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Protecting Our World, Conquering New Frontiers

Spatial clustering for generation of routes ajusted to vehicle fleet in spatial database

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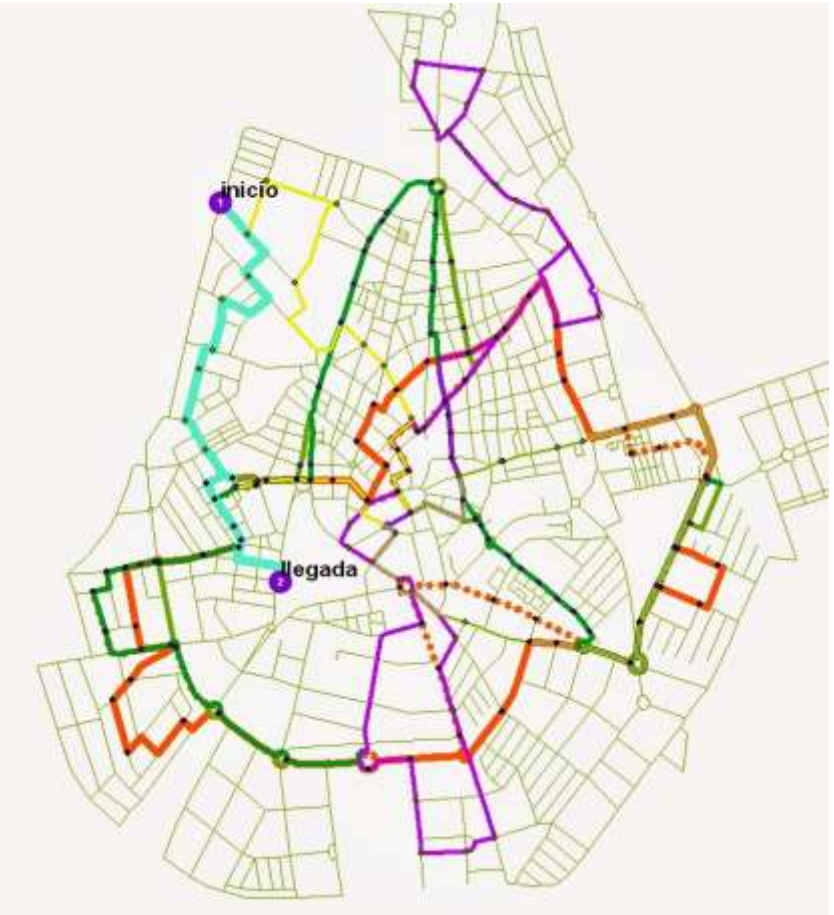
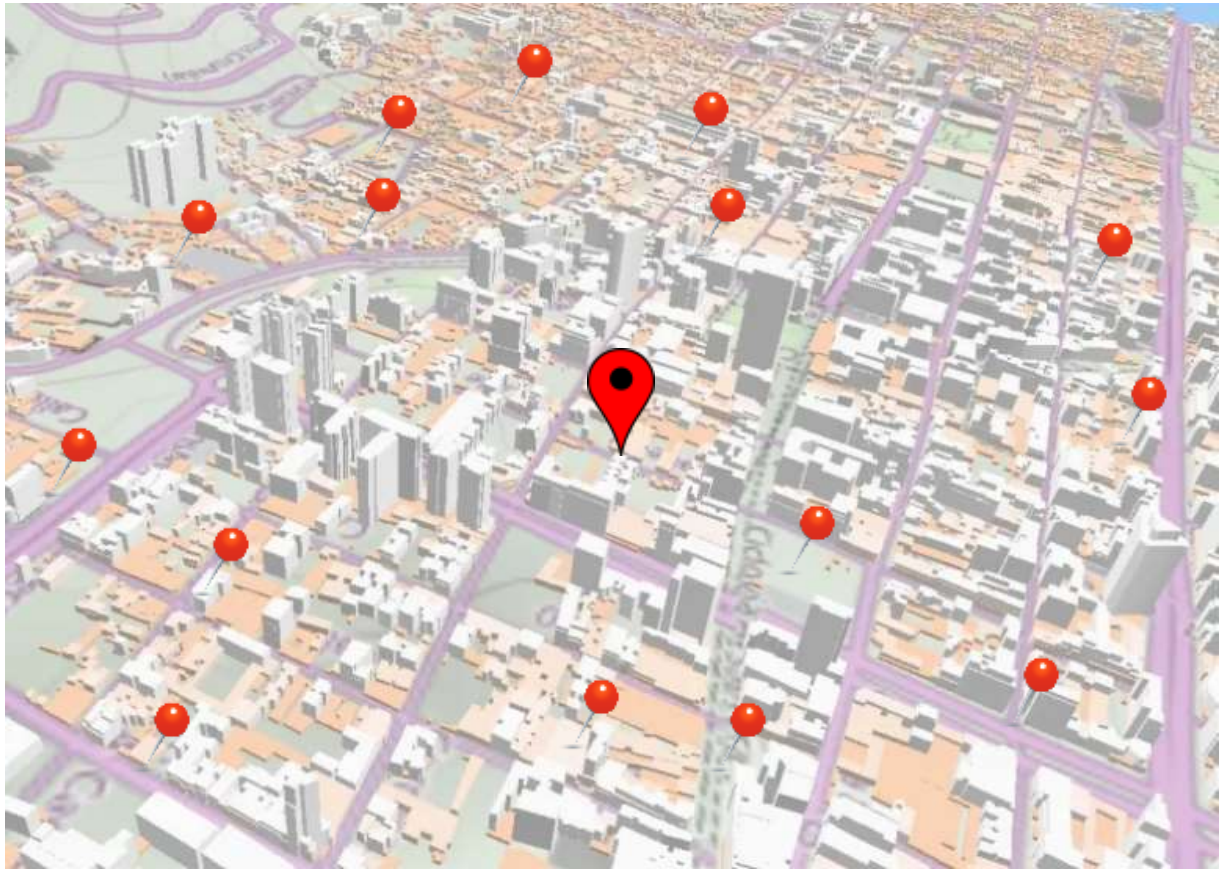
Summary

A clustering algorithm was designed that adjusts to the fleet of vehicles available in a company to carry out the routes that must be carried out efficiently on the roads of a city.



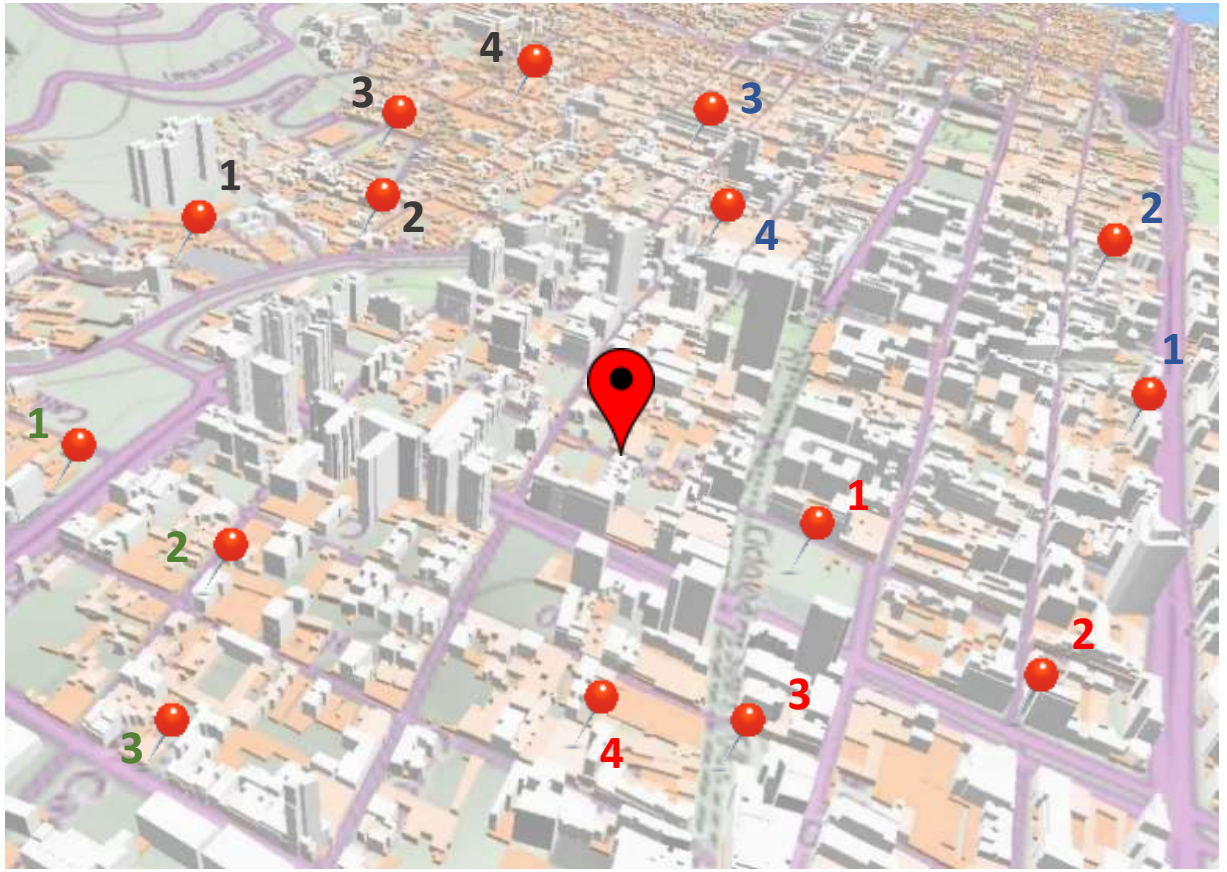
Context of the problem

Some businesses need to efficiently solve transportation logistics problems



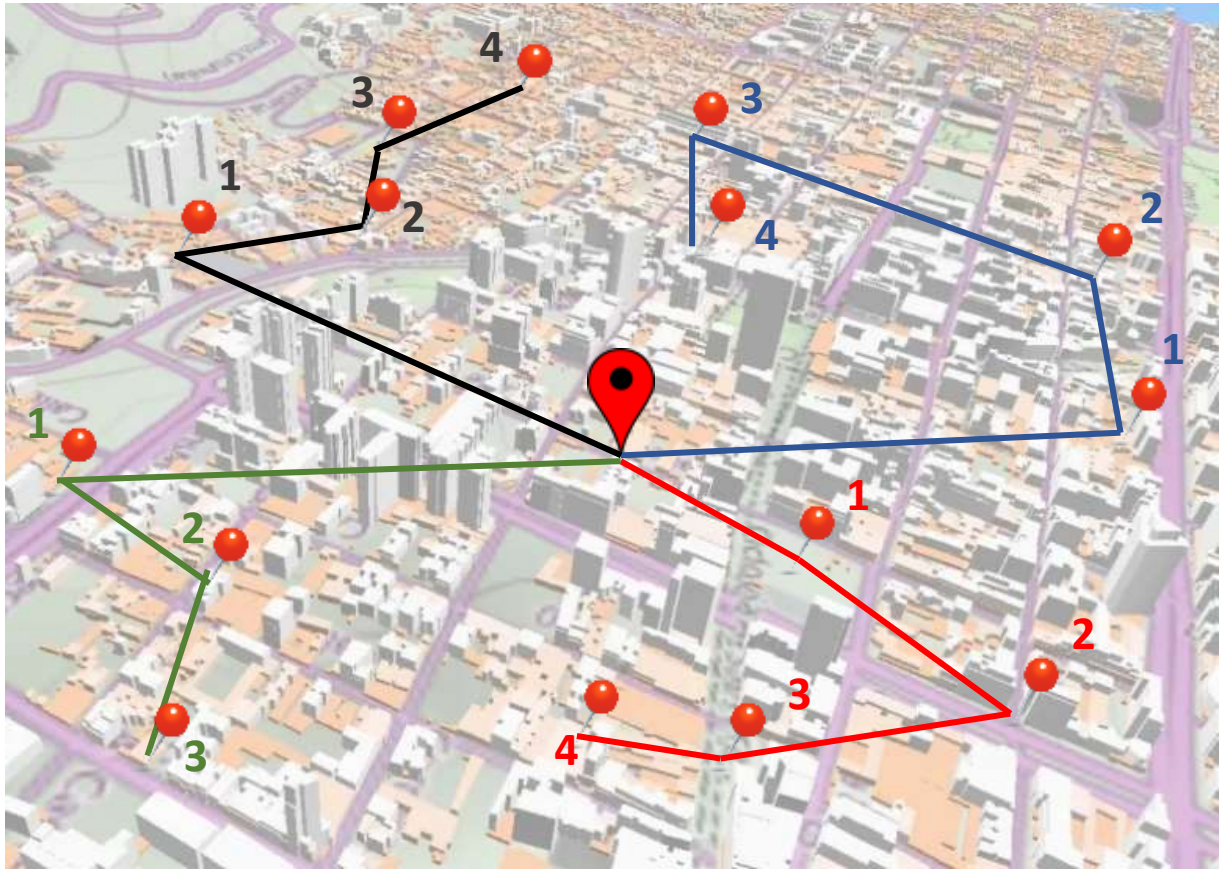
Context of the problem

According to their transport fleet, they select the groups and the order of each route by vehicle



Context of the problem

Subsequently, select the optimal path in the route assigned to each vehicle



Context of the problem

When it is necessary to group adjusted to the fleet of heterogeneous vehicles, in size and capacity, it is not possible to adjust the algorithms to that fleet of vehicles to optimize their use.

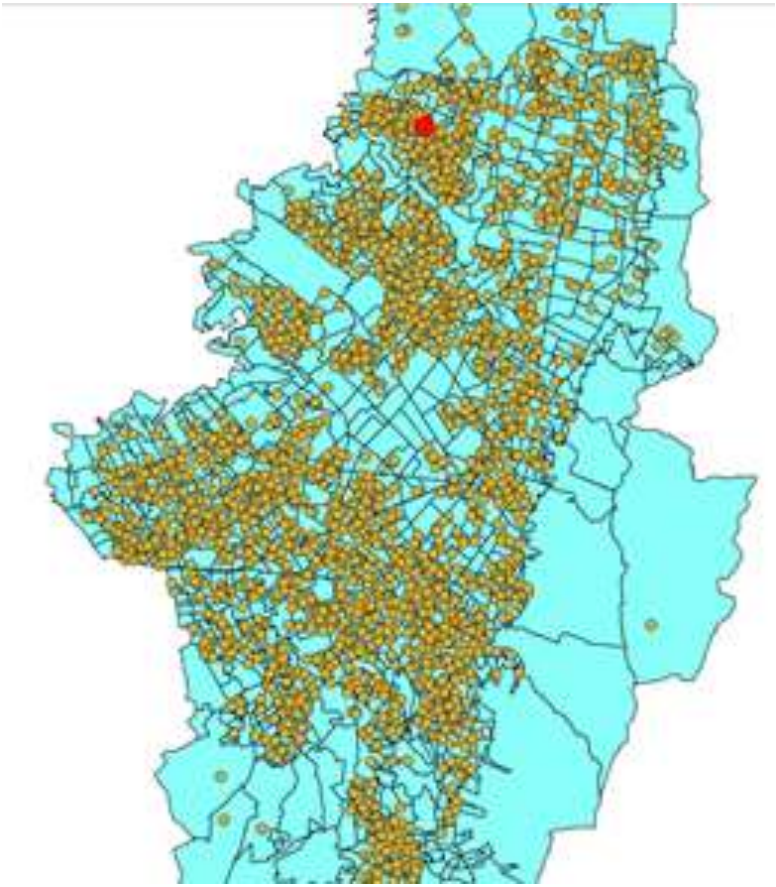
Context of the problem

For many cases of route generation, the existing algorithms are insufficient, or simply do not fit the specific case of the problem.

Through spatial data science, an algorithm is proposed that adjusts to a fleet of heterogeneous vehicles to perform their routes efficiently in their load capacities, automatically in spatial databases.

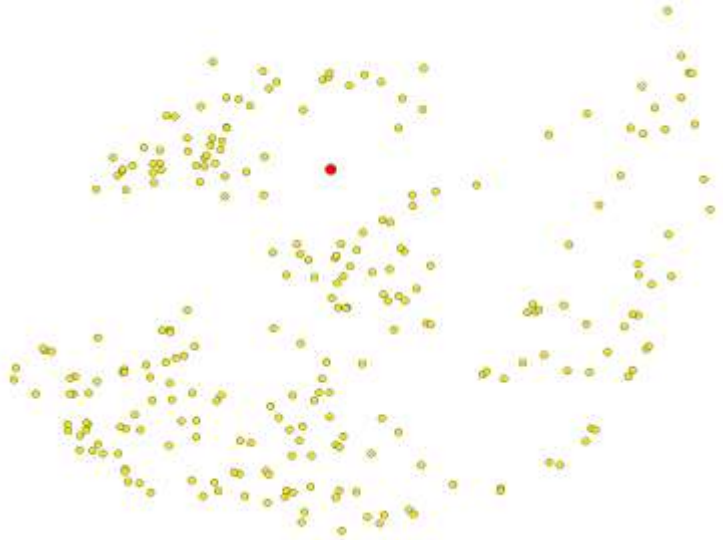
Case stydy

As a case study to carry out a practical approach, information is taken from a school that must cover the routes of its students from the house of each one of them to the school headquarters, and of course back to the respective houses of the students.



Methodology

Initially, it is required to carry out a process of georeferencing the address of each one of the students, this process is called Geocoding



Clustering algorithm

the clustering algorithm proposed (group_route), select the members of the group that facilitate the traversal of a route. This algorithm starts from the point furthest away from a central point or collection center, and begins to select its members from the point closest to each new member of the cluster, in such a way that it simultaneously defines the order of the route to follow. The tour ends when the maximum size of the cluster is reached, thus it also optimizes the transport resources, and also allows adjusting different capacities of the buses to particular groups.

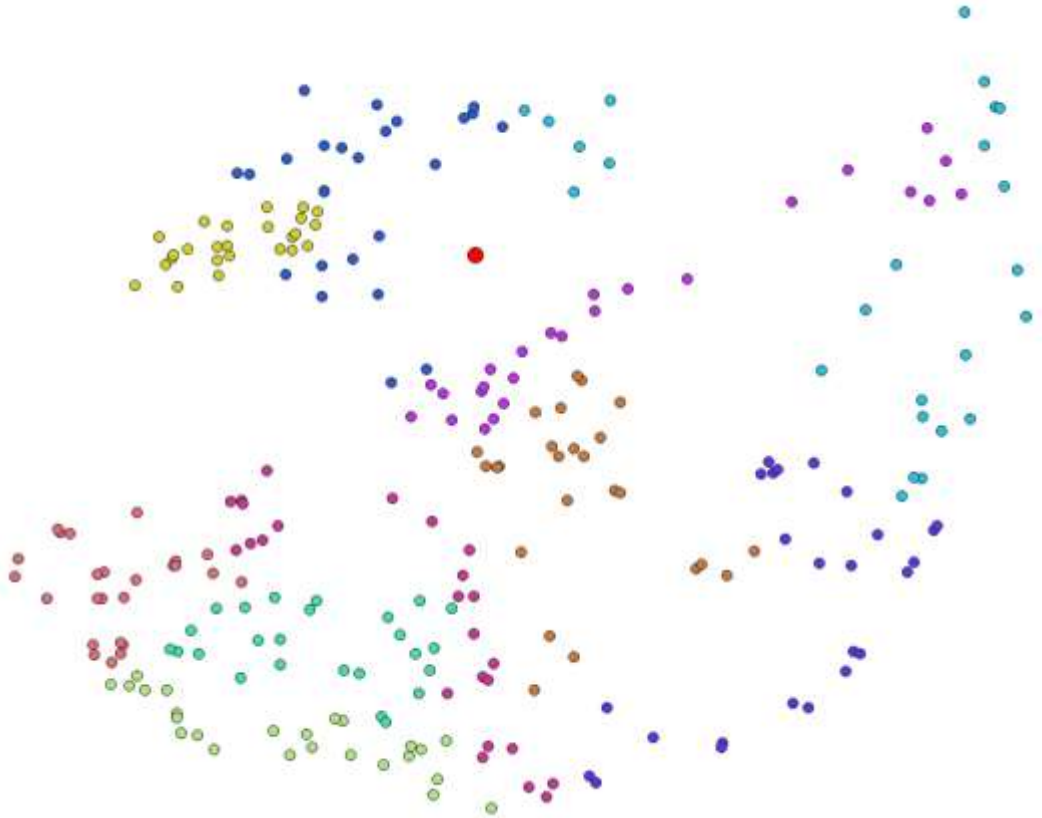
Clustering Algorithm (group_route)

```
Begin Group_Route (GP, PC, T, N, D)
    J=1, G=1
        While there are ungrouped points AND G <= N
      i=1, d=0
      P = GP point not marked and farthest from PC
      Mark_point (P, G, i)            # mark point P in group G and order i
      i = i + 1
      While i <= T AND d <= D
          Q = Point not marked and closest to P
          d = distance (P, Q)
          If d <= D
              Mark_point (Q, G, i)
              i = i + 1
          End If
          P = Q
      End While
      G = G + 1
    End While
End Group_Route
```

Clustering algorithm

And we obtain 10 groups of 25 students to generate the routes.

In the database, the plate table will have the fields "group" and "num" to indicate the group and the order of travel to generate the route to the school.

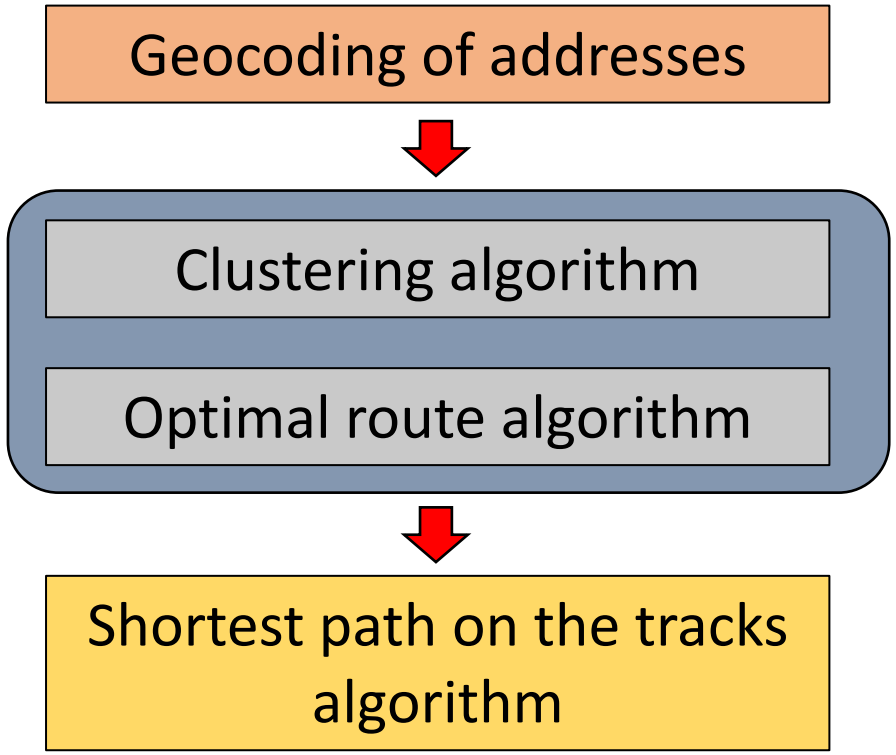


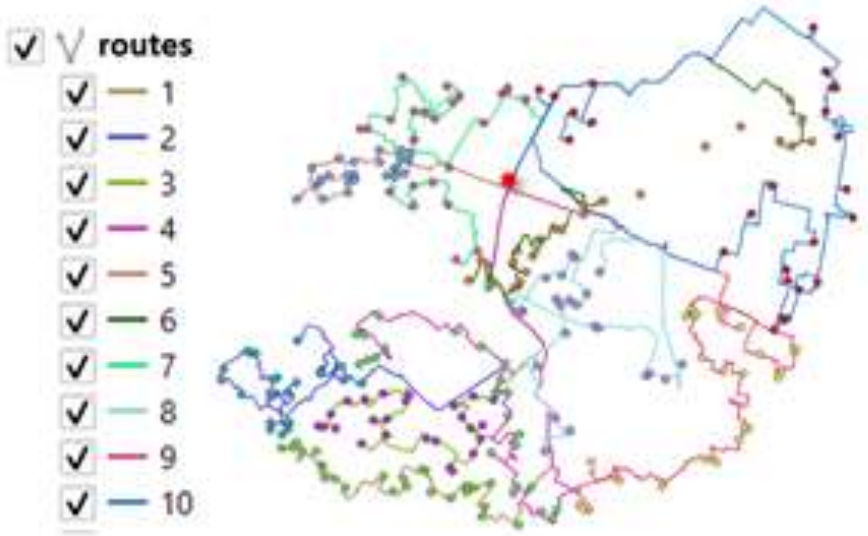
Route algorithm

Once the origin of each of the routes and the subsequent stops for each of the students have been identified, all that remains is to trace the respective routes through the city roads. The algorithm of shortest paths, or Dijkstra's algorithm is very appropriate for its implementation

Summary

Each section of the route generated is spatially joined to form the route for the group, which is represented with a different color





Conclusions

The proposed algorithm (route_group) is adaptable to the number of occupants for each vehicle that makes the route, of course, it can be adapted to any type of capacity, and to different vehicles with different capacities.

The implementation of the algorithm on a spatial database, allows to have the abstraction of the routes in a graphic way, and the exact calculation of their lengths, in addition to a textual description of the order of the route through the streets of the city.

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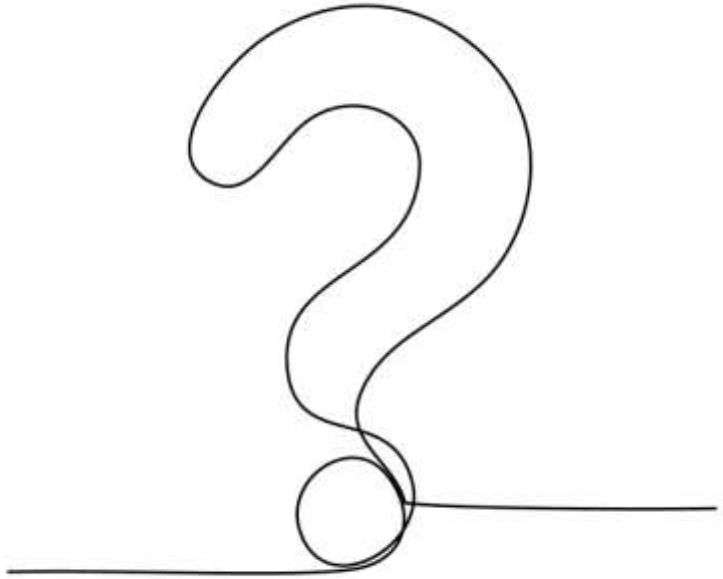
Conclusions

The combination of methods and algorithms used has made it possible to adapt the spatial database to the required functionality, allowing solutions to specific problems through different spatial data science techniques. This adaptability makes the database a fundamental base of an architecture for solving problems that require spatial analysis and computational programming tools.

Questions



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