

Project 1 – Sudoku

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Group members

Zhijian Wang (90281052)

Chongwei Shi

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 position 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.

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
```

This result seems too good, maybe pulp.solve is so strong. However, I do not know why in the lecture professor said that sometimes we could get wrong solution.

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>.