DiscreteMathematics 02

21800147 Kim Youyoung

<Number Cross>

Not only should the sum of the black squares in each column be the same as the labels of each column, but also the sum of the white squares in each row and the labels of each row.

[Constraints]

1. Number Cross consists of an M×N grid and is labeled as a positive integer.
2. M and N shall not exceed 50.
3. All square labels shall be not less than 1 and not more than 9.

$$\bigwedge_{i=1}^{9}\bigwedge_{j=1}^{9} 1 \le a_{ij} \le 9$$

4. The row of the first line consists of an N token and rows of the remaining lines consist of an N+1 token.

[Logic Formula]

1. Declare each square label
   A. $X = \{a_{10}, a_{11}, \dots , a_{(i-1)(j-2)}\}$
2. $\forall a_{ij} \in X$ is assert $o \le a_{ij} \le 1$
3. The value of all square labels in the same column multiplied by a_{ij} shall be equal to the value of the labels in each column.

$$a_{10} * num[1][0] + a_{20} * num[2][0] + a_{30} * num[3][0] + \cdots + a_{pq} * num[p][q]$$

$$= \sum_{q=0}^{m}\sum_{p=1}^{n} num[p][q] * a_{pq} = a_{0q}$$

4. If a_{ij} is 1, replace it with 0 (if it is 0, it changes to 1.) to make it equal to the previous procedure, but equal to the label for each row.
   A. $a_{ij} = 0$(to 1), $(a_{ij} - 1) * -1$ and so on is $a_{ij} = 1$ (to 0)

$$((a_{10} - 1) * -1) * num[1][0] +$$
$$((a_{11} - 1) * -1) * num[1][1] +$$
$$((a_{12} - 1) * -1) * num[1][2] +$$
$$\dots + a_{pq} * num[p][q]$$

$$= \sum_{p=1}^{n}\sum_{q=0}^{m} num[p][q] * a_{pq} = a_{p(q+1)}$$

[Discussion]

1. I learned that it is important to get the proper number of brackets when making z3.
2. It was much easier to identify true cases through z3's assert, which would have been more complicated if written in C language.
3. Wouldn't it be possible to have a puzzle that, as opposed to Number Cross, is filled with black and white on a square label and gets the right number to enter the square label when each column and row label has numbers?

   EX) 20 23 30 29 34 6 9 21 19

   1 1 0 1 0 0 1 0 0 18

   0 1 1 0 1 0 0 0 0 28 …