Programming Exam 9

Date/Time: 2024.06.04

（程式檔命名學號_quiz9.py，上傳至 Moodle PE9 上傳區）

Problem: Advanced Maze Map Manipulation

Write a Python program to read a *N* (number of rows) by *M* (number of columns) **maze blueprint with some pre-set obstacles** from a text file, and accordingly generate a maze map with a clear path from the starting point (the top-left cell) to the bottom-right cell. Prompt the user to input the number of *min_obstacles*, i.e., the minimum number of obstacles to be randomly added into the 2-dimensional map. The movement in the path allows only two directions (down or right). Also **allow the user to manually place or remove obstacles on the grid**. The maze is represented as a **dictionary** data structure, where each cell is stored as a key-value pair. The keys are **tuples** that represent the cell's coordinates, and the values are integers that denote the cell's state: **0 for an empty cell, 1 for an obstacle, and 2 for a path cell**. Once the maze is created, the user is provided with a menu of options to manipulate the maze. They can set or remove obstacles by providing the coordinates of the desired cell. If they attempt to manipulate a cell that's part of the path, or if the coordinates are out of bounds, **an appropriate error message is displayed.** After removing or adding obstacles, **the maze state needs to be displayed once**. The user can also choose to exit the program.

Requirements

(1) Read the maze grid blueprint with some pre-set obstacles from the specified text file (**grid77.txt** or **grid99.txt**). If the file is not found, the program should prompt the user to enter a valid file name.

(2) Generate a random path through the maze from the top left cell to the bottom right cell.

(3) Allow the user to input the minimum number of obstacles randomly placed in the maze at the start. If the input number is invalid, the program should prompt the user to enter a valid number.

(4) Handle user options for setting and removing obstacles at given coordinates. If the coordinates are either out of bounds or at the cells in the path, the program should display an error message.

(5) Display the current state of the maze after setting or removing obstacle, showing empty cells as ' ', obstacle cells as 'X', and path cells as 'O'.

(6) Must handle exceptions and errors appropriately, providing meaningful error messages for the user. The program should handle IOErrors, ValueError, NameError, and KeyError correctly.

(7) Continue to prompt the user for options until they choose to exit. If an invalid option is entered, need to display an appropriate error message and prompt the user again.

We provide you the code with six functions, including **generate_maze(N, M),** **add_obstacles(maze, min_obstacles, N, M), set_obstacle(maze, N, M), remove_obstacle(maze,** **N, M), print_maze(maze, N, M)** and **main().** The comments in each function can guide you what to do. You need to complete all of these functions. Note that you may want to use the *random* module with *random.randint* and/or *random.choice* functions to randomly generate the path and to randomly add the obstacles.

Sample Input/Output　　　　　　　（以下是你程式執行後需印出的結果）

```
littlemilk > python pe9_extra.py
Enter file name: asdsad
IOError occurred in main function. File not found Please enter a valid file name
Enter file name: grid99.txt
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   | X | X |   | X | X |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   |   |   | X |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   | X |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   | X |   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   | X |   |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   |   |   | X |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   |   |   |   |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
Enter the minimum number of obstacles (0-55): aaaa
ValueError occurred in main function. Invalid number of obstacles.
Enter the minimum number of obstacles (0-55): 1111
ValueError occurred in main function. Invalid number of obstacles.
Enter the minimum number of obstacles (0-55): 20
+---+---+---+---+---+---+---+---+---+---+
| 0 |   |   | X |   |   | X |   | X |   |
+---+---+---+---+---+---+---+---+---+---+
| 0 | X |   |   |   |   | X |   | X |   |
+---+---+---+---+---+---+---+---+---+---+
| 0 | X | X | X | X | X | X |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
| 0 |   | X |   |   |   | X | X |   |   |
+---+---+---+---+---+---+---+---+---+---+
| 0 | 0 | 0 | 0 | X | X |   |   |   |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   | X | 0 | 0 |   |   |   | X |   |
+---+---+---+---+---+---+---+---+---+---+
|   | X |   | X | 0 |   |   |   | X |   |
+---+---+---+---+---+---+---+---+---+---+
|   |   |   | X | 0 | 0 | X |   | X |   |
+---+---+---+---+---+---+---+---+---+---+
| X | X |   | X | X | 0 | 0 | 0 | 0 |   |
+---+---+---+---+---+---+---+---+---+---+
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: 5
Invalid option. Please choose a valid option.
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: ▉
```

```
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: 2
Enter the coordinate to remove an obstacle, e.g. i,j: ijksjd
ValueError in remove_obstacle function. Need to be coordinates
Enter the coordinate to remove an obstacle, e.g. i,j: 111111
ValueError in remove_obstacle function. Need to be coordinates
Enter the coordinate to remove an obstacle, e.g. i,j: 111,111
KeyError in remove_obstacle function. 'Invalid coordinates. Please input coordinates within the range.'
Enter the coordinate to remove an obstacle, e.g. i,j: a,2
ValueError in remove_obstacle function. Need to be coordinates
Enter the coordinate to remove an obstacle, e.g. i,j: 0,2
Obstacle does not exist at this location.
Enter the coordinate to remove an obstacle, e.g. i,j: 4,1
Obstacle does not exist on the path.
Enter the coordinate to remove an obstacle, e.g. i,j: 1,3
Obstacle does not exist at this location.
Enter the coordinate to remove an obstacle, e.g. i,j: 2,5
Obstacle removed at (2, 5)
+---+---+---+---+---+---+---+---+---+
| O |   |   | X |   |   | X |   | X |
+---+---+---+---+---+---+---+---+---+
| O | X |   |   |   |   | X |   | X |
+---+---+---+---+---+---+---+---+---+
| O | X | X | X | X |   | X |   |   |
+---+---+---+---+---+---+---+---+---+
| O |   | X |   |   |   | X | X |   |
+---+---+---+---+---+---+---+---+---+
| O | O | O | O | X | X |   |   |   |
+---+---+---+---+---+---+---+---+---+
|   |   | X | O | O |   |   |   | X |
+---+---+---+---+---+---+---+---+---+
|   | X |   | X | O |   |   |   | X |
+---+---+---+---+---+---+---+---+---+
|   |   |   | X | O | O | X |   | X |
+---+---+---+---+---+---+---+---+---+
| X | X |   | X | X | O | O | O | O |
+---+---+---+---+---+---+---+---+---+
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: █
```

<div align="center">（下一頁還有）</div>

```
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: 1
Enter the coordinate to set an obstacle, e.g. i,j: asdasd
ValueError in set_obstacle function. Need to be coordinates
Enter the coordinate to set an obstacle, e.g. i,j: 999999
ValueError in set_obstacle function. Need to be coordinates
Enter the coordinate to set an obstacle, e.g. i,j: 999,999
KeyError in set_obstacle function. 'Invalid coordinates. Please input coordinates within the range.'
Enter the coordinate to set an obstacle, e.g. i,j: 1,0
Obstacle cannot be placed on the path.
Enter the coordinate to set an obstacle, e.g. i,j: 2,1
Obstacle already exists at the location.
Enter the coordinate to set an obstacle, e.g. i,j: 7,0
Obstacle placed at (7, 0)
+---+---+---+---+---+---+---+---+---+
| O |   |   | X |   |   | X |   | X |
+---+---+---+---+---+---+---+---+---+
| O | X |   |   |   |   | X |   | X |
+---+---+---+---+---+---+---+---+---+
| O | X | X | X | X |   | X |   |   |
+---+---+---+---+---+---+---+---+---+
| O |   | X |   |   |   | X | X |   |
+---+---+---+---+---+---+---+---+---+
| O | O | O | O | X | X |   |   |   |
+---+---+---+---+---+---+---+---+---+
|   |   | X | O | O |   |   |   | X |
+---+---+---+---+---+---+---+---+---+
|   | X |   | X | O |   |   |   | X |
+---+---+---+---+---+---+---+---+---+
| X |   |   | X | O | O | X |   | X |
+---+---+---+---+---+---+---+---+---+
| X | X |   | X | X | O | O | O | O |
+---+---+---+---+---+---+---+---+---+
Options:
1. Set obstale
2. Remove obstacle
3. Exit
Enter your option: 3
littlemilk >
```

(繳交學號_quiz9.py 檔，不是截圖) **Need to write comments in your code.**

4