# Map Routing [**Test Cases Description**]

- The input consists of 2 files:

  - ## Map file:

    Which contains the intersections locations and how the intersections are connected to each other.
    Each map file is organized as the following:
    The first line contains an integer **N** which represents the **number of intersections**.
    Each line of the following N lines contains 3 numbers (separated by single space):
    **Intersection_ID X_coordinate Y_coordinate**
    After that there is an integer **M** which represents the **number of roads**.
    Each line of the following M lines contains 4 numbers (separated by single space):
    **First_Intersection_ID Second_Intersection_ID Road_Length Road_Speed**
    Note: the road length is given in **kilometers** and road speed is given in **kilometer/hour**.

  - ## Queries file:

    Which contains the queries to be processed.
    Each query file is organized as the following:

    The first line of this file contains an integer **Q** that represents the number of queries.

    Each line of the following Q lines contains 5 numbers (separated by single space) represents a single query as the following:

    **Source_X Source_Y Destination_X Destination_Y R**
    Note: the maximum walking distance (**R**) is given in **meters**

- The **output file** should contain the result of the q queries that are in the query file.
  - Each query output should contain 5 lines as the following:
    1. **The ids of the intersections** of the **vehicle** path with the shortest time. The ids should be ordered by the visiting order and **separate by space**. **EX: 0 3 4 5 2**
    2. **The shortest time** to move from the source location to the destination location (**in minutes**). **EX: 4.63 mins**
    3. **The total distance** of the path with the shortest time **(in kilometers). EX: 1.72 km**
    4. **The total walking distance (in kilometers). EX: 0.28 km**
    5. **The total vehicle distance (in kilometers). EX: 1.44 km**
  - The shortest time and the distances "Points 2, 3, 4, 5" should be displayed rounded to **EXACTLY 2 DIGITS** after the decimal point.
  - Each query should be followed by an empty line
  - After printing all the queries print the total execution time for all queries "Start **query time after reading the query until calculating the query output** – without Input/output times" (in milliseconds) followed by an empty line. **EX: 1 ms**
  - At the end print the total execution time for the program "Including Input/output times" (in milliseconds). **EX: 5 ms**
- Your code **must** write the output for each query file in a separate file in a flexible way.

***Please refer to the input and output files to see the exact required formatting***

## FIRST: Sample Cases

| Map File Name | Queries File Name | Output File Name | # intersections | # Roads | # queries | Total Execution Time for all queries |
|---|---|---|---|---|---|---|
| **map1.txt** | queries1.txt | output1.txt | 6 | 7 | 1 | < 1 sec |
| **map2.txt** | queries2.txt | output2.txt | 6 | 7 | 10 | < 1 sec |
| **map3.txt** | queries3.txt | output3.txt | 9 | 12 | 10 | < 1 sec |
| **map4.txt** | queries4.txt | output4.txt | 9 | 8 | 10 | < 1 sec |
| **map5.txt** | queries5.txt | output5.txt | 9 | 8 | 10 | < 1 sec |

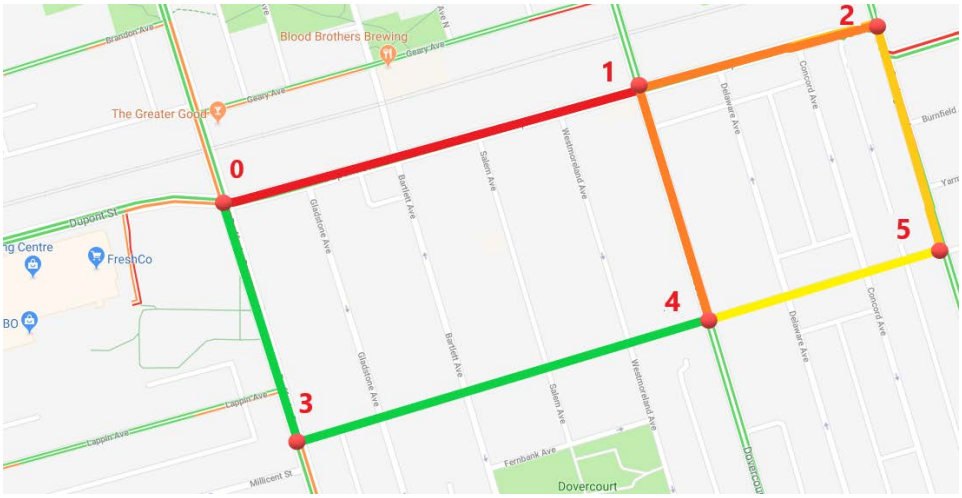



*Figure 1 The road network used in the first 2 sample files*

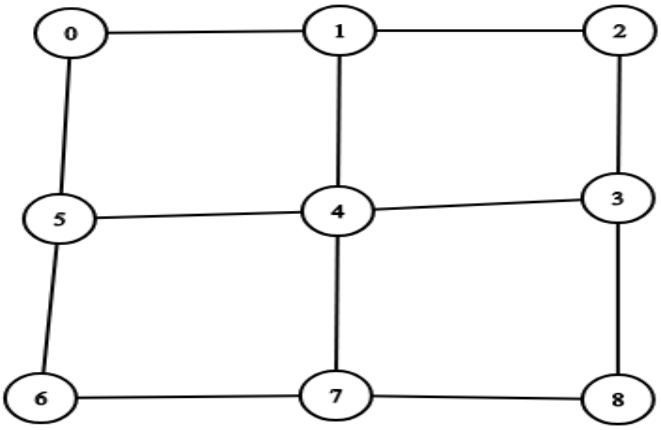



*Figure 2 The road network used in sample 3*

## SECOND: Medium Cases

The data of the medium case is for Oldenburg road network (Oldenburg is a German city)

| Map File Name | Queries File Name | Output File Name | # intersections | # Roads | # queries | Total Execution Time for all queries |
|---|---|---|---|---|---|---|
| **OLMap.txt** | OLQueries.txt | OLOutput.txt | 6105 | 7029 | 1000 | < 5 sec |

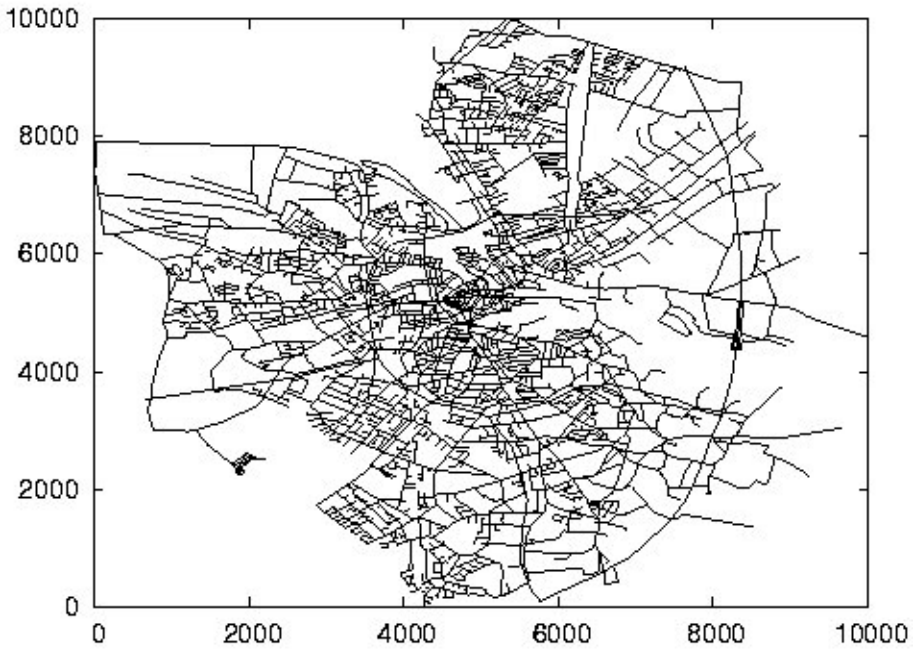



*Figure 3 the city of Oldenburg road network*

## THIRD: Large Cases

The data of the large case is for San Francisco Road Network

| Map File Name | Queries File Name | Output File Name | # intersections | # Roads | # queries | Total Execution Time for all queries |
|---|---|---|---|---|---|---|
| **SFMap.txt** | SFQueries.txt | SFOutput.txt | 174956 | 221802 | 1000 | < 3 min |

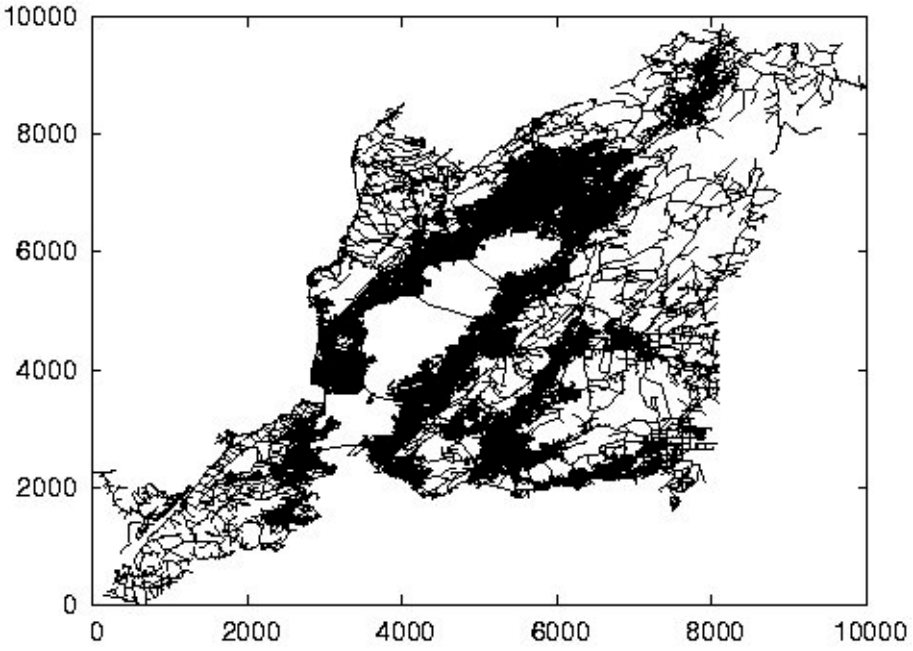


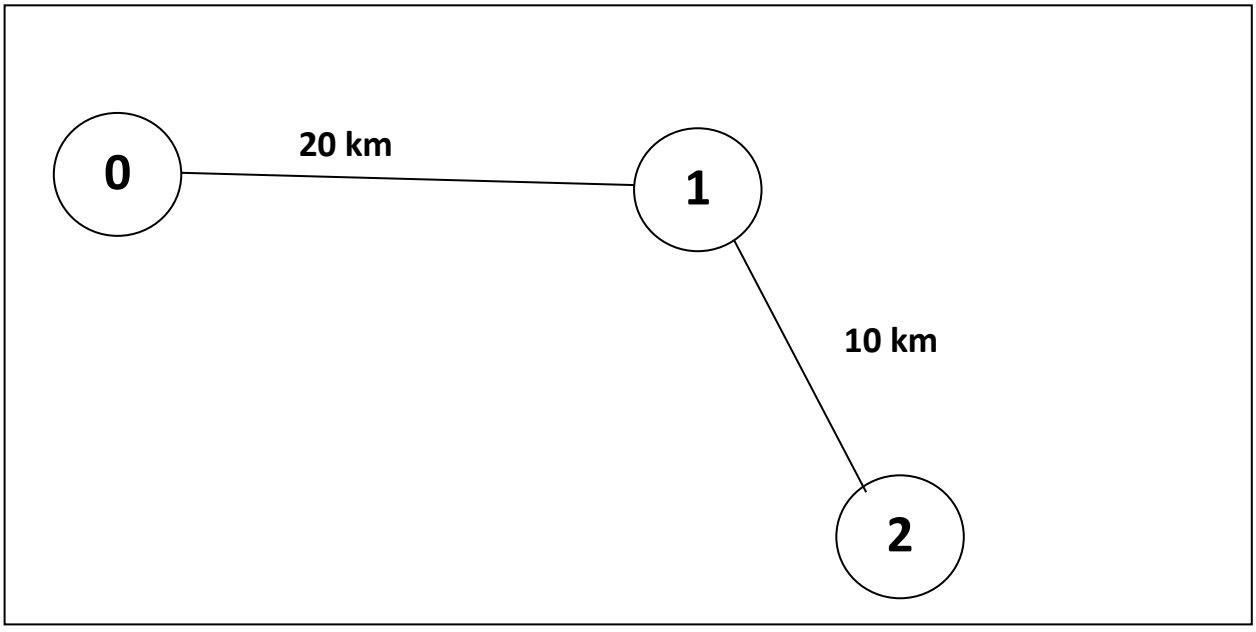

*Figure 4 San Francisco road network*

## Maps with changing speed (BONUS)

In this scenario, the road speed is not constant anymore. The speed changes depending on the time interval. You should consider the speed changing when finding the path with the shortest time.

For the following example:

- The speed interval is **10** minutes, each road has 2 speeds (speed count = 2).
- The **road length** from intersection **0** to intersection **1** is **20 km**. This road (from 0 to 1) has speeds **[80 km/h, 60 km/h]**.
- The road length from intersection **1** to intersection **2** is **10 km**. This road (from 1 to 2) has speeds **[30 km/h, 50 km/h].**
- The vehicle speed doesn't change in the middle of the road (even if the time interval changes).
- At the start of time (time = 0), the vehicle moves from intersection 0 to intersection 1. It will move with speed 80 km/h for the whole road (even if it exceeds the speed interval, speed doesn't change in the middle of the road).
- When the vehicle reaches intersection 1 (at time = 15 minutes), It would move form intersection 1 to intersection 2 with the speed of the second interval for that road (50 km/h).
- The time to move from intersection 0 to intersection 2 = 15 + 12 = 27 minutes.



## Input & Output Description

- The map file for this scenario will consist of the following:

  The first line contains an integer **N** which represents the **number of intersections**.

  Each line of the following N lines contains 3 numbers (separated by single space):

  **Intersection_ID  X_coordinate  Y_coordinate**

  After that there is three integers (separated by single space):

  **M  Speed_Count  Speed_Interval**

  Where **M** represents the **number of roads**. **Speed_Count** represents the number of speeds of each road, and **Speed_Interval** represents the interval of speed changing **(in minutes)**.

  Each line of the following M lines contains (**3 + Speed_Count)** numbers (separated by single space):

  **First_Intersection_ID  Second_Intersection_ID  Road_Length  $Road\_Speed_1$  $Road\_Speed_2$ , ….., $Road\_Speed_{Speed\_Count}$ .**

  This means that this road speed is $Road\_Speed_1$ in the interval **[0, Speed_Interval)**, The it will have the speed of $Road\_Speed_2$ in the interval **[Speed_Interval, 2 * Speed_Interval)** and so on..

  Note : the road length is given in **kilometers** and road speeds are given in **kilometer/hour**.

- The query file is in the same format as the normal case (constant speed).
- The output file should be in the same format as the normal case.

## Note:

- The speeds repeat if the time exceeds the speed count. For example:
  - The road from intersection 0 to intersection 1 in the previous figure will have the speeds 80 km/h in the interval [0, 10), then the speed becomes 60 km/h in the interval [10, 20), then it becomes 80 km/h in the interval [20, 30), and so on…