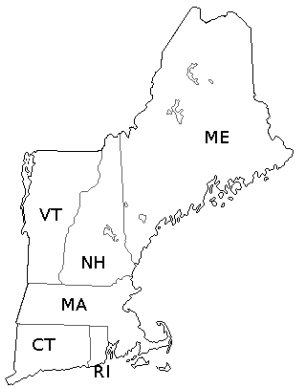
CISC 3410 Fall 2010, Homework 4

1. The following is a map of New England:



and our task is to color it using three colors, red (R), Green (G) and Blue (B) using constraint satisfaction techniques with the constraint that two adjacent states cannot be colored the same.

   (a) Write down a constraint graph for this map that takes into account the constraint on coloring states.
   (5 points)

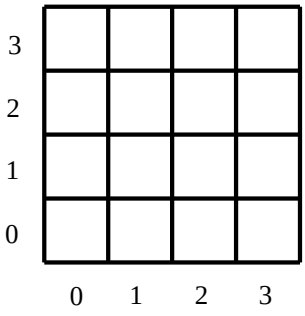
   (b) Write down a formal description of the constraint problem specifying variables, domains, and constraints.
   (5 points)

   (c) Show how backtracking search would lead to a consistent assignment of colors to states.
   (Use whatever representation of the partially colored map you prefer. If you want to color the map itself, as I did in the notes, you can download a JPEG of the map from the class website.)
   (10 points)

   (d) Demonstrate the use of forward checking on the problem when the first state to be colored is CT, and when the first state to be colored is MA. Your demonstration should show how the whole map gets colored.
   (10 points)

   (e) Describe the difference between the Least Constraining Value heuristic and the Minimum Remaining Values heuristic as applied to the problem of coloring the New England map.
   (10 points).

2. You are writing a program to play a version of the game "Battleships". The game is played on a 4×4 grid like this:



and the opponent has 4 ships at various locations. Your program is allowed to make a series of guesses as to the location of these 4 ships (so each guess is 4 locations). Each time the program makes a guess it gets feedback as to how good its guesses were.

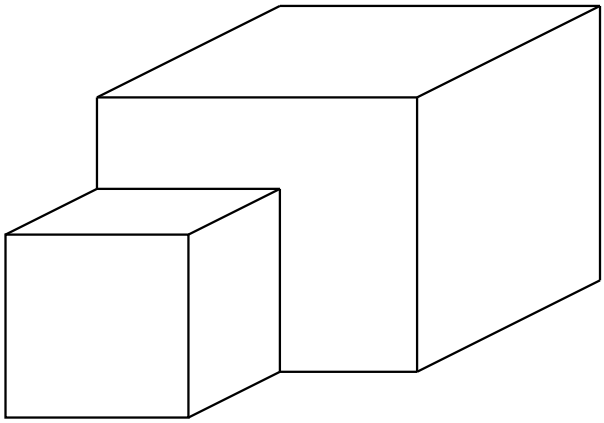
The feedback is a number, a combination of 10 points for every "hit" (every location in the guess that is the location of a ship) and a negative score for every "miss" (every location in the guess that is not the location of a ship), the negative score is the Manhattan distance between the "miss" and the nearest ship (maximum value 5 for this grid).

Describe how you would use hill-climbing to find a solution. What problems would you anticipate in using such a simple approach?

If the size of the grid was increased, what impact would it have on the use of hill-climbing? Would using a genetic algorithm have any advantage here?

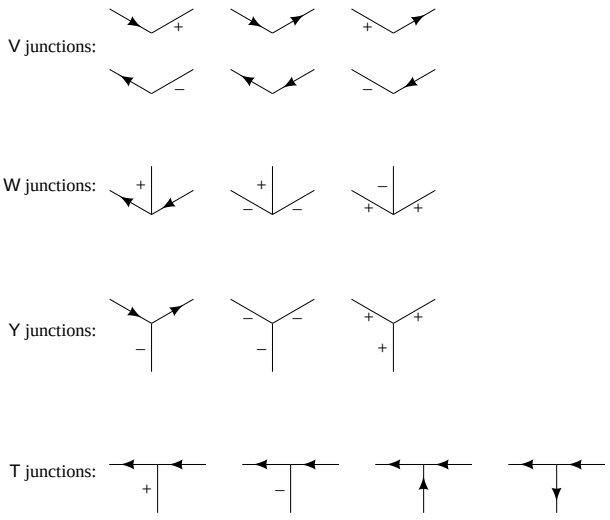
(30 points)

3. The following is a line drawing extracted from an image generated by a camera on a robot.



(a) Briefly describe the main processes that would need to be carried out on the image in order to extract the line drawing.
(5 points)

(b) Use the edge labelling technique we discussed in Lecture 4 to provide all consistent labelings of the image. Here is the full set of possible vertices.



(25 points)