**Título / Autores e Afiliações**

**Calculation of shortest paths with time windows and capacities for pharmacy delivery**

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**Abstract/Disclaimer**

This project was done for the Logic Programming subject, in the 3º Year of the Masters in Informatic Engeneering at FEUP.

The theme of our project resides on the need to program the schedule of a distribution company. The company operates from 10 AM to 10 PM, and needs to make a delivery to every pharmacy, based on their needs. Each pharmacy needs a different product quantity and also has a specific schedule in which it is available to receive the deliveries. For these deliveries, the company has delivery trucks (a finite amount), and each truck has a specific capacity. Each truck leaves the company central to deliver the products to a set of pharmacies, and then comes back to the central. Furthermore, the locations of the pharmacies and the central are known, as well as the distance/time between each pair of locations.

The objective of this project was to develop a Prolog application, using the clpfd library and its capacity to apply restrictions, that was capable of generating the schedule of the distribution company, while minimizing both the number of trucks used and the overall distance traveled by the trucks.

**Disclaimer:** Our problem corresponds to an instance of the Vehicle Routing Problem with Time Windows (VRP-TW). Unfortunately, due to lack of time and the sheer difficulty of this project/theme, we were not able to fully implement a solution for the problem. Instead, our solution is a modification of the Traveling Salesman Problem with Time Windows (TSP-TW). It associates each delivery with a vehicle, taking into account vehicle capacities and delivery quantities. However, instead of generating a route for each vehicle, only one route is generated, containing all pharmacies and respecting their time windows, while minimizing the total time spent on travels. Throughout the main portion of this article, we will describe our implementation. However, in the end of the article we will present a theoretical model for the VRP-TW problem, using restrictions, that would solve this problem completely (unfortunately we could not implement this model).

Despite everything, given the difficulty of this problem (specially compared to the other themes proposed in the subject), we hope our grade can still be good, because as we stated, our solution takes almost everything into account.

**Keywords:** PLR; Sicstus; Prolog; Shortest path; Traveling Salesman; Time Windows; Vehicle Routing Problem.

**1. Introduction**

As we have already described, the problem presented

**2. Problem Description**

**3. Approach**

**3.1. Decision Variables**

**3.2. Constraints**

**3.3. Evaluation Function**

**3.4. Search Strategy**

**4. Solution Presentation**

**5. Results**

**6. Conclusions and Future Work**

(falar do modelo VRP-TW)

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**Annex**