Module Specification

Module Summary Information

1	**Module Title**	Modern Optimisation
2	**Module Credits**	20
3	**Module Level**	7
4	**Module Code**	CMP7213

5	**Module Overview**

As technological advances accelerate development and revolutionise the shape of our future, businesses and individuals compete ever so vigorously to maximise their efficiency. The competition involves cutting costs and making data-informed decisions. Also, the nature of data itself is evolving with the arrival of new technologies such as the Internet of Things (IoT). In fact, at its extreme, even the entire working or living environment can be treated as data: natural evolution is a well-established scientific theory that supports such a notion.

Optimisation is a branch of computing that leverages developments from domains as diverse as mathematics, statistics and natural sciences to model information from diverse data sources as cited above, in order to maximise objectives such as efficiency or profitability, or minimise goals such as costs and latency of services. Therefore, optimisation is used in domains as diverse as agriculture, banking engineering, finance and scientific explorations. These methods are also at the heart of a variety of Data Mining and predictive algorithms which maximise or minimise objective functions such as classification accuracy or classification error respectively. In fact, optimisation algorithms extend beyond that by modelling evolution of systems or optimising the control parameters of Data Mining algorithms.

In this module, students will study the internals of a number of modern optimisation methods. The choice of methods includes both local search methods (also called hill climbing methods), as well as global search methods where the objective landscape may include multiple local and potentially also global optima.

These methods will be presented such that the students can critique their strengths and weaknesses and also suggest improvements specific to situations under consideration. The students will also build a practical know-how by using a variety of modern tools and learning how to report the results appropriately.

Learning and Teaching

This module will utilise a hands-on approach to teaching. The teaching sessions will include individual/team based experiential activities such as critique of example scenarios; these scenarios will include situations tailored to make a point as well as real world case studies. Essentially, lectures will be largely interactive. Students will also apply the lessons learnt on problem scenarios by employing suitable software tools.

The module will suggest a series of pre-readings that the students are expected to have studied and investigated before the session. This will allow the sessions to facilitate advanced insights into the topics such as what students can do to make the algorithms perform better. Essentially, the experience will be an interplay between theory and practice. Students are expected to come to

sessions prepared and having completed all the exercises and activities set. Also, the students are expected to complete the in-session exercises; however, the students are also encouraged to investigate further through post session activities.

This module is very practical and students will be expected to complete all exercises in the order that they are presented. This approach will enable students to build their knowledge and skills.

6	Indicative Content

This module will cover the following topics:

Optimisation as Search
Gradient Based/ Hill Climbing Methods
Population based Search Methods
Multiobjective Optimisation
Constrained Optimisation

7	Module Learning Outcomes On successful completion of the module, students will be able to:	
	1	Critically evaluate different optimisation techniques for suitability to a given optimisation problem.
	2	Apply, compare and numerically validate optimisation methods using modern relevant tools.
	3	Professionally report results by giving their details and evaluating their significance.
	4	Critically review recent trends in optimisation literature.

8	Module Assessment			
Learning Outcome				
		Coursework	Exam	In-Person
1 - 4		X		

9	Breakdown Learning and Teaching Activities	
Learning Activities		Hours
Scheduled Learning (SL) includes lectures, practical classes and workshops, peer group learning, Graduate+, as specified in timetable		48
Directed Learning (DL) includes placements, work-based learning, external visits, on-line activity, Graduate+, peer learning, as directed on VLE		62
Private Study (PS) includes preparation for exams		90
Total Study Hours:		200