CSCI-460 Fall 2003 - Homework 2 Due date10/16/2003

Question 1(20 pts):

Please answer the following questions in 1 or 2 short sentences.

1. What does it mean for a search algorithm to be optimal?
2. What does it mean for a search algorithm to be complete?
3. What does it mean for a logical inference method to be sound?
4. What doe sit mean for a logical inference method to be complete?

Question 2 (20 pts):

Consider the following evaluation function for TIC-TAC-TOE.

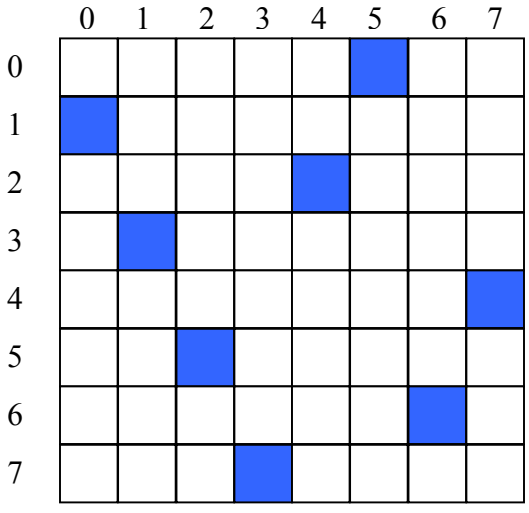
$$Eval = 3X_2 + X_1 - (3O_2 + O_1)$$

Where X_2 = number of rows, columns and diagonals with 2 X's and no O's
X_1 = number of rows, columns and diagonals with 1 X's and no O's
O_2 = number of rows, columns and diagonals with 2 O's and no X's
O_1 = number of rows, columns and diagonals with 1 O's and no X's

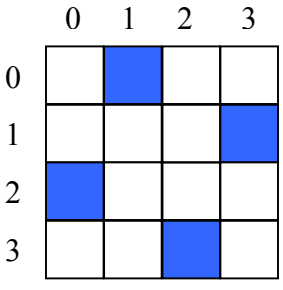
1. Starting from an empty 3x3 game board (no O's or X's written yet), expand the game tree for only non-symmetric moves up to depth 2. Use the evaluation function for evaluating the leaves, then circle the move that the root player should play.
2. Now do a-ß pruning on the tree assuming an optimal ordering of child nodes. Associate a, ß values with all internal nodes and mark the pruned nodes.

Question 3 (60 pts): Programming

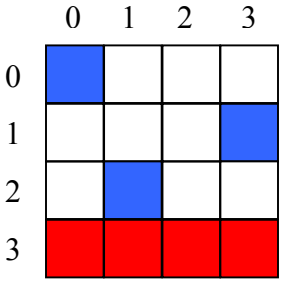
You have to implement **n-Queen** problem using **random-restart hill climbing**. In an nXn chess-board, there are n rows and n columns. A queen attacks another queen in the board if they are either in the same row or same column or same diagonal. You have to find an arrangement of the n queens so no one attacks any other queen. See below the board arrangement for **8-Queen** and **4-Queen** problems.



(a) 8-Queen board arrangement (5)



(b) 4-Queen board arrangement (1)



(c) 4-Queen board arrangement (0)

No solution

Each queen will be in a different row. Let us assume that the i^{th} queen will be in the i^{th} row. So we have to worry about the column position of every queen. The rows and columns are indexed from 0. In the problem you will be given the board size and position of the 1^{st} queen. You can try different column position for all the queens in the board except the 1^{st} one. For example figure (a) is a possible solution for 8-Queens with the 1_{st} queens position is 5. Figure (b) is a possible solution for 4-Queens with the 1^{st} queen's position is 1. It is possible that you may not be able find any solution given the 1^{st} queen's position. Figure (c) explains such a problem: 4-Queens with the 1^{st} queen's position is 0. Since after assigning the first 3 queens, all the squares in the 4_{th} row are attacked by some queen (**red**). So a given particular problem may or may not have a solution.

Input: You will be given a text file called **problem.txt**. The file will be located in the current directory. The first line contains an integer **n** specifying the number of problems in the file. Each line will contain a problem. In each line there are 2 integers, separated by white spaces. 1^{st} integer is the size of the board or the number of queens. 2nd integer is the fixed column position of the 1^{st} queen. For the above 3 problems, the sample input file, **problem.txt,** is as follows:

Line number	***File contents:***
1.	3
2.	8 5
3.	4 1
4.	4 0

Output: All the output should be written to a file called **solution.txt** in the current directory. For each problem in **problem.txt**, there will be a **corresponding line** in **solution.txt.** If there is a solution for the problem, the line should contain n+1 integers: size of the board, followed by column positions of n queens starting from 1^{st} to nth queen. If there is no solution for the problem, the line should contain the string "**No solution**". The sample **solution.txt** for the sample **problem.txt** is as follows:

Line number	***File contents:***
1.	8 5 0 4 1 7 2 6 3
2.	4 1 3 0 2
3.	No solution

Caution: Please follow the following things
1. Do not expect any command line argument(s).
2. There can be any number of white spaces between fields in the input file.
3. Assume that only space or tab will be used for separating the fields in the input file.

Answer the following question (bonus, 10pts, not included in 100pts)
1. With this search method (random-restart hill climbing) are you guaranteed to find a solution?