



Science and Technology

Computing and Technology Module Booklet

NOTTINGHAM^{NTU}
TRENT UNIVERSITY

Year 1

Computer Technology

This module aims to introduce you to the fundamentals of microprocessor based systems operation. You will gain an understanding of the design and operation of the main microprocessor hardware components. You will also develop an understanding of how to design a typical low level assembly language program.

Introduction to Computer Technology and Infrastructure

This module aims to introduce you to the fundamentals of computer technology and infrastructure. For computer networks, this includes understanding the underlying technologies and some practical applications. For microprocessor based systems operation, you will gain an understanding of the design and operation of the main microprocessor hardware components and you will also develop an understanding of how to design a typical low level assembly language program.

Introduction to Audio-Visual Science and Multimedia

This module is aimed at providing an introduction to the science of audio-visual technologies and the use of digital media tools. It will explain the physics of light and sound and demonstrate how this relates to interaction with multimedia interfaces. By studying this module you will develop basic skills in the use and application of digital media tools.

Introduction to Computer Technology and Programming

This module is aimed at providing an introduction to Computer Programming. You will develop an understanding of the relationship between binary logic signals and the operation of digital hardware within a computer. You will gain an understanding of problem analysis and the procedures undertaken to design programs. It will highlight the importance of design documentation. You will develop an understanding of various program structures and data types. The module will utilise scripting languages for the development of programs during your study.

Introduction to Networking

This module aims to develop an understanding of the key principles of computer networks, the underlying technologies and practical application. A series of lectures will give you a thorough overview of networks and will cover the fundamental principles governing their operation. Seminars will consider examples to reinforce your understanding of these principles. You will also start to develop practical networking skills and observe network operation in practice through a series of laboratory exercises.

Introduction to Systems Analysis and Design

The fundamental aim of the module is to introduce you to the main principles of systems analysis and design and to provide you with a working knowledge of the key methodologies, techniques and tools used when employing a structured and systematic approach to developing and maintaining computer-based information systems (IS) within a business organisation.

Mathematics for Computing

This module aims to maintain, improve and extend the mathematical knowledge and ability of students on the Computing undergraduate programmes and to provide mathematical background and support for other modules that involve mathematics.

Personal and Professional Development

The module introduces you to the profession of Computing and Information Technology and the nature of the significance of that profession in the context of society. The role of the British Computer Society in supporting professionalism in Computing will be introduced.

It will provide an introduction to current issues in society, business and the environment, with emphasis on the powerful role that computers and computer professionals play in a technological society. Key legislation, such as the Data Protection Act, Computer Misuse Act and Freedom of Information Act will also be discussed.

The module also introduces you to key life and learning skills necessary for continued professional development and lifelong learning. You will be encouraged, and supported, to make full use of Personal Development Planning to enhance your learning experience.

Software Design and Implementation 1

The module introduces you to computer programming using a standard high-level language and Integrated Development Environment. You will be taught an appropriate subset of a programming language. The module will also provide a simple introduction to program design within the context of good software engineering practice and the need for design documentation, designing and documenting test plans, and designing for quality.

Software Implementation

The module introduces you to computer programming using a number of language and development environment combinations; these will be a standard high-level language with an Integrated Development Environment as well as embedded and stand-alone scripting language environments. You will learn the fundamentals of programming and to apply them across the variety of platforms. The module will also provide a simple introduction to program design within the context of good Software Engineering practice.

Year 2

Applied Maths and Graphics

This module aims to provide you with a range of mathematical skills necessary for the implementation of computer systems which interact with or model the physical world. The module will introduce the mathematical techniques required to describe images and to transform images. The available methods required to generate high-quality images will then be explained and demonstrated. You will also learn how to approximate non-linear equations (important in signal processing), and how to efficiently solve large sets of linear equations (a standard technique in simulation).

Communications Technology

This module aims to develop an understanding of the key principles of electronic communication, its underlying technologies and applications. This should lead to the ability to analyse and test the characteristics of communication systems and understand their constraints and limitations.

Computer Security Management

It is essential for organizations of all sizes to address the security implications inherent in the use of information technology (IT) so that their information remains confidential, available and retains integrity. The overall aim of this module is to develop an understanding of how to manage the security of computer-based information and systems within organisations. In the module you will:

- Develop an understanding of the options available to computer security managers in managing the security threats to the continuity of business.
- Learn about methodologies that will support the development of policies and procedures to ensure appropriate IT governance
- Develop the ability to make informed choices about the selection of technology based on business drivers
- Discuss the emerging professional and ethical issues in IT security.

Decision Support Systems

The overall aim of this module is to introduce you to Decision Support Systems and their applications.

The module will provide understanding and knowledge of Decision Support Systems, types and technology involved, and the various methodologies of the possible subsystems.

It also provides you with some practical experience of implementing basic modelling and decision-making.

Information and Database Engineering

On this module you will build on the knowledge gained in data modelling and database design. The overall aims of the module are:

- To develop an understanding of the nature and application of Database Management Systems (DBMSs).
- To acquire skills that are needed for database administration and management.
- To introduce current methods of applying a structured approach to information analysis and design and to apply a particular structured methodology to a typical applications area.

Interface Technology and Design

This module is aimed at providing a practical understanding of modern human-computer interface technologies and the principles of effective interface design. It will explain the limitations and capabilities of modern human-computer interface technologies, and thus provide the fundamental understanding necessary to design effective and accessible visual interfaces for interactive systems. In addition, you will develop the skills necessary to characterise interface technologies.

This module details the fundamentals of interactive computer based machine–human interface systems. The module places maximum emphasis on the visual interface, which is the most important mode of information communication.

Information Systems Development

The overall aim of the module is to study and use a variety of techniques and practices associated with the effective development of user-based information systems.

The development of a user-based information system requires that developers have a working knowledge of a variety of skills and techniques, and can apply them at the appropriate stages of the software development lifecycle. These include:

- The ability to use or develop a system specification document.
- An ability to carry out prescribed analysis and design skills. These include:
- Use or development of finite-state machine (analysis) or pencil-and paper storyboard (design) techniques.
- Develop a test plan.
- To perform code reviews.
- The ability to develop user-based information systems.
- Apply a test plan.
- Document aspects of the points mentioned above.

Internet Applications Development

The aim of this module is to introduce dynamic web applications where the contents are gathered from a database. To achieve this server-side scripting (PHP) is introduced. After studying this module you will have the skills to design and produce a dynamic website that adheres to current stylistic and usability standards and which may contain complex scripted components.

Internet Applications Programming

The aim of this module is to develop an understanding of the analysis, design and implementation of browser-based internet and intranet based applications. After an introduction to Web based mark-up languages the main focus of the module will be to study the multi-tier architecture of internet based applications in the context of current object oriented systems methodologies. This will introduce the student to the pattern based approach to design that separates style, content, and interactivity. The approach of this module is characterised by viewing internet applications as comprising of a collection of server-side software objects which render the XHTML code that represents a Web page in response to user-interaction via Web controls.

Introduction to Networking

This module aims to develop an understanding of the key principles of computer networks, the underlying technologies and practical application. A series of lectures will give you a thorough overview of networks and will cover the fundamental principles governing their operation. Seminars will consider examples to reinforce your understanding of these principles. You will also start to develop practical networking skills and observe network operation in practice through a series of laboratory exercises.

Introduction to Robotic Control

This module is intended to give you an introduction to the world of robotics. The aim is to make you familiar with and demonstrate developed skills in the principal areas of sensors, actuators, feedback control systems, embedded systems programming and algorithm development.

Marketing for Entrepreneurs

The module will introduce you to the concepts of marketing, entrepreneurship and business planning, and will give an overview of what venture capitalists look for in a business plan. It is the main module in the course with an entrepreneurial focus and where business skills are taught, leading to enhanced graduate employability. It allows you to be creative and innovative and to apply your skills to creating a business plan as a practical application of technical skills learned elsewhere in your course.

Network Design and Administration

Network infrastructure has become key to the effective operation of most organisations. Building on the year one module "Introduction to Networks", this module will enable you to plan, configure and manage networking solutions to support business needs.

Professional Development 2

The module continues the development of key life and learning skills necessary for continued professional development and lifelong learning. One key life skill is teamwork, and this module ensures you have experience of this by requiring you to develop a piece of software as a team. Time management, presentations and report writing are also developed by the regular meetings with your supervisor, and deliverables during the year.

Rich Media Technology

This module will develop your knowledge and skills in ICT multimedia applications via a detailed study of the use of high bandwidth audio-video transmission for the delivery of rich media content. State-of-the-art in AV capture and encoding techniques will be discussed and practical workshops will enable you to develop the skills necessary to produce web based demonstrations of the use of rich media content.

Software Design and implementation 2

The overall aim of this module is to contribute to the programme aim to develop the precise combination of skills and knowledge required to design and develop robust, efficient, quality software and to:

- equip you with knowledge of and skills in software development techniques to support the development of robust, maintainable, portable software systems,
- provide an introduction to object-oriented design techniques and to explore these using an object-oriented language,
- enable the selection and use of appropriate containers and generic algorithms,
- provide skills and experience in the use of software development tools.

Web Development

The aims of this module are to introduce current internet technologies and to develop an understanding of the analysis, design and implementation of internet and intranet based software. After studying this module you will have the skills to design and produce a static website that adheres to current stylistic and usability standards and which may contain complex scripted components.

Software Engineering

This module is designed to give a Software Engineering perspective to software development; you will learn a number of new programming and modelling techniques. These include the use of the Standard Library containers and their iterators, programming using assertions, an introduction to and investigation of some C++ coding standards. Part of the software development will be in a Linux environment, using makefiles and command line tools for compiling, linking and debugging. This is very much a practical module and the assessments reflect this, with the focus on the process of software development (rather than the product); half of the first assessment (25% in total) involves researching a topic and preparing a presentation or document for the module Wiki.

Systems Software

The module consists of 3 distinctive parts:

- Operating Systems
- Basics of an Internet-oriented language programming e.g. – Java
- Internet basic principles

The boundaries between the three parts are blended and the material is presented in such a way that you should be able to see and study one seamless topic where the examples from one part of the study are almost always taken as use-case scenarios by another part of the same module.

The module aims are:

- To develop an understanding of the principles of the operating system e.g. file handling, memory control, concurrent access to a resource etc.
- To instil in you the necessary minimum to feel comfortable in using other operating systems than “Windows OS” – e.g. Linux.
- To equip you with the underpinning knowledge and skills necessary for developing advanced software in the Internet domain by studying the basics of an Internet-oriented language.
- To provide an understanding of the underpinning Internet technologies like TCP/IP, HTTP etc.
- To enable you to create advanced distributed-computers Internet applications.

The ICT Industry

This module is aimed at providing you with knowledge of the Information and Communications industrial market and an overview of the role played by IT and the IT specialist within society. It will enhance your employability potential by increasing your awareness of the technological, social and economic factors driving the IT industry. The module will use a combination of lectures, seminars and case studies to examine the major driving forces behind the development and global implementation of IT and its effect on e-commerce, technology change, business development, and social practices. From an historical perspective, the impact of communications and computing technology on society will provide a contextual basis to develop analytical discourses on the current state of IT and future trends. A particular emphasis will be the importance of enabling technologies, commercial opportunities for enabling technology integration, the concept of a successful supply chain, and the cost of ownership. Case studies will help to develop the skills required to make effective design decisions based on analysis of: application, technological limitations, costs, and risks. Timeliness and industrial relevance of the taught material will be underpinned by a series of guest lectures from leading industrialists via the School’s membership of the Communication & Mobile Information Technology Faraday Partnership, and the UK Displays Network.

3D Design for Games

This module will provide you with practical training in the use of advanced software tools used for the generation of 3D objects and environments. It will give you the skills and knowledge to be able to design and develop 3D environments and characters suitable for use in computer game systems. You will be modelling buildings and objects, and using digital photographs to realistically texture their surfaces.

The module will teach you how characters are rigged with skeletal based animation systems and techniques utilised by the games industry will be used to bring these characters to life through animation. Eventually your character and environment will be displayed by importing them into a commercial games engine.

The module will develop your knowledge and understanding of the underlying principles of game environment and character design. You will learn about the subtle nuances of animation that create a characters identity and make it realistic and appealing to the audience. You will find out about the techniques used in industry to design game levels and understand the role that software tools fulfil in this process.

Year 3

3D modelling

This module will provide you with practical skills in the application of advanced software tools for the generation of 3D objects and environments. It will give you the skills and knowledge to be able to design and develop 3D environments for use in virtual reality and computer game systems. You will be modelling buildings and objects, and using digital photographs to realistically texture their surfaces.

The module will develop your knowledge and understanding of the underlying principles of real time digital 3D and understand the role that software tools fulfil in this process.

Advanced Analysis and Design

This module aims to give you a sound understanding of the object model – what it is based on, and how it can be applied to build systems. You will learn how to use the notation and follow the process for object-oriented development. You will also learn how to design and develop robust, effective, quality OO software using an object-oriented language, and then critically assess your product and the process.

Advanced Software Engineering

This module covers the techniques and strategies to analyse, choose, propose, design and evaluate data structures and algorithmic solutions to software development problems. You will investigate the computational cost of the use of complex data structures and their associated algorithms; you will develop experiments to confirm or refute your theoretical predictions of performance. The module will enable you to choose appropriately between alternative development strategies that utilise both library and custom code/structures.

Artificial Intelligence

This module covers the theoretical foundations of AI, basic methods and techniques, and covers key areas of AI. The module will give you a solid grounding in the important issues and basic techniques in AI. You will be made aware of current research and applications. The module will enable you to develop your understanding and practical abilities in the field by considering and analysing AI applications.

Business Analysis

This module will allow you to develop an understanding of the fundamental factors within the design and operation of business systems. Such business systems are now commonly compelled to operate on a global basis. This module will investigate the principles, role and practice of business modelling as it is applied to manufacturing, service and retail business operations.

Communicating Science and Technology

This final year option module will be of interest to you if you are considering a career in teaching and/or want to develop your transferable skills portfolio. The aims are to provide you with an opportunity to gain first-hand experience of communicating science/technology in an educational setting. You will work with local schools alongside practicing science/technology teachers in a classroom environment. (N.B. the exact subject area will depend on your background)

Through your class preparation and assessments you will practice gathering, processing and evaluating information from a variety of paper, audio-visual and electronic sources. You will develop your powers of critical evaluation and will produce new resources for teaching science/technology.

Computer Crime and Forensics

Criminals use computers – either to facilitate their activities or as a weapon to attack others. This module covers the types of computer crime and methods by which such

crimes can occur. It also shows methods by which a computer security professional can investigate a crime and generate documentary evidence necessary for legal proceedings.

Computational Intelligence

This module aims to provide you with a sound understanding of computational intelligence (also known as soft computing). Computational intelligence refers to a class of methodologies that create, use and manipulate numerical representations to process incomplete and imprecise data to enable computer systems to model intelligent behaviour. The module provides you with opportunities to gain an understanding of three core methodologies, namely artificial neural networks, fuzzy logic and genetic algorithms. The module will enable you to apply and analyse the different techniques associated with each methodology within the context of real-world problems. A significant emphasis is placed on the complimentary nature of each methodology and learning opportunities are provided to facilitate you to build and synthesise the different methods to solve complex problems.

Distributed Object Computing

This module introduces you to the theory, practice, and advanced techniques for integrating large-scale applications across multiple, possibly heterogeneous, platforms. The module will:

- provide you with the technical knowledge necessary to analyze the scalability and interoperability problems associated with large-scale heterogeneous systems
- enable you to become accomplished in the design and implementation of object-based distributed solutions for interoperable large-scale applications
- introduce you to the practice of analyzing the quality of service (QoS) of the proposed distributed object solutions to make educated decisions about their viability and cost-effectiveness

Games Development Technology

To provide you with knowledge and understanding of the technologies used to develop computer games on a games console.

To provide you with experience of using software tools to develop computer games.

Graphics for Games and Dynamics Modelling

- To provide an understanding of the fundamental principles of advanced 3D rendering and physical simulation.
- To provide an appreciation of "fitness for purpose" in the context of 3D games.
- To enable you to understand the full implications of choices of hardware and software tools for 3D rendering and physical simulation.

VR system architecture and design, interfaces, geometry calculations, requirements analysis. Graphics implementation, performance calculations. Principles of 3D hardware design with reference to current practice. Advanced Graphics Algorithms: the aliasing problem; illumination and shading; diffuse and specular reflection; Gouraud and Phong shading; ray tracing and radiosity; texture and texture anti-aliasing. Graphics Algorithm Research. Creating Virtual Worlds - Database Generation, CAD techniques for model building, Hierarchical data structures. Gathering terrain data. Use of fractals to generate synthetic terrain.

Introduction to computational geometry, Delaunay triangulation and convex hull
Review of Newtonian mechanics, torque, angular momentum and the inertia tensor.
Systems with constraints, Lagrangian and Hamiltonian formulations.
Numerical methods of solution and alternative approaches to the constraint problem.
Collision detection.

Human Computer Interaction

This module will provide you with the knowledge to be able to take into account current thinking on human information processing when designing and implementing interactive software. You will be made aware of the importance of designing for usability, and evaluating usability, at each stage of the software development lifecycle. The module will enable you to develop your understanding of human computer interaction and your practical abilities in interface development by analysing, designing, implementing and planning the evaluation of a software interface.

Image Processing & Advanced Displays Technology

This module is aimed at providing you with an understanding of the principles and visual requirements of advanced display technology. You will study various display technologies and the applications within which they are used, including both current and newly developed display systems, such as the specialist area of imaging in security systems. This topic is based upon research carried out within the School, and will provide you with an understanding of the visual requirements of security and forensic imaging systems. This will be further extended into the field of three-dimensional electronic imaging, its principles and uses within a 3D X-ray scanning system. The module will also cover image processing and include topics such as digital image formation, image enhancement and analysis.

Information Systems Management

The creation of effective information systems for an enterprise requires decision making that is informed by an awareness of the business implications, an awareness of technological issues and an understanding of the management issues required to implement such a system. The overall aim of this module is to develop an understanding of how to manage the build and deployment of enterprise and internet information systems within small to medium organisations, or be part of a team to do the same in a larger organisation. In the module you will:

- Develop an understanding of the options available to IS managers in managing, designing and implementing the technical infrastructure associated with these systems.
- Learn about methodologies that will allow you to manage the business consequences of implementing internal and external systems
- Develop the ability to make informed choices about the selection of technology
- Discuss the organisational issues associated with managing the introduction and ongoing support of information systems

Multimedia Portfolio

The aim of this module is to give you an opportunity to develop and demonstrate advanced skills in multimedia areas of your choice through the completion of a portfolio. The portfolio should be aimed at the potential employers or industry sectors that you wish to target and should integrate knowledge of the course, clearly demonstrating your skills. You will develop your portfolio independently with tutor guidance.

You are required to define your own portfolio plan, subject to approval by your supervisors that they meet the programme aims, can be resourced and brought to a satisfactory conclusion within the time available. The chosen topic should enable you to:

- integrate learning;
- illustrate well developed technical skills;
- relate theory to practice;
- demonstrate an understanding of visual communication;

The project is expected to focus on two or three areas of interest as the focus is on quality, rather than quantity of output. You will also be required to give a formal presentation of what you have achieved.

Natural Language Processing

Natural Languages (NL) are human languages, as opposed to computer programming languages. This module introduces the field of Natural Language Processing (NLP), using the English language as the prime NL. After an introduction to English grammar, common methods and techniques used in NLP and Computational Linguistics are covered. The module also introduces the field of Machine Translation (MT). The module will give you a solid grounding in the important issues and basic techniques of NLP, and you will be made aware of current research. The module will enable you to develop your understanding and practical abilities in the field by analysing, designing and building NLP functions within the framework of a chatbot program.

Pervasive Computing

This module builds on the knowledge and experience gained from the pre-requisite modules to consider how technology can be used to build systems which are outside the traditional desktop paradigm. It considers systems that are more infrastructural – whether worn, embedded in buildings or in vehicles. It will provide you with an awareness of the requirements, capabilities and constraints of a variety of computing technologies that can be used in this way, and the facilities that they can build.

Project

The Final Year Project is a major piece of work in the (very broad) areas of Computing and Technology. The project is considered such an important component of our degree programmes that prizes are awarded for outstanding work. The project allows you to demonstrate and document your skills, knowledge and independent initiative. It gives you the opportunity to develop your abilities to investigate and plan solutions to problems in computing; to implement solutions; to critically evaluate and reflect on your work; and to develop your abilities to communicate, self-organize and manage.

Project Management

Project management is concerned with the application of knowledge, skills, tools and techniques to a broad range of activities to meet the requirements of the particular project (thus ensuring that the project is completed in a satisfactory way). The aim of this module is to provide you with a conceptual understanding of the role and function of project management. It is also to develop your ability to apply appropriate techniques and skills in the management of projects.

Real Time Analysis and Design

This module aims to give you an understanding of the different issues that apply to real-time systems. You will learn about the importance of hardware and software architectures and facilities when designing such a system, and how to take an initial specification through to a final design that incorporates the relevant timing, bandwidth and other real-time considerations.

- System parameters and bounding the scope.
- Estimation and evaluation of key parameters of a system
- Comparison of real-time modelling methods.
- Ward-Mellor in detail.
- Hardware and software – constraints and capabilities
- Scheduling policies, measures, resource sharing, deadlock avoidance
- High reliability systems
- Games/simulation systems and scalability

Security Technologies

Information security means protecting information and information systems from unauthorized access, use, disclosure, disruption, modification or destruction.

Technologies are used to protect confidentiality, integrity and availability, which are three key concepts of security. This module is aimed at introducing fundamental principles of security and provides you with some core technologies of information security which are extensively used in both industry and academia. This module also develops your understanding of security applications. This will be further extended into the field of biometrics, which is the investigation, development and application of methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioural traits. It is used as a form of identity access management and access control.

Virtual Reality

This module will provide you with the skills and knowledge to be able to design and develop advanced multimedia applications utilising 3D technology. The module will develop practical skills around the creation and display of real time and pre-rendered 3D models and environments using a variety of development tools and different display systems. The module will develop your knowledge and understanding of the underlying technology of Virtual Reality. It will also present past and current research into real world applications of this technology, looking at fields such as VR training and simulation, architectural visualisation, disability access and 3D recording of ancient monuments and artefacts.

Wireless & Mobile Communications

This module is a continuation of the level 2 module Communications Technology, but specialises in the field of wireless and mobile systems. You will develop knowledge of the principles underlying wireless and mobile communication systems. You will study and examine a range of current and emerging wireless communication systems and their applications. By studying this module, you will have the underpinning knowledge and skills necessary to develop or use wireless and mobile communications for various applications.

Serious Games

This module will examine theory, research and contemporary practice in the use of computers for teaching and learning focusing particularly on the application of games for learning. The module aims to provide you with the skills and knowledge necessary to contribute to the development and evaluation of a game for serious educational purposes. It is envisaged that most students will develop software for a game, whilst students on BSc Computing and Cybernetics will develop assistive interface devices. Special emphasis will be placed on Virtual Reality and Multimedia Systems in the development of novel learning systems. Coursework will reflect the current research projects of our research team - The Interactive Systems Research Group (ISRG) and their use of CAL to promote the social inclusion of all European citizens.

The module will be in 3 phases. In the first you will learn about the theory related to CAL and you will develop your implementation skills by developing a prototype package or device. Following on from the prototyping stage, you will enter into a group implementation phase. This will simulate a real-world project.

You will work in a group as if the group was a professional development team and will have expert project consultants to help you develop your ideas and approaches. The assumption of the approach is that the team already possess or are self-sufficient in developing the technical skills required for the development. The consultants, as in a real project of this nature will give feedback on the extent to which different approaches are likely to work with the target group.

The third phase will involve an evaluation of what you have produced, having developed an evaluation plan.