University of Exeter

COURSEWORK SPECIFICATION
ECMM409 – Nature-Inspired Computation
Module Leader: Alberto Moraglio
Academic Year: 2025/26

Title: **Team Project**

Submission deadline: **26 November 2025 (12:00 noon)**

This assignment is worth **70%** of the total module mark and assesses the following **intended learning outcomes**:

- demonstrate deep understanding of the difficulties associated with certain intelligence-related tasks that we would wish to program computers to do;

- analyse and choose appropriate techniques for given problems from a very diverse toolbox of methods;

- understand how new ideas in science and engineering can emerge from lateral thinking and ideas from other disciplines.

This is **individual and team** assessment and you are reminded of the University's regulations on collaboration and plagiarism. You must avoid plagiarism, collusion, and any academic misconduct behaviours. Further details about academic honesty and plagiarism can be found at https://ele.exeter.ac.uk/course/view.php?id=1957.

Generative AI

This assessment has been categorised as **AI-Assisted**. In AI-assisted assessments, **you must include the prompts and links used in your list of references if you use GenAI tools.** You can find further information in the university's policies around using AI in assessed work.

This coursework involves complex tasks that require students' original work and critical thinking, such as algorithm implementation, experimentation, and analysis. While AI tools can assist with proofreading and data visualisation, the core elements—including the literature review, implementation, experimental runs, and interpretation of results—must be the student's own work. **AI can make mistakes, and you are ultimately responsible for the correctness of the submitted work.** This approach allows for responsible AI use while ensuring the assessment meets its learning objectives and maintains academic integrity.

You can find further guidance on using GenAI critically, and how to use GenAI to enhance your learning, on Study Zone digital.

Instructions

CA2: Solving Complex Problems with Nature-Inspired Algorithms

INTRODUCTION

Your assignment is to tackle a problem from a conference using a Nature-Inspired technique. The problems are part of an international competition to develop a Nature-Inspired algorithm to solve a given problem in accordance with the goals as stated for each problem.

Your task is to optimise the travelling thief problem (TTF). The problem is bi-objective and you can find details about its structure at `https://www.egr.msu.edu/coinlab/blankjul/gecco19-thief/`.

You must implement a Nature-Inspired algorithm to solve the problem and write up your experiments as if they were to be presented at the conference. You have to provide solutions to the nine test instances in the competition. You can test more than one algorithm if you wish but you should only present one as the final 'best' algorithm.

HINT: To make the most of your time, it is likely to be beneficial for you to separate the task into subproblems that you can work on in parallel.

TASK

- **Carefully study the rules of the competition**. Make sure your implementation adheres to the requirements of the competition as close as possible.
- **In your team, discuss the various approaches that might be taken to solve this problem**. There is invariably more than one way to solve a particular problem and there will be a number of ways in which you might solve this problem with a Nature-Inspired method. You should perform research into the range of possible techniques that might be applied to this problem, including methods not covered in lectures. You should include a discussion of likely representations and fitness functions for each method you describe and select on a final method or methods to implement.
- **Develop an algorithm in your choice of language** (but bear in mind the deliverables for the competition) to solve the problem in the competition.
- **Perform experimentation** on the competition data/problem and make adjustments to the algorithm to improve performance. This might include the introduction of heuristics or modified operators to increase the performance of the algorithm (for instance, an adaptive mutation operator which varies the rate according to convergence).
- **Produce the deliverables for the problem** as stated on the competition page.
- **Keep minutes of the team meetings that have taken place, including who attended (virtual attendance through Teams/Zoom/Skype or similar is acceptable). This should be signed by all team members before submission.**

TEAM SUBMISSION (max 4 pages)

One member of the team will need to submit several additional elements electronically, with their individual submission:

1. A short report of maximum 4 pages (sides of A4, references do not count towards the limit) submitted by one team member and clearly identified with your team name. This report should describe the project including the research undertaken, the division of the larger problem into tasks, details of the developed algorithm and the results obtained.
2. The problem deliverables (as specified by the problem webpage) and commented code for your algorithm.
3. A set of signed minutes from the meetings.
4. A README file explaining how to reproduce the outputs.

Submit these electronically using ELE2 (https://ele.exeter.ac.uk/) as a zip file, **no later than 12 noon on the submission deadline given above.**

INDIVIDUAL SUBMISSION (max 4 pages)

Each team member will need to submit an individual report. The individual report and any material for the competition can overlap in content (max 10%), but please note that they will need to consist of mostly different information. The individual report should be no more than 4 pages (sides of A4, references do not count towards the limit) and should contain the following:

- A description of how you contributed to the project (e.g. sections of code that you wrote, experiments you conducted, or other tasks you undertook).
- A discussion of the algorithm survey: e.g.
  - What research was conducted to determine the best nature-inspired approach to this problem?
  - Which methods were identified as suitable for solving this problem?
  - Why were these chosen?
  - What representations and objective functions would be required for each method?
  - What were the reasons for the final algorithm selection?
- A discussion of the experimentation process: e.g.
  - What experiments did you conduct and why?
  - What changes to the algorithm were made to try to improve its performance?
  - Were the changes successful? If not, why not?
- A discussion of the teamworking process: e.g.
  - Did the team make use of all its available resources? If not, why not?
  - What were the most challenging and enjoyable aspects of working in a team?
  - Did all members of the team contribute?
- A conclusion section discussing the success of the overall approach, the teamworking process, and briefly any further approaches you consider might be appropriate.

Your individual report should be submitted via ELE2 (https://ele.exeter.ac.uk/), **no later than 12 noon on the submission deadline given above.**

Marking criteria

Submissions will be marked as follows:

TEAM (from the team deliverables)

10% How well you worked as a team: The degree to which tasks were effectively identified, planned, and distributed amongst team members, demonstrating clear coordination and collaborative decision-making.

20% Algorithm selection and implementation: The degree to which the algorithm selection process demonstrates comprehensive research of available approaches, provides well-reasoned justification for methodological choices, and includes appropriate representation schemes and algorithmic modifications.

10% Overall success and quality of the team submission: e.g. The degree to which the implemented algorithm effectively addresses the problem requirements, achieves good performance within computational constraints, and demonstrates professional presentation standards and code documentation.

INDIVIDUAL (from individual report)

20% Individual contribution to the task: To what extent does the individual contribute to each of the aspects of the task including the division of the task, the algorithm selection process, the implementation of the code and experimentation.

20% Discussion of experiments and modifications made to the algorithm: To what extent does the individual make use of their knowledge of Nature-Inspired Computation in determining the algorithm to use and suitable modifications to improve performance based on experimental results?

20% Quality of team-working discussion and conclusions: To what extent does the individual provide reasoned critical analysis of the team working process taking into account the skillsets, personalities and availability of other members in team?

Finally, you may be asked to individually attend a 15-minute 'viva' to discuss your role in the project in the case that there are conflicting accounts between team members and/or between the team and individual reports.

Over-length submissions will receive a penalty of -10% for each additional page over the limits described above.