# Assignment Specification

Module: Optimisation Techniques (6MA502)

Assignment Title: Coursework

Assessment Tutor: R. Conniss

Weighting Towards Module Grade: 100%

Date Set: 1 Oct 18

Hand-In Deadline Date: 11 Jan 19

Feedback Deadline: + 15 working days

## Penalty for Late Submission

There is no automatic right to late submission. After the Deadline, work accepted as 'Late Submission' will only be marked when there has been unexpected and severe disruption to study and has been authorised by the relevant Program Leader or Head of Joint Honours. Work submitted more than one week after the deadline will not be marked. The only exceptions to this rule are when the Module Leader, or nominee, has given permission for the work to be handed in late or you have been ill and produce appropriate certification. In both cases an online Exceptional Extenuating Circumstances Form (EEC) ([available here](https://udo.derby.ac.uk/sites/udohe/MyStudyGuidance/Pages/EEC.aspx)) should be completed before the Deadline Date. The EEC will be treated in line with the University’s policies and procedures.

## Level of Collaboration:

NONE

## Learning Outcomes:

1. Demonstrate a knowledge of the underlying concepts of optimisation and metaheuristics and apply appropriate techniques to a range of problems.
2. Derive solutions to various problems through the application and implementation of modern optimisation techniques;
3. Appraise and contrast a range of optimisation techniques, comparing the efficiency and effectiveness of traditional methods with current popular methods.

# Assignment Brief.

Students should select ONE of the coursework options detailed in this brief. Those who wish to submit a case study, MUST discuss the problem with the module leader before beginning work, to ensure that the study is at an appropriate level for the module.

Submission for both options will be via a technical report. Indicative word count will be 3500 words or a minimum of 8 pages at no more than 14-point font. Appendices are not required for the report and any code or other additional work should be submitted as a zip file along with your final submission.

## Option 1 – Technical Report – Default

Optimisation Techniques introduces you to three (computer intensive) modern heuristic methods: Gradient Descent/Hill Climbing, Simulated Annealing (SA) and Tabu Search (TS). The study materials provided, include a set of MATLAB routines which enable you to perform an in-depth investigation and comparison of these algorithms, within the context of application to functions.

### Problem 1

Minimise the following function using metaheuristic techniques:

**Hint**: The function is non- differentiable (at x=100) and code can be found here: <http://uk.mathworks.com/help/gads/example-global-vs-local-minima-with-ga.html>

### Problem 2

A manufacturer produces four types of cloth (A, B, C and D) in various patterns and colours. One length of cloth uses different colours of wool in the following amounts.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Cloth** | | | |  |
| **Wool Colour** | A | B | C | D | **Available Wool** |
| **Green** | 1 | 2 | 1 | 1 | 10 |
| **Red** | 2 | 1 | 2 | 1 | 6 |
| **Blue** | 3 | 1 | 0 | 0 | 10 |
| **Yellow** | 1 | 4 | 0 | 0 | 18 |
| **Brown** | 0 | 0 | 1 | 3 | 8 |
| **Purple** | 0 | 0 | 3 | 3 | 12 |

For each length of cloth, the following profit is obtained:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cloth** | **A** | **B** | **C** | **D** |
| **Profit** | 3 | 5 | 4 | 1 |

Formulate a Linear Programming model that maximises profit for the manufacturer. Using the model produced, attempt to maximise profits using metaheuristic methods. NOTE: The provided code will need to be developed to include constraint checking.

MATLAB example code for Tabu Search, Simulated Annealing and Hill Climbing is provided.

1. Carry out one iteration by hand to illustrate each of the methods used. It is sufficient to do this for one of the problems, to demonstrate you understand each of the methods you have used.
2. Implement your chosen set of algorithms in order to obtain your ‘best’ solution to the problems.
3. Compare the efficiency and success of each algorithm,
4. Experiment by changing parameters for the set of algorithms. Comment on the effect of these changes and describe how the changes have affected the solution time/efficiency. Changes could include, step size, neighbourhood selection rules and differing starting solutions.

**Electronic submission** via the module digital drop box (UDo Course Resources) is required.

## Option 2 – Case study – By Negotiation

After negotiation with the module leader, you may submit a case study based on a real-world application of optimisation.

This will take the form of a mini research project into a scheduling/timetabling/assignment problem for which you have access to data/domain knowledge.

The case study should be submitted as a technical report, following the same specifications as for Option 1.

**Electronic submission** via the module digital drop box (UDo Course Resources) is required

## Marking Criteria:

1. Efficient experimental design.
2. Appropriate choice of parameters.
3. Correct use/implementation of computerised algorithm.
4. Evidence of testing / validation.
5. Evidence of independence in learning. This could include an implementation of a metaheuristic method not taught on the module or use of a method where code has not been provided e.g Genetic Algorithms.
6. Appropriate technical report style, clear explanation of investigation, presentation of results using tables/diagrams as appropriate, together with a critical evaluation and appropriate conclusions.

|  |  |
| --- | --- |
| 70+ | Very good/excellent performance with respect to criteria 1-6. |
| 60-69 | Good performance with respect to most of the above criteria. |
| 50-59 | Satisfactory performance with respect to 1, 3, 4, 6. |
| 40-50 | Evidence of some understanding of the techniques investigated but significant shortcomings with respect to the given criteria |
| Less than 39 | Some understanding demonstrated but outweighed by errors and misconceptions. |

## Bonus Marks – Reflective piece – Optional

Up to an additional 10 marks are available by submitting a reflective piece on your learning during the module. The format for submission is not specified. Formats may include

* A written reflective piece of 500-1000 words
* A video log.
* A podcast
* Any other format I can access to mark in reasonable time.