

MSc Computer Science modules 2012-13

Computational Operations Research

This module looks at ways in which computation can be used to optimise discrete solutions for complex real world problems that require decision-making. Originating from classical problems, a wide range of commercial issues arise of this nature, including resource allocation, scheduling and timetabling for airlines, hospitals, container movements through to green logistics and route optimisation for fuel efficiency. Efficient computational heuristic algorithms can be used to get highly near optimal solutions with relatively little computational effort. These approaches frequently support software packages that are adopted in a commercial setting. In this module students will look at wide-ranging artificial intelligence approaches that are used in this field. Valuable skills will be developed in framing problems as well as developing and deploying efficient techniques to achieve high quality solutions.

Distributed and Cloud Computing

The aim of this module is to familiarise students with a wide range of distributed systems, from truly decentralised peer-to-peer environments such as Gnutella and Jxta, to brokered Web Services and modular co-operating services supported by Jini through to centrally coordinated structures such as social networking sites and Clouds. The module studies the organisation of distributed systems, focusing on various architectural styles used in their development; core technologies to implement distributed systems; various models and infrastructures to support Cloud computing – such as virtualisation; and emerging themes in distributed computing, such as fault tolerance and policy driven autonomic self-management.

E-Commerce and Innovation

This module will develop your understanding of the new business opportunities afforded by the Internet. You will examine the concept of innovation and the techniques and underpinning technology associated with electronic commerce via case studies of companies both large and small. Group work will be used to develop your practical skills and will include the development of a business plan.

Forensics, Trust and Identity

Organisations require Trust and Identity Management Solutions to effectively and securely manage access to their networks. This module introduces the concepts of trust, privacy and identity and allows students to address the fundamental issues that affect an organisation's ability to undertake diverse transactions and maintain appropriate levels of assurance and integrity. In addition, this module looks at the correct forensic response to deal with an incident in a professional way. Case-based analysis will be undertaken to learn computer forensic techniques (across various operating systems and mobile devices) using industry standard software such as Micro Systemation XRY alongside open-source forensics tools. Students will also have the opportunity to gain external accreditation for use of forensic tools including the market-leading Micro Systemation XRY forensic software.

High Performance Computing

This module provides students with tools and techniques associated with programming in a High Performance Computing (HPC) environment. The module gives fundamental knowledge and understanding of techniques associated with HPC and its practical application. Students will practice parallel programming through the use of OpenMP, MPI and OpenCL and use the tools available to profile code and the use of libraries to improve application performance. This module will also cover the architectures and programming models of High Throughput Computing using platforms such as Condor and application acceleration using General Purpose Graphics Processing Units (GPGPUs).

Human Centric Computing

This module is concerned with how systems can deliver information effectively to end users, and how end users can interact with computing. Beyond the traditional desktop GUIs (Graphic User Interfaces) this module explores the next generation of interaction mechanisms (3D displays, gestures, tactile feedback, Augmented Reality, etc) in context and from a human centric perspective. This is considered with reference to theory from Human Computer Interaction (HCI), Visualisation and Pervasive Computing. Students will deconstruct, explore and evaluate case-based examples - including a state-of-the-art minimally invasive surgical simulation system - in order to understand and apply human centric system design methodologies.

Informatics

This module aims to provide students with fundamental knowledge and an understanding of the techniques associated with informatics – the science of acting and interaction with information. Students will focus on the generation, organisation, and dissemination of information in the web era, including the use of Semantic Web techniques and post-relational database management systems. The module will draw on the research strengths of the School and will include a number of in-depth case studies involving: GeoInformatics, Sensor Informatics, Health Informatics and Biodiversity Informatics. In each of these information is exploited to provide new knowledge and functionality to users in an important setting.

Information, Network and Cyber Security

This module focuses on the concepts of information security within the context of an organisation's IT and information systems. The fundamentals of network security are taught, from internal networks through to issues arising from Cloud computing. The module introduces the skills required for risk assessment and to design information security policies in line with standards, legal and ethical aspects of information security. The technical concepts of cryptography are introduced, and students will be taught to evaluate and use applications to secure information, networks, and manage personal identities.

Pattern Recognition and Data Mining

Within massive data sets important collective information is often hidden in the form of trends, patterns, structures and dependencies. This module introduces some classic and state-of-the-art Pattern Recognition, Machine Learning and Data Mining techniques. You will apply these methods when programming

examples using existing toolkits (such as WEKA) and examine and develop applications of these techniques using examples taken from different fields. Competing techniques will be assessed and the underlying strengths and drawbacks will be considered. On completion of the module students will be equipped with the ability to successfully tackle diverse problems to produce sophisticated insights on important relationships.

Programming Paradigms

This module explores the boundaries of what can be achieved through different approaches to programming. It provides a breadth of experience with a range of programming languages that an advanced computer scientist should have fluency in. The module considers choices and aspects of programming language design, and illustrates approaches to programming other than the imperative and object-oriented approaches. Students will study and use programming languages that support different programming paradigms such as parallel processing using OpenMP and MPI, functional code in Haskell and logic problems with Prolog. This module will also look at concurrency and parallel programming constructs and libraries.

Visual Computing

This module aims to provide students with fundamental knowledge and practical understanding of the programming, algorithmic and mathematical techniques associated with Visual Computing. Students will study and practice topics in Computer Aided Geometric Design, Advanced Image Processing and Computer Vision, together with the underpinning mathematical skills. The tools and techniques taught in this module are transferrable to a wide range of applications from robotic vision, rendering and biometrics. These techniques underpin many of the advanced applications that support diverse multimedia.

Web and Social Computing

The web now increasingly facilitates and exploits social interactions between individuals for a wide range of purposes and applications, from social network services for communication and self-expression through to collaborative crowd sourcing for collaborative filtering, online auctions and reputation systems. At the same time, an enormous diversity of devices and information sources are becoming connected to the web, including sensors and linked databases. Increasingly social services are woven with the physical world through the use of mobile devices and sensors, enabling social services to have a spatial or geographical context, often able to draw on highly-local data. This module looks at how social computation can be exploited to provide knowledge and feedback for societal and commercial applications. The module examines a range of key theoretical, modelling and implementation issues that underpin social computing via the web.