MMDM Lab Work 1

General Rules

- Grade = 0.3×Task1 + 0.3×Task2 + 0.4×Task3
- You can work in small groups: 1-3 students.
- Correct but basic solution of each task costs 8 points. To get 9, 10 be creative: think of some modification for basic algorithms; cool visualisation may also give you additional points
- Write your own code for algorithms!

Problems

1. Use genetic algorithm to find global extremum of given functions. Make sure your algorithm works for n dimensional objective functions.

   (a)

   $$\max_{x,y} f(x,y) = 3(1-x)^2 \exp\left(-x^2-(y+1)^2\right) - 10\left(\frac{x}{5}-x^3-y^5\right)\exp(-x^2-y^2) - \frac{1}{3}\exp\left(-(x+1)^2-y^2\right)$$

   (b)

   $$\min_{x,y} f(x,y) = -0.0001\left(\left|\sin x \sin y \exp\left(\left|100 - \frac{\sqrt{x^2+y^2}}{\pi}\right|\right)\right| + 1\right)^{0.1}, \quad (x,y) \in [-10,10]^2$$

2. Find pareto front for the given multi-objective optimisation problem using NSGA II algorithm. Take $n = 3$, but you may try other values as well.

   $$\min_x = \begin{cases} f_1(x) = 1 - \exp\left(-\sum_{i=1}^n \left(x_i - \frac{1}{\sqrt{n}}\right)^2\right) \\ f_2(x) = 1 - \exp\left(-\sum_{i=1}^n \left(x_i + \frac{1}{\sqrt{n}}\right)^2\right) \end{cases}, \quad -4 \le x_i \le 4,\ 1 \le i \le n$$

3. Due to the upcoming holiday (8^{th} of March), flower market decided to optimize its delivery (= minimize delivery costs). At the begging of the day couriers pick up flowers from the flower market and deliver them to clients. Each client needs only certain number of flowers and each courier can carry only certain number of flowers. Couriers are paid for the distance travelled.

   All required data is in the attached file.

   Make sure to write your mathematical model for the given problem (yes, using formulas). Then code it in python and solve.