The Sudoku Project

Project Presentation

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Agenda

- Overview
- Toolchain
- Brief Description
- Results
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Overview

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.

Toolchain and Statistics

- Languages: Python, C++ and Java
- Libaries used in Python: Numpy, OpenCV and Keras
- Total commits: 50
- Total lines of code: 2694

Brief Description

- Tested backtracking and brute force algorithm

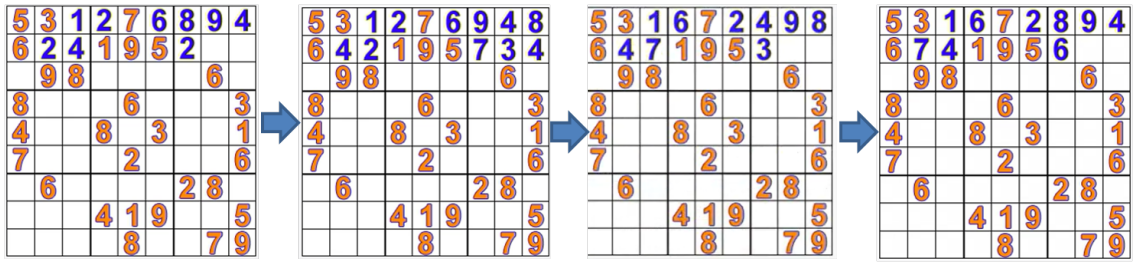


Figure: A representation of backtracking algorithm

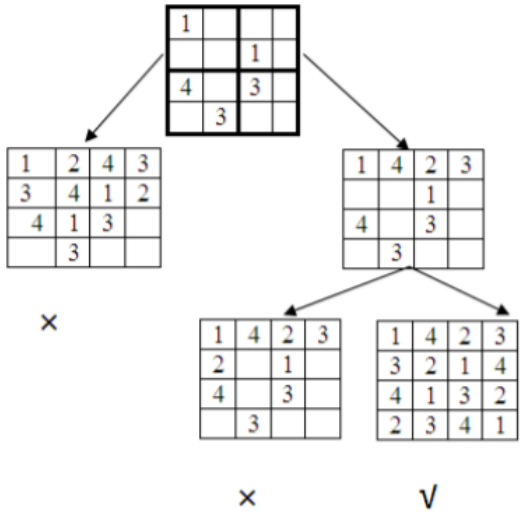
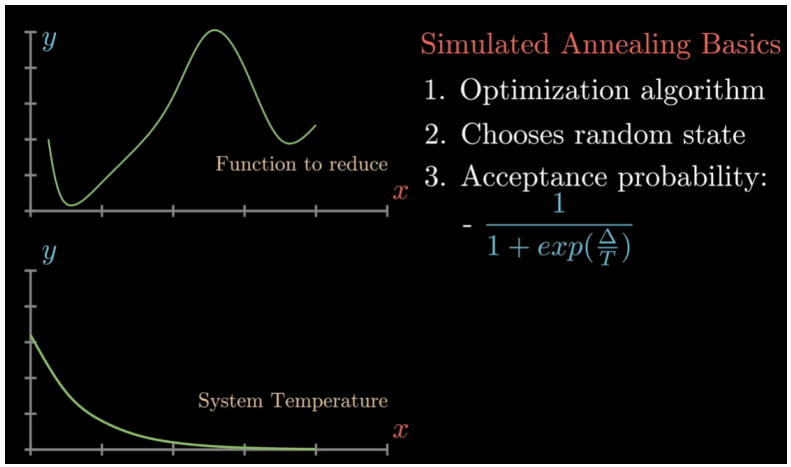


Figure: A representation of brute force algorithm

Brief Description

- Tried implementing stochastic simulated annealing algorithm and Crook's algorithm



(a) Simulated annealing - Basics

57	579	3679	2	356	4	8	1	59
57	4	179	9	579	8	2	6	3
3	25789	2789	1	6	579	9	79	4
1	679	679	39	4	67	5	8	2689
6	3	5	8	2	1	49	9	7
2	78	478	5	9	67	1	38	68
9	1	236	7	15	256	368	4	268
45	25	234	6	8	259	7	2	1
8	267	267	4	1	3	69	5	269

(b) Representation of Crook's algorithm

Brief Description

- Generated random sudoku puzzles
- Recognized a sudoku from an image and solved it

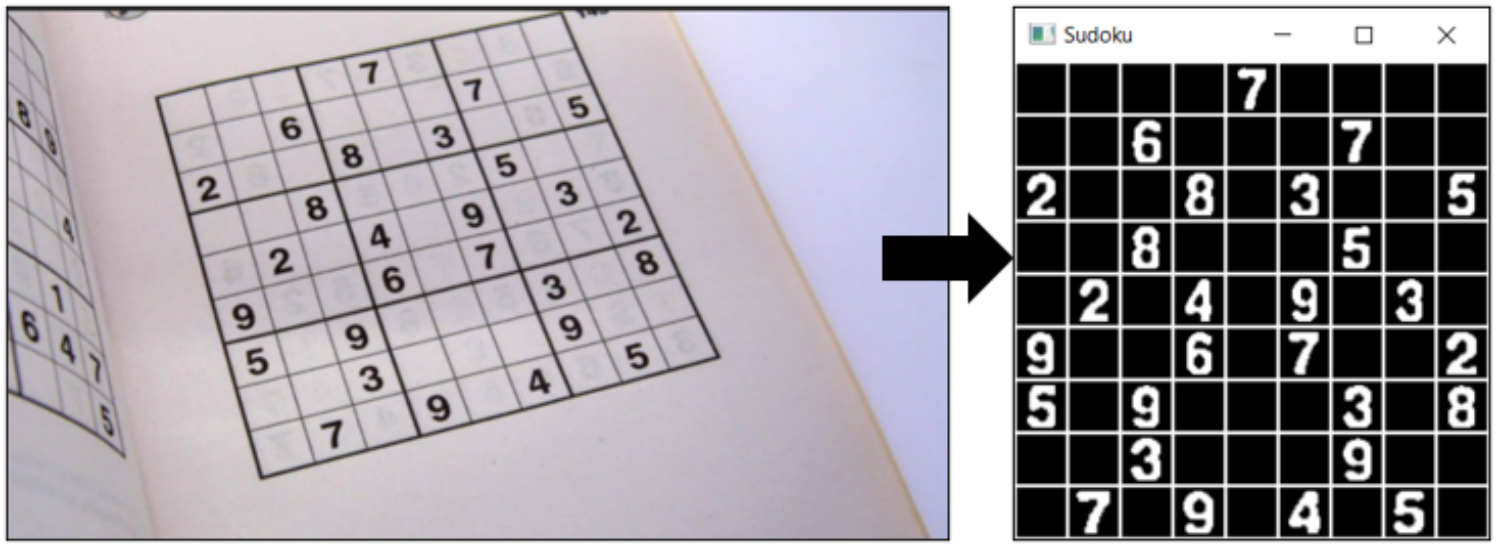


Figure: Image after processing

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).

Challenges

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

Learnings

- Collaborate using git
- Write the same algorithm in different languages
- Explain our code, thought processess 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

Future Scope

- Implement a sudoku solver in Haskell and Elixir
- Explore more algorithms like dancing links algorithm

Thank You