Course Outlines

Year One

INTRODUCTION TO COMPUTER SYSTEMS

General competences

Module aims

In this module you will study the fundamental principles and devices used in the design of digital computers, and the way in which primitive control logic can be organised to construct a programmable machine.

Learning outcomes

Upon successful completion of this module you will be able to:

- Explain combinatorial circuit design and synchronous sequential circuit design

- Design a CPU using Boolean algebra and functional design

- Describe the basic architecture of a CPU and its components and explain how to map CPU control to hardware

- Compare and be able to use different number representations

Module syllabus

Number representations and computer arithmetic

Boolean algebra

Combinatorial logic functions

Principles of semiconductor devices and logic gates

Adders subtractors and multipliers

Bistable storage devices

Flip-flop design

Registers

Multiplexers and decoders

Counters

Finite state machines

Static and dynamic RAM

Register transfer descriptions

ALU and CPU design

Teaching methods

The module starts from first principles with no assumed previous knowledge of digital circuit design. The emphasis is on how digital systems work and how they can be designed and the module strikes a balance between theory and practice.

Each week there will be two lectures and one supervised turorial. During the tutorials you will be given a problem sheet comprising unassessed, formative, exercises with space for you to complete the solution. The tutorials are primarily intended to reinforce the lecture material using practical design examples, although they also provide examples of the types of question that will be found in the written exam. Solutions to the tutorial problem sheets will be posted online. In addition to helping you with the problem sheets, the tutors will be pleased to answer any other questions on the material covered during lectures.

Support is given by the Course Leader and Graduate Teaching Assistants (GTAs), and through carefully selected software for the coursework. An online service will be used as a discussion forum for the module.

Assessments

There will be two assessed exercises (small, focussed, practical, exercises) undertaken alone which count for 20% of the final mark. The first coursework task can be solved with pen and paper, while the second one makes use of professional hardware and design software. There will be a final written exam, testing fundamental knowledge on an individual basis. This exam counts for the remaining 80% of the marks for the module.

There will be the opportunity to receive feedback as you work through the formative tutorial exercises in class. Feedback for the assessed exercise is provided by written feedback through the online system.

INTRODUCTION TO DATABASES

General competences

Module aims

In this module you will have the opportunity to:

learn how modern database systems are structured

model relational databases

normalise relational schemas

write SQL queries

learn about recent developments in database technology

Learning outcomes

Upon successful completion of this module you will be able to:

compare and contrast different database models and supporting architectures

model information in a relational system

optimise a relational schema and demonstrate correctness of optimisations

design relational queries and write SQL queries

set up a database, implement a schema as well as the queries

explain the benefits of separating physical and logical models

Module syllabus

Database systems

Relational model

Database design

Entity-relationship modelling

Functional dependencies, keys and normal forms

Relational database languages

Relational algebra

Views integrity and security

Transaction management and concurrency

Teaching methods

The material will be taught through traditional lectures, backed up by assessed coursework designed to reinforce the material as it is taught. To practise key concepts, a small number of tutorials will also be run throughout the term. These will provide you with the opportunity to work through unessessed, formative, exercises under the supervision of Graduate Teaching Assistants (GTAs).

An online service will be used as a discussion forum for the module.

Assessments

There are two assessed coursework exercises (one lab-based) which collectively contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

Written feedback will be given on the assessed coursework exercises and this will be returned within two weeks of submission. You will also get feedback from the GTAs in the tutorial classes, as you work through the unassessed problems.

CALCULUS

General competences

Module aims

In this module you will study the calculus needed for many applications of Computing, such as graphics, vision, robotics, operations research and statsitical machine learning. It also provides the background for follow-on mathematics modules that lay the foundations for advanced electives in the above topics and other mathematically-focused areas such as optimisation and finance.

Learning outcomes

Upon successful completion of this module you will be able to:

- Establish convergence or divergence of sequences and series and determine limit values
- Derive Maclaurin and Taylor series and determine radius of convergence
- Find approximations from below and above to the value of an integral
- Find the minima, maxima and saddle points of multivariate functions
- Find approximations to roots of multivariate functions
- Compute integrals with respect to cylindrical and spherical coordinate systems

Module syllabus

Ordering and supremum of real numbers

Sequences, series and convergence

Limits of functions and continuity, intermediate value theorem, uniform continuity

Differentiation and its properties

Mean value theorem

Riemann integral and its properties

Trapezium rule

Uniform convergence and power series

Metric spaces

Contraction mapping theorem

Multivariate Differential Calculus

Partial derivatives

Hessian and the Taylor series formula

Extrema of scalar fields

Newton's method

Vector valued functions

Jacobian matrix

Cylindrical and spherical coordinate systems

Teaching methods

The material will be taught through lectures that mix problem solving exercises and taught content.

There are regular unassessed, i.e. formative, tutorial exercises that are submitted for marking and feedback as part of separate Maths Methods Tutorials (MMTs), which run throughout the Autumn and Spring terms. These tutorials encourage group discussions and group problem solving designed to reinforce your understanding of key topics in calculus and linear algebra.

An online service will be used as a discussion forum for the module.

Assessments

There is one assessed coursework which counts 20% of the mark for the module. There is also a written exam which counts for the remaining 80%. Formative assessment is via weekly mathematics methods tutorials (MMTs) which address topics in this module and Linear Algebra. Approximately half of the MMT exercises will be dedicated to Calculus.

A combination of written and verbal feedback will be provided for the MMT tutorial exercises and assessed coursework.

INTRODUCTION TO DOC SYSTEMS

General competences

Module aims

A collection of materials to help students navigate through the network of systems and applications that underpin remote learning.

Learning outcomes

N/A

Module syllabus

N/A

Pre-requisites

N/A

Teaching methods

N/A

Assessments

N/A

DISCRETE MATHEMATICS, LOGIC & REASONING

General competences

Module aims

In this module you will learn how discrete mathematics and logic can be used to describe and reason about computational structures and systems. The module provides an important foundation for many core topics in Computing, such as computer hardware design, algorithm analysis, and program reasoning. Central to this module are proof techniques, which are important when establishing whether or not a program or system behaves according to its specification. The ability to use mathematics and logic to formalise such specifications is also a key learning outcome.

Learning outcomes

Upon successful completion of this module you will be able to:

- construct various types of mathematical proof using informal and formal reasoning

- define properties of fundamential discrete structures, such as sets, relations and functions

- read, parse and evaluate logical formulas

- formalise English statements into logic

- use logic to specify the desired properties of a system, program or algorithm

- use induction to reason about the correctness of recursive programs and data structures

- provide suitable pre, post and mid conditions and invariants for imperative program fragments

- use logic to reason about the correctness of imperative programs

Module syllabus

Logical connectives

Proof methods

Sets, relations and functions

Countability

Orderings

Induction

Inductive reasoning applied to recursive programs and data types

Formalisation of logic syntax and semantics

Validity and satisfiability

Equivalence

Logical proof systems

Soundeness and completeness

Specification of pre-, post- and mid-conditions

Loop invariants and variants

Logical reasoning applied to imperative programs

Teaching methods

The material will be taught through traditional lectures, backed up by formative exercises designed to reinforce the material as it is taught. Classroom sessions will comprise traditional lecture material interspersed with problem solving, using selected formative exercises as examples. Some of the other exercises will be covered in small-group tutorials, Personal Maths Tutorials (PMTs), which are weekly one-hour tutorials run by academic tutors and Undergraduate Teaching Assistants (UTAs). These tutorials encourage group discussions and group problem solving designed to reinforce your understanding of key topics in logic, discrete mathematics and program reasoning. The remaining exercises are intended for you to use for self-study.

An online service will be used as a discussion forum for the module.

Assessments

There will be a small number of assessed tests (typically two or three) that contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks. The exercises selected for the PMT tutorials will be assessed by your academic tutor and UTA. This assessment does not count to your final degree mark, but is intended to give you an indication of how you well you are assimilating the material taught and how effectively you are applying that material to solving unseen problems.

Detailed feedback, both written and verbal, will be given on the exercises covered in the PMT tutorials. These exercises will be issued weekly and written feedback will be returned at the following PMT session. You will receive written feedback on the assessed coursework exercises, which counts for 20% of the module mark. There will also be opportunity for you to receive feedback during the in-class problem solving sessions.

COMPUTING PRACTICAL 1

General competences

Module aims

In this module you will have the opportunity to develop various practical skills, including programming, Web development, basic academic research and both written and oral communication skills, all of which are important attributes of a professional software engineer. The programming aspects of this module will also give you a chance to put into practice some of the theoretical material covered in the first year lecture courses and to explore additional topics in Computing that will be built on in later years.

Learning outcomes

Upon successful completion of this module, you should be able to:

demonstrate proficiency in using programming languages from three of the major paradigms

develop working solutions to well-specified programming problems of small to medium size

create a website that meets stakeholder needs

use core software development tools effectively, including those for version control

undertake basic research into Computing topics, including those related to Computing ethics

write short technical documentation that demonstrate proficiency in scientific communication

deliver short oral presentations summarising practical project work and research findings

operate effectively as a member of a group to produce deliverables that meet set criteria

Module syllabus

Functional programming in Haskell

Functional and procedural programming in Kotlin

Object-oriented programming in Kotlin and Java

Assembler programming

Programming in C

Web development using HTML, CSS and JavaScript

Computer systems project

Introduction to research methods

Introduction to Ethics in Computing

Introduction to academic writing

Oral presentation skills

Teaching methods

The emphasis is on self-study, both as an individual and as part of a small group. In the first two terms there will be weekly small-group personal programming tutorials (PPTs) which will give you the chance to develop your individual programming skills under the guidance of an academic tutor and Undergraduate Teaching Assistant (UTA). There will also be timetabled laboratory sessions, supported by both Graduate Teaching Assistants (GTAs) and UTAs, which will give you dedicated time to work on the practical exercises and receive support and guidance on your work. There will be formative programming exercises each week in the first two terms and these will be assessed by your UTA and returned to you at the following week's PPT session. The first two terms will focus on Haskell and Java/Kotlin, alongside Web development skills. In the third term you will work in small groups to develop an assembler and emulator for the ARM architecture. An accompanying exercise will involve you developing a simple application for the Raspberry Pi and then building an extension of your choice. The objective here is to combine your C and assembler programming skills with some basic hardware development skills to build a novel application for the Pi from first principles.

The module also exercises your ability to communicate the results of practical work and how to use basic research methods to find things out for yourself. These are exercised through research into a Computing topic of your own choice as well as ethical issues that you need to bear in mind when developing computer-based systems. You will be giving basic training in technical writing and oral presentation skills, in order to help you to communicate effectively the findings of both project work and research. These are important skills that will be exercised throughout your degree programme.

Assessments

The weekly formative programming exercises are assessed and returned within 7 days, but this is for feedback only - the marks do not count towards your year total. The assessed components include tests in both Haskell and Kotlin/Java, and a C programming test. These are undertaken using an online programming test system and under exam conditions. The assembler/emulator project in the summer term is assessed in small groups via a demonstration and short presentation. Your Web development skills will also be assessed. The research and ethics components are assessed by a short report and presentation; the assessment addresses technical content as well as your written and oral communication skills.

Detailed feedback, both written and verbal, will be given on the weekly formative programming exercises covered in the PPT tutorials, as well as the assessed online programming tests. You will get verbal feedback on your summer term assembler/ emulator and Raspberry Pi projects as part of the assessment. You will receive written feedback on the content of your research and ethics investigations and also your technical writing and communication skills.

INTRODUCTION TO COMPUTER ARCHITECTURE

General competences

Module aims

In this module you will have the opportunity to develop a fundamental understanding of the organisation and operation of a computer system. The emphasis of the module is on understanding how high-level language programs are represented and executed at an architectural level.

Learning outcomes

Upon successful completion of this module you will be able to:

- describe the basic organisation of a computer
- explain different representations used for instructions, numbers and text
- show how machine code instructions are executed by a computer
- compare different implementations of a computer's control unit
- explain program behaviour by reading the binary representation of machine code
- translate high-level program fragments into assembler code
- explain the effect that memory hierarchy has on a program's execution time
- estimate the performance of a program on a given computer

Module syllabus

Basic organisation of a computer

Representations for instructions, numbers and text

Translation of high-level programs into instructions

Instruction execution

Implementation choices of the control unit

CISC and RISC Instruction Set Architecture

Assembler programming

Memory organisation and concepts of spatial and temporal locality

Performance estimation and Amdahl’s Law

Teaching methods

The material will be taught through traditional lectures, backed up by unassessed formative exercises and assessed courseworks designed to reinforce the material as it is taught.

An online service will be used as a discussion forum for the module.

Assessments

There will be two assessed courseworks which together contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks. There will be written feedback on the assessed coursework exercises and in-class and/or email feedback explaining common pitfalls and suggestions for improvement.

GRAPHS AND ALGORITHMS

General competences

Module aims

In this module you will have the opportunity to:

prove mathematical properties of graphs

explore classical algorithms associated with graphs and trees

design algorithms for sorting and searching

apply various methods for determining the time complexity of algorithm

study the complexity classes P and NP and the concept of NP-completeness

Learning outcomes

Upon successful completion of this module you will be able to:

Prove basic properties of graphs

Describe, and establish the correctness of, some of the fundamental algorithms in computing

Analyse the time complexity of an algorithm

Explain the complexity classes P and NP and the P=NP problem

Determine to which complexity class a computational problem belongs

Module syllabus

Graphs and graph representations

Algorithms for graph traversal

Minimum spanning trees

Shortest paths

Dynamic programming

Divide and conquer

Searching and sorting

Algorithm analysis (time complexity, recurrence relations, Master Theorem)

Decision trees

The complexity classes P and NP, NP-completeness

Teaching methods

The material will be taught through traditional lectures, backed up by formative exercises designed to reinforce the material as it is taught. Approximately half of these exercises will be covered in small-group tutorials, Personal Maths Tutorials (PMTs), which are weekly one-hour tutorials run by academic tutors and Undergraduate Teaching Assistants (UTAs). These tutorials encourage group discussions and group problem solving designed to reinforce your understanding of key topics in logic, discrete mathematics, algorithm design and program reasoning. The remaining exercises are intended for you to use for self-study.

An online service will be used as a discussion forum for the module.

Assessments

There will be one assessed coursework that contributes 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks. The formative exercises selected for the PMT tutorials will be assessed by your academic tutor and UTA. This assessment does not count to your final degree mark, but is intended to give you an indication of how well you are assimilating the material taught and how effectively you are applying that material to solving previously unseen problems.

Detailed feedback, both written and verbal, will be given on the exercises covered in the PMT tutorials. These exercises will be issued approximately every two weeks and written feedback will be returned the week after submission. You will receive written feedback on the assessed coursework exercise, which counts for 20% of the module mark.

LINEAR ALGEBRA

General competences

Module aims

In this module you will study linear algebra which underpins many applications of Computing that involve analysis of aggregated data in vector or matrix form. A core central topic is the formalisation and solution of linear systems of equations which are ubiquitous. Linear algebra features in many later modules, including graphics, robotics, performance engineering, operations research and statstical machine learning. The module also provides the background for follow-on mathematics modules that lay the foundations for advanced electives in the above topics and other mathematically-focused areas such as optimisation and finance.

Learning outcomes

Upon successful completion of this module you will be able to:

- Solve systems of linear equations using Gaussian elimination

- Determine matrices representing linear mappings

- Compute matrix rank

- Compute Eigenvalues and Eigenvectors for simple matrices and explain their application

- Define projections and rotations in matrix form

- Find the spectral decomposition of real symmetric matrices

Module syllabus

Vectors and matrices

Solution of linear systems of equations

Gaussian elimination

Vector spaces

Linear transformations and matrix representation

Change of basis

Orthonormal Bases and Gram-Schmidt

Rank and Nullity Theorem

Scalar products

Orthogonal subspaces

Fundamental theorem

Introduction to linear regression

Eigenvalue and eigenvector problem

Determinants and their properties

Diagonalisability of matrices

Caley-Hamilton theorem

Projections

Rotation matrices

Symmetric matrices

Spectral decomposition

Teaching methods

The material will be taught through lectures that mix problem solving exercises and taught content.

There are regular unassessed, i.e. formative, tutorial exercises that are submitted for marking and feedback as part of separate Maths Methods Tutorials (MMTs), which run throughout the Autumn and Spring terms. These tutorials encourage group discussions and group problem solving designed to reinforce your understanding of key topics in calculus and linear algebra.

An online service will be used as a discussion forum for the module.

Assessments

There is one assessed coursework which counts 20% of the mark for the module. There is also a written exam which counts for the remaining 80%. Formative assessment is via weekly mathematics methods tutorials (MMTs) which address topics in this module and Calculus. Approximately half of the MMT exercises will be dedicated to Linear Algebra.

A combination of written and verbal feedback will be provided for the MMT tutorial exercises and assessed coursework.

DISCRETE MATHEMATICS, LOGIC & REASONING

General competences

Module aims

In this module you will learn how discrete mathematics and logic can be used to describe and reason about computational structures and systems. The module provides an important foundation for many core topics in Computing, such as computer hardware design, algorithm analysis, and program reasoning. Central to this module are proof techniques, which are important when establishing whether or not a program or system behaves according to its specification. The ability to use mathematics and logic to formalise such specifications is also a key learning outcome.

Learning outcomes

Upon successful completion of this module you will be able to:

- construct various types of mathematical proof using informal and formal reasoning
- define properties of fundamential discrete structures, such as sets, relations and functions
- read, parse and evaluate logical formulas
- formalise English statements into logic
- use logic to specify the desired properties of a system, program or algorithm
- use induction to reason about the correctness of recursive programs and data structures
- provide suitable pre, post and mid conditions and invariants for imperative program fragments
- use logic to reason about the correctness of imperative programs

Module syllabus

Logical connectives

Proof methods

Sets, relations and functions

Countability

Orderings

Induction

Inductive reasoning applied to recursive programs and data types

Formalisation of logic syntax and semantics

Validity and satisfiability

Equivalence

Logical proof systems

Soundeness and completeness

Specification of pre-, post- and mid-conditions

Loop invariants and variants

Logical reasoning applied to imperative programs

Teaching methods

The material will be taught through traditional lectures, backed up by formative exercises designed to reinforce the material as it is taught. Classroom sessions will comprise traditional lecture material interspersed with problem solving, using selected formative exercises as examples. Some of the other exercises will be covered in small-group tutorials, Personal Maths Tutorials (PMTs), which are weekly one-hour tutorials run by academic tutors and Undergraduate Teaching Assistants (UTAs). These tutorials encourage group discussions and group problem solving designed to reinforce your understanding of key topics in logic, discrete mathematics and program reasoning. The remaining exercises are intended for you to use for self-study.

An online service will be used as a discussion forum for the module.

Assessments

There will be a small number of assessed tests (typically two or three) that contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks. The exercises selected for the PMT tutorials will be assessed by your academic tutor and UTA. This assessment does not count to your final degree mark, but is intended to give you an indication of how you well you are assimilating the material taught and how effectively you are applying that material to solving unseen problems.

Detailed feedback, both written and verbal, will be given on the exercises covered in the PMT tutorials. These exercises will be issued weekly and written feedback will be returned at the following PMT session. You will receive written feedback on the assessed coursework exercises, which counts for 20% of the module mark. There will also be opportunity for you to receive feedback during the in-class problem solving sessions.

Year Two

ALGORITHM DESIGN AND ANALYSIS

General competences

Module aims

In this module you will have the opportunity to:

Explore the main algorithmic design paradigms

Apply algorithmic techniques to practical and unseen problems

Quantitatively analyse the performance of algorithms

Model the mathematical structure of computational tasks and apply the right algorithmic tools on them

Develop your algorithmic thinking and problem solving skills.

Learning outcomes

Upon successful completion of this module you will be able to:

Compare, characterise and evaluate different implementations of basic algorithms

Analyse algorithms using quantitative evaluation

Formulate algorithmic abstractions of computational problems

Design and implement efficient algorithms for practical and unseen problems

Specify which algorithms can be applied to which classes of problems

Module syllabus

Quantitative Analysis of Algorithms and Growth Order

Divide and Conquer

Dynamic Programming

Greedy Algorithms

Randomised Algorithms

Advanced Graph Algorithms

String Processing Algorithms

Teaching methods

The material will be taught through traditional lectures, backed up by in-class tutorial sessions addressing unassessed, i.e. formative, tutorial problems designed to reinforce the material as it is taught. The lectures will also include occasional demonstrations of algorithms in action using various tools, such as Jupyter notebooks.

An online service will be used as a discussion forum for the module.

Assessments

There will be two assessed courseworks, both including a practical programming element, that contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

Feedback will be given on the two assessed courseworks in form of annotated electronic submissions.

SOFTWARE ENGINEERING DESIGN

General competences

Module aims

In this module you will have the opportunity to:

consider the effects of various design choices on the flexibility, maintainability and cost of software systems

practise different refactoring techniques to improve code quality

practise automated testing techniques

select appropriate design patterns and architectural styles to suit a given problem

reflect on the impact of different design choices on the long term health of a software system

consider how these technical practices fit in the context of iterative and incremental software delivery

Learning outcomes

Upon successful completion of this module you will be able to:

Identify and describe various design patterns, the problems they address, and any trade-offs involved

Make informed engineering decisions to minimise the cost of change

Implement common design structures for various common software application types

Construct automated tests for code through test-driven development

Perform refactoring operations on a codebase using appropriate tools

Consider and critique the qualities of the design of a given codebase

Module syllabus

This module covers the following topics:

Test-driven development

Refactoring

Mock objects

Encapsulation and the Law of Demeter

Design patterns for re-use and extensibility

Code quality metrics

Design patterns for data processing and concurrency

Design patterns for object creation and dependency management

Interactive (GUI) applications

Patterns for system integration

Patterns for distribution

Web applications, REST and web services

Teaching methods

This module focuses on learning through doing. Each week a new topic is introduced in a lecture, followed by a hands-on computer-based lab session in which you can put software design principles into practice.

Design ideas and principles are made concrete by working with real software.You will implement different design options, and experience the pros and cons of each approach. You will complete the weekly exercises working in pairs, which will allow you to develop your ideas in discussion with colleagues, and learn from one another.

Support is given by the lecturer, Graduate Teaching Assistants (GTAs), and through automated tests that you can run at will, to get fast, automated feedback on fundamental elements of the exercises. Lab sessions are supervised allowing you to get further advice and feedback from experts.

Over the course of the module you will build up a set of techniques, and will use them to work with systems of increasing size and complexity.

The course features a computer-based exam, a more natural environment for assessing software development skills than working on paper. To familiarise you with the computer-based exam environment, a mock exam will be included as a final coursework exercise, before the module concludes.

An online service will be used as a discussion forum for the module.

Assessments

There will be weekly assessed exercises (small, focused, practical, computer-based exercises) undertaken in pairs. In total these exercises count for 20% of the marks for the module. Weekly exercises give the opportunity for weekly feedback to help you to improve your software engineering skills. There will be a final computer-based exam, testing practical skills and knowledge on an individual basis. This exam counts for the remaining 80% of the marks for the module.

For each weekly exercise there will be feedback from an automated online testing system and additional written feedback from either the lecturer or GTAs. This feedback will be returned electronically, before the next week's exercise is undertaken. General feedback on each exercise will also be given in class each week, discussing common approaches and mistakes.

MODELS OF COMPUTATION

General competences

Module aims

This module focuses on formal descriptions (models) of computational behaviour. You will learn about:

the operational semantics (formal description) of a simple 'WHILE' programming language

the operational semantics of other styles of real-world languages, such as Java and Haskell

equivalent definitions of algorithm, initiated in the 1930s and providing the foundations for programming languages and computation

Learning outcomes

Upon successful completion of this module, you will be able to:

provide formal descriptions of the precise behaviour of several styles of programming language

prove properties of such languages

provide several formal definitions of algorithm

link the definition of algorithm with the fundamental notion of a computable function

Module syllabus

This module covers the following topics:

operational semantics for a simple while language (WHILE) and many extensions

simple properties of programming language such as confluence and totality

inductive proofs or counter examples of such properties for WHILE and extensions

an introduction to simple featherweight semantics for other styles of programming languages

register machines and the universal register machine

computable functions expressed as register machines

the Halting problem for register machines

Turing machines

the lambda calculus with language properties such as confluence and totality

the Church-Turing thesis

Teaching methods

This module introduces mathematical techniques which provide formal descriptions of computational behaviour. The material is taught through traditional lectures, backed up by unassessed, formative tutorial exercises, all designed to reinforce understanding of the comprehensive course notes that accompany the module. The tutorial exercises will be accompanied by specimen answers, and the tutorials will be supported by Graduate Teaching Assistants (GTAs). The tutorial questions will include past exam questions, in preparation for the final exam.

An online service will be used as a discussion forum for the module.

Assessments

The module will feature two courseworks which carry 20% of the marks, and one exam which carries the remaining 80% of the marks. One coursework can be undertaken either on your own or in groups. The other coursework is an individual exercise.

There will be detailed feedback on the coursework exercises, including comprehensive written answers, written feedback on your individual submission, and an in-class question and answer session with an explanation of the common pitfalls and suggestions for improvement.

OPERATING SYSTEMS

General competences

Module aims

In this module you will have the opportunity to:

develop an understanding of the main operating system abstractions

explore the trade-offs in the implementations of operating system functionality

study the different sub-systems that make up a modern operating system

investigate different operating system mechanisms and policies for resource management and allocation

apply a theoretical understanding of operating systems to a real-world operating system implementation

Learning outcomes

Upon successful completion of this module, you will be able to:

distinguish between different styles of operating system design

explain the main principles behind resource abstraction and resource management

explain the main priniciples behind process isolation and both process and thread models

explain the problems of scheduling and the mechanisms behind inter-process communication

identify the main problems related to concurrency and explain different synchronisation mechanisms in operating systems

evaluate security risks in operating systems and understand the role operating systems should play in establishing security

Module syllabus

Operating system kernel organisation

Process and thread abstractions

Inter-process sychronisation mechnaisms

Concurrency control and scheduling algorithms

Virtual memory abstractions and mechanisms, including on-demand paging

Device and disk management

I/O APIs, and file system abstractions

Basic security concepts and attacks

Teaching methods

The material will be taught through traditional lectures, backed up by unassessed, formative, tutorial-style exercises designed to reinforce the material as it is taught. In addition, the module aligns with a substantial practical laboratory exercise, 'Pintos', which is part of the second-year Integrated Laboratory, in which you will implement an operating system, applying the concepts covered in this module.

An online service will be used as a discussion forum for the module.

Assessments

There will be four courseworks that collectively contribute 20% of the mark for the module. These courseworks are aligned with the Pintos laboratory exercise, which involves implementing key components of a real operating system. There will be a final written exam, which counts for the remaining 80% of the marks. This close coupling between the module content and Pintos laboratory exercise provides an opportunity for you to appreciate how the theoretical underpinnings of operating system design are put into practice.

Feedback will be given on the unassessed, formative, exercises in class. You will also receive written feedback on the assessed coursework exercise, which counts for 20% of the module mark.

LABORATORY 2

General competences

Module aims

In this module you will have the opportunity to develop your practical programming skills, with a majority of the time being spent on two large system-level projects (operating system and compiler). This module will also give you a chance to put into practice the theoretical material covered in the second year lecture courses, at all times considering software design, maintenance and licencing issues that you will encounter in any future software-based career.

Learning outcomes

Upon successful completion of this module you will be able to:

recall the syntax and intuitive semantics of some common programming languages

design and implement programs in the Imperative and Declarative paradigms that conform to a given specification

develop concurrent programs using PThreads that conform to a given specification

describe in detail the operation of the core components of both an operating system and a compiler

critically analyse and effectively communicate project design decisions and experimental results

Module syllabus

Implementation and testing of the core components of an operating system

Concurrent programming using PThreads

Link loading

Logic Programming

Continuous integration and deployment of software

Design, implementation and testing of a compiler for a simple programming language

Teaching methods

The emphasis is on self-study, both as an individual and as part of a small group. To help you with this there will be weekly laboratory support lectures outlining the key elements of each week's practical

work, highlighting common pitfalls and suggesting approaches for solving each of the tasks set. There will also be timetabled laboratory sessions, supported by both Graduate and Undergraduate Teaching Assistants (GTAs and UTAs), which will give you dedicated time to work on the practical exercises and receive support and guidance on your work.

An online service will be used as a discussion forum for the module.

Assessments

All exercises will involve partical laboratory work and will be submitted via git repositories through an online Testing System (LabTS). Automated tests for each exercise account for 40% of the mark. Beyond this, all remaining marks will be allocated for the design, style and readability of your solutions. Individual assignments will be assessed off-line by GTAs who will both mark and provide constructive feedback on your work. Group assessments will be assessed with you during the interactive code review sessions by GTAs.

There will be interactive code review sessions at the end of each assessment milestone, which will provide you with personalised feedback on your work and progress. Feedback for each exercise is returned both verbally and electronically. The latter consists of a numerical mark, letter grade and detailed comments justifying the marking decisions and key strengths and weaknesses of your submission.

ADVANCED LABORATORY 2

General competences

Module aims

Please refer to Laboratory 2 for further details.

Learning outcomes

Please refer to Laboratory 2 for further details.

Module syllabus

The advanced lab consists of the final exercises of the WACC and Pintos lab projects.

In particular, the WACC Extensions milestone and Pintos Task 3 - Virtual Memory.

JMC students are not required to complete these milestones.

Teaching methods

Please refer to Laboratory 2 for further details.

Assessments

Please refer to Laboratory 2 for further details.

NETWORKS AND COMMUNICATIONS

General competences

Module aims

In this module you will have the opportunity to:

Study the principles of computer networking

Analyse and discuss the OSI & TCP/IP models

Demonstrate how a network is designed based on specific requirements

Familiarise yourself with the basic principles of computer security

Learning outcomes

Upon successful completion of this module, you should be able to:

define and classify the major concepts of Computer Networking

design a computer network based on given requirements

calculate important network metrics

identify and analyse potential security risks

Module syllabus

Introduction to Networking Concepts

The Application/Presentation/Session Layer

The Transport Layer

Network Security

Practical Applications

The Network Layer

The Data Link Layer

The Physical Layer

Client/Server Programming

Future Directions

Teaching methods

The lectures will follow a Q&A approach, with the help of tools such as Mentimeter, which will allow you to participate actively during the classroom sessions. The module is backed up with unassessed, formative exercises, where you get to test your understanding of the material as it is taught.

One entire week is dedicated to practical applications of networking, with a "Bring Your Own Device" (BYOD) lab that takes place in-class, as well as an impromptu team exercise. You will also be given a variety of external resources, in addition to the official reading list, which will give you the opportunity to expand your knowledge beyond the core material taught.

An online service will be used as a discussion forum for the module.

Assessments

There will be one coursework that contributes 20% of the mark for the module, plus a final written exam that contributes the remaining 80% of the marks.

Part of the feedback comes from the in-class discussions and mentimeter Q&A. You will also receive electronic feedback on your coursework submission, approximately two weeks after submission.

COMPILERS

General competences

Module aims

In this module you will have an opportunity to:

appreciate how a compiler for a high-level programming language works

understand how programming language design is influenced by compiler structure and how computer architecture is influenced by the needs of compiled programs

develop the technical skills needed for constructing practical compiler components, such as parsers, interpreters, semantic analysers, code generators and code optimisers

Learning outcomes

Upon successful completion of this module, you will be able to:

use regular expressions and context-free grammars to specify programming language syntax

explain how parsers and parser generators work

use state of the art tools to implement a parser for a given grammar

generate machine code from the internal representation of a program

use static analysis to facilitate code and register optimisation

explain the role of run-time systems in supporting program execution

Module syllabus

This module cover the following topics:

Lexical Analysis

LL and LR Parsing

Semantic Analysis

Runtime memory organisation

Code Generation

Code Optimisation

Teaching methods

The module aims to build your understanding through lively interactive classes, driven by exposure to principles, examples in various programming languages, interesting ideas, and provocative challenges. You will develop and test your understanding through unassessed, formative tutorial exercises, which will include examples of past exam paper questions. The course leads directly into a compiler laboratory exercise, which forms part of Computing Practical 2 that runs in parallel with the module. This close coupling between the module content and compiler laboratory exercise provides an opportunity for you to appreciate how the theoretical underpinnings of compiler design are put into practice.

An online service will be used as a discussion forum for the module.

Assessments

There will be one practical coursework exercise that contributes 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

There will be detailed feedback on the coursework exercises which will include written feedback on your individual submission and in-class feedback explaining common pitfalls and suggestions for improvement.

INTRODUCTION TO PROLOG

General competences

Module aims

This is a short, intensive 'taster' course intended to provide an introduction to:

the programming language Prolog and its basic features

logic programming concepts

a typical Prolog environment (Sicstus Prolog)

some common Prolog programming techniques

The emphasis is on explaining that Prolog has both a declarative and a procedural reading, and on the importance of clear and concise programs.

Learning outcomes

Students will:

be able to develop succinct and clear Prolog programs for unseen, but well specified, problems of small to medium scale;

have a sense of the computational efficiency of their programs and be able to employ some of Prolog's control primitives to improve efficiency;

have an awareness of the main differences and similarities between Prolog and functional programming languages (in particular Haskell).

Module syllabus

Declarative and procedural readings; variables and unification; computations, finite failure, and the search space; nondeterminism and multiple solutions. Logical and operational semantics.

Prolog terms. Lists and list processing. Tail recursion and last call optimisations.

Arithmetic and other built-in predicates.

Negation as failure.

Control primitives: the 'cut'; Prolog conditionals.

Aggregation operators: findall and setof.

Pre-requisites

The basics of syntax and semantics of propositional and predicate logic, as covered in the first year Logic course. Some familiarity with functional programming languages (Haskell) and recursive programs is an advantage but is not essential.

Teaching methods

This is an intensive course spread over three days, consisting of lectures and timetabled laboratory sessions, with tutorial assistance available.

A series of unassessed programming exercises are designed to introduce features of the language and associated programming techniques. Model answers are made available and also discussed briefly in lectures.

Assessments

There is one assessed programming exercise.

PROBABILITY AND STATISTICS

General competences

Module aims

In this module you will have the opportunity to:

use probability theory to model uncertainty

design simple probabilistic models that facilitate prediction

conduct sound scientific analysis of data

study the mathematical foundations of probabilistic modelling with Markov chains and simulation

Learning outcomes

Upon successful completion of this module you will be able to:

Describe notions of probability in terms of sample spaces

Define and use random variables

Design simple probability models and estimate their parameters from data

Construct confidence intervals

Perform hypothesis tests and draw scientific conclusions

Apply estimation and testing procedures

Module syllabus

This module covers the following topics:

Foundations of probability theory

Discrete random variables and their probability distributions

Poisson processes

Continuous random variables and their probability distributions

Central Limit Theorem

Joint random variables

Estimation

Fundamentals of simulation

Markov chains

Teaching methods

The mathematical techniques will be developed from first principles, so you will obtain a deep understanding of both the foundations of probability and statistics and their application. Numerous examples will be given throughout aimed at linking the theory with practice. The material will be taught through traditional lectures, backed up by assessed exercises designed to reinforce the material as it is taught. There will be small-group tutorials, which you can join on a voluntary basis, run by Graduate Teaching Assistants (GTAs).

An online service will be used as a discussion forum for the module.

Assessments

There will be a number of small assessed exercises throughout the term designed to reinforce the material as it is taught. These collectively count for 20% of the marks for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

Written feedback will be given on the assessed exercises and this will normally be returned within one week of submission. If you elect to attend the small-group tutorials then you will also get regular additional verbal feedback and will benefit from the group discussions.

2ND YEAR COMPUTING GROUP PROJECT

General competences

Module aims

In this module you will have the opportunity to apply the software engineering techniques taught throughout the year to the implementation of a large web-based or mobile-based application that solves a real-world problem. This application will be designed following the principles and practices of Human Centred Design (HCD), which will be taught as part of the module. Additionally, you will learn, and will be expected to adhere to, the core aspects of Computer Law which must be taken into account when developing computing applications of this type.

Learning outcomes

Upon successful completion of this module, you will be able to:

describe and discuss the concepts involved in Human-Centred Design (HCD) and agile software development

conduct research into a real-world problem following HCD principles

design, engineer and deploy a web-based or mobile-based application to solve a real-world problem

work effectively as part of a small group to deliver software iteratively using modern agile software development methods

report, present and demonstrate a solution and its value proposition to an interdisciplinary audience

recall relevant Computer Laws and act in a manner that demonstrates awareness and conformity with those laws

Module syllabus

Human-Centred Design

Agile software development

Design and implementation of a multi-user application that solves a real world problem

Copyright and Data Protection law

Teaching methods

You will be able to work on a project of your choosing from either a list of proposed topics, many of which come from industrial partners, or based upon an own proposal. The material on HCD, agile software development and project/ product management, will be introduced via traditional lectures given by discipline experts, but the objective is for you to apply the methods taught as part of your chosen project. The project itself is self-driven, although input and guidance will be provided by the course support staff during weekly milestone assessments.

An online service will be used as a discussion forum for the module.

Assessments

The module comprises mostly practical project-work that will be assessed through weekly milestone review sessions run by interdisciplinary assessment teams. The project will culminate with a presentation and demonstration to showcase the final state of your application. This will be assessed by the same interdisciplinary team responsible for the weekly milestone review sessions, which ensures some continuity of assessment. In addition there are assessed written courseworks, one being a short report documenting your application and the other involving the evaluation of a case study in computer-related law.

The project review panel will consist of an interdisciplinary team who will provide tailored face-to-face feedback on each project milestone as it is delivered. This feedback will then be converted into an electronic format, including a numerical mark and letter grade, with comments justifying the marking decisions and key points to improve on for future milestones.

AN INTRODUCTION TO LAW FOR COMPUTER SCIENTISTS

General competences

Module aims

To introduce computing students to some core aspects of the law which impact on the practice of computing.

Learning outcomes

Students should be able to analyse and understand the terms of software licences, and the key features of contracts. They should understand the impact that data protection law has on computing practice.

Module syllabus

* Software Copyright
  - Copyright as intellectual property
  - The exclusive rights of copyright holders
  - Exceptions to copyright
  - Software copyright licences
* Contract
  - Agreement
  - Communication
  - Consideration
  - Remedies for breach of contract
  - Liquidated damages and the rule against penalties
* Data protection
  - Data protection principles
  - Personal data
  - Regulated activities
  - The Google case and the right to be forgotten.
* Sources of law

- Statute
- Common law
- European law

Teaching methods

4 hours of lecture

Assessments

A group assignment including case studies covering the major areas of law in the course.

SYMBOLIC REASONING

General competences

Module aims

This module covers the foundations of symbolic reasoning: SAT solving, logic programming, answer set programming, and SMT solving. It equips you with the practical skills necessary to use to solve real-world problems in program reasoning and symbolic artificial intelligence. It also provides the theoretical background for more advanced modules in these areas.

Learning outcomes

Upon successful completion of this module you will be able to:

describe theoretical foundations of Boolean Satisfiability (SAT) and Satisfiability Modulo Theories (SMT) solving

implement algorithms for SAT solving

encode problems in SMT form and solve them using state-of-the-art SMT solvers

explain the theoretical foundations of logic programming

apply resolution as an inference system for logic programming

encode problems using Answer Set Programming (ASP) and solve them using state-of-the-art ASP solvers

Module syllabus

The module is divided into four parts:

1.Boolean Satisfiability (SAT):

- The SAT problem and its NP-complete status

- The DP and DPLL algorithms for SAT solving

- The abstract DPLL framework and conflict-driven clause learning

2. Theoretical foundation of knowledge representation and reasoning in AI:

- Logic programming syntax

- Definite logic programs semantics: herbrand models, minimal models, immediate consequent operator

- Normal logic programs semantics: stratification, iterative fixed point, stable models, answer set semantics

3. Methods and approches for knowledge-driven inference:

- Inference systems: SLD resolution and SLDNF resolution

- Answer set programming: syntax, choice rules, aggregation, optimization statements, hard constraints and weak constraints

4. Satisfiability Modulo Theories (SMT)

- A variety of first-order theories and their decidability

- Lazy SMT solving

- The DPLL(T) architecture for SMT solving

Teaching methods

The material will be taught through lectures, backed up by formative exercises designed to reinforce the material as it is taught. Approximately one third of the timetabled activities will be dedicated to problem solving, using selected formative exercises as examples. Some of these will be in the form of small-group laboratory exercises, in order to encourage group discussions and group problem solving. These exercises wil reinforce the practical aspect of the material through application to real-word problems.

An online service will be used as a discussion forum for the module.

Assessments

There will be two assessed coursework that, combined, contribute 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

Detailed verbal feedback will be given on the exercises covered in the tutorial/lab sessions. Written feedback will be given on assessed work.

COMPUTATIONAL TECHNIQUES

General competences

Module aims

In this module you will have the opportunity to study additional mathematical topics that form prerequisites for later third and fourth year modules in areas such as computer graphics, machine learning and computational finance. The focus is on how mathematical methods can be applied to complex computational problems.

Learning outcomes

Upon successful completion of this module you will be able to:

apply advanced topics in linear algebra to problems in machine learning and deep learning,

be able to understand and implement mathematical methods in image processing, graphics and computational finance

use vector calculus to solve computational optimisation problems

solve problems in linear programming

Module syllabus

The indicative module content is as follows:

Vector and matrix norms, Generalised eigenvectors, Jordan normal form, Singular Value Decomposition, Dimensionality Reduction, Positive definite matrices, Cholesky factorisation, Normal Equations, Least Square Method, QR-decomposition, Householder transform, QR algorithm, LU-decomposition, Conditions of a matrix, Iterative solution of linear systems of equations, Jacobi method, Gauss-Seidel method, Iterative computation of eigenvectors, Power method, Inverse iteration, Rayleigh Quotient, Steepest descent method, Conjugate method, Linear programming.

Teaching methods

The module will be taught through lectures, backed up by unassessed, formative, exercises, that you will solve in-class. There will be one or more assessed coursework exercises designed to reinforce your understanding of the material. Small-group tutorials will be organised, which you can engage in on an optional basis.

An online web service will be used as an open online discussion forum for the module.

Assessments

There will be one or more assessed coursework exercises which collectively count for 20% of the marks for the module. There will be a final written exam, which counts for the remaining 80% of the marks.

Written feedback will be given on the assessed exercises will be returned through department's online platform. If you elect to attend the small-group tutorials then you will also get regular additional verbal feedback and will benefit from the group discussions.

Year Three

INDIVIDUAL PROJECT BENG

General competences

Module aims

In this module you will have the opportunity to demonstrate independence and originality, to plan and organise a large project over a long period, and to put into practice the knowledge, skills and research methods that you have learnt throughout the module.

Learning outcomes

Upon successful completion of this module, you will have demonstrated your ability to:

apply previously taught knowledge and skills to a substantial problem in Computing, as an individual

discover and apply appropriate methods, technology and thinking from relevant sources

present complex technical material orally to a mixed audience

exercise scientific writing skills by way of a substantial written report, summarising your findings

Module syllabus

There will be a small number of supporting lectures that will

describe the structure of the project, including expectations, milestones and deliverables,

give guidance on writing and presentation skills targeted specifically at individual projects,

explain the assessment procedures.

The rest of the project involves an independent investigation under the supervision of an academic advisor.

Teaching methods

This is an independent project, although you will be supervised throughout by an academic supervisor, possibly in conjunction with a Postdoctoral Research Assistant or PhD student. BEng individual project topics vary widely: some involve contributing novel and potentially publishable research, whilst others are concerned with tackling a substantial practical or theoretical problem using technologies, tools and

methods appropriate to the problem. The supervisor's role is to provide guidance and expertise when needed, but it is up to you to demonstrate your ability to think and work independently and to evaluate your findings in a sound manner. You will have regular meetings with your supervisor(s), typically one every week or two on average, although more regular interactions are common as the project nears completion. A second marker for the project will be assigned at around the midpoint of the project and they will conduct a progress check, based on an interim report and a short interview.

Assessments

The project will be assessed by an assessment team which will include the supervisor and second marker. Each team assesses a number of projects in order to facilitate effective moderation. The assessment is based on a. individual reports from the supervisor and second marker, b. an oral presentation. The presentation is not assessed in its own right but it is used to extract a detailed account of what you have achieved. All students' progress will be checked at approximately the mid way point. Underperforming students will be given guidance and additional support to help them back on track. The final assessment is based on the supervisor and second marker's preliminary assessment of the project background/ research, management, technical achievement and final report, along with input from the other members of the assessment team based on the presentation and Q&A. Any disputes are resolved by independent assessors, although these are rare in practice.

There will be continuous feedback throughout the supervision period and verbal feedback at the midpoint and during the final presentation via Q&A.

ADVANCED COMPUTER ARCHITECTURE

General competences

Module aims

Computer architecture concerns the design of general-purpose and special-purpose processors, and of parallel computer systems for applications ranging from embedded robotics through mobile handsets to datacentres and supercomputers.

Through this module you will:

develop a thorough understanding of high-performance and energy-efficient computer architecture

learn principles and techniques for evaluating architectural proposals

explore how knowledge of computer architecture informs software performance engineering

gain a deep understanding of topical trends in advanced computer architecture, compiler design, operating systems and parallel processing

Learning outcomes

Upon successful completion of this module you will be able to:

Justify the design of current, leading-edge processor products at various architectural levels, from microarchitecture to large-scale parallel systems

evaluate architecture design alternatives and tradeoffs in terms of power and performance

identify architectural security hazards and attack vulnerabilities and explain how they can be mitigated

optimise application software kernels to exploit architectural capabilities effectively

Module syllabus

Pipelines, hazards, instruction-level parallelism, locality and caching

Dynamic scheduling, Tomasulo's algorithm and register renaming

Software instruction scheduling and software pipelining

Superscalar and long-instruction-word architectures

Branch prediction and speculative execution

Simultaneous multithreading

Vector instruction execution

Caches, cache coherency, memory systems, address translation

Optimisations for parallelism and locality and their automation in compilers

Graphics processors and manycore architectures

Security vulnerabilities and their mitigation

Teaching methods

The module aims to build your understanding through lively interactive classes, driven by exposure to principles, examples, cunning architectural ideas, and provocative challenges. You will develop and test your understanding through unassessed, formative, exercises that will be undertaken both in-class and in the laboratory. There will also be two assessed laboratory exercises where you will learn to use simulation, in combination with your understanding of underlying architecture principles, to explain performance phenomena. Through these various exercises you will learn to formulate and test performance hypotheses, and to present the results. The goal is to understand the design rationale for current and future designs. The final exam, for which we will prepare extensively, will be based on reading and answering questions on an article describing a leading-edge commercial processor product.

An online service will be used as a discussion forum for the module.

Assessments

The module will feature two assessed coursework components: the first, based on the first half of the course, will explore single-core microarchitecture energy efficiency using a simulator running a given program example. The second component, which is more open-ended and can be done in groups of up to three, involves optimising the performance of a simple but interesting application code kernel on hardware of your choosing. These courseworks together count for 20% of the marks for the module. There will be a final written exam assessing both theoretical and practical aspects of the subject, and will, to a substantial extent, be based on an article about a recent processor product, which we will study in class in advance. This exam counts for the remaining 80% of the marks.

There will be detailed feedback on the coursework exercises which will include written feedback on your individual submission and in-class and/ or written feedback explaining common pitfalls and suggestions for improvement.

THE THEORY AND PRACTICE OF CONCURRENT PROGRAMMING

General competences

Module aims

This course focuses on the theory and practice of concurrent programming, in order to familiarise the students with a range of modern concurrent programming models, and with the challenges of correct concurrent programming. It is divided into two parts: a largely practical part that gives an overview of shared memory and message passing concurrency in a variety of programming languages, and a more theoretical part that treats shared memory concurrency from the ground up, covering low-level topics such as hardware memory models, primitives for shared-memory concurrency, building up towards higher-level synchronisation techniques such as locks, mutexes and transactional memory. Throughout the course, a main objective is to reinforce correct concurrent programming through the use of tools, formal specification and verification techniques.

Learning outcomes

Upon successful completion of this module you will be able to:

write correct and efficient concurrent software in modern programming languages using a range of concurrency models

evaluate the differences between, and strengths and weaknesses of, a variety of concurrency models

explain the architectural mechanisms for supporting shared memory concurrency

formalise the semantics of shared memory concurrency

specify, test and verify properties of concurrent systems using state-of-the-art practical tools and formal methods

Module syllabus

The course will be split into two halves. One half will focus on practical concurrent programming in a variety of programming languages using a range of paradigms. It will cover:

+ Shared memory concurrent programming in C++

+ Synchronisation using locks and atomic operations

+ Implementation of synchronisation primitives

+ Functional programming and concurrency

+ Dynamic data race detection

The other half will explore the theory and practice of shared memory concurrency, which underpins many of the concurrency models studied in the first half. It will focus on:

+ Primitives for shared-memory concurrency

+ Architecture support for single- and multi-core shared memory

+ Strong and weak memory models

+ Challenges of correct concurrent programming (races, deadlocks, livelocks, progress guarantees)

+ Design patterns for synchronisation (mutexes, locks, monitors)

+ Concurrent objects and linearisability

The practical part of the course will use the C++ programming language. A series of videos providing a crash course in C++ tailored to the needs of this course will be provided.

The course will rely heavily on knowledge from the Java concurrency material in Computing Practical 1 (40009), the material on concurrency in operating systems in Computing Practical 2 (50007), and on Models of Computation (50003). JMC students who have not already taken Models of Computation should consider taking it in parallel with this course - it will be tough to succeed in the theoretical part of this course without background from Models of Computation.

Teaching methods

This module will be taught via a combination of live lectures and problem solving classes applied to unassessed, formative, exercises. Interaction will also be encouraged through the use of Mentimeter Q&A, which will test student understanding of the often very subtle issues that pervade the subject.

An online service will be used as a discussion forum for the module.

Assessments

There will be two assessed coursework exercises designed to reinforce your understanding of the taught material. The first will be a practical coursework involving solving a concurrency-related problem using one of the programming models studied during the course. The second will be a written coursework addressing the more theoretical aspects of the subject. These collectively contribute 20% of the module mark; the remaining 80% comes from a written examination.

Written feedback will be given on the two assessed coursework exercises and there will be additional class-wide feedback highlighting common strengths and weaknesses. In-class feedback will also be facilitated through Mentimeter Q&A.

INTRODUCTION TO MACHINE LEARNING

General competences

Module aims

This module aims to provide students with a fundamental understanding of core machine learning ideas and concepts. It introduces different machine learning problems and basic algorithms used to address these problems. The module will cover fundamental machine learning knowledge required to tackle more advanced, specialised modules.

Learning outcomes

By the end of the module you will be able to:

- Evaluate the strengths and weaknesses of machine learning algorithms.
- Appraise the suitability of a machine learning algorithm to solve a given problem.
- Formulate appropriate methodologies to evaluate machine learning algorithms.
- Implement algorithms to solve machine learning problems.
- Develop predictive models with machine learning algorithms.
- Design unsupervised clustering programs based on machine learning algorithms.

Module syllabus

This module covers the following topics:

1) Machine Learning Concepts:

Definition and taxonomies, Supervised learning pipeline (classification/regression), Feature encoding, Model learning, Bias-variance tradeoff.

2) Instance Based Learning and Inductive Learning:

K-nearest neighbours, Locally weighted regression, Decision trees.

3) Model Evaluation and Comparison:

Training/validation/test data splits, Cross-validation, Evaluation metrics, Confidence intervals, Statistical significance.

4) Neural Networks:

Perceptron, Multilayer perceptron, Back-propagation, Stochastic gradient descent, Activation and error functions, Overfitting, Data normalization, Hyper-parameter tuning.

5) Unsupervised Learning:

Clustering algorithms (K-means), Models for density estimation (Kernel Density, Gaussian and Gaussian Mixture Models).

6) Evolutionary Algorithms:

Genetic algorithms, Evolutionary strategies, Novelty search, Quality-Diversity optimisation.

Teaching methods

The module is taught through lectures, practical exercises and quizzes to reinforce what has been taught in lectures, and computer-based coursework exercises done during lab sessions. The coursework exercises are in the form of mini-projects in which students will apply the methodology seen in class to solve machine learning problems.

Assessments

There will be computer-based coursework exercises that contribute 30% of the marks for the module. In these coursework exercises, students will implement machine learning algorithms to solve practical problems. There will be a final written exam, which counts for the remaining 70% of the marks.

During the weekly lab sessions, teaching assistants and lecturers will be available to answer questions and provide feedback. There will be detailed feedback on the coursework exercises which will include written feedback on submissions and class-wide feedback explaining common pitfalls and suggestions for improvement.

OPERATIONS RESEARCH

General competences

Module aims

This module will give you the opportunity to:

explore quantitative mathematical methods for taking decisions in the presence of constraints or finite resources

learn about linear programming, integer linear programming, robust optimisation, and game theory and their application

classify mathematical programs on the basis of the number and types of their solutions

implement solution techniques for linear programs with both real and integer-valued variables

familiarise yourself with fundamental notions of duality, degeneracy, and sensitivity

Learning outcomes

Upon successful completion of this module you will be able to:

classify mathematical programs on the basis of the number and types of their solutions

apply linear programming to real-world decision problems with real and integer-valued variables

model adversarial decision problems using linear programming

select an appropriate solution method or sythesise a new method for a given mathematical program

formulate mathematical programs used for decision-making and decision-making under uncertainty

formulate an adversarial decision problem in terms of a game

Module syllabus

Introduction to linear programming

Basic feasible solutions

Simplex method

Degenerate linear programs

Duality and shadow prices

Integer linear programming

Cutting planes

Branch-and bound and branch-and-cut

Game theory & robust optimization

Teaching methods

This module primarily operates as a lecture-style module, but we place significant emphasis on (i) interaction with students during lecture, (ii) discussion of modern research implications, (iii) a community of learners, e.g. via the Piazza discussion boards, (iv) open ended coursework that encourages students to try different possibilities, (v) optional hands-on exercises based on the GNU linear programming kit. Lectures are used to develop the mathematical concepts and ideas. But we augment the lecture with quizzes designed to encourage student interaction. These quizzes will reinforce your understanding and will inspire you to raise questions. As parts of the module are fairly close to the research, a small number of research papers could also be discussed in due course.

An online service will be used as a discussion forum for the module.

Assessments

The module features two courseworks, one for each part covered by the lecturers, to better pace and consolidate the learning of the algorithms and modelling techniques explained in the course. You will be able to work on your own or in small groups, and receive written feedback on each submission. These coursework collectively contribute 20% of the module marks. The remaining 80% will be assessed in a final written exam, which will test the understanding of the methods presented in the course as well as of their underpinning theory.

There will be detailed feedback on the coursework exercises which will include written feedback on your individual submission and class-wide or written feedback explaining common pitfalls and suggestions for improvement.

TYPE SYSTEMS FOR PROGRAMMING LANGUAGES

General competences

Module aims

In this module you will study in detail the design of type assignment systems for programming languages and focus on the importance of a sound theoretical framework, in order to be able to reason about the properties of a typed program. You will also study and compare the types systems of various modern functional and object-oriented programming languages.

Learning outcomes

Upon successful completion of this module you will be able to:

evaluate the relative merits of dynamic and static typing for functional, imperative, and objected oriented languages

formalise type systems and prove properties such as decidability, soundness, and completeness

describe and implement algorithms for type inference and type checking

describe and formalise selected type system extensions required to support modern programming language features

demonstrate advanced features of modern statically-typed programming lanaguges through small applications

Module syllabus

Review of Lambda calculus

Curry type assignment and principal types

Recursion and polymorphism

Type checking vs type inference

System F

Extensions for practical type inference, including data types, type classes, type constraints and coercion

System F_C

Subtypes and subtype inference

Advanced topics, e.g. higher-rank types, dependent types and ownership types

Teaching methods

The emphasis in this module is on combining theory with practice. There will be traditional lectures showing how type systems can be formalised and reasoned about and these will be interspersed with in-class discussions backed up with unassessed, formative, exercises designed to reinforce your understanding of the taught material. There will be additional laboratory exercises where you will get to explore advanced typing features and implement type checking/ inference algorithms, representative of those in modern statically-typed programming language compilers. Graduate Teaching Assistants will be on hand to support the laboratory exercises.

An online service will be used as a discussion forum for the module.

Assessments

There will be one assessed coursework containing both theoretical and practical components, which accounts for 20% of the module mark. The remaining 80% of the marks come from a written examination which will test both theoretical and practical aspects of the subject.

There will be written feedback on the assessed coursework exercise. Graduate Teaching Assistants will also provide verbal feedback as part of the administration of the laboratory exercises.

DATA PROCESSING SYSTEMS

General competences

Module aims

In this module you will have the opportunity to:

- advance your knowledge of data-structures and algorithms to data-processing algorithms and applications

- acquire theoretical and practical knowledge of data processing systems design and implementation for correct results and (close-to) optimal performance

- understand how Database Management Systems (DBMSs) optimize query performance

- understand Data Processing System tuning

- explore challenges & opportunities of cloud-native Data Processing Systems

- explore research directions such as Big Data or data management on modern hardware

Learning outcomes

Upon successful completion of this module you will be able to:

- select, apply and implement appropriate algorithms for common data-processing problems

- plan and optimize the execution of declarative queries

- design and implement a query processor

- assess fundamental bottlenecks in data management applications and how to optimise for them

- solve data processing scalability challenges through scale-up and scale-out techniques

- reason about concurrency control and transactions

Module syllabus

We will assume prior knowledge of the following material/courses:

- 40007: Introduction to Databases

- 40005: Introduction to Computer Architecture

- 50001: Algorithm Design and Analysis

We will cover

- Data Processing Algorithms
- Data Storage Models
- Data Processing Models
- Query planning and optimization
- Data Indexing
- Concurrency Control
- Scale-Up and Scale-Out Data Processing

Teaching methods

The module will be delivered in a flipped-classroom style: two hours of pre-recorded lectures per week combined with one hour of interactive discussion/Q&A and one hour of unassessed exercises/worksheets/short coding assignments (also per week). The module has a practical flavor: we will discuss specific techniques by attempting their implementation (under simplified assumptions).

An online service will be used as a discussion forum for the module.

Assessments

Coursework is implementation-focused and team-based, counting for 30% of the module mark; the remaining 70% comes from a written examination which is designed to assess both theoretical and practical aspects of the subject.

There will be detailed feedback on the coursework exercise which will include written feedback on your submissions and class-wide feedback explaining common pitfalls and suggestions for improvement.

NETWORKED SYSTEMS

General competences

Module aims

In this module, you will get an overview and hands-on experience on how modern networked systems are designed and implemented. The module assumes prior networking knowledge and goes into more detail on the evolution of networking, new network architectures, and new software and hardware infrastructure at the network control plane, data plane, and the endpoints. You will also explore and enumerate the systems principles, e.g. layering and the end-to-end argument, that led to certain design choices and understand how the same principles are applied across a variety of systems.

Learning outcomes

Upon successful completion of the module you will be able to:

- enumerate and analyse the basic network mechanisms, their design and implementation, and the underlying principles across different network settings and architectures.

- design and reason about the scalability and performance requirements for different parts of the networking infrastructure: control plane, data plane, endpoints

- use network simulation, debugging, and monitoring tools, such as wireshark, tcpdump, and NS2

- implement a network middlebox in different technologies, e.g. eBPF, DPDK, P4

Module syllabus

Overview: TCP/IP stack refresh, Remote Procedure Calls, basic operating system and network stack design

Network Architecture &Topologies: WAN, datacenter networks, clos, optical networking, basic switch architecture

Control Plane I: Routing Algorithms BGP and OSPF

Control Plane II: Software-Defined Networks

Programmable Dataplanes: introduction to P4, match-action tables, PISA architecture

Basic queueing theory, packet scheduling algorithms, and QoS

EndHost: congestion control, flow control, kernel-bypassing, eBPF, virtual networking

Congestion Control: congestion signals in different networking settings, DCTCP, HPCC, BBR, Timely

Teaching methods

The material will be taught through class-based lectures. There will be a combination of formative in-class tutorial exercises and practical sessions that will help you to practise the concepts in action and learn the necessary tools. Tutorials and practical sessions will be unassessed.

An online service will be used as a discussion forum for the module.

Assessments

There will be three small courseworks that contribute 30% of the mark for the module. There will also be a final exam contributing the remaining 70%.

You will receive written feedback on your coursework and verbal feedback during the tutorial and lab sessions.

COMPUTING RESEARCH COLLECTIVE

General competences

Module aims

In this module, you will work as a member of a small research Collective, supported by a mentor, to explore an area of Computing research. You will identify, read and critique academic research papers, and present your findings to the group verbally and in writing. The Collective provides you with an opportunity to meet researchers within the Department, explore areas of personal and/or emerging interest, and to hone your research skills to support your Individual Project. The range of Collectives formed will vary from year-to-year.

Learning outcomes

Upon successful completion of this module, you will have demonstrated your ability to:

Identify and analyse key academic papers in a specific area of computing research, distinguishing between primary findings, research methodologies, and implications for future work

Evaluate and provide constructive feedback on peers' presentations and written work, demonstrating critical thinking and the ability to discern the strengths and areas of improvement

Apply effective communication techniques to present complex computing research concepts, both orally and in writing, ensuring that their audience can understand and engage with the material.

Synthesise a comprehensive literature review drawing from multiple academic sources, integrating diverse perspectives to present a cohesive understanding of the chosen research topic

Actively participate in discussions, share insights, and contribute to the co-construction of knowledge, demonstrating commitment and professionalism

Module syllabus

The Computing Research Collective is designed to allow students to explore an area of academic research as part of a small group that they would not otherwise cover on the Computing degrees. The collective also allows students to develop an understanding of academic research methods, to critically appraise academic research, to develop their academic writing and presentation skills, and to consider topics that they may wish to pursue further for their Individual Project.

A collective will typically consist of five students and one academic mentor who together agree a topic to explore. The mentor may be a member of academic staff, a Teaching Fellow, or an approved researcher

or PhD student. Mentors may propose topics and try and attract students, or students may propose topics and try and interest a mentor. A Collective may choose to look at a human, engineering or societal problem and consider how to address this. They may use this as an opportunity to explore the work of a particular research group. The intention is that both students and mentors will learn together, so a mentor does not have to be an expert in the topic, although they will take responsibility for assessment. Where more than five students are interested in a topic, it may be possible to offer more than one collective in the same or related areas.

There is no guarantee that every student wanting to take the module will be able to find a suitable Collective to work within.

A 2 hour weekly slot will be held for the module on the timetable, although the Collectives have some autonomy as to the exact meeting times that will work best for them.

Teaching methods

Each Collective is supported by a suitable mentor. All mentors will have experience with academic research, although they may not know the details of all identified research studies. They will provide general guidance to the Collective.

The mentors will be encouraged to signpost students towards relevant central support where this is useful. The module leader will also suggest resources of general use to students across all Collectives, such as information on how to produce a Literature Review.

Each Collective operates autonomously in terms of the subject matter reviewed, but follows a centrally developed framework. An overview of the framework is as follows:

Week 1 – An introductory session is held. Mentors and students share ideas and collaboratively form Collectives.

Week 2 – The Collective meets for the first time. The mentor provides core knowledge necessary for the Collective (if known) or the Collective discuss the area together and identify any background understanding they will need to develop.

Week 3 – The Collective find and explore key academic papers on the topic. The mentor helps the students to prioritise the papers based on importance and relevance. Each student is allocated one paper to study and review in-depth through a process of agreement.

Weeks 4 to 8 – Each student presents the paper they have been allocated, helping to explore the key ideas, to present the importance of the paper, and to suggest future work. The student also answers questions from the group. The remainder of the Collective agree a peer assessment mark for the student and provide then with written feedback.

Week 9 – Wrap up week. The students bring with them to the session a short literature review of the subject area, which may also include further papers not directly discussed in the previous weeks. The Collective peer reviews the Literature Reviews providing marks and comments. The Mentor summarises the contributions and main findings of the Collective for sharing more widely across the Department.

The module is primarily delivered within each Collective, adhering to a standard framework to encourage consistency. Students will be active learners. Through research engagement and discussion, students will develop the ability to independently review research papers, along with the confidence necessary to write a detailed Literature Review for their Indvidual Project.

Assessments

For a Collective to be successful, active participation is required by all members. Each Collective operates according to a common framework. The Collectives are developed from student partnership principles, so students are also involved in the assessment process proving feedback for their peers. Final summative marks are determined by the mentor.

During the module, each student will typcially develop a 30 minute presentation, to be followed by Q&A and group discussion. Students will write a Literature Review, typically 1,500 words long. Their participation throughout the Collective will also be evaluated by the mentor.

Students will receive mentor and peer feedback throughout the module during the weekly meetings, following their individual presentation, and for the final Literature Review. Feedback will primarily be given verbally.

Each Collective will identify its own current reading list, supported by the mentor.

COMMUNICATING COMPUTER SCIENCE IN SCHOOLS

General competences

Module aims

In this module you will have the opportunity to support the teaching of Computer Science in a local area school. At first, you will observe the host teacher to help you understand the layout of the school, the teaching and the expecations after which you will take the lead in implementing a teaching project to help teach Computer Science in the school.

Learning outcomes

Upon successful completion of this module you will be able to:

Design and evaluate an original teaching project specifically aimed at school children

Apply core technical knowledge and practical skills to enhance existing teaching of Computer Science in schools

Analyse and reflect on how your teaching skills had progressed

Module syllabus

The main remit of this course is to help support the teaching of Computer Science in schools.

There are two parts to the course. In Part 1, you will visit a school one half-day a week during the Spring term and act as a teaching assistant. You will be required to keep regular logbook during this phase, which details their preparatory activities, teaching material prepared, and reflections on the experience. Examples of appropriate activities could include computer clubs, introducing interesting programming languages, problem solving, designing robots, etc. It depends on the school involved as well as the student.

Part 2 involves a a teaching project of your own choosing and it is relevant to promoting good Computing practice in school, and again could involve any of the aspects above. This should complement the regular experience and should be planned directly in conjunction with the teacher at the school.

Teaching methods

This module is motivated by the fact that there is a paucity of good Computer Science teachers in school (especially important in the time when this subject has been made as part of the curriculum in schools in the UK). The main aim is to place one you in a local area school to help with the teaching of this subject, while also giving you some practical teaching experience, thus enhancing your skills. In order to ensure that you are well taken care off, you will be placed with a teacher with the school (who will act as a mentor) and you will spend the first few weeks observing them to get a better understanding of the classroom. Once you feel comfortable and gain more experience, you will be able to deliver your

teaching project in collaboration with the teacher at the school. We will guide you as and when necessary by providing examples as well as material (such as the CPD toolkit for Secondary Teachers to teach Computer Science in schools). We will also provide training on presentation skills as well as give you an introduction into the school environment and some dos and don'ts. At the end, the final exercise is meant for you to reflect back on how your teaching has gone and what you may have done to improve it.

An online service will be used as a discussion forum for the module.

Assessments

There are five components to the assessment:

Classroom teaching quality (10%), which is based on discussion with and feedback from the schoolteacher

Weekly logbook or diary (15%), which assesses your activities on a week by week basis

Presentation (15%), which summarises your experience in the classroom, your teaching project(s) and what you learnt

Teaching Materials (25%), which assesses the content that you created in order to deliver your teaching project, for example worksheets, teaching aids, code snippets, evaluation, etc.

Final Report (35%), which details the whole experience including teaching activities, teaching project evaluation and evolution, personal reflections, and lessons learnt.

You will be provided with feedback throughout the term based on communication with the teachers. You will also benefit from ongoing Q&A with the module leader during your teaching activities. We will also visit the school half-way through the term and you will get verbal feedback on your progress at that stage. You will also receive personalised verbal feedback on the deliverables used to form the final assessment.

GRAPHICS

General competences

Module aims

In this module you will have the opportunity to study core computer graphics concepts, including the mathematical principles used for computer generated imagery, shading and light approximations. You will also learn different geometry representations and modelling techniques and will have the opportunity to apply what you have learnt to practical computer graphics problems, using modern shader languages and graphics accelerators.

Learning outcomes

Upon successful completion of this module you will be able to:

explain the core principles of programmable shading pipelines, such as vertex, fragment, and geometry shading

compare and contrast methods for modelling object geometry and surfaces

describe polyhedral and ray-based rendering methods evaluate their tradeoffs

analyse and deploy fundamental algorithms associated with computer graphics

read, explain and adapt graphics existing graphics source code and computer graphics pipeline diagrams

design, analyse and implement new software for solving complex computer graphics problems

Module syllabus

Device-independent graphics

Polygon rendering

3D geometry

Texture mapping and anti-aliasing

Shading planar polygons

Representation of colours

Ray Tracing

Radiosity

Geometric Warping and Morphing

Special Visual Effects, e.g. particle systems for fire smoke and water

Inverse kinematics in animation

Non-photorealistic rendering

Teaching methods

This module focuses on learning through doing. Each week a new topic is introduced in a lecture, followed by hands-on computer-based lab sessions, formative self-study tasks and assessed coursework exercises. These are wll designed to help you put computer graphics principles into practice.

Algorithms and principles are made concrete by working with real software. You will implement different rendering algorithms and experience the pros and cons of each approach. You will complete three assessed coursework exercises on your own and you are free to explore a number of voluntary practical problem tasks in small groups which will allow you to develop your ideas in discussion with colleagues, and learn from one another.

Support will given by the module leader, Graduate Teaching Assistants (GTAs), and through a computer graphics framework specially designed for this module that lets you explore modern, shader-based graphics programming. Lab sessions are supervised allowing you to get further advice and feedback from experts.

As the module progresses you will build up a set of techniques, and will use them to work with graphics algorithms of increasing size and complexity.

An online service will be used as a discussion forum for the module.

Assessments

There will be three assessed exercises, which are small, focused, practical, computer-based exercises, undertaken as individuals. In total these exercises count for 20% of the marks for the module. Weekly voluntary exercises give the opportunity for weekly feedback to help you to improve your shader programming skills. There will be a final written exam,which will test both theoretical and practical aspects of the subject. This exam counts for the remaining 80% of the marks for the module.

Feedback for the assessed exercises is provided by written feedback. The supervised lab sessions also provide an opportunity for you to receive verbal feedback as you work through the exercises.

COMPUTER VISION

General competences

Module aims

In this module you will learn how images are represented on computers and how they can be analysed by computer algorithms to extract semantic information. As part of the module you will have the opportunity to develop algorithms for detecting interesting features in images, design neural networks to perform natural image classification and explore algorithms for solving real-world problems such as hand-written digit recognition etc.

Learning outcomes

Upon successful completion of this module you will be able to:

- Differentiate commonly used filters for image processing, edge detection and interest point detection
- Describe features and classifiers used for image classification
- Implement neural networks for image classfication
- Extend image classification methods to object detection and image segmentation
- Recall commonly used methods for motion estimation and object tracking
- Transform between the 2D coordinate system of an image and the 3D world

Module syllabus

This module covers the following topics:

- Image filtering
- Edge detection and interest point detection
- Feature descriptors
- Image classification
- Object detection and image segmentation
- Neural networks
- Motion estimation
- 3D vision

Teaching methods

The teaching approach is centred around the desire to solve real-world visual information processing problems, such as natural image classification, object detection and image segmentation etc. Such examples are used throughout to demonstrate how the principles taught can be applied in practice.

The concepts that you have learnt in lectures will be reinforced by unassessed, formative, tutorial exercises and assessed computer-based courseworks. The courseworks will cover both low-level and high-level vision topics. The lab sessions are supervised, so you will receive technical support from Graduate Teaching Assistants (GTAs).

An online service will be used as a discussion forum for the module.

Assessments

Computer-based courseworks count for 30% of the marks and the final exam counts for the remaining 70% of the marks. The courseworks are in the format of Jupyter notebook, which enables you to fill in source code, discuss your solutions and display results as a pdf file for submission.

There will be detailed written feedback for each of the assessed courseworks and class-wide feedback explaining common pitfalls and suggestions for improvement.

CUSTOM COMPUTING

General competences

Module aims

In this module you will have the opportunity to:

explore applications of custom hardware in applications such as signal processing and databases

develop parametric descriptions for custom computers

analyse performance and resource usage of custom computers

optimise custom computers to meet design requirements

compare realisation of custom computers based on different technologies

explore system-on-chip architectures for implementing custom computers

Learning outcomes

Upon successful completion of this module you will be able to:

develop parametric descriptions of custom computers

develop alternative designs for custom computers that meet specified requirements

analyse the performance of a custom computer in terms of time space

evaluate space/ time trade-offs between competing custom computing designs in order to determine optimal solutions

use simulation to compare the intended and actual behaviour of custom computers

design system-on-chip architectures for supporting a specified custom computation

Module syllabus

This module covers the following topics for custom computing systems:

features and examples

technologies for implementation

parametric descriptions

development methods and tools

resource and performance characterisation

optimisation techniques

system-on-chip architectures

comparison and trade-off analysis

Teaching methods

The module will be taught through lectures, backed up by unassessed, formative exercises, that you will solve in-class. Graduate Teaching Assistants (GTAs) will be on hand to provide advice and feedback. There will be one assessed coursework which is designed to reinforce your understanding of the theoretical aspects of the material as well as give you hands-on experience of designing custom hardware using industry-standard tools.

An online service will be used as a discussion forum for the module.

Assessments

There will be one coursework that you will complete as an individual. It has three components: an essay-style component assessing general understanding, numerical components assessing relevant analytical skills, and a computer-based practical component assessing skills in using relevant development tools. The coursework counts for 20% of the marks for the module. There will be a final written exam, worth 80% of the marks, which will test both theoretical and practical aspects of the subject.

There will be detailed feedback on the coursework exercises which will include written feedback on your submission, and class-wide feedback explaining common pitfalls and suggestions for improvement.

NETWORK AND WEB SECURITY

General competences

Module aims

In this module you will have the opportunity to gain a broad knowledge of network and web security from the network to the application layer. The emphasis of the course is both on the underlying principles and techniques, and on examples of how such principles are applied in practice.

Learning outcomes

Upon successful completion of this module you will be able to:

evaluate main threats, attack techniques and defences relevant to cybersecurity and network security

analyse web applications in order to identify vulnerabilities

propose countermeasures to address vulnerabilities

design secure web applications by leveraging security principles

Module syllabus

Cybersecurity overview

Threat analysis and bug finding

Internet security

Serverside security

Client-side security

Secure Web Sessions

Emerging security standards

Online Privacy issues

Teaching methods

The material will be taught through traditional lectures, in-class demos and additional guest lectures by experts from cybersecurity companies with presence in the UK. There are additional scheduled laboratory sessions where you will practice concepts learned during the lectures. These will be supervised by Graduate Teaching Assistants (GTAs) and the lecturers. There will also be additional

in-class tutorials where you will work through unassessed, formative exercises designed to reinforce your understanding of the material taught.

An online service will be used as a discussion forum for the module.

Assessments

There will be one coursework that contributes 20% of the mark for the module. There will be a final written exam, which counts for the remaining 80% of the marks. The final exam will take place in the computer labs, where you will answer traditional questions designed to test the theoretical aspects taught and also perform practical security-relevant exercises on dedicated virtual machines.

Verbal feedback will be provided via the GTAs and lecturers during the scheduled laboratory hours and also the in-class tutorial exercises. You will also receive detailed feedback on the coursework submission.

SYSTEM PERFORMANCE ENGINEERING

General competences

Module aims

Performance engineering is the area of computer science ensuring that computer systems (comprised of hardware as well as software) are responsive, scalable, and efficient. The course aims at introducing fundamental principles and techniques used in performance management of modern computer systems, either purpose-built applications or generic system (single-node as well as distributed). In particular, in this module you will have the opportunity to learn to:

Design, conduct and interpret a meaningful performance assesments for a given system or application through benchmarking, monitoring and profiling

Provision computing resources to meet performance requirements for a given system or application

Resolve performance bottlenecks in software and hardware systems using the appropriate tools and techniques

Trade-off different resources for each-other to achieve balance in their utilization

Learning outcomes

The learning outcomes of this module are as follows:

explain and apply the design principles, techniques, tools and metrics of performance assessment

make and explain performance trade-offs in software and hardware systems

forecast performance of a system or application with the aim to improve it

apply the principles, techniques and tools of performance-optimization

Module syllabus

This module covers the following topics:

Performance engineering methodology

Profiling systems to find bottlenecks

Macro and micro-benchmarking

Critical sections

Cost modeling

Resource management

Scaling (up and out)

Single-thread, multi-thread and multi-process performance (analysis and optimization)

Performance-critical operating system features used by applications

Specialized devices

Teaching methods

This module is motivated by the problem of efficiently running computer systems in spite of uncertainties and variabilities in the workloads that they process. The module will first deliver a set of methods, both practical and analytical, to understand and quantify the performance of an existing computer system through benchmarking, tracing and profiling. Building on this understanding, you will be exposed to techniques to optimize the performance of the system, alleviating performance bottlenecks, while being aware of the expected impacts on costs, resource saturation, and quality-of-service experienced by the end users or the running applications. These methods and techniques will be learned through lectures and practical exercises assessed as part of the coursework component. Case studies arising from databases, cloud computing, stream processing systems, computer games, and other application areas will be used to contextualize and motivate the study of these methods. The key idea is for you to learn how to abstract enough the specific implementation details of a given system through general notions that can help you understand and optimise the performance of arbitrary computer systems.

An online service will be used as a discussion forum for the module.

Assessments

The course will feature two assessed coursework components: the first will cover the first half of the course, the other the second half of the course. Coursework will normally involve work with actual computer systems, either on your own or in small groups (usually two students per group, depending on the nature of the problem). These courseworks are equally weighted and, together, count for 20% of the marks for the module. There will be a final written exam, which will test both theoretical and practical aspects of the subject. This exam counts for the remaining 80% of the marks.

There will be detailed feedback on the coursework exercises which will include:

a) written feedback on your individual submission

b) in-class and/or written feedback explaining common pitfalls and suggestions for improvement

ROBOTICS

General competences

Module aims

This module focuses on mobile robotics, emphasising practical algorithms for navigation, all based around real hardware and tested in the real world. Key elements are:

1) Wheeled locomotion, motor control, and motion calibration

2) Outward-looking sensors for behavioural control loops

3) Probabilistic localisation using particle filtering

4) Advanced use of sensors for place recognition, occupancy mapping and planning

5) An introduction to Simultaneous Localisation and Mapping.

This course is intensively practical, and all the key methods you learn will be tested on robots you build and program from scratch in groups using kits based around the Raspberry Pi single board computer and Lego Mindstorms components.

Learning outcomes

Upon successful completion of this module you will be able to:

build, program and experiment with practical robots

calibrate and model imperfect motors and sensors

use knowledge of the essentials of feedback control to implement sensor/ motor control loops

use probabilistic methods to implement 2D localisation and mapping functionality on a mobile robot

evaluate algorithms for relocalisation, mapping, and planning in the context of a mobile robot navigation system

Module syllabus

What is a robot? Applications and state of the art in mobile robotics. Case study on robotic floor cleaners.

Robot Motion: wheel kinematics. Motors, gearing and PID control. 2D coordinates and rigid kinematics. Motion uncertainty.

Sensors: sensor types and processing. Sensor/ motor control loops with feedback. Reactive behaviours.

Motivation for probabilistic methods in robotics. Probabilistic representation of uncertain motion using particles.

Monte Carlo Localisation: a full algorithm of probabilistic localisation within a known map, using odometry and sonar.

Place Recognition, Occupancy Mapping and Dynamic Window planning.

Introduction to Simultaneous Localisation and Mapping (SLAM).

Review and Competition: all students take part in groups in a challenge race to complete a timed robotics objective.

Pre-requisites

Essential geometry (vectors, rotations, trigonometry).

Essential probability theory.

Programming: you will write a lot of code in Python.

Willingness to work in groups with robot kit hardware, which is not always reliable.

Teaching methods

In this module we emphasise “learning by doing”, and from the start of the course you will be given a robot kit to work with in groups in the extended practical sessions and in your own study time. Every week, once new methods have been introduced in lectures, you will be set a practical task and will need to build and program robots from scratch to achieve a set of objectives. The robot kits are designed such that a simple robot can be built and programmed to move within a few hours, but we focus on the challenge of going beyond the capabilities of toys towards robots which can move precisely and repeatable in the challenging real world. This involves getting to grips with the sometimes frustrating but essential issues of tuning and calibration of motors and sensors which are so important in any practical system. You will then be able to progress quickly to implementing for yourself highly satisfying methods such a probabilistic localisation using a particle filter. Our kits allow such methods to be visualised on-screen in real-time which will greatly aid your intuitive understanding. Most importantly, you will have implemented the full journey from an algorithm in paper to a working demonstration on a robot you have built yourself. The course always finishes with a competition, where the groups go head to head against the clock on a challenge. Finally, the course regularly features a guest lecture on robotics in industry.

An online service will be used as a discussion forum for the module.

Assessments

The coursework element counts for 30% of the total, and takes the form of weekly in-lab practical assessments by demonstration and discussion in groups. Since the practical work is the core part of the

course, the final individual examination, which counts for 70%, is closely based on methods covered in the practical exercises, with questions which focus on the implementation of practical techniques.

The weekly practical sessions are highly interactive, and you will regularly get advice and feedback from the course leader and Graduate Teaching Assistants (GTAs). More formally, in practical assessments you will present and demonstrate your week's work in the lab and receive immediate feedback and marks on the spot, with advice for improvement and time to ask questions. We also give whole class feedback on practicals in the following lecture.

3RD YEAR SOFTWARE ENGINEERING GROUP PROJECT

General competences

Module aims

This is a project-based module where you work in a team to carry out the development and management of a relatively large scale software project, building a piece of software to fulfil the needs of a particular customer. You will put into practice state-of-the-art techniques used in industrial software development to ensure that your team produces software co-operatively, reliably and on schedule. Each team will work on a different project, and will receive individual coaching to provide support and advice relevant to their particular project.

Learning outcomes

Upon successful completion of this module you will be able to:

build a complex software system to a customer's specification

deliver a system iteratively, over a number of months, in a medium-sized team

apply an agile development method (e.g. XP, Scrum or Kanban) to your work

work effectively as part of a team and manage your work schedule over a period of several months

present the outputs of your project, and your reflections on it, orally and in writing

Module syllabus

Agile software development

Project management

Risk management

Quality assurance

Delivering for the customer

Group project presentation skills

Pre-requisites

Course contents of COMP50002 Software Engineering Design. Familiarity with version-control systems or the ability to learn basic use of such systems from online resources.

Teaching methods

Following the structure of common agile development methods, these projects run as set of four two-week iterations over the course of the term. During each iteration you will agree a set of requirements to work on with your customer, and then demonstrate some working software implementing these features at the end of the iteration.

There will be a small number of introductory lectures (see the above module content) but most of the core content will be made available online, through a series of articles, videos etc. covering the main topics.

In addition to your regular customer meetings you will also have the opportunity for special consultations with an experienced industrial software engineer to discuss your approaches to project management, technical design, testing strategies, etc.

An online service will be used as a discussion forum for the module.

Assessments

20% of the marks for the project are given at the end of iteration checkpoints (5% x 4 checkpoints) to encourage a sustained delivery of work.

The remaining 80% is given for the project overall - a combination of the technical achievement, the group collaboration and management, report and presentation.

Peer assessments at each checkpoint will be used to monitor individual contributions. If any significant imbalances are detected then the work schedule will be adjusted with a view to roughly equalising the contributions of each member. Differential marking will be applied when significant differences in contribution have emerged over the lifetime of a project. In all other cases, where there has been an approximately equal contribution from each member, they will all receive the same mark.

Feedback will be given to each team orally at each bi-weekly checkpoint by the project supervisor/customer. Feedback and advice will also be given in discussion with the Software Engineering consultants during each group’s consultation sessions.

ACCOUNTING ONLINE

General competences

Module Description

The aim of this module is to develop certain accounting related skills, by explaining the techniques of financial accounting and management accounting and examining their relevance to the broader issues of financial decision-making and management control in organisations. The module will give you a basic insight into the way that business performance is measured, and how business decisions can be structured and analysed.

Learning Outcomes

By the end of the module, you will be able to:

• Apply generally accepted accounting principles to create the main corporate financial statements.

• Appraise a company's performance and financial position using information from corporate annual reports.

• Select relevant accounting tools to support short- and long-term business decisions.

• Apply appropriate accounting tools to support managerial decisions.

Module Content

The module is structured in two parts (each five weeks):

Part A - Financial Accounting

• The nature and roles of financial accounting

• The Balance Sheet

• The Income Statement

• The Statement of Cash Flows

• Types of ratios

• Ratio and annual report analysis

Part B - Management Accounting

• The nature and roles of management accounting

• Basic cost concepts

• Cost accounting systems

Short-run decision making

• Investment decisions

• Budgetary control

• Performance evaluation

Teaching Methods

The module will comprise 10 self-guided sessions as well as online live lectures and tutorials. Teaching is delivered by a pragmatic blend of pre-recorded lectures, synchronous scheduled live tutorials, asynchronous peer-to-peer and staff-moderated discussion forums, case studies, problem exercises and online simulations. This approach encourages the achievement of the various learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the theory and concepts covered in the module and how these can be applied to real-world contexts. Learning throughout the module is typically structured around 10 1-week sessions.

Assessments

The module will be assessed by:

• Individual in-term MCQ Test 30%

• Final Examination 70%

BUSINESS ECONOMICS

General competences

Module Description

Economics provides a useful set of tools for analysing the world and aiding decision-making by businesses and governments. This module aims to give you an overview of several of these tools and of the insights that can be obtained with them. We will particularly focus on the tools most relevant to businesses. We will pay particular attention to the actions of firms and individuals in the context of market interaction and strategic (game theoretic) interactions in business contexts.

Learning Outcomes

By the end of the module, you will be able to:

• Define key concepts in economics such as Nash equilibrium and Adverse selection.

• Recognise how common social institutions reflect economic concepts, such as demand and supply.

• Calculate the outcomes of simple quantitative economic questions.

• Discuss economic articles in a newspaper such as the Financial Times or The Economist.

• Appraise the welfare merits of simple government regulations and interventions.

Module Content (this structure may vary slightly)

• Consumer choices and demand

• Firm costs, production decisions and supply

• Market equilibrium, welfare, and taxation

• Monopoly, perfect competition and oligopoly

• Strategic interaction and game theory

Teaching Approach

Teaching is delivered by (10 x 2 hour) sessions. Sessions will normally be based on a combination of lectures, class discussion, group presentations, guest talks and case study analysis. This approach encourages the achievement of the various module learning

outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the learnt theory and concepts and how these can be applied to realworld contexts.

You are expected to participate actively during lectures with questions and comments. You will also be questioned during the lectures. There will be online resources to help in the analysis of economic models, which will be referred to during the module.

Requirements

No previous knowledge of economics is required.

However, you will need to have the following mathematical background:

• Calculus in multiple variables. You should know how to maximize a differentiable function f(x 1 , x 2) with respect to just x 1 , or to both x 1 and x 2 . You should understand first order and second order conditions for identifying extrema of functions.

• Probability. You should know what probability is. You should be familiar with binomial and normal probability distributions. You should know what mean and variance is. You should know how to compute the mean and variance of a probability distribution.

• Solving systems of 2 equations.

Assessment

The module will be assessed by:

• Group Report 40%

• Final Examination 60%

ENTREPRENEURSHIP

General competences

Module Description

How do you go from idea to business? This entrepreneurship module offers you a unique opportunity to build your knowledge, skills, and experience in starting up a new business. You will gain a behind-the-scenes perspective into the entrepreneurial world through lectures, project work, and guest lectures. The module aims to inspire you to develop an entrepreneurial mindset when setting up and driving new projects or when building your own businesses. Students participating in the module will also have the opportunity to win a prestigious fellowship and competition prize fund for their business idea.

Learning Outcomes

By the end of the module, you will be able to:

• Apply key methods and tools used in the start-up ecosystem.

• Recognise key steps in discovering, evaluating, and implementing a startup idea in

practice.

• Identify challenges and ways to overcome them in testing and validating a new idea.

• Describe systemic issues (i.e., gender and racial inequality) prevalent in

entrepreneurship more broadly.

• Recognise key organisational aspects in starting up a new business.

• Develop teamwork, project management and presentation skills.

Module Content (this structure may vary slightly)

1. Entrepreneurship and Innovation

2. Entrepreneurship Methodologies

3. Evidence and Entrepreneurship (I)

4. Evidence and Entrepreneurship (II)

5. Markets and Customers

6. Leadership and Teams

7. Strategy and Start-Up Finance

8. Pitching

9. Sources of Capital

10. Purpose and the Dark Side of Entrepreneurship

Teaching Approach

Teaching is delivered by 10 x 2 hour sessions. Sessions will normally be based on a combination of lectures, class discussion, group reflections, and guest talks. This approach encourages the achievement of the various module learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the learnt theory and concepts and how these can be applied to real-world contexts.

It is important that you come to class and be prepared to participate.

Assessment

- Group Coursework 80%
- Participation 20%

ENTREPRENEURSHIP ONLINE

General competences

Module Description

The Entrepreneurship Online module offers you a unique opportunity to build your knowledge, skills and experience in developing a new business idea. The module aims to inspire you to develop an entrepreneurial mindset for setting up and driving new projects or ventures.

Learning Outcomes

At the end of the module, you will be able to;

• Apply key concepts, processes, and tools used in the startup ecosystem.

• Learn and follow key steps to discover, validate, nurture, and build on top of a novel entrepreneurial opportunity.

• Design, iterate or pivot, validate and further develop a business model for your startup in any domain.

• Identify the challenges you could face in starting up a new venture and apply tactics to overcome them.

• Identify, access and use resources to support your startup activities within Imperial and the wider startup ecosystem.

• Develop teamwork, project management, prototyping, experimentation, analytical, and presentation skills.

Module Content (these contents may vary slightly)

• Discovering Opportunities, Problems, Customers & Stakeholders

• The Lean Startup method: 4 building blocks

• Customer Discovery: finding early customers, signals and insights

• Crafting your Value Proposition

• Customer Development and Validation

• The Minimum Viable Product (MVP)

• Verifying your Business Model: pivot or proceed through running experiments

• Entrepreneurial strategy, revenue models and pricing

• Funding, finance and acceleration

• Storytelling and Pitching

• Impact Entrepreneurship and Sustainable Development Goals (SDGs)

Teaching Methods

This module is made up of 10 self-guided sessions as well as online materials and support, providing content that is equivalent to a face-to-face module. The module is self-contained, in that all of the chosen topics are covered within its range of online resources (including links to external readings).

Teaching is delivered by a pragmatic blend of pre-recorded lectures, synchronous scheduled live tutorials, asynchronous peer-to-peer and staff-moderated discussion forums, case studies and online polls and activities. You will also be supported by a Teaching Assistant who actively monitors engagement with weekly activities and responds to posts on the online forum, providing additional opportunity for you to consolidate your understanding and ask questions. This approach encourages the achievement of the various learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the theory and concepts covered in the module and how these can be applied to real-world contexts.

Assessment

The module will be assessed by:

• Group Lean Canvas - 20%

• Group Validation Report – 50%

• Group Pitch Video - 30%

MANAGERIAL ECONOMICS ONLINE

General competences

Module Description

In this module you will explore the value to businesses of understanding economics concepts, tools and analytical frameworks. You will gain a better understanding of how consumers and firms make economic decisions and how these affect the outcomes observed in markets. You will also develop an appreciation of circumstances in which markets do not operate efficiently and how governments may intervene to improve situations. From this micro basis, you will move on to explore what makes economies large or small and what factors affect economic growth. This will include considering the role of monetary and fiscal policy on business cycles, in normal times and in times of crisis.

Learning Outcomes

By the end of the module, you will be able to:

• Analyse the factors that affect decision-making in markets

• Compare and contrast the impact of different competitive and anti-competitive

strategies on market outcomes

• Identify and apply appropriate economics concepts and tools to evaluate changes in

the economy and how they impact on business

• Examine the role of government in individual markets and on the whole economy

• Write clear, well-reasoned and well-evidenced economics arguments

• Work effectively with others in teams

Module Content

The module comprises 10 self-guided sessions, each of which take 5-6 hours to work through, which will cover current topics in economics relevant to businesses including, for example:

1. Efficiency of market outcomes

2. Consumer decision-making

3. Profit-maximisation with market power

4. Strategic decision-making and game theory

5. Impact of competition, and anti-competitive strategies, on market outcomes

6. Market failure and the role of government policy

7. Understanding the scale and growth of the economy

8. Impact of productivity and trade on economic growth

9. Interest rates, investment, inflation and monetary policy

10. Macroeconomic crisis and the role of fiscal policy

Teaching Methods

Teaching is delivered by a pragmatic blend of pre-recorded lectures, synchronous scheduled live tutorials, asynchronous peer-to-peer and staff-moderated discussion forums, case studies, problem exercises and online games. This approach encourages the achievement of the various learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the theory and concepts covered in the module and how these can be applied to real-world contexts.

Assessment

The module will be assessed by:

• Group Report 25%

• Participation 15%

• Final Examination 60%

MANAGING INNOVATION

General competences

Module Description

Innovation management is one of the most challenging and exciting areas of managerial practice. In many industries, the ability to innovate is critical to building and sustaining competitive advantage. Innovation management is thus a critical aspect of almost all businesses, whether they be manufacturers or service providers, technology leaders or followers, or in mature or emerging industries. Innovation is about more than generating ideas; it is also about implementing these ideas and capturing value from them. Although innovation is inherently complex and uncertain, there are a range of tools and practices that can help organisations be more successful at developing new products, processes and services. This module analyses the innovation management function, including research, development, acceleration, and new product development. It examines the organisational aspects of how firms develop innovations and react to them.

Learning Outcomes

By the end of this module, you will be able to:

• understand the key steps, milestones and measures of the innovation process

• assess, interpret and evaluate the different data resulting from the innovation process

• establish, develop and formulate managerial strategies to shape innovative

performance and outcomes

• utilise tools of both closed and open innovation management to map and measure

innovative activities

• diagnose different innovation challenges and make effective recommendations for

resolving them

• employ different ethically and socially sound mechanisms to profit and to create welfare

from innovative efforts

Module Content

The module aims to equip you with the skills to organise and shape the innovation process in

different type of firms. You will develop an understanding of how innovations emerge and gain

adoption in the marketplace and how firms can transform and sustain themselves into effective

innovators. You will be expected to understand, interpret, and evaluate managerial strategies and structures associated with different types of innovation. You will also learn different ways in which organisations seek to profit from their innovations, including through the collaboration with other organisations. Therefore, the module is particularly applicable if you are interested in working for, or learning about technology-driven companies.

Topics include:

1. Technological Change and Disruptive Innovation;
2. Co-Production and Adoption of Innovations;
3. Moving first or following fast;
4. Standards, Platforms & Ecosystems;
5. Appropriability: Protecting Innovation and Capturing Value;
6. Free Culture, Social Production & Innovation Commons;
7. Open Innovation;
8. Innovation and Wicked Problems

Teaching Methods

The module will be taught primarily through discussions of cases and readings supplemented with lectures, videos, and class discussion. In order to benefit from and contribute to class exercises, it is critical that you prepare for each session and read the case studies and other learning material assigned for the session in advance.

The teaching philosophy is based on “active learning” whereby you are active participants in the learning process and create your own experiences through independent and interactive inquiry and analysis. Active and thoughtful class participation will be critical to your learning and the learning of your classmates. You may be “cold called” throughout any discussion.

You may be expected to give presentations on a regular basis and are expected to participate in any in-class exercises during the module. There might be one or two guest speakers from industry.

Assessment

The module will be assessed by group and individual work, comprising the following:

- Group Project (50%)
- Individual Participation (20%)
- Final Exam 30%

Please note that the examination for this module is considered a ‘must pass’. You are required to obtain a mark of 40 or above in the final examination to pass the module overall.

THE SCIENCE OF CROWDS

General competences

In this module you will be introduced to the basic principles of pedestrian dynamics, such as crowd movement theory, computer modelling, human behaviour, and experimental design. You will also work on a group project, using pedestrian dynamics principles to develop solutions to a real-word design problem. The course will be provided through online video and face-to-face workshops.

Learning outcomes

At the end of this module, you will be better able to:

Define the topics of pedestrian and evacuation dynamics, and explain how these concepts are important to consider when designing infrastructure.

Identify the main emergent properties of crowd behaviour.

Describe the main theories of human behaviour in emergencies.

Explain the different algorithms used for pedestrian dynamics simulation models, including their advantages and disadvantages.

Evaluate the design of pedestrian dynamics and evacuation experiments.

Generate pedestrian dynamics based design solutions for real-world problems.

Communicate design solutions effectively to scientifically literate, multidisciplinary audiences.

Indicative core content

The first half of the course will teach you the science of crowds: how they behave, how they can be modelled and measured, and the impacts that design changes can have on them. This will involve you learning elements of maths, physics, engineering and design, computing, sociology and psychology. This will enable you to analyse crowds and building designs through pedestrian dynamics concepts.The first half of the course will be delivered through online videos and workshops. Online videos will be available to watch a week in advance of the lecture. The workshops will begin with discussions between students and lecturers to clarify the concepts introduced in the online videos. Group activities are at the core of the workshops.

The second half of the module comprises of a group design project - you will work as a group to develop crowd-science based design solutions relating to a real-life design problem. You will be free to select the topic based upon your choice as a group. For example, you could design new evacuation procedures for the intensive care unit of a hospital, or propose how to optimise evacuation procedures in a particular building at Imperial College London. You will be expected to attend online sessions each week where you will present progress updates on your design solutions and receive feedback on them. In the final session

of the course, you will present your design solutions to the rest of the class in person. The VR session and the final session are both in person, the remainder of the module is online.

Learning and teaching approach

For the first 5 weeks this course will follow a 'flipped classroom' approach, where you will watch a series of videos online before attending the weekly workshop sessions. In each of these weekly sessions you will complete a workshop aimed at developing your knowledge and understanding of the course content, before taking a quiz on the material you have just learned. During these workshops you will be asked to perform a variety of tasks, from experiments to theoretical and numerical calculations. In weeks 6 students will participate in an immersive virtual reality environment exercise which is based upon an evacuation from an Underground station.

Further to this you will take part in a group project, meeting in classes and independently to propose design solutions. This will be a self-directed project, based on the material learned in the initial 5 weeks.

Assessment

Coursework

Quizzes based on lecture material (20%)

Group project (20%)

Reflective account (5%)

Test after VR session (10%)

Practical

Attendance and contribution (15%)

Presentation of Group project (30%)

DESIGNING INTERVENTIONS FOR BEHAVIOURAL CHANGE

General competences

This module is about scoping, analysing and developing creative interventions for behaviour change. Possible interventions include wearables to improve health, products for more sustainable consumption and policy to improve techenabled business models. There is a strong focus on design process within the module. Students with a strong interest in creative design process, human behaviour, and hands on coursework will enjoy this module.

You will be exposed to several creative behavioural frameworks that can be applied to the development of (digital and physical) product, service, event, policy and organisational interventions. Next, you will work as a team to analyse and develop an intervention of your own. Learning is enhanced through interactive workshops and discussions complemented by individual and group learning activities to translate your understanding into real-world contexts.

Learning outcomes

By the end of this module, you will better be able to:

Interplays (Masters K2: Creativity and Design, Masters K3: Enterprise Knowledge, Develops S1: Skills in Design Engineering):

Analyse the interplay between human behaviour and environmental, societal, organisational and individual outcomes

Opportunities (Develops S2: Contextual Evaluation):

Identify, critically analyse and scope opportunities for behaviour change interventions

Behavioural Interventions (Develops A3: Team Working, Develops S3: Creative Products, Services and Systems):

Create, evaluate and communicate creative interventions for behaviour change

Reflection (Masters A1: Reflection, Develops A2: Communications):

Reflect on the intersection of creative interventions for behaviour change and ethics within and beyond your discipline

Indicative core content

This module takes place over 9 weeks with a two-hour face to face session each week. The module content can be divided into three main parts. In the first part of the module, you will be introduced to various frameworks for analysing and designing behavioural interventions. Frameworks may include behavioural settings, daily rituals, and psychological ownership. These will be presented through pre-reading and interactive workshops during scheduled class time. The workshops will teach theory through real-world examples worked out in groups. Individual assignments following each session will help you understand how you can apply your learning more broadly. In the second part of the module,

student teams will work together to scope, analyse and develop behavioural interventions. Interventions may include: encouraging healthy eating and exercise, aiding refugee integration into a community, structuring interactions with IoT-enabled products, de-siloing organisations to improve innovation and policy for sustainable consumption. Supporting content will be presented during scheduled class time such as ethical considerations, exposure to broader approaches to behavioural interventions, and practical ways to make and test interventions. The third part of the class involves team presentations and structured reflections regarding how learning can be applied to your current and future endeavours.

Learning and teaching approach

Contact time will mainly be interactive workshops or discussions grounded in real case studies. Outside class, you will:

Individually show how what you have learnt can be applied to various contexts

As a group, you will scope, analyse and develop an intervention in a structured project

Self-study and engage in individual participation

There will be formative feedback during workshops and throughout the group project. Written feedback and grades will be given during formal assessment, but students are encouraged to write down informal feedback given to them as well. All feedback will be given within 10 working days unless otherwise noted.

Assessment

There will be quizzes at the start of each week on prereading material (usually no more than about 10 pages). Quizzes are pass/fail with multiple attempts allowed. A failed quiz will result in deductions from the other assignments.

Coursework:

Behaviour comprehension (three individual tasks) (45%)

Group project (55%);

CREATING EVIDENCE-BASED SOLUTIONS TO ENVIRONMENTAL POLLUTION AND HEALTH

General competences

Throughout this module, you will be introduced to environmental exposure to pollution and its impacts on human health internationally, focusing on solutions, their implementation and evaluation. You will receive a transdisciplinary experience and set of skills to successfully propose a potentially viable pilot intervention. You will learn from pollution, exposure, modelling, toxicology, 'big data' and biostatistics, epidemiology, behavioural change and policy analysis. You are expected to apply complementary interdisciplinary approaches to solve a problem using STEMM, but also employing business, entrepreneurship, project planning and communication skills. You will cover pollution from different sources and types, how they're created and who they affect. You will also examine pollution from a 'solution' perspective and consider what stakeholders are involved in mitigating pollution. You will utilize your presentation and research skills to bring forth your solutions in an engaging and innovative way.

Learning outcomes

By the end of this module, you will better be able to:

Explain why pollution is a public health concern based on evidence

Analyse and generate evidence from across multiple disciplinary fields to identify and justify a need to address an environmental pollution issue

Evaluate existing pollution interventions and suggest potential improvements to increase their impact in a multi-disciplinary context

Identify, design and plan the development of a tangible intervention which aims to create a solution to an environmental pollution problem and propose its expected outcomes

Indicative core content

You will be guided in how to create evidence-based solutions across up to eight topic areas, including for example:

Understanding sources and types of pollution

Measuring human exposure

Modelling human exposure

Toxicology

Opportunities for 'big data' and biostatistics

Epidemiology and assessing health impact

Social and behavioural change

Implementing policy and cost-benefit analysis

Learning and teaching approach

You will learn through mixed approaches of a-/synchronous activities including: (a) a series of short online tasks including recorded lectures on up to eight topic areas; multiple podcasts showcasing government, industry and academic initiatives; independent reading material; and formative quizzes; and (b) synchronous online workshops aligned to the eight topics to include problem-based learning activities, critical Q&A/discussions with stakeholders to build on STEMM areas and teamwork, interdisciplinary cooperation and independent, creative learning skills; (c) one workshop to enhance skills in proposal building, entrepreneurship, business and communication; (d) a formative workshop that will critically assess example dragon's den pitches & Q&A that enhances your presentation skills.

After the presentation and Q&A, oral feedback will be provided immediately and students will be given a consolidated written assessment form under each of the criteria headings from the panel judges.

You will receive formative feedback in oral workshops for the presentation skills while you will also receive online feedback in the written quizzes under each topic to assist you to gain further understanding of the topics.

Assessment

Attendance and participation (20%)

Quality of presentation in “Dragon’s Den” pitch (40%)

“Dragon’s Den” pitch Q&A session (40%)

FRENCH LEVEL 4

General competences

This module aims to:

Develop your listening, speaking, reading and writing skills to the advanced B2+ level of the Common European Framework of Reference (CEFR)

Introduce complex grammatical structures and broaden vocabulary, so that you can produce sophisticated language and operate in formal environments (academic, professional, etc.)

Aid you to engage with different language registers from a range of contexts, so that you can develop the ability to recognise stylistic and idiomatic features and apply them to your own communication

Provide the opportunity to study and reflect on aspects of contemporary France presented in the media

Enable you to study and work with relative ease in French-speaking countries

You will extend your background knowledge on social, political and cultural developments in France, which will be especially helpful if you are planning to study abroad.

To be eligible for this module, you need to have done one of the following:

Successfully completed French Level 3

Gained a French A-level qualification

Already achieved B1+ or equivalent on the Common European Framework of Reference (CEFR)

You are advised to review material from your previous courses before the start of this module.

This module is not intended for native or near-native speakers.

Indicative core content

In this module, you will cover the following linguistic structures:

Revision of grammatical structures as appropriate

Revision of past tenses, passive and subjunctive mood

Construction of complex sentences: subordinate clauses in indicative/subjunctive

Relative clauses

Object pronouns

Dependent clauses of cause, consequence, purpose, opposition, condition

Expression on comparison

Connectors

Summaries

Essay writing

Writing and presenting a press review

These linguistic structures will be applied to the following topics:

The French Republic: indentification and analysis of its principle values and their evolution

Freedom of speech and the French media

Educational system

Work

Environmental issues

Ethics in science

Current issues in France and Europe, as presented in the media

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodologies, the in-class activities you will complete will cover all four skills (reading, writing, listening and speaking). These will include pair work and groupwork (information gap exercises, texts, audio-visual material analysis and discussion); individual tasks (presentations); discovery and formulation of grammatical rules. Homework and coursework tasks will give you the opportunity to revise and consolidate your knowledge and skills and to develop your awareness of how to use language-learning tools independently. Our approach not only ensures you engage with a wide range of tasks and activities, but also seeks to support different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

The module includes formative as well as summative assessment. Homework tasks (theory revision, reading, writing, listening, etc.) are set every week on the virtual learning environment, following a flipped-classroom approach to ensure face-to-face time is devoted for interactional learning and communicative skills acquisition. This means that you will be provided with materials to study independently beforehand, and then apply these during classroom time. Your lecturer will give you support materials and guidance to reinforce topics covered at your own pace.

You will need to complete two pieces of summative coursework (set during mid-autumn term and mid-spring term), which will include rubrics and revision guidance to ensure you are supported when completing your work and you are aware of the assessment expectations. There will also be two 1-hour in-class tests (scheduled at the end of autumn term and at the end of spring term), and one practical in the form of an oral examination during the summer term. The coursework, examinations and practical contribute to your final grade.

Coursework (15%): Mid-autumn term project-based coursework on the virtual learning environment: listening/ reading/ writing (300-320 words).

Examination (15%): In-class test run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term. It will include: grammar/ reading/ writing (300 words approx).

Coursework (20%): Mid-spring term project-based coursework: speaking (pre-recorded: 5 minutes), writing: (320 words approx).

Examination (20%): In-class test run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include: grammar/ reading/ writing (320 words approx).

Practical (30%): Oral examination in the summer term, including presentation of pre-prepared material and discussion (approx. 20 minutes)

FRENCH LEVEL 6

General competences

A very high-level language module for students in their third year of French study post-A-Level.

This module will examine the French response to the various ethical dilemmas presented to modern societies. It will cover a range of topics on the social and political evolution of contemporary France and the implications of globalisation and the technological revolution.

This module aims to:

Enable you to consolidate and develop all previously-acquired skills to attain a high level of competence in spoken and written French

Study a range of scientific and technical texts, which will broaden your vocabulary and enable you to read and use with greater confidence documents related to your own field of study

Provide you with background knowledge and vocabulary on contemporary France

Study the political, economic, social and cultural events of the current year, as reported in the media

Study a wide range of texts, to understand and analyse radio, television broadcasts and long feature films

Give and listen to talks on scientific and technical topics from your own discipline and increase competence in question and answer sessions

By the end of the module, students should have reached approximately the C1/C2 standard of the Common European Framework of Reference (CEFR).

To be eligible for this module, you need to have done one of the following:

Successfully completed French Level 5

Already achieved B2/C1 or equivalent on the Common European Framework of Reference (CEFR)

This module is not intended for native or near-native speakers.

Learning outcomes

On successful completion of this module, you will be able to:

Process and engage with extended native speech with ease, recognising explicit, implicit, and culturally relevant meanings

Interact with ease in a variety of social and professional contexts, conveying meaning precisely, persuasively and effectively, to adapt to the demands of each communicative context

Navigate and critique a broad range of complex fictional, non-fictional texts and specialised articles, and write clear and smoothly-flowing complex texts, employing conventions of a variety of genres and using sophisticated linguistic structures, register, style of c1.2 level

Demonstrate a high level of intercultural awareness in critically-appraising cultural, scientific practices and socio-political perspectives from French-speaking contexts, comparing these with your own backgrounds and contexts of practice

Expand your knowledge independently in using a range of language learning and research tools effectively to tackle sophisticated communication and cultural translation.

Indicative core content

In this module, you will:

Explore social and demographic trends in contemporary France, alongside cultural, economic and STEM-related issues from French-speaking contexts

Work with advanced language structures, enhancing your awareness of discursive style, and register your understanding of linguistic purpose and function in practical situations

Expand your essay-writing skills and engage critically with a broad range of texts (literary, scientific, etc.)

Present, debate and/or report on current affairs

Apply research strategies to data collection and presentation, producing texts and other relevant materials to a professional standard

Work with different registers to improve communicative sophistication

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodologies, the in-class activities you will complete will cover all four skills (reading, writing, listening and speaking). These will include pair work and groupwork (critical evaluation of texts, audio and video material and discussion); individual tasks (presentations); discovery and formulation of grammatical rules. Homework and coursework tasks will give you the opportunity to revise and consolidate your knowledge and skills and to develop your awareness of how to use language-learning tools independently. Our approach not only ensures you engage with a wide range of tasks and activities, but also seeks to support different learning styles.Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term project-based coursework on the virtual learning environment: reading/ listening/ writing (450 words).

Examination (10%): In-class test run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term and will be a 450-470 word-essay.

Coursework (20%): Mid-spring term project-based coursework on the virtual learning environment: speaking (pre-recorded presentation: 8 minutes)/ writing (450 words).

Examination (20%): In-class test run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term and will be a 500-word essay.

Practical (35%): Oral examination in the summer term, including presentation of topics and summary/commentary of text (25 minutes).

GERMAN LEVEL 2

General competences

This module aims to:

Develop existing basic skills in everyday language use, through revision and consolidation

Extend your range of vocabulary, simple structures, and introduce more complex constructions

Provide students with the opportunity to develop all the fundamental language skills (reading, writing, listening and speaking) in German

Equip you with the necessary tools for independent language learning

Offer an insight into a range of aspects of the culture and daily life in German-speaking countries

Prepare you to progress towards higher language levels

By the end of the module, students should have reached approximately the A2+ standard of the Common European Framework of Reference (CEFR).

To be eligible for this module, you need to have done one of the following:

Successfully completed German Level 1

Gained a German GCSE qualification

Already achieved A1+ or equivalent on the Common European Framework of Reference (CEFR)

Indicative core content

In this module, you will cover the following linguistic structures:

Declension of the noun and pronoun

Present, future and perfect tenses of the verb

Rules of word order

Imperfect tense of the verb

Use of prepositions

Use of adjectives (comparison and adjectival endings)

Relative and reflexive pronouns

Subordinate clauses

You will be able to revise and consolidate your knowledge and skills:

Culture and customs

Languages and communication

Accommodation

Travel and sights

Leisure activities

Health

Work

Bank

Clothes

Inventions

Features of modern life (including social and behavioural norms), selected cultural areas and personalities of German-speaking countries

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodologies, the in-class activities you will complete will cover all four skills (reading, writing, listening and speaking). These will include pair work and groupwork (dialogue practice, information gap exercises, discussion), individual tasks, discovery and formulation of grammatical rules, work with texts, etc. Homework and coursework tasks will give you the opportunity to revise and consolidate your knowledge and skills and to develop your awareness of how to use language learning tools independently. Our approach not only ensures you engage with a wide range of tasks and activities, but also seeks to support different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term. Integrated skills pack, including writing (c.150-170 words) and grammatical/lexical awareness tasks.

Examination (10%): In-class test, on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term. It will include reading comprehension and a writing task (c.150 words).

Coursework (20%): Mid-spring term. Integrated skills set of tasks: receptive / productive skills, including listening from a video/audio and an individual speaking task (3-4 minutes).

Examination (30%): In-class test, on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include grammar/lexicon questions, a reading comprehension and a writing task (c. 170 words).

Practical (25%): Oral exam in summer term consisting of general conversation about the topics covered in class and a role-play (approx. 15 minutes total).

GERMAN LEVEL 3

General competences

This module aims to:

Introduce more complex grammatical structures

Revise and consolidate basic grammar, as required by the class

Provide background knowledge and vocabulary on current issues in Germany and on scientific and technological topics

Improve students' oral and written communication skills

By the end of the module, students should have reached approximately the B1+ standard of the Common European Framework of Reference (CEFR).

To be eligible for this module, you need to have done one of the following:

Successfully completed German Level 2

Gained a German AS level qualification

Already achieved A2+ or equivalent on the Common European Framework of Reference (CEFR)

Indicative core content

In this module, you will cover the following linguistic structures:

passive voice (present tense and past tenses), past tense;

pluperfect;

present participle used as adjectives;

pronouns: reciprocal pronouns;

sentence structure: connectors, sub-ordinate clauses, subjunctive;

revision and consolidation of your knowledge and skills.

Topics include:

intercultural communication;

regions and cities in Germany;

research and science;

social issues: volunteering and online realities;

higher education in Germany and student experience;

transport and environmental issues;

visions of the future;

use of digital media;

urban planning.

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodologies, the in-class activities you will complete will cover all four skills (reading, writing, listening and speaking). These will include pair work and groupwork (dialogue practice, information gap exercises, discussion), individual tasks, discovery and formulation of grammatical rules, work with texts, etc. Homework and coursework tasks will give you the opportunity to revise and consolidate your knowledge and skills and to develop your awareness of how to use language learning tools independently. Our approach not only ensures you engage with a wide range of tasks and activities, but also seeks to support different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term. Integrated skills pack, including reading comprehension, grammatical/lexical awareness tasks & guided writing (c. 100-150 words).

Examination (15%): In-class test on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term. It will include listening comprehension, grammar/lexicon questions and a writing task (c. 120-140 words).

Coursework (20%): Set at the end of autumn term (submission in spring term). Video production (c. 2-3 minutes).

Examination (20%): In-class test on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include reading comprehension and a writing task (c.180-200 words).

Practical (30%): Summer term: 1/2-hour oral exam in small groups consisting of a peer-to-peer Q&A and debate on topics from a pre-prepared dossier.

GERMAN LEVEL 4

General competences

This module aims to:

Improve your comprehension skills using written (scientific, journalistic and literary), oral, video and documentary material

Enable you to practice, both orally and in writing, a range of complex grammatical structures

Acquaint you with a knowledge of current affairs in the German-speaking countries

Provide you with background knowledge and vocabulary on social, political, cultural, scientific and technological developments in the German-speaking countries

By the end of the module, students should have reached approximately the B2+ standard of the Common European Framework of Reference (CEFR).

To be eligible for this module, you need to have done one of the following:

Successfully completed German Level 3

Gained a German A level qualification

Already achieved B1+ or equivalent on the Common European Framework of Reference (CEFR)

This module is not intended for native or near-native speakers.

Indicative core content

In this module, you will cover the following:

revision of grammatical structures as appropriate;

analysis of a range of linguistic registers in speech and writing;

further aspects of word order, adjectives and verb forms, including use of the subjunctive;

further work on prepositions and conjunctions;

nouns;

the subjunctive (including reported speech) and the passive voice;

the language of science.

Topics include:

immigration/emigration;

the German language;

poverty, community projects;

the consumer society;

the future;

the world of work in the German speaking countries;

art, history, communication;

current topics (where applicable).

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodologies, the in-class activities you will complete will cover all four skills (reading, writing, listening and speaking). These will include pair work and groupwork (dialogue practice, information gap exercises, discussion); individual tasks, discovery and formulation of grammatical rules, work with texts, etc. Homework and coursework tasks will give you the opportunity to revise and consolidate your knowledge and skills and to develop your awareness of how to use language learning tools independently. Our approach not only ensures you engage with a wide range of tasks and activities, but also seeks to support different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term. Integrated skills pack including reading comprehension, grammatical/lexical awareness tasks & writing (c.225-250 words).

Examination (15%): In-class test on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of the autumn term. It will include writing based on a choice of topics covered during the semester (c. 270-300 words).

Coursework (20%): Mid-spring term. Integrated skills pack including listening comprehension tasks & an essay (c.225-250 words)

Examination (20%): In-class test, on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include a reading comprehension and lexical/grammatical awareness tasks.

Practical (30%): Oral exam in term 3 including commentary on prepared topics and unprepared discussion (approx. 20 minutes in total).

JAPANESE LEVEL 2

General competences

This module aims to:

Develop further all the basic language skills, i.e. reading, writing, listening and speaking

Revise and consolidate basic grammar

Introduce more complex grammatical structures and extend vocabulary

Introduce 85 Kanji characters for reading and writing purposes

Gain further insights into culture and daily life in Japan

To be eligible for this module you need to have done one of the following:

Successfully completed Japanese Level 1

Gained a Japanese GCSE Qualification

Have already achieved the equivalent level by other means

Indicative core content

Japanese Lanterns

In this module, students will cover the following linguistic structures:

Revision of structures covered in Level 1

Different counters

Adjectives (past, past negative)

Comparatives and superlatives

Te-form

Polite requests

Progressive

These linguistic structures will be applied to the following topics:

Animals

The town

Weather

Seasons

Family

Travel and outings

Sending post/parcels

Eating out

Directions

How to use an ATM machine

Invitations

Everyday life

In addition, students will be introduced to 85 Kanji characters and the related vocabulary for writing and reading purposes.

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include pair work (e.g. dialogue practice, information gap exercises and vocabulary/grammar quiz), individual tasks (e.g. forming/writing sentences for various tasks and discovery/formulation of grammatical rules), and group work (e.g. reading aloud new vocabulary for pronunciation practice and reading texts/listening to the audio files for comprehension exercise), following the teacher's introduction on new language items (grammar, vocabukary and Kanji characters). Homework tasks give students the opportunity to revise and consolidate knowledge and skills covered each week as well as to receive an individual feedback. This approach not only ensures students engage with a wide range of tasks, but also supports different learning styles.

All pieces of coursework are marked and feedback will be given in two weeks. Detailed feedback will be provided alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (6%): Composition 1: 400 Japanese Letters (i.e. one A4 paper or more) during the second half of autumn term (approx. 1-3 hours for task completion).

Examination (25%): Test for Grammar, Vocabulary, Reading & Kanji in the last class of autumn term. 70 minutes.

Coursework (7%): Composition 2: 400 Japanese Letters (around one A4 paper or more) during the first half of spring term (approx. 1-3 hours for task completion).

Examination (5%): Kanji test in the last week of spring term. 10 minutes.

Examination (30%): Test for Grammar, Vocabulary, Reading and Listening, in the last class of spring term. 90 minutes.

Coursework (7%): Composition 3: 400 Japanese letters (around one A4 paper or more) during the last week of spring term (approx. 1-3 hours for task completion).

Practical (20%): Oral Exam (prepared speech followed by generic Q&A) during the first three weeks of the summer term. 15 minutes.

JAPANESE LEVEL 3

General competences

This module aims:

To develop further the basic language skills of listening, speaking, reading and writing

To revise and consolidate basic grammar as required by the class

To introduce more complex grammatical structures and extend vocabulary

To be eligible for this module you need to have done one of the following:

Successfully completed Japanese Level 2

Gained a Japanese A/S Level Qualification

Have already achieved the equivalent level by other means

You should be able to write approximately 100 Kanji characters.

Learning outcomes

On successful completion of this module, you will be able to:

read and write around 100 new Kanji characters and the related vocabulary on top of the 85 Kanji covered in Level 2 with accuracy;

deploy grammatical structures with different forms and registers and various vocabulary accurately and appropriately;

produce and respond to relatively simple written texts in Japanese writing system with different registers;

produce and respond to a range of simple spoken languages appropriately in different settings;

comprehend and respond to the information by listening to monologes / dialogues which use a wide range of the beginner-level grammar and vocabulary.

Indicative core content

In this module, you will cover the following linguistic structures:

revision of structures covered in Level 2;

adjectival and nominal use of te-form;

nai-form, ta-form and plain form;

casual form of speech;

indirect speech;

temporal clauses;

relative clauses;

conditionals;

prohibition and obligation.

These linguistic structures will be applied to the following topics:

hobbies;

ability and possibility;

giving instructions;

giving and asking for advice/directions;

everyday life;

experience;

holding casual conversations;

clothing;

accommodation;

directions;

instructions on how to use machine/equipment;

showing gratitude to others.

In addition, students will be introduced to around 100 Kanji characters and related vocabulary for writing and reading purposes.

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include pair work (e.g. dialogue practice, information gap exercises and vocabulary/grammar quiz), individual tasks (e.g. forming/writing sentences for various tasks and discovery/formulation of grammatical rules), and group work (e.g. reading aloud new vocabulary for pronunciation practice and reading texts/listening to the audio files for comprehension exercise), following the teacher's introduction on new language items (grammar, vocabukary and Kanji characters). Homework tasks give students the opportunity to revise and consolidate knowledge and skills covered each week as well as to receive an individual feedback. This

approach not only ensures students engage with a wide range of tasks, but also supports different learning styles.

All pieces of coursework are marked and feedback will be given in two weeks. Detailed feedback will be provided alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment..

Assessment

Coursework (6%): Composition 1: 500 Japanese letters (around one and 1/4 A4 papers), during the second half of autumn term (approx. 1-3 hours for task completion).

Examination (8%): Kanji & listening test, in the second to last class of autumn term. 20 minutes.

Examination (20%): Test for grammar, vocabulary and reading, in the last class of autumn term. 60 minutes.

Coursework (7%): Composition 2: 500 Japanese letters (around one and 1/4 A4 papers), during the first half of the spring term (approx. 1-3 hours for task completion).

Examination (12%): Kanji & listening test, in the second to last class of spring term. 30 minutes.

Examination (20%): Test for grammar, vocabulary and reading, in the last class of spring term. 60 minutes.

Coursework (7%): Composition 3: 500 Japanese letters (around one and 1/4 A4 papers), during the last week of spring term (approx. 1-3 hours for task completion).

Practical (20%): Oral exam: Prepared speech, followed by Q&A (both related to the speech and general) and a picture description task, during the first three weeks of the summer term. 15-20 minutes.

JAPANESE LEVEL 4

General competences

This module aims:

To develop further the basic language skills of listening, speaking, reading and writing

To revise and consolidate basic grammar as required by the class

To introduce more complex grammatical structures and extend vocabulary

To be eligible for this module you need to have done one of the following:

Successfully completed Japanese Level 3

Gained a Japanese A-Level Qualification

Have already achieved the equivalent level by other means

You should be able to write approximately 200 Kanji characters.

Learning outcomes

On successful completion of this module, you will be able to:

read and write around 100 new Kanji characters and the related vocabulary on top of the 185 Kanji covered in the previous levels with accuracy and fluency;

deploy moderately complex grammatical structures and a wider range of vocabulary with accuracy and fluency;

produce and respond to written texts of moderate complexity in Japanese writing system using the grammar & vocabulary covered in the module on top of those of the previous levels;

produce and respond to a range of spoken languages in familiar contexts;

comprehend and respond to the information by listening monologes/dialogues which use a wide range of the post-beginner-level grammar and vocabulary.

Indicative core content

In this module, students will cover the following linguistic structures:

revision of structures covered in level 3;

more complex grammar and alternative modes of expression are introduced, including different types of subordinate clauses;

use of polite expression in different situations.

These linguistic structures will be applied to the following topics:

office situations;

daily life in Japan and culture;

reporting a lost article to the police/ lost property office;

provision/preparation for the future events including emergency;

asking for favours and decline indirectly and politely by implying reasons;

illness and hospital visits.

In addition, students will be introduced with around 100 Kanji characters and the related vocabulary for writing and reading purposes (in addition to the 200 characters learned at level 2 and 3).

Learning and teaching approach

In line with modern foreign languages communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include pair work (e.g. dialogue practice, information gap exercises and vocabulary/grammar quiz), individual tasks (e.g. forming/writing sentences for various tasks and discovery/formulation of grammatical rules), and group work (e.g. reading aloud new vocabulary for pronunciation practice and reading texts/listening to the audio files for comprehension exercise), following the teacher's introduction on new language items (grammar, vocabukary and Kanji characters). Homework tasks give students the opportunity to revise and consolidate knowledge and skills covered each week as well as to receive an individual feedback. This approach not only ensures students engage with a wide range of tasks, but also supports different learning styles.

All pieces of coursework are marked and feedback will be given in two weeks. Detailed feedback will be provided alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (6%): Composition 1: 600 Japanese letters (around one and half A4 papers), during the second half of autumn term (approx. 1-3 hours for task completion).

Examination (5%): Kanji test, in the second to last class of autumn term. 10 minutes.

Examination (20%): Test for grammar, vocabulary, reading and listening, in the last class of autumn term. 60-70 minutes.

Coursework (7%): Composition 2: 600 Japanese letters (around one and half A4 papers), during the first half of spring term (approx. 1-3 hours for task completion).

Examination (10%): Kanji & listening test, in the second to last class of spring term. 30 minutes.

Examination (20%): Test for grammar, vocabulary and reading, in the last class of spring term. 60 minutes.

Coursework (7%): Composition 3: 600 Japanese letters (around one and half A4 papers), during the last week of spring term (approx. 1-3 hours for task completion).

Practical (25%): Oral exam: Prepared speech, followed by Q&A (both related to the speech and general) and a role play. 20-25 minutes.

SPANISH LEVEL 2

General competences

This module aims to:

Develop further all the basic language skills, i.e. reading, writing, listening and speaking

Consolidate GCSE language topics and introduce more complex grammatical structures extending vocabulary accordingly

Gain further insights into culture and daily life in the Spanish-speaking countries

By the end of the module, students should have reached approximately the A2+ standard of the Common European Framework of Reference (CEFR).

To be eligible for this module. you need to have done one of the following:

Successfully completed Spanish Level 1

Gained a Spanish GCSE Qualification

Already achieved A1+ or equivalent on the Common European Framework of Reference (CEFR)

Learning outcomes

On successful completion of this module, you will be able to:

respond to and produce a range of simple spoken language within familiar everyday contexts;

respond to and produce short written texts applying your grammatical and lexical knowledge at a CEFR A2-level (Common European Framework of Reference, waystage level);

demonstrate the relevant level of intercultural awareness in your handling of routine social interactions in Spanish and in your use of language;

use a basic range of digital language learning tools to support your production and expand your knowledge.

Indicative core content

In this module, you will revise all the basic structures of the language including:

pronouns, prepositions, ser/estar and impersonal verbs;

all indicative tenses (present, perfect forms, preterites, reflexives);

comparative and superlative forms;

reflexive and object pronouns, their use, position and combination;

new structures such as the future tense and the imperative will also be introduced.

These linguistic structures will be applied to the following topics:

leisure activities;

real-life communication;

health issues;

tourism and holidays;

lifestyle and traditions;

personalities from Spanish-speaking countries;

further aspects of the history, geography and culture of relevant countries.

Learning and teaching approach

In line with MFL communicative and active learning methodologies, in-class activities cover all four skills (reading, writing, listening and speaking) and include: pair work and groupwork (dialogue practice, information gap exercises, discussion and collection of key terms/ideas followed by report to plenum); individual tasks (face to face and online); discovery and formulation of rules; work with texts, audio and video material to develop learning and communicative skills. Homework and coursework tasks give you the tools required to participate in class and the opportunity to revise and consolidate knowledge and skills while developing an awareness of how to use language learning tools independently. This approach not only ensures you engage with a wide range of tasks, but also supports different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term, integrated skills set of tasks: receptive/ productive skills including writing (c. 120-150 words).

Examination (15%): In-class test, run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term. It will include a grammar/lexicon quiz, a reading comprehension and a writing task (150 words).

Coursework (20%): Mid-spring term, integrated skills set of tasks: receptive/ productive skills, including listening comprehension from a video/ podcast (3-5 minutes).

Examination (25%): In-class test, run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include a grammar/lexicon quiz, a reading comprehension and a writing task (c. 200 words).

Practical (25%): Oral exam in the summer term, including graded, open conversation on topics seen in class and describing an image (approx. 15 minutes).

SPANISH LEVEL 3

General competences

This module aims to:

Revise and consolidate grammar, as required by the class

Introduce complex grammatical structures

Extend both general and specific vocabulary related to the field of the work environment and of science

Read and understand texts of some complexity about the world of work, contemporary Spain, and science

Improve students' oral and written communication skills

Equip students with skills for studying and working in Spanish-speaking countries.

By the end of the module, students should have reached approximately the B1+ standard of the Common European Framework of Reference (CEFR).

To be eligible for this module you need to have done one of the following:

Successfully completed Spanish Level 2

Gained a Spanish AS level Qualification

Already achieved A2+ or equivalent on the Common European Framework of Reference (CEFR)

Learning outcomes

On successful completion of this module, you will be able to:

participate in oral interactions producing connected and comprehensible spoken language to deal with a range of familiar topics and personal interest matters;

respond to and produce written texts of moderate complexity applying your grammatical and lexical knowledge at a CEFR B1-level (Common European Framework of Reference, threshold level);

demonstrate the relevant level of intercultural awareness in your handling of routine social interactions in Spanish and in your use of language;

use a basic range of digital language learning tools independently to support your production and expand your knowledge.

Indicative core content

In this module, you will cover the following linguistic structures:

revise basic structures such as the conjugation of irregular verbs;

past tense contrast;

ser/estar;

direct and indirect object pronouns;

the subjunctive and its uses;

impersonality.

The study of linguistic structures will be embedded within topics such as:

lifestyle and traditions;

cultural aspects of Spanish-speaking countries;

the world of work, and the world of science.

Learning and teaching approach

In line with MFL communicative and active learning methodologies, in-class activities cover all four skills (reading, writing, listening and speaking) and include: pair work (dialogue practice, information gap exercises, discussion and collection of key terms/ideas followed by report to plenum); group work (discussion, creation of posters); individual tasks (presentations [with PP as well as video uploaded to Blackboard]); discovery and formulation of rules; critical evaluation of texts, audio and video material. Homework and coursework tasks give you the tools required to participate in class and the opportunity to revise and consolidate knowledge and skills while developing an awareness of how to use language learning tools independently. This approach not only ensures you engage with a wide range of tasks, but also supports different learning styles.

Your coursework will be marked and returned within two weeks. Rubrics and revision guidance (how-to guides) will be included as needed with each coursework. You will receive detailed feedback alongside suggestions for improvement and an overall percentage showing your provisional grade for that assessment.

Assessment

Coursework (15%): Mid-autumn term, integrated skills set of tasks: writing, listening, speaking (including essay of c. 200 words).

Examination (15%): In-class test, run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of autumn term. It will include a grammar/ lexicon quiz, a reading comprehension and a writing task (200-220 words).

Coursework (20%): Mid-spring term, integrated skills set of tasks: listening, writing, speaking (including essay of c. 250 words).

Examination (20%): In-class test, run on the virtual learning environment (bring your own device). This 1-hour test will take place at the end of spring term. It will include a grammar/ lexicon quiz, a reading comprehension and a writing task (220-250 words).

Practical (30%): Oral exam in the summer term, including graded, open conversation on topics seen in class (approx. 20 minutes).

RUSSIAN LEVEL 3

General competences

This module aims to:

Help you revise and consolidate all previously-acquired skills (listening, speaking, reading and writing), to the A2+/B1 level of the Common European Framework of Reference (CEFR)

Introduce more complex grammatical structures

Increase your range of vocabulary

Extend your background knowledge of the Russian language, its culture and people, through the study of a wide range of issues currently addressed in the modern societies where Russian is spoken

Equip you with important skills for studying and working in Russian-speaking countries

To be eligible for this module, you need to have done one of the following:

Successfully completed Russian Level 2

Gained a high grade at Russian GCSE or gained an A/S level qualification in Russian

Have already achieved the equivalent level by other means

Learning outcomes

On successful completion of this module, you will be able to:

Respond to and produce simple spoken language in familiar contexts, applying your knowledge of A2+/B1 grammar and vocabulary

Respond to and produce simple written texts, applying your knowledge of A2+/B1 grammar and vocabulary

Demonstrate intercultural awareness in the handling of everyday social interactions in Russian and engage with a basic range of digital language-learning tools to support your production

Indicative core content

In this module, you will cover the following linguistic structures:

Verbs taking the genitive, including the use of prepositions to express time, the use of the verbal aspects, direct and indirect speech

The formation of abstract nouns, the use of aspects in the infinitive and conditional sentences

Verbs taking the accusative, how to express concessional clauses (starting with 'although'), the use of aspect in the imperative

More verbs taking the accusative, verbs of motion without prefixes, how to express cause and effect relations

Verbs taking the dative, prefixed verbs of motion and how to express purpose

These linguistic structures will be applied to the following topics:

Education

The world of work

Leisure activities

Family and family relationships

Town, suburbs and country

Learning and teaching approach

In line with MFL communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include: pair work and group work (dialogue practice, information gap exercises, discussion and collection of key terms/ideas followed by report to plenum), individual tasks (face-to-face and online); discovery and formulation of rules; work with texts, audio and video material to develop learning and communicative skills. Homework and coursework tasks give you the opportunity to revise and consolidate knowledge and skills and to develop awareness of how to use language-learning tools independently. This approach not only ensures you engage with a wide range of tasks, but also supports different learning styles.

All pieces of coursework are marked and returned within two weeks. Marking criteria and revision guidance (how-to guides) are included as needed with each coursework to ensure you are supported to complete your work and aware of assessment expectations. Detailed feedback is provided for each individual section of the coursework, giving the correct answer(s) along with suggestions for improvement. In addition to the number of points out of a maximum total, an overall percentage grade is given. Generic feedback on each individual piece of coursework is also provided in class.

Assessment

The module includes formative as well as summative assessment. Homework tasks (theory revision, reading, writing, listening, etc) are set every week on the VLE, following a flipped classroom approach to ensure face to face time is devoted to interactional learning and communicative skills acquisition. Independent study and support materials/guidance are also provided so that you can reinforce topics covered at your own pace. Feedback is given for task submitted to ensure you are supported to complete your work and aware of assessment expectations. Summative assessment consists of two pieces of coursework (one per term), two 1-hour timed assessments (tests scheduled at the end of autumn term and at the end of spring term), and one practical i.e. oral examination (at the end of spring term or at the beginning of the summer term). Coursework and written/oral examinations all contribute to the final grade.

Coursework (15%): Reading, listening, speaking.

Examination (15%): 1 hour in-class test on the virtual learning environment, including grammar, reading, and writing approx. 180-200 words by hand).

Coursework (20%): Listening, comprehension, grammar and writing (approx. 250 words)

Examination (20%): 1 hour in-class test on the virtual learning environment including reading and writing (approx. 200-230 words by hand)

Practical (30%): Oral exam in Term 2 or 3 including a 4-5 min. prepared presentation and open conversation on topics covered in class (total duration of exam: c 15 min).

MANDARIN LEVEL 3

General competences

This module aims to:

extend your range of expression across all four language skills (reading, writing, speaking and listening) by equipping you with the grammatical structures necessary to be able to describe objects, events and people with clarity;

expand your knowledge of Chinese characters;

assist you in acquiring the ability to describe past events and experiences, using the correct grammatical forms, and become more familiar with aspects of Chinese society and culture;

prepare you for progression to higher levels.

To be eligible for this module, you need to have done one of the following:

Successfully completed Mandarin Level 2

Gained a Mandarin GCSE qualification

Obtained an HSK Certificate, Level 2

Have already achieved the equivalent level by other means

Learning outcomes

On successful completion of this module, you will be better prepared to:

express yourself in writing, using sophisticated and descriptive vocabulary and structures;

deploy a wide range of grammatical function words, identifying the appropriate structure to apply when talking about past events;

engage with and respond to a selection of aural material;

answer general questions orally;

complete an unseen practical task describing past events using spoken Mandarin.

Indicative core content

In this module, you work may cover the following linguistic structures:

coverbs

sentence particle and verb suffix "le"

question words used in an indefinite sense

experiential guo

The shi…de… construction

verbs of locomotion

comparative forms

These linguistic structures will be applied to the following topics:

travel

study

work

Learning and teaching approach

In line with MFL communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include: pair work and group work; individual tasks (face-to-face and online); discovery and formulation of rules; work with texts, audio and video material to develop learning and communicative skills.

Preparation tasks and formative assessment tasks will give you the opportunity to revise and consolidate knowledge and skills and to develop an awareness of how to use language-learning tools independently. Tasks and independent study and support materials are set every week on the VLE to reinforce topics covered at your own pace. Feedback will be given for tasks submitted, to ensure you are supported to complete your work and are aware of assessment expectations.

Assessment

Coursework (15%): Mid-autumn term, task-based portfolio to be completed on the VLE by the beginning of spring term. This pack contains seven tasks in total, including listening; grammar & lexicon quiz; script practice; speaking; and reading.

Coursework (20%): Mid-spring term, task-based portfolio to be completed on the VLE by the end of term. This pack contains five tasks in total, including listening; grammar & lexicon quiz; script practice; speaking; and reading.

Examination (20%): In-class listening comprehension test at the end of spring term.

Examination (25%): 90-minute in-class test at the end of spring term. It will include a writing task (approx. 250 characters); grammar and lexicon.

Practical (20%): Oral exam (20 minutes), including an unseen practical conversation task, followed by general questions on topics seen in class (taken in the summer term).

Summative assessment consists of two portfolios, comprising a total of 12 coursework tasks, an in-class listening test and a written test at the end of spring term, and one practical i.e., oral, examination (in the summer term). Coursework and written/oral examinations all contribute to the final grade.

Feedback on pieces of formative assessment will be given within two weeks of all students having submitted their work.

ARABIC LEVEL 3

General competences

This module aims to:

Help you to develop existing skills in everyday language use through revision and consolidation

Extend your range of vocabulary, as well as more complex structures, and introduce more sophisticated constructions

Provide you with the opportunity to extend all your language skills (reading, writing, listening and speaking), to be able to communicate more confidently and understand, and respond to, standard speech and authentic material (adapted as appropriate) in Arabic

Equip you with the necessary tools for independent language learning.

Offer you an insight into a range of aspects of the culture and daily life in Arabic-speaking countries

Prepare you to progress towards higher language levels

By the end of the module, students should have reached approximately the B1+ level of the Common European Framework of Reference (CEFR).

To be eligible for this module, you need to have done one of the following:

Successfully completed Arabic Level 2

Gained an Arabic AS-level qualification

Already achieved A2+ or equivalent on the Common European Framework of Reference (CEFR)

Learning outcomes

On successful completion of this module, you will be able to:

Respond to the main points of standard speech on familiar topics relating to personal or work-related matters

Read and demonstrate comprehension of factual texts, consisting of standard and mainly high-frequency everyday or job-related language

Interact on topics that are familiar, of personal interest or pertinent to everyday life

Produce simple texts on familiar topics using Arabic script to narrate events, describe feelings, and express opinions

Demonstrate intercultural awareness and understanding of differences in social and everyday practices between own and target culture

Engage with a range of digital language-learning resources to support language development

Indicative core content

In this module, you will cover the following linguistic structures:

The negative particle ‘laysa’

Interrogatives and question words

‘Amma’ and ‘fa’ (as for ….)

Ordinal numbers

The prepositions ‘ilaa’ and ‘3ala’ + pronouns

Object pronouns

The subjunctive

Quantifiers (e.g. all, several, no one, each, every)

The adjectival sentence

The comparative and superlative: ‘af3al’ form

Conjugation of verbs with a vowel letter: (initial, medial, final)

Negation of the future: ‘lan’

‘Kaana’ and its sisters

‘Inna’ and its sisters

The jussive mood: ‘lam’

Verbs with doubled ending

Conjugation of ‘maa zaala’

Topics:

Daily activities and living with the extended family

The ‘family house’

Social clubs: ‘al-nadi’

Media Arabic

The weekend

Friendships and relationships

Personalities and lifestyles

A hotel guide

Life-changing decisions

Biographies

Working and studying abroad

Edward Said immigration and nostalgic feelings

Learning and teaching approach

In line with MFL communicative and active learning methodology, in-class activities cover all four skills (reading, writing, listening and speaking) and include: Pair work (dialogue practice, information gap exercises, discussion and collection of key terms/ideas followed by report to plenum); group work (discussion, creation of posters); individual tasks (presentations [with PowerPoint, as well as video uploaded to Blackboard]; discovery and formulation of rules; critical evaluation of texts, audio and video material. Homework tasks give you the opportunity to revise and consolidate knowledge and skills. This approach not only ensures you engage with a wide range of tasks, but also supports different learning styles.

All pieces of coursework are marked and returned within two weeks. Marking criteria and revision guidance (how-to guides) are included as needed with each coursework, to ensure learners are supported to complete their work and aware of assessment expectations. Detailed feedback is provided for each individual section of the coursework, giving the correct answer(s) along with suggestions for improvement. In addition to the number of points out of a maximum total, an overall percentage grade is given. Generic feedback on each individual piece of coursework is also provided in class.

Assessment

The module includes formative as well as summative assessment.

FORMATIVE: Homework tasks relating to grammar and syntactic knowledge and the skills of listening, reading, and/or writing are set every week on the VLE. Students are encouraged to complete the tasks to get feedback from the course teacher and familiarise themselves with the assessment expectations. Additional self-study materials and guidance are also available on the VLE to reinforce learning and allow students to develop at their own pace.

SUMMATIVE: You need to complete two pieces of coursework (one per term); two 1-hour timed assessments (tests scheduled at the end of autumn term and at the end of spring term); and one practical, i.e. oral examination (at the end of spring term or at the beginning of the summer term). Coursework and written/oral examination all contribute to the final grade.

Coursework (10%): Set mid-autumn term on the virtual learning environment, it consists of listening/grammar and writing (full task: approx. 200 words). Submission timeframe: 1 week.

Examination (20%): In-class test (hard copies will be distributed, and answers to be handwritten). This 1-hour test will take place at the end of autumn term. It will include reading, grammar task(s), and writing (full task approx. 300 words).

Coursework (10%): Set mid-spring term on the virtual learning environment, it consists of an in-class listening and speaking task on Microsoft Teams (7 minutes each).

Examination (20%): In-class test (hard copies to be distributed, and answers to be handwritten). This 1-hour test will take place at the end of spring term. It will include reading, grammar control, and writing (full task approx. 300 words).

Practical (40%): End-of-module Oral Exam (20 minutes).

ADVANCED CREATIVE WRITING

General competences

This advanced module in creative writing is intended for students who have a demonstrable interest in and appreciation of creative writing and wish to develop and refine their creative and critical skills and potential as writers. Your aim is to write fiction that engages a readership. Our approach is practical and technical with a particular emphasis on creative practice. We explore the creative process in lectures that are highly interactive, using contemporary novels, short stories and extracts from essays. You will share your writing with classmates in workshops, actively engaging in peer review and collaborating on creative problem-solving. You will be encouraged to make creative use of your own scientific knowledge and experience.

Learning outcomes

On successful completion of this module, you will be able to:

Acquire technical and composition skills in fiction

Present, receive and engage with oral feedback in peer review workshop

Refine critical analysis skills

Develop, progress and refine compositional skills

Indicative core content

Narrative form and purpose

Developing a creative practice: raising critical awareness of the creative process

Characterisation: investigating and developing psychology

Language and style

Worldbuilding

Narrative structure

Point of view

Autobiographically informed fiction

Presenting creative work for publication

Editing and revision

Opportunity to contribute creative and critical work to College publications

Peer review in creative writing workshops

Making creative use of your scientific knowledge and experience

Developing a critical vocabulary to discuss your own creative work

Learning and teaching approach

Term 1

Private study reading is discussed in class in term 1. You will participate in individual and small group exercises on composition which includes problem solving in fictional narratives and world building. You will also participate in an object exploration workshop for sensory awareness.

During term 1 you are required to read a maximum of 8 short stories of appropriate length which will be discussed in class. There is a recommended novel for the module which you are encouraged to read. Reading materials are selected from a long list on Leganto that is designed to inspire students to read short fiction, novels and critical works outside the required texts. You will have access to The New Yorker magazine to read contemporary fiction and essays.

Term 2

All students participate in two peer review workshops and in "speed dating" critical essay topics in term 2.

Generally, any guest lecturers on the module are asked to engage students in practical exercises (writers and Imperial academics) and deliver general feedback to you. When opportunities permit, you will be invited to attend cultural events/ lectures related to creative writing studies.

Summative assessments are submitted online through the module VLE. First marks and feedback are returned to you and will include a detailed written report on your work, together with annotations to your text. Feedback from one assessment is designed to feed into subsequent assessments.

Assessment

Coursework: Creative writing - 2,000-3,000 words (30%)

Coursework: Creative writing - 2,000-5,000 words (50%)

Coursework: Analytical essay - 1,000-1,500 words (10%)

Practical: Workshop participation mark (10%)

CHANGE MAKERS INDEPENDENT PROJECT

General competences

Follow up your own interests in a global issue, such as human sustainable development or environmental stewardship, with an extended independent project of your own design.

The Change Makers Independent Project is ideal if you have a particular interest in global issues and have an idea or topic of special interest that you would like to explore in some depth. The module consists of independent study, supervised by a Change Makers Teaching Fellow who will meet with you on a regular basis to discuss your progress. Your supervision will consist of some individual one-to-one meetings and some meetings with the whole cohort of students undertaking Independent Projects to share ideas and progress.

The topic and design of the project must be agreed with both your supervisor and the Change Makers Field Leader. You will be given guidance to help you define and focus your topic appropriately so that you can complete a rich and stimulating project. At the start of the module, you will be helped to develop a proposal that details the topic, your research question or objective and the mechanism by which you wish to complete your project and be assessed. You will be given lots of ideas and shown different examples of the types of work you could produce. However, if you have your own clear ideas, we will work to incorporate them fully into a project that meets the module description. You will develop your own timetable and meeting schedule in discussion with your supervisor and then begin work on your project.

Learning outcomes

On successful completion of the module you will be better able to:

Demonstrate systematic knowledge and critical understanding of your chosen topic.

Propose ways of investigating a real-world issue from a new perspective, utilizing your own skills, knowledge and expertise

Synthesise, evaluate critically and challenge information and arguments from a range of sources to produce an original analysis

Work in an interdisciplinary manner to produce work for assessment

Plan, monitor and review your progress as an independent learner, acknowledging the value of your own unique contributions to knowledge on your subject

Indicative core content

Topics are to be negotiated with individual supervisors and receive the approval of the Module Leader. There is broad scope for the topic, as long as you can demonstrate how it relates to global issues.

What happens in this module?

In this module you will learn:

How to ideate and execute an independent project

About a global challenge topic you feel passionate about

About critical theories and how they can be used as a lens to frame your research

How to incorporate feedback to improve your work

In this module you will do:

Independent, self-directed research on a global challenge topic of your choice

Peer review and brainstorming sessions with your cohort

Establish your own timeline and project deliverables

Something creative, of your own choosing, to expand, enhance or compliment your project

Produce a portfolio of work that explores your chosen topic and is unique to you

Learning and teaching approach

An active learning approach is achieved with the use of workshop sessions and practical activities to help you develop your ideas. You will conduct library and empirical research to support your understanding of your chosen topic. The module progresses with opportunities for self, peer and lecturer formative and summative evaluation and all feedback is provided within seven days and is dialogic in nature. You will be offered opportunities to reflect on the skills that you are developing and to consider how they might be transferable to your core studies. You will be encouraged to incorporate your personal experience and interests into your work, and will be supported to ensure that this is inclusive.

You will receive ongoing formative feedback on your progress and written feedback and provisional marks for your submitted assessments within two term time weeks of submission. Dialogic written feedback is provided for each assignment. As part of the feedback process, you will be asked to write a response to the feedback which is reviewed by the lecturer. In addition, you can sign up for further individual support if required.

Mapping the Sustainable Development Goals (SDGs) in this module

You choose the focus of your independent project. Therefore, you can address any of the seventeen SDGs in your project.

Also, we recognise the interrelated nature of the UN Sustainable Development Goals (SDGs) and do not consider individual SDGs in isolation. We adopt a systems-based approach that recognises their cross-cutting nature. Therefore, on this module, your research will be related to a number of the SDGs.

For example, in previous years, students have focused on the following SDGs with their choice of projects:

A project investigating ways of improving domestic air quality in the Global South:

SDG 3 on Good Health and Well Being (by researching potential for healthier air in people's homes).

SDG 7 on Affordable and Clean Energy (through recognition of the unaffordable and polluting nature of commonly used fuels).

SDG 11 on Sustainable Cities and Communities (by prompting consideration of cleaner and renewable energy).

A project critiquing the 'fast fashion' industry:

SDG 8 on Decent Work and Economic Growth (by evaluating the approach towards labour rights)

SDG 12 on Responsible Production and Consumption (through a consideration of waste and overconsumption).

SDG 5 on Gender Equality (by assessing the situation for female workers).

A project investigating plastic pollution:

SDG 12 on Responsible Production and Consumption (by exploring potential for sustainable use and disposable of materials).

SDG 14 on Life Below Water (through eradication of waste disposal dangerous to marine life).

SDG 15 on Life on Land (by ensuring sustainable waste disposal).

Assessment

Coursework: Independent Project Submission - see below (90%)

Practical: Course Performance - decided by your supervisor/s (10%)

Independent Project Submission - Overall submission equivalent workload of a 3000-5000 word essay. E.g. a written report (2500 words) and a ten-minute video (1000 word equivalent). There is scope for the analytical essay assessment to be partially substituted by an alternative form of assessment – i.e. a presentation, a poster or piece of artwork.

The Course Performance mark reflects the level of professional engagement you demonstrate with your supervisor when arranging and attending supervision meetings, responding to feedback that you are given and meeting deadlines.

CONFLICT, CRIME & JUSTICE IN THE GLOBAL ERA

General competences

This module will give you the opportunity to explore the conceptions and developments of crime and conflict in the contemporary globalised world and their difficult relations with justice.

We will discuss legal policy in the prevention and management of conflict and the evolution of warfare. Whilst war-related content will consider the impact of the twentieth century world wars as historical examples, there will be a strong focus on legal policy and the future of conflict in the digital era of technology and mass communication.

We will consider the proposition that the lines between war and crime are becoming increasingly blurred and consider the classification of conduct. We will analyse the construct of criminal offences and explore key issues in how they impact upon the rights, freedoms and protections of the individual.

The methodology will be highly interactive and problem-oriented. To this purpose, the learning materials will comprise academic writings plus journalism, fiction, TV and radio broadcasts.

Learning outcomes

On completion of this module, you will be better prepared to:

Critically assess the developments in conflict, crime and justice brought about by globalisation

Interpret and apply relevant findings and theories from different disciplines (e.g. criminology, law, sociology) and their practical relevance

Employ and critically assess relevant definitions, key concepts and theoretical frameworks and use them accurately in their analysis

Find, study and interpret academic sources and materials independently and use them to assess case studies.

Indicative core content

Topics covered will include:

International law and the categorisation of conflict

Disinformation and misinformation: social control and the online environment

Computerised systems, conflict, and the digital era

Artificial intelligence

World war in the twentieth century: the impact of generational trauma and lessons in strategies for peace

Legal policy and cyber dependent crimes: hacking and disruption of functionality of a computerised system

Legal policy and cyber enabled economic crimes

Harassment and crimes against the person in the online environment

Restricting personal freedom and offending behaviour: The justification and function of sentencing in criminal law

The impact of changing medical and technological advancements on legal philosophy and legal rights and freedoms

Autonomy of the person and the limitation and criminalisation of individual choice and identity

Learning basic legal skills.

Learning and teaching approach

This module is organised into three main parts:

Conflict, law, and digital technologies

Cybercrime and transnationalism

Justice, rights, and freedom of the individual

Each part of the module includes special skills sessions to complement your knowledge and assist you in the preparation of your assignments. At the end of the course, you should be able to understand key global developments in conflict, crime, and justice - especially those enabled by science and technology.

Active learning is essential for this module. Collective and interdisciplinary critical discussions are encouraged during each session through stimulating issues, case studies and scenarios. A number of practical sessions during the year will see you actively engaged in the learning process.

You will participate in several, specifically designed activities:

Law reform exercise: divided into groups of advisors to the Government and Parliament on a particularly problematic issue of criminalisation.

Mock trial: you could act as prosecutors, defence lawyers, judge, jurors, witnesses in a mock trial on a criminal case.

Research and writing-skills session: conducting research in small groups on specific legal or socio-political themes assigned by your module leader and then writing a draft structure for a possible essay. You would then self-assess the results of your exercise and receive feedback from your module leader.

Your learning will be augmented digitally in the following ways:

The module lead’s slides delivered beforehand via the VLE.

The slides alternate the theoretical explanation/discussion of certain issues with the showing of videos and pictures, to give you practical and concrete examples of the relevance of the issues.

Occasionally digital polling is used.

You can expand your knowledge through optional materials, which will also be helpful when writing your assessments. The reading materials are listed on Reading List (Leganto), accessible via the VLE. You will be introduced in class to library and IT sources/services to support your research.

This module uses an appropriate VLE, through which summative assessments are submitted.

Summative marks and feedback are returned to you, via the module VLE, within two weeks of submission. Individual feedback will include extensive comments from both the first and the second marker. They will focus on the strengths and weaknesses of each submission, and on possible ways to improve. General feedback will be also provided to the whole cohort via announcement on the VLE to outline the overall results and general issues. Feedback from the first assessment will inform the second assessment.

Additional formative feedback includes in-class feedback from your module leader on class exercises, and peer feedback on presentations and group projects.

Summative assessment and feedback will be returned with a disclaimer that marks may be modified by later markers or external examiners.

Assessment

Coursework: Problem-based exercise - 1,000-1,500 words (30%)

Coursework: Essay - 1,500-2,000 words (70%)

CONTEMPORARY PHILOSOPHY

Gen Embark on an interdisciplinary journey into 20th and 21st-century philosophy, focusing on meaning, representation, ethics, and Artificial Intelligence. The central topic is meaning: what does it mean for something to mean something? (Confused? …exactly!)

Explore analytic philosophy, ordinary language philosophy, and phenomenology, while delving into philosophy of language, existential phenomenology, and AI ethics. This course sharpens logic and reasoning, develops decision-making, encourages high-level debate, and fosters appreciation for diverse scientific disciplines. Through engaging discussions, interactive activities, and tailored content, deepen your understanding of contemporary philosophical methods and AI.eral competences

Learning outcomes

On successful completion of this module, you will be better able to:

Recognise and evaluate the relevance of philosophy to you as science and engineering students

Contribute to high-level debate on/appraise advanced topics, even when the problem exceeds your understanding

Develop and demonstrate sensitivity to differences between the skills of different scientific disciplines

Synthesise, explain, interpret and analyse texts and sources

Demonstrate ability to go beyond critical summary and generalise to a relatively mature defence of your own position

Indicative core content

Historical background to problems of contemporary philosophy

Sense and nonsense

The semantics/pragmatics interface

The Mind/Body problem. Knowing how and know that

Speech act theory

Language-games and forms of life

Determinism and free will

Phenomenology of consciousness

The ontological difference

The analytic of Da-sein

Modern existentialism

Applications of existential phenomenology

Analytic philosophy and philosophy of language

Ethics and Artificial Intelligence

Philosophy of AI

Learning and teaching approach

A range of fun discussion activities and language games/puzzles will be used to make learning active and uniquely interactive. Though you would benefit from some guided preparation for sessions, including videos or selected passages of text, you will be encouraged to regard the sessions themselves as the times when you study for the module. You will have the exciting opportunity to decide what you think, not told what to think, and will be awarded the time to do this in class, in addition to any private study after class. You will be warmly invited to respond to presentations from the module leader and to listen and respond to other students' responses. Content may be personalised each year based on student interest and knowledge, so you will have the chance to express yourself and suggestions are warmly invited during lectures.

Live teaching sessions will be augmented digitally in the following ways: there is a module VLE, augmented by the Imperial College Library reading (Leganto) list. This means that you will have all the materials you need available digitally and in accessible format. Interactive tools will be used to augment learning, particularly breakout groups/group discussion, polls etc. Podcasts (Philosophy Bites, In Our Time, etc.) and videos (YouTube, Vimeo) may be used. Panopto recordings of live sessions will be made available.

Contemporary Philosophy uses a VLE, with all materials available online, with digital and accessible versions provided; and summative assessments are submitted via the online portal. Feedback to the essay will be provided through Turnitin, with personalised feedback potentially, but not always, including one or more of the following, where available and relevant: individual comments on the text, overall appraisal of your work, a breakdown of the grade based on the available marking scheme, and suggested points of improvement (on a case-by-case basis).

Due to the very high degree of personalisation mentioned above, written feedback and expected turnaround of such will vary depending on the particular cohort and external feedback. Questions about one's own performance are always welcome. Please note that all marks are in the first instance provisional and can change at any point before they are finalised, through either internal or external feedback, including modifications of the grade or addition of extra feedback. Additional formative feedback includes in-class feedback from the lecturer, as well as peers, on class exercises/discussions.

Assessment

40%: Multiple-choice Question online problem sheet/test (MCQ). This test, taken at the end of Term 1, in the form of a problem sheet taken through Blackboard, can be taken multiple times and encourages deeper understanding of taught material.

60%: 1,500-2,000 word essay. Chosen from a list of set questions and submitted after Term 2, this essay is designed to consolidate your knowledge and provide an opportunity to develop your writing skills.

HUMANITIES PROJECT (YEARS 3 & 4)

General competences

The Humanities Project is intended for those students who have a particular interest associated with one of the areas covered by the Humanities and Social Sciences modules.

The module consists of research skills training and independent study, supervised by a nominated member of staff who will meet with you on a regular basis to discuss progress. Where students have research methods or topics in common, you might meet in small group tutorials.

The topic of the Humanities Project must be agreed with the supervisor and should be of sufficient scope and allow for appropriate depth of analysis for you to meet the learning objectives. Prospective candidates must supply a proposal that details the scope, the research questions and the timetable that sets clear goals for monitoring progress.

For creative subjects like music technology and creative writing, the essay may include an element of practice (e.g. a composition or a chapter) in which case there should be an adjustment in the word count expected for the analytical component of the module.

Restrictions on module selection: If you have taken the Humanities Project (Year 2) module in your 2nd year, you are not eligible to enrol in this module during your 3rd or 4th year.

Learning outcomes

On successful completion of this module you will be able to:

Formulate a research proposal

Draw together ideas from relevant subjects by producing a literature review

Organise a research plan for discussion with supervisor

Integrate concepts using self-directed primary and secondary research

Complete a writing plan for agreement with supervisor

Apply key concepts, research, and feedback to write an analytical humanities project

Indicative core content

You are generally free to propose you own Humanities Project topic, which will then be refined with input from individual supervisors and receive the approval of the head of field. You will be able to change your topic to an extent in term 1. By term 2 it is expected that you will have fully decided on your topic and approach.

Learning and teaching approach

This project is an independent piece of work which begins with relevant training and becomes increasing formulated and led by yourself.

Term 1

You will be given clear written and tutorial guidance in term 1 on topics such as introduction to research skills, ethics, literature review, timeline formulation, essay writing and results presentation. When possible these sessions will be delivered in a seminar format with other Humanities Project students.

Term 2

In term 2, you will embark on individual research, structured around individual tutorials and feedback. You can expect up to 2.5 hours contact time with your supervisor, which includes meetings and studying a draft of your work.

Feedback

Informal, formative feedback will be provided throughout, particularly in your individual supervision sessions. First marks and feedback are returned to you, via the VLE, within two weeks of submission. You will be notified if there will be any delay.

Assessment

You have a choice of final project assessment:

Coursework: Essay - 3,000-4,000 words (100%)

OR

Coursework: Creative work submission - variable length depending on media (65%)

Coursework: Essay - up to 2,000 words (35%)

The latter is generally more suitable for subjects with a creative component such as art or music.

PHILOSOPHY OF MIND

General competences

The module will explore a range of topics in the philosophy of mind, such as the nature of consciousness and thought, the nature of human action and the problem of determinism, the relation between mind (or mental phenomena) and body (or physical phenomena), and the possibility of artificial intelligence. You will gain a deeper understanding of the interplay between philosophical research in these areas and research across a broad range of scientific disciplines, such as neuroscience, life sciences, medicine and computing.

By comparing the work of thinkers as diverse as Dennett, Davidson, Putnam, the Churchlands, Fodor, Ryle, Wittgenstein and Heidegger, you will encounter and critically evaluate the cutting edge of modern thinking about the mind, and the issues that must be resolved before embarking on any scientific exploration of the mind.

Learning outcomes

On successful completion of this module, you will be able to:

Analyse the structure of some of the major debates within the philosophy of mind.

Communicate verbally and in writing the contrasting arguments in the philosophy of mind.

Use creativity and innovation in approaching practical and conceptual problems

Evaluate and analyse the relevance of complex conceptual issues to your area of degree study.

Select and use a range of sources to critically evaluate and compare the merits of philosophical positions through independent research.

Indicative core content

The basic structure of the mind/body problem.

The nature of consciousness.

Dualist theories of mind and modern versions of dualism.

Reductive Physicalism, such as Identity theory, Eliminative Materialism and Behaviourism.

Property dualism, Emergentism and Machine Functionalism.

The Computational Theory of mind has gained many adherents in recent years, so the module will look in detail at what must be the case in order for this theory to be true.

Questions about the nature of personal identity and what it is that makes a person the same person throughout their lives.

Action theory and the question of mental causation.

The free-will/determinism debate

Heidegger’s challenge to conventional thinking about mind and his claim that mind is embodied.

Wittgenstein and Ryle

The Internalist/Externalist debate

Philosophy of mind and neuroscience.

What is the nature of emotions?

Is artificial intelligence possible?

Learning and teaching approach

Discussion is built into the classroom sessions, both in small groups and as a whole class. All lecture material is debated and discussed in class. You will also be required to do preparatory reading that will be discussed in class, where you will be encouraged to test your ideas. Written assignments require you to do independent research beyond the lecture material.

There will also be various practical learning techniques, each designed to illustrate and develop specific topics covered during the module e.g. a blindfolded (where acceptable to you) exercise designed to illustrate phenomenological engagement and focus.

Summative assessments will be submitted through the module VLE. You will receive written feedback via the VLE on your individual essays, as well as tutorials on essay technique and how to research and plan a discursive essay. The feedback from your Term 1 essay will be designed to support your development for your Term 2 essay. Extensive support materials on essay writing will also be provided through the VLE.

Assessment

Coursework: 1500-2000 word essay due after the end of term 1 (40%)

This assessment has a lower weighting than the later essay of the same length, as it comes early in the course and you may not yet have much subject experience

Coursework: 1500-2000 word essay due after the end of term 2 (60%)

This assessment has a higher weighting than the prior essay of the same length because it comes at the end of the module and so will better evaluate your summative learning

PSYCHOLOGY OF PERFORMANCE

General competences

Do you want to perform at your best? To understand how the greats in business, science, music, sport, medicine, theatre, and countless areas achieve what they achieve? This module will lead you through the latest science examining what it means to perform at the highest level. Looking across disciplines, we will examine the psychology behind leadership, teamwork, motivation, creativity and, very importantly, the psychology of relating to self. We will question whether 10,000 hours of practice is really all it takes to become an expert. We will explore how performance is assessed and valued, and how unconscious biases can affect judges. We will confront the dreaded stage-fright, and how it can be managed. Throughout the module, you will be given the opportunity to experience and reflect on your own performance.

Learning outcomes

On completion of this module, you will be better prepared to:

Critically evaluate the efficacy of, and scientific evidence underpinning, approaches to performance in your domain

Compare your areas of performance with others, assessing parallels and differences

Plan concrete steps to enhance your own performance (including communication and collaboration) based on evidence and best practice

Design and produce high-impact individual and team performance.

Indicative core content

The Road to Excellence: Gifts, talents, and the social and psychological antecedents of expertise. Role of emotions & emotion regulation in optimising excellence

Under Pressure: The psychological bases underlying – and strategies for the management of – performance anxiety and stage fright

All for One: The psychology of teamwork, including the drivers of effective leadership and team building

Assessing the X-factor: Defining the quality of a performance, how it is assessed, and how an audience's biases affect their perception

Taking Centre Stage: Group Coaching in preparation for Group Presentations.

Performance as Communication: Practicing and experiencing group performance with guided feedback.

Effective Practice: Experiential Learning and Goal Setting.

Seeing the Big Picture: The psychology of attention and focus influencing performance in complex environments

The Empowered Performer: The role of affect and emotion in the preparation and delivery of performance

The Embodied Performer: Addressing the role of embodiment and coherence in (lived / embodied) performance

The Creative Performer: Perspectives on creativity, how it is measured, and how the public responds to and evaluates creative products.

Learning and teaching approach

The module employs a variety of teaching strategies to facilitate active learning. Within teaching hours, approaches include group discussion, debate, and reflection as well as subject-specific experiential learning activities such as acting as a competition judge panel and self-discovery tasks (such as psychometric mapping of signature strengths).

For independent study, you are given discussion questions with the session notes for each session and given take-home assignments to prepare for forthcoming sessions (e.g. find an online recording of a performance in a discipline you know nothing about that moves you).

Assessments are designed to be active in nature, encouraging you to go beyond the materials and concepts learned in the sessions and apply them to tasks that reflect real-world scenarios (e.g., presenting, and performing in groups).

This module will be digitally augmented in several ways:

Performance examples are provided in a variety of contexts.

Videos are used within sessions to promote structured observations and class discussions.

Seminar notes, required and suggested readings, and instructions for take-home assignments are disseminated through the module VLE.

Summative assessments for this module will be submitted through an appropriate VLE. Marks and constructive feedback will be returned to you via the VLE. Ahead of the group presentations, you will receive bespoke coaching and formative feedback on your presentation content and style that can be used in your assessment. Ahead of both written assessments you will be given the opportunity to seek clarification and pose questions during the class.

Summative assessment and feedback will be returned with a disclaimer that marks may be modified by later markers or external examiners.

Assessment

Coursework: Group presentation (15 minutes) (40%)

Coursework: Reflective commentary (1,800-2,000 words) (60%)

HISTORY OF SCIENCE, TECHNOLOGY & INDUSTRY

General competences

This innovative module situates the histories of science, technology and industry within global history, from ancient times to the present day. The concepts of historical time, social and economic development, and even progress, will be examined throughout. Continuity, change and the diffusion of knowledge and practices are central themes.

We will cover a variety of activities, such as innovation, research, development, production, distribution, maintenance, and disposal. In so doing, we'll draw on a diverse array of historical sources and research gathered around themes such as power, control, empire, (de)globalisation, autarchy, logistics, gender, organisation, and work. The module considers older social science thinkers such as Marx, Weber, and Foucault, as well as more recent commentators.

Learning outcomes

By the end of this module you will be better able to:

Examine key concepts across the discipline of history, science and technology

Explore concepts using self-directed primary and secondary research

Integrate concepts studied, research, and feedback received

Communicate relevant academic concepts and findings in at least two formats

Indicative core content

Historical continuity and differences in science and technology

Science in medieval China

Islamic and European science in the Middle Ages

European discovery and the role of scientific thinking in early colonialism. Indigenous science and technology

The industrial revolution in Europe

Population and history

Science, improvement and empire

Science, authority and the Enlightenment

Mass production and the 'American century'

Big science in the Cold War

Development in the Cold War

Counterculture and science studies

Globalisation

Tacit knowledge, organisational behaviour and memory decay

Futures, forecasting and decision-making

Public uses of history

Historical research challenges

Learning and teaching approach

This module is designed to develop your skills and confidence as an independent analyst and researcher. In terms of assessment, it builds in complexity from an essay chosen from a set list, to a presentation on a subject of your choice, to a final written project on that subject.

Most classes include discussion time, organised group discussions around both pre-set and in-class reading. In some classes we undertake paired/group activities such as source identification, research in secondary literature, and presentation of findings to peers and the module leader. Some summative assessed group work such as research, and essay and presentation planning, will be conducted in structured class time to ensure fairness and effectiveness.

In-person sessions will be augmented digitally as follows:

The module VLE will be used for making readings, slides and handouts available to you: everything is available from the start of the module

Documentaries will be made available to you, and videos are used in the class for you to watch and analyse historical documentaries and re-enactments

We record teaching sessions to enable you to revise in your own time, and to foster inclusive methods in case you cannot attend any given session

Deploy digital technology into learning and teaching, such as using Mentimeter for polling your responses to scenarios presented

This module uses a suitable VLE for submission of summative assessments, through which your feedback will be delivered. Feedback from your first essay, in term 1, will be designed to feed into your term 2 assessments. Given that your presentation and second essay form part of the same project, feedback on your presentation will aid you both in your presentation skills as well as developing your final written project.

Assessment

Coursework: Essay - 1200-1500 words (30%)

Practical: Individual 5-minute presentation (15%)

Coursework: Essay - 1500-2000 words (55%)

SCIENCE, POLICY & POWER

General competences

With guest lecturers from Silicon Valley, politics, think tanks and activist groups, this module explores the intersection between science and policy using multidisciplinary methods.

We explore the question of why policy does not always 'follow the science' using case studies where science and policy interact such as abortion law, stem cell research, AI development and climate change, looking at the balance of power between the media, public opinion, social norms, and scientific evidence.

We also take a deep dive into innovation policy. How do governments and companies foster innovation in science and technology? What is the secret sauce that has made Silicon Valley so successful?

This module is taught interactively, requiring students to be engaged and active throughout, whether verbally or in a support role. Two sessions are completely student led.

Learning outcomes

On successful completion of this module, you will be able to:

Appreciate the role played by social and ethical values, alongside scientific evidence, in evidence-based policy making.

Use self-directed primary and secondary research to inform debate on key science funding issues.

Summarize complex scientific research and adapt it to the needs of policy makers.

Analyse science policy topics and persuasively communicate complex concepts

Indicative core content

In this module you will learn about the relationship between government and science. We will cover the Haldane principle, multiple streams theory and the roles of the scientist in forming policy. Important theorists covered include Roger Pielke Jr and JD Bernal. We will study both policy for science and science for policy. This will include in depth analysis of funding and 'innovation' policies from various governments and companies. We will also interrogate a variety of case studies analysing the use of scientific evidence to form policy and how various actors utilise rhetoric around scientific evidence. We will use the tools of ethics, media studies, philosophy and policy studies to analyse a range of case studies which may include scientific and political controversies such as BSE, badger culling, pandemic response and drug policy. Particular areas of interest include, how media, public opinion and activism can influence policy and how scientific uncertainty and risk are treated by various actors.

Learning and teaching approach

Teaching and learning will be interactive and will involve lots of group and class discussions and activities, hypotheticals and a simulated 'British Parliamentary Rules' debate as well as some excellent guest lecturers, from activist groups and think tanks. Case studies will be our primary route into theoretical approaches to policy. We will make use of podcasts, YouTube videos and documentaries as well as primary and secondary written sources. Where possible, these will be available on the module

VLE. There will also be room for student-directed learning within the module. In the autumn term, students will direct part of a lecture on Brexit and in the spring term a lecture is left free for you to suggest a topic, which will be worked on collaboratively between the lecturer and students.

Formal feedback for your assignments (from first and second markers) will be available on the VLE within two weeks of submission. You will also receive feedback for your work verbally, by email and on the VLE where appropriate.

Assessment

Coursework: Science briefing - 1,000 words (30%)

Coursework: Analytical essay - 2,000 words (50%)

Practical: Module performance (20%)

Contribution to all activities on the 20-week module are assessed in four core areas:

- Contribution to online research tasks

- Contribution to class and group discussions

- Contribution to a formal debate

- Contribution to short informal class presentations

MUSIC TECHNOLOGY (YEAR 3 & 4)

General competences

The Music Technology module offers you the opportunity to compose and create electronic music using state-of-the-art equipment.

The practical aspects of the module are embedded in a theoretical and analytical framework which encourages critical evaluation of contemporary music and its associated technology and an appreciation of the contributions made by the pioneering users of this technology.

The module combines skills acquisition with a high level of scholarship.

Learning outcomes

On successful completion of this module, you will be able to:

Employ a wide range of music technology and compositional core skills.

Critically reflect on the cultural context in which these technologies were applied in the past, and are applied today.

Critically analyse musical repertoire.

Present creative ideas and judgement.

Demonstrate the ability to work both independently and as part of a group.

Indicative core content

The cultural contexts in which music technologies have been applied since c.1948

The theory and practice of audio/MIDI sequencing

Physics of sound, human hearing and the basics of psychoacoustics.

Digital audio, the audio interface and digital audio formats.

The theory and practice of sound synthesis.

The theory and practice of sampling: sample manipulation, using found sound, creating sampled instruments.

The theory and practice of sound capture

Specific production techniques such as compression, equalization, reverb and delay

Creative production techniques such as side-chain compression, bit reduction, saturation, resampling.

Compositional analysis: noise, silence, Musique Concrete.

The studio as a musical instrument.

Interrogating assumptions about modes of musical production, genres, styles and audience expectation, in order to focus compositional intentions.

Developing aural sensitivity and compositional assurance by the practice of active, analytical listening.

Exploring approaches to arrangement and compositional structure.

Learning and teaching approach

Most sessions will include a time for you to individually or in pairs and work towards the completion of a specific given task, to freely experiment the new techniques and skills learned in that session or for self-directed work. Some sessions will include Problem Based Learning tasks where you are required - at the start of the session - to undertake a task through which you figure out what skills you need to learn in order to complete it.

We deploy an array of digital tools in this module:

We use Spotify Playlists as a teaching and learning tool.

We use the Ed Discussion tool to encourage your engagement.

We allow and encourage you to borrow equipment such as midi keyboards, portable recorders and microphones, so that you can work independently outside the music technology lab.

Feedback

All summative assessments are submitted through an appropriate VLE.

At the start of the Spring Term, students receive written feedback in the VLE on their Work-in-Progress composition (their first submission) and this feedback is intended to inform their work on the completed version of the same composition, which they are expected to submit as one of the two compositions in their Final Portfolio - which is submitted at the end of the Spring Term.

It is permitted to submit two new compositions in the Final Portfolio (i.e. not completing the work-in-progress composition), as long as the student justifies this decision in the write-up of the Final Portfolio.

Assessment

Coursework: Work-in-progress portfolio - 1 composition of 3-5 minutes plus pdf write up 300-600 words (10%)

Coursework: Final portfolio submission - 2 compositions of 3-5 minutes plus pdf write up 600-1200 words (60%)

Practical: Individual contribution to a 5-minute group presentation (20%)

Practical: Participation based on constructive class contribution, good teamwork, good preparation, respectful use of equipment and facilities (10%)

CONTEMPORARY THEMES IN GLOBAL POLITICS: POPULISM, IDENTITY & INEQUALITY

General competences

From international relations, globalisation, demography and populism, to the politics of religion and identities, this module will introduce you to core areas of debate in the study of contemporary societies the globe over. The module will provide insight into how these themes impact international relations and policy, and how these tensions often stem from, and can exacerbate, intra- as well as inter-group conflict.

You will study and debate the ways that analysts research these issues through examining and using different social research methods, working in groups within the seminars to design a research project examining aspects of global politics. In so doing, the module supports your development as an independent, engaged analyst capable of designing research projects, embracing new software and open data techniques, as well as adapting to future research challenges.

Learning outcomes

On successful completion of this module, you will be better prepared to:

Engage with a variety of approaches of exploring global political issues and international relations.

Synthesise a range of relevant frameworks.

Develop skills in sourcing relevant empirical data.

Design and conduct a social research project using appropriate methods.

Collaborate effectively with others to complete a group project.

Indicative core content

Module topics will include:

Populism in global contexts.

Theories and practice of nations and nationhood and political sovereignty.

Theories of global political conflict, such as the ‘Clash of Civilizations’ and ‘soft power v. hard power’ theses; tensions in identities such as national v. ethnic, or cultural cleavages.

The shifting bases of power and negotiations within intra-state relations and relations between states and global institutions.

Different approaches to identities within societies, such as secularism and multiculturalism.

Notions of ‘the global’, globalisation and de-globalisation.

Introduction to social science research techniques and options - literature reviews, qualitative and quantitative data production and analysis.

Writing research and policy reports.

Learning and teaching approach

The learning and teaching approach throughout the module is collaborative and interactive, with in-class discussion built into every session. This becomes explicitly self-directed in weeks 13-20 of the module when you'll devise, design, execute and write-up a political science research project of your own choosing. For these weeks, the learning and teaching approach is intended to facilitate your research through providing resources, an overall structure and ongoing formative oral feedback week-to-week as the project progresses.

You will receive written summative feedback on your written essay via the module VLE within 2 weeks of submission. You will receive written summative feedback on the group research project via the module VLE after the end of the module. Formative assessment is provided through classroom group and individual feedback on a session-by-session basis. You will also receive specific and structured ongoing in-class oral formative feedback during the development of the group research project in weeks 13-20 of the module. Summative assessment and feedback will be returned with a disclaimer that marks may be modified by later markers or external examiners.

Assessment

Coursework: 1,500-word essay (50%)

Coursework: 2,000-word group research project (50%)

COLLECTIVE INTELLIGENCE: THE PHILOSOPHY AND PSYCHOLOGY OF THINKING IN GROUPS & CROWDS

General competences

No one thinks alone; it is always something we do in groups. But how do we think together and collectivise our mental resources to the best effect? To answer this question, we will need to draw on a huge range of disciplines: history, politics, economics, psychology, neuroscience, science-fiction and even entomology (insects also do a lot of collective thinking).

There are lots of groups in which you can see a common mind or collective intelligence at work: packs, swarms, herds, tribes, corporations, colleges and classrooms, markets and governments. Ever increasingly, the job of connecting our individual minds up together has been taken on by technology and the networks of information that wire us up together. Very soon we may see super-intelligent technologies taking-over the job of organising human society altogether.

This module will take you through the debates around collective intelligence and follow the evolution of the group-mind from past to present and on into the future. We will be looking at how the act of thinking together can go wrong in paranoid conspiracy theories, information bubbles and market panics and how, perhaps, it might be done better.

Learning outcomes

On successful completion of this module, you will be able to:

Analyse structures of collective thinking in a wide variety of different social and historical settings: organisations, corporations, colleges and classrooms, markets, governments, nations, and insect swarms

Identify and evaluate optimum social arrangements for collective reasoning

Assess the impact of different forms of communication technology on public knowledge and public discourse

Apply this understanding to create forecasts of possible and likely effects of forthcoming developments in technology

Indicative core content

Crowd

How public opinion is formed

How hierarchies of knowledge contrast with distributed networks of knowledge

The madness of crowds vs. the wisdom of crowds

Some early history of the World Brain idea in H.G. Wells and Stafford Beer

The role of information networks, platforms and algorithms in shaping public knowledge and opinion

How human communication systems compare to other biological information systems

The emergence of AI in human organisation and public discourse and its implications for the future of government and society

Learning and teaching approach

All classes will feature collective discussion time prominently. We aim for a 2:1 discussion to lecture time ratio if not more. Classes will feature frequent smaller group discussions to allow you to develop ideas with each other and develop learning relationships. You will be frequently on your feet recreating experiments, mingling and exchanging information with each other.

The module takes as one of its primary fields of study the different media and channels through which we gain information. We will thus be looking at a whole range of different digital sources – though always with a sceptical eye regarding their potential hazards. All lectures will be recorded for you to go back to in your own time. An abundance of module materials, further literature, examples for discussion, and lecture slides will be made available through Blackboard. We also make use of the 'discussion' function on the module VLE where you can carry on the discussion after class has finished. Also on the VLE there is a 'wiki' function where you can create multi-authored documents which can act as an interesting demonstration of collective intelligence at work which is part of the module subject matter.

Summative written assessments are delivered via the Virtual Learning Environment and you are given extensive feedback through in-text commentary and three or more paragraphs of overall feedback. These cover both your understanding of the module materials and your writing technique. Feedback on oral presentations will be given both by the module leader and by your peers.

Assessment

Coursework: Essay - 1500- 2000 words (50%)

Practical: Individual 10-15 minute presentation (50%)

MANAGEMENT AND DECISION-MAKING: MAKING SMART DECISIONS

General competences

The module is designed to equip you to make effective decisions in a wide variety of contexts. The primary context will be in the workplace, whether that be in the private, public or third sector, including government. Many of the methods covered will also be of service in your private lives.

Emphasis will be given to broad approaches to decision making, such as Systems Thinking, the PROACT method and understanding common psychological biases in decision making. This will enable you to be intelligent about the process by which decisions are arrived at.

In addition, several central decision making tools will be explained and evaluated, which can support effective decision making within the framework of a well-designed decision process.

Learning outcomes

On successful completion of this module, you will be able to:

Select and use appropriate systems methods to address complex issues

Select and apply appropriate decision support tools

Critically evaluate alternative solutions and strategies for addressing complex problems

Integrate concepts and ideas from your wider knowledge and viewpoints in a coherent fashion to address real world problems

Undertake independent, critically analytical and reflexive research

Indicative core content

This module will cover the following broad topic areas:

Total Quality Management

Systems thinking and key systems methodologies

Decision analysis tools including investment appraisal methods, cost-benefit analysis, multicriteria decision making, scenario planning, risk appraisal and the incorporation of risk and uncertainty, game theoretic tools and decision trees

Decision support systems and the use of expert systems and AI in decision making

Psychological biases in decision analysis

The political aspect of decision-making in organisations

Ethical principles in decision making

Learning and teaching approach

This module will be taught by a series of interactive lectures, which will introduce and reinforce key frameworks and methods. Class time will also include individual and group work on key questions and use of methods. Individual consultations on coursework projects will be made available to you. You will learn by guided independent reading. Initial assessments will be a mixture of formative and summative, leading to a summative and integrative coursework project, which may be an extension of either individual assignment 1 or 2, incorporating feedback received.

You will be given individual and all group feedback on each assignment. In the first instance this feedback will be written, delivered via the VLE and you will have an opportunity for face to face feedback on request. Feedback on assignments 1&2 will give advice relevant to later assignments.

Assessment

Coursework: Individual written assignment - 500 words (20%)

Coursework: Individual written assignment - 500 words (20%)

Coursework: Individual coursework project - 2500 words (60%)

GLOBAL ECONOMICS

General competences

Global economics is a key contemporary topic, which also bears on a range of pressing political, social and environmental issues. This module provides a comprehensive treatment of the key contemporary issues in global economics and the leading models deployed by global economics institutions such as the WTO, United Nations, IMF and World Bank, as well as by global companies.

It will equip you with the conceptual tools to analyse global economic environment of business, both from the corporate and public policy perspectives. The module also provides an opportunity to conduct policy analysis of a global economic issue.

Learning outcomes

On successful completion of this module, you will be able to:

Explain the key issues in global economics

Apply economic analysis tools to a rapidly changing landscape of international business and produce recommendation for business strategy

Apply theory and principles to analyse a key policy issue and produce a reasoned recommendation for policy intervention

Present individual work to peers and respond to constructive feedback from facilitator and other learners

Indicative core content

What is global economics and why does it matter?

Key debates in global economics

Global economic landscape and business strategies

Determinants of economic growth

Stabilisation policy. Monetary and fiscal policies. Domestic and foreign debt

Currency and exchange rate policies

Global economic integration

Industrial policy and trade policy

Global digital economy and its development

The international trade and monetary system including the WTO, United Nations, IMF and World Bank

The economics of population growth

Poverty, inequality, and social welfare

Sustainable development and the environment

Key challenges in the current global economic environment

Learning and teaching approach

The module will be taught by a series of interactive lectures, which will introduce and reinforce key frameworks and methods. These lectures will incorporate workshop activities, group discussion and videos. Individual consultations on coursework will be made available. You will learn by guided independent reading.

Module presentations will be marked live using bespoke marking software, with feedback provided through that software. Summative essay assessments will be submitted via the module VLE. Written feedback for essays will be suppled to you via the module VLE.

Assessment

Summative assessments are an opportunity for you to take an in-depth look at a real world policy issue, including a review of the literature and clear policy and/or business recommendations.

Group presentation (10-min) and participation in a classroom debate on a specific global economics issue (arguing for or against a policy/view). Group report (12-15 slides), comprehensively consider the policy/view from both perspectives (40%)

Individual report (up to 2,000 words), analysing an global economic issue with a critical review of policy options or analysing an issue in the global economic environment of business with a review of business strategy options (60%)

The report is intended to be integrative of the material in the module and at the same time providing an opportunity to focus on issues central to your growing interests.

PRACTICAL ART: 3D OBSERVATIONAL DRAWING

General competences

This innovative, hands-on drawing module teaches approaches to investigating space in paintings and drawings through practical exercises, drawing from the works of past artists and drawing from life.

When most people initially approach copying or drawing from life it is often to employ such ideas as classical perspective, such as 1-point or 2-point perspective used in technical or architectural drawing. This can have the effect of becoming technically measured, photographically precise or even cold, with drawings lacking sensation or feeling.

In contrast, this module will instead deploy alternative approaches to investigating line, tone and space that allows for a playful, individual approach to thinking about drawing on a flat surface. By drawing from life alongside looking at how artists embraced the flat surface of paper, you will get your hands dirty. Moreover, you will understand the physicality of drawing in a new way, with the goal of changing the way you think about how space in drawings works, and how you see the world around you.

Learning outcomes

On successful completion of this module you will be better able to:

Identify and evidence (through drawn outcomes) understanding of drawing processes and how they interlink with, and inform, one another

Demonstrate an understanding of core foundational ideas around observational drawing (materials and subject matter)

Evidence an understanding of drawing from historical works through your development across the module

Reflect critically on your practical drawing work in class via evidencing personal development through your personal sketchbook.

Indicative core content

Through a focus on drawing, you will examine ideas and approaches to creating the illusion of space on a flat surface (also known as the picture plane). By examining and breaking down historical images by artists of the past we will gain a deeper practical and academic knowledge of what these artists were doing and how they were doing it, what they were looking at and how they responded and even the similarities in these artists work even though they may be separated by decades. Alongside this a development and understanding of drawing from life through practical approaches shall inform your own unique outcomes and insights in drawing. Considering ‘good’ or ‘bad’ drawing will not help us and only serves to create a concern for being ‘correct’, instead we shall take the position that everyone’s drawings are of worth as they tell us how they experience the world! What we can gain is confidence and an ability to play and take risks, to risk failure and find opportunities and insights in our drawings. To this end, we shall consider a series of approaches to drawing toward visual problem solving. We shall remove ideas around classical perspective drawing made famous by the Italian Renaissance and instead

consider the how marks, lines and flat shapes or ‘planes’ related to the edges of the paper to create exciting, sensorial, spatial drawings that our eyes move around and through, which some have suggested is closer to how we experience space in the real world. In considering these dynamics we will gain a new appreciation of how drawings and paintings can work and how, through looking intensely at them and the world around us, they can be ‘unlocked’ and opened.

The module will include:

Copying past artists’ work

Drawing from life

Re-evaluate how we approach line, form and tone

To look at how flat shapes and forms in drawings can relate to one another to create light and space

A self-led sketchbook in which to draw outside the workshops to embrace mistakes and increase confidence

Learning and teaching approach

This practical drawing module is primarily designed to increase your confidence and skills in drawing.

Anyone can draw! You can only embrace how you draw rather than try to be somebody else. Development (as opposed to a style) in drawing is achieved through an historical understanding alongside practice and application. This module will combine both toward a deeper experience in how you think about images and how they work.

Each session will focus on a specific idea or process such as line/contour, tone, composition, speed and so on. In this way the complexities that observational drawing entails will be broken down into 'bite size' elements, separated from one another. As the module progresses these individual processes will be combined. First, it may be line with elements of tone, then bringing in touch or sensation, then applying those to ideas around copying artists work or drawing from still life. In this way you will be able to identify your learning and understanding toward assessment on which you can reflect, considering how you’ve gained a deeper understanding of how you might approach drawing and the value derived from the experience.

Drawing materials will be provided and each session will employ a combination of practical exercises and historical references either on screen or printed out. Comparisons of work will allow students to learn from each other, encouraging further risk-taking and insights towards boosting confidence.

You will be provided with a sketchbook and encouraged to continue drawing between sessions to ‘keep your eye in’. Over the weeks this will support you to gain confidence in your drawing and greater hand to eye co-ordination to develop as well as considering the ideas from the sessions. Your progress in the sessions across the module will be evidenced through submission for assessment in the form of a Personal Development Blog and a selection of images you have made. This will be done in two stages, once before the Christmas break and once before the Easter break. This will allow a mid-way point to give context to your leaning and a final assessment of your work.

Assessment

Practical: 4 Drawings/Sets of drawings (30%)

Coursework: Personal Development Blog – 1,200-1,300 words (40%)

Practical: 4 Drawings/Sets of drawings (30%)

LEADING TEAMS & ORGANISATIONS

General competences

Module Description

It is widely recognised that there is an increasing need to equip you, as students, with soft skills that complement hard skills or technical skills required for a job you are trained to do. Soft skills fulfil an important role in shaping individuals and improving their performance at work. Working with others, leading teams, making unbiased decisions, and managing conflict are some of the soft skills that are relevant in the workplace. Developing soft skills can greatly contribute to not only enhancing existing expertise but also achieving career goals while increasing job satisfaction.

This module will help you answer a number of questions: Why do some leaders prove effective, while others do not? Is it good to have conflict in teams? How can social networks help organisations or individuals achieve their goals? It is based on the premise that effective leadership requires an in-depth understanding of both yourself and how organisations work. It will provide you with tools to get work done effectively with and through others.

The module focuses on two aspects of managing and leading organisations: First, we explore how to influence and motivate others to get cooperation for your own goals. Topics include negotiation, leading and managing teams, motivation, and personality. Second, we explore the organisational systems that coordinate individual work to meet business objectives and the impact of technology (e.g., artificial intelligence) and new business models (e.g., gig economy) on how we work.

Learning Outcomes

By the end of this module, you will be able to;

- Demonstrate self-awareness of your own individual personalities, motivation preferences, and negotiation and leadership styles.
- Use analytical skills to identify, diagnose and evaluate key organisational issues.
- Practice behavioural skills that will improve your effectiveness as a leader.
- Work productively in a team situation to produce a team assignment.

Module Content (this structure may vary slightly)

Weekly topics:

• Session 1: Introduction to Leading Teams and Organisations

• Session 2: Personality and Individual Differences

• Session 3: Leadership and influence

• Session 4: Meaning and calling at work

• Session 5: Organisational culture

• Session 6: Motivating individuals and teams

• Session 7: Working in Teams

• Session 8: Negotiations

• Session 9: Conflict Resolution

• Session 10: Group presentations

Teaching Methods

This is a hands-on module designed to provide you with feedback about yourself as a person and as a leader. There will be exercises to help you learn more about your personality and your personal strengths, as well as simulations that give you experience with negotiation and leadership. The class format of discussions structured around cases or videos means that there is also opportunity for debate and engagement.

Assessment

The module will be assessed by:

• Individual weekly in-class tasks - 10%

• Group Coursework - 30%

• Case Study Analysis - 60%

DIGITAL INNOVATION IN CONTEXT: STAKEHOLDERS, COMMUNITIES AND CONSEQUENCES

General competences

The module aims to introduce you, as a student with a STEMM (Science, technology, engineering, mathematics, and medicine) background to the theories and concepts from social sciences and especially the area of Science and Technology Studies (STS), which is concerned with the the relationship between scientific knowledge, technological systems, and society. You will be able to engage in co-creation and responsible innovation in the areas of Artificial Intelligence (AI) and Robotics and analyse consequences of these technologies in their economic, social, and political contexts. You will also be asked to apply the theoretical insights to real applications, case studies, and ongoing projects at Imperial College or with partners from industry.

You will learn about the political, cultural and social effects of Artificial Intelligence and Robotics. You will discuss the democratization of these technologies as well as the ever-pressing question, who is responsible for this technology? You will work with a group to delve into these subjects, as well as work independently.

Learning outcomes

By the end of this module, you will better be able to:

Understand and apply the main concepts of Science and Technology Studies (STS),

Discuss the different perspectives on co-creation and responsible innovation,

Debate the intended and unintended consequences of innovation in robotics and artificial intelligence,

Assess the value of inclusion of external users in their design and testing

Apply co-creation to case studies and to the design of AI and Robotics solutions/innovation.

Indicative core content

The module will introduce you to the following theories and concepts from social sciences:

Social dimensions of technology

Empathising vs configuring the user

Democratizing innovation

Innovation governance and responsibility

Challenges of co-creation at the public/private interface

How do technologies become shaped by social, economic, and political influences and why is this consequential for our engagement with AI/robotics innovation?

How do technologies enable and constrain processes of organizing?

How do crowds and open sourcing influence digital innovation?

How does digital innovation differ in public and private sectors?

How do we design with stakeholders in mind to achieve more effective and sustainable outcomes?

Learning and teaching approach

The course will combine theory and practice. After each lecture on theory, we will ask you to work in groups under the supervision of a tutor who will guide you with the use of brainstorming platforms and observations of the design and testing of robotics or artificial intelligence solutions.

Peer review and informal suggestions from the instructors will happen in a live session 75% of the way through the module (ungraded). The group projects and individual essays will be marked with feedback and returned within ten business days of the due date.

Assessment

Practical:

Group presentation (50%)

Coursework:

Individual short essay assignment (1,000-1,200 words) (50%)

BUSINESS STRATEGY

General competences

Module Description

The goal of this module is to learn the fundamentals of how to manage organisations strategically. Business strategy asks the central question: why do some companies succeed while others fail? The module will provide you with the concepts, principles, frameworks and methodologies necessary to analyse and understand how to formulate and implement the appropriate policies and strategies for a firm. In order to do so, you will be taking a general management perspective in this module and will think of how each action, decision or event will affect the firm as a whole. By the end of this module, you should be able to apply module concepts to analyse firms.

Learning Outcomes

By the end of this module, you will be able to:

- Analyse, appraise, and interpret the external and internal environments of various types of firms
- Outline the current strategic position of firms and identify the key strategic challenges they face
- Apply concepts and frameworks to discover strategic options
- Produce appropriate future strategies for firms to respond to their challenges and opportunities

Module Content

The module covers key concepts and frameworks relating to business strategy and corporate strategy, including:

- An overview of business strategy, including different strategy "lenses"
- Industry analysis, complements and business ecosystems
- Competitive response
- Resources and capabilities and strategic fit
- Generic strategies and dimensions of competitive advantage

• The stakeholder view of strategy and the UN SDG impact on the business environment

• Industry evolution and change

• Corporate strategy, including vertical integration, diversification, M&A and alliances

• Global strategy and internationalisation

The module will include case studies and real world examples to illustrate how the theory can be applied to generate insights and formulate strategy.

Teaching Methods

Teaching is delivered by 10 x 2 hour sessions. Sessions will normally be based on a combination of lectures, class discussion, guest talks and case study analysis. This approach encourages the achievement of the various module learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the learnt theory and concepts and how these can be applied to real-world contexts.

Assessments

The module will be assessed by:

• Group Project 30%

• Final Examination 70%

CORPORATE FINANCE ONLINE

General competences

Module Description

This module is an introduction to financial markets. We first want to understand the role that financial markets play in the economy; the role of financial intermediation. Financial markets move capital from savers to borrowers: the savers because they want to consume more in the future and the borrowers because they want money to invest in projects today. We need to understand who the savers are, who the borrowers are, the basic financial securities that facilitate the flow of funds and how the markets are organised to support this flow.

Learning Outcomes

By the end of the module, you will be able to:

1. Explain the roles played by financial markets in the macroeconomy in allocating capital, and the different function played by equity and debt securities in facilitating that allocation.
2. Describe how business risk is transferred and priced in equity and debt securities.
3. Understand the basic finance valuation models and select an appropriate model to estimate project and company value.
4. Analyse the basic finance decisions of the corporation, and to apply analytical thinking to inform these decisions.

Module Content

In this module we will cover the following:

We start by introducing the role of financial markets in allocating capital, and discuss the organisation of these markets. In particular, we will highlight the difference between the equity and debt markets in facilitating the transfer of capital. We will then analyse in detail the two basic securities: bonds in the debt markets and shares in the equity markets. We will focus in turn on how these securities are issued, traded and priced. This will require us to learn about various financial tools, the yield curve, the dividend discount and discounted cash flow models, and how to apply these tools.

We will then discuss how the securities transfer economic business risk between investors, and how this risk is priced; for this we will need to understand the capital asset pricing mode (CAPM).

The module will then move onto analysing the core decisions of the corporation. In particular, we will apply our understanding to the capital structure decision (how to raise capital as efficiently as possible), the cash disbursement decision and the risk management decision. Throughout this discussion, we will illustrate the ideas through case studies and assess their ability to explain the main empirical stylised facts.

Teaching Methods

Teaching is delivered by a pragmatic blend of pre-recorded lectures, synchronous scheduled live tutorials, asynchronous peer-to-peer and staff-moderated discussion forums, case studies, problem exercises and online simulations. This approach encourages the achievement of the various learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the theory and concepts covered in the module and how these can be applied to real-world contexts. Learning throughout the module is typically structured around 10 1-week sessions.

Assessment

- Group Report - 15%
- Group Essay - 15%
- Final Examination - 70%

FINANCE AND FINANCIAL MANAGEMENT

General competences

Module Aims

The aim of this module is to enable you to understand one of the core purposes of finance: the setting of prices in a market. The first half of the module works at a market-level, dealing with risk-management and diversification. The second half of the module works at the securitylevel, thinking about bond, stock, and derivative valuation.

Learning Outcomes

By the end of the module, you will be able to:

1. Analyse the interplay between value and risk for the most common financial instruments.
2. Interpret financial and economic news and policy with improved comprehension
3. Discuss current financial issues intelligently and understand the financial mechanisms that cause prices to move.
4. Develop intuition for pricing models for stocks, bonds, and options.

Module Content

There are nine lecture blocks plus a review session:

1. Institutional Background
2. Time Value of Money
3. Portfolio Selection
4. The Capital Asset Pricing Model (CAPM)
5. Arbitrage
6. Stock Valuation
7. Bond Valuation and Interest Rates
8. Introduction to Options
9. Valuation of Options
10. Review Session

Teaching Methods

Teaching is delivered by 10 x 2 hour sessions. Sessions will normally be based on a combination of lectures, class discussion, group presentations, guest talks and case study analysis. This approach encourages the achievement of the various module learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the learnt theory and concepts and how these can be applied to realworld contexts.

Assessment

- Individual Quizzes – 10%
- Group Assignment – 35%
- Final Examination – 55%

PROJECT MANAGEMENT

General competences

Module Description

The module provides you with an understanding of project management and its central role in the modern business organisation. It presents methods that are used to:

• Define project environments, such as organisational strategy and major stakeholders

• Design project processes via time planning, cost and benefits planning, as well as risk management

• Execute projects, by considering elements of organisational theory, management and leadership, as well as project control

• Improve project performance via organisational learning

The module challenges some of the assumptions underlying traditional project management, such as the focus on time, cost and quality (the “triple constraints”) and the “one-size-fits-all” approach. While traditional project management tools and techniques are essential, you will be introduced to new concepts, frameworks and models which show that projects are increasingly important to the growth and innovation objectives of the modern organisation.

Learning Outcomes

By the end of the module, you will be able to:

• Plan for project success beyond the triple constraints of time, cost and quality.

• Analyse, interpret and provide solutions to strategic, organisational and operative challenges arising in the management of projects.

• Use and apply basic tools of project management likely to be encountered in practice.

• Identify a project’s potential risks and create risk mitigation strategies for the project

Module Content

The module consists of one lecture a week for ten weeks. Classroom sessions will be interactive and include a combination of lectures, classroom discussions and in-class exercises of topics in project management.

The module is based on self-study, lectures, module notes, group work and in-class exercises.

The lectures are illustrated with examples of major projects and the practice experiences of international firms.

The use of exercises will illustrate the challenges of managing projects and project-based organisations in real-world settings.

You are provided with module notes that are based on the book listed below. You are expected to engage in class discussions and exercises related to the topic of each week's session.

Teaching Methods

Teaching is delivered by 10 x 2 hour sessions. Sessions will normally be based on a combination of lectures, class discussion, group presentations, guest talks and case study analysis. This approach encourages the achievement of the various module learning outcomes by ensuring the acquisition of knowledge and facts, as well as the development of critical appreciation of the learnt theory and concepts and how these can be applied to realworld contexts.

Assessment

The module will be assessed by:

- Group Assignment 40%
- In-class Participation Activities 10%
- Final Examination 50%

TECHNOLOGIES TO COMBAT CLIMATE CHANGE

General competences

This module will enable you to appreciate the challenge posed by climate change, and the technologies and systems that will be required to mitigate it. This will be achieved by introducing you to key mitigation technologies and giving you skills to perform basic economic analysis of the options. Lectures will also cover technoeconomic assessment and emissions estimation methods, possible future technology developments and approaches to systems thinking, as well as the policy background on climate change.

You will learn about the technologies and systems for combating climate change and calculate performance metrics for these technologies. The module will also teach you how energy systems are interconnected, and how interdisciplinary approaches are needed to combat climate change. On completion of the course, you will be able to develop and analyse technical approaches to tackle climate change, while considering policy, regulatory, and social aspects.

Learning outcomes

By the end of this module, you will better be able to:

List and describe the key functions of technologies and systems that can be used to combat climate change

Calculate key economic and environmental performance metrics for technologies that can combat climate change

Describe how energy systems are interconnected, and how changes in one part of the system influence other parts across technical, economic and social aspects

Analyse, understand and critique approaches to combatting climate change from a range of disciplinary backgrounds

Plan holistic approaches to combating climate change, undertaking a robust techno-economic assessment and communicate this plan to a diverse audience in a convincing and inclusive manner

Indicative core content

This module will look at:

System approaches to combating climate change e.g., Carbon Trading, Tax & Offsetting

Renewable Electricity Generation and Storage e.g., Hydro, Wind, Geothermal and other assorted electricity generation methodologies

Carbon Capture & Storage

Decarbonisation of End Uses (Transport, Buildings, Industry)

Policy around climate change (e.g., EU-ETS, carbon leakage, grants/FITs/CfDs, efficiency regulation, etc.)

Learning and teaching approach

This module will use lectures to provide context to climate change and ensure everybody has the required level of understanding of the factors influencing climate to assess mitigation technologies. There will be a series of interactive lectures (e.g., flipped classroom lectures, where you are given reading material on a given mitigation technology/methodology (e.g., CCS), you will then be given an introduction to the technical aspects of how the mitigation technology works, followed by a discussion led by you and your peers on the pros and cons of the technological approach). In the following lectures you will be shown how to perform a techno-economic assessment, emissions projection methodologies, as well as the policy background on climate change in various places (UK/EU/USA/China/Australia etc).

Feedback drop-in sessions will be made available after online assessments, where you can ask questions about the topics with which you struggled in the quizzes.

You will receive verbal feedback on your presentations immediately on conclusion from the assessors, as well as access to a written feedback form on your presentation within 10 working days.

Assessment

Coursework:

Online Quiz 1 - individual assessment (10%)

Online Quiz 2 - individual assessment (10%)

Practical:

Debate/Presentation - group assessment (80%)

BUILDING RESILIENT STRUCTURES: THE SCIENCE AND TECHNOLOGY OF EARTHQUAKE ENGINEERING

General competences

This module will provide you with a contextualized overview of the science and technology of structural earthquake engineering. You will reflect on how earthquake engineering relates to different disciplines within society and gain an understanding of the tool's engineers use to protect infrastructure from earthquakes through a project involving hands-on design, 3D printing and shake-table testing.

You will learn to identify the socioeconomic, political, and environmental impacts of earthquakes and their influence on seismic resilience. You will be taught how different structures are designed to survive earthquakes, with earthquake shaking table demonstrations to explain their behaviour. You will learn to use your mobile devices to record and study the dynamic behaviour of simple objects/structures. You will also have the opportunity to use drafting software, create physical models using 3D printing technology and remotely participate in the shake-table testing of your models under seismic action. All this will develop your critical thinking, data analysis, and communication skills.

Learning outcomes

By the end of this module, you will better be able to:

Identify the social, economic, political and environmental impacts of earthquake events (and their influence on seismic resilience), and critically appreciate your own professional role in dealing with these

Classify different types of structures, explain how they are designed to survive earthquakes, and understand how structural damage is assessed/managed in the aftermath of earthquakes

Construct a low-cost earthquake shaking table and utilize it to study/improve the behaviour of simple structures made using common materials

Apply fundamental concepts of structural dynamics to the design of a small-scale structural model, render drawings using drafting software, develop physical 3D prints of the structural model and perform tests using an earthquake shaking table

Develop and apply your critical thinking, data analysis, and communication skills, through team-work, public engagement, problem-solving, logical decision-making and data collection/evaluation

Indicative core content

Covered in the course are:

Social, economic, political and environmental impacts of earthquake events

Seismic-resistant structural systems

Post-earthquake damage assessment and management

Lessons learned from previous earthquakes

Social, political, economic and cultural aspects of seismic resilience

Principles of structural dynamics

Principles of seismic risk and vulnerability

Earthquake preparedness and response

Structural design, drafting and experimental testing

Learning and teaching approach

This module will be taught using:

Online lectures

Computer-aided remote learning exercises and classroom discussions

Videos and animations

Recorded demonstrations

Remote tutorials will be available to provide support

Online multiple-choice quizzes (2-minute drills) and a recap (admit tickets) of what you have learnt from prep work before each online session

At the end of each remote session, groups will present a major structural failure from an earthquake event (structural stories) and receive live feedback from peers. Marks from quizzes will be posted on the VLE. Your reports and/or multimedia content will be marked and returned with grades and feedback, and the marks from the reflective piece/outreach activity will be posted.

Assessment

Structural dynamics activity using mobile devices (20%)

Multimedia report on 3D printed model testing (40%)

Poster reflective piece or scientific outreach (30%)

Participation in structural stories, admit tickets, and 2- minute drills (10%, formative)

MULTIDISCIPLINARY GROUP PROJECT

General competences

This module aims to provide students with the opportunity to undertake a group project, identifying a meta-theme challenge and develop selected aspects of a solution and scoping means for its realisation. Project areas need to be multidisciplinary in nature and may address aspects of, for example, Med-Tech (Medical Technologies), Fin-Tech (Financial Technologies), Ed-Tech (Educational Technologies) or Fit-Tech (Fitness and Lifestyle Technologies), but are not limited to these. During the module you will upskill in script writing, video, production and direction and the project is assessed based on a 3-minute video that you will produce.

Students opting for this module will be asked to fulfil the following criteria:

Have a skill to offer for a project (from subject specific to general)

Be willing to work on someone else's project idea

And optionally:

Have an idea for a project that they are willing to share (we are not expecting all students to arrive on the module with an existing project idea)

Learning outcomes

By the end of this module, you will better be able to:

apply the methods and techniques you have learned through project activity to effectively progress and implement your project

demonstrate use of storyboarding and scripting to construct a narrative to support

use filming, video editing, production and direction techniques to present and promote a project

demonstrate effective multidisciplinary teamwork

Indicative core content

Project discovery, definition, development and delivery. Storyboarding, scripting, filming, video editing and production techniques to present and promote a project. Upskilling in the designated executive roles (such as Producer(s), Director(s), Screenwriter, Cinematographer), setting context and providing guidance for the week-by-week development of the project.

Learning and teaching approach

The module will use an exploratory approach comprising phases of discovery, definition, development and delivery. The first few weeks will set the scene for the module, followed by a series of group work activieties, in combination with on-line resources enabling upskilling in designated roles, and setting

context and providing guidance for the week by week development of the project. The tutor team will meet with each group for weeks 4-10 providing guidance for the development of the project.

Formative feedback will be provided by tutor feedback statements. Summative feedback will be provided by: Tutor reports of students' engagement and project progress for week 5- week 11 activities; Peer feedback statements and feedback for group videos; Course team feedback statements and proforma assessment of the group videos. In order to assess the videos following the end of term comments will be sought from peers during the first two weeks of the subsequent term. These comments will then be combined with the tutor feedback and communicated during week 4 of the following term.

Assessment

Coursework

Group project video (60%)

Peer Assessment of other groups' project videos (20%)

Tutor reports of student engagement in activities undertaken during Weeks 5 to 10 (20%)

THE SCIENCE OF LEARNING

General competences

This module will introduce you to the concept of learning through exploration of three theoretical frameworks routed in neuroscience, psychology, and the socio-cultural context. You will explore learning first as a biological function of the brain, then as a psychological function of the mind, and finally as a socially-situated activity. You will also experience some research practices and paradigms used to study learning from all three theoretical perspectives. The content of the module will continuously be connected to your experiences as a learner and aims to provide you with strategies you can use to better engage with your future learning.

Learning outcomes

By the end of this module, you will better be able to:

Critically evaluate the process of learning from a neurogical, psychological, and socio-cultural perspective

Reflect on your learning experiences using the neurogical, psychological, and socio-cultural theoretical perspectives

Critique how neurogical, psychological, and socio-cultural perspectives are (mis)applied in a range of pedagogic contexts

Identify significant pedagogic challenges and/or opportunities and design appropriately theoretically-informed interventions

Indicative core content

The module takes place over 10 weeks with a two-hour face to face session each week. These sessions will combine expert input with regular opportunity for learners to apply concepts and methods to real-world contexts, including their own. This will be supported by examples, case studies, discussion and participatory pedagogic research. The face to face sessions will be supported by reading, video and on-line material and will be interactive, using elements of team-based learning (TBL) to help students learn independently and from each other. Typically, a taught session would require some independent study of the available resources in advance and would include individual and group activity in the classroom. Each of the three theoretical approaches (neuroscience, psychology and sociocultural) will be introduced and then used as a theoretical lens to examine educational practice and your experience. For each approach you will also have a chance to participate in educational research techniques typical of that approach. For example, you may undertake memory testing tasks used by neuroscientists and complete learning inventories or confidence scales used by psychologists. You will also experience observational study of both video material and your own practice as used to investigate education in a sociocultural context.

Each of the three theoretical approaches will have a short assignment based around you applying the theoretical lens to examine an educational topic of interest and relevance to you, which will be submitted for formative feedback. You will do three of these formative tasks applying the three different theoretical lenses to the same or different areas of teaching and learning relevant to you. You will receive feedback on each task as the module progresses; these tasks will then form the basis of a final summatively assessed task which integrates the three previous formative submissions and draws some brief final conclusions or recommendations. This final assessment will be a group presentation using two or more examples from the groups' formative assignments to present a comparative study using the theoretical lenses to analyse the teaching and learning and formulate recommendations. This may be done as a 'live' presentation or by presenting a short video. In addition to this all students will complete a short reflective diary of their learning throughout the module. This will both inform the assignments and will be used to give a mark for individual insight and engagement.

Learning and teaching approach

This module will introduce ideas and theories from neuroscience, psychology and socio-cultural views of learning using interactive delivery combining individual independent learning using reading and online support materials with interactive lecture delivery. This will be supported by examples, case studies and discussion. The approach is designed to help you better appreciate how you and your peers experience learning, and through this develop greater insight and evidence for a range of learning strategies. You will be exposed to a variety of methodologies used to explore, measure, and understand learning and will participate in simple educational experiments commonly used in each of the three approaches. You will engage in individual and group learning tasks, you will receive and provide regular peer feedback and will get feedback on the regular formative assignments that will build towards a final group presentation. Whilst the primary aim of the formative assessments is to aid your learning each caries a proportion of credit, so you can build your final mark as you progress.

Assessment

Coursework:

Individual Reflective Log (1,000 words) (10%)

Individual Assignment: Neuroscience (500 words) (20%)

Individual Assignment: Psychology (500 words) (20%)

Individual Assignment: Socio-cultural (500 words) (20%)

Practical:

Group oral presentation, either 'live' online or asynchronously via video (30%)

VIRTUAL REALITY: FROM CONCEPT TO CREATION

General competences

In this module you will explore various Virtual Reality applications before creating your own simple Virtual Reality experience relating to your Imperial College student experience. You will work within a multidisciplinary group of students and specialise in the development area of your interest, e.g. user experience/interaction design, graphics, or coding. By the end of the module, you will have enhanced your collaboration, project management, and technical skills and developed a unique Virtual Reality experience.

Learning outcomes

By the end of this module, you will be better able to:

Critically reflect on the strengths and limitations of Virtual Reality for different applications

Identify and apply the key elements that contribute to a high-quality Virtual Reality experience, focusing on the design of graphics, interactivity and user experience.

Apply basic technical skills and creative approaches in your chosen area of design to help create a component of a Virtual Reality experience.

Plan, manage and execute a Virtual Reality project by defining the scope, breaking down tasks, and adhering to a project timeline.

Work effectively in a multidisciplinary team, negotiating responsibilities and using everyone's skills to achieve an inventive, common goal.

Indicative core content

This module will provide a collaborative creator space for you to acquire the skills and knowledge required to contribute towards the design and development of a simple Virtual Reality (VR) experience. It is therefore not a taught module, but project-based combining independent learning with team work to create an inventive VR product.

At the beginning of the module, you will explore various existing VR applications to understand their strengths and weaknesses across different contexts. For the majority of the module, you will work in a small, multidisciplinary group to develop a VR experience relating to your Imperial College student experience, that integrates into an existing VR world. Within your group, you will decide on the scope of your project and divide roles amongst yourselves according to skills and interest so that each of you focusses on a specific component of the VR experience. This will allow you to do a deep dive into an area of VR development, directing your own learning into for example user experience / interaction design, graphics, or coding in C# using Unity.

Learning and teaching approach

There will be weekly face-to-face, interactive sessions. Some of these sessions will involve using Virtual Reality headsets, whereas others are focussed on group work, creating your own Virtual Reality experience. Individuals in project groups will break out into specialism workshops on a regular basis so that you can discuss your progress on your individual component of the VR experience with members from other project groups with similar roles. This will allow project groups to share expertise and support each other's learning.

Every week, there is individual work to complete in your own time between sessions. This will include set tasks and learning activities as well as independent research into relevant topics of your choosing and applying what you have learned to your project. During the weeks when you are working on your project, you will also need to communicate (asynchronously) with other students or staff using online platforms, such as Teams or Discord. Support will be offered to you both during and outside of sessions by the module lead as well as teaching assistants and technical experts.

Assessment

Coursework:

Group presentation (50%)

Individual journal (50%)

The assessment of this module is based on both the group's working process and output as well as your individual contributions to the project and personal reflections. In this way we ensure that your individual progress and learning journey are of similar importance to the output your group produces.

Your main assignment is to work as a group to create a VR experience that integrates into an existing VR world, related to your Imperial College student experience.

THINKING THROUGH MATERIALS: CAN SCIENCE, HISTORY AND ART/DESIGN ILLUMINATE EACH OTHER?

General competences

This course will provide you with a practical understanding of how Materials Science, History and Art/Design are intertwined and inform each other's path and evolution. Through this module you will develop tools for understanding historic materials, their evolution through art/design and how materials selection has guided the development of social, cultural and material life. You will conduct practical experiments on materials and gain the tools to evaluate a material's suitability for different applications in the past and present. In these practicals, you will also explore the theories and practices of 'bioinspiration' as these manifest in historical material cultures and current experimental processes. By the end of the course, you will have acquired general and practice-based knowledge from craft and digital fabrication, passing through materials synthesis, to curating and conservation, all viewed through the lens of the UN sustainability development and production goals.

You will learn about the different histories of materials science and art/design and examine how they are constantly overlapping. You will develop the skills to characterize different materials and assess the production of materials knowledge. You will work both independently and with a group to explore these topics, and you will home in on your presentation and collaboration skills.

Learning outcomes

By the end of this module, you will better be able to:

Engage with intertwined histories of materials science and art/design, and use this to interpret the development and reception of materials in the past and present. This will be rooted in the partnership between Imperial College London and the Victoria and Albert Museum.

Acquire the tools to understand materials-based knowledge from the past and present, and how these can be applied to current UN sustainability goals.

Develop and apply a common 'language' (e.g., textual, visual, material and sensorial) for reflecting different and multiple modes of learning (e.g., book-based, seminar, lab-based, practice-based).

Demonstrate a range of materials selection processes and artefact-focused analytical skills and methods (e.g., close-looking, handling, reconstruction, manipulation, repurposing, contextual research…) in order to build a convincing evidence base.

Acquire the basic skills to perform key modern characterisation techniques to analyse and differentiate materials based on their compositions and properties.

Mobilise historical knowledge, specifically histories of disciplines and processes, to evaluate how historical theories and practices impact on the production of knowledge about materials in the present day (e.g., the colonial, imperial and patriarchal underpinnings of modern disciplines, institutions, forms of production, and the potential for 'decolonising' disciplines, institutions and material-knowledge-based practices).

Indicative core content

This module, rooted in the partnership between Imperial College London and the Victoria and Albert Museum, offers you the unique opportunity to understand materials and materials-based knowledge across academic disciplines, across time periods and cultural frameworks, and using a wide range of theoretical, historical and practical approaches.

The module will take place over 10 weeks. Each week will involve a two-hour face-to-face session with a member of staff in the form of a seminar, practical workshop or museum visit. This programme will be complemented by short online lectures and readings (available through the module's online learning environment) and home-based activities.

The first week will provide an introduction to key debates and issues in materials-based knowledge and histories, including the intertwined dimensions of the histories of art, design and science. In weeks 2–8, you will develop your materials and materials-based knowledge 'toolkit'. Each session will equip you with new methods for analysing and contextualising materials. In small groups, you will work through a series of lab-based practical sessions facilitated by scientists, designers and makers; object-focused sessions that mobilise the V&A's collection and expertise; and student-led group work rooted in multidisciplinary teams.

This work will culminate in student-led groupwork and presentations in weeks 9 and 10. In your multidisciplinary groups, you will mobilise, apply and extend the knowledge and skills developed across the module by collaborating to produce a materials infographic and linked social media campaign. This group work will also form the basis of the group presentations in the final week.

Learning and teaching approach

This is a practical module where most of the work will be done in groups. The groups will be multidisciplinary, and the students will be chosen from different disciplinary backgrounds to ensure diversity and highlight the importance of collaborating across departments. Learning will be active and collaborative, and mostly take the form of hands-on workshops at Imperial College London, alongside object-focused sessions at the V&A.

The module's combination of individual and group-led activities will improve your ability to fruitfully engage in team work, think and work across disciplinary and professional boundaries, and boost your confidence and skills as a communicator across oral presentations, written work and social media formats. This emphasis on multiple modes of learning (e.g. discursive, critical written work, practical and experimental…) is also designed to support your development as a self-motivated and reflexive learner. In addition to participating in group work, each student will maintain a logbook during the module as well as producing a short critical reflection essay that will inform the final infographic activity.

You will receive feedback and support at every stage of the process. The feedback will be provided within 10 working days from the submission of your assignment. You will also get feedback on the formative reflective writing you submit.

Assessment

Coursework:

Critical thinking reflection (1000-1500 words) (20%)

Group activity - Infographic (30%)

Practical:

Object-led presentation - Show and Tell (10%)

Social media campaign (10%)

Group presentation - Walking Tour (30%)

HOW TO OUTREACH: MULTIDISCIPLINARY SCIENCE IN SCHOOLS AND FOR SCHOOLS

General competences

This course is a practical introduction to STEMM outreach, where you will learn how to effectively communicate science to a wider public and develop the confidence and skills to carry out a demo or talk for a school. The course will give you the chance to work within multidisciplinary groups to develop an innovative kit or activity to be delivered in schools, to demonstrate to pupils how different STEMM disciplines work together to solve real-world problems.

This course will teach you about the importance of outreach and how to differentiate between different methods of science communication. You will learn about using different methods of delivery as you communicate to a wide audience, and the importance of tailoring your communication to suit the relevant age-group. You will also learn basic public-speaking skills and presentation techniques. By the end of the module, you should be comfortable working in a team and explaining to children how STEMM subjects can help solve global problems.

Learning outcomes

By the end of this module, you will better be able to:

Be aware of the importance of outreach and differentiate between the various methods of science communication (to public, schools, children, scientists…)

Properly and confidently communicate big scientific subjects, global challenges and multidisciplinary research to a wide audience, and tailor the delivery to the appropriate age-group, with an aim to inspire and enthuse

Use different methods of delivery and communication including talks, kits, demos and hands-on activities

Explain to school children of any age group that real-world problems are multidisciplinary in nature and how a range of different STEMM subjects contribute the solutions of these problems

Collaborate and communicate effectively within a multidisciplinary team

Indicative core content

The module will take place over 10 weeks. Every week there will be a 2-hour face to face session with a member of staff which could be either a workshop, lecture or group work. Initially you will be given a brief overview of different types of outreach & public engagement work – including different audiences and types of delivery. You will then be immersed in workshops to actively learn to be a better public speaker and communicator and will receive the basics on school engagement and requirements. The workshops will include effective public speaking and hands on experience in the outreach lab, to learn how to communicate through demos.

After this initial introduction you will then be assigned to a multidisciplinary group based on a series of multidisciplinary real-world STEMM topics and you will be guided through the planning, prototyping and making of an outreach activity or talk to explain these subjects to selected schools. Each group will be assigned a mentor to help throughout the development of the project until the delivery. Each member of the group will provide a different point of view from the perspective of their current studies or experience, resulting in a strong interdisciplinary approach to the delivery of one of the topics provided.

Topics to choose from have a wide reach and background and include subjects such as: the weather, global warming, materials of the future, rail travel, online security etc.

You will then be delivering the activity or kit to peers as a practical trial run (and assessment) in communication before being delivering it in the selected partner schools. The delivery in the school will be the main part of the assessment and will help school children understand the multidisciplinary nature of most STEMM subjects and will provide them with a selection of possible careers for their future, stimulating their enthusiasm for science.

The kits and activities will be then kept at Imperial College and used for future events.

The final piece of work and assignment will consist of a piece of reflective writing to feedback on the activities, outcomes and potential improvements to the delivery.

Learning and teaching approach

This is a practical module where most work will be done in multidisciplinary, diverse groups and learning will be active and collaborative, mainly through workshops. This includes:

Group work

Group presentation to a a class of school students

Short reflective pieces about your experiences

Feedback will be provided within 10 working days from the submission of your assignment. You will meet with your mentor regularly and will receive formative oral feedback on your ideas. You will also get feedback on the formative reflective writing you submit. You will also receive feedback (both formal and informal) from your peers, as well as pupils and teachers involved in your activity.

Assessment

Coursework:

Initial plan (10%)

Reflective piece (1000-1500 words) (20%)

Practical:

Initial presentation of outreach activity (15%)

Outreach activity (55%)

The bulk of the marks for this module will come from the final outreach event. The assessment will be "full circle" – i.e. audience, peers and academic mentors will all contribute to the final mark, albeit with different weightings. You will be asked to write a final reflective piece (1000 - 1500 words) – which will be assessed individually.

To prepare for the final event you will be asked to submit an initial plan. You will also get a chance to present the outreach activity to your peers to gain initial feedback. Both of these items will be marked, and you will be able to use the feedback to prepare for and improve your final outreach event. Throughout the process you will be asked to submit short (250 words) formative reflective pieces to prepare for your final essay.

ORIGINS

General competences

Over the last 25 to 50 years there have been huge advances in our knowledge of our origins. In physics and astronomy we now know the history of the universe and the processes that drive it back to the very first fractions of a second after the Big Bang. We have learnt how stars and planets form and have discovered thousands of planets orbiting other stars. Life is being sought on these planets and on planets and moons in our own Solar System, and we are beginning to understand the processes behind the origin of life. This module will allow you, through student-centred learning, to examine the current scientific view of the origin of the Earth, the universe, matter, and life, as well as the evidence upon which these views are based. The course also includes the development of these views in different cultures, and areas of uncertainty.

Through team-based and independent research you will learn how to explain the status and results of scientific research into origins questions, and to critically evaluate the scientific evidence for these conclusions. You will also be able to consider where results and conclusions are uncertain, and where our knowledge is currently limited. This course provides you with the opportunity to learn how to independently research unfamiliar topics, supported by the Origins team, and how to communicate the results of this research to a non-specialist audience. By the end of the module, you should also be able to discuss the diversity of cultural approaches to origins questions.

Learning outcomes

By the end of this module, you will better be able to:

Explain the current status and results of scientific research into origins questions, and critically evaluate the scientific evidence that supports these conclusions, taking into account where results and conclusions are uncertain, and where our knowledge is currently limited

Work independently and in multidisciplinary small groups to research an unfamiliar topic using review papers, textbooks, popular texts and articles, to communicate the results of this research to a non-specialist audience

Discuss the diversity of cultural approaches to origins questions and reflect on how their disciplinary and cultural backgrounds influence their approach to these origins questions

Indicative core content

The key question addressed by this module is what is the origin of the world and universe around us? This will be broken up into subtopics as follows: what is the origin of matter and the universe? What is the origin of the stars and planets? What is the origin of life?

Specific subtopics that may be the subject of student presentations or questions include:

Experimental basis of quantum mechanics

Fundamental particles

Modern particle experiments

Historical conceptions of matter

The key observations of cosmology

The Big Bang, History of the universe

The missing bits: dark matter & dark energy

Origin stories of the world

The nature of stars

Planets in the Solar System – terrestrial and gas giant

Searches for Exoplanets

Star and planet formation

Habitable planets

Astronomy before the telescope

What is life?

History of life on earth

Scientific scenarios for the origin of life

The search for life elsewhere

The possibility of & search for extraterrestrial intelligence

Learning and teaching approach

There will be an introductory talk and online discussion session on each of the topics on the course, followed by a 2 - week period to study the topic in groups, or independently as appropriate. This will be followed by:

Online workshop sessions

Online group presentations

Online test

Feedback on presentations will be provided after the presentation sessions and through written feedback forms filled out by students and course leaders. Feedback will also be available during the

workshop sessions, and peer feedback from the groups will be available during the team learning stage of the online tests and during the final reflective session.

Assessment

Practical:

Group presentation about an Origins subtopic (45%)

Contribution to reflective exercise at end of course (10%)

Examination:

Three online multiple-choice quizzes (each worth 15%) on each of the three parts of the course.