Enhancing the Chess AI with a "First Blood" Approach to an Alphabeta Algorithm

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Abstract

Chess algorithms concentrate on finding the best score within a given number of plies (i.e. moves by one side). First Blood does not look for the best move within a given ply, instead it looks for the best move at the given ply.The rapidity of First Blood allows it to be able to search deeper into the future and therefore come out with overall better results.

Alpha-beta pruning

Alpha-beta is a search algorithm that maximizes the low score for a board (alpha) while minimizing the opponents possible score on their next move (beta).

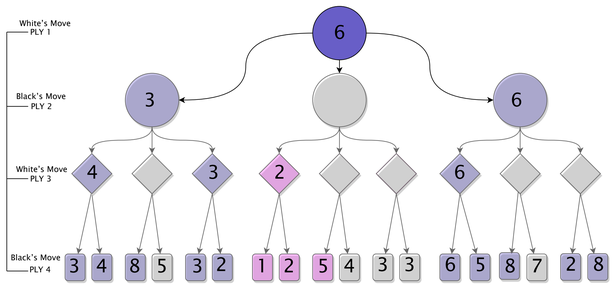


Figure1: A typical alpha-beta chart 4 plies deep

We call alpha-beta by using MTD(f) which uses a clever guess for upper and lower bounds. This process is then repeated using the return score to set new boundaries for our next search. We return when our lower bound is greater than our upper bound.

"First Blood" cutoffs

First blood is worked into the MTD(f) call as a cutoff. Once the search finds a better scored moved than the current board at our deepest chosen depth it returns that move, even if it isn't the best scored move in the whole search tree.

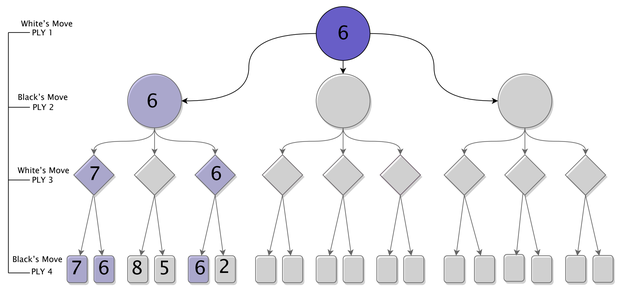


Figure 2: First Blood cutoffs, current board score is zero.

Opening Book

```
Computer's chess_move:          Computer's chess_move:
f2f4 time=1.71 sec              d2d4 time=8.69 sec
(avg = 1.71)                    (avg = 3.48)
Ply number: 0                   Ply number: 2

8  r n b q k b n r              8  r n b q k b n r
7  p p p p p p p p              7  p p p . p p p p
6  . . . . . . . .              6  . . . . . . . .
5  . . . . . . . .              5  . . . p . . . .
4  . . . . . P . .              4  . . . P . P . .
3  . . . . . . . .              3  . . . . . . . .
2  P P P P P . P P              2  P P P . P . P P
1  R N B Q K B N R              1  R N B Q K B N R

   a b c d e f g h                 a b c d e f g h
```

Output 1: Left: White (capitalized) opens with the pawn f2 to f4. Right: Black has moved it's pawn to d5 and white responds by moving it's d2 pawn to d4.

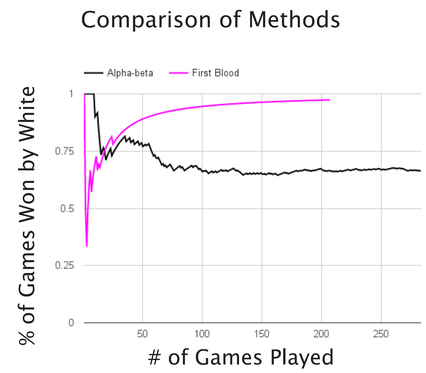
After having played three games using First Blood white opens with a Bird's Opening, a defensive opening move. Black responds with a Stonewall Dutch Defense to which white responds in kind. Overall the approximate chances of winning with this move is 35% for white, and 39% for black. [2]

```
Computer's chess_move:          Computer's chess_move:
c2c4 time=13.8 sec              e2e4 time=65.2 sec
(avg = 13.8)                    (avg = 26.4)
Ply number: 0                   Ply number: 2

8  r n b q k b n r              8  r n b q k b n r
7  p p p p p p p p              7  p p p p . p p p
6  . . . . . . . .              6  . . . . . . . .
5  . . . . . . . .              5  . . . . p . . .
4  . . P . . . . .              4  . . P . P . . .
3  . . . . . . . .              3  . . . . . . . .
2  P P . P P P P P              2  P P . P . P P P
1  R N B Q K B N R              1  R N B Q K B N R

   a b c d e f g h                 a b c d e f g h
```

Output 2: Left: White opens with the pawn at c2 to c4. Right: Black has moved it's pawn to e5 and white responds by moving it's e2 pawn to e4.

After a few more games white opens with the English Opening. Black responds with a Reverse Sicilian Defense by moving it's pawn. Even though this particular game ends in a tie it is a better opening move. The English Opening has a success rate of 37% for white and a 29% chance for a black win. [2]

Results



Graph 1: As of 7/29/15, functionality of code.

The graph shows that having a database in an alpha-beta search is beneficial for white. Around fifty games though the size of the database starts to act against white. Using First Blood counteracts this disadvantage and after fifty games white wins consistently.

Discussion

The chess ai has been a benchmark for man vs machine in the information age. The First Blood enhancement allows the chess ai to learn in a clever, human and more intuitive way. By making deep but understandable cutoffs First Blood was able to search at a deeper ply with considerable time gains over a regular alpha-beta routine. Using First Blood, white showed significant learning in it's move choice regardless of its opponent.

The next step in this project would be to see how First Blood fares against more complex algorithms.

References

[1] Nunn, John et al. Nunn's Chess Openings. London: Gambit/Everyman Chess, 1999. Print.
[2] "Chess Opening Theory." - Wikibooks, open books for an open world. Web. 28 Jul. 2015.

Acknowledgements

I would like to thank Frank Loeffler for advising on certain components of our code.
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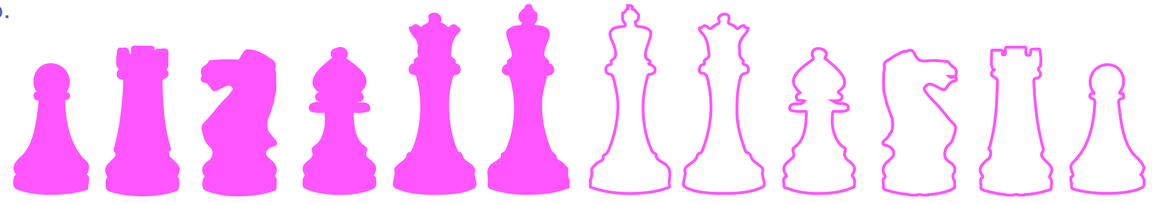

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