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Assignment 4

To run double click exe file in x64/Release/

Note: Since it is written in c++ it is compiled for my CPU so it may run a lot slower on your machine. For this reason I lowered the depth by half in my submission version so you can test it easier. (for the competition I will set it to the normal one)

For me each move takes no longer than 5 seconds, to get the optimized version for your CPU you would have to launch visual studio and build it from there.

What is included:

1. First I implemented the basic minimax algorithm with a 2d array of strings as game field.
2. Added alpha beta pruning.
3. Multi-threaded minimax for improved performance.
4. Incorporated the use of a 8-ply opening book. This is used only when the ai plays first because otherwise it thinks it loses 100% and plays randomly. (because the opening book considers perfect play from both sides)
5. Added some minor move order optimization. (this uses the best move stored in the transposition table array)
6. Changed ai to use bit boards, which means representing the board in 2 64 bit numbers (one for the ai board and one for the player board).
7. Added Transposition table functionality which stores a 32 bit value key. The first 2 bits represent the type of value stored (alpha, beta or exact), the next 3 bits store the best move given that board position, the next 10 bits store the score, the next bit shows if it is a positive or negative score, and the last 6 bits store the depth. The rest are just 0.
8. The transposition tables use the zobrist hash algorithm.
9. Lastly, added minor modification of iterative deepening so the ai responds instantly to obvious moves. (Before I do the standard depth search I do a small one with a depth of 2.)

The evaluation function is a simple scoring system based on a table of values. This table has higher values for nodes that have more possibilities of having a win condition. It adds the score of all the player tokens and their respective nodes and subtracts that number from ai’s respective score calculated the same way.

Additional minor comments in code and if you have any questions you can ask me in class ☺