Exercise 7: Implementation of a Simple Evolution Strategy

Summer Term 2024

It is now time to do your own programming stuff. The goal is to have a running evolutionary algorithm with which you can do further exercises. In order to ease this task quite a bit and in order to focus on the algorithmic issues rather than on tedious implementation details, we have prepared a framework for you. Since this exercise still requires some time, you are expected to do the programming as a **homework** and to bring the result to the next class!

Review: In this class, we distinguish between three different types of optimization problems:

1.
2.
3.

What type is in the focus of this class? Why not the others?

To Do: Implement a running evolutionary algorithm step by step.

Tasks: Happy programming!

1. Download the prepared material from `http://www.imd.e-technik.uni-rostock.de/ma/rs/lv/hosc/ea.zip`.
2. **Read the API documentation.** You are strongly advised to do so!
3. Implement the `main()`-function of the simple `ea`-program. The fitness function should be simply the sum of the squared x_i, which is also known as the sphere model. Where does this function has its minimum? Test the program by running it for a few generations in order to see whether you did everything correctly or not. As a recommendation, try $\mu = 1$, $\lambda = 6$, and $n = 5$ dimensions. Now, try also other values for μ, λ, and n in order to test your program a bit more.
4. To get a deeper understanding of the nature of an evolutionary algorithm, you should now implement the `mutation_offspring()`-routine by yourself. Also, implement a simple uniform crossover operator that may work on two successive offspring.
5. You are now almost ready to solve the minimization of the power distribution network from Exercise 4. Replace the fitness function (i.e., the sphere model as noted above), by the calculation of the total network length (as described in Exercise 4). Questions:
   (a) How many parameters x_i do you need?
   (b) How can you map those parameters onto the specification of the distributors D_i?

   Test your program by doing some runs and report your minimal network length to the research assistant.

Have fun, Theo and Ralf.