111B Data Science and Python Programming

Homework Assignment #2

Due: 3/16 12:00:00

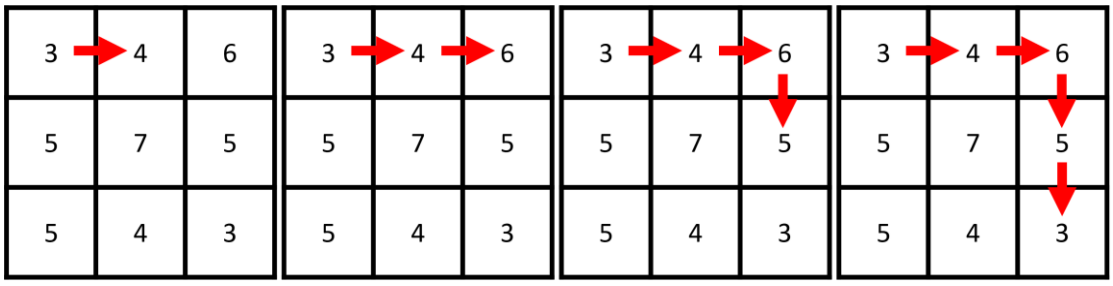
Steven is an outdoorsman and one of his favorite activities is hiking. After he heard about the news of Ho Ho Cheng's luxury trip, he invited Ho Ho Cheng and his lovely friends to a mountain called "pillow" next week. As a sweet person, Steven is considerate of them and wants to find a route with least altitude change since they are rookies of hiking. However, he is so confused and has no idea about route planning when he saw the map on his iPhone 15 Pro Max. Please write a program to help this poor one-day guide Steven to find the easiest route so that Ho Ho Cheng and his lovely friends can come back to this classroom safely.

Please create a "***MountainClimbing***" class object with your solutions. You will receive a "***test_data.npy***" file which contains 20 maps so that you can randomly choose one of them to validate your algorithm. The pixel values of every 2D map represent the altitude of the corresponding location. Please notice that, Steven and his friend will start from the upper left corner, and their destination is the lower right corner. They only go right or down because someone is behind them and they don't want to go back.

Problem #1: Greedy Algorithm

Please create a method called "***GAclimbing***" in "***MountainClimbing***." Your goal is to find a route from the upper left to the lower right corner with **the minimum sum of altitude changes** via greedy algorithm. Then, return the route and the cumulative altitude changes as your answer.

Example:



Cumulative altitude changes = 1 + 2 + 1 + 2 = 6

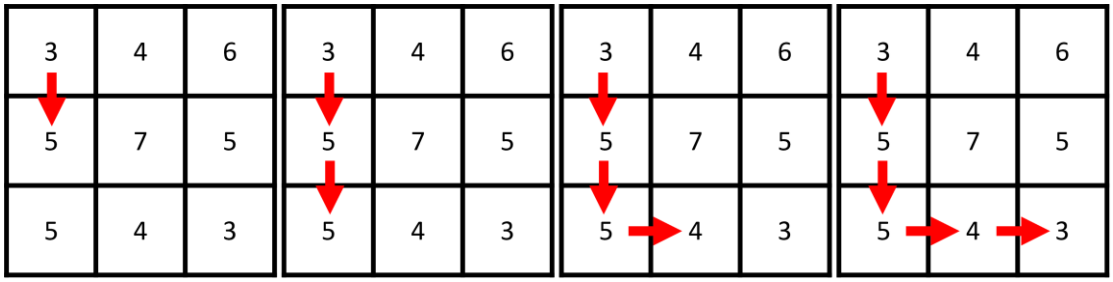
FRIENDLY REMINDER

If there is no difference in altitude change, choose going down.

Problem #2: Optimal Solution

Please create a method called "***OSclimbing***" in "***MountainClimbing***" and search the optimal route via breadth-first search or depth-first search. Again, your goal is to find a route from the upper left to the lower right corner with **the minimum sum of altitude changes**. Then, return the route and the cumulative altitude changes as your answer.

Example:

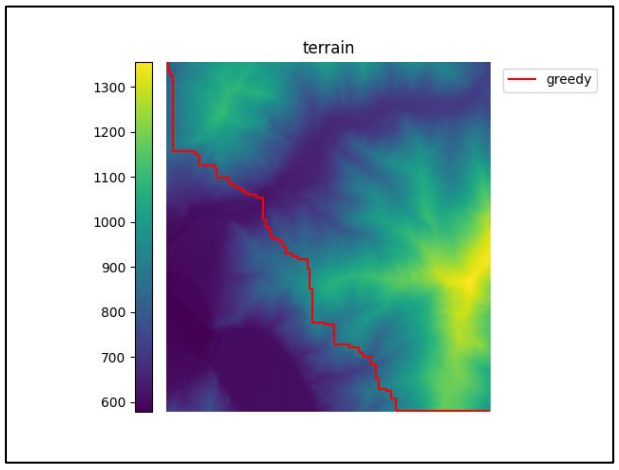


Cumulative altitude changes = 2 + 0 + 1 + 1 = 4

Problem #3:

After finding the route, Steven need you to draw the path on the map. Please create a method called "***DrawPath***" in "***MountainClimbing***," and **adding a parameter called "*solution*"** in "***DrawPath***". Choosing "***greedy***" for greedy algorithm, choosing "***os***" for optimal solution, and choosing "***both***" for both solutions, then draw the route on the map with "***matplotlib.pyplot***" module.

Example:



FRIENDLY REMINDER

You don't have to plot an image that is exactly as same as the example.

!!!NOTICE!!!

In this homework, you are only allowed to import "**numpy**", "**argparse**", "**matplotlib**" and your own modules.

The sample code for "**MountainCliambing**" class:

```
class MountainClimbing:
    def __init__(self, map):
        self.map = map

    def GAclimbing(self):
        # your solution
        return result

    def OSclimbing(self):
        # your solution
        return result

    def DrawPath(self, solution='greedy'):
        # draw: solution for drawing the path, 'greedy', 'os', 'both'
```

The required argument parser for this homework:

```
if __name__ == '__main__':
    parser = argparse.ArgumentParser(description='Homework#2')
    parser.add_argument('--data_path', default='./test_data.npy',
                        type=str, help='Testing data file location')
    parser.add_argument('--solution', default='greedy', type=str,
                        help='pathfinding solution (greedy, os, both)')
    parser.add_argument('--draw', default=False, type=bool,
                        help='whether to draw the path on map?')
```

Please accomplish this homework with an organized code (e.g., with main script and function script). For example, you can package your scripts that related to the "**MountainClimbing**" object in a module "**obj.py**" and remain the main content in the main script "**main_hw2.py**" clear. In addition, you should use "**argparse**" to set all related parameters of this homework. Here is a template for your code structure:

```
111B_hw#2_0123456789
      ├─ obj.py          # Objects
      └─ main_hw2.py     # Main scripts of hw2
```

You don't need to follow this structure, just keep your main script clean.

Hand in procedure:

As we had mentioned in the lecture, you should list all your collaborators in your programs. Here is the template:

```
"""
Created on Sun Aug 7 01:23:45 2022

@author: Xi Winnie, student ID

@collaborators: Jane Doe, her student ID
                John Doe, his student ID
"""
```

Please save your code as a "**.zip**", "**.7z**", or "**.rar**" file, where the file name should follow this format:

111B_hw2_ID.zip

For example,

111B_hw2_0123456789.zip

Please be aware. **We are not going to accept any homework file with wrong file name or without signature**. Please double check the content of your files.

Once you have accomplished your works, you can upload your homework to the "E3@NYCU" system. There will be a section for uploading your homework.