In this exercise, we will first study real-coded genetic algorithm (GA) works and then practice three basic constraint handling techniques with real-coded GA.

In programming exercise 1, we have implemented binary-coded GA. The main differences between real-coded GA and binary-coded GA are in the genetic operators, i.e., crossover and mutation. The genetic operators which can be used in real-coded GA can be found in Kanpur Genetic Algorithms Laboratory's website https://www.iitk.ac.in/kangal/resources.shtml in the Section 'Real coded genetic algorithms´. Please study this short section and implement the crossover and mutation operators for real-coded GA.

Consider the following problem:

$$
\begin{aligned}
\text{minimize} \quad & x_1 + x_2 \\
\text{subject to} \quad & -5 \le x_1 \le 10 \\
& 0 \le x_2 \le 15 \\
& (x_2 - \frac{5.1x_1^2}{4\pi^2} + \frac{5x_1}{\pi} - 6)^2 + (10 - \frac{10}{8\pi})\cos(x_1) + 9 \le 0 \\
& x_2 + \frac{x_1 - 12}{1.2} \le 0
\end{aligned}
\tag{1}
$$

Use the following constrain handling techniques with real-coded GA to solve problem (**??**) and compare the results:

- Death penalty

- Kuri's Static penalty (introduced in Section 2.1 in the survey paper you read as the reading assignment

- Joines and Houck's Dynamic penalty (introduced in Section 2.2 in the survey paper)

Submit your implementations and your results by 8,15, 22nd of February to yue.y.zhou-kangas@jyu.fi with a subject TIES451_exercise3_yoursurname.