Computer Science - optional modules

Up to two from:

**CS4052 Logic and Software Verification**

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<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level: 10</th>
<th>Semester:</th>
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</table>

Planned timetable: To be arranged.

Building on earlier coverage of elementary logic, this module motivates the need for formal methods and software verification approaches as model checking for guaranteeing the correctness of software systems. The module covers modelling, system property specification using temporal logics, and more applied approaches to software specification and verification through the use of model checkers. Model checkers such as SPIN and UPPAAL are used both in lectures and in practical work. Petri nets and program semantics are also explored. Software correctness is thus presented as a matter not of testing but of pre-execution verification through model checking.

Programme module type: Optional for Dependable Software Systems Postgraduate Programme

Learning and teaching methods and delivery: **Weekly contact**: 2 lectures (x 10 weeks) and fortnightly tutorial.

Assessment pattern: 2-hour Written Examination = 60%, Coursework = 40%

Module coordinator: hons-coord-cs@st-andrews.ac.uk

**CS4102 Computer Graphics**

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<tr>
<th>SCOTCAT Credits:</th>
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<th>SCQF Level: 10</th>
<th>Semester:</th>
<th>2</th>
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</table>

Planned timetable: To be arranged.

This module covers the fundamental concepts of computer graphics, and develops the ability to apply the concepts to the generation of realistic, synthetic images of 3D objects and scenes. On completion of the module, students should be competent to undertake many tasks in computer graphics, and should have an understanding of the theory underlying many of the relevant techniques.

Programme module type: Optional for Postgraduate Programmes in the School of Computer Science

Learning and teaching methods and delivery: **Weekly contact**: 2 lectures (x 11 weeks) and fortnightly tutorial.

Assessment pattern: 2-hour Written Examination = 60%, Coursework = 40%

Module coordinator: hons-coord-cs@st-andrews.ac.uk

**CS4103 Distributed Systems**

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<th>SCOTCAT Credits:</th>
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<th>Semester:</th>
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</table>

Planned timetable: To be arranged.

This module covers the fundamentals of distributed systems, with reference to system models, programming languages, algorithmic techniques, concurrency and correctness.

Programme module type: Either CS4103 or CS5024 is compulsory for Computer Communication Systems Postgraduate Programme

Optional for other Postgraduate Programmes in the School of Computer Science

Learning and teaching methods and delivery: **Weekly contact**: 2 lectures (x 11 weeks) and fortnightly tutorial.

Assessment pattern: 2-hour Written Examination = 60%, Coursework = 40%

Module coordinator: hons-coord-cs@st-andrews.ac.uk
## CS4201 Programming Language Design and Implementation

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<tr>
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</table>

**Planned timetable:** To be arranged.

This module studies the design and implementation of programming languages. Topics include language design principles, abstract syntax, evaluation mechanisms, binding, type systems, polymorphism, data encapsulation, exceptions, formal definition of programming languages, compiling techniques, abstract machine design, run-time systems and garbage collection.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science

**Learning and teaching methods and delivery:** Weekly contact: 2 lectures (x 10 weeks) and fortnightly tutorial.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** hons-coord-CS@st-andrews.ac.uk

## CS4202 Computer Architecture

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<th>SCOTCAT Credits:</th>
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</table>

**Planned timetable:** To be arranged.

This module studies the principles and technology of modern computer architectures, with particular emphasis on performance and acceleration. Topics include the CPU, memory, interconnect architectures, performance concepts and programming models.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science

**Learning and teaching methods and delivery:** Weekly contact: 2 lectures (x 10 weeks) and fortnightly tutorial.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** hons-coord-CS@st-andrews.ac.uk

## CS4203 Computer Security

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**Planned timetable:** To be arranged.

This module introduces the basic concepts of computer security and cryptography, common attacks and defences against them, and relevant legal and policy frameworks.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science

**Anti-requisite(s):** IS5104

**Learning and teaching methods and delivery:** Weekly contact: 2 lectures (x 11 weeks) and fortnightly tutorial.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** hons-coord-CS@st-andrews.ac.uk
**CS4204 Concurrency and Multi-Core Architectures**

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<th>SCOTCAT Credits:</th>
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<td>Planned timetable:</td>
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This module presents the key concepts of programming multi-core/many-core and other parallel architectures, ranging from the identification and use of parallel patterns; the use of structured parallelism to implement task and data parallelism; key implementation issues, including task identification, granularity, scheduling, threads, garbage collection, task placement, locality; performance monitoring and debugging.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science

**Learning and teaching methods and delivery:**
Weekly contact: 2 lectures (x 11 weeks) and fortnightly tutorial.

**Assessment pattern:**
2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:**
hons-coord-cs@st-andrews.ac.uk

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**CS4302 Signal Processing and Perception for Digital Media**

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<td>Planned timetable:</td>
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The module will introduce students to the concepts of analogue and digital media and review current standards and technologies used in the production, transport and rendering of digital multimedia. Within the context of networked multimedia the concept of Quality-of-Service will be introduced and the issues involved in transporting time-sensitive data across computer networks will be explained. Specific examples drawn from Internet-based projects, protocols and standards will be used to illustrate these issues.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science.

**Learning and teaching methods and delivery:**
Weekly contact: 2 lectures (x 10 weeks) and fortnightly tutorial.

**Assessment pattern:**
2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:**
hons-coord-cs@st-andrews.ac.uk

**Module teaching staff:**

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**CS4303 Video Games**

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<th>SCOTCAT Credits:</th>
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This module builds on the general-purpose programming abilities acquired earlier, introducing games-specific techniques and material. Computer games are now a bigger industry than films, yet they are continuing to develop. While the budget for a new game may rival that of a Hollywood blockbuster, there is also a growing demand for lower octane coffee-break games that can be accessed for short periods in a browser, and for games that can be played on-the-go with a mobile device. Games programming skills are developed through lectures and laboratories, culminating in the creation of actual games.

**Programme module type:** Optional for Postgraduate Programmes in the School of Computer Science.

**Learning and teaching methods and delivery:**
Weekly contact: 2 lectures (x 10 weeks) and fortnightly tutorial.

**Assessment pattern:**
Coursework = 100%

**Module coordinator:**
hons-coord-cs@st-andrews.ac.uk
### CS4402 Constraint Programming

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</table>

**Planned timetable:** To be arranged.

This module introduces constraint-based reasoning as a powerful mechanism for knowledge representation and inference. It provides a thorough grounding in the constraint satisfaction/constrained optimisation problem formalism, and covers both basic techniques for implementing constraint solvers and the use of advanced techniques with a modern solver.

**Programme module type:** Either CS5012 or CS4402 is compulsory for the Artificial Intelligence Postgraduate Programme. Optional for Erasmus Mundus Dependable Software Systems Postgraduate Programme and other Postgraduate Programmes in the School.

**Learning and teaching methods and delivery:** Weekly contact: 2 lectures (x 11 weeks) and fortnightly tutorial.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** hons-coord-cs@st-andrews.ac.uk

### ISS102 Database Management Systems

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<th>SCOTCAT Credits:</th>
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**Planned timetable:** To be arranged.

This module introduces the core principles and techniques required in the design and implementation of database systems. With a focus on relational database management systems, topics include database design theory; E-R modelling; data definition and manipulation languages; database security and administration. There is a significant practical element to the module, which will require students to build and manipulate a database.

**Programme module type:** Optional for all Postgraduate Programmes within the School of Computer Science. Optional for Applied Statistics and Datamining MSc programme.

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 40%, Coursework = 60%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### ISS103 Web Technologies

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</table>

**Planned timetable:** To be arranged.

This module introduces the principles and techniques involved in the design and implementation of web applications. A web application is a collection of web pages that interact with the user, with each other, and with various resources on a web server, including databases. There is a significant practical element to the module, which will require students to build and manipulate dynamic web pages.

**Programme module type:** Optional for all Postgraduate Programmes.

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 40%, Coursework = 60%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
### IS5104 Information Security Management

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<td>Planned timetable:</td>
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</table>

This module reviews key theoretical and practical aspects of Information Security Management. The module content covers higher-level technical and theoretical issues as well as management issues such as organisational, planning, certification, auditing and governance. From the student's perspective the module introduces students to a topical field of business and IT concern via varied learning styles and in depth consideration of current issues, standards and scenarios. The module uses both block learning and individual self-learning.

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<td>Anti-requisite(s):</td>
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<td>Learning and teaching methods and delivery:</td>
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<td>Assessment pattern:</td>
<td>2-hour Written Examination = 40%, Coursework = 60%</td>
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<td>Module coordinator:</td>
<td><a href="mailto:dopgt-cs@st-andrews.ac.uk">dopgt-cs@st-andrews.ac.uk</a></td>
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### IS5106 Green Information Technology

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<th>SCOTCAT Credits:</th>
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<td>Planned timetable:</td>
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This module introduces students to a variety of topics and technologies in the area of Green IT and Sustainable IT. Students investigate the way in which technology contributes towards global emissions as well as its potential to enable a positive sustainable future. This includes the responsibilities and actions of IT users, as well as service providers. The module covers key factors driving Green IT from a technical, political, financial, social and legal perspective, and includes the IT life cycle, approaches to product design and the provision of IT services. Students gain understanding and insight into current issues related to sustainable IT usage and future development.

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<tr>
<td>Learning and teaching methods and delivery:</td>
<td>Weekly contact: Lectures, seminars and tutorials</td>
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<tr>
<td>Assessment pattern:</td>
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<tr>
<td>Module coordinator:</td>
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### IS5108 Information Technology Projects

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<td>Planned timetable:</td>
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This module reinforces information technology and project management skills gained during semester 1, by means of a selection of coursework assignments posed as information technology projects. These are designed to offer increasing depth and scope for creativity as the module progresses.

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<tr>
<td>Anti-requisite(s):</td>
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<tr>
<td>Learning and teaching methods and delivery:</td>
<td>Weekly contact: Lectures, tutorials and practical classes</td>
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<td>Assessment pattern:</td>
<td>Coursework = 100%</td>
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<td>Module coordinator:</td>
<td><a href="mailto:dopgt-cs@st-andrews.ac.uk">dopgt-cs@st-andrews.ac.uk</a></td>
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## Further optional modules:

### CS5003 Masters Programming Projects

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</table>

**Planned timetable:** Variable

This module reinforces key programming skills gained in CS5002, by means of a series of coursework assignments posed as small programming projects. These are designed to offer increasing depth and scope for creativity as the module progresses.

**Programme module type:** Compulsory for Computing and Information Technology Postgraduate Programme. Optional for Advanced Computer Science, Artificial Intelligence, Computer Communication Systems, Intensive Analysis, Information Technology, Human Computer Interaction MSc Programmes, EngD in Computer Science

**Pre-requisite(s):** CS5002  
**Anti-requisite(s):** IS5108

**Learning and teaching methods and delivery:** Weekly contact: Lectures, tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5010 Artificial Intelligence Principles

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<th>SCOTCAT Credits:</th>
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**Planned timetable:** To be arranged.

This module covers foundational knowledge of Artificial Intelligence (AI). The module gives an overview of AI and its philosophy. It covers fundamental principles in AI: logical reasoning, reasoning in the presence of uncertainty, and machine learning. It shows how search is used to solve a variety of problems in AI. Notions such as agency and uncertainty in AI are covered. Finally, the philosophy of AI in practice and the philosophical problems in AI are shown.

**Programme module type:** Compulsory for Artificial Intelligence Postgraduate Programme. Optional for all Postgraduate Programmes in the School of Computer Science.

**Anti-requisite(s):** CS3105  
**Required for:** CS5011

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5011 Artificial Intelligence Practice

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**Planned timetable:** To be arranged.

This module covers practical design and implementation of Artificial Intelligence (AI). It provides grounding in AI technique, covering techniques in the areas of AI reasoning, planning, doing, and learning. Finally, it is shown how to implement AI ideas in software and how to evaluate such implementation.

**Programme module type:** Compulsory for Artificial Intelligence Postgraduate Programme. Optional for other Postgraduate Programmes.

**Co-requisite(s):** CS5001, CS5010  
**Required for:** CS5012, CS5019

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
### CS5012 Language and Computation

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**Planned timetable:** To be arranged.

This module covers the major aspects of natural language processing and speech understanding, including computational syntax, computational semantics, discourse processing, machine translation and speech recognition.

**Programme module type:** Either CS5012 or CS4402 is compulsory for the Artificial Intelligence Postgraduate Programme. Optional for Postgraduate Programmes in the School of Computer Science.

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5019 Artificial Intelligence (Special Subject)

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**Planned timetable:** To be arranged.

This module is a guided reading module on any aspect of Artificial Intelligence not covered by other available modules. It is intended only for MSc students in Artificial Intelligence whose circumstances make it appropriate to deliver an individually designed programme of study in a specialist area of Artificial Intelligence not covered by other modules.

**Programme module type:** Optional for Artificial Intelligence Postgraduate Programme.

**Pre-requisite(s):** the consent of the Head of School

**Anti-requisite(s):** CS5029, CS5039

**Weekly contact:** Tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5020 Principles of Computer Communication Systems

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**Planned timetable:** TBC

This module aims to equip students with a deep knowledge of fundamental concepts and terminologies of computer communication systems (CCS). It will illustrate fundamental principles with reference to widely-used systems and technologies for CCS and enable students to use high level tools for networked systems configuration, exploration and management of CCS. Students will also be made aware of security and privacy principles and how they are used in CCS.

**Programme module type:** Compulsory for MSc in Computer Communication Systems

Optional for all other taught postgraduate programmes in the School of Computer Science

**Weekly contact:** 2 lectures (x 11 weeks), 1 tutorial (x 6 weeks)

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
## CS5022 Practice in Computer Communication Systems

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**Planned timetable:** To be arranged.

This module aims to introduce students to the applications, protocols and architecture of Computer Communication Systems in terms of their practical realisation, operation, control and management. It will enable them to use standard programming languages and tools in order to build communication applications and protocols and to use standard analytical and statistical tools for examining the operation and performance of communication applications, protocols and systems.

**Programme module type:** Compulsory for MSc in Computer Communication Systems
Optional for all other taught postgraduate programmes in the School of Computer Science.

**Co-requisite(s):** CS5001 and CS5020

**Learning and teaching methods and delivery:**
- **Weekly contact:** 2 lectures (x 10 weeks), 1 tutorial (x 4 weeks), lab session (x 4 weeks)

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

## CS5024 Advanced Topics in Computer Communication Systems

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<th>SCOTCAT Credits:</th>
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**Planned timetable:** TBC

This module reinforces the basic principles and fundamental concepts of computer communication systems (CCS). It will cover, in depth, new developments and emerging topics in CCS and allow students to analyse, evaluate, critique and reproduce results from CCS research papers.

**Programme module type:**
- Either CS4103 or CS5024 is compulsory for Computer Communication Systems Postgraduate Programmes
- Optional for all other taught postgraduate programmes in the School of Computer Science

**Pre-requisite(s):** CS5022

**Learning and teaching methods and delivery:**
- **Weekly contact:** 2 lectures (x 11 weeks), 1 tutorial (x 6 weeks)

**Assessment pattern:**
- 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

## CS5029 Computer Communication Systems (Special Subject)

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**Planned timetable:** To be arranged.

This module is a guided reading module on any aspect of Computer Communication Systems not covered by other available modules. It is intended only for MSc students in Computer Communication Systems whose circumstances make it appropriate to deliver an individually designed programme of study in a specialist area of Computer Communication systems not covered by other modules.

**Programme module type:** Optional for Computer Communication Systems Postgraduate Programme.

**Pre-requisite(s):** the consent of the Head of School

**Anti-requisite(s):** CS5019, CS5039

**Learning and teaching methods and delivery:**
- **Weekly contact:** Tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
### CS5030 Software Engineering Principles

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**Planned timetable:** To be arranged.

This module examines the key concepts in small and large-scale software development. Project management is explored, along with the processes involved in developing system requirements, functionality and high-level descriptions necessary to guide the development of, and assess, a working system.

**Programme module type:** Compulsory for Software Engineering Postgraduate Programme. Optional for other Postgraduate Programmes.

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5031 Software Engineering Practice

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**Planned timetable:** To be arranged.

This module introduces advanced software engineering methods supporting the development of complex, composite software systems with an emphasis on software configuration management, reuse and test-driven development practices. It examines software reuse at different levels of scale, from software libraries and components to service-oriented architectures and discusses how reuse presents both challenges and opportunities for the development of quality software. A key process in today's software engineering practice is testing; the module introduces testing methods that complement the different scales of reuse-oriented development, from unit-level testing to integration testing and system-level testing. Students work on a project to design, implement and test a complex, distributed application to put the content of the lectures into practice. Reference is made to the content of the co-requisite Software Engineering Principles module where appropriate, so that students learn how the practices studied fit into a larger software engineering lifecycle.

**Programme module type:** Compulsory for Software Engineering Postgraduate Programme. Optional for other Postgraduate Programmes.

**Co-requisite(s):** CS5001, CS5030

**Required for:** CSS5032, CSS5033, CSS5039

**Learning and teaching methods and delivery:** Weekly contact: Weekly lectures, seminars, tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
### CS5032 Critical Systems Engineering

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<th>SCOTCAT Credits:</th>
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</table>

**Planned timetable:** To be arranged.

The aim of this module is to provide students with an understanding of the concepts and development techniques used for critical, socio-technical systems. When students have completed this module they will:
- understand the notion of system dependability and the key characteristics of dependable systems;
- understand the specialised software engineering techniques that may be used to ensure dependable system operation; have practical experience of applying some of these techniques in systems specification, design or implementation.

**Programme module type:** CS5032 or CS5033 is compulsory for Software Engineering Postgraduate Programme
Optional for all other Postgraduate Programmes in the School of Computer Science

**Learning and teaching methods and delivery:** Weekly contact: Weekly lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5033 Software Architecture

<table>
<thead>
<tr>
<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level: 11</th>
<th>Semester:</th>
<th>2</th>
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</thead>
</table>

**Planned timetable:** To be arranged.

This module introduces students to the concept of software architecture, as an aid to software design, reuse and evolution. When students have completed this module, they will:
- have knowledge of the key elements of software architectures; recognise architectural styles of existing software systems; be able to describe the software architecture of a non-trivial system accurately; be able to construct systems that satisfy an architectural description; understand how software architecture aids design, reuse and evolution of software.

**Programme module type:** CS5032 or CS5033 is compulsory for Software Engineering Postgraduate Programme
Optional for all other Postgraduate Programmes in the School of Computer Science

**Learning and teaching methods and delivery:** Weekly contact: Lectures, seminars, tutorials and practical classes.

**Assessment pattern:** 2-hour Written Examination = 60%, Coursework = 40%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

### CS5039 Software Engineering (Special Subject)

<table>
<thead>
<tr>
<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level: 11</th>
<th>Semester:</th>
<th>2</th>
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</thead>
</table>

**Planned timetable:** To be arranged.

This module is a guided reading module on any aspect of Software Engineering not covered by other available modules. It is intended only for MSc students in Software Engineering whose circumstances make it appropriate to deliver an individually designed programme of study in a specialist area of Software Engineering not covered by other modules.

**Programme module type:** Optional for MSc in Software Engineering Postgraduate Programme.

**Pre-requisite(s):** the consent of the Head of School

**Anti-requisite(s):** CS5019, CS5029

**Learning and teaching methods and delivery:** Weekly contact: Tutorials and practical classes.

**Assessment pattern:** Coursework = 100%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
### CS5040 Human Computer Interaction Principles and Methods

<table>
<thead>
<tr>
<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level</th>
<th>11</th>
<th>Semester:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planned timetable:</strong></td>
<td>To be arranged.</td>
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</tbody>
</table>

This module provides a grounded introduction to the principles of human computer interaction in the context of evaluation paradigms. Material includes: history of interfaces and interaction; the human (vision, perception, memory, hearing); the computer (from existing to next generation ubiquitous computing systems); paradigms of interaction; evaluation paradigms in HCI; guidelines and heuristics; experimental design and hypothesis testing in HCI; quantitative evaluation methods in HCI; qualitative evaluation methods in HCI.

<table>
<thead>
<tr>
<th>Programme module type:</th>
<th>Compulsory for MSc Human Computer Interaction Postgraduate Programme. Optional for other Postgraduate Programmes</th>
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</thead>
<tbody>
<tr>
<td><strong>Anti-requisite(s):</strong></td>
<td>CS3106</td>
<td></td>
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<tr>
<td><strong>Learning and teaching methods and delivery:</strong></td>
<td>Weekly contact: Lectures, practical classes and tutorials.</td>
<td></td>
</tr>
<tr>
<td><strong>Assessment pattern:</strong></td>
<td>2-hour Written Examination = 60%, Coursework = 40%</td>
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<tr>
<td><strong>Module coordinator:</strong></td>
<td><a href="mailto:dopgt-cs@st-andrews.ac.uk">dopgt-cs@st-andrews.ac.uk</a></td>
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### CS5041 Interactive Software and Hardware

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<tr>
<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level</th>
<th>11</th>
<th>Semester:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability restrictions:</strong></td>
<td>The module is available to all students enrolled on the MSc Human Computer Interaction Programme. A quota for other students may be necessary due to lab equipment constraints, in which case preference will be given to other MSc students.</td>
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<tr>
<td><strong>Planned timetable:</strong></td>
<td>To be arranged.</td>
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</table>

This module develops prototype-building skills for a wide range of interactive technologies. Students learn how to create interactive hardware and software using technologies such as tangible programming kits, mobile devices, microprocessor kits and depth cameras. There is a strong emphasis on practical assignments.

<table>
<thead>
<tr>
<th>Programme module type:</th>
<th>Either CS5041 or CS5044 is compulsory for Human Computer Interaction Postgraduate Programmes. Optional for other Postgraduate Programmes</th>
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</thead>
<tbody>
<tr>
<td><strong>Co-requisite(s):</strong></td>
<td>CS5001</td>
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<tr>
<td><strong>Learning and teaching methods and delivery:</strong></td>
<td>Weekly contact: Lectures, practical classes and tutorials.</td>
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</tr>
<tr>
<td><strong>Assessment pattern:</strong></td>
<td>Coursework = 100%</td>
<td></td>
</tr>
<tr>
<td><strong>Module coordinator:</strong></td>
<td><a href="mailto:dopgt-cs@st-andrews.ac.uk">dopgt-cs@st-andrews.ac.uk</a></td>
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</table>
### CS5042 User-Centred Interaction Design

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<tr>
<th>SCOTCAT Credits:</th>
<th>15</th>
<th>SCQF Level: 11</th>
<th>Semester: 2</th>
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</thead>
</table>

**Availability restrictions:** The module is available to all students enrolled on the MSc Human Computer Interaction Programme. A quota for other students may be necessary due to lab equipment constraints, in which case preference will be given to other MSc students.

**Planned timetable:** To be arranged.

This module studies methodologies in interaction design that are at the core of current practice for user interface engineering and application development. Students work towards creating designs of interactive systems that are based on human, group and organisation needs rather than on technical constraints. The module does not involve a great deal of programming.

**Programme module type:**
- Compulsory for MSc Human Computer Interaction Postgraduate Programme
- Optional for all Postgraduate Programmes

**Learning and teaching methods and delivery:**
- Weekly contact: 2 lectures, 3 practicals and 1 tutorial.

**Assessment pattern:**
- Coursework = 85%, Presentation = 15%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk

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### CS5044 Information Visualisation and Visual Analytics

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<tr>
<th>SCOTCAT Credits:</th>
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<th>SCQF Level: 11</th>
<th>Semester: 2</th>
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</table>

**Planned timetable:** To be arranged.

This module provides an introduction to information visualisation and visual analytics. It focuses on the question of how to utilise visual representations to make information accessible for exploration and analysis. The module covers basic principles of visualisation design and interaction principles. It introduces a range of visualisation techniques and tools, and discusses how these can be effectively applied in various scenarios for communication, exploration and analysis, and how to evaluate information visualisations in different contexts.

Skills in designing, developing, and evaluating information visualisations are reinforced through practical assignments. There are no pre-requisites for this module but students should have basic programming skills (e.g. in Java or JavaScript).

**Programme module type:** Either CS5041 or CS5044 is compulsory for Human Computer Interaction Postgraduate Programmes
- Optional for all Postgraduate Programmes

**Learning and teaching methods and delivery:**
- Weekly contact: 3-hour lecture (x 11 weeks), 1-hour seminar (x 8 weeks)

**Assessment pattern:**
- 2-hour Written Examination = 40%, Coursework = 60%

**Module coordinator:** dopgt-cs@st-andrews.ac.uk
The era of big data is upon us - the volume, velocity and variety of enterprise and scientific data are growing at an exponential rate and will continue to do so for the foreseeable future. This module presents the programming paradigms, algorithmic techniques and design principles for large-scale distributed systems, such as those utilised by companies such as Google, Amazon and Facebook. This module is different in scope from CS4103 (distributed systems) as it focuses primarily on building and utilising large-scale clusters. The module will cover: distributed systems architecture, replication and fault tolerance, storage, coordination, scheduling algorithms, cluster computing, cloud computing, virtualisation, programming models (e.g., MapReduce), stream processing, decentralised systems (e.g., Chord), incentive-based systems (e.g., BitTorrent), and social computing (e.g., crowd sourcing techniques). This module will draw from the latest research in both academia and industry.

Programme module type: Optional for Data-Intensive Analysis MSc Programme.
Optional for Computer Communication Systems MSc and all other Postgraduate programmes within the School.

Pre-requisite(s): CS5001

Learning and teaching methods and delivery: Weekly contact: 2 lectures (x 11 weeks), 1 tutorial (x 5 weeks)

Assessment pattern: 2-hour Written Examination = 60%, Coursework = 40%

Module coordinator: dopgt-cs@st-andrews.ac.uk

Contemporary data collection can be automated and on a massive scale e.g. credit card transaction databases. Large databases potentially carry a wealth of important information that could inform business strategy, identify criminal activities, characterise network faults etc. These large scale problems may preclude the standard carefully constructed statistical models, necessitating highly automated approaches. This module covers many of the methods found under the banner of "Datamining", building from a theoretical perspective but ultimately teaching practical application. Topics covered include: historical/philosophical perspectives, model selection algorithms and optimality measures, tree methods, bagging and boosting, neural nets, and classification in general. Practical applications build sought-after skills in programming (typically R, SAS or python).

Programme module type: Compulsory for Applied Statistics and Datamining Postgraduate Programme.
Compulsory for Data-Intensive Analysis MSc Programme.
Optional for all Postgraduate Programmes.

Anti-requisite(s): MT5759

Learning and teaching methods and delivery: Weekly contact: Lectures, seminars, tutorials and practical classes.

Assessment pattern: 2-hour Written Examination = 60%, Coursework = 40%

Module coordinator: masters-coord-cs@st-andrews.ac.uk