CSCI 3202 PS 2; due 10/20

Problem 2.1 (9 points) SIM game

Write a program to play the game of SIM with eight points (labeled A-H). Again, the two players are RED and BLUE; you can assume that RED moves first by convention; each player alternately chooses an edge to "claim" for the given color; and the loser is the player who is forced to create a complete triangle of edges in their own color. Your program should play interactively against the user. It needn't involve any fancy graphics or interface, but it should play a decent and competitive game of SIM. The interaction could be entirely textual, and could look something like this:

Are you playing Red? (Y/N): Y
RED move: A, B
BLUE move: E, G
etc.

Some notes: you should probably use alpha-beta pruning (it'll come in handy for the next problem anyway). In any event, whatever algorithmic strategy you use for your program, you should explain and document your approach. Since the computer program will probably not display the current state of the game (though of course it could), you may want to play against the program with a paper-and-colored-pencil representation of the game board handy. You should submit the important source code for your program (i.e., the major procedures for deciding on a next move) and a sample game or two to show how it plays the game

Problem 2.2 (3 points) Alpha-Beta Pruning

Construct a tree with a branching factor of 3 at each level, and 81 leaves. This tree will represent two complete MAX-MIN pairs of moves. The top level of the tree is MAX; the next level (3 nodes) is MIN; the third level (9 nodes) is MAX; the fourth (27) is MIN; and the fifth (81 nodes) are the leaves of the tree, labeled with the following numbers, grouped in sets of 27, and reading from left to right:

9 4 6 3 7 8 5 4 8 2 5 7 9 5 8 6 3 1 4 8 5 3 7 2 2 1 6

1 4 7 8 5 2 6 7 8 2 4 6 7 5 6 1 0 2 4 5 4 9 2 7 3 1 6

9 5 6 4 0 1 3 2 5 1 2 3 7 3 4 2 3 4 8 2 7 1 9 3 2 7 3

As usual, MAX is trying to achieve the highest number; MIN the lowest.

(a) What is the overall value of this tree to MAX?

(b) How many of these leaves 81 leaves actually have to be evaluated by an alpha-beta game search algorithm assuming that possible moves are examined from left to right?

(c) How many leaves have to be evaluated by alpha-beta assuming that moves are examined from right to left?

(d) Suppose the root player is MIN. (That is, the levels of the tree are now MIN, MAX, MIN, and MAX.) Now how many of the 81 leaves have to be evaluated by an alpha-beta searcher if moves are examined from left
to right?

Problem 3. (2 points) Hitori

The rules of the puzzle game "Hitori" are as follows: you are given a starting grid in which each cell contains a number. Your job is to shade squares in the grid such that: (a) no one digit appears in each row or column more than once; (b) shaded squares cannot touch each other vertically or horizontally (but they may touch each other diagonally); and (c) all the unshaded squares form a single continuous area in which any unshaded square can be reached from any other by a sequence of horizontal or vertical moves.

3a. Solve the following Hitori puzzle on a 5 by 5 grid by shading the appropriate cells:

4 1 5 3 2
1 2 3 5 5
3 4 4 5 1
3 5 1 5 4
5 2 5 1 3

3b. Devise a representation for this game in first-order predicate logic. Your representation should include SQUARE objects and numbers (possibly among others); and functions ROW-OF, COLUMN-OF, NUMBER-CONTENTS, and SHADED?.

You should define an ADJACENT relation -- i.e., a logical rule expressing the idea that two squares are adjacent in a row or column. (You can assume that any necessary numeric relations such as equal, less-than, or consecutive are already defined.) Then, using the ADJACENT relation, define a CONNECTED relation that expresses the idea that two squares can reached from each other by a sequence of horizontal or vertical moves. Finally, using these relations (and any others that you may wish to define), express the constraints of a solved Hitori grid in logical terms.