

The second big assignment: Conway's Game of Life

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1 The game

The Game of Life is a zero-player game. It is played on an infinite two-dimensional board. The cells of a board are indexed by pairs $\langle n, m \rangle$ of integers. Each cell can be either *alive* (denoted by hash '#') or *dead* (denoted by space ' '). We shall say that a cell $\langle n, m \rangle$ is neighbour to a cell $\langle n', m' \rangle$ iff both $|n - n'| \leq 1$ and $|m - m'| \leq 1$ hold.

The game starts by specifying a finite number of alive cells (all other cells are assumed to be dead) and a number of turns. During each turn:

- any alive cell that has (strictly) less than two alive neighbours dies
- any alive cell that has (strictly) more than three alive neighbours dies
- any dead cell that has exactly three alive neighbours becomes alive
- any other cell remains unchanged

Since the whole board is infinite, we shall be interested in parts of the board that contain all alive cells. Let us assume that integers $l \leq r$ and $t \leq b$ are such that every alive cell $\langle n, m \rangle$ satisfies $l \leq n \leq r \wedge t \leq m \leq b$ and moreover there exist alive cells whose first coordinates are l, r and there exist alive cells whose second coordinates are b, t . In other words, integers $l \leq r$ and $t \leq b$ specify the smallest rectangular part of the board that contains all alive cells. We shall call this part of a board the defining sub-board. The textual representation of the part of a board corresponding to $l \leq r$ and $t \leq b$ consists of $b - t + 1$ lines of $r - l + 1$ characters ('#' or ' ') denoting the cells. The textual representation of a board consists of a single line containing four

integer $l \leq r, t \leq b$ that specifies the defining sub-board followed by the textual representation of the defining sub-board.

For example, the textual representation of the board whose only alive cells are:

$$\langle -1, -2 \rangle, \langle 0, -2 \rangle, \langle -1, -1 \rangle, \langle 0, 0 \rangle, \langle 0, 1 \rangle$$

is:

```
-1 0 -2 1
##
#
#
#
```

More information about the Game of Life can be found here:

https://en.wikipedia.org/wiki/Conway's_Game_of_Life

2 The task

Your task is to build a simulator for the Game of Life. Write a program that takes three parameters:

- n — the number of turns
- *init* — the name of a file that describes an initial state of the game
- *result* — the name of a file to store the result of simulation after n turns

reads from file *init* an initial state of the game (given as the textual representation of a board), performs n turns of simulation and writes the solution to file *result*. The solution should be given as the textual representation of a board provided the board contains at least one alive cell, otherwise the solution should contain a single line with a single character 'E'.

Please, send your programs to:

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before 12.06.2016!

3 Examples

Input: 1 sample.txt, solution.txt.

sample.txt:

```
-1 0 -2 1
##
#
#
#
```

solution.txt:

```
-1 0 -2 0
##
#
##
```

Input: 2 sample.txt, solution.txt.

sample.txt:

```
-1 0 -2 1
##
#
#
#
```

solution.txt:

```
-2 0 -2 0
##
#
##
```

Input: 3 sample.txt, solution.txt.

sample.txt:

```
-1 0 -2 1
##
#
#
#
```

solution.txt:

```
-2 -1 -2 0
#
#
#
```

Input: 4 sample.txt, solution.txt.

sample.txt:

```
-1 0 -2 1
##
#
#
#
```

solution.txt:

```
-2 -1 -1 -1
##
```

Input: 5 sample.txt, solution.txt.

sample.txt:

```
-1 0 -2 1
##
#
#
#
```

solution.txt:

E