Marathon Match

Problem Statement

Contest: 2012 TCO Marathon Round 1

Normal view

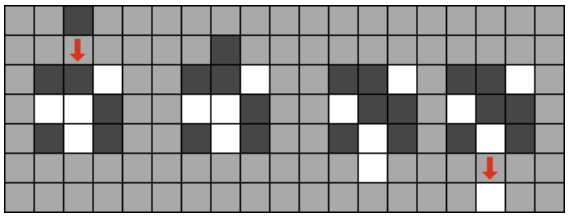
Problem: BlackAndWhiteGame

Problem Statement

BlackAndWhite is a game played by moving black and white tiles on a square board of size **SZ * SZ**. There are **SZ * SZ** + 1 tiles in the game, **SZ * SZ** of them are placed on the cells of the board, and the last one is held by the player. On each turn, the player shifts all tiles of a selected row/column by one cell in the selected direction, puts the tile he holds onto the cell which emptied after the shift and picks up the tile which got pushed out of the board. The goal of the game is to arrange the tiles on the board so that all white tiles are on the board (the player holds a black tile) and they all form a single 4-connected region. Your task is to find a way to reach this goal using as few shifts as possible.

You have to implement a single method **makeConnected** which provides you the initial layout of the tiles on the board as a tuple (string) **board**. **board**[**r**][**c**] gives the color of the tile placed in row **r** and column **c**: 'X' for white or '.' for black. The tile held by the player initially is black.

This method should return the sequence of shifts the player should do to arrange the white tiles into a 4-connected group, formatted as follows. Each element of the return describes a single shift and is formatted as "row col" (without quotes). To perform this shift, the player's tile is placed at one end of the row or column which will be shifted, in a cell with coordinates (**row**, **col**). After this the whole row or column is shifted by one cell, so that the placed tile gets shifted into the board, and the cell on the other end of the row/column moves outside of the board. On the image the player's tile is black and it is used to shift the middle column down.



The shifts are performed in the order in which they are given in the return. Each shift description must be valid: either **row** or **col** must be -1 or **SZ**, and the other coordinate must be between 0 and **SZ**-1, inclusive. After all shifts white tiles must form a 4-connected group: for any pair of white tiles there must exist a chain of white tiles which connects them, and consecutive tiles in the chain should be adjacent on the board (vertically or horizontally).

The score for a test case will be 100 * max(0, 1 - (number of shifts in your return) / (SZ*SZ)). Invalid returns or returns which result in non-connected group of white tiles result in 0 score for that test case. The overall score is calculated as a sum of individual scores for all test cases.

The test cases are generated as follows. The size of the board **SZ** is chosen between 20 and 100, inclusive. Then the board is filled with black tiles, and a region of white tiles is chosen randomly as a rectangle (in 2/3 of the cases) or a stripe (in 1/3 of the cases) so that the number of white tiles is between 5% and 40% of the total number of tiles on the board. Finally, the rows and columns of the board are shifted randomly, so that each shift modifies the layout of the board. For the details of test case generation see the visualizer (method `generate` is responsible for this).

A visualization tool is provided for offline testing. It also allows manual play.

Definition

Class:	BlackAndWhiteGame
Method:	makeConnected
Parameters:	tuple (string)
Returns:	tuple (string)
Method signature:	def makeConnected(self, board):
(be sure your method is public)	

Notes

- The memory limit is 1024 MB and the time limit is 10 seconds (which includes only time spent in your code).
- There is no explicit code size limit. The implicit source code size limit is around 1 MB (it is not advisable to submit codes of size close to that or larger). Once your code is compiled, the binary size should not exceed 1 MB.
- The compilation time limit is 30 seconds. You can find information about compilers that we use and compilation options here.
- There are 10 example test cases and 100 full submission test cases.

Examples

0)

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Seed = 1
Grid size = 20
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1)

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Seed = 3
Grid size = 78
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3)

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Seed = 4
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4)

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Seed = 5
Grid size = 43
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5)

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Seed = 6
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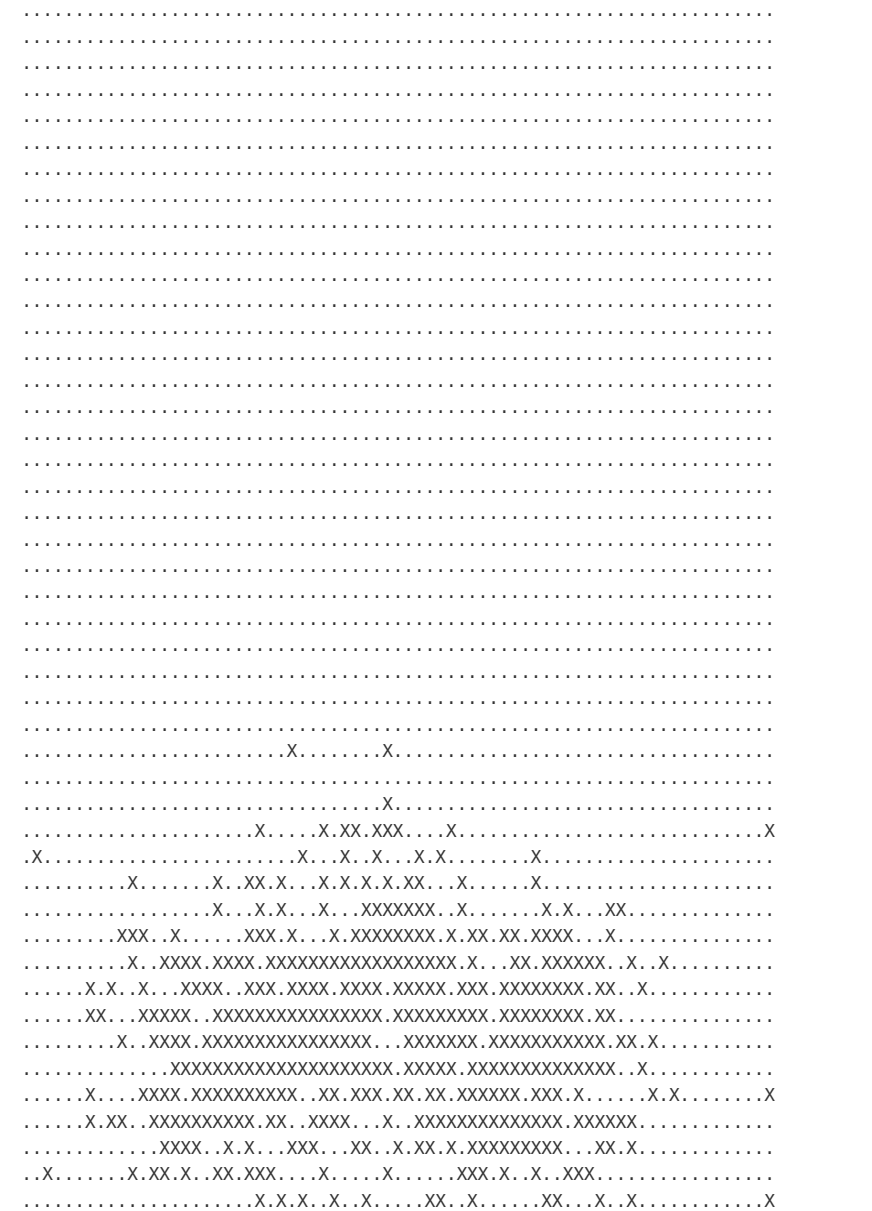

6)

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Seed = 7
Grid size = 80
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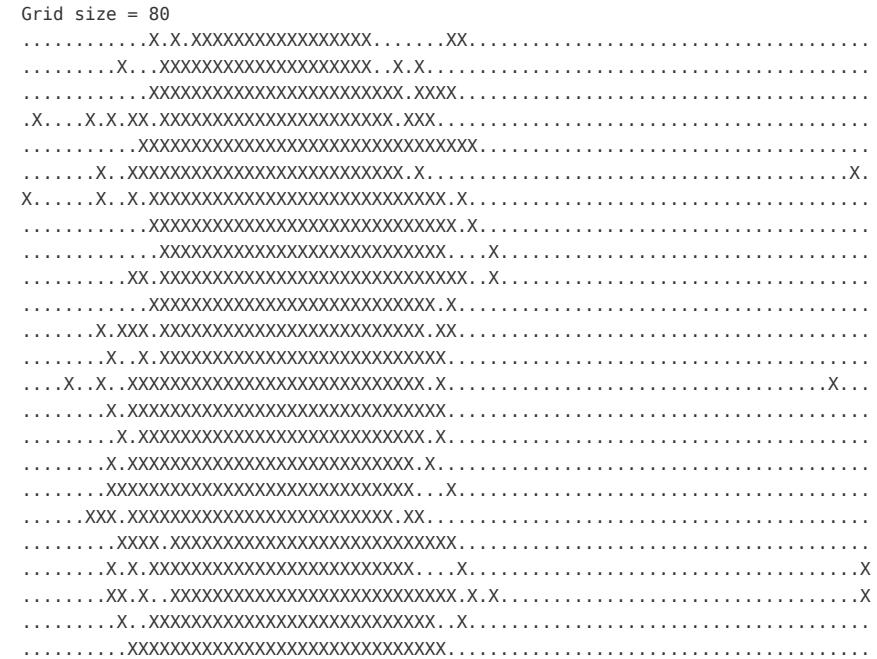

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7)

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Seed = 8
Grid size = 24
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8)

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Seed = 9
Grid size = 84
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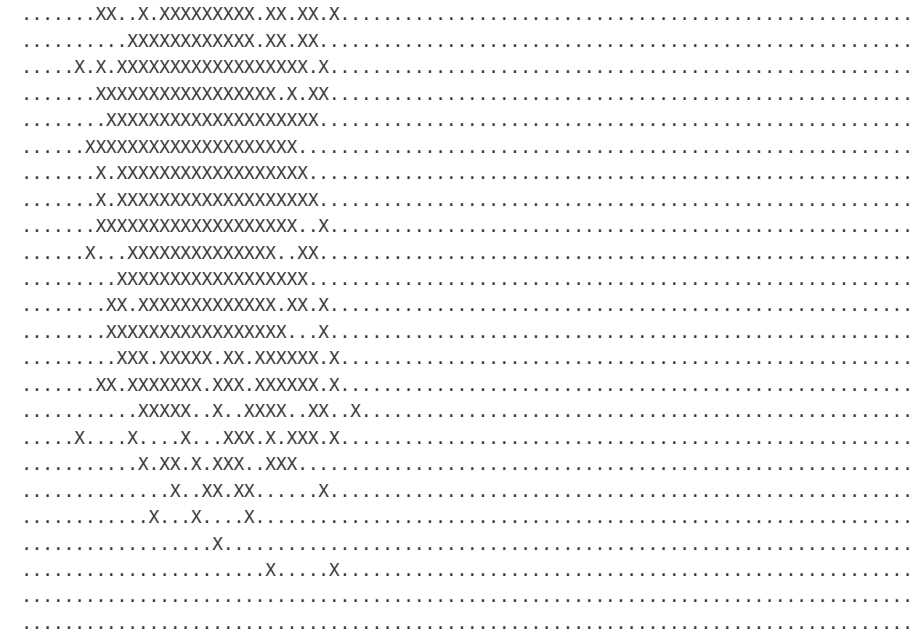

9)

Seed = 10
Grid size = 87