CT5141 Optimisation Assignment 2

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Topic Experiments with knapsack problems.

Deadline Midnight Friday 18th November (end Week 11).

Groups Students may work in groups of 2, or solo. A student may not work with another student they have worked with on any other assignment in this module or other modules on this programme. In a group of 2, both students should submit and submissions should be identical. **Groups must be declared to the lecturer and approved before beginning.**

Problem Compare multiple approaches on the **knapsack problem**. Specifically, solve the problem instance `knapPI_1_500_1000_1`, provided in Bb. Code for reading knapsack data and evaluating knapsack solutions is provided in Bb.

Use and compare multiple approaches, e.g. random search, hill-climbers or variants, GA or variants, constructive heuristics or variants; e.g. different operators; e.g. different hyperparameter values; e.g. different genome representations or genotype-phenotype mappings; e.g. different objective functions or multi-objective approaches (but your final reported result for each run must be the knapsack evaluation of value, obeying the weight constraint); e.g. additional techniques such as elitism, alternative GA loops, or something else. Some of these approaches will be introduced in the coming weeks.

You should have at least 2 distinct algorithms and least 4 distinct setups (e.g., 2 algorithms with 2 different hyperparameter settings each), but potentially many more.

Each setup should be indexed as "setup 0", "setup 1", etc.

The different approaches you choose to implement and test must be different from those used by other students/teams. To enforce this, **your choice of approaches must be proposed to the lecturer and approved**.

Any setup which is randomised should be run 5 times with the random seeds (0, 1, 2, 3, 4).

Any setup which uses objective function evaluations must use a maximum of 50,000 objective function evaluations per run.

Your code should be automated, so that you can re-run your entire experiment with a single Python command (i.e. you don't: do some runs, record the results, edit the code, do some more runs, etc.).

Your code shoult collect your experimental results in a Pandas DataFrame. Each row must represent one run, including the setup index, the method name, the random seed if any, any customisations, and hyperparameter values, and the best solution's value and weight for that run, and the time elapsed in seconds.

Numbers in the table should not include meaningless digits, e.g. `72834.238734` could be shortened to `72834`. Suggestion (not mandatory): if you store results in a Pandas DataFrame `df` you can print them out nicely in a notebook using `print(df)`.

You must supply your code and experimental results.

You may use your own code, code given in CT5141, and/or code from the internet (with citation). You may import any module in the standard library or installable using `pip` or `conda`. Any `pip` or `conda` install commands should be documented in the code. No unused code should be included in the submission.

Identify the best setup based on knapsack value (taking the mean over multiple runs if needed). Write a short paragraph (max 100 words) to state your findings.

Submission Submit a single `.ipynb` file containing code, results, and conclusions. Include student name(s) and ID(s) at the top of the file. Don't type anything in the submission box.

Grading This is worth 10% of the module. Grading is weighted as follows:

- 30% Choice of approaches and experimental design
- 30% Implementation including automation
- 20% Table and results
- 20% Conclusions

Possible penalties: incorrect submission format and other deviations from the spec. Failure to declare/receive approval for group or for proposed approaches.

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 (including from previous years), or allow others to look at theirs. Any online sources used must be cited with URL and date of access. 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 University of Galway authorities.