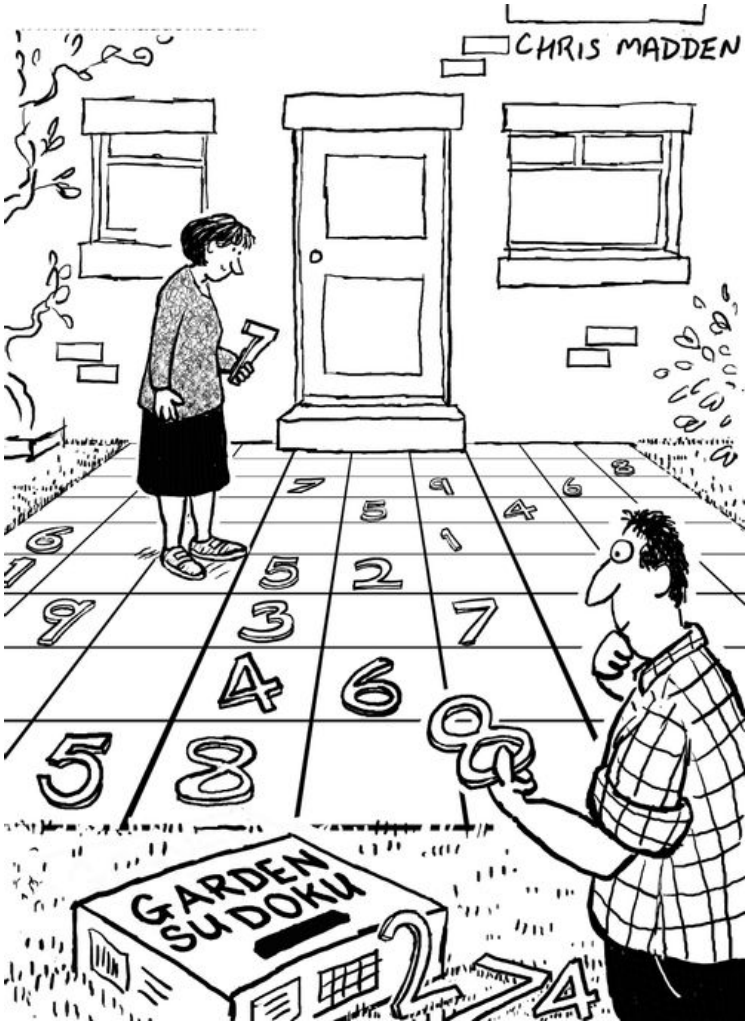
PROJECT ASSIGNMENT 2

Issue Date : 10.11.2023 - Friday
Recitation Date : 10.11.2023 - Friday (13:40) (held on Zoom)
Due Date : 26.11.2023 - Sunday (23:00)
Advisor : R.A. Görkem AKYILDIZ
Programming Language : Python 3.6.8



1 Introduction

Sudoku is a logic-based, combinatorial number-placement puzzle. In classic Sudoku, the objective is to fill a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 sub grids that compose the grid (also called "boxes", "blocks", or "regions") contains all of the digits from 1 to 9. The puzzle setter provides a partially completed grid, which for a well-posed puzzle has a single solution.[1]

Aim of this project is helping to people who are trying to learn Sudoku, you are supposed to implement a system that solves a Sudoku puzzle step-by-step and this system must output the steps to the user.

2 Definition of Input

Initial status of the Sudoku map will be given as a text file. Lines correspond to rows and each digit at the row corresponds to a cell. It can be interpreted as how it seems visually. Each cell is separated with space from each other for the sake of better visualization. Empty cells are represented with number zero instead of white space to make input file more understandable. You must take the name of the input file as the first command line argument of your program. A sample Sudoku puzzle and its text representation can be found below:

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

Figure 1: Puzzle

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

Figure 2: Text file for that puzzle

3 Definition of Output

Text representation of the map will remain the same as the input but you must printout all of the steps for the solution. The solution must be consisting of the number of empty cells of the steps inherently. For example, for the puzzle given at Figure 1&2 there are 48 empty cells which means there are exactly 48 steps for the solution as each step fills exactly one empty cell. You must take the name of the output file as the second command line argument of your program. Each step will be structured as follows:

- Dash "-" character printed out for 18 times
- Step <SN> - <VAL> @ R<ROW>C<COL>
- Dash "-" character printed out for 18 times
- Situation of the puzzle at the end of the current step.

Definitions:

- <SN>: Number of current step.
- <VAL>: Value of the last solved cell.
- <ROW>: Row number of the last solved cell.
- <COL>: Column number of the last solved cell.

4 Hints for the Solution

There are several ways to solve a Sudoku Puzzle, some of them are naive, some of them are eager. For this assignment your solution must follow (or result the same with) the naive approach which you can find some hints about it at following definitions:

This approach actually depends on a brute-force solution, it tries every single possible solution and eliminates the ones that are impossible. Think it as follows: You are playing the Sudoku and writing each possible value for each cell to cell itself. If there is a cell that has only one possibility, so, it is clear that the cell must be filled with that possibility, which may create new cells with only one possibility as filling a cell eliminates some other possibilities. So, in short, the solution depends on at least one cell that has one possibility which also creates new cell or cells with only one possibility. Note that it is guaranteed that there will be at least one cell with only one possibility at the each step either by eliminating the possibilities after filling a cell or the ones that already exist.

IMPORTANT NOTE: If there are more than one cell with only one possibility, you must select the one that is at the upmost row; if there are more than one cell with only one possibility at that row, you must select the one that is at the leftmost column. Say that following cells are the ones that have only one possibility at a step, you must select the (2, 3) amongst them and also they are ordered by given rule for the sake of better understanding of yours. Note that the representation is in (R, C) format where R corresponds to row and C corresponds to column.

- (2, 3)
- (2, 5)
- (3, 1)
- (6, 2)
- (6, 4)

5 Restrictions

- Your code must be able to execute on our department's developer server (dev.cs.hacettepe.edu.tr).
- You must obey given submit hierarchy and get score (1 point) from the submit system.
- **You must benefit from loops and functions.**
- Your code must be clean, do not forget that main method is just a driver method that means it is just for making your code fragments run, not for using them as a main container, create functions in necessary situations but use them as required.
- You must use comments for this project and you must give brief information about the challenging parts of your code. Do not over comment as it is against clean code approach. Design your comments so that they make your code fully understandable and not excessive for others.
- You can benefit from Internet sources for inspiration but do not use any code that does not belong to you.

- You can discuss high-level (design) problems with your friends but do not share any code or implementation with anybody.
- Do not miss the submission deadline.
- Source code readability is a great of importance. Thus, write READABLE SOURCE CODE, comments, and clear MAIN function. This expectation will be graded as "clean code".
- Use UNDERSTANDABLE names to your variables, classes, and functions regardless of the length. The names of classes, attributes and methods should obey Python naming convention. This expectation will be graded as "coding standards".
- You can ask your questions through course's Piazza group, and you are supposed to be aware of everything discussed in the Piazza group. General discussion of the problem is allowed, but **DO NOT SHARE** answers, algorithms, source codes and reports.
- All assignments must be original, individual work. Duplicate or very similar assignments are both going to be considered as cheating.
- Submit system for this homework will be opened a few days before deadline, so please be patient.

6 Execution and Test

Your code must be executed under **Python 3.6.8** at **dev.cs.hacettepe.edu.tr**. If your code does not run at developer server during the testing stage, then you will be graded as 0 for code part even if it works on your own machine. Sample run command is as follows:

- python3 sudoku.py input.txt output.txt

7 Grading

Task	**Point**
Correct Output	80
Clean Code & Comment	20*
Total	100

*** The score of the part of clean code & comment will be multiplied by your overall score (excluding clean code & comment part) divided by the maximum score that can be taken from these parts. Say that you got 60 from all parts excluding clean code & comment part and 10 from clean code & comment part, your score for clean code & comment part is going to be 10*(60/80) which is 7.5 and your overall score will be 60+7.5=67.5.**
Note that you must score one at the submit system, otherwise 20% of your grade will be deducted, moreover, you must implement a main function otherwise 10% of your grade will be deducted! There may also be other point deductions if you do not obey the given rules, such as if you do not use functions and/or loops as necessary.

8 Submit Format

File hierarchy must be zipped before submitted (Not .rar, only not compressed .zip files because the system just supports .zip files).

```
- b<StudentID>.zip
    - sudoku.py
```

9 Late Policy

You have two days for late submission. You will lose 10 points from maximum evaluation score for each day (your submitted study will be evaluated over 90 and 80 for each late submission day). You must submit your solution in at the most two days later than submission date, otherwise it will not be evaluated. Please do not e-mail to me even if you miss the deadline for a few seconds due to your own fault as it would be unfair for your friends, e-mail submissions will not be considered if you do not have a valid issue.

References

[1] Sudoku - wikipedia. https://en.wikipedia.org/wiki/Sudoku (Last access: 07.11.2023).