

COMS3005A - Advanced Analysis of Algorithms - 2020

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Assignment 2

1. Aim

This assignment is intended to give you some exposure to the experimental nature of Computer Science - specifically the concept of measuring the performance of an algorithm and relating these measurements to the theoretical analysis of the said algorithm. This is accomplished by performing an experiment and compiling a document detailing the design procedures, implementation processes, and evaluation findings of the experiment.

2. Group Registration

A major portion of this assignment can be completed in groups. Each group should consist not more than 3 students.

3. Sudoku - Backtracking Algorithm

A game of Sudoku can be solved by using the Backtracking Algorithm. In this assignment, you are required to:

1. Study the backtracking algorithm. Make sure you fully understand the algorithm along with its theoretical analysis.
2. Implement the backtracking algorithm for solving Sudoku. The algorithm should accept a 9×9 partially completed grid as input, solve the puzzle and output the final fully completed grid that satisfies the constraints: each number can only occur once in each row, column and any 3×3 subgrid.

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

Input

The input is a 9×9 partially completed sudoku board. The 9 lines will consist of numbers (separated by a space) from 0 to 9 where 0 indicates an empty cell and digits from 1 to 9 indicate the given clues to the sudoku board. It is safe to assume that the input sudoku board has unique solution.

Output

Output a solved sudoku board. That is, the board will have no cells with 0 and the numbers are filled according to the above stated constraints.

Sample Input

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

Sample Output

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

4. Instructions

As a group, you must complete the following:

1. Implement the backtracking algorithm to solve the above described problem in *Java* with the appropriate input and output. You are to be expected to develop the code from scratch as a group.
2. Perform empirical analysis and compare the observation to the theoretical analysis of the Backtracking algorithm for solving the above problem.

3. Compile a laboratory report using LaTeX discussing the work done in 1 and 2.

Notes on *Empirical Analysis* and LaTeX are available on Moodle.

5. Submission

You are required to submit the following to Moodle:

1. Sudoku solver
2. pdf laboratory report
3. zipped latex folder containing all the associated files to compile the report (including figures, bibtex etc)

The deadline for the submissions is Sunday, October, 2020, 23:59.

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