Applied Algorithms project M2 (2023-2024)

General introduction

The European Parliament recently adopted a new rule on the placement of charging stations for electric cars on motorways. By 2026, all motorways will have to be equipped with at least one charging station every 60km.

To meet this requirement, it will be necessary to be able to give the location of the charging stations to be installed so that for every shortest freeway journey of at least 60km, there will be at least one charging station accessible. The aim is to minimize the number of stations installed.

The project will be carried out in several stages:

1. modeling the problem ;
2. implementation of algorithms (brute force, etc…);
3. possible extensions.

About the organization:

- groups of 3 or 4 students;
- the final version must be submitted before the Christmas vacations, and oral presentations will take place in January;
- several intermediate submission.

Problem

The problem is to place a minimum number of stations on the motorways. These stations will have to be placed in such a way as to satisfy certain constraints. Any path longer than 60km must be covered by a station. Charging stations can only be placed where the infrastructure allows, at rest areas and existing stations.

The input will therefore be the motorway network, the rest areas and the maximum number of km. The output will be a list of rest areas.

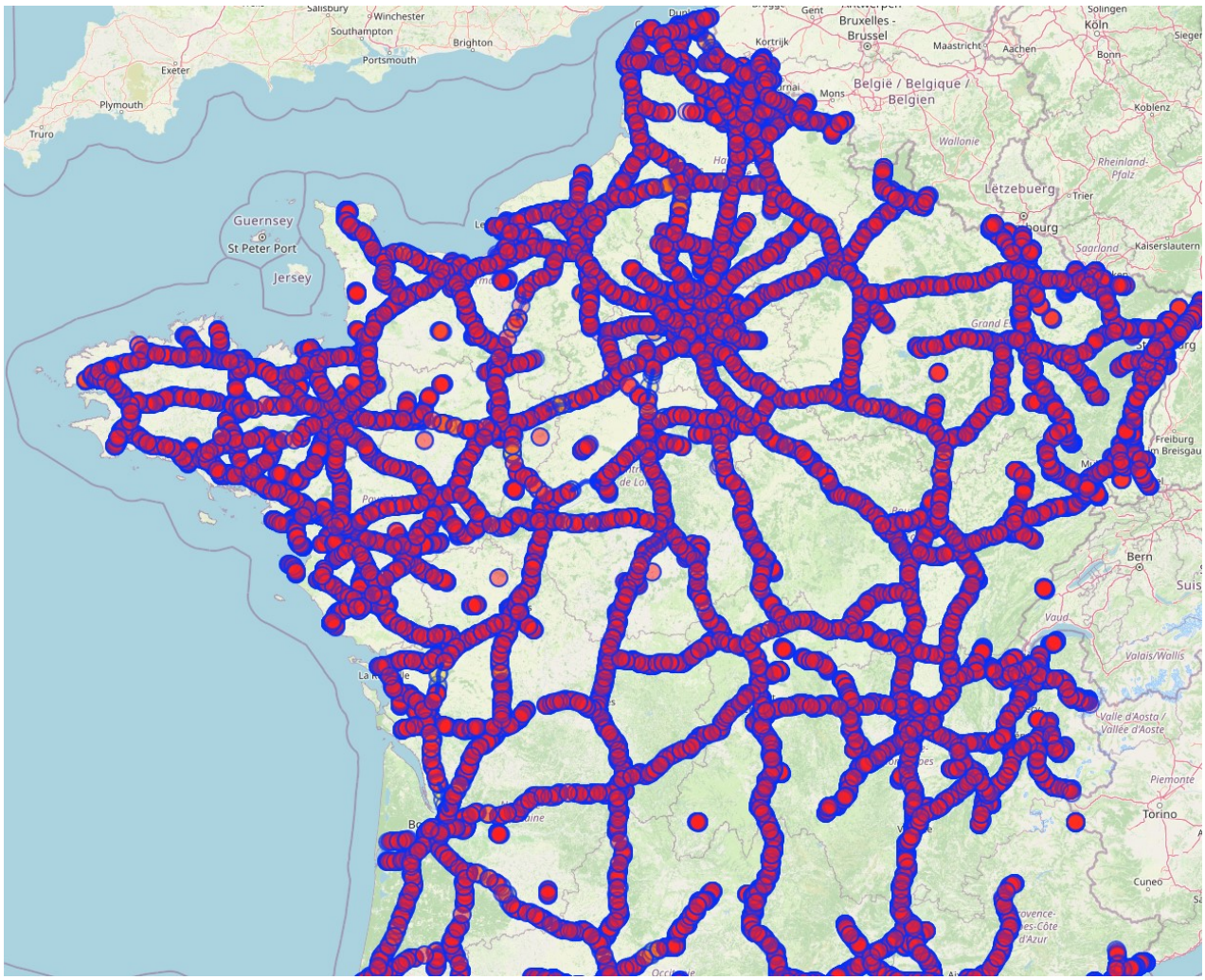
You will have to provide a visualization of the results including equipped freeways and stations.

Data

To solve this problem, we suggest you use openstreetmap data. You can retrieve them in json format by writing queries to overpass-turbo.eu.

The following query retrieves freeways in France:

```
[out:json];
area[name = "France"];
(way(area)["highway"~"^(motorway|trunk)$"];>;);
out;
```



The `highway=services` and `highway=rest_area` correspond to existing service stations and rest areas. Refer to the openstreetmap wiki to retrieve other necessary information.

You will create instances of different sizes to be able to test even the slowest algorithms.

From this data, you will automatically build the problem instances.