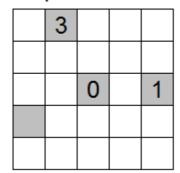# Task 5. Akari

Available marks: 28

Akari is yet another logic puzzle developed by the Japanese *Nikoli* puzzle magazine. It's also known as *Light Up*, and is played on a rectangular grid.

The grid consists of white and grey cells, and some of the grey cells contain numbers. The goal of the game is to place lights in some of the white cells to illuminate the grid. Each light illuminates its row and column of the grid as far as a border or a grey cell, and they must be placed according to these rules:
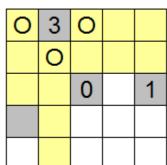
1. Every white cell is eventually illuminated;
2. No light may illuminate another light; and
3. If a grey cell contains a number, that is the number of adjacent cells (excluding diagonals) that contain lights in the final configuration.

Here is an example of a puzzle in its initial state, then partially and fully completed. Illuminated cells are shaded yellow. It suggests one placement algorithm, as in this case there are only three unlit cells adjacent to the grey **3** cell. The requirement that there are no lights adjacent to the grey **0** cell leaves only one unlit cell adjacent to the grey **1** cell. The final light is placed to cover the remaining unlit cells.
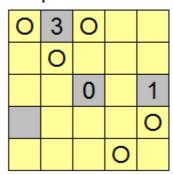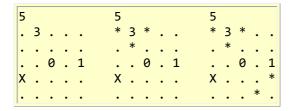

Data Format

Input and output formats are identical, except that the output doesn't have to repeat the grid size. The first line of input files contains a single number representing the number of rows and columns (for this task we will use only square grids). The maximum size is 10. The remaining lines contain the grid from the top row down, one row per line. Cells are separated by a single space, and use this notation:

. an empty cell (whether illuminated or not)

X a grey cell without a number

N a grey cell containing the number *N* (0, 1, 2, 3 or 4)

* a light

Inputs can be provided at any stage of the puzzle solution. The three files corresponding to the above are in `task5sample1.dat`, `task5sample2.dat` and `task5sample3.dat`:

```
5                5                5
. 3 . . .        * 3 * . .        * 3 * . .
. . . . .        . * . . .        . * . . .
. . 0 . 1        . . 0 . 1        . . 0 . 1
X . . . .        X . . . .        X . . . *
. . . . .        . . . . .        . . . * .
```

Tasks and Assessment

Your tasks (assessed separately) are

1. Validate an apparently completed puzzle, that is, determine if it obeys all three rules above. Possible responses include the following, where *CR* is a cell reference using row and column number, starting at 0:
    - o Puzzle is solved.
    - o Puzzle is incomplete, cell *CR* is not illuminated
    - o Puzzle is invalid, cells *CR* and *CR* illuminate each other
    - o Puzzle is invalid, wrong number of adjacent lights for grey cell *CR*

    Data files to test the validation code with are `task5A.dat`, `task5B.dat` and `task5C.dat`. They are worth 4 marks each.

2. Solve a puzzle, that is, display the solution using the same notation as the input. Data files to test the solver with are `task5D.dat` and `task5E.dat`. They are worth 7 marks and 9 marks respectively.

    Note: Judges may provide an additional test file if it appears that the code is focused too heavily on solving just these two problems. 5 marks are withheld until this last test is passed.

Reference:
Nikoli's website: http://www.nikoli.com/en/puzzles/bijutsukan/