New Second and Third Year Structure

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Aim of This Session

To inform students of the proposed structure and content of 2\textsuperscript{nd} and 3\textsuperscript{rd} year Computer Science Programmes for 2009/2010 and 2010/11.
Terminology

- **Programme:**
  - Something you can get a degree in.

- **Theme:**
  - An inter-dependent collection of course units across years that together provide key knowledge and skills in a focused area.

- **Course unit:**
  - The unit of assessment.
Themes

Main change is introduction of Themes.

- Themes consist of coherent collections of course units spread across years.
- Programmes are characterised by their mandatory themes
Themes

- The following are the current themes:
  - Agile Methods.
  - Computer Architecture.
  - Computer Languages.
  - Enterprise Information Systems.
  - *Information Systems in Business*.
  - Learning and Search in Artificial Intelligence.
  - Mobile Computing and Networks.
  - Natural Language, Representation and Reasoning.
  - Programming and Algorithms.
  - Rigorous Development.
  - Software Engineering.
  - System-on-Chip.
  - Visual Computing.
  - Web and Distributed Systems.
Agile Methods

- Agile Methods focus on processes and techniques for managing software projects under challenging conditions. Agile Methods are important because computer systems often have to be developed and deployed under pressures of time and in uncertain settings, where more traditional software development techniques have proved to be too cumbersome. The Agile Methods theme addresses iterative software development, the construction of software from components, and evolution of existing software systems. The Agile Systems theme builds on Object-Oriented Programming in Java in the first year.

  - Year 2: Software Engineering (20 Credits)
  - Year 3: Agile Software Engineering Development (10 Credits)
  - Year 3: Software Evolution (10 Credits)
Computer Architecture

- Computer Architecture involves the selection and interconnection of hardware components to create computers that meet functional, performance and cost goals. As a result, the development of effective computer architectures is a central part of technology development, and an understanding of the capabilities of architectures is important for developers of higher-level systems. The Computer Architecture theme includes fundamental material on the components of architectures, before progressing to specific advanced architectures. The Computer Architecture theme builds on Fundamentals of Computer Architecture in the first year.
  - Year 2: Operating Systems (10 Credits)
  - Year 2: System Architecture (10 Credits)
  - Year 3: High Performance Microprocessor Architectures (10 Credits)
  - Year 3: Chip Multiprocessors (10 Credits)
Computer Languages

- Computer Languages are central to the development of software systems; a good understanding of programming languages is important for software developers, and many sub-disciplines of computer science use specialised languages that suit their specific requirements. The Computer Languages theme addresses the design and specification of programming languages, and the techniques that have been developed for implementing languages in different settings. The Computer Languages theme builds on Object-Oriented Programming in Java in the first year:
  - Year 2: Algorithms, Data Structures and Programming (20 Credits)
  - Year 3: Understanding Programming Languages (10 Credits)
  - Year 3: Compilers (10 Credits)
Enterprise Information Systems

- Enterprise Information Systems are central to the management of data and provision of services in government and commerce; such systems typically manage, and support the use of, the data resources that are central to the operation and management of any large organisation. The Enterprise Information Systems theme covers the data management technologies that underpin enterprise systems, and related techniques for database design, data integration and data analysis. The Enterprise Information Systems theme builds on the Group Project in the first year:
  - Year 2: Databases (10 Credits)
  - Year 3: Advanced Database Systems (10 Credits)
  - Year 3: Data Integration and Analysis (10 Credits)
Information Systems in Business

- Information Systems in Business addresses the role and impact of software systems within organisations. Many large scale software development projects fail either because business requirements, organisational structures or inter-organisational relationships are less than fully reflected in the design or deployment of the new software. The Information Systems in Business theme covers both the modelling and design of business information systems, and the context within which they must work. The Information Systems in Business theme builds on the Fundamentals of Information Systems course unit in the first year:
  - Year 2: Information Systems and Business Process Modelling (20 Credits)
  - Year 3: e-Business (10 Credits)
  - Year 3: Information Technology and Organisations (10 Credits)
Learning and Search in Artificial Intelligence

Learning and Search in Artificial Intelligence is concerned with constructing intelligent systems that can adapt to a changing and uncertain environment. Machine learning combines real-world data with flexible models to address a broad range of applications, including pattern recognition, robot navigation, game playing and financial prediction. Search methods are required to parameterize models, make optimal decisions and carry out intelligent actions. The Learning and Search in Artificial Intelligence theme builds on the Fundamentals of Artificial Intelligence course unit in the first year:

- Year 2: Machine Learning and Optimisation (10 Credits)
- Year 3: Probabilistic Modelling and Inference (10 Credits)
- Year 3: AI and Games (10 Credits)
Mobile Computing and Networks

- Mobile Computing and Networks is concerned with the provision of an infrastructure whereby distributed computational devices can co-operate efficiently and securely. Both wired and wireless networks are increasingly ubiquitous, and the importance of networked computing increases with the number and diversity of networked devices and mobile applications. The Mobile Computing and Networks theme builds on Fundamentals of Distributed Systems in the first year:
  - Year 2: Mobile Systems (10 Credits)
  - Year 2: Computer Networks (10 Credits)
  - Year 3: Digital Wireless Communications and Networks (10 Credits)
  - Year 3: Computer Networks and Security (10 Credits)
Natural Language, Representation and Reasoning

- Natural Language, Representation and Reasoning is concerned with techniques and tools for capturing and making use of knowledge in computer systems. Knowledge representation is important in many applications, from the description of web pages in the semantic web, to the interpretation of natural language statements in grammar checkers and machine translators. The Natural Language, Representation and Reasoning theme builds on Fundamentals of Artificial Intelligence in the first year:
  - Year 2: Symbolic AI (10 Credits)
  - Year 3: Knowledge Representation and Reasoning (10 Credits)
  - Year 3: Natural Language Engineering (10 Credits)
Programming and Algorithms

- Algorithms capture the way in which a problem is to be solved. As a result, algorithms are central to software development, and a wide range of techniques have been developed that underpin the design and analysis of algorithms. This theme explores a wide range of algorithms and data structures, investigates how their properties can be analysed systematically, and explores how they can be implemented efficiently. The Programming and Algorithms theme builds on Object-Oriented Programming in Java in the first year:
  - Year 2: Algorithms, Data Structures and Programming (20 Credits)
  - Year 3: Advanced Algorithms I (10 Credits)
  - Year 3: Advanced Algorithms II (10 Credits)
Rigorous Development

• Rigorous Development is concerned with techniques for specifying and analysing algorithms and systems, with a view to reaching a level of understanding that enables guarantees to be made about their behaviour. Rigorous Development is important as many applications of computer systems are both complex and safety critical, and thus stand to benefit from a systematic investigation of their properties. The Rigorous Development theme builds on Fundamentals of Computing in the first year:
  - Year 2: Logic and Modelling (10 Credits)
  - Year 3: Verified Development (10 Credits)
  - Year 3: Concurrency and Process Algebra (10 Credits)
Software Engineering

- Software Engineering is concerned with all aspects of software production, from the early stages of requirements gathering, through system design and implementation, to maintenance and evolution. Software Engineering is important because software projects many involve large teams of people, diverse or conflicting requirements, tight timescales and limited budgets. The Software Engineering theme provides practical experience in group development projects of a wide range of tools and techniques that have been developed with a view to supporting systematic software development. The Software Engineering theme builds on the Group Project in the first year:
  - Year 2: Software Engineering Project (20 Credits)
  - Year 3: Software Design Using Patterns (10 Credits)
  - Year 3: Software Quality (10 Credits)
Systems-on-Chip

- System-on-Chip involves the integration of the components in a computer or other electronic system into a single integrated circuit. System-on-Chip techniques are of increasing importance because they support the development of specialised embedded systems, such as MP3 players. The System-on-Chip theme explores the techniques used in digital system design and implementation, the languages used to express such designs, and design to support specific requirements such as low power. The System-on-Chip theme builds on Fundamentals of Computer Engineering in the first year:
  - Year 2: VLSI System Design (10 Credits)
  - Year 3: System-on-Chip modeling with SystemC (10 Credits)
  - Year 3: Implementing System-on-Chip Designs (10 Credits)
Visual Computing

- Visual Computing is concerned with all aspects of the acquisition, analysis and production of visual data. Visual Computing is important because numerous applications capture or present visual data. For example, visual data presentation is central in applications from scientific visualisation to games, and image capture and analysis is important in applications from face recognition to medical imaging. The Visual Computing theme introduces the theory and practice of 2 and 3 dimensional computer graphics, and explores the tools and algorithms of computer vision for recognising and interpreting features in images or sequences of images. The Visual Computing theme builds on Object-Oriented Programming in Java in the first year:
  - Year 2: Computer Graphics and Image Processing (10 Credits)
  - Year 3: Advanced Computer Graphics (10 Credits)
  - Year 3: Computer Vision (10 Credits)
Web and Distributed Systems

- Web and Distributed Systems are among the most widely used computing systems, and are increasingly central to commercial, educational and leisure activities. However, the design and development of efficient, robust and scaleable distributed systems presents many challenges. The Web and Distributed Systems theme provides experience on the principles, techniques and methods of distributed computing, and explores the concepts and technologies that support web applications. The Web and Distributed Systems theme builds on Fundamentals of Distributed Systems in the first year:
  - Year 2: Distributed Systems Development (10 Credits)
  - Year 3: Engineering Web Applications (10 Credits)
  - Year 3: Web Data and Services: the Semantic Wave (10 Credits)
Relating Themes to Programmes

• All students complete some themes; by this means all students obtain depth in their final year.

• All programmes include a choice of relevant themes.
Computer Science

- Students on the Computer Science programme must complete at least two themes.
Students on the Software Engineering programme must complete at least two of the following themes:

- Agile Methods.
- Software Engineering.
- Rigorous Development.
Artificial Intelligence

- Students on the Artificial Intelligence programme must complete at least two of the following themes:
  - Learning and Search in Artificial Intelligence.
  - Natural language, Representation and Reasoning.
  - Visual Computing.
Distributed Computing

• Students on the Distributed Computing programme must complete at least two of the following themes:
  - Mobile Computing and Networks.
  - Rigorous Development.
  - Web and Distributed Systems.
Computing for Business Applications

• Students on the Computing for Business Applications programme must complete:
  - Information Systems in Business.

• Together with at least one of the following themes:
  - Agile Methods.
  - Enterprise Information Systems.
  - Software Engineering.
Computer Science and Mathematics

• Students on the Computer Science and Mathematics programme must complete at least one theme in Computer Science.
Computer Science with Business and Management

• Students on the Computer Science with Business and Management programme must complete at least one theme in Computer Science.
Themes Not Named in Some Programme

The following are not named parts of any specific programme:

- Computer Languages.
- Programming and Algorithms.

System-on-Chip and Computer Architecture are implicitly part of Computer Systems Engineering.
Years and Course Units

- The following slides describe:
  - The purpose of each year.
  - The course units in each year.
Second Year: Breadth

- Develop core skills on foundation from first year:
  - Software engineering project.
  - Algorithms and imperative programming.
- Core material that forms the starting point for themes and allows selection from across the discipline.
# Second Year Options

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Third Year: Depth

• Depth through themes:
  - Everyone specialises to some extent, by following selected themes to completion.

• Wider exposure to advanced topics by:
  - Following parts of some themes.
  - Taking Advanced Topics Workshops.
Advanced Topics Workshops

- Observation: themes increase coherence, but reduce flexibility and strengthen the core at the expense of the edges.

- The Advanced Topics Workshops provide a flavour of different less-core topics.
Example Format

• In the following format:
  - Each workshop involves 5 credits worth of material.
  - Students take 2 workshops (10 Credits) or 4 workshops (20 Credits).

• Format:
  - Semester 1:
    • Weeks 1-6: Workshop 1, Workshop 2.
    • Weeks 7-12: Workshop 3, Workshop 4.
  - Semester 2:
    • Weeks 1-6: Workshop 5, Workshop 6.
    • Weeks 7-12: Workshop 7, Workshop 8.
Examples of Possible Topics for Workshops

- Computational biology.
- Medical informatics.
- Optical computing.
- Research seminar series.
- Robotics.
- ...

Fourth Year: MEng

- Provide comprehensive coverage of selected topics:
  - Design themes at masters level that follow on naturally from those at third year, but without dependencies.
## Third Year Options (2010)

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Calculating the final degree mark

- The mark for each year is calculated from the unit marks using the credit weightings.
- The second and third year marks are combined in the ratio 1:3.
Questions?