

## Logical reasoning and programming, task I

(October 17, 2022)

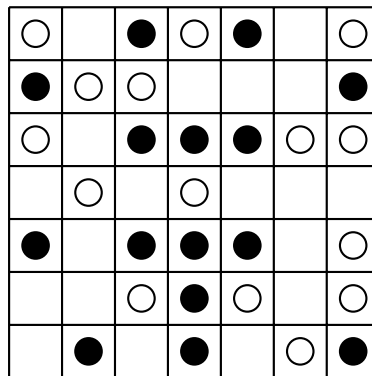
### Problem

Your task is to produce a solver for a puzzle called Shirokuro using a SAT solver.

You have a grid, in our case always  $n \times n$ , containing white and black circles. The goal is to connect each white circle with a black circle by a straight horizontal or vertical line. Moreover, it holds that

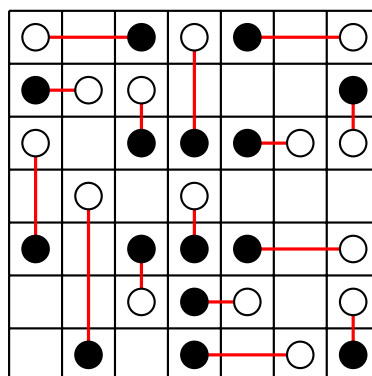
- in each circle exactly one line ends,
- lines do not pass through other circles,
- lines do not cross other lines, and
- not necessarily each cell is visited by a line.

For example, a possible input can be the following grid  $7 \times 7$  filled with white and black circles



Example: input

It has exactly one solution



Example: output

## Program

You should upload an archive to BRUTE that contains an executable script `shirokuro` that expects an input string on `stdin` and produces a solution to `stdout`.

It is expected that you use Python 3.8 (use `python3`), but MATLAB 9.2 (use `matlab`) should also work. You may use

- PycoSAT in Python, `import pycosat`,
- PySAT in Python, `import pysat`,
- MiniSat, command `minisat`,
- PicoSAT, command `picosat`,

as SAT solvers. You are allowed to use another SAT solver included in your archive.

Every input has a maximum execution time assigned. However, the given time should be enough for solving the given problem using any of the previous solvers with a decent (non-optimized) encoding.

Non-standard settings are discussed individually.

## Input

It is a string of length  $n \times n$ . In our example, it is

```
w0bwb0wbww000bw0bbbww0w0w000b0bbb0w00wbw0w0b0b0wb
```

where

- `w` is a white circle,
- `b` is a black circle, and
- `0` (zero) is an empty cell.





The  $(i, j)$  cell is described by the character at the position  $(n \cdot i) + j$  in the string; we start counting from zero.







## Output

It is a string of length  $n \times n$ . In our example, it is

```
EHWSEHWEWSV00SSONNEWNVSOS000NVSNEHWOVNEWOSONOEHWN
```

where

- `0` (zero) is an empty cell,
- `H` is an originally empty cell that now contains a horizontal line ()
- `V` is an originally empty cell that now contains a vertical line ()
- `N` is a circle that is connected from north ( or )

- E is a circle that is connected from east ( or )
- S is a circle that is connected from south ( or )
- W is a circle that is connected from west ( or )

You may assume that there is at most one solution. If no solution is possible, then output the string

X

### Points

Your score is assigned automatically by BRUTE; you can even see some test cases including the one presented here. However, only slightly incorrect code may get very little points. For that reason, your code will be manually reviewed after the deadline, and additional points may be awarded.

*Please, do submit even incomplete solutions!*