Master Degree in "Ingegneria Informatica" and "Computer Engineering"
Università degli Studi di Genova

*"Optimization and Control of Logistics Systems"*

**Team Working Activity on the Vehicle Allocation Problem**

Let us consider a Dutch logistic provider which has a fleet of 3 trucks and serves costumers in the Netherlands and in Germany. The company wants to plan the trips of the trucks for next week (from Monday to Saturday, excluding Sunday in which trucks cannot travel).

The customers of this company have made some transport requests for next week, reported in the next table.

| Day | Origin | Destination | Quantity [TEU] |
|---|---|---|---|
| Monday | Amsterdam | Hamburg | 1 |
| Tuesday | Frankfurt | Dresden | 2 |
| Tuesday | Hamburg | Amsterdam | 1 |
| Wednesday | Dresden | Hamburg | 2 |
| Thursday | Amsterdam | Frankfurt | 1 |
| Thursday | Hamburg | Frankfurt | 1 |
| Thursday | Dresden | Frankfurt | 1 |
| Friday | Dresden | Amsterdam | 1 |
| Friday | Dresden | Hamburg | 1 |
| Friday | Hamburg | Amsterdam | 2 |
| Saturday | Hamburg | Frankfurt | 1 |
| Saturday | Dresden | Amsterdam | 1 |

While one of the 3 trucks is available starting from Monday (this vehicle will be located in Amsterdam on Monday morning), the other two vehicles will be available from Tuesday (because they will be under maintenance on Monday), respectively in Frankfurt and Hamburg. Note that the 3 vehicles have the same dimensions and costs and each of them can transport 1 TEU. According to the contract with truck drivers, each driver can make only one transport from a city to another one in one day.

The transport costs can be estimated considering a unit cost of 0.5 [€/km], while the profit can be estimated considering a unit profit of 0.9 [€/km]. The costs associated with the stop of vehicles in each city are negligible and assumed equal to 0. The distances between the considered cities are reported in the following table.

| Connection | Distance [km] |
|---|---|
| Amsterdam-Hamburg | 465 |
| Amsterdam-Frankfurt | 440 |
| Amsterdam-Dresden | 735 |
| Frankfurt-Hamburg | 500 |
| Frankfurt-Dresden | 465 |
| Hamburg-Dresden | 480 |

The company wants to decide the trips of the trucks (full or empty) for the next week by considering a discretization of the time horizon in days and in order to maximize the profit.

1. Write the mathematical programming formulation for this model (with data with their values, decision variables, objective function and constraints).

2. Implement this model: how much is the optimal total cost? what is the demand (if any) which is not satisfied by the company? where are the drivers at the end of the week?