A routing system for Meals-on-Wheels

Routing problems must be solved daily by countless companies delivering goods or services (be it express mail, heating oil, food or air transportation) to spatially dispersed customers.

In this project, we consider the situation faced by Meals-on-Wheels, a small organization which delivers hot meals to senior citizens located in a North American city (this case is inspired from a study by Bartholdi, Platzman, Collins, and Warden (1983)). Ten drivers are in charge of deliveries. We assume that, for all practical purposes, drivers complete their routes within the limit so that time constraints are not active. However, all 10 delivery vehicles have capacities which is 100 and they must deliver hot meals to 79 locations where senior citizens are located. This means that every location has a specific demand to be delivered. All drivers start at the same time from a single depot. If we describe the customers' addresses by (x,y)-coordinates, then the distance between any pair of subscribers can be approximated by the Euclidean distance: dist((a,b),(c,d)) = $\sqrt{(a-c)^2+(b-d)^2}$.

The daily challenge of Meals-on-Wheels is to minimize the total distance travelled by 10 vehicles. Furthermore, they should deliver all the required demand, not exceed the capacities of the vehicles, and they should use all 10 vehicles since they employ 10 part-time drivers. Can you help them with their problem?

You are asked to develop a simulated annealing algorithm or a genetic algorithm which allows to handle Meals-on-Wheels' delivery problem. All algorithmic details are left to your creativity! First, you will try your code on two small instances with 31 customers + 5 vehicles and 32 customers + 6 vehicles. You can use these two instances for coding and debugging purposes. You will also be able to evaluate the quality algorithm you implement. Three numerical tables containing the (x, y) coordinates of the depot and of customers will be provided separately. You should compare the quality of the solution that you obtain to a lower bound on its optimal value.

The quality of your work will be evaluated on the basis of:

_ the quality of the delivery plan computed for the largest numerical instance (for the two small numerical instances you can submit the best objective function values you find);

_ the correctness, elegance, sophistication and efficiency of the algorithmic approach;

_ the quality of the written report.

Reference: Bartholdi, Platzman, Collins, and Warden (1983).