UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Engineering, Built Environment and IT
Department of Computer Science

Imperative Programming
COS 132

Semester Test 2 (ST2)

Scenario

13 June 2020

Instructions

1. Read the scenario carefully.
2. Begin writing the program as described.
3. Queries pertaining to this scenario may be posted to the COS132 discussion board **Semester Test 2 - Discussion board** forum when the semester test opens at 11:30 on 13 June 2020. Make sure you choose the correct question thread when you submit to the discussion board.
4. Remember to charge your cell phone, laptop etc. before tomorrow.
5. This scenario is subject to the University of Pretoria Integrity statement provided below.

Integrity statement:
The University of Pretoria commits itself to produce academic work of integrity. I affirm that I am aware of and have read the Rules and Policies of the University, more specifically the Disciplinary Procedure and the Tests and Examinations Rules, which prohibit any unethical, dishonest or improper conduct during tests, assignments, examinations and/or any other forms of assessment. I am aware that no student or any other person may assist or attempt to assist another student, or obtain help, or attempt to obtain help from another student or any other person during tests, assessments, assignments, examinations and/or any other forms of assessment.

Scenario

You are put in charge of developing a system to manage the delivery service of the company you work for. The previous system, which worked when people were able to physically discuss issues, is no longer workable during the quarantine. Thus, a replacement management system has to be developed in order to keep the delivery service going. Unfortunately for you, the previous system's manual was lost so you will have to do a lot of your own system that will need to be able to meet the needs of delivery.

However, the rest of the development team is available to work from home so each member will be responsible for a single component of the new delivery system. The aspect that you get to do, is the job management aspect of the system. Specifically the part of the system that works out if it is possible to actually send drivers to the delivery addresses based on the restrictions imposed by the city.

This is not to say that you are going to make a fully fledged system. With the current circumstances, the company first has to trial each of the components and thus you need only make a trial version of the component that will eventually be incorporated into a larger system.

1 Data

The delivery company is restricted to operating in a single district and consequently, there is a map that are going to be present that the system has to consider. Each potential map reflects the district in terms of houses, shops and health checkpoints that drivers must use for the purposes of being allowed inside and out. For the purposes of this practical, the map is a fixed size of 10-by-10, referring to rows and columns of characters.

An example of such a map is given below:

```
#O########
#**------#
#**--**--#
#----**--#
O--------#
#***--**-#
#***--**-O
#***--**-#
#--------#
########O#
```

The key for this map, and all other maps that might be considered is as follows:

- O: A health checkpoint that drivers can enter the district from.
- #: This represents the district domain. The district can't be entered from any of these points and they border the district in the way a fence does.
- $*$: This represents a housing unit that a delivery point for the company. The more houses that are clustered together, the higher the value of deliveries made to that area. For example, a single housing unit would be less efficient than delivering multiple packages to houses that are clustered together.
- $-$: This represents a street that the driver can move on in that district.

2 Inputs

In terms of inputs, your system has to consider the map, **d1.txt**, and a list of deliveries called **delivery.txt**. The list of deliveries will contain lists of required deliveries that describe where the delivery driver is going to have to go to, along with the delivery cost and the profit margin that is expected on that delivery.

An example of the delivery file is given below:

```
(3,2);32
```

The first element of this line are the delivery coordinates. The second is the cost to make that delivery to the company.

3 Outputs

The output of the programme is going to be a set of results relating to each delivery. Specifically, the profit margin on each delivery and whether or not the delivery would be viable to do based on the profit margin associated with each delivery.

An example of the output, see below:

```
5.5 - viable
0.4 - not viable
```

The first component of the output is the profit potential for that delivery. The second is an indication of whether that delivery is viable or not viable. These are the only two potential outcomes for each delivery.

4 Calculation of Profit

In order to calculate the viability of a delivery you need to follow the given process for each delivery:

1. Profit potential is made up 2 components
2. The first component,c_1, is the distance from the entry point to the delivery point. Euclidean distance is how this is calculated. The entry point for each delivery will be the closest health check point to the delivery location. Then divide 1 by this distance.

$$c_1 = \frac{1}{min(d(entry, delivery))} \tag{1}$$

3. The second component,c_2, is the number of nearby deliveries. This is the number of deliveries that could be made to a house that is directly adjacent to the delivery house. Adjacent refers to any house that is in immediately next to the target house. This includes the the 8 cardinal directions.

The final profit potential is the first component multiplied by the second. A delivery is viable if the value is at least above 2.5, including 2.5. Every line of output should have a new line at the end.

$$final_{profit} = c1 * c2 \tag{2}$$

5 Euclidean Distance

The euclidean distance formula is provided for you here.

$$d(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2} \tag{3}$$

where p and q are the two points in question, in the format (p_1, p_2) referring to the x,y coordinate system. Remember that the coordinate system is 0 indexed.

6 Example

Consider the map presented below:

```
#O########
#**------#
#**--**--#
#----**--#
O--------#
#***--**-#
#***--**-O
#***--**-#
#--------#
########O#
```

Consider a delivery being made to the position $(1, 1)$ in the top left corner. The closest entry point to that position is the entry point at $(0, 1)$. For the purposes of this example, there are no deliveries in any houses that are adjacent to the target delivery zone.

Therefore c_1 would be 1. The second component would be 0. Therefore the final profit potential is 0. And thus, this delivery would not be viable.