

Homework #3

Due May 10 by 11:59pm **Points** 20 **Submitting** a file upload
Available Apr 27 at 12am - May 12 at 11:59pm

This assignment was locked May 12 at 11:59pm.

1. (6 points) Give precise formulations of each of the following as constraint satisfaction problems. In each case, precisely specify the variables, domains and the constraints.
 - a. Placing k knights on an $n \times n$ chessboard such that no two knights attack each other.
 - b. Rectilinear floor planning: find non-overlapping places in a large rectangle for a number of small rectangles.
 - c. Class scheduling: There is a fixed number of professors and classrooms, a list of classes to be offered, and a list of possible time slots for classes. Each professor has a set of classes that he or she can teach. Each professor should be assigned 1-2 courses. Each class is taught by one professor.
2. (4 points) Use AC3 algorithm to show that arc consistency can detect the inconsistency of the partial assignment $\{WA = \text{green}, V = \text{red}\}$ in the map of Australia.
3. (10 points) Consider the game Tic-Tac-Toe. Let X_n be 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 n O's and no X's. The utility functions 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 non-terminal positions, we use a linear evaluation function defined as $\text{Eval}(s) = 3X_2(s) + X_1(s) - (3O_2(s) + O_1(s))$.
 - a. Approximately how many possible games of Tic-Tac-Toe are there?
 - b. 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.
 - c. Mark on your tree the evaluations of all positions at depth 2.
 - d. 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.
 - e. Circle the nodes at depth 2 that would not be evaluated if alpha-beta pruning were applied, assuming that the nodes are generated in the optimal order for alpha-beta pruning.