# School of Computer Science

# Study Abroad Module Handbook 2024/25

**Module Title:** LC Computer Systems and Professional Practice

**Module Code:** 40086

**Semester:** 1

**Credits:** 20

**Level:** LC

**Module Description:** An understanding of fundamental concepts in the design and implementation of computer systems is essential to the development of computer scientists, particularly where they will operate in scientific and professional environments. This module provides students with an introduction to computer systems design, focusing on fundamental concepts in computer architecture, and the contexts in which computer systems are commonly deployed, covering legal, social, ethical, and professional issues relevant to computing professionals. Students will also gain a range of technical skills in the design and implementation of electronic circuits and systems-level computer programs.

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**Module Title:** LC Mathematical and Logical Foundations of Computer Science

**Module Code:** 35324

**Semester:** 1

**Credits:** 20

**Level:** LC

**Module Description:** Mathematical and logical reasoning underpins almost all of Computer Science, from linear algebra in graphics and machine learning, to algebra in cryptography and logic in verification. This module introduces essential topics in mathematics and logic including linear algebra; abstract algebra; set theory (a fundamental language of mathematics); and propositional and predicate logic. The key ideas will be illustrated with applications across a range of topics in computer science.

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**Module Title:** LC Object Oriented Programming

**Module Code:** 34229

**Semester:** 1

**Credits:** 20

**Level:** LC

**Module Description:** Object oriented programming is one of the most popular techniques in industrial software development. This module will introduce students to the principles of object-oriented programming, imperative algorithms and data structures.

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**Module Title:** LC Theories of Computation

**Module Code:** 35393

**Semester:** 2

**Credits:** 20

**Level:** LC

**Module Description:** Computers have been used to solve an astonishing range of different problems, but this does not mean that they can be used to solve all possible problems: some cannot be solved efficiently, and some cannot be solved at all. In this module, we will introduce a set of principles and techniques for formalising computation and computability to understand what problems can be solved, how efficiently they can be solved, and what problems cannot be solved. We will develop mathematical models of computations using ideas such as sutomata theory (including Turing machines), of formal languages using ideas such as regular expressions and grammars and will conclude by considering the notions of non-computability and complexity.

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**Module Title:** LC Artificial Intelligence 1

**Module Code:** 34238

**Semester:** 2

**Credits:** 20

**Level:** LC

**Module Description:** Artificial Intelligence (AI) is the area of Computer Science which studies algorithms capable of problem solving and learning. In recent years AI systems have become increasingly prominent in society and industry. This module will introduce fundamental concepts from AI and Machine Learning, covering knowledge representation, search, optimisation and learning. It will provide experience applying these concepts to solve practical problems.

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**Module Title:** LC Data Structure & Algorithms

**Module Code:** 30175

**Semester:** 2

**Credits:** 20

**Level:** LC

**Module Description:** Algorithms lie at the heart of Computer Science and software development. They embody the way in which we solve problems using computers. This module will introduce the fundamentals of data structures and algorithms. Data structures will be formulated to represent information in such a way that it can be conveniently and efficiently manipulated by the algorithms that are developed. The ideas will be presented both abstractly, and via problem-solving and implementations.

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**Module Title:** LI Operating Systems and Systems Programming

**Module Code:** 38059

**Semester:** 1

**Credits:** 20

**Level:** LI

**Module Description:** An Operating System is the system software that manages computer hardware, hardware and software resources and provides common services for user programs. System programming is the type of programming necessary to produce software, such as operating systems, that deal with hardware, provide services to other software or manage performance constraints. This module teaches the technology of operating systems and introduces students to the challenges of systems-level programming.

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**Module Title:** LI Functional Programming

**Module Code:** 34253

**Semester:** 1

**Credits:** 20

**Level:** LI

**Module Description:** This module develops practical programming skills in a typed functional programming language. It will strengthen the algorithmic and design skills of the students within the functional framework and will introduce them to some advanced programming language features.

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**Module Title:** LI Software Engineering and Professional Practice

**Module Code:** 34257

**Semester:** 1

**Credits:** 20

**Level:** LI

**Module Description:** This module introduces students to the field of software engineering and the principles of systematically engineering large scale software systems. The module covers widely used techniques for engineering requirements, designing and modelling, and architecting dependable and evolvable software. The module discusses Software Quality Assurance, testing and project management with appreciation to the economical, legal and ethical aspects.

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**Module Title:** LI Security and Networks

**Module Code:** 30195

**Semester:** 2

**Credits:** 20

**Level:** LI

**Module Description:** As computers are embedded in everyday life, protection against the criminal or unauthorized use of electronic data is essential and measures must be taken to achieve this. The module will introduce a range of topics in the theory and practice of computer security, including attacks, vulnerabilities and defences. Cloud and Web services will be used as a motivating example for the importance of security.

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**Module Title:** LI Artificial Intelligence 2

**Module Code:** 34255

**Semester:** 2

**Credits:** 20

**Level:** LI

**Module Description:** Artificial Intelligence (AI) and Machine Learning are often applied in situations characterised by various kinds of uncertainty, for example uncertainty in data measurements, missing data or uncertainty in our prior knowledge about the problem. This module will provide principles that enable AI to treat uncertainty consistently in inference, search, optimisation and learning.

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**Module Title:** LH Advanced Networking / LM Advanced Networking (Extended)

**Module Code:** 30209 / 30236

**Semester:** 1

**Credits:** 20

**Level:** LH / LM

**Module Description:** One of the defining characteristics of today's computer systems is their ability to exchange information. Whether we are talking about the smallest home network or the Internet as a whole, computer networks play a key role in many computer applications. An enormous number of applications, from general services such as the World Wide Web to specialised messaging or video streaming apps rely on networks and the common standards and protocols which make them work. This module introduces the basic concepts, technologies, architectures and standards involved in computer networks, together with methods for their design and implementation. This will include discussion of data transmission protocols, TCP/IP, LANs and WANs, communication mechanisms and synchronization issues. The module will be based on the discussion of real-world case studies, research papers and standardisation documents.

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**Module Title:** LH Dependable and Distributed Systems / LM Dependable and Distributed Systems (Extended)

**Module Code:** 38963 / 38966

**Semester:** 2

**Credits:** 20

**Level:** LH / LM

**Module Description:** Distributed systems have become commonplace, with such systems providing the vast majority of services that we have come to depend on every day. This module studies a range of topics in distributed systems from a practical and theoretical perspective. Students will learn how to analyse, design and implement efficient, fault tolerant solutions to modern problems throughout a rigorous understanding of classical approaches and results.

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**Module Title:** LH Intelligent Data Analysis / LM Intelligent Data Analysis (Extended)

**Module Code:** 38964 / 38968

**Semester:** 1

**Credits:** 20

**Level:** LH / LM

**Module Description:** The ‘information revolution’ has generated large amounts of data, but valuable information is often hidden and hence unusable. In addition, the data may come in many different forms, e.g. high-dimensional data collections, stream and time-series data, textual documents, images, large-scale graphs representing communication in social networks or protein-to-protein interactions etc. This module will introduce a range of techniques in the fields of pattern analysis, data analytics and data mining that aim to extract hidden patterns and useful information in order to understand such challenging data.

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**Module Title:** LH Machine Learning / LM Machine Learning (Extended)

**Module Code:** 38965 / 38969

**Semester:** 1

**Credits:** 20

**Level:** LH / LM

**Module Description:** Machine learning studies how computers can autonomously learn from available data, without being explicitly programmed. The module will provide a solid foundation to machine learning by giving an overview of the core concepts, theories, methods, and algorithms for learning from data. The emphasis will be on the underlying theoretical foundations, illustrated through a set of methods used in practice. This will provide the student with a good understanding of how, why and when various machine learning methods work.

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**Module Title:** LH Neural Computation / LM Neural Computation (Extended)

**Module Code:** 32167 / 32212

**Semester:** 1

**Credits:** 20

**Level:** LH / LM

**Module Description:** This course focuses on artificial neural networks and their use in machine learning. It covers the fundamental underlying theory, as well as methodologies for constructing modern deep neural networks, which nowadays have practical applications in a variety of industrial and research domains. The course also provides practical experience of designing and implementing a neural network for a real-world application.

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**Module Title:** LH Intelligent Interactive Systems / LM Intelligent Interactive Systems (Extended)

**Module Code:** 37809 / 37792

**Semester:** 2

**Credits:** 20

**Level:** LH / LM

**Module Description:** Computer systems are increasingly designed to cooperate with people. For example, semi-autonomous vehicles automate part of the problem of driving but leave overall control with a human driver. Similarly, medical systems make use of vast amounts of data and the latest machine learning but must work with doctors to determine a diagnosis. Similarly, decision supports systems, tutoring systems, dialogue systems, and recommender systems. These Intelligent Interactive Systems, and the theory of human psychology that underpins them are the subject of this module.

This is an area of computer science that is making rapid progress with new theory and methods influencing real-world systems. It is an area that is driven, in part, by the vast amount of data concerning human behaviour that is now routinely collected and the desire to not simply classify it but to understand it. The module will introduce students to this new and exciting topic and to the methods needed to build Intelligent Interactive Systems. There will be a strong focus on algorithms for modelling and understanding people using computers.

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**Module Title:** LI Building Useable Software / LM Building Usable Software

**Module Code:** 34206 / 34208

**Semester:** 1

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module will introduce the concept of user-centred software design, integrating concepts from software engineering such as the software life cycle and modern methodologies for software development with the main principles of human-computer interaction (HCI).

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**Module Title:** LI Computer Systems / LM Computer Systems

**Module Code:** 34212 / 34221

**Semester:** 1

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module will cover the fundamental principles of computer systems, including how information is represented in computers, how computer programs are executed, the relationship between software and hardware, reasoning about programs, and the foundations of operating systems and network technologies.

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**Module Title:** LI Software Workshop 1 / LM Software Workshop 1

**Module Code:** 34168 / 34153

**Semester:** 1

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module introduces and develops the principles of object oriented and imperative programming. Students will learn how to design and develop computer programs using an object-oriented programming language, and how to test their correctness. The development of complete applications with a graphical user interface (GUI) will be introduced.

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**Module Title:** LI Artificial Intelligence & Machine Learning / LMArtificial Intelligence & Machine Learning

**Module Code:** 34190 / 36404

**Semester:** 2

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module introduces the core concepts of artificial intelligence and machine learning. The principal focus of the module will be on the underlying principles such as knowledge representation, search, decision theory, probability, and statistical learning.

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**Module Title:** LI Data Structures, Algorithms and Databases / LM Data Structures, Algorithms and Databases

**Module Code:** 34139 / 34140

**Semester:** 2

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module will introduce a range of methods for working with data. Fundamental abstract data structures and their associated algorithms will be introduced, and their representation in high-level programming languages will be discussed. The fundamental principles of database systems will be introduced, including the necessary mathematical background and the practical application.

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**Module Title:** LI Software Workshop 2 / LM Software Workshop 2

**Module Code:** 34169 / 34157

**Semester:** 2

**Credits:** 20

**Level:** LI / LM

**Module Description:** This module will develop advanced object-oriented software development skills. Students will learn how to work with complex data structures and algorithms (including those that are recursive) and will learn how to build programs with components that run concurrently and over networks. In addition, the students will work in teams to build a substantial piece of software from specification through analysis and design to implementation.

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