

Team Research Investigation

N×N Sudoku Solver

Team: Attack On Titan

Members: Abdulaziz Aljohani & William Smith

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

Puzzle by www.sudoku.com

Agenda

- Background
- Research Paper 1
- Research Paper 2
- Research Paper 3
- Questions?

Recap

[illegible]

1

Research Paper 1

Title: Sudoku Solver Using Minigrid based Backtracking

Authors: Maji A. and Pal R.

Name of Journal: IEEE International Advance Computing Conference (IACC)

Date: 2014

Page number: 36-44

Problem Statement

All the existing sudoku solving techniques are primarily guess based heuristic or computation intensive soft computing methodology.

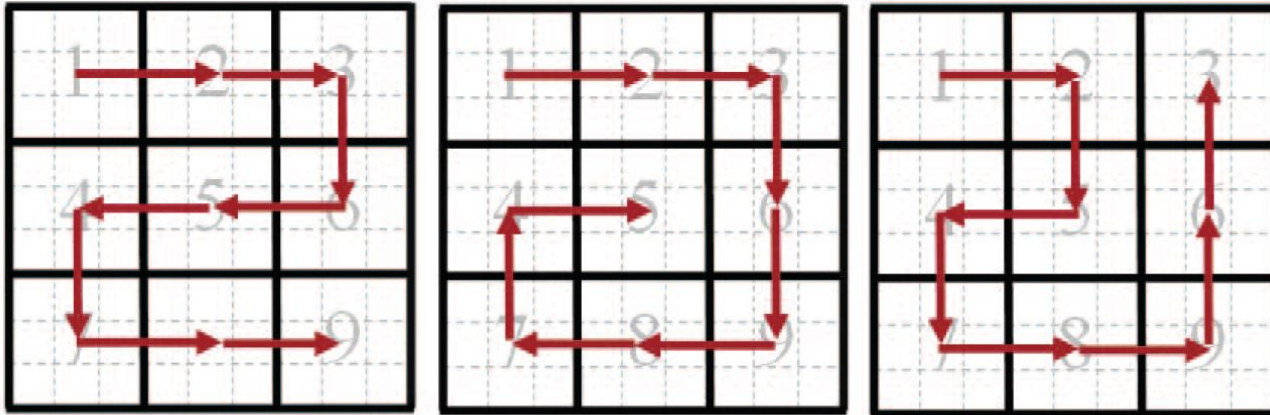
Two examples of existing sudoku solver:

- Backtracking Technique
- Elimination Based Approach

Difficulty level	Number of clues
1 (Extremely Easy)	More than 46
2 (Easy)	36-46
3 (Medium)	32-35
4 (Difficult)	28-31
5 (Evil)	17-27

The Proposed Sudoku Solver

Developing an algorithm which is minigrid based, by going through 9 minigrids (instead of 81 cells) individually and perform backtracking only on them, which is less time consuming. Moreover, no guessing is involved and no redundant computation is performed during the whole computation.



How it Will be Used

Our research project uses a similar approach by dividing the $N \times N$ sudoku into N mini grids. We may consider using the same transition from one minigrid to another by using the same approach that has been proposed.

2

Research Paper 2

Title: The Effect of Guess Choices on the Efficiency of a Backtracking Algorithm in a Sudoku Solver

Authors: Schottlender M.

Name of Journal: Systems, Applications and Technology Conference (LISAT), 2014 IEEE Long Island

Date: 2014

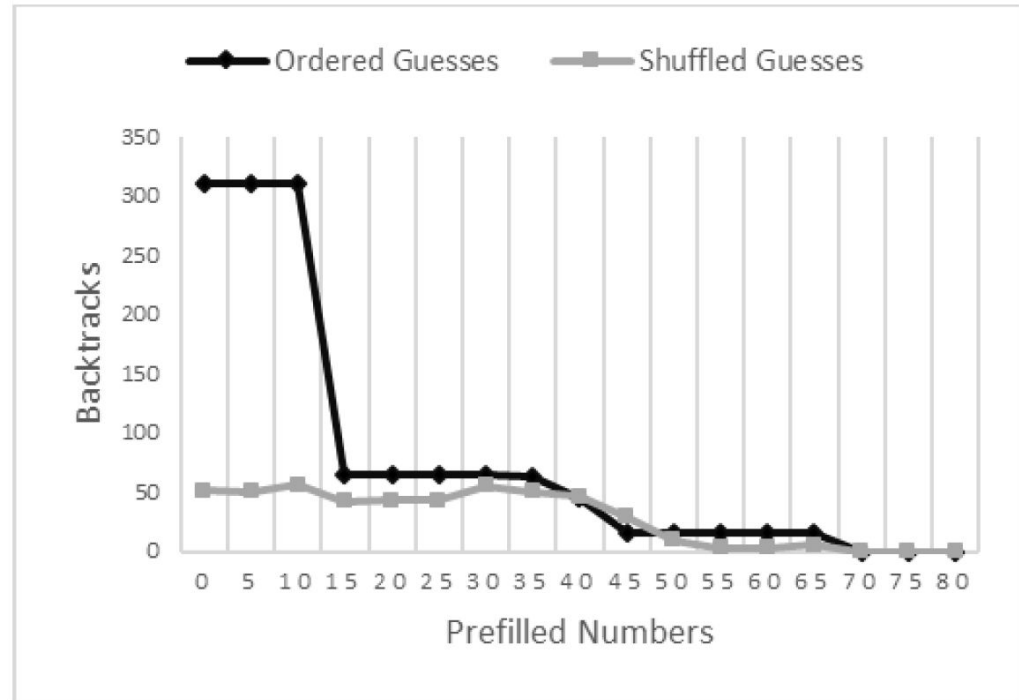
Problem Statement

Backtracking algorithm can vary in efficiency based on their implementation, and the statistical distribution of the guesses, which it attempts to “plug in” to the board in every given cell.

The more errors the solver makes, the more backtracks it must perform, which decreases its overall efficiency and increases its effective runtime.

The Novel Contributions

The backtracking algorithm should choose its guesses randomly instead of in sequential order.



How it Will be Used

Our research project creates a smaller array of legal values by applying constraints to each square at the start. However, the approach of shuffling the legal value array will now be implemented in our project in order to further reduce the number of times the project needs to backtrack, improving the speed of execution.

3

Research Paper 3

Title: A Novel Sudoku Solving Technique using Column based Permutation

Authors: Sunanda Jana, Arnab Kumar Maji, and Rajat Kumar Pal

Name of Journal: 2015 International Symposium on Advanced Computing and Communication (ISACC)

Date: 2015

Problem Statement

Most sudoku solvers take a backtracking approach across all of the cells in the board, resulting in N^2 positions to backtrack on on a given board.

According to cited papers, a 9x9 board requires 17 clues at minimum to guarantee only a single solution.

The Novel Contributions

The authors proposed a method of backtracking column-wise instead of using the individual cells. This results in N objects to backtrack on, decreasing the time spent on the calculations.

The authors' algorithm uses a tree to generate all of the possible permutations of each column, then tries each.

How it Will be Used

At the start of the research paper, the authors addressed multiple algorithms for generating valid backtracking solutions, which will be applicable to our research project.

In addition, the paper proposes a different way to view backtracking which we may look into applying, as it results in less computational steps.

References

- [1] Maji A. and Pal R. (2014). Sudoku Solver Using Minigrid based Backtracking. IEEE International Advance Computing Conference (IACC).
- [2] Schottlender M. (2014). The Effect of Guess Choices on the Efficiency of a Backtracking Algorithm in a Sudoku Solver. Systems, Applications and Technology Conference (LISAT).
- [3] Jana, Sunanda, Maji, Arnab Kumar, and Pal, Rajat Kumar. 2015. *A Novel Sudoku Solving Technique using Column based Permutation*. International Symposium on Advanced Computing and Communication (ISACC).

Questions?

Thank you for Listening