

Sudoku Write Up

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The model itself generates $9^3=729$ variables and there are $4(\text{col, row, box, grid}) \times 81$ fixed constraints and the constraints provided by the puzzle itself. In the code, we construct fixed_constraints from the board itself and extract the nonzeros (clue constraints) from the quiz string. We then combine the constraints to formulate A.

We now want to solve $\min f(x)$ subject to $Ax=B$, B is just all ones.

We transform the equation in the picture below into matrix representation.

Let x_{ijk} indicate the event that the (i, j) element of the Sudoku grid contains k . If it is true, $x_{ijk} = 1$, otherwise $x_{ijk} = 0$. Then the constraints are

- 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 $1 \leq i, j \leq 9$.

Use cvsopt package to solve the objective function.

Below are the results:

success rate:

small1:100%

large1: 81%

small2: 31%

large2: 100%

It matches the attribute that small 1 and large 2 are the easiest.