Comparison with State-of-the-Art: Traps and Pitfalls

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Popular road to publication

- Create some algorithm
- Compare to state-of-the-art
- If the algorithm is better for some problems, then write an article
Popular road to publication

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What is state-of-the-art? – known algorithms with source code available in researchers favorite programming language

Cite the first paper that introduced algorithm used in comparison
Usual road to publication

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Article-implementation gap

- Usually articles skip some details that are needed by the implementation
- These details can be filled in different ways by the developers
- Different implementations can give different results
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Use trusted implementation

- What will happen if we download and use implementations created by one person, an author of a method
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Experimental setup

- For all implementations, the same population size, initial $\sigma$, and maximal number of objective function evaluations were set.
- The comparison and analysis of the results were performed by COCO using 24 noiseless single-objective functions formerly used in 2009 in Workshop on Real-Parameter Black-Box Optimization Benchmarking.
- Bounds of the area of interest were used as bounds for constrained search, which better reflects a real-world application.
- Python version comes with two constraint handling techniques – transformation (default) and weighted quadratic penalty.
- A simple implementation in Python which was meant for reading, was also included in the experiments as it is used in direct translations into other languages.
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Results on selected functions in 5D

5 Linear slope

Fraction of function, target pairs

bbob f5, 5-D
51 targets: 100 \times 10^{-8}
15 instances

best 2009

PySqPen

Mat

Py

C

PySimple

Java

\log_{10}(\text{# f-evals / dimension})
Results on selected functions in 5D

Comparison with State-of-the-Art: Traps and Pitfalls
Results on selected functions in 5D

18 Schaffer F7, condition 1000

bbob f18, 5-D
51 targets: 100..1e-08
15 instances

Comparison with State-of-the-Art: Traps and Pitfalls
Results on selected functions in 5D

19 Griewank-Rosenbrock F8F2

bbob f19, 5-D
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Comparison with State-of-the-Art: Traps and Pitfalls
Results on selected functions in 5D

22 Gallagher 21 peaks

Comparison with State-of-the-Art: Traps and Pitfalls
Results on selected functions in 5D

Comparison with State-of-the-Art: Traps and Pitfalls

23 Katsuuras

bbob f23, 5-D
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Algorithms that use the same bound constraint handling were compared in pairs using the Wilcoxon rank-sum test along with the Bonferroni correction by the number of functions. The star means that there is a statistically significant difference with p-value 0.05. The number $k$ after the star shows the p-value was $10^{-k}$.
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<th>Fun.</th>
<th>C</th>
<th>Matlab</th>
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Tracing the differences

- **Bound constraint handling**
  - Internal stopping conditions (sanity checks) – 8 in C, 11 in Python; stopTolFun, stopTolFunHist, stopTolX are different
  - After setting Python like C, Python was interrupted on function 19
  - Implementing different versions of the method – Python implements ActiveCMA version
  - Different heuristics used to detect and escape from flat areas of the fitness
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- Authors of the CMA-ES cited sequence of four articles when referring to CMA-ES
- Article-implementation relation is not clear:
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  - there are five references in Matlab and five in Java, four of them are common for both implementations
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Best practice recommendations

- Publishers should require the availability of the source code for all new optimization methods.
- Authors should reveal how all parameters were set up, not only in the proposed method but also in methods used for comparison.
- The code used for running experiments should be available.
- Authors should use the most up-to-date trusted implementation of the state-of-the-art and reveal its origin, name, and version.
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Thank you for watching!