CT5141 Optimisation Assignment 2

James McDermott

Topic Experimentation with real-valued metaheuristics

Deadline 5pm Friday 27 November (end of Week 9).

Groups Students may work in groups of 2, or solo. A student may not work with another they have worked with on any other assignment in this module or other modules on this programme. If working in a group, just one student from the group need submit, but if preferred both may submit.

Requirements

1. Choose multiple metaheuristics suitable for real-valued optimisation, including at least random search, CMA, and PSO. You may choose to include algorithms we have studied, algorithms we have not studied, and variants, including novel variants of your own. Implement these algorithms together with any necessary operators. You may use your own code, code given in this module, and code from the internet (with citation).
2. For each algorithm identify the important hyperparameters and some possible values for them. You should have at least 10 different configurations (different algorithms and/or different hyperparameter values).
3. Implement an optimisation **problem** of your choice. It should have at least 6 real-valued decision variables. It should not be a linear programming problem. Be clear on whether it is maximisation or minimisation.
4. Carry out a factorial-design experiment. Calculate the mean and standard deviation over 5 runs for each algorithm configuration. Use random seeds 0-4 (`random.seed` and/or `np.random.seed`). Use a fitness evaluation budget of 50,000 for each run.
5. Write a 2 page report. Describe your problem, your experiment design including choice of algorithms and hyperparameters, and your results. Include a table of results, one line per algorithm configuration, to include the mean and standard deviation (not all 5 individual results from 5 runs). Based on this state which algorithm and configuration was the best, and by how much. You do not need to carry out any statistical tests, but you may wish to refer to standard deviations for this.

   For population-based algorithms, comment on the trade-offs between population size and number of generations. Include a figure showing objective value versus iterations for a run or runs, and use it to comment on whether a longer run would help. Comment on the nature of the search landscape.

Recommended reading Luke, **Essentials**, Section 11.1 (Experimental Methodology). Also **Experimental Methodology**, part of Lecture 6.

Submission Submit a single zip file containing a short pdf report and Python code. Include student name(s) and ID(s) at the top of the pdf and each .py file.

Grading This is worth 15% of the module. Grading is weighted as follows:

- 25% Code
- 25% Experimental design and results

- 25% Figures and tables
- 25% Well-written report including interpretation.

Possible penalties: incorrect submission format and other deviations from the spec.

Policy Students are reminded of the University's policy on plagiarism. Students may discuss the assignment with other students but must not look at other students' work, or allow others to look at theirs. Any online sources used must be cited with URL and date of access in a comment. Materials from CT5141 need not be cited. By making a submission you declare that you have abided by these conditions. Suspected infringements will be investigated and may be referred to NUI Galway authorities.