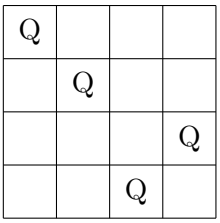
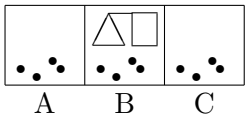
CS341 Artificial Intelligence and Machine Learning – Fall 2018
Homework 4 – 70 points
Due: Oct. 9

1. (5 points) Consider the following initial layout in a search for a solution for the 4-queens problem:



   If we use hill-climbing search with sideways moves, find a minimum length path to a solution, assuming we are using the state space where we allow only one queen per column. Display your path using grids like the one shown in Figure 4.3 (a).

2. (10 points) Consider a three room vacuum world shown below:



   Assume we are in a non-deterministic environment as described on page 134 in the text. Find an AND-OR tree solution to this problem. Your answer should look like the tree displayed in Figure 4.10, i.e.:

   (a) show all possible expansion results for each node in the solution.

   (b) do not display a path from any node not in the solution, but label any ones which are repeated states with the word LOOP and any goal states with the word GOAL.

   (c) highlight the solution in your tree using dark lines.

   You may also simplify the drawing of each state by using a 4-tuple (R, d_A, d_B, d_C), where R is the room the vacuum is in (either A, B or C) and $d_i = 0$ if room i is clean, or 1 if it is dirty. For example, the initial state above would be designated $(\mathrm{B}, 1, 1, 1)$, and one possible goal state would be $(\mathrm{A}, 0, 0, 0)$

3. (15 points) Exercise 5.8, pg. 197.

4. (15 points) Exercise 5.9, pg. 198.

(over)

5. (20 points)

   (a) Consider the 6-queens problem. Treating this as a constraint satisfaction problem, we can model this problem using six variables `col1, col2, ..., col6`, where the value of `coli` specifies the row in which the queen resides in that column. Assume we have `col1 = 1`. Using both the most-constrained variable heuristic and the least-constraining value heuristic, place the remaining 5 queens on the board. Be sure to explain how you chose any particular variable and value. If there is ever a tie, go with the lower row or column value. NOTE: we are not using branch-and-bound here so you will NOT have a solution to the 6-queens problem after you place the last queen (a full solution would involve some backtracking). For the last placement, just select a location which minimizes any conflicts.

   (b) At what point would forward checking have rejected one of your choices in the above problem? At what point would arc-consistency checking have rejected one of your choices? Explain your answers.

   (c) Take your result from part (a) as a starting point for a local search solution to the 6-queens problem. Make use of the min-conflicts heuristic, find a series of steps which gets to a solution. You can randomly break ties here.

6. (5 points) Exercise 6.11, pg. 232. For each step of AC-3 specify the arc (X_i, X_j) that is removed from the queue (you can remove them in any order you like) and the resulting effect on the domain of X_i.