Recursion Puzzles

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Abstract

In this lab you will implement recursive solutions to classic CS questions. One will be a chess problem, and the other is Towers of Hanoi.

1   Backtracking with Recursion - Featuring Chess

Choose and complete one of the two following chess problems. These problems can be solved using the backtracking algorithm shown below.

```
boolean solve(board,  pos){

        if( pos is such that there is nothing left to solve){
                return true;
        }

        for each possible choice {
                if(valid(choice)){
                        mark board at pos with choice;
                        if(solve(board, pos + 1) == true){
                                return true;
                        }
                }
        }
        clear any choices entered at pos on board;

        return false; // backtrack
}
```

1.1 The Eight Queens Problem

Write a recursive method which solves the eight queens problem. You must find a state where you can place eight queens on a chessboard such that no queen can capture another queen. Queens can move and capture pieces in the same row, column, or any diagonal.

You may use an 8×8 `int[][]` array to represent your chess board. An example solution is below.
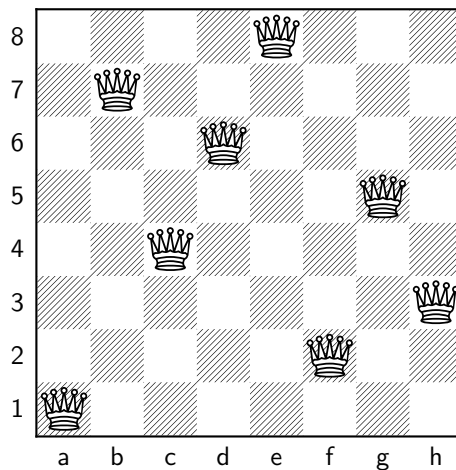
Hint: only one queen can be placed in each column. This means we can simplify the problem a bit by asking "for this current column, which row can I put a queen on?"

1.2 Knight's Tour (More Challenging)

Write a program to solve the Knight's Tour. In the Knight's Tour, we place a Knight on the chess board and move him until he visits each square of the chess board exactly once.[1] A knight moves two squares horizontally or vertically and then one square in the axis it did not move it, creating a sort of "L" shaped (see below). A square counts as visited once the knight lands in it.
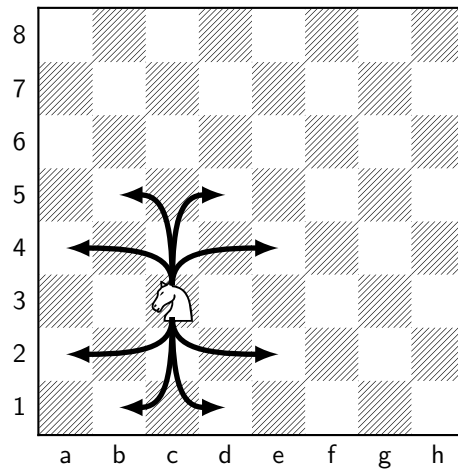
You may start your knight anywhere you like. Your output should be either the chess board, but with each square marked by a number to designate the order in which the square was visited, or by listing the moves the knight makes. If you can figure out a better way to represent your answer, we are open to that too.

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[1] Please do not sack Constantinople on your way to the answer.

2 Sudoku

Write a program that can solve a Sudoku puzzle. You can put the puzzle you want to solve into your source code as a 2D integer array. See the lecture videos on the homework for more details.

You can use the same base recursive-backtracking algorithm that was used in the 8 queens problem.

2.1 Extra Credit: 10 points

Solve Project Euler Problem 96. This entire line is a link to it.