Project 1 – Sudoku

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Group members

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Mathematics Method

Method:

Deterministic Optimization formulation

Domain:

$$Column: [1, 2, 3, 4, 5, 6, 7, 8, 9]$$
$$Row: [1, 2, 3, 4, 5, 6, 7, 8, 9]$$
$$Value: [1, 2, 3, 4, 5, 6, 7, 8, 9]$$

Variable:

Choices: $x_{ijk}, i \in Columns, j \in Rows, k \in Rows$

Range: [0, 1], $x_{ijk} = 1\ means\ that\ the\ postion\ of\ (i, j)\ in\ the\ Sudoku\ is\ k$

Optimization Function

$Maximize: f(choices) = 0$ (This function can be arbitrary because we only need the only the constraint to be satisfied)

Constraint (Reference from sudoku.ipynb):

- Column, $\sum_{i=1}^{9} x_{ijk} = 1$ for $1 \leq j, k \leq 9$
- Row, $\sum_{j=1}^{9} x_{ijk} = 1$ for $1 \leq i, k \leq 9$
- Box, $\sum_{j=3p-2}^{3p} \sum_{i=3q-2}^{3q} x_{ijk} = 1$ for $1 \leq k \leq 9$ and $1 \leq p, q \leq 3$.
- Grid, $\sum_{k=1}^{9} x_{ijk} = 1$ for $1 \leq i, j \leq 9$.
- Clues, should be given from the problem.

How we solve:

Because we already have some constraints, this constraint contains 729 variables and 243 sudoku constraint functions, and some Grid constraint functions. This means we can have a super large matrix from these variables. With this constraint matrix, the Pulp module can help us solve the module.

Result

	Data1	Data2	Total	Note
Small Data(A)	24/24	1011/1011	1035/1035	All the data
Large Data(B)	1000/1000	1000/1000	2000/2000	Random sample 1000 data

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Small Data Result
  Small Data1 Result:
  Total: 24, Correct: 24, Correct_Percentage: 1.0
  Small Data2 Result:
  Total: 1011, Correct: 1011, Correct_Percentage: 1.0
  All Small Data Result:
  Total: 1035, Correct: 1035, Correct_Percentage: 1.0
Large Data Result
  Large Data1 Result:
  Total: 1000, Correct: 1000, Correct_Percentage: 1.0
  Large Data2 Result
  Total: 1000, Correct: 1000, Correct_Percentage: 1.0
  All large Data Result:
  Total: 2000, Correct: 2000, Correct_Percentage: 1.0

Process finished with exit code 0
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Reference

Code Reference

https://gist.github.com/allisonmorgan/c2f831cb01532fe51834f471634f4d58

Article Reference

Morgan, A. (2018, February 6). *Using integer linear programming to solve sudoku puzzles*. Medium. https://towardsdatascience.com/using-integer-linear-programming-to-solve-sudoku-puzzles-15e9d2a70baa.