



Universiteit  
Leiden  
The Netherlands

# Practical Assignment 2

# General Info

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- ▶ Deadline
  - ▶ Submission: **December 7, 23:59**
  - ▶ Submit your report/codes on Brightspace
- ▶ Penalty : -0.5/week
- ▶ Bonus: 0.5/group for the highest PA grades
- ▶ Can work with a group(max. 2 persons)
  - ▶ Register your team on Brightspace

# General Info

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- ▶ How to evaluate your PA? Average grade over all the sections.
  - ▶ Following the guidelines
    - ▶ You will get full score if you follow all guidelines
  - ▶ Algorithm level
  - ▶ Code Reproducibility (sec.3)
    - ▶ You will get 0 if there are still bugs with the codes that you submit.
  - ▶ Experimental Results (sec.4)
    - ▶ Based on the rank of your algorithm result among algorithms of all groups.
  - ▶ Presentation (sec.5)
  - ▶ Code (sec.6)
  - ▶ Overall impression (sec.7)
- ▶ Formula:
  - ▶  $\left(\frac{1}{7}\sum_{i=1}^7 \text{sec}[i]\right) + \text{penalty} + \text{bonus}$
- ▶ Other:
  - ▶ Plagiarism check: if report copies more than 30%, PA grade is 0.

# Black-Box (Continuous) Optimization Using Evolution Strategy

# Problems (BBOB suite)

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- ▶ 24 noise-free real-parameter single-objective benchmark problems.
- ▶ Each problem consists of a function that is to be minimized:
$$f: [-5,5]^n \rightarrow \mathbb{R}$$
- ▶ Details can be found at  
<http://coco.lri.fr/downloads/download15.01/bbobdocfunctions.pdf>.

# Example settings

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- ▶ Dimensionality  $n$ : 2,5,20
- ▶ Multiple independent on 25 instances
- ▶ Evaluation budget:  $10000n$
- ▶ Implementation: Please follow the structure of the given examples (available on Brightspace).

# What to submit

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- ▶ A **runnable** c++/python code, containing your implementation of the algorithm
- ▶ A **readable** report that summaries
  - ▶ Details of the evolution strategy that you implement
  - ▶ Settings of your algorithm.
  - ▶ Result of your algorithm
  - ▶ (Observation/Analysis of algorithm performance, features of the problems, and any interesting findings)

# What to report

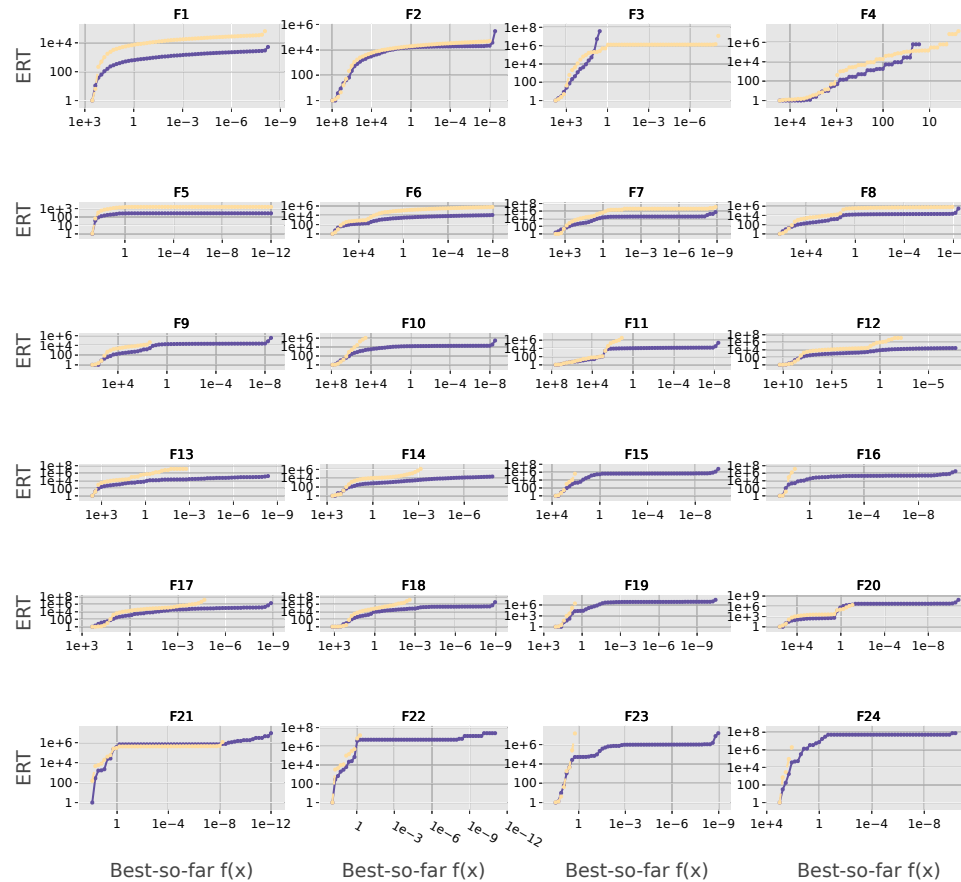
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- ▶ Algorithm details
  - ▶ You may try and present different configurations of ES, please give **one** suggested for the problem suite.
- ▶ A plot of fixed-target ERT values across 24 functions on 20 dimension.
- ▶ An ECDF curve across all tested functions, dimensions and instances.



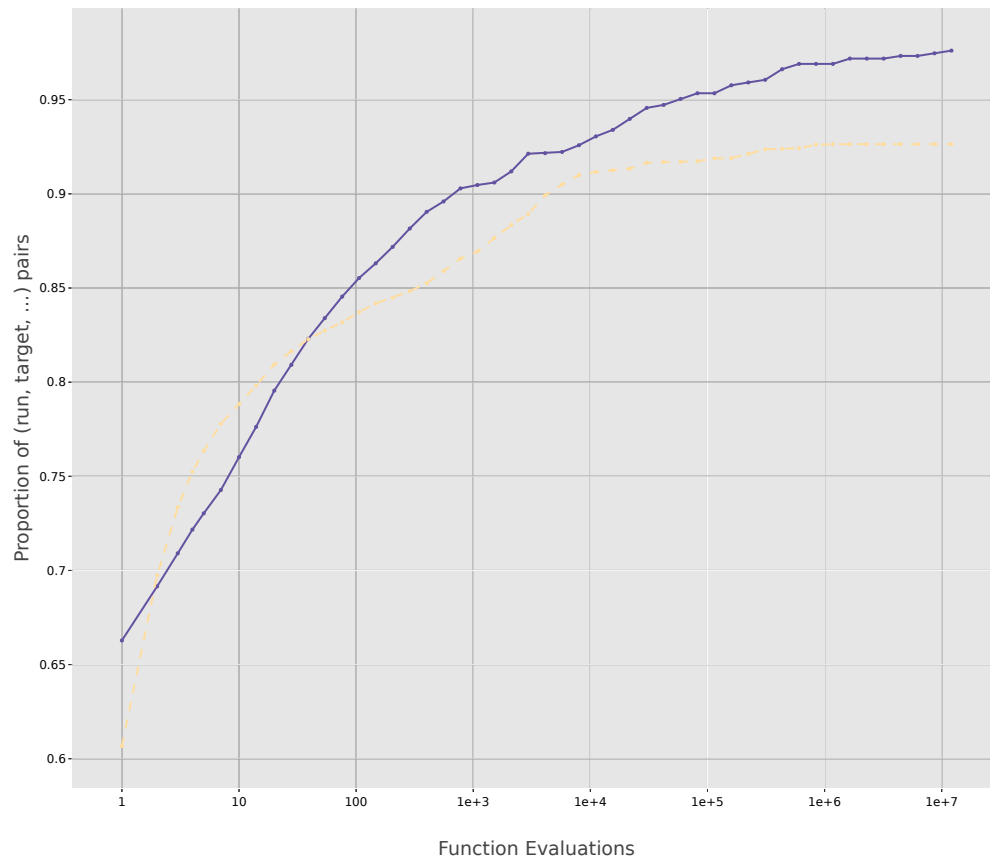
# What to report

- ▶ A plot of fixed-target ERT value across 24 functions on 20 dimension.



# What to report

- ▶ An ECDF curve across all tested functions, dimensions and instances.



## Generational ES model:

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**Algorithm 1** Generational ES Model

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```
1:  $t \rightarrow 0$ 
2: Initialize( $P(t)$ )
3: Evaluate( $P(t)$ )
4: while Termination criterion not met do
5:    $P'(t) \leftarrow \text{Recombine}(P(t))$ 
6:    $P''(t) \leftarrow \text{Mutate}(P'(t))$ 
7:    $P'''(t) \leftarrow \text{Select}(P''(t) \cup Q)$   $\triangleright Q \in \{\emptyset, P(t)\}$ 
8:   Evaluate( $P'''(t)$ )
9:    $P(t+1) \leftarrow P'''(t)$ 
10:   $t \leftarrow t + 1$ 
11: end while
```

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# What to play

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## ▶ Mutation

- ▶ One  $\sigma$ ,
- ▶ individual  $\sigma$
- ▶ correlated mutations

## ▶ Recombination

- ▶ Intermediate recombination
- ▶ Global recombination

## ▶ Selection

- ▶  $(\mu + \lambda)$
- ▶  $(\mu, \lambda)$