

The Sudoku Project

Project Presentation

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Agenda

- Overview
- Toolchain
- Brief Description
- Challenges
- Learnings
- Future Scope

The goal of this project is to investigate a variety of algorithms (backtracking, brute force, stochastic search and Crook's algorithm) that are capable of solving sudoku puzzles, of ranging difficulties, in order to learn more about sudoku solving techniques.

We also wanted to use the OpenCV library to read a sudoku from an image and solve it.

- Languages: Python, C++ and Java
- Libraries used in Python: Numpy, OpenCV and Keras

Brief Description

- Tested backtracking and brute force algorithm
- Tried implementing stochastic simulated annealing algorithm and Crook's algorithm
- Generated random sudoku puzzles
- Recognized a sudoku from an image and solved it

Results

Language	Difficulty	Time taken by an algorithm (milliseconds)	
		Backtracking	Brute force
C++	Easy	0.02	1.11
	Medium	0.08	21.43
	Hard	0.24	48.89
Java	Easy	0.03	18.27
	Medium	0.26	65.07
	Hard	0.40	83.35
Python	Easy	30.96	41.83
	Medium	66.86	253.84
	Hard	175.50	6,520.23

Figure: Average time taken to solve a sudoku (tested 100 puzzles).

Results

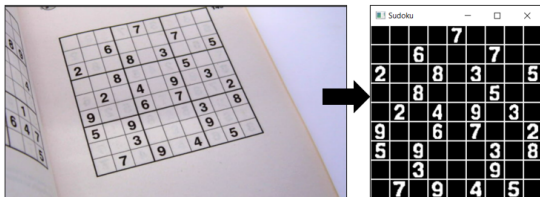


Figure: Image processing of a sudoku.

[0, 0, 0, 0, 7, 0, 0, 0, 0]	[3, 5, 4, 1, 7, 6, 2, 8, 9]
[0, 0, 6, 0, 0, 0, 7, 0, 0]	[1, 8, 6, 2, 9, 5, 7, 4, 3]
[2, 0, 0, 8, 0, 3, 0, 0, 5]	[2, 9, 7, 8, 4, 3, 1, 6, 5]
[0, 0, 8, 0, 0, 0, 0, 5, 0]	[4, 6, 8, 3, 1, 2, 5, 9, 7]
[0, 2, 0, 4, 0, 9, 0, 3, 0]	[7, 2, 1, 4, 5, 9, 8, 3, 6]
[9, 0, 0, 6, 0, 7, 0, 0, 2]	[9, 3, 5, 6, 8, 7, 4, 1, 2]
[5, 0, 9, 0, 0, 0, 3, 0, 8]	[5, 4, 9, 7, 6, 1, 3, 2, 8]
[0, 0, 3, 0, 0, 0, 9, 0, 0]	[6, 1, 3, 5, 2, 8, 9, 7, 4]
[0, 7, 0, 9, 0, 4, 0, 5, 0]	[8, 7, 2, 9, 3, 4, 6, 5, 1]

Figure: Solved the sudoku from the image

Challenges

- Setting unrealistic deadlines
- Explaining each other's ideas/concepts
- Failure to implement a few algorithms
- Dealing with code errors

- Collaborate using git
- Write the same algorithm in different languages
- Explain our code, thought processes and ideas to each other
- Apply the concept of cost function and thermodynamics in simulated annealing
- Process an image to extract digits of a sudoku
- Implement neural networks to predict digits of a sudoku from an image
- Importance of changeability of code

- Implement a sudoku solver in Haskell and Elixir

Thank You