MCS 1201 – Advanced Algorithms

Take-home Assignment

Due: - 02nd September, 2018 – 2355 Hrs to PGVLE

Warning: - Plagiarized Assignments (including copying and pasting from the Internet or other places including submitting other students work as your own) will be awarded zero marks. In cases where it is found that submission is a copy of another students work, both students will be awarded zero marks.

Due to the current torrential downpours in the Kingdom of Devil's Rule an emergency flood situation has arisen. The flood has totally cut of the cities of the Kingdom and apart from the cities all the other parts remain submerged in water. However, even after the rains have ceased the water levels have not dropped due to the changes to the landscape made by cronies of witless politicians. Now a there is an immediate need to connect all the cities in the Kingdom to avoid a humanitarian catastrophe.

A company has been appointed to look at building floating roads connecting all cities of the Kingdom. The adjacent cities of the kingdom are connected by a perimeter road (P) and the other cities could be connected by roads that are placed inside the perimeter road of the cities. However, when building roads, according to the world standards the following constraints have to be observed.

- The roads should be straight lines
- Each road inside the perimeter should begin and end in a city connected by the perimeter road.
- The inside perimeter, roads cannot have cross points over each other and should only meet in a city.

The company appointed to do this task has proposed a cross point of roads that are internal to the perimeter so that they meet somewhere in between and not at the cities as per the world standards. However, this is a very costly task and the cross point itself will cost about 100 times more than the all possible roads. However, the minister for roads strongly backs the decision by the company. This issue was reported by the morning paper and the ruler of the Kingdom got to know about this fact via the newspaper. Subsequent to getting to know these facts in the paper the ruler halted the building project and asks you to advise him on how to create the maximum number of roads (including P) with the lowest cost adhering to the above constraints. Assume the cost is proportionate to the length of the roads.

Following input data will be given

- The cities in `(x,y)` coordinates:- The coordinates are supplied as a line separated file with each line containing a coordinate of a city and the first line containing the number of cities.
  E.g.
  ```
  5
  0,0
  7,2
  10,7
  8,20
  4,30
  ```

The expected output should be the road segments (internal and perimeter) and the total minimum length of maximum possible roads (internal and perimeter)

Solve the above problem using

1. **Dynamic Programming (35 marks) –** In the report the optimal substructure property and all other aspects relating to the solution should be explained.
2. **Greedy Algorithms (35 marks) –** In the report the greedy choice property and all other aspects relating to the solution should be explained.

DELIVERABLES

- The source codes of the solution. Implementation language can be a language of choice. However, in cases it requires special compilers those has to be made available.

- With the source code, an executable version of the program is required. As executable version is not the source code loaded to an IDE and pressing F5 or the run option. Executable version is a thing that runs when you click on it. Examples of executables are .exe files, .jar files. No compliance to this step will be penalized.

- A report (30 marks) is required to be submitted along with the source code and the executable. The report shall have maximum of five pages and additional pages will be penalized 10 marks per page. The report should include the aspects required to solve the problem as mentioned above. Furthermore, the following question also needs to be answered with proper reasoning.
  - Can you identify a setup of points where the proposed algorithm fails? Explain the reason for failure.

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