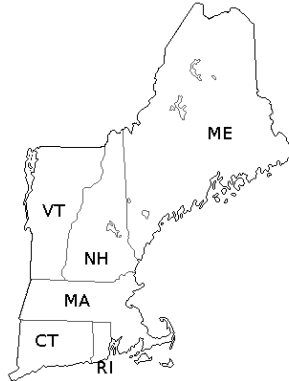


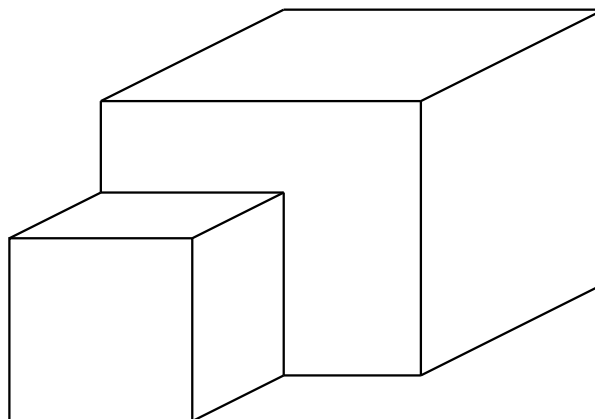
## CISC 3410 Fall 2012, Homework 4

1. The following is a map of New England:

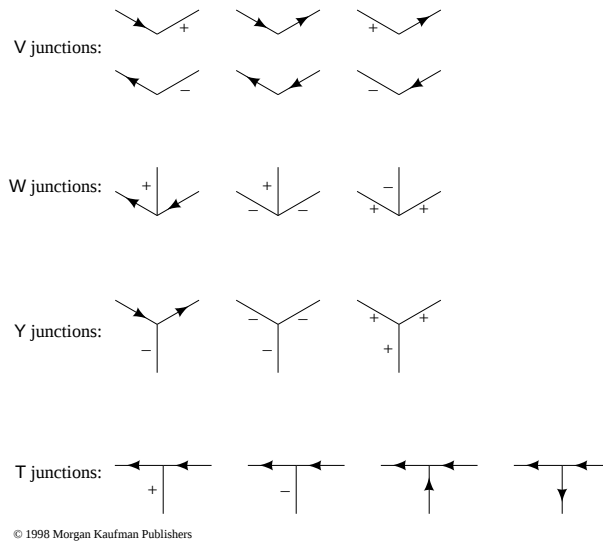


and our task is to color it using three colors, red (R), Green (G) and Blue (B) using constraint satisfaction techniques with the constraint that two adjacent states cannot be colored the same.

- Write down a constraint graph for this map that takes into account the constraint on coloring states.
  - Write down a formal description of the constraint problem specifying variables, domains, and constraints.
  - 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.)
  - 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.
  - 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.
2. The following is a line drawing extracted from an image generated by a camera on a robot.



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 labellings of vertices:



3. Consider the game tree in Figure 1 (overleaf). Nodes represent states of a game. The numbers in the nodes are the names of the nodes. Numbers next to the nodes, if any, are the values of the nodes, reflecting the values of the corresponding states of the game. The top node of the tree is a MAX node.
  - (a) Apply minimax search to the game tree to compute the values of the triangular nodes.
  - (b) Which nodes should be pruned using the alpha/beta technique? Your answer should explain why each node that you list should be pruned.

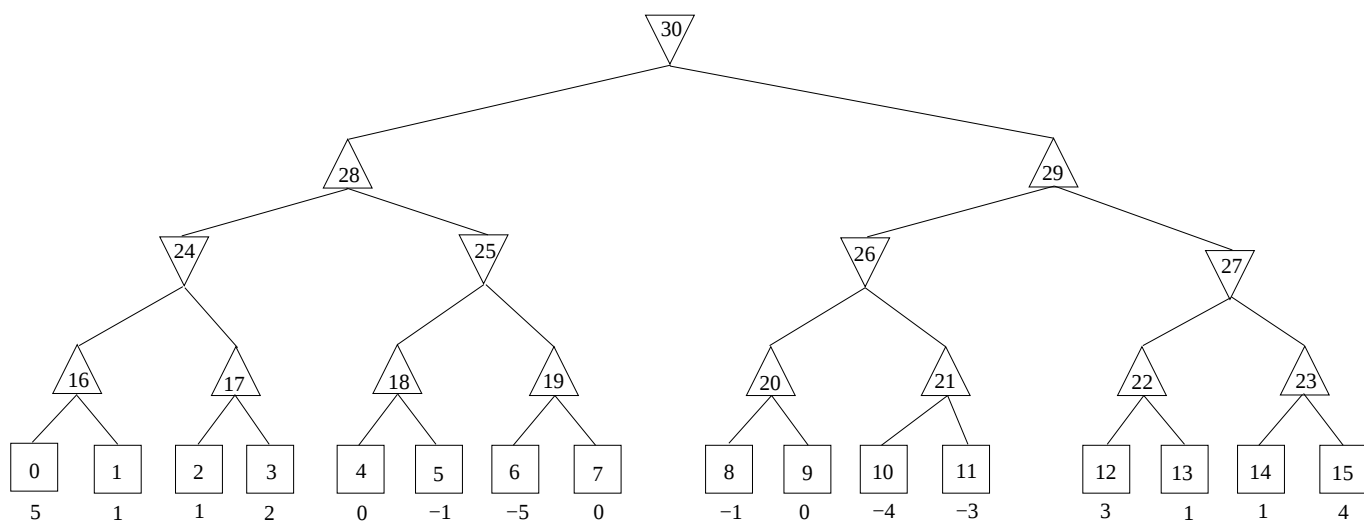


Figure 1: The game tree for Question 4.