Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 2 (FHEQ LEVEL 5)

COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Pro-Vice-Chancellor and Executive Dean	Professor David Smith
Director of Faculty Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Mathematics and Computer Science	
Head of School	Professor Elaine Crooks
School Education Lead	Dr Neal Harman
Head of Computer Science	Professor Xianghua Xie
Computer Science Programme Director	Undergraduate – Dr Liam O'Reilly
Year Coordinators	Year 0 – Dr Deepak Sahoo Year 1 – Dr Trang Doan Year 2 – Dr Fabio Caraffini Year 3 – Dr Jens Blanck Year 4 – Dr Tom Owen

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions.
We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-

info-taught-students/your-programme-explained/

Year 2 (FHEQ Level 5) 2023/24
Computer Science and Artificial Intelligence
BSc Computer Science and Artificial Intelligence with a Year in Industry[GG5I]

Coordinator: Dr F Caraffini

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
CS-230 **Software Engineering** **15 Credits** **Dr LP O'Reilly**	**CS-265** **Artificial Intelligence** **15 Credits** **Dr AZ Wyner/Dr B Muller** **CORE**
CS-250 **Database Systems** **15 Credits** **Dr KL Tam**	
CS-260 **Introduction to Modelling and Simulation** **15 Credits** **Dr N Picco** **CORE**	
CS-270 **Algorithms** **15 Credits** **Dr O Kullmann**	
CS-201 **Placement Preparation: Science Industrial Year** **0 Credits** **Miss VV Wislocka**	
Total 120 Credits	

Optional Modules
Choose a maximum of 45 credits

CS-200	Introduction to Human-Computer Interaction	Prof JS Pearson/Prof SNW Robinson	TB2	15
CS-210	Concurrency	Dr F Caraffini	TB2	15
CS-253	Web Service Development	Dr NA Harman	TB2	15
CS-256	Visual Computing	Prof MW Jones	TB2	15
CS-275	Automata and Formal Language Theory	Dr AM Pauly/Dr M Valenti	TB2	15

And

Choose a maximum of 15 credits
You may choose to make no selection in this section.

CS-239	Software Security Engineering	Dr G Sabaliauskaite/Dr H Nguyen	TB2	15
CS-279	Intelligent Robotics	Dr D Cafolla	TB2	15

Year 2 (FHEQ Level 5) 2023/24
Computer Science and Artificial Intelligence
BSc Computer Science and Artificial Intelligence[GG53]
BSc Computer Science and Artificial Intelligence with a Year Abroad[GG5A]

Coordinator: Dr F Caraffini

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
CS-230 **Software Engineering** **15 Credits** **Dr LP O'Reilly**	**CS-265** **Artificial Intelligence** **15 Credits** **Dr AZ Wyner/Dr B Muller** **CORE**
CS-250 **Database Systems** **15 Credits** **Dr KL Tam**	
CS-260 **Introduction to Modelling and Simulation** **15 Credits** **Dr N Picco** **CORE**	
CS-270 **Algorithms** **15 Credits** **Dr O Kullmann**	
Total 120 Credits	

Optional Modules
Choose a maximum of 45 credits

CS-200	Introduction to Human-Computer Interaction	Prof JS Pearson/Prof SNW Robinson	TB2	15
CS-203	Professional Development and Career Planning	Miss VV Wislocka/Miss VV Wislocka	TB1	0
CS-210	Concurrency	Dr F Caraffini	TB2	15
CS-253	Web Service Development	Dr NA Harman	TB2	15
CS-256	Visual Computing	Prof MW Jones	TB2	15
CS-275	Automata and Formal Language Theory	Dr AM Pauly/Dr M Valenti	TB2	15

And
Choose a maximum of 15 credits
You may choose to make no selection in this section.

CS-239	Software Security Engineering	Dr G Sabaliauskaite/Dr H Nguyen	TB2	15
CS-279	Intelligent Robotics	Dr D Cafolla	TB2	15

CS-200 Introduction to Human-Computer Interaction

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof JS Pearson, Prof SNW Robinson

Format: 30 Lectures

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This module introduces the key principles and practices of human-computer interaction (HCI). It describes in detail the basic concepts, methods and issues surrounding interaction design, explores the properties which make good and poor interfaces and presents the major design principles in the discipline. Students will learn how to gather and analyse requirement data, how to prototype designs, how to construct more usable user interfaces and how to design and run user evaluations.

Module Content: - Introduction to human-computer interaction - what is HCI and why is it important?: provides examples of good and bad design and the process involved in the interaction design process.
- Key concepts: describes major design principles associated with HCI (e.g., visibility, flow, affordance, metaphors, feedback, consistency etc.)
- Understanding users; data gathering: an overview of how to plan and run successful data gathering sessions including how to plan interviews, design questionnaires and run observations.
- Establishing requirements: describes how to interpret results from data gathering sessions into requirements for design, explains the process and purpose of literature reviews and goes through how to develop scenarios and use-cases.
- Interfaces and modalities: introduction to the many different types of user interface and how they are used (e.g., command-based, GUIs, speech, haptics, robotic, etc.)
- Design, prototyping and construction: explains why to prototype, how to construct prototypes (low and high fidelity), and how to begin construction based on designs.
- Evaluation: describes the process of evaluation including, determining goals, selecting participants, obtaining ethical approval and analysing, interpreting and presenting the data. We also go through the different types of evaluation (e.g., usability lab testing and field studies) and touch on statistical analysis and heuristic evaluation.
- Data analysis: discusses the differences between qualitative and quantitative data and describes how best to analyse the results from data gathering sessions.
- Future directions: what is next for HCI and interaction design?

Intended Learning Outcomes: Students will:
- Understand the basic principles of human-computer interaction, including what makes a good or a poor user interface
- Be able to establish usability requirements via data gathering techniques
- Have an understanding of different types of user interface
- Get experience of both prototyping and basic interface design
- Gain an understanding of how to evaluate and analyse interactive systems

Assessment:	Examination 1 (60%) Coursework 1 (5%) Coursework 2 (5%) Coursework 3 (30%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: The coursework is group-based and will require students to collect user requirements, design and prototype (to a basic level) and evaluate a design to a specification given at the start of the module.

Two milestones (labelled as Coursework 1 and Coursework 2) will be video-based (all submissions are made available to all students to watch in their own time). The final submission is a written report (labelled as Coursework 3).

The examination will take the standard format for Computer Science and will test the range of learning outcomes stated above.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Grades, group and collective written feedback for coursework.

Failure Redemption: Resit exam and/or resubmit coursework as appropriate.

Additional Notes: Available to visiting and exchange students.

CS-201 Placement Preparation: Science Industrial Year

Credits: 0 Session: 2023/24 Academic Year

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Miss VV Wislocka

Format: 6 hours of face-to-face delivery, an optional one-to-one meeting, and weekly drop-in sessions.

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This generic cross-disciplinary module is a mandatory module for all students who have enrolled (or transferred) onto the Science Industrial Placement Year. The module focuses on the underpinning and fundamental requisites required to gain, enter and progress effectively through an industrial placement. Learners will be introduced to (a) sourcing placements, CV writing, and application techniques; (b) Interview techniques, how to pitch yourself and be successful; (c) workplace fundamentals and IP awareness, behaviors and expectations; and, (d) Key employability skills; getting the most from your Industrial Placement. This module is only mandatory for students who have enrolled on a Science Industrial Year programme of study or who transfer up to the end of level 5.

Module Content: The module will focus on the key requirements to gain and be successful whilst on a placement. Directed and self -directed activity will address the following topics:

1) Science Industrial Placements - What they are, how to search and how to apply.

2) CV writing, cover letters and application processes.

3) Assessment centres, interview techniques and a mock interview.

4) Recognizing and developing employability skills.

5) reflecting and maximising your placement experience.

6) one to one meeting with careers and employability officers.

Intended Learning Outcomes: By the end of this module, students will be able to:

1) Be aware of and possess the essential skills needed to secure placement opportunities; alongside having the skills to apply for relevant placements.

2) Have a general understanding of an interview process and what tools and attributes make a good interview.

3) Discuss and share what is expected within the workplace including behavioral and professional conduct.

4) Identify personal employability skills and how these will be used in a workplace setting.

5) Understand the need to reflect and maximise the placement experience in future career decisions.

Assessment: Participation Exercise (100%)

Assessment Description: Students are required to attend all taught sessions and the one to one meeting (if required). The module has no credit attached. However to ensure engagement a compulsory quiz will be undertaken in session 6. Students who do not attend and have no valid reason will not be permitted to continue on a Science Industrial Placement Year programme of study.

Moderation approach to main assessment: Not applicable

Assessment Feedback: N/A

However feedback on progress and the progression through the module will be provided in the one to one mandatory meeting and MCQ quiz.

Failure Redemption: Successful completion of this module depends upon satisfactory attendance at, and engagement with, all sessions. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

Additional Notes: This module is only available for students enrolled on the Science Industrial Year, specifically:
CS-E00
BI-E00
GE-E00
MA-E00
PH-E00

CS-203 Professional Development and Career Planning

Credits: 0 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Miss VV Wislocka, Miss VV Wislocka

Format: 6 hours of face-to-face delivery, an optional one-to-one meeting, and weekly drop-in sessions.

Delivery Method: On-campus lectures and sessions.

Module Aims: This generic cross-disciplinary module is an additional module for all students who are not enrolled on (or transferred to) the Science Industrial Placement Year. The module focuses on the underpinning and fundamental requisites required to gain, enter and progress effectively through a successful career. Learners will be introduced to (a) sourcing placements, CV writing, and application techniques; (b) Interview techniques, how to pitch yourself and be successful; (c) workplace fundamentals and IP awareness, behaviors and expectations; and, (d) Key employability skills; getting the most from your Job or an Industrial Placement. .

Module Content: The module will focus on the key requirements to secure placement and/or employment opportunities. The following topics will be covered:

1) CV writing.

2) Writing a Cover Letter.

3) Assessment centres, interview techniques and mock interviews.

4) Utilising social media such as LinkedIn for your placement search.

Intended Learning Outcomes: By the end of this module, students will be able to:

1) Be aware of and possess the essential skills needed to secure placement opportunities; alongside having the skills to apply for relevant placements or jobs.

2) Have a general understanding of an interview process and what tools and attributes make a good interview.

3) Discuss and share what is expected within the workplace including behavioral and professional conduct.

4) Identify personal employability skills and how these will be used in a workplace setting.

5) Understand the need to reflect and maximise the placement experience in future career decisions.

Assessment: Participation Exercise (100%)

Assessment Description: Quiz on Health and Safety.

Moderation approach to main assessment: Not applicable

Assessment Feedback: Pass/fail feedback on the Health and Safety quiz.

Failure Redemption: Successful completion of this module depends upon satisfactory attendance at, and engagement with, all sessions. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

Additional Notes: Module code reserved by N.A.Harman on 01/05/2019 :12:03

CS-210 Concurrency

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr F Caraffini

Format: Lectures (including Problem Sessions) and Lab Sessions

Delivery Method: On Campus Lectures

Module Aims: This module provides an introduction to the issues raised in developing and using concurrent and distributed systems. Consideration of practical and formal solutions to example problems from operating systems and networking.

Module Content: Background and motivation: concurrent programs and modelling.
Processes and Threads: modelling and implementing processes.
Concurrent execution: modelling concurrency and multi-threaded programs.
Shared objects and mutual exclusion: interference, mutual exclusion in Java.
Monitors and condition synchronization: semaphores, bounded buffers.
Deadlock and livelock: analysis, dining philosophers.
Safety and liveness properties.
Model-based design: from requirements to models to implementations.
Java memory model. Amdahl's law.
Deterministic and non-deterministic parallelism.
Software Transactional Memory (STM).

Intended Learning Outcomes: Students will have an appreciation of the subtle and complex problems in concurrent systems. They will be aware of strategies to reliably solve these problems. They will be aware of the core algorithms used in concurrent/distributed systems in practice (operating systems, networks - including web applications - and hardware), and will appreciate the link between models of concurrency and their practical application.

Assessment: Examination 1 (70%)
Coursework 1 (20%)
Laboratory work (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs.
Guided and Supported Laboratory Sessions.
Coursework 1 is a practical programming.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarising strengths and weaknesses of the class.
Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.

Failure Redemption: Resit exam and/or resubmit assignments as appropriate.

Additional Notes: Available to visiting and exchange students

CS-230 Software Engineering

Credits: 15 Session: 2023/24 September-January

Pre-requisite Modules: CS-110; CS-115; CS-130; CS-135

Co-requisite Modules:

Lecturer(s): Dr LP O'Reilly

Format: 30

Delivery Method: On Campus Lectures

Module Aims: This module exposes the student to the major components of a practical software lifecycle through team-based practical software engineering. This module introduces students to prototyping, software design and implementation, and testing. Students are introduced to the issues and techniques of working in teams.

Module Content: General software engineering and project management:
• Conventional software process and software life-cycle models
• Software project management and team organisation
• Risk assessment and management
• Prototyping
• GUI programming,
• Requirements analysis,
• System design,
• System implementation,
• Version Control Systems

Intended Learning Outcomes: Knowledge and application of software engineering methodologies.
Application of software prototyping methods.
Practical experience in designing and building non-trivial software.
Experience with basic testing strategies for software.
Ability to work in a team for the development of software.

Assessment:	Group Work - Coursework (30%)
	Group Work - Coursework (45%)
	Examination 1 (25%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Group work - Object Oriented Software Design.
Group work - System Implementation.
Examination - Multiple Choice.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Group and individual analytical feedback for courseworks. Examination feedback summarising strengths and weaknesses of the class.

Failure Redemption: Resit examination and/or resubmit coursework(s) as appropriate.

Additional Notes: Not suitable as an elective or optional module

CS-239 Software Security Engineering

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules: CS-230

Co-requisite Modules:

Lecturer(s): Dr G Sabaliauskaite, Dr H Nguyen

Format: 20 hours lectures, 10 hours lab classes

Delivery Method: On-campus lectures and lab sessions.

Module Aims: The aim of this module is to provide students with the background in the specification, design, implementation, and evaluation of secure software systems.

Module Content: Threat analysis and risk assessment.
STRIDE model, attack and attack-defence trees.
Cyber-security requirement specification.
Security standards, such as MISRA, ISO 21434, and ISO/IEC 27000-series standards.
Security countermeasures, including both technical (e.g., reference monitors) and non-technical measures, such as user training and organizational processes.
Secure coding in Java.
Security testing, including fuzzing and model-based testing.
Secure software updates.
Cyber-security case studies.

Intended Learning Outcomes: Students will have the ability to apply state-of-the-art cyber-security methods to create a secure-by-design software system.
Students will be able to explain in detail cyber-security concepts throughout the software lifecycle.
Students will be able to demonstrate an in-depth understanding of cyber-security standards.
Students will have practical experience in using cyber-security design tools and applying best-practice rules for secure coding.

Assessment:	Examination 1 (70%) Coursework 1 (20%) Laboratory work (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination. Coursework and lab work.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for coursework.
Examination feedback summarising strengths and weaknesses of the class.

Failure Redemption: Resit exam.

Additional Notes: Available to visiting and exchange students.

CS-250 Database Systems

Credits: 15 Session: 2023/24 September-January

Pre-requisite Modules: CS-110; CS-115

Co-requisite Modules:

Lecturer(s): Dr KL Tam

Format: 30 hours (20 lectures, 10 problem classes)

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This module will discuss the theory, design and implementation of databases.

Module Content: What is a database? What is data? Database software and benefits. ANSI/SPARC model, database structure.

Relational databases - properties, designing, problems. Normalisation - normal forms, functional dependence,
primary keys, integrity constraints and rules, validation.

Real world examples - SQL and practical sessions using a relational database. Client/server technology, web and database programming (eg. PHP/MySQL), including examples and applications.

ER Model - entities, relationships, modelling, attributes, converting to relational model.

Relational calculus, relational algebra - select, project, join, union, intersection, difference, cartesian product, query optimisation, and its application to databases

Recovery and concurrency - transaction processing, locking, detecting deadlocks. Multi-user databases - client/server, distributed, commit protocols.

Security - managing users and passwords, SQL injection, data security in a database environment, e.g. cryptography (RSA/SSL), preventive measures and responses to security breach.

Intended Learning Outcomes: Students will be aware of relational databases and the need for the normalisation of data. Students will have been exposed to transaction processing and how to detect and avoid problems that can arise in a multi-user and/or distributed environment. Students will have designed a database using the ER model, and have practical experience of a relational database.

Assessment:	Examination 1 (70%)
	Coursework 1 (10%)
	Coursework 2 (10%)
	Coursework 3 (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs (70%).
Database Coursework 1 10%
Database Coursework 2 (PartA) 10%
Database Coursework 2 (PartB) 10%

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarising strengths and weaknesses of the class.

Failure Redemption: Resit exam and/or resubmit assignments as appropriate.

Additional Notes: Available to visiting and exchange students.

CS-253 Web Service Development

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr NA Harman

Format: Lectures and Lab Classes

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This module is about writing REST Web Services and the technology needed to do that - including programming tools, libraries and technologies like HTTP, XML, JSON, Spring Boot and AJAX.

Module Content: What are Web Services?
The technology underlying Web Services - TCP/IP, Sockets and HTTP
Object Oriented Web Services - why they are not a good idea, and why this is important to us
Tools to build Web Services - Maven
SOAP Web Services - mapping Object Oriented data and it's limitations
XML and data representation
REST Web Services - construction, best practices, limitations, data representation using JSON
REST with Javascript, jQuery and AJAX
Web Service security concepts in REST
Web Sockets

Intended Learning Outcomes: Students will be able to

- Explain the underlying data technology (in particular sockets and HTTP) of web services
- Explain why the OO model does not map well to web services
- Describe and explain the format and operation of SOAP Web Services
- Describe and explain the format and operation of REST Web Services
- Be able to build Web Services in Java using REST
- Demonstrate an understanding of data representation using XML and JSON
- Demonstrate an understanding of REST application security
- Demonstrate an understanding of Web Service technologies including AJAX, Javascript, jQuery and Web Sockets

Assessment: Examination 1 (60%)
Coursework 1 (10%)
Coursework 2 (30%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Standard format Computer Science Exam
Coursework 1 - Issues that affect client-server applications.
Coursework 2 - Build a REST Web Service application.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Written collective feedback for examinations. Grades, individual and collective written feedback for courseworks 1 and 2.

Failure Redemption: Resit exam and/or resubmit coursework as appropriate.

Additional Notes: Available to visiting and exchange students.

CS-256 Visual Computing

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules: CS-115

Co-requisite Modules:

Lecturer(s): Prof MW Jones

Format: 30 hours of lectures and labs

Delivery Method: On-campus lectures and assignment advisory sessions.

Module Aims: This module will provide an introduction to Visual Computing and its applications including visualisation, visual analytics, graphics and machine learning. It will help students to extend their programming skills and theoretical knowledge on the analysis and understanding of advanced algorithms. It will also allow students to make good choices about specialist modules they can take in year 3, the projects they can follow in year 3, and future careers.

Module Content: Images
Fundamentals to image representation, storage and pixel, cross-correlation and its relationship to machine learning, image-resizing (to introduce interpolation).

Visualisation
Case study: Volume visualisation - marching cubes and volume rendering.

Human Centred Visual analytics
Scatter plots, Parallel coordinates, dimension reduction, interfaces (think of the human: focus and context, multiple coordinated views). Dimension reduction will be autoencoder to pre-introduce machine learning and PCA.

Visual Computing
Ray tracing, leading to how a GPU works and onto machine learning.

Machine learning
Draw the threads together above (human directed machine learning), with some existing human-centric case studies (fake news - text).

Assignment
Some lectures will be dedicated to the assignment. Some example assignments include:
Image resizing and cross-correlation
Volume rendering
Marching cubes
Autoencoder
A basic ray tracer
Scatterplots and parallel coordinates (in JavaFX).

Intended Learning Outcomes: Students will be able to:
- Compare and contrast the relationships between Computer Graphics, Visualisation, Human Computer Interaction and Machine Learning under the umbrella term of Visual Computing.
- Identify and select appropriate methods from computer imagery techniques and use them to synthesise images from data.
- Implement a selection of algorithms for post-processing of images.
- Describe and explain the main operations of graphics processing hardware (GPU) and the relationships to machine learning.

Assessment:	Coursework 1 (20%)
	Examination (80%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Assignment is a programming assignment. See syllabus for examples.

Examination is a 2 hour unseen invigilated examination.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Students will be marked during a one-to-one viva after submission of the coursework. They will be informed of their coursework result and any issues during the viva. Examination Feedback summarising the strengths and weaknesses of the class.
Failure Redemption: Failure is redeemable using the resit instrument.
Additional Notes: Available to visiting and exchange students.

CS-260 Introduction to Modelling and Simulation

Credits: 15 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr N Picco

Format: 44 hours of lectures, examples classes and PC labs

Delivery Method: All programmes will employ a blended approach to delivery using the Canvas digital learning platform.

Lectures supported by examples classes and PC labs

Module Aims: The module provides a basic introduction to mathematical modelling of the real world and use of computer programming to analyse and simulate such models. It will include basic modelling techniques, basic calculation methods, and computational approaches to solve simple models.

Module Content: 1) Introduction to mathematical modelling
2) Introduction to programming in Math lab
3) Numerical methods and implementation
4) Discrete-time population growth
5) Analytical and computational techniques for Difference Equations
6) Continuous-time population growth using Ordinary Differential Equations (ODEs)
7) Analytical and computational techniques for ODEs
8) Numerical schemes to solve ODEs

Intended Learning Outcomes: At the end of this module, students should be able to
1) Perform basic computations, and write modeling and simulation algorithms in Matlab.
2) Interpret and write basic algorithms for root finding and integration problems.
3) Interpret mathematical models describing population growth dynamics.
4) Interpret how variations in the model equations reflect in the resulting dynamics, and make appropriate changes to a basic model to describe dynamics of a different nature.
5) Select appropriate analytical and numerical methods to study a model.

Assessment: Examination (70%)
Assignment 1 (20%)
Assignment 2 (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination: is a written, closed-book examination at the end of the module. Assignment 1: is formed of a number of coursework assignments during the semester along with participation in the module during the semester. The assignments will develop skills in problem solving, mathematical modelling of the real world and the use of computers to simulate real world problems. Assignment 2: is a computing test to be taken in controlled conditions at the end of the module to assess skills in the use of computers to investigate models of real world problems.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: For the coursework assignments and computing test, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary examination.

Additional Notes: Available to visiting and exchange students.

CS-265 Artificial Intelligence

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AZ Wyner, Dr B Muller

Format: 20 hours lectures, 10 hours lab.

Delivery Method: On-campus lectures and lab sessions.

Module Aims: CS-265 is an introduction to Artificial Intelligence (AI) focusing primarily on reasoning and problem solving as a search for a solution.
The central notions of a rational agent and multi-agent systems are used to introduce concepts like beliefs, desires, and intentions that are fundamental to the search for solutions within the context of an observable environment. Further aspects of symbolic AI such as knowledge representation and expert systems, planning, and language processing will be covered. All of these topics are embedded into a human-centred perspective of AI.

Module Content: - Introduction
- Symbolic and ML Approaches
- HCI/Human-centred: Limitations of humans; limitations of AI

- Problem solving as Search
- Min-max
- Alpha-beta prunning

- Agent Concepts
- BDI (Belief Desire Intention)
- Communication
- Collaboration
- Multi-Agent Systems

- Knowledge Representation & Reasoning
- Ontologies
- Expert Systems, explanation and abduction
- Forwards/backwards; Negation As Failure

- Planning

- Natural Language Processing
- Lexicons
- Syntax: Ngrams, parsing
- Semantics: semantic representation and inference

Intended Learning Outcomes: On completion of this module, students will
1. be able to demonstrate a systematic knowledge of the fundamental concepts in symbolic AI, as well as their limitations.
2. be able to apply a wider range of AI techniques and to evaluate their advantages and disadvantages, also from an human centred perspective.
3. be able to identify problems that are amenable to solution by AI methods and methods which may be suited to solve a given problem.
4. be able to demonstrate competency in developing programs to address problems in AI automatically.

Assessment:	Examination (60%) Coursework 1 (15%) Coursework 2 (15%) Laboratory work (10%)
Resit Assessment:	Examination (Resit instrument) (100%)
Assessment Description: Standard format Computer Science exam. Practical programming assignments. Laboratory work.	
Moderation approach to main assessment: Moderation by sampling of the cohort	
Assessment Feedback: Outline solutions provided along with analytical individual feedback for assignment. Examination feedback summarising strengths and weaknesses of the class.	
Failure Redemption: Redemption of failure via the resit instrument.	
Additional Notes: This module will be open to visiting and exchange students.	

CS-270 Algorithms

Credits: 15 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr O Kullmann

Format: lectures, tutorials, and laboratory sessions

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This module introduces students to the formal concepts of algorithms and data structures and will enable them to understand how the selection of different algorithms and data types affects the performance and efficiency of a program. Particular attention will be paid to the fundamental problems of searching, sorting, and graph traversal.

Module Content: Introduction to the concept of algorithm and program efficiency.
Mathematical foundations: asymptotic notation, summations, recurrence relations.
Introduction to various abstract data types: stacks, queues, lists, heaps and tables.
Searching algorithms: binary search trees, balanced search trees, hash tables.
Sorting algorithms: merge sort, quick sort, heap sort.
Graph representations and algorithms: adjacency lists and matrices, depth-first and breadth-first search.

Intended Learning Outcomes:
Students will appreciate the idea of analysing an algorithm to determine its efficiency.
Students will be familiar with, and be able to manipulate, basic abstract specifications of some standard data types.
Students will know and understand various standard sorting and searching algorithms and be able to comment on their relative performance.
Students will be familiar with directed and undirected graphs, in particular their various representations, and be able to solve algorithmic problems based on depth- and/or breadth-first search.

Assessment:	Examination 1 (70%) Coursework 1 (10%) Coursework 2 (10%) Laboratory work (10%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs.
Coursework 1.
Coursework 2.
Guided and Supported Laboratory Sessions. Online quizzes.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarising strengths and weaknesses of the class.
Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.

Failure Redemption: Resit exam.

Additional Notes: Available to visiting and exchange students.

CS-275 Automata and Formal Language Theory

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr AM Pauly, Dr M Valenti

Format: 30 (20 hours lectures, 10 hours problem classes)

Delivery Method: On-campus lectures and lab sessions.

Module Aims: This module introduces the notion of grammars for defining the syntax of formal languages, especially programming languages. It introduces the limits of computation using Turing Machines and other models of computation.

Module Content: • Use of Grammars for defining syntax. The Chomsky hierarchy and the language recognition (parsing) problem.

• Finite-state automata, regular languages and regular expression: equivalences between formalisms, methods for determining when a language is or is not regular.

• Context-free languages and context-free grammars: methods for determining when a language is or is not context-free.

• Turing analysis of computation. Turing machines. Algorithmically decidable languages. Equivalences between formalisms. Methods for determining when a language is or is not computable. Register machines. Hierarchy and compilation.

Intended Learning Outcomes: Students will know the key steps in the historical development of programming languages and the basic techniques for defining the syntax of languages. They will be familiar with the standard hierarchy of formal languages and their various characterisations. They will be aware of the limits of description and computation.

Assessment:	Examination 1 (65%) Coursework 1 (20%) In class test (non-invigilated) (15%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs.
Coursework 1: theoretical questions about the module content.
Class test: a series of quizzes based on the content delivered in lectures

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarising strengths and weaknesses of the class.

Failure Redemption: Resit exam and/or resubmit assignments as appropriate.

Additional Notes: Available to visiting and exchange students.

CS-279 Intelligent Robotics

Credits: 15 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr D Cafolla

Format: 30 hours of lectures and labs.

Delivery Method: On-campus lectures and lab sessions.

Module Aims: Robotics has profound cultural roots. Over the course of centuries, human beings have constantly attempted to seek substitutes that would be able to mimic their behaviour in the various instances of interaction with the surrounding environment. Several motivations have inspired this continuous search referring to philosophical, economic, social, and scientific principles.

In all robot applications, the performance of a general task necessitates the execution of a predetermined motion. The correct execution of this motion is assigned to the control system, which must issue commands to the robot's actuators that correspond to the required motion. Motion control requires a precise study of the mechanical, actuator, and sensor features. The objective of such an analysis is to derive mathematical models explaining the input/output relationship of robot components.

This module is composed of formal lectures and group-based labs where the design and development of simple robotics take place.

Module Content: - Introduction to intelligent robotics and their components
- Design and programming of intelligent robotic systems
- Modelling of kinematics and dynamics
- Sensing, control, and human-robot interaction technologies
- Programming small intelligent robots for specific applications
- Applications of intelligent robotics

Intended Learning Outcomes: - Students will be able to design and implement both simulated and physical simple robots.
- Students will be able to describe the kinematics and dynamics aspects of intelligent robot systems with multiple degrees of freedom.
- Students will be able to integrate software/hardware in robot architectures for tasks and industrial applications.
- Students will be able to work in a team.

Assessment:	Laboratory work (10%) Report (50%) Presentation (40%)
Resit Assessment:	Coursework reassessment instrument (100%)

Assessment Description: Students will be divided into groups of approximately 5 to 10, where each group member will be responsible for a portion of the project (e.g., hardware interface, hardware programming, robot control, etc.), but everyone must be aware of and knowledgeable about the entire project.

Lab: Each group's progress will be evaluated during weekly laboratory work.
Report: All aspects of the project will be documented in a comprehensive group report.
Presentation: The final evaluation will consist of an interactive presentation with questions, along with a demonstration/competition of the robot's ability to accurately perform the specified task.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Informal formative feedback on laboratory sessions.
Group and individual feedback for the presentation and report.

Failure Redemption: Redemption of failure is via a resit coursework.

Additional Notes: Due to hardware requirements, this module has a strict capacity. Due to this reason, it is not available to visiting and exchange students.