# NEA JSCHESS

## Analysis

## Design

### Algorithms

* Min-Max Searching algorithm:
* Alpha-Beta Pruning algorithm:
* Perft testing:

### Data structures

* Board representation:
  + Algebraic notation:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | A1 | B1 | C1 | D1 | E1 | F1 | G1 | H1 |
| 2 | A2 | B2 | C2 | D2 | E2 | F2 | G2 | H2 |
| 3 | A3 | B3 | C3 | D3 | E3 | F3 | G3 | H3 |
| 4 | A4 | B4 | C4 | D4 | E4 | F4 | G4 | H4 |
| 5 | A5 | B5 | C5 | D5 | E5 | F5 | G5 | H5 |
| 6 | A6 | B6 | C6 | D6 | E6 | F6 | G6 | H6 |
| 7 | A7 | B7 | C7 | D7 | E7 | F7 | G7 | H7 |
| 8 | A8 | B8 | C8 | D8 | E8 | F8 | G8 | H8 |
|  | a | b | c | d | e | f | g | h |

Each rank is assigned a digit 1 to 8 and each file is assigned a letter a to h

* + 64 Square board representation:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 3 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 4 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 5 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| 6 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
| 7 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 |
| 8 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
|  | a | b | c | d | e | f | g | h |

Each file in each rank is represented by a digit ranging from 0 to 63

* + 120 Square board representation:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
| 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
| 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 |
| 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 |
| 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 |

Each square is represented with a digit from

* + Representing pieces for the engine:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 4 | 2 | 3 | 5 | 6 | 3 | 2 | 4 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 8 | 10 | 8 | 9 | 11 | 12 | 9 | 8 | 10 |
|  | a | b | c | d | e | f | g | h |

When a square has no piece on it, it is represented with a 0, white pawns are represented with a 1, white knights are represented with a 2, white bishops are represented with a 3, white rooks are represented with a 4, white queens are represented with a 5, the white king is represented with a 6 and the black pieces are represented with digits 7 to 12.

* + FEN string:

Forsyth-Edwards Notation is a standard notation for describing a particular board position of a chess game. The main use of FEN is to be able to restart a game from any particular position, I will use FEN to store the initial position of the board as well as using it to represent the puzzles. A FEN string is made up of 6 parts, these parts are separated by spaces.

1. The 1st part is the piece positions on the board, it describes each rank starting from rank 8 to rank 1. Pieces are represented by “P” for pawn “R” for rook “N” for knight “B” for bishop “Q” for queen and “K” for king. If a piece is white than the letter representing the piece is a capital and if the piece is black than it’s a lowercase letter. Empty squares are represented using digits 1 through 8 according to how many empty squares there are in a row and “/” divides each rank.
2. The 2nd part is which side has to move next, “w” means white moves next and “b” means black moves next
3. The 3rd part represents the castling rights. If neither side can castle than the representation will be “-“. Otherwise if white can castle kingside than this is represented by a “K” and if white can castle queen side than it is represented as “Q”, this is the same for black just with lowercase letters.
4. The 4th part represents the En passant target square in algebraic notation. If there is no en passant target square than this is represented with “-“. Every time a pawn makes a two-square move than the position behind the pawn is recorded.
5. The 5th part represents the Halfmove clock. This is the number of halfmoves since the last capture or pawn advance. This is used to determine if a draw can be claimed under the fifty-move rule.
6. The 6th part represents the Fullmove number. The full move number is increased by one every time after black moves.

For an example this is the starting position FEN string:

rnbqkbnr/pppppppp/8/8/8/8/PPPPPPPP/RNBQKBNR w KQkq – 0 1

* Move string:

### User Interface