Gomoku - Game Playing using Alpha–beta pruning algorithm Simulation in Greenfoot

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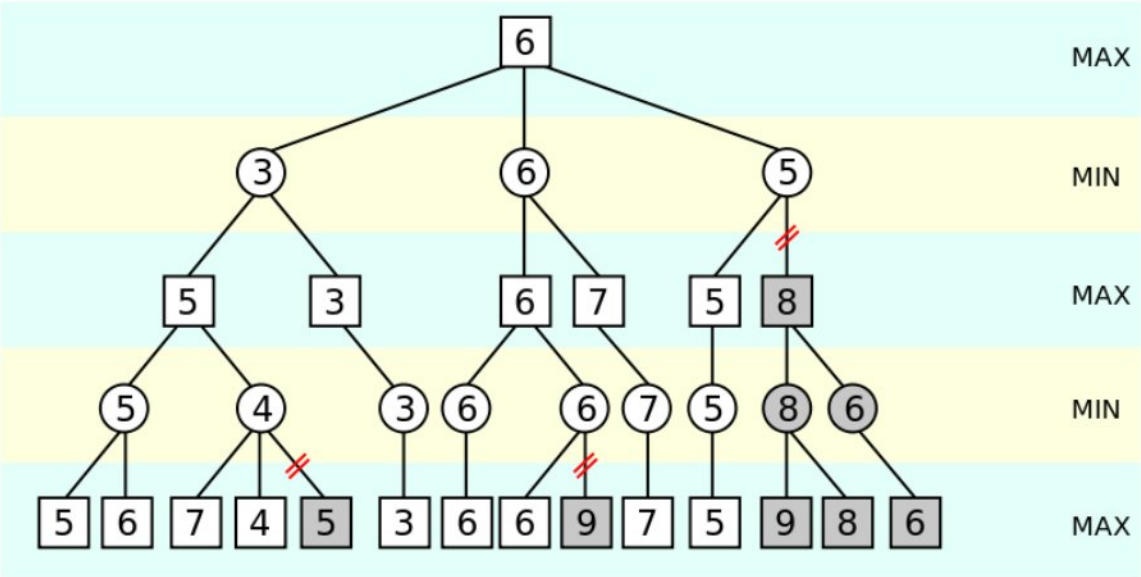
Alpha–beta pruning is a search algorithm that seeks to decrease the number of nodes that are evaluated by the minimax algorithm in its search tree. It is an adversarial search algorithm used commonly for machine playing of two-player games (Tic-tac-toe, Chess, Go, etc.). It stops completely evaluating a move when at least one possibility has been found that proves the move to be worse than a previously examined move. Such moves need not be evaluated further. When applied to a standard minimax tree, it returns the same move as minimax would, but prunes away branches that cannot possibly influence the final decision.

Alpha represents the maximum score the maximising player is assured of, Beta the minimum score the minimising player is assured of. If alpha≤beta, it means a maximising parent node is guaranteed higher score on another branch, or a minimising parent node a lower score on another branch. If this is the case, this branch can be culled and the rest of this node's children can be skipped.

Alpha-beta pruning is strongly affected by the order in which branches are explored. The sooner the best moves are discovered the sooner worse branches can be discarded. In the optimal case alpha-beta can explore to twice the depth with the same amount of computation as pure minimax.



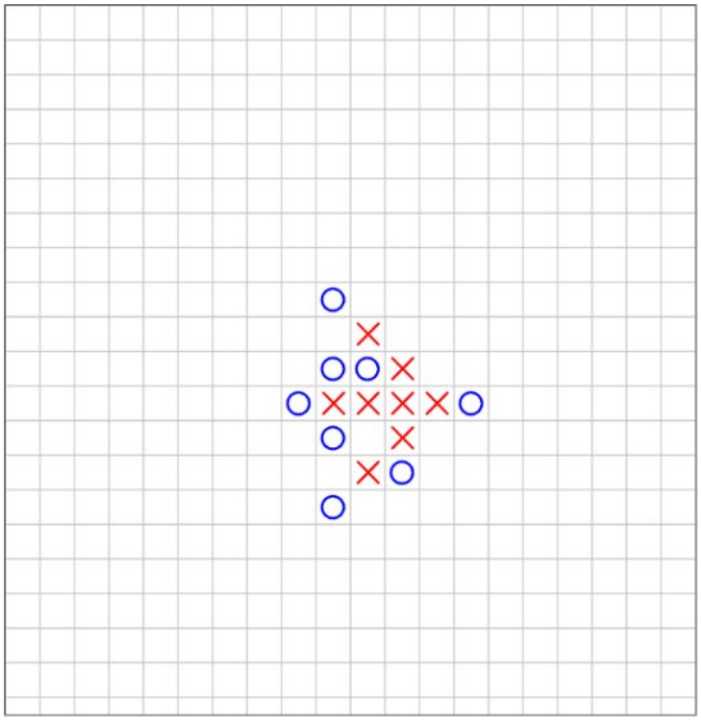
The game - Also called Gobang or Five in a Row, it is traditionally played with Go pieces (black and white stones) on a go board with 19x19 (15x15) intersections. However, because pieces are not moved or removed from the board, gomoku may also be played as a paper and pencil game (X and O). This game is known in several countries under different names.

Black plays first if white did not win in the previous game, and players alternate in placing a stone of their color on an empty intersection. The winner is the first player to get an unbroken row of five stones horizontally, vertically, or diagonally.

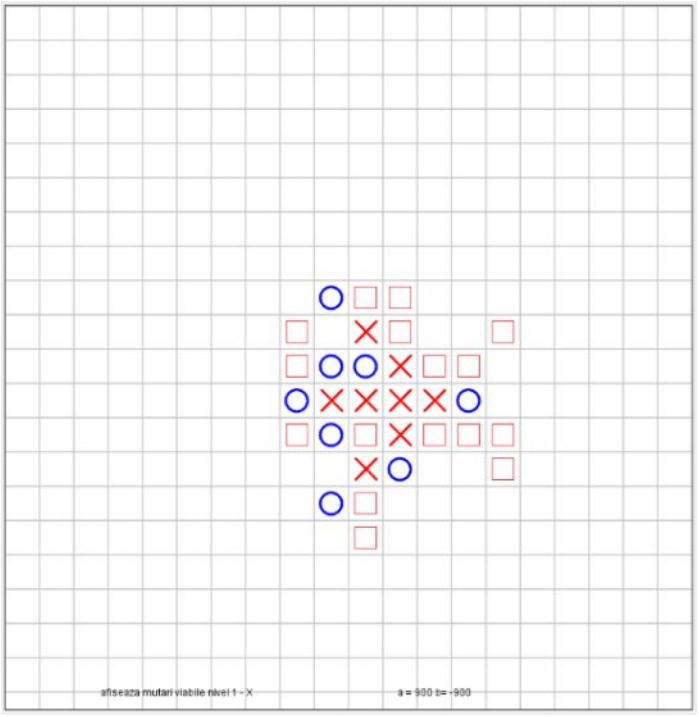
Implementation – in Greefoot. The AI of the game calculates the best moves for X two moves ahead (X-O-X). The program uses a evaluation function of the given table, returning possible moves with best values for each player. The possible moves forms a search tree. For each nodes it calculates a min/max value and a alpha-beta value and verify if alpha≤beta for prunning.

Simulation

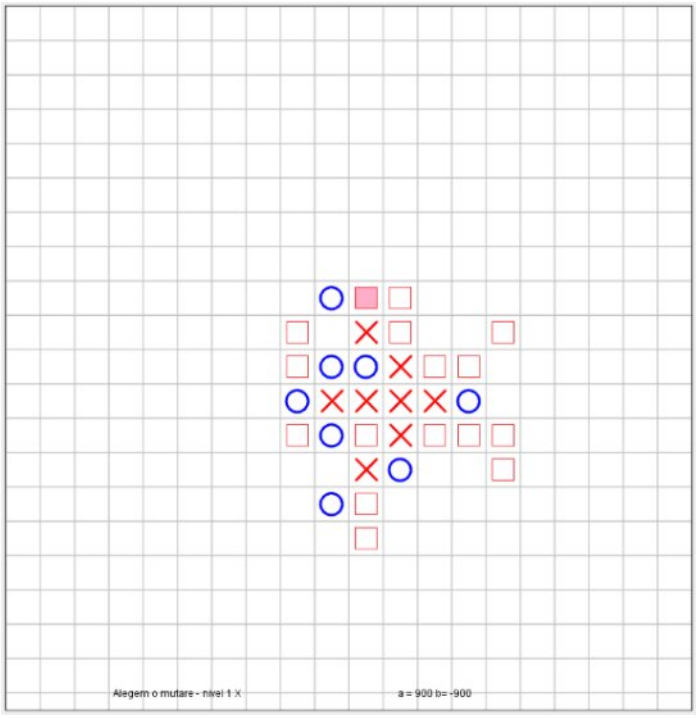
This is an instance during the game with x to move



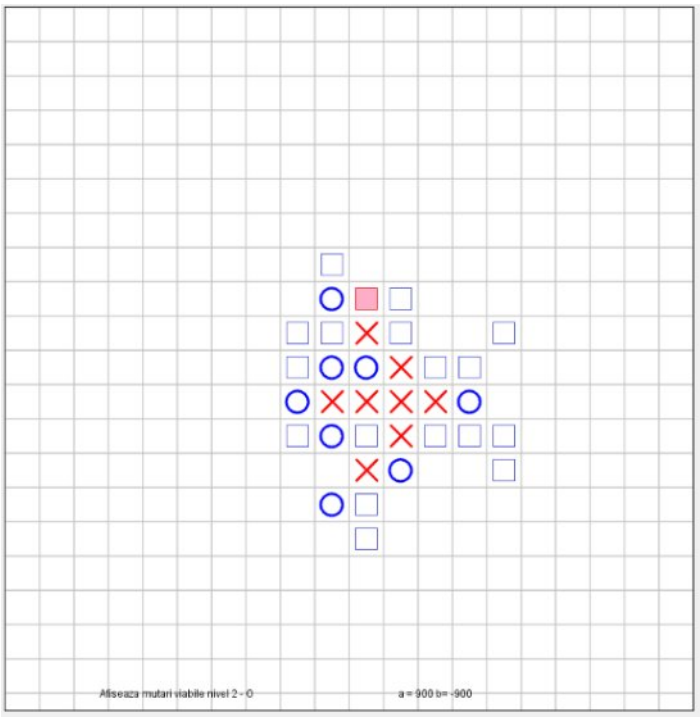
The possible moves for X.



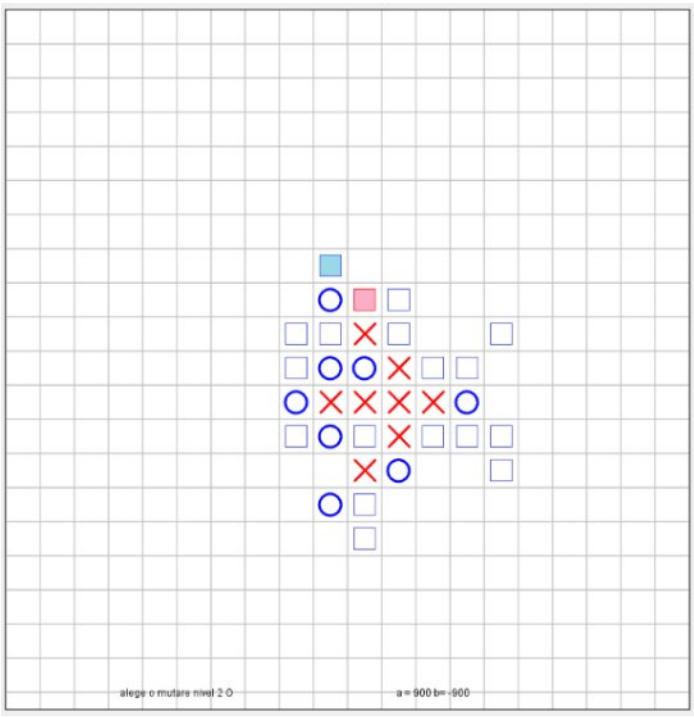
choose the first move possible for X



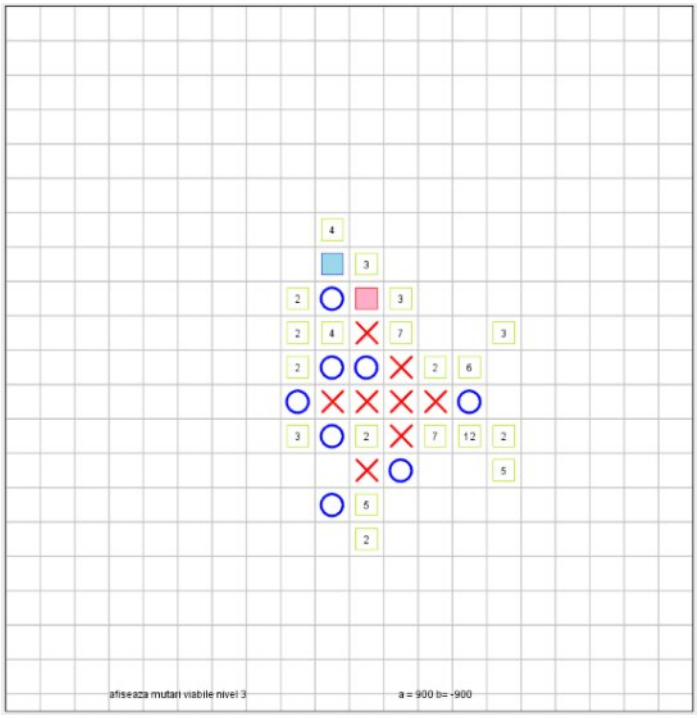
the possible moves for O.



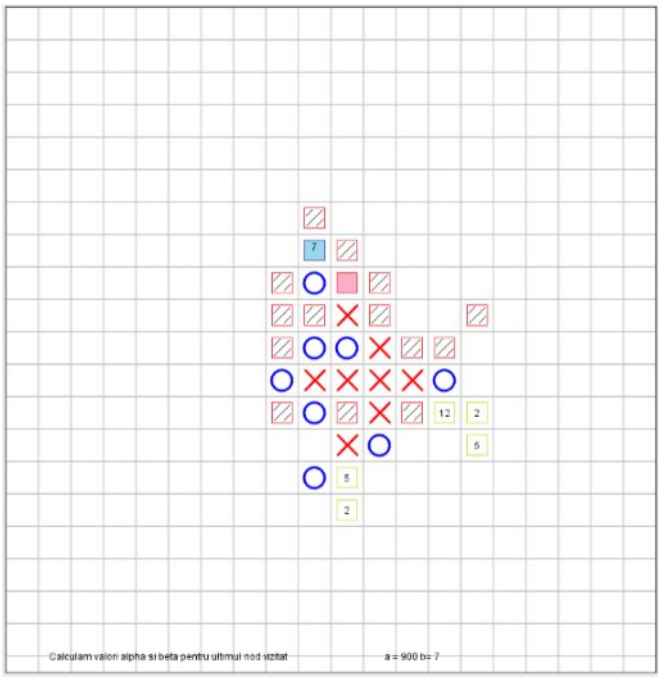
choose the first move possible for O.



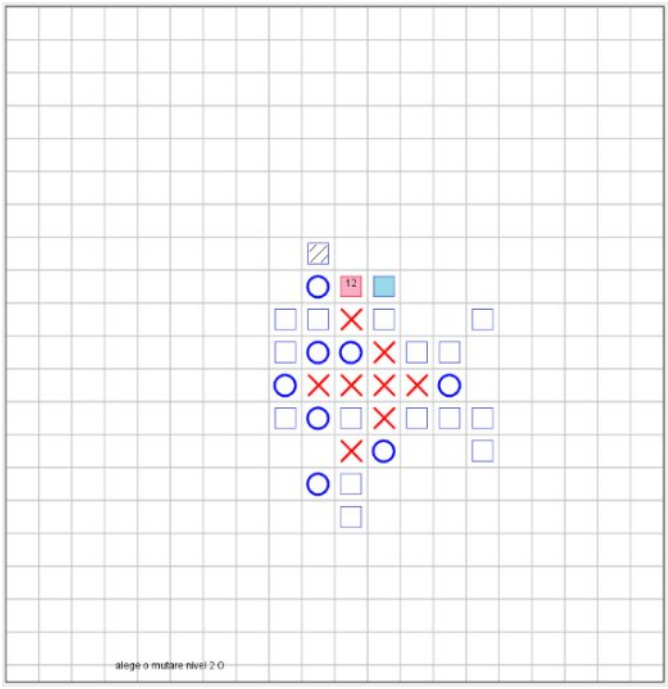
calculate the values for the second move of X using a evaluation function



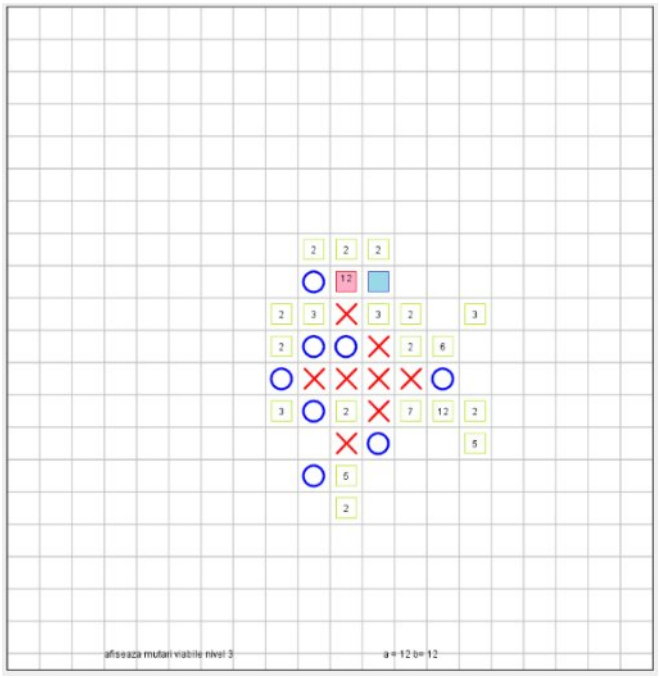
marks the evaluated moves and puts the max value in the upper nod.



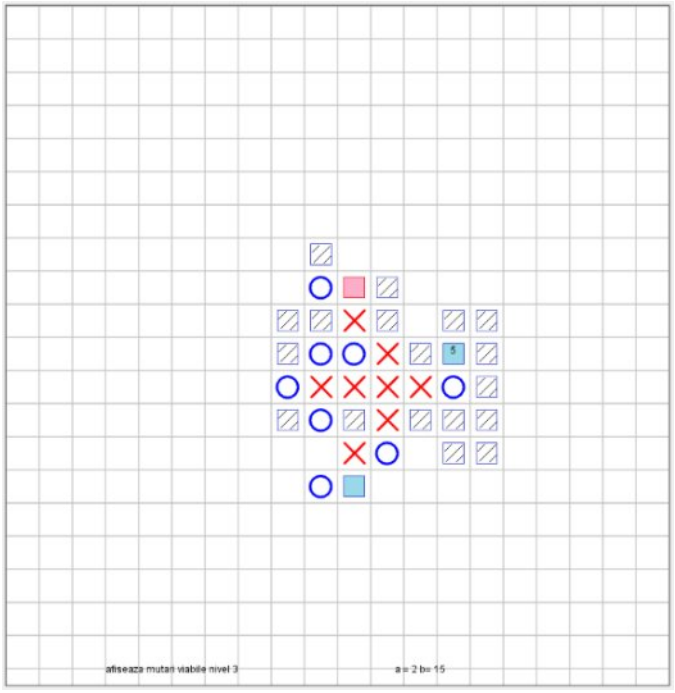
after evaluating all possible moves, in higher node there is the maximum value and it show to the next possible move of O. is the move of O already evaluated, is the next move of O evaluated and is the first move of X.



calculate the values for the second move of X and the second posible move of O.



after evaluating several moves of O. we have a situation of pruning a<b



After evaluating the possible moves the program will indicate the best move for X.