UNIVERSITY OF LIVERPOOL

Computer Science MEng

COURSE DETAILS

- A level requirements: AAA
- UCAS code: G401
- Study mode: Full-time
- Length: 4 years

KEY DATES

- Apply by: 25 January 2023
- Starts: 25 September 2023

Course overview

From the underlying principles to the very edge of modern technology, this programme will cover all aspects of Computer Science and ensure that when you graduate you will know exactly what is and isn't possible with computers.

INTRODUCTION

Study Computer Science at Liverpool and develop a deep understanding of the technology that underpins much of modern life and society. Computer Science is a great choice for those with a keen interest in computers, software and technology. You'll create functional applications as well as how to consistently iterate and improve your work.

After learning core theory you can choose to maintain a balanced mixture of modules throughout your degree or opt to follow a specialist pathway in artificial intelligence, algorithms and optimisation or data science.

This integrated master's programme offers the same specialism pathways as Computer Science BSc (Hons). You will not only develop a good 'all-round' understanding of the academic discipline of computer science, you will also go on to develop a much deeper and systematic specialisation in topics at the forefront of current research.

In the first two years you will cover programming, computer systems, databases, software engineering, algorithmic foundations, complexity of algorithms & decision and computation & language.

The course is accredited by the British Computer Society which means that the course is continually updated and adapted to reflect new technologies and emerging trends.

After you've covered the core elements, we give you the flexibility to tailor your own learning to your own interests, offering

specialisms in in artificial intelligence, algorithms and optimisation, data science, and software development.

WHAT YOU'LL LEARN

- Programming in Java
- Understanding different computer systems
- Building and structuring databases
- Fundamentals of software engineering
- Algorithmic foundations
- Complexity of algorithms and decision
- Computation and language
- Uses and possibilities of biocomputation
- Introduction of computation game theory
- Complex social networks

ACCREDITATION

Accredited by the British Computer Society so opens up a wide variety of career opportunities with excellent employment prospects.

Course content

Discover what you'll learn, what you'll study, and how you'll be taught and assessed.

YEAR ONE

In year one you will learn the fundamentals of Computer Science. Starting with an introduction to procedural programming using commonly found language platforms, you'll move on to learn about the importance of hardware and software components within the operation of computer systems, formal analytic techniques and the development of artificial intelligence.

In year one students will typically undertake either COMP101 (Introduction to Programming) or COMP105 (Programming Language Paradigms) based on prior exposure to programming (eg Computer Science A level). Students without a computer science background will normally study COMP101, however in some instances may be permitted to enrol on COMP105 instead.

All other year one modules are required.

COMPULSORY MODULES

ANALYTIC TECHNIQUES FOR COMPUTER SCIENCE (COMP116)

Credits: 15 / Semester: semester 2

Many areas of Computer Science rely on formal analytic techniques and this module presents a basic grounding in a number of these topics focusing on their role and application to computational issues. Among the topics reviewed are Linear Algebra (with particular attention to Matrix Theory); Statistical aspects; Introductory calculus including the concepts of limits, continuity, basic differentiation and integration formulae; properties of Complex Numbers. If time allows a very brief overview of the principles of Information Theory will be included. The overriding aim of this module is to present the methods discussed in the context of practical Computer Science, and as such the emphasis will be on instilling confidence in applying techniques and not on providing rigorous supporting justifications of their validity.

COMPUTER SYSTEMS (COMP124)

Credits: 15 / Semester: semester 2

This module provides a basic introduction to the important hardware and software components supporting the operation of computer systems. The module presents coverage of how low-level hardware components are organised so as to provide a platform on which complex software systems can be built. Coverage includes the important components of modern operating systems, including abstractions such as processes and concurrency. There is an opportunity to gain some practical awareness of low-level programming and a modern command-line environment.

DATA STRUCTURES AND ALGORITHMS (COMP108)

Credits: 15 / Semester: semester 2

This module introduces students to some basic algorithms and data structures. It gives some fundamental concepts of design and analysis of algorithms, and implementation of algorithms by choosing appropriate data structures.

DESIGNING SYSTEMS FOR THE DIGITAL SOCIETY (COMP107)

Credits: 15 / Semester: semester 1

This module will provide students with an all rounded appraisal of what is expected from a computing professional in the current digital society. Students will be introduced to social, legal and ethical aspects on computing and will develop employability skills. As a way to blend both theory and practice, students will be equipped with concepts and techniques for designing digital systems tailored to the needs of the user.

FOUNDATIONS OF COMPUTER SCIENCE (COMP109)

Credits: 15 / Semester: semester 1

This module provides students with the mathematical foundation, mathematical tools and basic proof techniques necessary for the study of Computer Science and develops the study skills necessary to learn new concepts in this area.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE (COMP111)

Credits: 15 / Semester: semester 1

Artificial intelligence (AI) is the theory and development of machines able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. In the 21st century, AI techniques became an essential part of the technology industry. High-profile examples include autonomous vehicles, medical diagnosis, creating art, proving mathematical theorems, playing games, search engines, and online assistants. This module provides an application driven introduction to AI through studying the basic problems most AI systems have to deal with: search problems, reasoning under uncertainty, knowledge representation, planning, and learning in intelligent systems. The module will also provide a basic introduction to the history and philosophy of AI as well as recent issues in ethics of AI.

OBJECT-ORIENTED PROGRAMMING (COMP122)

Credits: 15 / Semester: semester 2

The intention of COMP122 is to introduce students to the concepts and methodology of object-oriented programming using the Java programming language. Topics covered include hierarchical structures, polymorphism, collections and iterators, exception handling, and graphical user interface design. Basic concepts of software design methodology, testing, and version control are also included in the module. It is normally expected that students have prior programming experience.

OPTIONAL MODULES

INTRODUCTION TO PROGRAMMING (COMP101)

Credits: 15 / Semester: semester 1

The module provides an introduction to procedural programming using current language platforms. The module incorporates program design, problem solving, the importance of maintainable, robust software and testing as well as introducing procedural language main programming constructs. Students gain practical experience with program design, programming and testing during weekly laboratory sessions.

PROGRAMMING LANGUAGE PARADIGMS (COMP105)

Credits: 15 / Semester: semester 1

This module is for students that already have some programming skills. Students will learn about the two main programming paradigms: imperative programming and functional programming. Since most introductory programming courses teach imperative programming, this module will focus on the functional paradigm. Students will learn how to program in Haskell, a popular functional programming language. They will learn how to formulate programs in a functional way, and the common techniques and idioms that are used to solve problems in functional programming.

Programme details and modules listed are illustrative only and subject to change.

YEAR TWO

In year two you will expand your knowledge of key concepts and skills related to software development and database development. You will also begin to choose which wider elements of computer science you want to engage with such as cyber security, computer based trading in financial markets and principles of computer game design.

You will take the compulsory modules listed, in addition to selected optional modules. Depending on your choice of optional modules you will be able to graduate with one of the following degrees

- MEng Computer Science
- MEng Computer Science with Artificial Intelligence

- MEng Computer Science with Algorithms and Optimisation
- MEng Computer Science with Data Sciences

COMPULSORY MODULES

COMPLEXITY OF ALGORITHMS (COMP202)

Credits: 15 / Semester: semester 2

DATABASE DEVELOPMENT (COMP207)

Credits: 15 / Semester: semester 1

This module introduces students to the problems arising from databases, including concurrency in databases, information security considerations and how they are solved; the integration of heterogeneous sources of information and the use of semi-structured data; non-relational databases and the economic factors involved in their selection and to techniques for analysing large amounts of data, the security issues and commercial factors involved with them.

GROUP SOFTWARE PROJECT (COMP208)

Credits: 15 / Semester: semester 2

Software development skills form a fundamental part of the professional expertise of a Computer Scientist. Often the development is a team activity. The module provides the students with the unique opportunity to complete a sizeable software development project working as part of team.

SOFTWARE ENGINEERING I (COMP201)

Credits: 15 / Semester: semester 1

This module deals with the issues associated with the analysis, design, implementation and testing of significant computing systems (that is, systems that are too large to be designed and developed by a single person).

OPTIONAL MODULES

ADVANCED OBJECT ORIENTED C LANGUAGES (COMP282)

Credits: 7.5 / Semester: semester 2

This module looks at the ways in which the C programming language can be extended to incorporate object oriented principles. Using two example languages – C++ and C# – it compares and contrasts unmanaged and managed coding approaches. The module also examines the ways in which object orientation offers a natural means of developing graphical, event-driven applications within a powerful IDE.

ADVANCED ARTIFICIAL INTELLIGENCE (COMP219)

Credits: 15 / Semester: semester 1

This module will provide students with an introduction to the machine learning. It will contain traditional machine learning algorithms, deep learning algorithms, and probabilistic graphical models. Both theoretical knowledge and practical skills will be offered.

COMPUTER AIDED SOFTWARE DEVELOPMENT (COMP285)

Credits: 7.5 / Semester: semester 2

This module covers the theory and practice of the application of tools to the software development lifecyle

COMPUTER-BASED TRADING IN FINANCIAL MARKETS (COMP226)

Credits: 15 / Semester: semester 2

COMPUTER NETWORKS (COMP211)

Credits: 15 / Semester: semester 1

This module provides an introduction to current computer networks and communications technologies. We will use the architecture and protocols of the Internet as a primary vehicle for studying fundamental computer networking concepts. This will include an in-depth study of the key protocols that enable communications accross the Internet. You will become familiar with the various network devices and network addressing schemes. We will identify critical network security issues and study approaches towards addressing these issues.

INTRODUCTION TO THEORY OF COMPUTATION (COMP218)

Credits: 15 / Semester: semester 1

This module aims to introduce formal concepts of automata, grammars and languages; to introduce ideas of computability and decidability, and to illustrate the importance of automata, formal language theory and general models of computation in Computer Science and Artificial Intelligence.

DISTRIBUTED SYSTEMS (COMP212)

Credits: 15 / Semester: semester 2

This module covers the concepts of distributed systems and the underlying principles of distributed computing and discusses the issues and various solutions proposed in the distributed computing community. Specifically, communication and broadcast, election algorithms, synchronization and concurrency, fault-tolerance and security related issues will be discussed in the lectures. Where applicable practical implementations of the concepts will be introduced.

PLANNING YOUR CAREER (COMP221)

Credits: 7.5 / Semester: semester 1

This module aims to provide a more in depth experience of crucial employability skills needed to secure either a placement or a graduate job.

PRINCIPLES OF C AND MEMORY MANAGEMENT (COMP281)

Credits: 7.5 / Semester: semester 2

When dealing with computationally intensive tasks, such as in scientific computing, it is important to make the most out of the available computational resources. In order to accomplish this, one can use low-level programming languages, such as assembly, but the downside is that these are difficult to write, port and maintain. Alternatively, one can pick a high-level language with a small computational overhead. This module will teach how to program in one such a language: the C programming language.

PRINCIPLES OF COMPUTER GAMES DESIGN AND IMPLEMENTATION (COMP222)

Credits: 15 / Semester: semester 2

This module introduces topics commonly present in the modern computer games from software architecture principles to advanced artificial intelligence techniques to the creation of 3D content. As part of the continuous assessment, students create a simple 3D video game using an existing game engine and an AI control procedure for a multiuser framework.

SCRIPTING LANGUAGES (COMP284)

Credits: 7.5 / Semester: semester 2

COMP284 `Scripting Languages' is one of several technical skills/employability skills modules offered in the second semester of the second year of study. It addresses both the demand by employers and the desire of students that students should encounter a range of programming languages during their studies and should be able to use these programming languages productively. Scripting languages have gained enormously in their popularity with the expansion and development of the world wide wide and world wide web technologies as they are now the predominant languages used in the development of web applications. The module will cover two scripting languages, namely, JavaScript and PHP. At the end of the module students should be able to develop applications, both web-based and computer-based, in them.

SOFTWARE DEVELOPMENT TOOLS (COMP220)

Credits: 15 / Semester: semester 2

This module covers the skills and knowledge required for the effective use of tools in the software development lifecycle.

CYBER SECURITY (COMP232)

Credits: 15 / Semester: semester 2

The module provides a thorough introduction to the area of Cyber Security, including cryptographic algorithms and protocols, systems vulnerabilities and attacks, computer networks and web security. The main basic concepts and theoretical foundations are presented in the lectures, while extensive practical sessions support the development of skills in practical cybersecurity.

INTRODUCTION TO DATA SCIENCE (COMP229)

Credits: 15 / Semester: semester 1

This module provides a thorough introduction to the new subject of Data Science starting from the fundamental mathematical methods and developing real-life applications in several areas including Pattern Recognition, Materials Science, Computer Vision, Climate Analysis. The basic concepts from Linear Algebra and Metric Geometry will be gradually introduced without assuming any prior knowledge. The methods and algorithms from Graph Theory and Computational Geometry will be illustrated by worked examples and short programs/scripts.

APP DEVELOPMENT (COMP228)

Credits: 15 / Semester: semester 1

App Development is an exploration of the design and programming of application programs on mobile devices. It covers topics such as how to design for small displays and non-traditional input devices; what the expectations of mobile users are; how to use publicallly accessible data sources to develop innovative solutions.

PROGRAMMING LANGUAGE PARADIGMS (COMP105)

Credits: 15 / Semester: semester 1

This module is for students that already have some programming skills. Students will learn about the two main programming paradigms: imperative programming and functional programming. Since most introductory programming courses teach imperative programming, this module will focus on the functional paradigm. Students will learn how to program in Haskell, a popular functional programming language. They will learn how to formulate programs in a functional way, and the common techniques and idioms that are used to solve problems in functional programming.

Programme details and modules listed are illustrative only and subject to change.

YEAR THREE

Year three is where you will start to build on what you've learnt to far with your own research and exploration by undertaking an individual project. Whilst guided, you will work independently to explore a substantial computer science problem in depth,

making use of the principles, techniques and methodologies acquired elsewhere in the programme.

You will take the compulsory modules listed, in addition to selected optional modules. Depending on your choice of optional modules you will be able to graduate with one of the following degrees

- MEng Computer Science
- MEng Computer Science with Artificial Intelligence
- MEng Computer Science with Algorithms and Optimisation
- MEng Computer Science with Data Sciences

COMPULSORY MODULES

HONOURS YEAR COMPUTER SCIENCE PROJECT (COMP390)

Credits: 30 / Semester: whole session

The honours year project gives students the opportunity to study independently on an extended piece of work under the guidance of an academic supervisor. Many diverse projects are available for selection, inspired by the research of the department. Each student is encouraged to propose a project in an area that meets their own personal needs, whether it's related to their career aspirations or simply an interesting academic pursuit. The project consolidates learning from the taught part of the course, with authentic assessment that is designed to encourage communication of complex ideas via a range of media. On completion of the module, students will have the confidence to pursue their career, having developed proficiency in their chosen topic and an ability to communicate clearly and effectively.

OPTIONAL MODULES

BIOCOMPUTATION (COMP305)

Credits: 15 / Semester: semester 1

Biology inspired adaptive algorithms such as Artificial Neural Networks (ANNs) and Genetic Algorithms (GAs) play an important role in modern computing, information processing, and machine learning. The latest increase in computer power ensured broad use of the algorithms to solve problems in science and engineering previously considered impossible to tackle. ANNs are now broadly used in pattern recognition, including speech recognition and classification problems, statistics, functional analysis, modelling financial series with considerable stochasticity, etc. GAs are search procedures based on the mechanics of natural selection and natural genetics. They provide effective solutions to a variety of optimisation problems in economics, linguistics, engineering, and computer science. Both ANNs and GAs can exploit massively parallel architectures to speed up problem solving and provide further understanding of intelligence and adaptation.The main goals of the module are to introduce students to some of the established work in the field of Artificial Neural Networks and Genetic Algorithms and their applications, particularly in relation to multidisciplinary research. To equip students with a broad overview of the field, placing it in a historical and scientific context. The module provides students with the knowledge and skills necessary to keep up-to-date in actively developing areas of science and technology and be able to make reasoned decisions.

COMPLEX INFORMATION NETWORKS (COMP324)

Credits: 15 / Semester: semester 2

Complex network structures are ubiquitous: the world-wide web, the internet, mobile phone networks, social communities, network structures in
biology are just a few popular examples. The module shows how simple combinatorial and algorithmic techniques can be exploited to obtain useful information
about these (often) massive structures. The content is delivered through a mixture of lectures on core topics and more informal presentations on
various application areas. A series of interactive tutorials and on-line tools in VITAL complete the support offered by this module.

COMPUTATIONAL GAME THEORY AND MECHANISM DESIGN (COMP326)

Credits: 15 / Semester: semester 2

In this module we introduce and study games that have some underlying network structure or that appear in auctions. A focus will be on scheduling and routing, as well as on the computational aspects in the design of mechanisms and auctions.

EFFICIENT SEQUENTIAL ALGORITHMS (COMP309)

Credits: 15 / Semester: semester 1

This module aims to teach students some advanced topics in the design and analysis of efficient sequential algorithms, and a few key results related to the study of their complexity.

FORMAL METHODS (COMP313)

Credits: 15 / Semester: semester 2

IMAGE PROCESSING (ELEC319)

Credits: 7.5 / Semester: semester 1

This module covers the fundamentals of how images are generated, represented, compressed and processed to extract features of interest.

INTRODUCTION TO COMPUTATIONAL GAME THEORY (COMP323)

Credits: 15 / Semester: semester 1

This module is an introduction to the area of algorithmic game theory, which is a novel area in the intersection of economics and computer science. It provides tools for dealing with and analysing problems related to applications motivated by the Internet. Examples involve various Internet auctions and e-commerce systems, like, Google's sponsored search, Ebay auctions, recommendation systems, etc.

KNOWLEDGE REPRESENTATION AND REASONING (COMP304)

Credits: 15 / Semester: semester 1

This module presents formal ways to reason about knowledge and uncertain or partial information.

MULTI-AGENT SYSTEMS (COMP310)

Credits: 15 / Semester: semester 2

NEURAL NETWORKS (ELEC320)

Credits: 7.5 / Semester: semester 2

Introduction to neural network theory, applications and artificial intelligence.

ONTOLOGIES AND SEMANTIC WEB (COMP318)

Credits: 15 / Semester: semester 2

This modules provides a basic introduction to the main principles behind representing and retrieving knowledge effectively on the Web. The module covers the evolution from the standard Web to the Semantic Web, and gives student the opportunity to gain an awareness of the main methods and techniques, including practical awareness, of the main issues arising in annotating web pages with semantic information, in interlinking pages with similar semantic content and in effectively querying these pages.

OPTIMISATION (COMP331)

Credits: 15 / Semester: semester 1

This module is an indepth tour over optimisation methods applied for various optimisation models. These methods are extensively used in both academic and industrial practices.

AUTONOMOUS MOBILE ROBOTICS (COMP329)

Credits: 15 / Semester: semester 1

The aims of this module are to develop an understanding of the principals of Robotics and Autonomous Systems, as well as the pragmatic skills of developing such systems on top of a Robotics Platform.

TECHNOLOGIES FOR E-COMMERCE (COMP315)

Credits: 15 / Semester: semester 2

COMPUTER FORENSICS (COMP343)

Credits: 15 / Semester: semester 2

Forensic Computing involves the examining and analysing of data retrieved from various computer storage mediums, to be used as evidence in a court of law. Students will develop the skills and knowledge to undertake a forensic computing investigation in a systematic manner utilising existing methods, tools and techniques.

BIG DATA ANALYTICS (COMP336)

Credits: 15 / Semester: semester 1

This module provides an initial overview of key algorithms and algorithmic approaches and corresponding software environments used when developing solutions to Big Data problems and explains how to use these to analyse data. A significant portion of statistics, some advanced AI approaches as well as key deterministic and hybrid algorithms are included to support the development of future data analytics and to understand how to develop stochastic, machine learning and hybrid algorithms that can exploit Big Data and can be applied to solve real life problems.

COMPUTER VISION (COMP338)

Credits: 15 / Semester: semester 1

This module provides an introduction to the topic of Computer Vision and helps students develop the practical skills necessary to build computer vision applications. It presents fundamental problems in both 2D and 3D vision with a variety of classical and emerging approaches to overcome them.

DATA MINING AND VISUALISATION (COMP337)

Credits: 15 / Semester: semester 2

To provide an in-depth, systematic and critical understanding of some of the current research issues at the forefront of the academic research domain of data mining. Google search framework and IBM Watson QA system and various other industrial level data mining applications are discussed.

HIGH PERFORMANCE COMPUTING (COMP328)

Credits: 15 / Semester: semester 2

ADVANCED TOPICS IN COMPUTER GAME DEVELOPMENT (COMP342)

Credits: 15 / Semester: semester 2

This modules aims to cover advanced concepts underpinning computer games development; including game AI, content generation, graphics, physics and sound. As part of the continuous assessment, students apply those concepts to computer games development.

Programme details and modules listed are illustrative only and subject to change.

YEAR FOUR

In year four you will join with the MSc programme for students with a computer science first degree. You will undertake a research-oriented group project in the first semester and a research-oriented individual project in the second. Alongside your compulsory modules, you will also select from a range of optional modules.

COMPULSORY MODULES

MENG GROUP PROJECT (COMP591)

Credits: 30 / Semester: semester 1

The MEng Group project is to give students the opportunity to work in a group, in a guided but independent fashion, on a substantial problem that allows to show innovation and creativity, to make practical use of principles, techniques and methodologies acquired elsewhere in the programme. The MEng Group Project will provide students with experience of carrying out a large piece of group work involving the synthesis of advanced information, ideas and practices to achieve a quality solution together, with a critical evaluation of the process and the solution.The Group Project will enhance students' communication skills, both oral and written, in particular through collaboratively producing a report that documents the conduct of the project, the solution produced and giving a critical evalution of process and solution.

MENG INDIVIDUAL PROJECT (COMP592)

Credits: 30 / Semester: semester 2

OPTIONAL MODULES

ADVANCED ALGORITHMIC TECHNIQUES (COMP523)

Credits: 15 / Semester: semester 2

This module aims to teach basic algorithmic methods for design and analysis of algorithms.

EFFICIENT ALGORITHMS (COMP526)

Credits: 15 / Semester: semester 1

Masters module on practical algorithms and data structures for large datasets.

BIG DATA ANALYTICS (COMP529)

Credits: 15 / Semester: semester 1

This module provides an initial overview of key algorithms and algorithmic approaches and corresponding software environments used when developing solutions to Big Data problems and explains how to use these to analyse data. A significant portion of statistics, some advanced AI approaches as well as key deterministic and hybrid algorithms are included to support the development of future data analytics and to understand how to develop stochastic, machine learning and hybrid algorithms that can exploit Big Data and can be applied to solve real life problems.

COMPUTATIONAL INTELLIGENCE (COMP575)

Credits: 15 / Semester: semester 2

Biologically inspired optimisation and introduction to neural networks for artificial intelligence.

DATA MINING AND VISUALISATION (COMP527)

Credits: 15 / Semester: semester 2

To provide an in-depth, systematic and critical understanding of some of the current research issues at the forefront of the academic research domain of data mining. As part of the module students program with Python selected data mining algorithms and experiment using real-world datasets. Google search framework and IBM Watson QA system and various other industrial level data mining applications are discussed.

Skills: Communication skills (listening andquestioning, respecting others, contributing to discussions, communicating in a foreign language, presenting own work in form of a talk) This skill is not evaluated in the module. However, students are encouraged to verbally participate in the numerous in-class quizzes about data mining concepts.

Problem solving
Two Python programming assignments (accounting for 25% of the total mark for the module) arecirculated. The students are expected to implement a selected group of data mining algorithms from the scratch by themselves and experiment using real-world datasets.

Business and customer awareness (basic understanding of the key drivers for business success – including the importance of innovationand taking calculated risks – and the need to provide customer satisfaction and build customer loyalty) Google search framework, IBM Watson QA system and various other industrial level data mining applications are discussed in the class as specific implementations of the algorithms introduced in the module.

Information Technology (IT) skills (IT skills, including familiarity with word processing, spreadsheets, file management, use of internet search engines, use of specific software and/or IT and programming paradigms) Students are required to use industry-level data processing libraries such as numeric python library, scientific python library and scikit-learn machine learning library during the lab sessions.

Computer science principles
Examples: Formal tools for building and verifying complex electronic-commerce systems (name some concrete software). Formal methods for deriving classification algorithms that focus on different loss functions such as the cross-entropy loss (logistic regression), hinge loss (support vector machines) are taught in the module.

KNOWLEDGE REPRESENTATION (COMP521)

Credits: 15 / Semester: semester 1

The module introduces formalisms to reason about knowledge and information. One such formalism is epistemic logic, where one can explicitly represent of what an agent (robot, human, system) knows about the world or about others, as in "I have sent a message, how do I know that it has been received, and that the receiver knows I know this?"

MACHINE LEARNING AND BIOINSPIRED OPTIMISATION (COMP532)

Credits: 15 / Semester: semester 2

This module teaches you about bio-inspired algorithms for optimisation and machine learning. The algorithms are based on reinforcement learning, DNA computing, brain or neural network models, immune systems, the evolutionary version of game theory, and social insect swarm behaviour such as ant colonies and bee colonies. These techniques are extremely useful for searching very large solution spaces (optimisation) and they can be used to design agents or robots that have to interact and operate in dynamic unknown environments (e.g. a Mars rover, a swarm of robots or network of satellites). The idea of learning optimal behaviour, rather than designing, algorithms and controllers is especially appealing in AI.

MULTI-CORE AND MULTI-PROCESSOR PROGRAMMING (COMP528)

Credits: 15 / Semester: semester 1

This is a module to cover theoretical and practical aspects of parallel programming for multi-core architectures with the main focus on hand-on programming experience with latest multi-core and multi-processor platforms.

PRIVACY AND SECURITY (COMP522)

Credits: 15 / Semester: semester 1

The module "Privacy and Security" covers topics such as: identification and authentication, monitoring protocols, attacks and defences, legal and ethical issues and future directions.

SAFETY AND DEPENDABILITY (COMP524)

Credits: 15 / Semester: semester 2

Safety and Dependability will cover techniques for the validation of systems against formal specifications. In a first part, safety specifications (something bad never happens) using the Hoare calculus and safe abstraction are covered. A second part refers to termination (something good eventually happens), exploiting well foundedness. In a third part, Markov chains and decision processes are studied, extending the qualitative safety and termination problems from the first part to qualitative/probabilistic properties, and extending them to a simple probabilistic specification language, PCTL. As part of the module, the ability of formulating (probabilistic) models as Markov chains and decision processes are taught, as well as the use of of-the-shelf tools like PRISM or IscasMC for their analysis.

REASONING ABOUT ACTION AND CHANGE (COMP525)

Credits: 15 / Semester: semester 2

The module introduces the student to the use of logic as a tool for specifying the desired behavior of hardware, software and artificial intelligence systems, and for checking whether a given system does indeed behave as desired. The module enables the student to gain familiarity with a set of techniques which are critical in contemporary industrial applications and in academic research. It consists of 30 lectures and 10 practical sessions.

Programme details and modules listed are illustrative only and subject to change.

HOW YOU'LL LEARN

Teaching is a mix of formal lectures, small group tutorials and supervised laboratory-based practical sessions. Students also undertake individual and group projects. Key problem solving skills and employability skills, like presentation and teamwork skills, are developed throughout the programme.

HOW YOU'RE ASSESSED

The main modes of assessment are through a combination of coursework and examination, but depending on the modules taken you may encounter project work, presentations (individual or group), and specific tests/tasks focused on solidifying learning outcomes.

LIVERPOOL HALLMARKS

We have a distinctive approach to education, the Liverpool Curriculum Framework, which focuses on research-connected teaching, active learning, and authentic assessment to ensure our students graduate as digitally fluent and confident global citizens.

Careers and employability

Liverpool's computer science graduates go onto well-paid graduate jobs and careers such as: computer programmer; software developer; systems analyst; software engineer; technical consultant; web designer.

87% **OF COMPUTER SCIENCE STUDENTS FIND THEIR MAIN ACTIVITY AFTER GRADUATION MEANINGFUL.**

Graduate Outcomes, 2018-19.

Computer science graduates are among the highest-earners globally: there is a huge demand from industry for computer programmers, data scientists, artificial intelligence researchers, systems analysts, software engineers, technical consultants and web developers. In 2016, six out of the 10 best performing global companies had a focus on information technology.

RECENT EMPLOYERS

- BAE Systems
- BT
- Guardian Media Group
- Royal Bank of Scotland
- Siemens
- Unilever

PREPARING YOU FOR FUTURE SUCCESS

At Liverpool, our goal is to support you to build your intellectual, social, and cultural capital so that you graduate as a socially-conscious global citizen who is prepared for future success. We achieve this by:

- Embedding employability within your curriculum, through the modules you take and the opportunities to gain real-world experience offered by many of our courses.
- Providing you with opportunities to gain experience and develop connections with people and organisations, including student and graduate employers as well as our global alumni.
- Providing you with the latest tools and skills to thrive in a competitive world, including access to Handshake, a platform which allows you to create your personalised job shortlist and apply with ease.
- Supporting you through our peer-to-peer led Careers Studio, where our career coaches provide you with tailored advice and support.

Fees and funding

Your tuition fees, funding your studies, and other costs to consider.

TUITION FEES

Tuition fees cover the cost of your teaching and assessment, operating facilities such as libraries, IT equipment, and access to academic and personal support. Learn more about tuition fees, funding and student finance.

UK fees **Also applies to Channel Islands, Isle of Man and Republic of Ireland**	
Full-time place, per year	£9,250
Year in industry fee	£1,850
Year abroad fee	£1,385

International fees	
Full-time place, per year	£25,750

*Fees stated are for the **2023-24** academic year.*

ADDITIONAL COSTS

We understand that budgeting for your time at university is important, and we want to make sure you understand any course-related costs that are not covered by your tuition fee. This could include buying a laptop, books, or stationery.

Find out more about the additional study costs that may apply to this course.

SCHOLARSHIPS AND BURSARIES

We offer a range of scholarships and bursaries to help cover tuition fees and help with living expenses while at university.

Scholarships and bursaries you can apply for from the United Kingdom

Select your country or region for more scholarships and bursaries.

Entry requirements

The qualifications and exam results you'll need to apply for this course.

Applicants with the Extended Project Qualification (EPQ) are eligible for a reduction in grade requirements. For this course, the offer is **AAB** with an **A** in the EPQ.

Your qualification	**Requirements** About our typical entry requirements
A levels	AAA including Maths or Computer Science Applicants with the Extended Project Qualification (EPQ) are eligible for a reduction in grade requirements. For this course, the offer is **AAB** with **A** in the EPQ. You may automatically qualify for reduced entry requirements through our contextual offers scheme.
GCSE	4/C in English and 4/C in Mathematics
Subject requirements	A level Mathematics or Computer Science. For applicants from England: For science A levels that include the separately graded practical endorsement, a "Pass" is required.
BTEC Level 3 Subsidiary Diploma	Acceptable at grade D* (any subject) alongside AA at A level. A Levels must include one of the following subjects: Mathematics or Computer Science.
BTEC Level 3 Diploma	D*D in BTEC considered alongside A Level grade A. A Level must include one of the following subjects: Mathematics or Computer Science

Your qualification	**Requirements** About our typical entry requirements
BTEC Level 3 National Extended Diploma	Not accepted.
International Baccalaureate	36 overall including 5 in Higher Level Mathematics or Computer Science
Irish Leaving Certificate	H1, H1, H2, H2, H2, H2, including H1 in Higher Maths or Higher Computer Science. We also require a minimum of H6 in Higher English or O3 in Ordinary English
Scottish Higher/Advanced Higher	Pass Scottish Advanced Highers with grades AAA including Maths or Computer Science
Welsh Baccalaureate Advanced	Acceptable at grade A or above alongside AA at A level including Maths or Computer Science
Cambridge Pre-U Diploma	D3 in Cambridge Pre U Principal Subject is accepted as equivalent to A-Level grade A M2 in Cambridge Pre U Principal Subject is accepted as equivalent to A-Level grade B Global Perspectives and Short Courses are not accepted.
Access	Not accepted.
International qualifications	Select your country or region to view specific entry requirements. Many countries have a different education system to that of the UK, meaning your qualifications may not meet our entry requirements. Completing your Foundation Certificate, such as that offered by the University of Liverpool International College, means you're guaranteed a place on your chosen course.

ALTERNATIVE ENTRY REQUIREMENTS

- If your qualification isn't listed here, or you're taking a combination of qualifications, contact us for advice
- Applications from mature students are welcome.

THE ORIGINAL REDBRICK