Module Catalogue

School of Computer Science

A DIRECTORY OF UNDERGRADUATE MODULES FOR EXCHANGE AND STUDY ABROAD STUDENTS
SEMESTER A, B AND AB 2019/20
List of modules

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INTRODUCTION

This module directory is specifically designed for exchange students to select modules at School of Computer Science, University of Hertfordshire.

1. Please see the box below explaining the module codes:

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<tr>
<td>Module level</td>
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2. As an exchange student you can choose modules from levels 5, 6 and exceptionally at level 4.

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3. Co-requisites, pre-requisites and prohibited combinations.

Some of the modules may have co-requisites or pre-requisites which you will find indicated in each module. Please note for you, as an exchange student, if a module has co-requisites or pre-requisites you must have previously studied the subject and have completed the relevant module(s) at your home institution. When sending your application, please include a copy of your transcript to show that you have taken the minimum required co-requisites or pre-requisites module(s) at your home institution. Additionally, we may require you to provide a module description in order to evidence prior study.

If you are in the process of completing the required module(s) at the time of the application and you do not have the final copy of the transcript, please include a letter from your home institution clearly listing the modules that you are registered on.

**Prohibited combinations**- please note if there are modules listed under prohibited combinations you can only study one of the modules.
Module name: Human Dimensions of Computing
Module code: 4com1035
Semester: AB
Credits: 30

Module Aims:

• gain an understanding of the history and major accomplishments of computer science and information technology;
• gain an insight into the importance and relevance of design principles and horizon scanning;
• gain an appreciation of the human and social dimension of computing, and how this is important and relevant to the professional practitioner;
• practice and develop skills in written communication and basic inferential statistics and to learn how to use these for effective communication in the field of computer science and information technology.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the history and major accomplishments of computer science;
• [ii] the importance and relevance of design principles;
• [iii] future trends and horizon scanning;
• [iv] the social and human aspects of computing.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] describe and use principles of design for user experience and interaction;
• [ii] perform calculations involving probability;
• [iii] apply and describe these at an appropriate level within specific case studies.
**Module Content:**
This module introduces the history and major accomplishments of computer science and information technology, and its impact on modern life. Technology is only one part of computer science and information technology, and the human and social dimension of computing, including user experience and interaction design, is just as important and relevant to the professional practitioner.

**Pre and Co requisites:**
None

**Total hours:** 300

**Assessment:**

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Module name: Human Dimensions of Computing (A)
Module code: 4com1036
Semester: A
Credits: 15

Module Aims:

• gain an understanding of the history and major accomplishments of computer science and information technology.
• gain an insight into the importance and relevance of design principles and horizon scanning.
• gain an appreciation of the human and social dimension of computing, and how this is important and relevant to the professional practitioner.
• practice and develop skills in written communication and basic inferential statistics and to learn how to use these for effective communication in the field of computer science and information technology.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the history and major accomplishments of computer science;
• [ii] the importance and relevance of design principles;
• [iii] future trends and horizon scanning;
• [iv] the social and human aspects of computing.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] describe and use principles of design for user experience and interaction;
• [ii] perform calculations involving probability;
• [iii] apply and describe these at an appropriate level within specific case studies.

Module Content:
Successful students will typically:

have a knowledge and understanding of:
• [i] the history and major accomplishments of computer science;
• [ii] the importance and relevance of design principles;
• [iii] future trends and horizon scanning;
• [iv] the social and human aspects of computing.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• [i] describe and use principles of design for user experience and interaction;
• [ii] perform calculations involving probability;
• [iii] apply and describe these at an appropriate level within specific case studies.

Pre and Co requisites:

None

Total hours: 150

Assessment:

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Module name: Programming  
Module code: 4com1037  
Semester: AB  
Credits: 30

Module Aims:

• understand a range of strategies for representing and/or solving problems in a program;
• understand the place and process of programming within the development of computer-based systems;
• understand and apply some of the fundamental principles of computer programming;
• develop some practical skills in creating computer programs in a high level programming language including coding, executing, testing, debugging and documenting;
• appreciate some of the principles of good program design.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] sufficient features of a high level programming language to develop solutions to simple programming problems;
• [ii] the concepts of data declaration and operations, control flow (sequence, selection, iteration, subroutine call) and modularisation;
• [iii] the terminology used in describing programs and programming.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] design and implement solutions to simple programming problems in a given programming language;
• [ii] execute, test and de-bug programs;
• [iii] document programs to an agreed standard.
Module Content:
This module is primarily concerned with developing basic skills necessary to produce computer-based
solutions to simple problems in high level languages. The emphasis is on problem solving, problem solving
strategies; fundamental constructs such as structure, syntax and semantics; variables and data types,
operations and the evaluation of expressions, control structures, and modularisation, data structures and
recursion. Program code will be expected to perform according to specification, be readable, maintainable and
well designed. Although the given problems will initially be relatively simple, there will also be an appreciation of
how simple solutions can be used in the solution of more complex problems.

Pre and Co requisites:
None

Total hours: 300
Assessment:

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Module name: Programming (A)
Module code: 4com1038
Semester: A
Credits: 15

Module Aims:

• understand a range of strategies for representing and/or solving problems in a program;
• understand the place and process of programming within the development of computer-based systems;
• understand and apply some of the fundamental principles of computer programming;
• develop some practical skills in creating computer programs in a high level programming language including coding, executing, testing, debugging and documenting;
• appreciate some of the principles of good program design.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] sufficient features of a high level programming language to develop solutions to simple programming problems;
• [ii] the concepts of data declaration and operations, control flow (sequence, selection, iteration, subroutine call) and modularisation;
• [iii] the terminology used in describing programs and programming.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] design and implement solutions to simple programming problems in a given programming language;
• [ii] execute, test and de-bug programs;
• [iii] document programs to an agreed standard.
**Module Content:**
This module is primarily concerned with developing basic skills necessary to produce computer-based solutions to simple problems in high level languages. The emphasis is on problem solving, problem solving strategies; fundamental constructs such as structure, syntax and semantics; variables and data types, operations and the evaluation of expressions, control structures, and modularisation, data structures and recursion. Program code will be expected to perform according to specification, be readable, maintainable and well designed. Although the given problems will initially be relatively simple, there will also be an appreciation of how simple solutions can be used in the solution of more complex problems.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Academic year 2019-2020
Module name: Programming (B)
Module code: 4com1039
Semester: B
Credits: 15

Module Aims:

• understand a range of strategies for representing and/or solving problems in a program;
• understand the place and process of programming within the development of computer-based systems;
• understand and apply some of the fundamental principles of computer programming;
• develop some practical skills in creating computer programs in a high level programming language including coding, executing, testing, debugging and documenting;
• appreciate some of the principles of good program design.

Intended Learning Outcomes:
Successful students will typically:
have a knowledge and understanding of:
• [i] sufficient features of a high level programming language to develop solutions to simple programming problems;
• [ii] the concepts of data declaration and operations, control flow (sequence, selection, iteration, subroutine call) and modularisation;
• [iii] the terminology used in describing programs and programming.

9b. Skills and Attributes:
Successful students will typically:
be able to:
• [i] design and implement solutions to simple programming problems in a given programming language;
• [ii] execute, test and de-bug programs;
• [iii] document programs to an agreed standard.
Module Content:
This module is primarily concerned with developing basic skills necessary to produce computer-based
solutions to simple problems in high level languages. The emphasis is on problem solving, problem
solving strategies; fundamental constructs such as structure, syntax and semantics; variables and data
types, operations and the evaluation of expressions, control structures, and modularisation, data
structures and recursion. Program code will be expected to perform according to specification, be readable,
maintainable and well designed. Although the given problems will initially be relatively simple, there will also be an
appreciation of how simple solutions can be used in the solution of more complex problems.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Models and Methods in Computing
Module code: 4com1040
Semester: AB
Credits: 30

Module Aims:

• gain an understanding of some principles of computation and the modelling of computer-based systems;
• gain experience of a variety of approaches to modelling and reasoning about computation;
• gain an appreciation how an understanding of computation supports software design and the application of information technology.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a coherent set of mathematical, logical and algorithmic concepts sufficient to understand and reason about simple computational systems, and appreciate some of the limitations on what computational systems can achieve;
• [ii] the differences between the static and dynamic characteristics of systems, and some of the ways in which mathematics, logic and other formalisms may be used to model or to specify such characteristics;
• [iii] the modelling, including requirement specification, of computational systems.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] interpret and manipulate expressions and other formal representations written using formalisms such as set notation, propositional logic and state transition diagrams;
• [ii] read, understand and reason about specifications of simple operations and machines expressed using appropriate formal notations;
• [iii] apply appropriate formalisms in the modelling of simple systems.

Module Content:
This module introduces a number of principles that underlie computation and computer-based systems, and how they may be modelled. Both the static and dynamic aspects of computing systems are considered, with computation being viewed both in functional terms, and as a series of state transitions defined over abstract or virtual machines. The module provides a clear concept of modelling and specification of computational systems. The module illustrates some of the ways in which the use of formalisms in modelling and specification can aid those involved in the design, development and operation of computer-based systems.

Pre and Co requisites:
None

Total hours: 300
Assessment:

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Module name: Models and Methods in Computing (B)
Module code: 4com1041

Semester: B
Credits: 15

Module Aims:

• gain an understanding of some principles of computation and the modelling of computer-based systems;
• gain experience of a variety of approaches to modelling and reasoning about computation;
• gain an appreciation how an understanding of computation supports software design and the application of information technology

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a coherent set of mathematical, logical and algorithmic concepts sufficient to understand and reason about simple computational systems, and appreciate some of the limitations on what computational systems can achieve;
• [ii] the differences between the static and dynamic characteristics of systems, and some of the ways in which mathematics, logic and other formalisms may be used to model or to specify such characteristics;
• [iii] the modelling, including requirement specification, of computational systems.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] interpret and manipulate expressions and other formal representations written using formalisms such as set notation, propositional logic and state transition diagrams;
• [ii] read, understand and reason about specifications of simple operations and machines expressed using appropriate formal notations;
• [iii] apply appropriate formalisms in the modelling of simple systems.

Module Content:
This module introduces a number of principles that underlie computation and computer-based systems, and how they may be modelled. Both the static and dynamic aspects of computing systems are considered, with computation being viewed both in functional terms, and as a series of state transitions defined over abstract or virtual machines. The module provides a clear concept of modelling and specification of computational systems. The module illustrates some of the ways in which the use of formalisms in modelling and specification can aid those involved in the design, development and operation of computer-based systems.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: Platforms for Computing
Module code: 4com1042

Semester: AB
Credits: 30

Module Aims:

• appreciate the role and structure of a typical computer platform;
• understand how computer hardware systems relate to the software;
• understand how computer platforms relate to other hardware devices and systems.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the way in which computing platforms use and manipulate data;
• [ii] the structures in computing platforms and how they relate to each other;
• [iii] the functionality of a computing platform and how that relates to the functionality of end-user software and devices.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] articulate concepts related to computing platforms, devices and end user software;
• [ii] solve simple problems in the design and development of computing platforms;
• [iii] demonstrate an understanding of how computing platforms use and manipulate data.

Module Content:

This module introduces the notion of the “computing platform” in the organisation and function of modern computing systems. The computer and network hardware are platforms that support the operating system; The operating system is a platform that supports the application software and programming environment; The
programming environment is a platform that supports the development of application software; The application
software is a platform that supports the user experience. The organisation and combination of these platforms
is illustrated by a historical succession of examples, culminating in the smartphone, the modern mobile
computing device.

The module also considers the nature of data used by computing platforms, the form that data might take,
manipulation and communication of that data, and constraints placed on that data by the choice of platform.

**Pre and Co requisites:**
None

**Total hours:** 300

**Assessment:**

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Module name: Platforms for Computing (B)
Module code: 4com1043
Semester: B
Credits: 15

Module Aims:

• have an overview of the role and structure of a typical computer platform;
• understand how some computer hardware systems relate to the software;
• understand how some computer platforms relate to other hardware devices and systems.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the way in which computing platforms use and manipulate data;
• [ii] the key structures in computing platforms and how they relate to each other;
• [iii] the key functionalities of a computing platform and how that relates to the functionality of end-user software and devices.

9b. Skills and Attributes:
Successful students will typically:
be able to:

• [i] articulate concepts related to computing platforms, devices and end user software;
• [ii] solve simple problems in the design and development of computing platforms;
• [iii] demonstrate an understanding of how computing platforms use and manipulate data

Module Content:
This module introduces the notion of the computing platform in the organisation and function of modern computing systems. The computer and network hardware are platforms that support the operating system; The operating system is a platform that supports the application software and programming environment; The
programming environment is a platform that supports the development of application software; The application software is a platform that supports the user experience. The organisation and combination of these platforms is illustrated by a historical succession of examples, culminating in the smartphone, a modern mobile computing device. The module also introduces the nature of data used by computing platforms, the form that data might take, the communication of that data, and constraints placed on that data by the choice of platform.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Contemporary Issues
Module code: 5com1051
Semester: A
Credits: 15

Module Aims:

• have a detailed understanding their main legal obligations when working in computing;
• develop an appreciation of their legal responsibilities as computing and/or information technology professionals in their employment and in other relevant contexts;
• contribute to discussions on legal, professional and ethical issues raised by the use of computing and organised data in modern society;
• develop a professional awareness of personal responsibility and appropriate professional codes of conduct.

Intended Learning Outcomes:
Successful students will typically:
have a knowledge and understanding of:
  • [i] detailed knowledge of the ethical standards from relevant professional bodies to which a computing professional is expected to adhere;
  • [ii] the wide range of English and International Laws within which a computing professional should operate;
  • [iii] current computing technologies where ethical, social, legal and professional dilemmas may occur.

9b. Skills and Attributes:
Successful students will typically:
be able to:
  • [i] collect and synthesises material in order to identify, and respond appropriately to, legal and ethical challenges in computing;
  • [ii] be aware of the areas of current computing technologies where ethical issues occur and be able to
suggest solutions to these issues based on ethical analysis;

• [iii] select appropriate criteria to identify and manage the risks inherent in the use of computing technologies

and the development of computer-based systems.

Module Content:
This module introduces the legal, ethical, social and professional landscape in which computing professionals

must work. The module promotes a professional approach on issues such as Green Information Technology,

Cybercrime, Hacking, Internet privacy, the Internet and ethical values and security measures in Cyberspace.

Legal aspects of the module are based mainly on English law, and include privacy (data protection),

intellectual property, the Computer Misuse Act and the Regulation of Investigatory Powers Act which deals with the lawful

interception of digital communications. The module also covers the codes of conduct of the relevant professional bodies and the support they can provide to computing professions with particular reference to the British Computer Society code of conduct.

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: Database Concepts
Module code: 5com1052

Semester: B
Credits: 15

Module Aims:

• understand the underlying concepts for and techniques by which data is stored in databases;
• use a query language to create, retrieve, update and delete information in a database;
• gain detailed knowledge of a wide range of applications and uses of databases.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a wide range of types and applications of databases;
• [ii] a detailed knowledge of a database query language;
• [iii] the principles and concepts behind a selection of advanced applications of databases.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] select and use an appropriate type of database for a specific application;
• [ii] describe the principles behind a range of simple and advanced applications of databases;
• [iii] develop a computer based system using a database application.

Module Content:
Many computer based applications, from enterprise to banks to airlines, e-commerce, or when looking at text and photos on a social media site, are underpinned by complex database systems.

This module introduces the different kinds of database, from databases stored entirely in memory or in a file on the computer's disc drive, to large-scale distributed databases stored in the cloud. The module covers how data are organised for storage, and how to retrieve, update or delete earlier information.
Manipulating databases often requires the use of a query language. A portion of this module will be spent learning and using a commonly used query language, to create and use databases.

Advanced topics such as big data, concurrent access, data mining, data warehousing and/or non-relational databases will also be introduced.

**Pre and Co requisites:**

None

**Total hours:** 150

**Assessment:**

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Module name: CS Development Exercise
Module code: 5com1053
Semester: AB
Credits: 30

Module Aims:

• to have experience of a complete system development project, and the professional issues that arise;
• to apply and extend existing knowledge and skills in system engineering techniques including program specification, design, testing and implementation;
• to become equipped with sufficient skills and knowledge to enable them to successfully apply for and complete an industrial placement.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a wide range of different approaches to software development and different project roles, and their application in a “real world” business environment;
• [ii] the principles and concepts of professional issues relating to software engineering.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] undertake a range of system development activities, particularly program design and implementation, selecting appropriate software engineering techniques and/or solutions, evaluating the appropriateness of these techniques and solutions where applicable;
• [ii] communicate effectively with different stakeholders, both internal and external to the project team, using a range of styles and media;
• [iii] work effectively as part of a team, to have an appreciation of the issues involved in this, and to be able to adapt accordingly.

Module Content:
This module provides the knowledge and skills needed for developing a software system within a realistic case study. Developing software in small teams is not just a matter of understanding the basics of software engineering and project management, but implies the challenge of identifying, comprehending and critically handling a number of advanced methodologies, concepts, techniques and technologies, with professional practices and attitudes. In order to meet the highest quality standard as expected nowadays in the IT industry, the module covers: An experience of working in a team on a complete systems development project; Knowledge and skills in software engineering techniques; An appreciation of the relevance of the academic content to the real-world IT workplace; The background and attitude for seeking professional employment in the IT industry, especially in software development.

Pre and Co requisites:
None

Total hours: 300
Assessment:

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Module name: Algorithms and Data Structures
Module code: 5com1054
Semester: A
Credits: 15

Module Aims:

• have a detailed understanding of the importance of the relationship between problems, and their solution through the development and use algorithms, data structures and their implementation;
• understand the significance of a range of underlying mathematical concepts;
• appreciate a range of different types of algorithm and data structure and their application in the problem solving process.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the processes involved in the systematic development of fundamental algorithmic concepts;
• [ii] the different data structures with the ability to evaluate when and where to apply them;
• [iii] the underlying mathematics relating to the development of algorithms;
• [iv] a range of applications for the algorithms.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] identify appropriate algorithms and data structures for a range of problems;
• [ii] develop appropriate algorithms and data structures for a range of problems;
• [iii] independently implement algorithms in pseudo code and an appropriate programming language.

Module Content:
This module focuses on the pre-coding stage of the programming process, studying and developing algorithms
and data structures appropriate for a range of different types of problem. The module emphasises throughout
the role of problems as an essential driver in the programming process and the design of algorithms and data
structures in particular.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Operating Systems and Networks
Module code: 5com1055
Semester: B
Credits: 15

Module Aims:

• consolidate understanding of operating systems and how they work by using alternative operating systems that some students have used and doing so as a system administrator rather than an ordinary user;
• develop their detailed understanding of computer networks, how they operate, and therefore what must be done to configure them correctly;
• become more familiar with the relationships between theoretical concepts and practical application in an area of computing;
• build their confidence in using command line tools and configuration files to work with operating systems and networks.

Intended Learning Outcomes:
Successful students will typically:
have a knowledge and understanding of:
• [i] how operating systems and networks concepts are embodied in practical systems;
• [ii] how operating systems and networks can be configured to meet user requirements;
• [iii] the underlying principles of operating systems and networks including points of similarity and difference between alternatives.

9b. Skills and Attributes:
Successful students will typically:
be able to:
• [i] use the command line and other tools to configure operating systems and networks;
• [ii] identify and correct system configuration errors;
• [iii] articulate and make decisions in the deployment of appropriate operating systems and networks.

**Module Content:**
This module covers both theory and significant practical content in the design, installation and configuration of operating systems and network services. The module helps to develop problem-solving skills in working with operating systems and networks, and builds confidence in using command line tools and configuration files in other areas of computer science and information technology.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Artificial Intelligence
Module code: 5com1056
Semester: A
Credits: 15

Module Aims:

1. implement a range algorithms of AI in a suitable programming language;
2. have a detailed understanding of a range of contemporary AI methods including agent-based models.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

[i] intelligent problem solving and agent-based models;
[ii] systems that learn;
[iii] basic data mining and visualisation.

Skills and Attributes:
Successful students will typically:

be able to:

[i] independently write programs to implement some basic AI methods of problem solving and learning;
[ii] state and describe contemporary AI methods;
[iii] extract essential knowledge from small to medium-sized data sets.

Module Content:
This module covers contemporary Artificial Intelligence and agent based modelling. The standard AI topics of
problem solving, learning and representation are included, together with typical applications of these
techniques. Producing working AI programs is integral to the module.
**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Computer Architecture
Module code: 5com1057
Semester: A
Credits: 15

Module Aims:

- view processor design as a series of inter-related trade-offs involving both hardware and software;
- view the function and design of the various computer components to process information digitally;
- view processor design as a problem in successfully exploiting the ever more instruction-level parallelism.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

- [i] the key engineering principles of processor system design;
- [ii] how the processor interacts with its immediate memory subsystem;
- [iii] how multiprocessors/threaded/clustered architectures work synergistically together.

9b. Skills and Attributes:
Successful students will typically:

be able to:

- [i] identify the concepts inherent in the design of a modern computer system;
- [ii] communicate the key principles of the concept of a stored program in the context of the computer system hardware;
- [iii] be able to articulate in appropriate detail the structure and function of modern computer systems.

Module Content:
This module develops the fundamental concepts underlying the design and operation of modern computing systems and the hardware/software interface. Modern computer system design is hierarchical and this module
focuses on this hierarchy and the issues and implementation involved in the separation of the
different
hierarchical levels. Ever increasing performance demands over recent years have lead to the
enhancement of
multiprocessor systems, thread level parallelism and clustered architectures resulting in parallelism
far beyond
that of a uniprocessor. This module investigates the trade-offs involved in the design of such systems
and their
immediate memory sub-systems, in particular, to reduce the impact of the 'memory wall problem'.
This module
focuses on general engineering concepts rather than specific implementations.

Pre and Co requisites:
None

Total hours: 150
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Module name: Cognitive and Social Robotics
Module code: 5com1058
Semester: B
Credits: 15

Module Aims:

The overall aim of this module is to provide students with a first theoretical and practical introduction to foundational notions, theories, techniques and tools to enable them to understand, design and program robots that embed principles of Embodied Artificial Intelligence and Social Cognition, namely cognitive and social robots. To achieve this overall goal, the concrete aims of this module are to enable students to:

• acquire an understanding of theories of embodied cognition and social intelligence;
• familiarize themselves with state-of-the-art models, techniques and tools to design and program simple cognitive and social robots;
• critically understand the scientific, technological and societal significance of cognitive and social robots.

Intended Learning Outcomes:

Successful students will typically:

have a knowledge and understanding of:

• [i] cognitive and Social robots as models and tools to understand natural and artificial intelligence;
• [ii] structure and organization of autonomous cognitive and social robots;
• [iii] the importance of the physical and social environment as an integral part of intelligence;
• [iv] assessing embodied physical and social intelligence: the notion of adaptation and its many facets.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• [i] understand and use the sensors, motors and controllers of small robots to make them interact with their
• [ii] design and program embodied architectures to drive the behaviour of cognitive and social robots;
• [iii] design and conduct experiments to test the behavior and performance of cognitive and social robots.

Module Content:
This module introduces the theory and implementation of autonomous cognitive and social robots capable of interacting physically and socially with the world. Small autonomous robots are capable of sensing, knowing, learning and doing things in the world through their interactions with objects, other robots, and people.
Understanding cognitive and social robots is important not only because they are increasingly present in our society, but also because they constitute very promising scientific models and tools to understand biological and artificial intelligence, as well as offering potential as tools to support and help people in daily activities.

Pre and Co requisites:
None

Total hours: 150
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Module name: The C Family
Module code: 5com1059
Semester: B
Credits: 15

Module Aims:

• understand the place and process of programming within the development of computer-based systems;
• understand and apply a range of the key principles of computer programming;
• develop practical skills in creating computer programs in a high level programming language.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the process of compilation and compile time checking;
• [ii] the concept of variables and pointers to memory;
• [iii] the use of functions with different parameter passing paradigms.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] develop and compile a C family program;
• [ii] write a program which accesses and manipulates memory;
• [iii] compare and articulate the value of different members of the C family.

Module Content:
The module introduces the C family of programming languages: C, C++, Objective-C, and C#. The module demonstrates the benefits and problems of low-level access to memory. The module shows how the process of compilation allows programs to be validated before they are run preventing variables of different types being
passed to functions that cannot process them. The module develops programming skills with a strong emphasis on the relationship between memory, memory addresses and pointers.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: IT in Organisations
Module code: 5com1060
Semester: B
Credits: 15

Module Aims:

• understand the nature of business models and how they are employed in a cost effective manner;
• understand the choices and main phases of business system development and the role of IT/IS within an organisation;
• understand and appreciate what part the internet plays in the modern day competitive environment;
• understand the legal and sector contextual issues related to the use of information applications to support business.

Intended Learning Outcomes:

Successful students will typically:

have a knowledge and understanding of:

• [i] the nature of business and the various ways they achieve a competitive advantage;
• [iii] how and why computers and information systems are used in a business context;
• [iii] the range of types of systems used in business;
• [iv] the legal and sector contextual issues related to the use of information applications to support business.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• [i] recognise and use a range of analytical business tools to aid decision making;
• [ii] analyse data using a number of graphical tools and techniques;
• [iii] present and articulate findings and recommendations using a variety of appropriate methodologies;
• [iv] to use the internet in a variety of ways to both support and promote an organisation.
Module Content:
This module introduces the information processing choices that organisations have in order to succeed. A range of business approaches is explored both in terms of the business needs and market position. This includes both a financial and legal context. The role of IT/IS will be discussed at length and how these and the internet can be used to support the business objectives. The module develops understanding of the nature of business and implementation of an IT/IS system to demonstrate how these systems can be used to aid business decisions.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: IT Development Exercise
Module code: 5com1061

Semester: AB
Credits: 30

Module Aims:

• to gain experience of working in a team to complete a system development project, and of the related professional issues;
• to develop knowledge and skills in system engineering techniques including project management, requirements analysis, design, testing, and implementation;
• to become equipped with sufficient skills and knowledge to apply successfully for an industrial placement, in particular one related to software development.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a wide range of approaches to software development, the different project roles, and their application in a “real world” business environment;
• [ii] the principles and concepts of professional issues applied to software development.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] undertake a range of system development activities, particularly system design and implementation,
selecting appropriate solutions and/or software development techniques, evaluating the appropriateness of these solutions and techniques where applicable;
• [ii] communicate effectively with different stake holders, both internal and external to the project team;
• [iii] work effectively as part of a team, to have an appreciation of the issues involved, and to be able to adapt accordingly.

Module Content:
The core of the module is a realistic case study, undertaken in small teams, to develop a software system.

Developing such a system is not just a matter of understanding the basics of software engineering and project management, but also requires skills acquired through hands-on practice. This approach of learning through experience involves the challenge of identifying, comprehending and critically handling a number of advanced methodologies, concepts, techniques and technologies. A further key element of the module is professionalism and the relevance of the academic content to professional practice in the IT industry. The module provides:

Experience of working in a team on a complete systems development project; Knowledge of and skills in modern software engineering techniques; An appreciation of the relevance to the IT workplace, in part acquired through business case studies; The background and attitude for seeking professional employment in the IT industry, especially in software development.

Pre and Co requisites:
None

Total hours: 300

Assessment:

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Academic year 2019-2020
Module name: System Requirements
Module code: 5com1062
Semester: A
Credits: 15

Module Aims:

• appreciate and explore in depth the role of requirements within the context of developing and maintaining a software system;
• develop an appropriate and critical understanding of the different processes used to define and capture requirements within a variety of contexts and approaches;
• gain practical experience in using a broad range of requirements engineering techniques.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the principal stages of requirements engineering and the key challenges in developing sound and usable requirements specifications;
• [ii] the range and different types of requirements including both functional and non-functional requirements;
• [iii] the professional issues relating to role of requirements engineer.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] utilise a broad range of appropriate techniques for the elicitation, modelling and validation of requirements;
• [ii] develop and use scenarios and critical thinking across the full range of requirements engineering processes from elicitation through to validation;
• [iii] identify and communicate with different relevant stakeholders using a range of styles and media.
Module Content:
This module focuses on the rationale, processes and outputs of software requirements engineering (RE) activities. This would typically require identification, analysis, and knowledge how to suitably specify by using appropriate strategies, approaches and techniques what organisations need in order to ensure their systems meet the requirements of all relevant stakeholders. Based on a number of sources, both from research and industry, this module will expose the main RE processes (i.e., eliciting, modelling and validating requirements) and their related issues. The module critically assesses the management of the above processes by using a broad range of diverse techniques. At the elicitation stage, for example, this could include individual techniques such as benchmarking and interviewing. Most techniques will also be considered in the context of multiple processes and against different software development approaches (for example, Agile).

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: Web Scripting
Module code: 5com1063
Semester: B
Credits: 15

Module Aims:

• develop programming skills that are relevant to the development of web applications;
• develop an appreciation of the constraints that the World Wide Web places on developers.

Intended Learning Outcomes:
Successful students will typically:
be able to:
[i] demonstrate detailed awareness of key aspects of the Internet, its structure and the protocols that it uses;
[ii] demonstrate awareness of how web applications are structured;
[iii] identify, analyse and communicate some of the constraints that the World Wide Web places on developers.

9b. Skills and Attributes:
Successful students will typically:
be able to:
[i] select and use appropriate programming techniques for the implementation of simple web applications;
[ii] apply their knowledge of different information storage approaches to the development of data-driven web applications.

Module Content:
This module introduces the fundamental concepts of the World Wide Web. It starts with an overview of HTML mark-up and cascading style sheets, and the importance of the separation between content and presentation.

The bulk of this module is concerned with extending the practical programming skills, and applying these to the
development of a web application that creates, reads, updates and deletes information using databases.

Further, an important part of this module is understanding the constraints that the World Wide Web places on developers, such as those imposed by its stateless nature and the various recommendations that guide core web technologies.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Enterprise Databases
Module code: Scom1064
Semester: A
Credits: 15

Module Aims:

• understand the principles, techniques and theory of relational databases;
• understand the design, implementation and management of multi-user relational databases;
• gain experience of using a shared multi-user system;
• have an awareness of where new types of database are emerging.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the relevant relational theory;
• [ii] how relational databases operate;
• [iii] the techniques and notations suitable for the design and implementation of a relational database;
• [iv] areas where new types of database are emerging.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] use an appropriate database design methodology to design a conceptual database model;
• [ii] use normalisation to produce a database schema ready for implementation;
• [iii] select, implement, populate and then query an appropriate physical database design based on the logical model;
• [iv] to be aware of issues surrounding the management of a multi-user database.

Module Content:
This module provides an in-depth study of the design and implementation of relational databases. The module
provides the principles and the techniques needed to develop relational database systems, together with the
database theory on which these principles and techniques are founded. There is a large practical element,

using a popular market leading product in the roles of database designer, database administrator and end user.

The module also raises awareness of areas where new types of database are emerging.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: ITMB Development Exercise
Module code: 5com1065
Semester: AB
Credits: 30

Module Aims:

• to have experience of a complete system development project, and the professional issues that arise;
• to apply and extend existing knowledge and skills in system engineering techniques including requirements analysis and specification, system and interface design, data modelling, testing and implementation;
• to become equipped with sufficient skills and knowledge to enable them to successfully apply for and complete an industrial placement and to further enhance their employability.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] a broad range of different approaches to software development and different project roles, and their application in a “real world” business environment;
• [ii] the principles and concepts of professional issues relating to software engineering.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] undertake a range of system development activities, particularly program design and implementation,
  selecting appropriate software engineering techniques and/or solutions, evaluating the appropriateness of these techniques and solutions where applicable;
• [ii] communicate effectively with different stake holders, both internal and external to the project team, using a range of styles and media;
• [iii] work effectively as part of a team, to have an appreciation of the issues involved in this, and to be able to adapt accordingly.

**Module Content:**
This provides the opportunity to create a software system in a professional manner, by learning and using an appropriate range of competencies and techniques. The system to be developed is typically an information management system and the development approach is based on the use of exploratory design, technical feasibility and agile methods, although reference is made to structured analysis methods too. Other aspects covered include communication and group working, while the technical skills focus on programming and program design. Industry-delivered ‘guru lectures’ form an essential resource for this module. This module provides sufficient skills and knowledge of current trends in the IT industry to enable successful application for an industrial placement and graduate employment.

**Pre and Co requisites:**
None

**Total hours:** 300

**Assessment:**

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Module name: Project Planning
Module code: 6com1031
Semester: A
Credits: 15

Module Aims:

• be fully prepared to undertake a complex individual project;
• understand the purpose of the project as an academic exercise based on around the creation of a practical artefact;
• be prepared for the writing of a substantial technical dissertation.

Intended Learning Outcomes:

9a. Knowledge and Understanding:
Successful students will typically:

have a knowledge and understanding of how to:
• attempt to solve a diverse range of computer science domain problems;
• develop a project proposal, identifying a significant body of work;
• critique and evaluate a project case study in order to produce a qualitative report.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• devise realistic solutions to real-world problems;
• construct an appropriate project plan to reflect a required body of work;
• produce a detailed, critical technical report reflecting a real-world project;
• articulate legal, social, ethical and professional issues within the context of a student directed body of work.

Module Content:
This module provides preparation for the BSc Project. The module covers: Defining and gauging the suitability of
a personal project to address a complex problem; Setting individual targets and goals relevant to the
undertaking of the project; Determining ethical, professional and social considerations related to project design,
implementation and delivery; Developing self-evaluation skills to support self-analysis of learning, skill acquisition and performance; Understanding particular models and methods used to initiate, plan, report on and
manage complex technical projects.

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: User Experience
Module code: 6com1032

Semester: A
Credits: 15

Module Aims:

• gain an in depth understanding of the body of knowledge relating to the fields of Interaction Design and User Experience (UX);
• identify, select and apply appropriate UX concepts and techniques to the design, analysis and critique of user interfaces.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] the scope and challenges of the User Experience field and its inter-relationship with the Interaction Design field;
• [ii] techniques for identifying and representing users in the design process.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] select and use appropriate techniques for the design of user interfaces, taking into account relevant standards, guidelines and legislation;
• [ii] design and conduct quantitative and qualitative studies for the evaluation of user interfaces;
• [iii] critically analyse and report on the results from UX evaluation studies.
Module Content:
This module explores the body of knowledge underpinning the topic of User Experience (UX), and how UX approaches can be applied to the design and evaluation of user interfaces.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Computer Systems Security
Module code: 6com1033
Semester: A
Credits: 15

Module Aims:

• explore advanced principles in computer security from a systems perspective;
• provide a detailed understanding of some of the fundamental principles underlying computer systems security;
• articulate both theoretical and practical aspects of computer security and operations.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] a range of current computer security techniques and of how the principles of systems security methods are embodied therein;
• [ii] essential facts, concepts and principles of systems requirements for secure operations and practices;
• [iii] computer systems risks, vulnerabilities, threats analysis, and software security.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] apply of particular computer security techniques to analysis and testing;
• [ii] analyse and solve problems in secure systems design and implementation;
• [iii] achieve familiarity with methods of secure systems development and to exercise critical evaluation of information accessed from a wide variety of sources.

Module Content:
This module provides a description of computer security techniques and mechanisms and the underlying
design trade-offs. It introduces the principles of computer systems risk, vulnerabilities and threat analysis. The module covers cryptographic tools, access controls and techniques. The techniques associated with adopting secure systems design and development and security testing will be covered. Using event monitoring and firewalls ensures the effectiveness of operating systems security and hardware operations. The module discusses a range of different issues related to software systems, malicious software and malware operations that are important aspects of software security.

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: Concurrency
Module code: 6com1034
Semester: B
Credits: 15

Module Aims:

• gain a detailed understanding of some of the principles and practice of concurrent software systems;
• gain an insight into the advantages and disadvantages of concurrent versus sequential processing;
• gain an appreciation of the way these apply to a specific problem domain.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] the issues involved in the development and operation of communicating sequential processes;
• [ii] the trade-offs inherent in concurrent systems;
• [iii] the importance of disciplined access to data.

Skills and Attributes:
Successful students will typically:

be able to:
• [i] describe the behaviours of communicating sequential processes in an appropriate language;
• [ii] identify and describe properties of these systems, such as safety, liveness, deadlock, non-determinism;
• [iii] apply and describe these at an appropriate level within a specific case study.

Module Content:
This module covers the issues and terminology in communicating sequential processes. The module provides insight into the advantages and risks inherent in such systems, and an appreciation of the need for disciplined access to data. The module provides an understanding of the desirable properties of concurrent systems, such
as safety and liveness, and some of the techniques, either within a programming language or the operating system, for ensuring these properties. The module applies these principles and practices to particular cases.

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: Constructive Artificial Intelligence
Module code: 6com1035
Semester: A
Credits: 15

Module Aims:

• develop detailed knowledge of key Artificial Intelligence (AI) principles, methods and algorithms;
• acquire skills in developing AI solutions for characteristic AI problems and scenarios.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] fundamental principles and methods for intelligent systems;
• [ii] AI algorithms implementing these principles.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] critically select appropriate models to address AI problems;
• [ii] implement intelligent algorithms to solve characteristic AI problems.

Module Content:
This module covers the essential principles and techniques of constructive Artificial Intelligence (AI), classical
and modern, as well as further core topics in Computational Intelligence. These have been selected as
identified to be central to the skill-set expected of the modern AI practitioner in industry and research. The
module provides an up-to-date working knowledge of constructive AI models and techniques for understanding,
selecting and implementing appropriate AI models, methods and algorithms for given scenarios and for
developing intelligent systems for the solution of problems.
Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: AI Robotics and Applications
Module code: 6com1036

Semester: B
Credits: 15

Module Aims:

• develop knowledge of selected theories and techniques in artificial intelligence and robotics;
• gain knowledge of different robotic applications where AI plays a substantial role;
• apply theories and techniques to appropriate problem domains in artificial intelligence and robotics and gain insight in assessing success in application domains;
• gain practical experience of using robots in an artificial intelligence context.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] some of the abstract principles underpinning the design and operation of artificial intelligence and robots;
• [ii] the application of theories and techniques to solve appropriate artificial intelligence and robotics problems;
• [iii] relevant application domains and frameworks;
• [iv] using AI to learn about and interact with humans.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] apply the theories and techniques to develop intelligent and robotic systems using appropriate tools
• [ii] critically and scientifically evaluate and assess the application of various AI paradigms applied to the control of behaviours of AI agents and robots that interact with humans or each other.
Module Content:
This module applies problem based learning in AI principles for solving modern day robotics problems. The course includes a series of application areas in which AI plays or has the potential to play a significant role. A series of case studies provides an opportunity for comparative analysis, while practical robotic implementation tasks allow for implementing robot learning and decision making. The module provides opportunities to develop knowledge of the principles of artificial intelligence and robotics, and to gain practical experience of the design, programming and behaviour of intelligent systems and robots.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Object Oriented Development
Module code: 6com1037
Semester: A
Credits: 15

Module Aims:

• explore object-oriented concepts, their realization in programming languages, and use in the design and architecture of software systems, using current and emerging technologies;
• develop practical skills in the use of a variety of object-oriented techniques;
• apply and critically evaluate object oriented design techniques to the development of software systems.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] object-oriented approaches to problem analysis and systems design, their principles and supporting justifications;
• [ii] modelling the requirements of software systems using object-oriented techniques;
• [iii] strategies for evaluating object-oriented software designs and architectures according to established quality criteria.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] use appropriate tools, techniques and notations in problem analysis, and in the design of programmed computer systems;
• [ii] select and apply suitable object-oriented tools and techniques productively in the design of software;
• [iii] use and critically evaluate object-oriented design techniques.
Module Content:
This module develops understanding of object-oriented technology in the analysis and design of software systems. Real-world problems are analysed and modelled in an object-oriented way, experience is gained in translating such models into executable systems. The module explores design concepts such as abstraction, encapsulation, and inheritance. The module considers how these design concepts can improve software quality, and how typical implementations of these concepts can be captured and reused by using design patterns.
Students will gain practical experience of a range of modelling techniques, and have the opportunity to use a variety of industry-standard tools for system development.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Software Engineering Practice
Module code: 6com1038
Semester: B
Credits: 15

Module Aims:

• extend expertise in the application of a range of advanced software engineering practices;
• extend understanding of the practical implications of technical context on the application of software engineering processes and practices.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] a range of leading edge software engineering practices;
• [ii] of the role of software engineering practices in the development cycle. Examples of which may include concurrent development and defect management.

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] practice and evaluate a variety of software engineering approaches to developing and evolving software;
• [ii] deploy version control within a software engineering context.

Module Content:
This module gives the opportunity to extend understanding and experience of software engineering practice. It offers exposure to the development and evolution of software. The module is very practical and is based around a substantial piece of software. The aim of the module is to enable the development of software engineering
knowledge and skills that are transferable to software companies. Leading edge practices are introduced such
as using program slicing to find code faults. Specialised software development approaches are investigated
such as those required for application areas such as safety critical systems.

Pre and Co requisites:
None

Total hours: **150**

Assessment:

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Module name: Cyber Security
Module code: 6com1040
Semester: B
Credits: 15

Module Aims:

• explore advanced principles in cyber security from a systems perspective;
• provide a further grounding in the fundamental principles underlying cyber security;
• introduce both theoretical and practical aspects of cyber security and operations.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a significant range of current cyber security techniques and of how the principles of systems security
methods are embodied therein;
• [ii] essential facts, concepts and principles of systems requirements for secure Internet operations and
practices;
• [iii] network systems risks, vulnerabilities, threats analysis, and Web security.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• [i] apply particular cyber security techniques to analysis and testing;
• [ii] demonstrate confidence and flexibility in analysing and solving problems in secure Internet systems design
and implementation;
• [iii] achieve familiarity with methods of secure network systems development and to exercise critical
evaluation of information accessed from the Web and a wide variety of other sources.
Module Content:
This module introduces the concepts and principles of cyber security including its theoretical and practical aspects. It covers the relevant mathematical techniques associated with cryptographic algorithms and applications such as user authentication and authentication protocols. This module focuses on how security services that are provided by underlying network infrastructure can be used to develop various secure systems.
These systems are used to protect information communication, computer networks and cloud resources from unauthorised access and malicious activities. In this module, various examples of secure systems such as secure email, secure web and secure protocols will be presented. Security violations and threats such as Distributed Denial of Service (DDoS), identity theft, information leaks, network eavesdropping, email spams are major issues in cyber security. Issues related to forensics, wireless security and cloud security are also discussed in this module.

Pre and Co requisites:
None

Total hours: 150
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Module name: Artificial Life
Module code: 6com1041
Semester: A
Credits: 15

Module Aims:

• unifying principles and methods of Artificial Life as tools to construct simple and insightful models of natural systems;
• role of distributed, situated bottom-up computation and modelling in understanding natural and life-like systems;
• aspects of life-like systems that can be exploited to perform computational tasks.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] various approaches to the modelling of implicit computation performed by living and life-like systems;
• [ii] the role of environment, embodiment and emergence in complex systems;
• [iii] methods to model and critically assess Artificial Life systems.

9b. Skills and Attributes:
Successful students will typically:

be able:

• [i] write programs to model life-like systems;
• [ii] critically assess Artificial Life systems;
• [iii] carry out and evaluate simulation experiments to understand their working.

Module Content:
Artificial Life is the study of the modelling and synthesis of living and life-like systems, especially with regard to
the computation they implicitly perform in interaction with their environment. It comprises one of the major directions of Artificial Intelligence of the last few decades, and its techniques are widely applied in areas as divergent as animation in movies and computer games, economics, machine learning, physics and engineering (robotics, space sciences) and systems biology. The importance of embodiment in the understanding of natural intelligence has led researchers in robotics, Artificial Life, and Artificial Intelligence to focus on Embodied Cognition, in which the role of the external environment and the way agents are build are at least as important as any algorithm. This module provides valuable and solid foundations in the increasingly important and applicable paradigms and techniques of Artificial Life and Embodied Cognition, supported by essential lectures and experimentation with self implemented simulations.

Pre and Co requisites:
None

Total hours: 150

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Module name: Software Quality
Module code: 6com1042
Semester: B
Credits: 15

Module Aims:

• what software quality means and its importance in all systems where software is a component;
• the role of measurement in software quality assurance;
• the technical practices and managerial processes that can be used to ensure software quality.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] the significance of software quality and identify the specific factors which contribute to software quality;
• [ii] applying software product and process metrics to predict software quality attributes;
• [iii] the importance of software development approaches to improve software quality.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] derive a series of software product and software metrics;
• [ii] apply software process and product metrics to evaluate software product attributes;
• [iii] demonstrate how techniques can be used to evaluate and improve software quality.

Module Content:
This module provides both a theoretical and practical introduction to quality both in terms of the software development process and the products of that process. It also investigates how quality can be defined and measured, and by analysing actual program code to determine its quality according to pre-determined quality metrics.
Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Embedded Systems Development

Module code: 6com1043

Semester: A
Credits: 15

Module Aims:

• understand the problem domain of resource-constrained computing systems and match them with adequate design solutions;
• understand the problem domain of dependable real-time computing and match them with adequate design solutions;
• appreciate the advantages of system design based on hybrid systems, which are a combination of the discrete controller with the continuous environment.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] requirements and design techniques for dependable real-time computing;
• [ii] techniques to critically analyse resource-requirements of embedded systems.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] develop software for an embedded platform;
• [ii] specify design solutions to ensure fulfilling the resource and dependability requirements of an embedded system.

Module Content:
This module lays out the knowledge for designing embedded systems. The fundamental characteristics of
embedded systems are that available resources are limited and/or that the computer control system interacts
with a control environment. The characteristics of the control environment may impose specific requirements to
the computer control system, for example, dependability properties or real-time guarantees of the control
signal.
This course will teach theoretical foundations and established practices for the design and evaluation of
embedded systems, including dependable and real-time computing. Practical exercises to model and develop
and embedded systems will strengthen the understanding of the taught concepts.

Pre and Co requisites:
None

Total hours: 150

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Module name: Machine Learning and Neural Computing

Module code: 6com1044

Semester: B

Credits: 15

Module Aims:

• understand and apply machine learning techniques and/or neural networks to analyse both labelled and unlabelled data;
• understand and use data visualisation techniques to further analyse data;
• understand how computational models can capture some aspects of brain function.

Intended Learning Outcomes:
Successful students will typically:
have a knowledge and understanding of:
• [i] data projection techniques;
• [ii] supervised and unsupervised learning;
• [iii] computational models of neural systems.

9b. Skills and Attributes:
Successful students will typically:
be able to:
• [i] use tools such as LibSVM and R to analyse data;
• [ii] write programs using a high level language such as Python or Matlab to analyse data;
• [iii] apply computational models to simulate aspects of brain function.

Module Content:
This module uses contemporary machine learning and neural network techniques to aid in the understanding and analysis of real world data and neural systems. Topics include supervised and unsupervised learning, data visualisation, and error-correction-based learning.
Pre and Co requisites:
None

Total hours: 150
Assessment:

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Module name: Programming Paradigms
Module code: 6com1045
Semester: B
Credits: 15

Module Aims:

- deepen their understanding of the nature of programming languages;
- appreciate the different paradigms which programming languages follow;
- gain an understanding of the impact of language features on program design and development;
- understand how programming language design has evolved over time.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

- [i] the different paradigms of programming languages and their effect on language design;
- [ii] issues of language design, such as underlying common features and the impact of application areas, such as web design or concurrency;
- [iii] a range of programming paradigms and example languages.

9b. Skills and Attributes:
Successful students will typically:

be able to:

- [i] write programs in a variety of programming paradigms using one of several different languages;
- [ii] critically evaluate and articulate the strengths and weaknesses behind the design of features from a range of languages;
- [iii] explain the evolution of at least one programming language over time.

Module Content:
Computers are instructed to carry out tasks using a programming language. The language can be critical to
that program's success: the choice of language for a web application is not the same as that for a device driver.

Many hundreds of programming languages exist today, with more invented every year, and popular languages evolve over time. This module makes sense of the diversity of languages and their evolution by examining the different types of programming language, called “paradigms”, exploring examples from procedural, functional, object-oriented, logic and concurrent programming. The module covers a variety of popular and historical languages.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: Quantum Computing
Module code: 6com1046
Semester: B
Credits: 15

Module Aims:

- understand a range of fundamental principles involved in Quantum Computing (QC).
- understand how issues and concerns in classical computing are modified when extended to QC;
- acquire a framework for understanding the concepts involved in QC.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

- [i] fundamental concepts in QC;
- [ii] underlying mathematical structures;
- [iii] a selection of applications within the field of quantum computing.

9b. Skills and Attributes:
Successful students will typically:

be able to:

- [i] identify and critically evaluate a selection of concepts key to quantum computing;
- [ii] select and deploy appropriate techniques to a range of applications from QC;
- [iii] critique, evaluate and review research undertaken relating to quantum computing.

Module Content:
Quantum information processing is an active research area that exploits fundamental quantum phenomena in
new applications from computation, secure data communication and information processing. A major paradigm
shift, the area is of significant interest and potential benefit to both computer scientists, mathematicians and
physical scientists. This is theoretical in nature, exploring concepts and applications from the area of quantum
information processing with an emphasis on quantum computing. Content will take into account current or predominant research directions.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Mobile Computing  
Module code: 6com1047  
Semester: A  
Credits: 15

Module Aims:

• understand the major ideas of ubiquitous computing;
• understand and apply the core principles of mobile development;
• become proficient in the coding of at least one of the major development platforms.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] the ideas and history of ubiquitous computing;
• [ii] principles of mobile operation and usability;
• [iii] development and evaluation practices in mobile development

9b. Skills and Attributes:
Successful students will typically:

be able to:
• [i] write an app using a well-supported mobile platform and development environment;
• [ii] handle issues of connectivity, user experience, accelerometry and location awareness in mobile programming;
• [iii] critically evaluate the usability of a mobile app.

Module Content:
This module examines mobile development and the issues around programming for a mobile device, understood here as a phone, tablet, or wearable computational hardware. In terms of programming this means dealing with: Novel forms of input: accelerometry or GPS reading; Understanding gesture: swiping, pinching, longpress;
Context awareness: battery level, light level, nearby sensors or devices; Mobile usability: developing for small screens with restricted space; Connectedness: interfacing with web services; Publishing apps on dedicated app stores. In terms of the conceptual issues it means looking at: The tradition of research in ubiquitous computing from Mark Weiser onwards; Issues of peripheral attention and so-called “calm technology”; Issues of privacy and security; Uses to which mobile applications have been used in areas such as Healthcare; Future directions (such as that represented by Google Glasses).

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Advanced Database Topics
Module code: 6com1048
Semester: A
Credits: 15

Module Aims:

• understand advanced principles, techniques and theories of relational databases and apply these to other types of databases;
• be capable of designing, implementing and managing multi-user relational databases;
• gain experience of using extensions to a regular relational database in particular spatial extensions and Online analytical extensions for data warehousing;
• have an awareness of where new types of database are emerging and gain practical experience in these areas.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] seek and apply the concepts of top down data modelling paradigms to produce a workable design which can be implemented in a multi-user environment;
• [ii] have an in-depth understanding of data warehousing, distributed databases and business intelligence;
• [iii] the techniques suitable for physical database design and database security;
• [iv] areas where new types of database are emerging (Spatial data, Big Data, NoSQL databases).

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] use a database design methodology to design an enhanced conceptual database model;
• [ii] map the conceptual model to a logical model for implementation in a relational database;
• [iii] analyse, design and critically evaluate databases in selected current and emerging topics;
• [iv] articulate issues surrounding the management and physical design of a multi-user database.

Module Content:
This module builds upon knowledge and skills acquired in the context of relational databases studied at Level 5. Issues of complexity in databases arise when the scale of the database increases and the focus here is on firstly the design and implementation in a large multi-user database and secondly, selected current and emerging topics in databases. This module provides an in-depth study of the design and implementation of relational databases using a top-down approach. There is a large practical element using a popular market leading product in the roles of database designer, database administrator and end user. The module also raises awareness of areas where new types of database are emerging and provides practical experience in these areas.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: Strategic IT Management
Module code: 6com1049

Semester: A
Credits: 15

Module Aims:

• appreciate the need for a corporate information strategy in an organisation and the contribution that the effective management of information, systems and technology makes to the competitive success of the organisation;
• gain a detailed understanding of methods and models for developing the information strategy and aligning it with the business strategy;
• understand current developments in Information Systems/Information Technology (IS/IT), their implications for information strategies and the need to manage strategic organisational change.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] methods and models for developing and aligning the information strategy to the business strategy;
• [ii] how to set the systematic use of an organisation’s Information Systems Strategy to operate flexibly and effectively, and enhance its competitive opportunities in a global environment;
• [iii] current issues and developments in IS/IT influencing organisations to change and the essential elements needed to ensure successful strategic change management.

9b. Skills and Attributes:
Successful students will typically:

Be able to:

• [i] critically evaluate current methods and techniques used to develop information strategies;
• [ii] critically analyse and evaluate corporate resource implications associated with sustainable
information strategies.

Module Content:
This module explores the issues around developing a strategic approach to planning and managing the
information, systems and technology (IS/IT) of an organisation to enable it to function smoothly and seek a
competitive advantage. It considers the current thinking surrounding the development and implementation of
corporate strategies for the use of IS/IT, and their relationship to the strategic frameworks of organisations. The
module introduces the ways in which strategic decisions are made, providing techniques and frameworks to
help formulate information strategies and issues surrounding the implementation of an IS/IT strategy.
Introducing and managing the IT strategy inevitably leads to change in terms of systems and technology,
therefore the need to manage change in organisations is discussed and the investigation of conditions, factors,
and tools that can help ensure successful change are critically analysed.

Pre and Co requisites:
None

Total hours: 150
Assessment:

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Academic year 2019-2020
Module name: Information Security Management
Module code: 6com1050
Semester: B
Credits: 15

Module Aims:

• explore advanced principles in information security from a management perspective;
• further develop knowledge of in the fundamental principles underlying information risk and security management;
• understand theoretical and organisational aspects of information security management and operations.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:

• [i] a range of current security management techniques and of how the principles of information risk assessment, incident management and information assurance methods are embodied therein;
• [ii] essential facts, concepts and principles of Security controls and IT security development and management;
• [iii] national and international information security standards, government policies, and compliance laws to data protection.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• [i] demonstrate detailed knowledge and understanding of information risk assessment and security management;
• [ii] demonstrate confidence and flexibility in security standards, managing security incidents and related IT
security problems in systems development and implementation;

• [iii] articulate methods of security controls, disaster recovery and business continuity management and to

exercise critical evaluation of information sources.

Module Content:
This module develops the concepts and principles of information security management including its organisational aspects such as security governance, policy procedures and security standards. It covers the relevant methods associated with risk assessment and management. In this module, various issues associated with information assurance, incident management and government legislation on data protection will be presented. This module introduces security controls that are used to protect information and underlying IT systems and infrastructure. Disaster recovery, business continuity management, investigation and digital forensics which are important aspects of information security management will be discussed in this module.

Pre and Co requisites:
None

Total hours: 150

Assessment:

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Module name: Advanced Web Scripting  
Module code: 6com1051  
Semester: A  
Credits: 15

Module Aims:

- develop a systematic understanding of the architecture, opportunities and issues associated with developing web applications;
- develop programming skills that are relevant to the creation and enhancement of web applications.

Intended Learning Outcomes:
Successful students will typically:
have a knowledge and understanding of:
- a knowledge of the abstract structure of web applications and common design patterns;
- a range of approaches for implementing different web application components.

9b. Skills and Attributes:
Successful students will typically:
be able to:
- identify, select and use appropriate programming techniques to enhance simple web applications;
- critically analyse and work with a range of appropriate development tools and resources, including third party services and libraries.

Module Content:
This module extends the basic web model in two ways. The first looks at the use of client-side scripting to enhance the user experience. This is done by examining the use of Javascript to increase the interactivity of the user view, and to exploit local data storage. The second is to consider the use of services to move beyond
a simple HTML page request/response model of interaction. In addition, the module considers the impact of third party tools in developing web applications. For enhancing the user experience this may include interface toolkits such as JQuery. Service-based extensions may include the use of functional libraries such as the Google Maps API.

Pre and Co requisites: None

Total hours: 150
Assessment:

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Module name: Enterprise Systems
Module code: 6com1052
Semester: B
Credits: 15

Module Aims:

• recognise the complexity of large scale systems that may be necessary to support organisations and enterprises, and the need to develop scalable system architectures;
• explore a range of techniques to support the integration of different large scale systems within a single enterprise.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of:
• [i] a range of approaches for systematically developing, managing and integrating IT services;
• [ii] the in-depth structure of enterprise systems and common design patterns.

9b. Skills and Attributes:
Successful students will typically:
be able to:
• [i] identify, select and use appropriate service-based methods and models to integrate different large scale enterprise systems;
• [ii] select and apply an appropriate range of established methods and models to critically analyse and design scalable enterprise systems.

Module Content:
This module explores different perspectives on the design, management and integration of software systems that support business processes across complex organisations. The first perspective examines the integration
and inter-operation of different applications within the same enterprise. The focus is on appropriate approaches and methods for bridging the gap between IT strategy, which aligns business goals and system requirements, and the design and management of individual IT services. This could include, but is not limited to, approaches based on ITIL and/or SOA. The second perspective examines the scalability of systems that provide specific functionality across the whole of an enterprise. This is done by breaking down an application into different tiers and looking at the issues, potential problems and design solutions to enable the delivery of high performance systems. This focus on individual systems is a natural extension to study of design patterns for web applications.

**Pre and Co requisites:**
None

**Total hours:** 150

**Assessment:**

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Module name: Computer Science Project
Module code: 6com1053
Semester: B
Credits: 30

Module Aims:

• devise a complex individual project answering a real-world problem, based on and underpinned by Computer Science principles;
• plan, undertake and evaluate a practical solution to an identified problem, designed to extend and deepen their knowledge of subject areas relevant to their studies;
• plan, produce and refine a significant technical report describing and reflecting upon the program of work undertaken to solve a real-world problem.

Intended Learning Outcomes:

Successful students will typically:

have a knowledge and understanding of how to:

• individually research, plan, develop and implement the solution to a substantial computer science problem;
• organise, evaluate and reflect on their capabilities to deliver a defined technical solution;
• critique and evaluate their work in order to produce a technical report;
• develop a body of work within the context of appropriate legal, social ethical and professional issues.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• deliver a realistic solution to a real-world problem;
• manage a project schedule that changes as a body of work is undertaken;
• produce an extensive, critical technical report reflecting a solution set of their design.
Module Content:
This module is almost exclusively self-directed study. The actual academic content is defined by the topic chosen by the student.

This module leads on from the Project Planning module. The Project Planning module will have developed many of the skills needed to undertake the BSc Project, including preparatory sessions on identifying a suitable project idea. The Project module provides an individually designed programme of study based around the principles of the chosen degree title. This programme of study should reflect a solution to a problem of the student’s devising.

Pre and Co requisites:
Pass achieved in Preparation for BSc Project.

Total hours: 300

Assessment:

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Module name: Artificial Intelligence Project
Module code: 6com1054
Semester: B
Credits: 30

Module Aims:

• devise a complex individual project answering a real-world problem, based on and underpinned by Computer Science principles in the specialist area of Artificial Intelligence;
• plan, undertake and evaluate a practical solution to an identified problem, designed to extend and deepen their knowledge of specialist subject areas relevant to their studies;
• plan, produce and refine a significant technical report describing and reflecting upon the program of work undertaken to solve a real-world problem, designed to extend and deepen their knowledge of subject areas relevant to the field of Artificial Intelligence.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of how to:

• individually research, plan, develop and implement the solution to a substantial Artificial Intelligence related problem;
• organise, evaluate and reflect on their capabilities to deliver a defined technical solution;
• critique and evaluate their work in order to produce a technical report;
• develop a body of work within the context of appropriate legal, social ethical and professional issues.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• deliver a realistic solution to an Artificial Intelligence problem or research topic;
• manage a project schedule which changes as a body of work is undertaken;
• produce an extensive, critical technical report reflecting a solution set of their design.

Module Content:
This module is almost exclusively self-directed study. The actual academic content is defined by the
topic
chosen by the student.
This module leads on from the Project Planning module. The Project Planning module will have
developed many
of the skills needed to undertake the BSc Project, including preparatory sessions on identifying a
suitable
project idea. The Project module provides an individually designed programme of study based
around the
principles of the chosen degree title. This programme of study should reflect a solution to a problem
of the
student’s devising.

Pre and Co requisites:
Pass achieved in Preparation for BSc Project.

Total hours: 300

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Module name: Networks Project
Module code: 6com1055
Semester: B
Credits: 30

Module Aims:

• devise a complex individual project answering a real-world problem, based on and underpinned by Computer Science principles in the specialist area of Computer Networks;

• plan, undertake and evaluate a practical solution to an identified problem, designed to extend and deepen their knowledge of specialist subject areas relevant to their studies;

• plan, produce and refine a significant technical report describing and reflecting upon a program of work undertaken to solve a real-world problem, designed to extend and deepen their knowledge of subject areas relevant to the field of computer networks.

Intended Learning Outcomes:

Successful students will typically:

have a knowledge and understanding of how to:

• individually research, plan, develop and implement the solution to a substantial computer networks related problem;

• organise, evaluate and reflect on their capabilities to deliver a defined technical solution;

• critique and evaluate their work in order to produce a technical report;

• develop a body of work within the context of appropriate legal, social ethical and professional issues.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• deliver a realistic solution to a computer networks problem or research topic;
• react to a project schedule which changes as a body of work is undertaken;
• produce an extensive, critical technical report reflecting a solution set of their design.

Module Content:
This module is almost exclusively self-directed study. The actual academic content is defined by the topic chosen by the student.

This module leads on from the Project Planning module. The Project Planning module will have developed many of the skills needed to undertake the BSc Project, including preparatory sessions on identifying a suitable project idea. The Project module provides an individually designed programme of study based around the principles of the chosen degree title. This programme of study should reflect a solution to a problem of the student’s devising.

Pre and Co requisites:
Pass achieved in Preparation for BSc Project.

Total hours: 300
Assessment:

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Module name: Software Engineering Project
Module code: 6com1056

Semester: B
Credits: 30

Module Aims:

• devise a complex individual project answering a real-world problem, based on and underpinned by Computer Science principles in the specialist area of Software Engineering;
• plan, undertake and evaluate a practical solution to an identified problem, designed to extend and deepen their knowledge of specialist subject areas relevant to their studies;
• plan, produce and refine a significant technical report describing and reflecting upon the program of work undertaken to solve a real-world problem, designed to extend and deepen their knowledge of subject areas relevant to the field of Software Engineering.

Intended Learning Outcomes:

Successful students will typically:

have a knowledge and understanding of how to:

• individually research, plan, develop and implement the solution to a substantial Software Engineering related problem;
• organise, evaluate and reflect on their capabilities to deliver a defined technical solution;
• critique and evaluate their work in order to produce a technical report;
• develop a body of work within the context of appropriate legal, social ethical and professional issues.

9b. Skills and Attributes:

Successful students will typically:

be able to:

• deliver a realistic solution to a Software Engineering problem or research topic;
• manage a project schedule which changes as a body of work is undertaken;
• produce an extensive, critical technical report reflecting a solution set of their design.

**Module Content:**
This module is almost exclusively self-directed study. The actual academic content is defined by the topic chosen by the student.

This module leads on from the Project Planning module. The Project Planning module will have developed many of the skills needed to undertake the BSc Project, including preparatory sessions on identifying a suitable project idea. The Project module provides an individually designed programme of study based around the principles of the chosen degree title. This programme of study should reflect a solution to a problem of the student’s devising.

**Pre and Co requisites:**
Pass achieved in Preparation for BSc Project.

**Total hours:** 300

**Assessment:**

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Module name: Information Technology Project
Module code: 6com1057

Semester: 8
Credits: 30

Module Aims:

• devise a complex individual project answering a real-world problem, which involves the solution of a self-defined, practically-oriented problem;

• plan, undertake and evaluate a practical solution to an identified problem designed to extend and deepen their knowledge of specialist subject areas relevant to their studies;

• plan, produce and refine a significant technical report reflecting a program of work designed to extend and deepen their knowledge of subject areas relevant to their studies.

Intended Learning Outcomes:
Successful students will typically:

have a knowledge and understanding of how to:

• individually research, plan, develop and implement the solution to a substantial technical problem;

• organise, evaluate and reflect on their capabilities to deliver a defined technical solution;

• critique and evaluate their work in order to produce a technical report;

• develop a body of work within the context of appropriate legal, social ethical and professional issues.

9b. Skills and Attributes:
Successful students will typically:

be able to:

• deliver a realistic solution to a real-world problem;

• manage a project schedule which changes as a body of work is undertaken;

• produce an extensive, critical technical report reflecting a solution set of their design.

Academic year 2019-2020
Module Content:
This module is almost exclusively self-directed study. The actual academic content is defined by the topic chosen by the student.

This module leads on from the Project Planning module. The Project Planning module will have developed many of the skills needed to undertake the BSc Project, including preparatory sessions on identifying a suitable project idea. The Project module provides an individually designed programme of study based around the principles of the chosen degree title. This programme of study should reflect a solution to a problem of the student’s devising.

Pre and Co requisites:
Pass achieved in Preparation for BSc Project.

Total hours: 300

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