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Section 01

c)
Running full minimax w/out alpha-beta pruning on 4x4 board:
Start State:
[' ', ' ', ' ', ' ']
[' ', 'B', 'W', ' ']
[' ', 'W', 'B', ' ']
[' ', ' ', ' ', ' ']

Terminal State for Optimal Game Play
['B', 'W', 'W', 'W']
[' ', 'W', 'W', 'W']
[' ', 'W', 'W', 'W']
['B', 'W', 'W', 'B']

(-8, [('B', 0, 2), ('W', 0, 3), ('B', 1, 3), ('W', 0, 1), ('B', 3, 0), ('W', 2, 3), ('B', 0, 0), ('W', 3, 2), ('B', 3, 3), ('W', 3, 1), ('B', -1, -1)])

From this terminal state we can see that the white player is guaranteed to win because the most optimal value is negative, meaning there are more white pieces on the board than there are black pieces on the board.

e)
Time taken for 4x4 board.

Running full minimax:
Elapsed time: 9.05992102623

Running full minimax w/ alpha-beta pruning:
Elapsed time: 0.497746944427

<u>4x4 Board</u>
Terminal states visited: 1743
Truncations: 2177
(-7, [('B', 0, 2), ('W', 0, 3), ('B', 1, 3), ('W', 0, 1), ('B', 3, 0), ('W', 2, 3), ('B', 0, 0), ('W', 1, 0), ('B', 2, 0), ('W', 3, 2), ('W', 3, 1), ('B', -1, -1)])

<u>5x5 Board</u>
Terminal State for Optimal Game Play
['W', 'W', 'W', ' ', ' ']

['W', 'W', ' ', ' ', ' ']
['W', ' ', ' ', ' ', 'B']
[' ', ' ', ' ', 'B', 'B']
[' ', ' ', 'B', 'B', 'B']
Terminal states visited: 14147
Truncations: 16691
(0, [('B', 2, 4), ('W', 0, 2), ('B', 4, 2), ('W', 2, 0), ('B', -1, -1)])
This terminal state shows us that no player is guaranteed to win. They both have an equal number of pieces on the board and no more moves are possible.