Project 2 – Heuristic Optimization using GA (Weeks 6-7)

1 – Objective

The Oeiras Municipality is implementing a new intelligent system for recollection of recyclable materials. 100 intelligent EcoPoints, where the citizens deposit recyclable materials, have been distributed along the Municipality. Each EcoPoint has sensors to detect and predict when they will get full, and each day, at 00:29, they communicate wirelessly to the Central indicating if they must be emptied.

Each day at 00:30, a program must be run to assign a route to the garbage truck that will collect the recyclables in the EcoPoints that are full. It is estimated that, on average, the truck will have to pass by 30 EcoPoints. It will rarely have to pass by more than 50 locations, although, the whole system must be prepared to cope with the day where all 100 EcoPoints get simultaneously full. The Municipality only has 20 minutes to decide the best route the truck should follow (otherwise the workers might not be able to finish the route during their work hours and extra hours will have to be paid).

It is assumed that the shorter the route, the less time the truck will take. However, some roads get congested very early, which penalizes visiting the following EcoPoints later in the evening: 3, 43, 52, 53, 58, 69, 71-78, 92. In order to take this into account, it was decided that whenever such EcoPoints are visited after passing by more than 30 other EcoPoints, the distance to reach them should be penalized by 40%.

You will develop an intelligent system that, given a list of up to 100 EcoPoints, returns the shortest route that starts from the Central (C), runs through all the Ecopoints locations in the list (E_i) and returns to the Central, taking into account the above-mentioned distance penalizations.

2 – Data

You will use the file "Project3_DistancesMatrix.xls", that contains distances between each of the 100 EcoPoints.

3 – Implementation, Evaluation and Validation

You will have to solve this problem using Genetic Algorithms (GA). Use the knowledge you have learnt about GA to make the appropriate choices regarding the implementation details.

The system will receive a list of the EcoPoints to visit each day (variable size, up to 100). The list should be a .csv file (the Central "C" shouldn't be in the list, only the EcoPoint numbers). The system will return a route (list of EcoPoints) that starts and ends at C, contains the distance to reach each EcoPoint, and also the total route length. Example: "C, 2.2E03, 6.8E24, 6.7C, Total=15.7" indicates a route that starts by driving 2.2Km to EcoPoint 03, then 6.8Km to EcoPoint 24, then 6.7Km to return to the Central, with a total length of 15.7Km.

3.1 – Show results for differently sized inputs (including run time) containing 10, 15, 20, 30, 50 and 60 EcoPoints.

3.2 – What is the length of the shortest route that runs through all 100 EcoPoints?

4 – Submission Details and Deadline

This project accounts for 30% of the Lab final grade. It must be completed and submitted via Fenix until **Monday, June 3rd, at 23:59**.

You will have to write a report where you indicate all the options you made regarding the implementation of the GA, and answer questions 3.1, 3.2. Include all the developed code in your report.

(Optional: include the files corresponding to lab 11 for obtaining bonus points)