Room Cleaning Problem

Xavier Huijts

Code

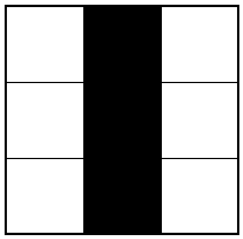
Please access the code and test examples for my solution **here** (Java and Python).

Problem

There are various variations of room cleaning algorithms varying from simple to more complex problems. In the problem presented by me, a matrix is presented, where each *cell* (akin to *coordinate*) can either be:

(1) a clean room
(2) a dirty room
(3) a wall

The goal is to find the required number of cleaning sessions. The walls may separate the global area (the entire matrix) into local areas. In the below, a matrix is presented where the white cells represent the clean rooms, while the black cells are the walls. In this case, the walls have clearly vertically separated the global area into 2 local areas of clean rooms. The local area is characterized by being *adjacent* (akin to *connected* or *neighbored*) to other clean rooms.

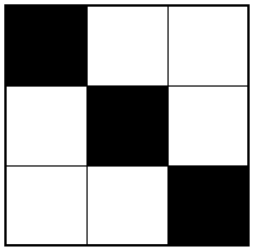


For each local area containing at least one dirty room, a cleaning session is required to clean the room(s). In case a local area has more than one dirty room, one cleaning session is still sufficient to clean all rooms in the local area.

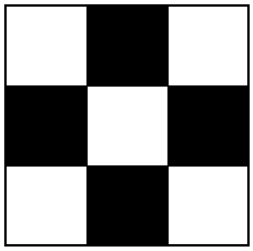
Additional rule

- Walls are diagonally connected and can diagonally separate areas. For example, the walls in *matrix 1* (see the next page) have separated the global area into 2 local areas of clean rooms. *Matrix 2* has 5 local areas of clean rooms.

Matrix 1 (2 local areas):



Matrix 2 (5 local areas):



Technical information

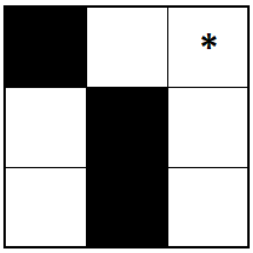
In computational language, the cell state can be expressed as strings:

‘0’ = a clean room

‘1’ = a dirty room

‘#’ = a wall

Also in computational language, the matrix is represented as a list of lists. Please see the following visual matrix:



This can be computationally denoted as:

[[‘#’, ‘0’, ‘1’],

[‘0’, ‘#’, ‘0’],

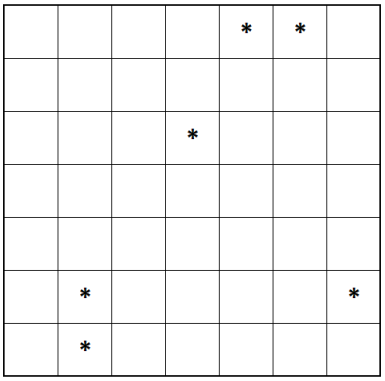
[‘0’, ‘#’, ‘0’]]

Examples

Now, I present several examples of inputs used for testing the effectiveness of the developed cleaning algorithm.

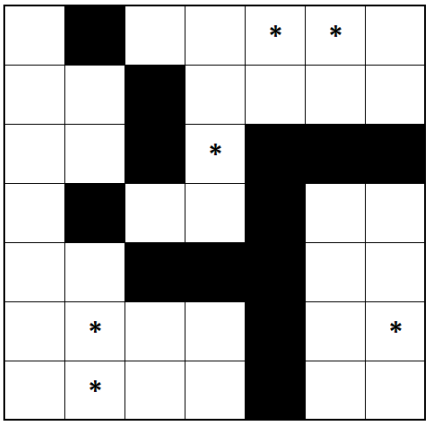
- **Example 1:** The first example contains 6 dirty rooms, however, have zero walls. Therefore, the global area is not separated into local areas and 1 cleaning session is sufficient for cleaning the entire space.

  Answer: 1 cleaning session required



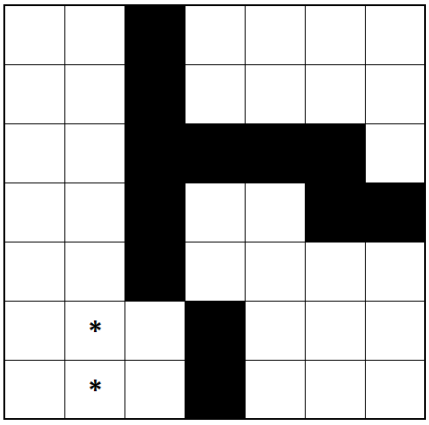
- **Example 2:** This example is more difficult: there are now 3 local areas all containing at least one dirty room. Therefore, each local area requires one cleaning session.

  Answer: 3 cleaning sessions required



- **Example 3:** In this example, there are 3 local areas. However, only one of the local areas contains a dirty room. Therefore, only the local area with dirty rooms requires a cleaning session.

  Answer: 1 cleaning session required



Tips

- Try to perceive a room as a coordinate and the matrix as a coordinate system – this might help you in identifying local areas.

- Some iterative (or recursive) process is needed to go through the rooms and detect connected areas.