Evolutionally Engineering Hardness Landscapes

15-48 EC thesis proposal

For:	Master Students that know how to program and are interested. If you've ever done a course in heuristics, it is a pre.
Load:	15 - 48 EC, depending on blocks (see below)
Period (approx.):	From September 2021 onward
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Introduction video:	https://bit.ly/3DWGFrG

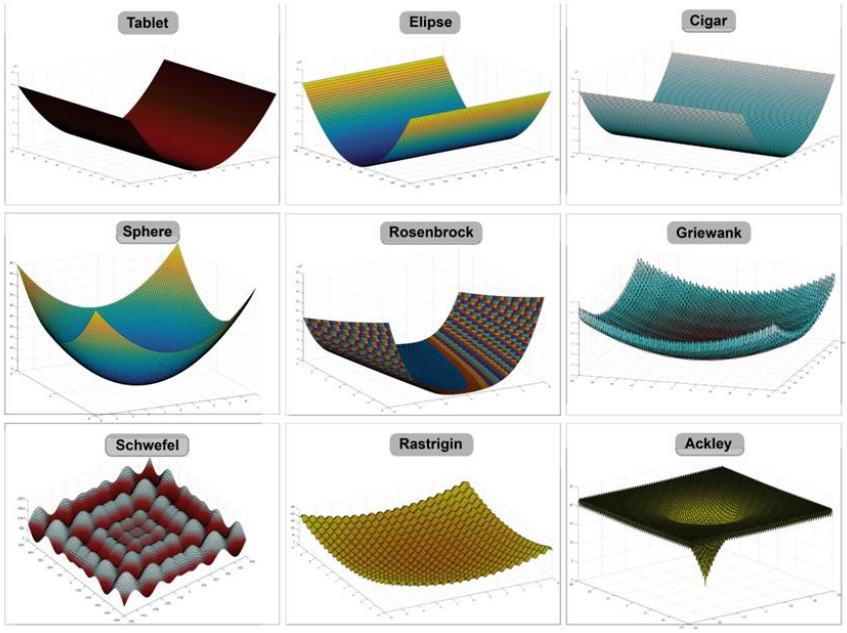

Fig.1: Some classic benchmark test functions for evolutionary algorithms. Why are some of these easier than others, and can we evolve even harder functions?

About the project

The Plant Propagation Algorithm (PPA) is a crossoverless population-based evolutionary algorithm whose performance has been extensively analyzed. Luckily, a lot has been done on the same benchmark algorithms [1-6], also seen in Figure 1.

In this project, we'd like to engineer not the algorithm, but the landscapes in Figure 1 themselves. This can be done by modifying the mathmatical equations underlying these landscapes, by changing $4x^2$ to $-2x^2$, or $5x^3$ to $5x^{-2}$, or cos(x) to sin(x) or even $e^{(x-3)}$ to $\sqrt{|x-3|}$. This gives a new landscape, with possibly new performance (worse or better) for PPA.

Block #1
Replicate (part of) Wouter Vrielink's work [1]. The best thing to do might be to take only the nD benchmark set, or significantly extend the set but with not all dimensionalities. The latter has, as an advantage, that we can get an early feeling of what kind of benchmark functions might be harder (in which dimensionalities). Leave the FWA out, just do PPA, with default parameter settings is good enough.

Block #2
Start engineering one benchmark function. Just slowly mutate the constants and assess performance of PPA. Maybe output some intermediate results, so we can make an animation the developing landscape?

Block #3
It is possible to assess the parameter stability, like in De Jonge's paper. This probably means less landscape evolution, but a more thorough analysis of the performance.

Block #4
Is it possible to evolve these landscape functions with PPA itself? Try it. Note: there is a chance that this leads to unpublishable results, but anything that comes out *will* be usable in your thesis. We will talk about this

Block #5
Try the process with simulated annealing. Use Dahmani's settings [7], or something else if you have some really good reason to do so (discuss with me!).

References

[1] https://bit.ly/3jH1Eqe

[2] https://bit.ly/3r2fc1D

[3] https://bit.ly/36qLTMQ

[4] https://bit.ly/3e4b4Jg

[5] https://bit.ly/36qNXEr

[6] https://lnkd.in/eWuMQd6H

[7] https://bit.ly/3yHtF5A