

Chess AI with Minimax α - β Pruning

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Table of Contents

1 Introduction

2 Algorithms

3 Further Development

- 1951: Alan Turing suggests theoretical possibility
- 1989: Chess world champion Gary Kasparov defeated IBM's Deep Thought in a chess match
- 1997: IBM's Deep Blue becomes the first chess AI to defeat a grandmaster in a match
- 2017: AlphaZero, a neural net-based digital automaton, beats Stockfish 28–0, with 72 draws in chess matches

<https://builtin.com/artificial-intelligence/chess-ai>

10 moves give around 10^{29} possible configurations

Reference

Board Representation

```
int _board[8][8] = {  
    { bR, bN, bB, bQ, bK, bB, bN, bR },  
    { bP, bP, bP, bP, bP, bP, bP, bP },  
    { NA, NA, NA, NA, NA, NA, NA, NA },  
    { NA, NA, NA, NA, NA, NA, NA, NA },  
    { NA, NA, NA, NA, NA, NA, NA, NA },  
    { NA, NA, NA, NA, NA, NA, NA, NA },  
    { wP, wP, wP, wP, wP, wP, wP, wP },  
    { wR, wN, wB, wQ, wK, wB, wN, wR }  
};
```

Figure: 8 x 8 Array of Enums

Board Representation

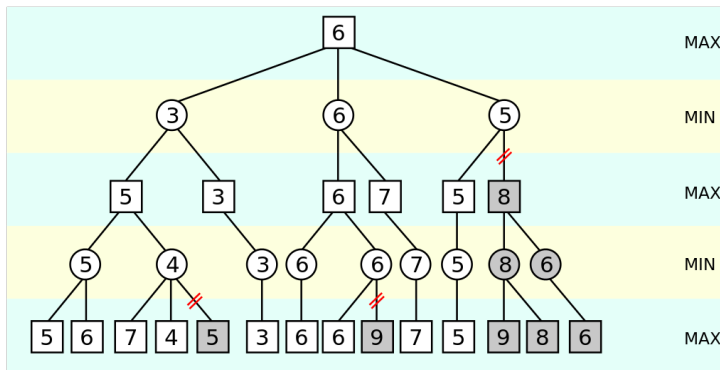


Figure: 8 x 8 Array of Enums

Wikipedia

Chess Piece	Value
Pawn	1
Knight	3
Bishop	3
Rook	5
Queen	9
King	20

Table: Values assigned to each chess piece for evaluation.

It's Playable! (github.com/Aki78/ChessAI)

		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
8			r		n		b		q		k		b		n		r												
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
7			p		p		p		p		p		p				p												
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
6																p													
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
5																													
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
4														P															
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
3																													
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
2			P		P		P		P		P					P		P											
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
1			R		N		B		Q		K		B		N		R												
		+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-	+
			A		B		C		D		E		F		G		H												

It's Playable! (github.com/Aki78/ChessAI)

	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
8		r		n		b		q		k		b		n		r													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
7		p		p		p		p		p		p				p													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
6														p															
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
5																													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
4												P																	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
3																													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
2		P		P		P		P		P				P		P													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
1		R		N		B		Q		K		B		N		R													
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+
		A		B		C		D		E		F		G		H													

Against 1500 Elo AI (chess.com)

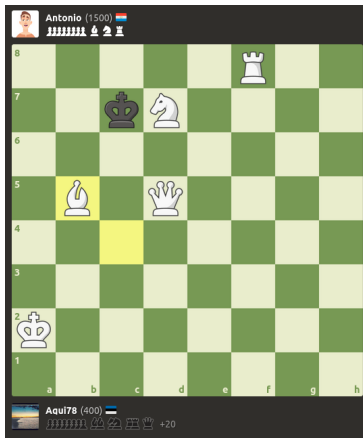


Figure: Draw: easily took all pieces, but couldn't finish it. (depth = 5)

Further Development

- Better Evaluation Function
- Reordering Moves for $\alpha - \beta$ pruning
- Using bit operations with a bit representation
- Use Opening books and End Game Tables
- Machine Learning? \rightarrow Need a super computer
- etc. etc.