



Amirkabir University of Technology
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Sudoku Report

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1 About the mathematical model

I am inspired by the modeling idea mentioned in Refrence.pdf file. For more detail about the modeling, please visit this file.

1.1 Sets, Params, and Vars

Sets:

V: from 1 to 9 (indexed by i,j,k)

P: from 1 to 3 (indexed by p,q)

We need i and j for iterating over rows and columns and k for iterating over numbers, which in our case range from 1 to 9). Moreover, k is going to be used for showing the number that each cell of our table has.

Params:

we just have one parameter showing the value of initial board's cells.

$\text{init}(i,j,k)$ is 1 if the value of the cell(i,j) is k . Otherwise it is 0.

Var:

Z: value of objective function.

$X(i,j,k)$: a binary variable shows whether the value of cell(i,j) is k or not.

1.2 Consts and obj function

obj function:

Since we are looking for one feasible solution, we don't need objective function and we can set it equal to any arbitrary.

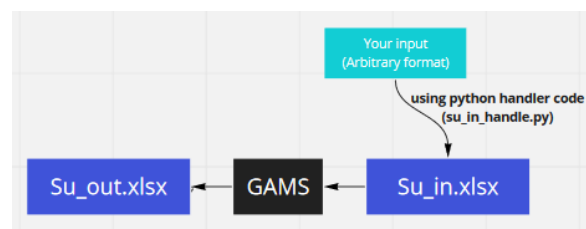
Constraints:

The first three constraints satisfy the principal constraints of standard Sudoku board,

which says from any number we have one occurrence in each row, column, and sub-squares. The fourth constraint forces our model to assign each cell to exactly one number and the last constraint ensures that we start from the initial board.

2 What is the data flow diagram?

The data flow diagram of the project is as bellow:



The following board is the initial board that we have fed into GAMS.

8			6			9	5
				2		3	1
		7	3	1	8		6
2	4						7
		2	7	9		1	
5				8		3	6
		3					

The following board is one of the alternative solutions of our initial board.

8	3	4	6	7	1	9	2	5
1	2	5	8	3	9	6	4	7
7	9	6	5	2	4	3	1	8
9	5	7	3	1	8	4	6	2
2	4	1	9	5	6	8	7	3
3	6	8	2	4	7	5	9	1
6	8	2	7	9	3	1	5	4
5	1	9	4	8	2	7	3	6
4	7	3	1	6	5	2	8	9

Note: In our output file (su-out.elsx) we have to Sheets. In the first sheet we show the status number of of our model. 1 means the model has been solved successfully with proven optimal solution. For more information, visit gams.com¹

3 How GAMS works?

Every line has a comment describing its function, so there is no problem in understating it. There are a few notes to bear in mind, however.

change the following address with the address of the input file on your local machine.

```
$call GDXRW C:\Users\Mohamadreza.a\Music\sudoku_project\su_in.xlsx @data.txt
$GDXIN su_in.gdx

$LOAD init
$GDXIN
```

change the following address with any valid address on your local machine.

```
Execute_unload "C:\Users\Mohamadreza.a\Music\sudoku_project\su_out.gdx" x, mstat;

$onecho > data.txt
var=x rdim=3 cdim=0 rng=Sheet2!A1
par=mstat cdim=0 rdim=0 rng=Sheet1!A1
$offecho

execute 'gdxrw.exe C:\Users\Mohamadreza.a\Music\sudoku_project\su_out.gdx o=C:\Users\Mohamadreza.a\Music\sudoku_project\su_out.xlsx @data.txt'
```

¹https://www.gams.com/34/docs/UG_GAMSOutput.html#UG_GAMSOutput_ModelStatus