”] [Variant ”twilightchess”] [Annotator ”1. +0.07 1... -0.29”]

1. Nc3 +0.07/8 54 a7@P -0.29/8 1:04 2. Nf3 +0.10/8 44 Nc6 -0.26/8 19 3. d4 +0.07/8 1:00 d5 -0.17/8 1:10 4. h2@P +0.28/7 49 g8@N -0.06/7 58 5. f1@B +0.14/7 1:18 Bf5 -0.04/7 1:41 6. B@a4 +0.29/7 33 N@b4 -0.09/7 1:05 7. P@d3 +0.32/7 1:09 Rxa4 +0.00/7 49 8. Nxa4 +0.02/7 30 P@e4 +0.09/8 2:17 9. Nh4 -0.09/8 31 exd3 +0.04/8 24 10. cxd3 -0.55/8 3:37 h7@P +0.66/8 37 11. a3 -0.42/7 33 e7@P +2.13/7 1.5 12. axb4 -2.26/8 1:38 Rxh4 +3.26/8 0.1 13. Rxh4 -2.55/6 29 Qxh4 +4.03/7 25 14. d4@P -3.45/7 11 Qh1+ +3.06/6 36 15. Kd2 -2.33/7 11 Qxd1+ +2.76/7 59 16. Kxd1 -2.70/7 0.1 Nd4 +1.97/7 33 17. Nc3 -2.39/8 22 P@c2+ +2.90/7 40 18. Kd2 -2.00/8 29 Nb3+ +2.57/8 26 19. Kxc2 -2.23/8 3 Nxa1+ +2.66/9 2:42 20. Kb1 -2.66/9 0.2 Nb3 +2.66/8 25 21. Bf4 -2.34/8 5 d5@P +2.71/6 25 22. e4 -2.70/7 30 Bg4 +2.82/7 17 23. P@a7 -2.59/6 30 P@a8 +2.66/7 29 24. b4@P -2.73/7 29 c7@P +3.02/7 36 25. P@h7 -3.02/6 29 P@h8 +2.89/7 23 26. d3@P -3.27/7 34 P@e2 +4.00/7 23 27. P@e1 -3.75/8 30 f7@P +3.58/8 31 28. h7@P -3.58/7 27 P@d2 +3.70/7 18 29. Bxd2 -3.80/8 26 Nxd2+ +4.23/8 0.2 30. Kc2 -4.83/9 19 g7@P +4.83/8 0.1 31. P@c6 -4.83/7 28 Bc8 +4.51/8 51 32. b2@P -3.54/7 25 P@h2 +2.45/8 1:16 33. P@d7+ -2.47/8 38 Kd8 +1.63/9 14 34. dxc8=Q+ -1.63/8 10 Kxc8 +2.09/9 9 35. e4@P -2.36/10 2:11 h1=Q +2.36/8 19 36. P@d7+ -2.36/8 0.3 Kc7 +2.36/8 19 37. cxb7 -2.37/8 0.1 Qh7+ +1.81/8 17 38. Kb2 -2.22/8 4 Nc4+ +2.21/8 16 39. Ka1 -2.46/9 0.1 Qd3 +2.46/8 14 40. b8=Q+ -2.46/8 8 Kxd7 +2.64/8 0.1 41. Qb5+ -6.07/9 48 Ke6 +3.51/9 0.2 42. Qe8+ -2.99/8 20 Be7 +3.71/8 0.2 43. Na4 -3.17/7 20 Qd1+ +5.33/7 0.2 44. Ka2 -2.68/4 0.2 Qc2+ +5.85/8 27 45. Ka1 -5.85/8 37 h8@P +14.11/8 0.1 46. Nc5+ -99.82/8 43 Kd5 +99.85/10 0.2 47. Qf7+ -99.86/8 13 Kxc5 +99.87/12 9 48. Qxe7+ -99.88/11 13 P@d6 +99.89/18 7 49. Qg5+ -99.90/17 18 Kb4 +99.91/47 16 50. Qf6 -99.92/47 0.7 Qa4+ +99.93/45 15 51. Kb1 -99.94/4 0.1 Na3+ +99.95/45 15 52. Kb2 -99.96/46 0.6 Qb3+ +99.97/45 25 53. Ka1 -99.98/46 0.1 Qb1 +99.99/42 17 Black mates 0-1