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Section 1: Overview of Assessment

This assignment assesses the following module learning outcomes:

1. To apply an appropriate technique(s) to a given problem
2. Formulate a problem such that it is amenable to modern Artificial Intelligence techniques
3. Appraise the usefulness of various techniques for particular situations

The assignment is worth ***50%*** of the overall mark for the module.

Broadly speaking, the assignment requires you to write a report on your attempts to solve a set of simple problems as effectively as possible using any form of evolutionary intelligence covered on the course. This requires you to write your own code, in a language of your choice, building upon your own code written and developed in the first lab sessions.

The assignment is described in more detail in section 2. This is an individual assignment.

Working on this assignment will help you to develop your understanding of how learning can be seen as a search process and how the parameters controlling search techniques affect their ability to solve tasks. If you have questions about this assignment, please email the module leader.

Section 2: Task Specification

There are three worksheets on Blackboard which take you through the implementation of a simple evolutionary algorithm. This assignment requires you to complete all three worksheets and then extend the algorithm to show competitive performance on a number of optimisation problems. Thereafter you are free to find other well-known problems and algorithms.

To pass the assignment, you must implement a system that successfully evolves solutions to the two minimisation fitness functions below and demonstrate the effects of parameter changes, through graphs, including your understanding of what is happening.

Approaches you might like to consider are different forms of mutation and crossover, as well as selection. It is also acceptable to use implementations of other related algorithms for comparison with your own code on benchmark functions.

All reports should include a research section which describes a chosen optimisation algorithm(s) inspired by nature *not* covered on the course and compares it in detail with evolutionary search, include others covered where appropriate. There are lots to choose from: bees, bats, beetles, butterflys, buffalo, etc. In an experimentation section on the use of evolutionary search describe the encoding(s) used, show example runs and solutions found. *More marks will be given to the effective use of more sophisticated approaches*.

$f(\boldsymbol{x}) = \sum_{i=1}^{n-1} \left[100\left(x_{i+1} - x_i^2\right)^2 + \left(1 - x_i\right)^2 \right]$	$f(\mathbf{x}) = -\sum_{i=1}^{d} \sin(x_i) \sin^{2m}\left(\frac{ix_i^2}{\pi}\right)$
where -100 ≤ *x* ≤ 100, start with *n*=20	where 0 ≤ x ≤ π, start with *d*=20 and *m*=10

Section 3: Deliverables

Depending on font size, and line spacing, around 5 pages is a reasonable target length. The intention is your hand-in approximates to a research paper – please use the template provided. Include commented source code as a printed Appendix. DO NOT make your report publicly available as well. A demonstration might be required during the lab sessions before the end of term if any aspects are unclear to the marker(s).

Section 4: Marking Criteria

	0-40%	40-60%	60-100%
General approach – technical writing style and visual impression (10%)	Use of template and basic word processing skills.	Coherent structure in presentation, including some graphs.	Well structured, results presented in multiple/suitable ways.
Research – relevance and level of understanding shown (20%)	Brief identification and discussion of aspects of chosen optimisation algorithm.	Description of chosen algorithm in general, with comparison to basic evo algorithm.	Review of chosen algorithm, summaries of related advanced work, thorough comparison to evo algorithm(s).
Experimental Method – no. of experiments, systematic parameter changes, etc.(30%)	Presentation of attempts on the given functions.	Presentation of increasingly successful attempts on the given functions, moving to others.	Presentation of successful attempts on all provided tasks, moving to others and relative comparisons.
Analysis and Discussion – presentation and discussion of learning behaviour (30%)	Brief discussion of apparent effects of varying one or more parameters.	Discussion of apparent effects of varying parameters clearly supported by results.	Demonstration of clear insight of effects from parameter sweeps and/or operators or algorithm type.
Conclusions (5%)	Concise summary.	Summary showing wider understanding.	Demonstration of clear understanding and implications of results.
Citation and Reference Scheme (5%)	A small number of relevant refs.	Some key refs for chosen algorithm.	Sets of refs for algorithm, state-of-art.