Assumption

This Integer Programming formulation is designed specifically for Sudoku puzzle of size 9*9. However, theoretically any Sudoku puzzle of size n by n is solvable with this model.

IP formulation

Suppose that i represents the order of rows and j represents the order of columns. k is a possible value of an entry in the puzzle that is in the range from 1 to 9. The formulation is as follows:

$$x_{ijk} = \begin{cases} 1 & \text{if ith row, jth column element is k} \\ 0 & \text{otherwise} \end{cases}$$

$$\text{G} = \text{set of all known entries of the puzzle}$$

$$\sum_i x_{ijk} = 1 \text{ for } j = 1, ..., 9, \text{ for } k = 1, ..., 9$$

$$\sum_j x_{ijk} = 1 \text{ for } i = 1, ..., 9, \text{ for } k = 1, ..., 9$$

$$\sum_k x_{ijk} = 1 \text{ for } i = 1, ..., 9, \text{ for } j = 1, ..., 9$$

$$\sum_p^{p+2} \sum_q^{q+2} x_{pqk} = 1, \text{ for } p = 3i - 2, \; q = 3j - 2, \text{ for } i, j = 1, 2, 3$$