A delivery company serves 30 customers daily. The owner of this company hired an industrial engineer to calculate the best routes in order to minimize the transportation costs. With the attached Excel file containing the distance matrix, customer requirements, and vehicle capacity, the industrial engineer was able to solve a Vehicle Routing Problem (VRP) that aims to minimize travel distance by requiring a minimum number of vehicles (Hint: $minimum\ number\ of\ vehicles = \left\lceil \frac{Total\ number\ of\ demands}{vehicle\ capacity} \right\rceil$).

The industrial engineer wants to develope a heuristic algorithm to obtain the optimal/close to the optimal solution. Thus, he/she chose to construct the initial solution based on the Savings Algorithm, followed by improving it with 2-opt and 2-exchange algorithms. Additionally, once a heuristic has been developed, he/she intends to compare the heuristic's solution to that of Gurobi for the same problem. In the case that you are hired as the mentioned industrial engineer, attempt to accomplish the tasks above. Note that node 0 represents depot and each vehicle should start and return to depot at the end of their tour.
Tasks:

1- Apply Savings algorithm for the VRP (note that this algorithm should be rewritten for the **VRP** and not TSP and the data is **asymmetric**)

2- Apply 2-exchange algorithms exhaustively (try all possible improvements) to improve the solution you obtained from 1.

3- Apply 2-opt algorithms greedily and stop when the first improvement is recognised to improve the solution you obtained from 2.

4- Add algorithms in 1, 2, and 3 to VRPlib library that we have and make the library general.

5- Formulate the proposed VRP problem and solve its mathematical model using Gurobi and illustrate your solution.

6- Prepare a well-written report which compares the results of your heuristic and Gurobi with respect to routes, objective function values, and computation times.

Provide the **python** files for the **heuristics** and **Gurobi** as well as a comprehensive **report** and discuss your solutions. Submit your files as a zip/rar file through the Yulearn platform.
A day will be announced, and all the groups and group members should present their work in my office.