

Artificial Intelligence

Written Problems

Minimax Payout (5pts)

This problem exercises the basic concept of game playing, using tic-tac-toe (noughts and crosses) as an example. We defined X_n as the number of rows, columns, or diagonals with exactly n X's and no O's. Similarly, O_n is the number of rows, columns, or diagonals with just n O's. The utility function assigns +1 to any position with $X_3 = 1$ and -1 to any position with $O_3 = 1$. All other terminal positions have utility 0. For nonterminal positions, we use a linear evaluation function defined as $Eval(s) = 3X_2(s) + X_1(s) - (3O_2(s) + O_1(s))$.

1. Approximately how many possible games of tic-tac-toe are there?
2. Show the whole game tree starting from an empty board down to depth 2 (i.e., one X and one O on the board), taking symmetry into account.
3. Mark on your tree the evaluations of all the positions at depth 2.
4. Using the minimax algorithm, mark on your tree the backed-up values for the positions at depths 1 and 0, and use those values to choose the best starting move.
5. Circle the nodes at depth 2 that would *not* be evaluated if alpha-beta pruning were applied, assuming the nodes are generated in the optimal order for alpha-beta pruning.

Submit

All homework for this course must be submitted electronically using Blackboard. Do not e-mail your assignment to a TA or Instructor! If you are having difficulty with your Blackboard account, you are responsible for resolving these problems with a TA, an instructor, or someone from IRT, before the assignment is due.

For this assignment, you must submit a PDF document with your answers to the "Written problems" (please do NOT submit a Microsoft Word, OpenOffice document, Pages, or any other format that is not a PDF, points will be deducted if you do so!).