Optimal route: An algorithm that simplifies the distribution of merchandise

Carla Daniela Rendón
Universidad Eafit
Colombia
cdrendonb@eafit.edu.co

Juan Diego Gutierrez
Universidad Eafit
Colombia
E-mail at Eafit

Mauricio Toro
Universidad Eafit
Colombia
mtorobe@eafit.edu.co

AUTHOR KEYWORDS

Algorithm: a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.

Backtracking: is a general algorithm for finding all solutions to some computational problems, notably constraint satisfaction problems, that incrementally builds candidates to the solutions, and abandons a candidate as soon as it determines that the candidate cannot possibly be completed to a valid solution.

Data structure: is a data organization, management and storage format that enables efficient access and modification. More precisely, a data structure is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data.

Graph(data structure): A set of items connected by edges. Each item is called a vertex or node. Formally, a graph is a set of vertices and a binary relation between vertices, adjacency. A graph G can be defined as a pair (V,E), where V is a set of vertices, and E is a set of edges between the vertices $E \subseteq \{(u,v) \mid u, v \in V\}$. If the graph is undirected, the adjacency relation defined by the edges is symmetric, or $E \subseteq \{\{u,v\} \mid u, v \in V\}$ (sets of vertices rather than ordered pairs).

ACM KEY WORDS

Theory of computation → Design and analysis of algorithms → Graph algorithms analysis → Shortest paths.

ABSTRACT

We are in the era of technology and information, and many of the problems that arise in real life are trying to solve by using computer artifacts and algorithms, for purposes of this project we will make an algorithm that finds the most optimal route to distribute a specific merchandise in certain points of a bidimentional map

1. INTRODUCTION

In real life, especially in the industry of distribution of merchandise, it is very important to find the most optimal route, since this represents a lower cost, time saving and above all customer satisfaction. For the realization of this project, we will create an algorithm that allows us to find the most optimal route between two points.

2. PROBLEM

The problem to be solved consists in making an algorithm to find the most optimal route, considering a limited set of electric vehicles, a list of clients located in a bidimensional map and a specific quantity of merchandise to be distributed.

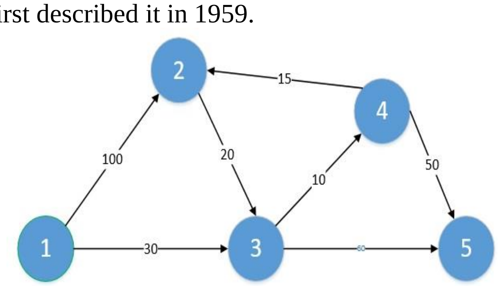
3. RELATED WORK

In this section we present 4 works related to the problem initially proposed.

3.1 The problem of the shortest path

In the theory of graphs, the problem of the shortest path is the problem of finding a path between two vertices (or nodes) in such a way that the sum of the weights of the edges that constitute it is minimal. An example of this is finding the fastest way to go from one city to another on a map. In this case, the vertices would represent the cities and the edges the roads that join them, whose weighting is given by the time used to cross them.

For the solution of this problem we propose the use of the Dijkstra algorithm, also called the minimum path algorithm, it is an algorithm for the determination of the shortest path, given a vertex origin, towards the rest of the vertices in a graph that has weights in each edge. Its name refers to Edsger Dijkstra, a computer scientist from the Netherlands who first described it in 1959.



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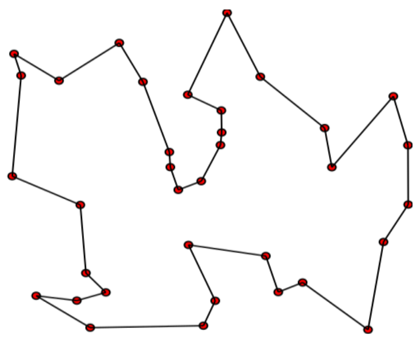
3.2 Traveling Salesman Problem

Traveling Salesman Problem (TSP) answers the following question: Given a list of cities and the distances between each pair of cities, what is the shortest possible route each city visits exactly once and at the end return to the origin city? This is a NP-Hard problem in combinatorial optimization, very important in operations research and in computer science.

The TSP has various applications even in its simplest formulation, such as: planning, logistics and in the manufacture of electronic circuits. A little modified, it appears as: a sub-problem in many areas, such as in the DNA sequence. In this application, the concept of "city" represents, for example: customers, welding points or DNA fragments and the concept of "distance" represents the travel time or cost, or a measure of similarity between the DNA fragments. In many applications, additional restrictions such as the resource limit or the time windows make the problem considerably difficult. The TSP is a special case of traveling problems (traveling purchaser problem).



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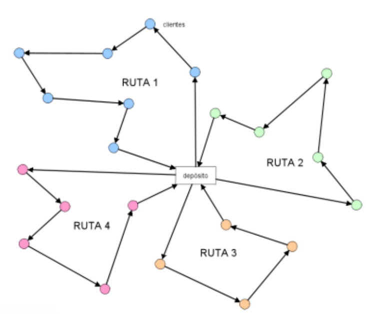
3.3 Vehicle Routing Problems

Vehicle Routing Problems (VRP) are a broad set of variants and customizations of problems. From those that are simpler to some that are still a research subject today.

In them in general, it is about finding out the routes of a transport fleet to service some customers. This type of problems belongs to combinatorial optimization problems. In the scientific literature, Dantzig and Ramser were the first authors in 1959, when they studied the real application in the distribution of gasoline for fuel stations.



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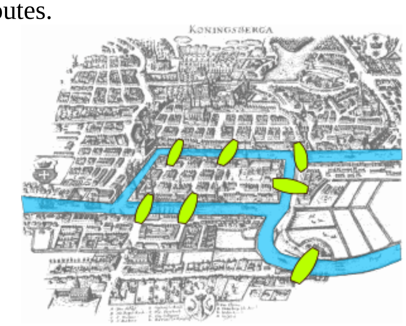
3.4 The problem of the Königsberg bridges

The problem of the Königsberg bridges, also called more specifically the problem of the seven bridges of Königsberg, is a famous mathematical problem, solved by Leonhard Euler in 1736 and whose resolution gave rise to the theory of graphs.1 His name is due to Königsberg, the city of East Prussia and then Germany that since 1945 would become the Russian city of Kaliningrad.

The problem, originally formulated informally, was to answer the following question:

“Given the map of Königsberg, with the Pregel River dividing the plane into four different regions, which are linked through the seven bridges, is it possible to take a walk starting from any of these regions, going through all the bridges, traveling only one each time, and returning to the same starting point?”

The answer is negative, that is, there is no route with these characteristics. The problem can be solved by applying a brute force method, which implies testing all possible existing routes.



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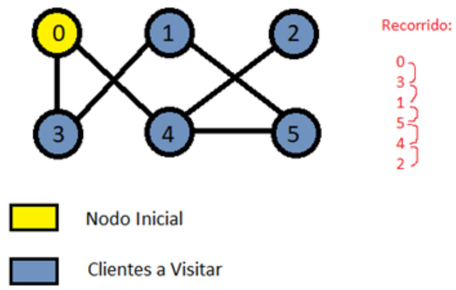
DESIGN OF THE DATA STRUCTURE:

Electric vehicles are one of the innovative technologies that helps reduce greenhouse gas emissions. The use of electric vehicles for Passenger transport has two limitations: The transport distance is limited and the battery charging time is relatively high. For this reason, it is necessary to consider recharging stations. The problem to solve is to design an algorithm to find the optimal routes for a set of electric vehicles distribute merchandise to a group of customers, taking into account the recharging stations. For the solution of this problem we propose the use of backtraking which is an algorithm for finding all solutions to some computational problems.
When we implement a backtracking to solve a problem where a series of nodes are presented, which in this case would represent the clients, the recharge stations and the starting point, we would be doing a DFS, where we start with a U node, and each node will be expands recursively in

a concrete way, when it is no longer possible to visit more nodes along this path, we return, this process is repeated with each of the neighboring nodes of the already visited node.



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