Assignment 2: *Delivery route optimization using genetic algorithms*

11753 - Computational Intelligence. Master in Intelligent Systems. Academic Year 25/26

A logistics company must make daily deliveries to a set of customers distributed across the city. It operates with several vehicles, each with limited capacity.

The goal of this assignment is to model and implement a genetic algorithm to optimize the delivery routes for the fleet of vehicles that start and end at a central warehouse, serving customers with individual demand requirements.

- Create several input scenarios with varying degrees of difficulty.
- Define the problem, including assumptions, and constraints.
- Describe your representation and operators, explaining how a candidate solution will be represented.
- State which are the soft and hard constraints of your algorithm and justify them.
- Define the fitness function, ensuring that infeasible solutions are appropriately penalized.
- Experiment with different parameters (population size, crossover and selection methods, mutation rates, number of generations, etc.) and analyze the results obtained.

Dataset

The company is located at position [20, 120] and has a single vehicle with a maximum capacity of 60 kg. Initially, there are five customers, each located at [35, 115], [50, 140], [70, 100], [40, 80], and [25, 60], who have placed the following orders:

- Customer 1: 2 units of Item 3 and 3 units of Item 1.
- Customer 2: 6 units of Item 2.
- Customer 3: 4 units of Item 7 and 2 units of Item 5.
- Customer 4: 8 units of Item 3.
- Customer 5: 5 units of Item 6 and 2 units of Item 9.

The available items and their corresponding weights are as follows:

Item 1	**Item 2**	**Item 3**	**Item 4**	**Item 5**
1.2 kg	3.8 kg	7.5 kg	0.9 kg	15.4 kg
Item 6	**Item 7**	**Item 8**	**Item 9**	**Item 10**
12.1 kg	4.3 kg	19.7 kg	8.6 kg	2.5 kg

In order to test the algorithm under different conditions, additional instances must be generated by adding more vehicles, customers, and items.

Deliverables:

1. Source code (in Python), along with execution instructions if necessary.
2. A report describing the problem, the design of the genetic algorithm, experimental results, comparison of configurations, and a critical analysis with conclusions.

Logistics: Groups of 2 or 3 people. Delivery date: November 23rd, 2025.