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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 ***75%*** 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 either competitive performance on a number of optimisation problems *or* to design rule-bases to model a number of data sets. Examples of both are provided separately, thereafter you are free to find other well-known problems.

To pass the assignment, you must first implement a system that successfully evolves solutions to the two fitness functions in worksheet 3. Then, you must extend your work to the assignment tasks and demonstrate the effects of parameter changes, preferably through graphs, and include your understanding of what is happening.

For the optimisation route, 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.

For the modelling route, the same applies regarding the search operators and you could consider allowing evolution to explicitly find the minimal set of rules for an accurate model, ie, variable length solutions. How you split the data for training and testing is important – no one is interested in a system than can give the correct output for an input it has seen during learning! Examining the learned solutions for problem structure may also be considered. Again, once you have solved the problems with your own code, you may use freely available software, eg, Weka or scikt-learn, to compare performance with other approaches on benchmark datasets.

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

Section 3: Deliverables

Depending on font size, and line spacing, around 2,500 words is a reasonable target length. The intention is your hand-in approximates to a research paper – please use the template provided, submitted as Word or PDF. Include commented source code as a printed Appendix. DO NOT make your report or code publicly available. 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 evolutionary algorithm.	Review of chosen algorithm, summaries of related advanced work, thorough comparison to evolution algorithm(s).
Experimental Method – no. of experiments, systematic parameter changes, etc.(30%)	Presentation of attempts on the third worksheet functions.	Presentation of increasingly successful attempts on third worksheet 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.
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(s).	Sets of refs for algorithm, state-of-art