CEGE0096: Flood Emergency Planning
2nd Assignment (50%)

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1 Introduction

Extreme flooding is expected on the Isle of Wight and the authority in charge of planning the emergency response is advising everyone to proceed by foot to the nearest high ground.

To support this process, the emergency response authority wants you to develop a software to quickly advise people of the quickest route that they should take to walk to the highest point of land within a 5km radius.

Figure 1: Isle of Wight

2 Instructions

To complete this assignment, you need to build a Python application. Your task is to create a Python program named 'main.py' that does what explained in the following subsections. To do this, you are allowed to use only the packages presented in the module.

The first 5 tasks will award you a total of 80 marks. The 6th task (10 marks) is designed to test your ability to carry out your own research in order to solve it. Finally, the 7th tasks is a creativity task that can award you 10 additional marks for the development of additional unspecified features.

2.1 Task 1: User Input

The application should ask the user to input their current location as a British National Grid coordinate (easting and northing). Then, it should test whether the user is within a box $(430000, 80000)$ and $(465000, 95000)$. If the input coordinate is outside this box, inform the user and quit the application. This is done because the elevation raster provided to you extends only from $(425000, 75000)$ to $(470000, 100000)$ and the input point must be at least 5km from the edge of this raster.

2.2 Task 2: Highest Point Identification

Identify the highest point within a 5km radius from the user location.

To successfully complete this task you could (1) use the window function in rasterio to limit the size of your elevation array. If you do not use this window you may experience memory issues; or, (2) use a rasterised 5km buffer to clip an elevation array. Other solutions are also accepted. Moreover, if you are not capable to solve this task you can select a random point within 5km of the user.

2.3 Task 3: Nearest Integrated Transport Network

Identify the nearest Integrated Transport Network (ITN) node to the user and the nearest ITN node to the highest point identified in the previous step. To successfully complete this task you could use r-trees.

2.4 Task 4: Shortest Path

Identify the shortest route using Naismith's rule from the ITN node nearest to the user and the ITN node nearest to the highest point.

Naismith's rule states that a reasonably fit person is capable of waking at

5km/hr and that an additional minute is added for every 10 meters of climb (i.e., ascent not descent).

To successfully complete this task you could calculate the weight iterating through each link segment. Moreover, if you are not capable to solve this task you could (1) approximate this algorithm by calculating the weight using only the start and end node elevation; (2) identify the shortest distance from the node nearest the user to the node nearest the highest point using only links in the ITN.

To test the Naismith's rule, you can use (439619, 85800) as a starting point.

2.5 Task 5: Map Plotting

Plot a background map 10km x 10km of the surrounding area. You are free to use either a 1:50k Ordnance Survey raster (with internal color-map). Overlay a transparent elevation raster with a suitable color-map. Add the user's starting point with a suitable marker, the highest point within a 5km buffer with a suitable marker, and the shortest route calculated with a suitable line. Also, you should add to your map, a color-bar showing the elevation range, a north arrow, a scale bar, and a legend.

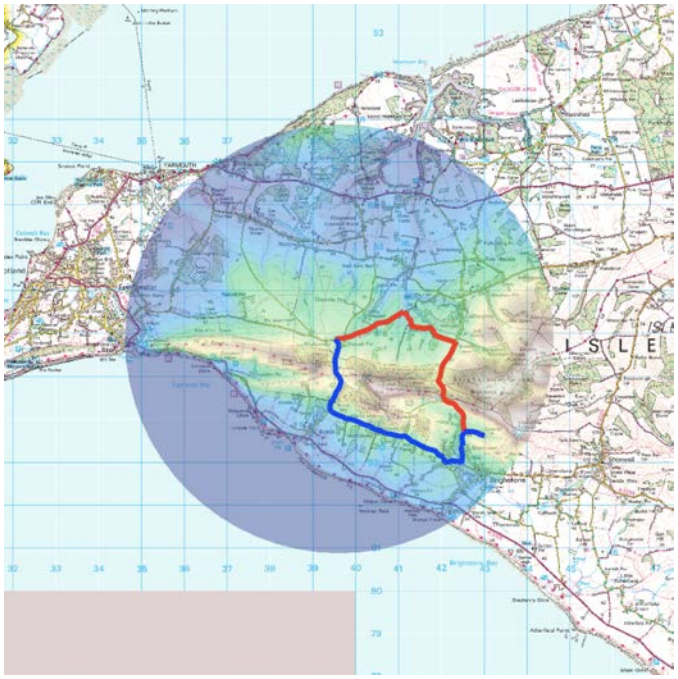

Figure 2: An incomplete solution to task n. 5

2.6 Task 6: Extend the Region

The position of the user is restricted to a region in where the user must be more than 5km from the edge of the elevation raster. Write additional code to overcome this limitation.

3 Material

You will be supplied with data and a report template.

The data consists of:

1. a shape file delimiting the island;
2. two shape files defining the roads;
3. a JSON file defining the ITN graph;
4. a raster file defining the elevation, and;
5. a raster file to be used as a background map.

The report template contains indication of what to write. This should be used to make sure to get full marks on the other tasks by presenting what you have done.

4 Submission

This assignment should be submitted as follows:

1. a zip file containing the project solution to the Assessment tab of the module Moodle page;
2. a pdf file of the project report to the Assessment tab of the module Moodle page;
3. as a GitHub repository by inviting me as a collaborator (aldolipani).

Failing to carefully follow these instructions may result in penalties.

5 Marking Scheme

The mark scheme is distributed in tasks as follows (total of 100):

n.	Task Description	Marks
1	User Input.	16
2	Highest Point Identification.	16
3	Nearest Integrated Transport Network.	16
4	Shortest Path.	16
5	Map Plotting	16
6	Extend the Region.	10
7	Creativity marks are available under certain conditions for adding features that have not been specified.*	10

Each completed task will be evaluated based on: the submitted project, the report, if regular commits on the GitHub repository have been made, if comments to your code are clear so that it can be understood by others, if PEP8 style is applied, if you incorporated some simple error handling functionality, if the work was properly distributed among the members of the group.

*The creativity marks will be considered only if you have scored more than zero on all the other tasks.