



**Universiteit
Leiden**
The Netherlands

Practical Assignment Part2

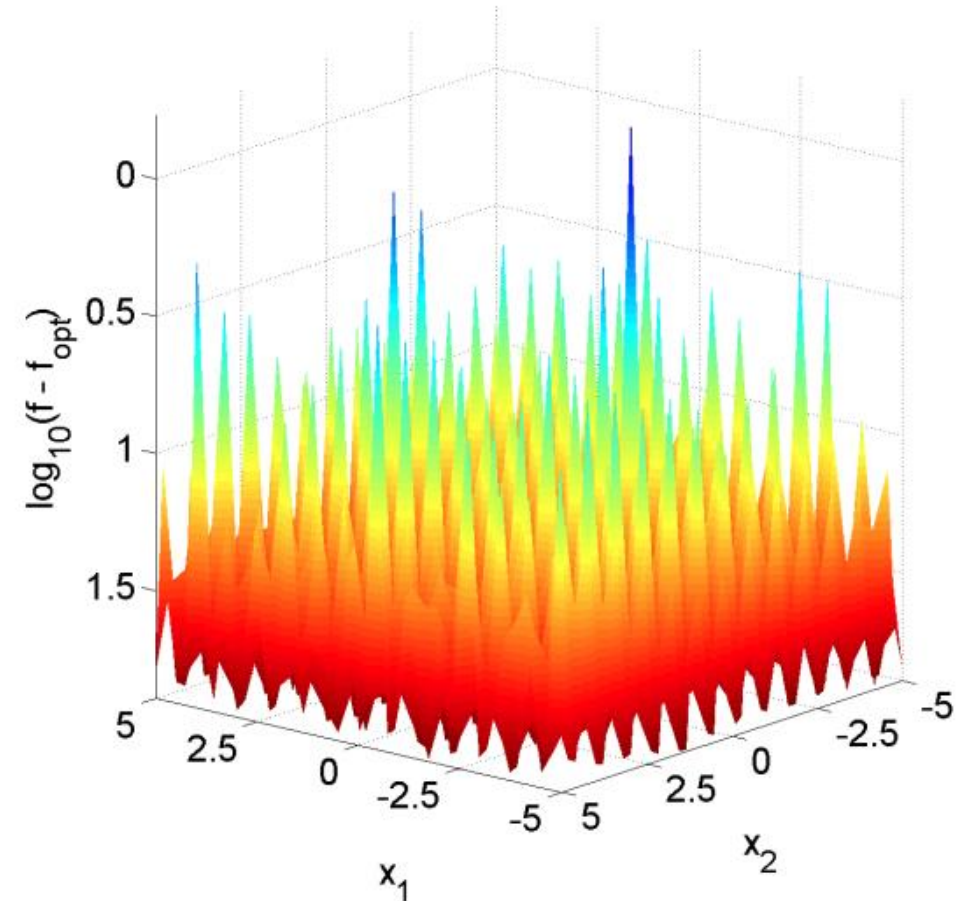
Evolutionary Algorithm Course, LIACS, 2024-2025

Solving the F23 problem from the *Black-box Optimization Benchmarking (BBOB)* problem set using Evolution Strategy

F23: Katsuura Problem

$$f_{23}(\mathbf{x}) = \frac{10}{D^2} \prod_{i=1}^D \left(1 + i \sum_{j=1}^{32} \frac{|2^j z_i - [2^j z_i]|}{2^j} \right)^{10/D^{1.2}} - \frac{10}{D^2} + f_{\text{pen}}(\mathbf{x}) + f_{\text{opt}}$$

- $\mathbf{z} = \mathbf{Q} \Lambda^{100} \mathbf{R}(\mathbf{x} - \mathbf{x}^{\text{opt}})$



1. Finck, S., Hansen, N., Ros, R., & Auger, A. (2010). *Real-parameter black-box optimization benchmarking 2009: Presentation of the noiseless functions*. Technical Report 2009/20, Research Center PPE, 2009. Updated February.
2. de Nobel, J., Ye, F., Vermetten, D., Wang, H., Doerr, C., & Bäck, T. (2024). lohexperimenter: Benchmarking platform for iterative optimization heuristics. *Evolutionary Computation*, 1-6.



Requirements and Details

Requirements

- ▶ Implement a Evolution Strategy (ES) to solve the F23 problem of Black-box Optimization Benchmarking (BBOB) problem.
 - ▶ We set the search dimension to 10 for F23.
- ▶ Submit the code of ES, '*studentnumber1_studentnumber2_ES.py*'.

Requirements

- ▶ Additional files of other functions are allowed. However, we will only execute the ES code.
- ▶ You can choose any ES version taught in the class.
- ▶ Submit the report introducing your algorithm and presenting the experimental results (One report includes both part1 and part2 practical assignment).
- ▶ Set a fixed random seed in the implementation to obtain the same results as those in the report by running the submitted codes.
- ▶ Goal: we want to get good performance upon **5,0000 function evaluations on this problem.**
- ▶ ES is random: we will execute it for **20** independent runs and take an aggregated performance value.

General Info

▶ How to evaluate your PA?

▶ Following the guidelines (10%)

- ▶ You will get a full score if you follow all the guidelines

▶ Experimental Results (45%)

- ▶ If your code reproduces the results in the report.

▶ Report (45%)

- ▶ Based on the presentation of the design of algorithms, experimental settings, and discussion about the results.

▶ Other:

- ▶ Plagiarism check: if the report copies more than 30%, the PA grade is 0.
- ▶ If the results in your report do not match the results we obtain from using your codes, the PA grade is 0.
- ▶ If the results of your algorithms rank top 2 among all teams, you will get a 0.5 bonus for the **final grade**.
- ▶ Submission ddl: December 20th.

Usage of IOHanalyzer

- ▶ GUI: <https://iohanalyzer.liacs.nl>
- ▶ GitHub project: <https://github.com/IOHprofiler/IOHanalyzer> . You can also install a local version following the tutorial on the git page.
- ▶ Paper: <https://dl.acm.org/doi/full/10.1145/3510426>

What to report

- ▶ Description of the Evolution Strategy
 - ▶ Introduce the operators and the parameter setting that you suggest.
- ▶ Report the average best-found fitness $f(x)$ of **20 independent runs**
- ▶ Report the AUC values
- ▶ The empirical analysis of your algorithms' performance using ERT and ECDF curves
- ▶ Any other details/results you wish to include

