SYLLABUSES FOR THE DEGREE OF
MASTER OF SCIENCE IN COMPUTER SCIENCE

The curriculum extends over two to three academic years of part-time or one to two academic years of full-time study.

The following is a list of modules offered by the Department of Computer Science. The list below is not final and some modules may not be offered every year. Candidates may also, in exceptional circumstances, select at most 2 modules from the syllabuses for the degree of MSc(Eng) and that for the degree of MSc(ECom&IComp), subject to approval of the Head of the Department or Course Co-ordinator concerned, and in accordance with the provisions of Regulation MCS 6(b).

Candidates who have failed to satisfy the examiners for the Degree of Master of Science in Computer Science may on termination of their study be awarded a Postgraduate Diploma in Science (Computer Science), subject to approval of the Faculty Board.

COMP7102. Transaction processing

The goal is to study the fundamentals of database transaction processing, with emphasis on advanced transaction processing techniques. Topics may include serializability theory, concurrency control protocols, database recovery protocols, distributed transaction processing, real-time databases.

COMP7103. Data mining

Data mining is the automatic discovery of statistically interesting and potentially useful patterns from large amounts of data. The goal of the course is to study the main methods used today for data mining and on-line analytical processing. Topics include Data Mining Architecture; Data Preprocessing; Mining Association Rules; Classification; Clustering; On-Line Analytical Processing (OLAP); Data Mining Systems and Languages; Advanced Data Mining (Web, Spatial, and Temporal data).

COMP7201. Analysis and design of enterprise applications in UML

This course presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include overview of object-oriented concepts; Unified Modelling Language (UML); object modelling using use cases and class diagrams; dynamic modelling using sequence, interaction and state diagrams; mapping object models to implementation models such as relational databases; and current trends in object technologies, such as components, design patterns and XML. Emphasis will be given on hands-on exercises with the use of CASE tools.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7202. Software quality assurance
This course presents current issues and solutions for ensuring the quality of enterprise systems. Topics include software quality concepts; software quality models; requirements tracking and management; code quality; reviews and inspections; software testing; software quality metrics and measurement; version control and configuration management; and software process improvement.

Prerequisites: A course in object-oriented programming and a course in software engineering or systems analysis and design.

COMP7203. Modern software design

The practice of software design has changed markedly in recent years as new approaches to design have gained broad acceptance and several have progressed to become mainstream techniques themselves. This course introduces the principles and practical application of these modern approaches. It first reviews the goals of software design and the qualities that differentiate good designs from bad ones. From this foundation it teaches domain-driven design, design patterns and anti-patterns, refactoring, refactoring to patterns, test-driven design, design for test, and design techniques for frameworks. There is an emphasis on implementation issues and programming idioms and effective use of the language are introduced where appropriate.

Prerequisites: The course requires the ability to program in Java. Student should also have a basic understanding of the UML class and sequence diagrams.

COMP7204. Project management

A disciplined project management approach is one of the critical success factors to project success. This course provides students with an insight and appreciation of the project management framework as advocated by Project Management Institute (PMI). These industry best practices are being recognized as US national standards by ANSI. The course is intended to offer a combination of lectures on project management concepts / theories, as well as experience sharing by the instructor and guest speakers. Topics include the studies of most of the nine knowledge areas, such as Scope Management, Time Management, Cost Management, Risk Management, Communications Management, Human Resource Management, Project Leadership and PMO. This will enrich students’ understanding of the subject matter with the opportunities to participate in an interactive learning environment under a classroom setting.

COMP7205. Enterprise architecture

This course aims to teach students the practical skills in modeling and developing enterprise IT architectures. It covers different enterprise architecture frameworks, methodologies and practices (such as TOGAF and Zachman). Students will also learn common enterprise integration patterns for implementation of complex enterprise applications based on Service-Oriented Architecture (SOA). New architecture trends (e.g., cloud computing, shared-nothing architecture, column-based database) will also be introduced.

COMP7301. Computer and network security

The aim of the course is to introduce different methods of protecting information and data in computer and information systems from unauthorized disclosure and modification. Topics include
COMP7302. Pervasive and mobile computing

Pervasive computing, often synonymously called ubiquitous computing, is to create ambient intelligence where network devices embedded in the environment provide unobtrusive connectivity and services all the time. These intelligent devices work cooperatively and autonomously to collect, process and transport information, in order to adapt to the associated context and activity, thus improving human experience and quality of life. In this course, we will study the following topics: (1) Software infrastructure for pervasive computing, (2) Sensors architecture and embedded OS, (3) Data routing protocols for wireless sensor networks, (4) Discovery protocols for spontaneous interaction between appliances and services, (5) Context modeling and reasoning techniques for realizing context-aware applications, and (6) Security and privacy solutions to protect access to user context information. Students are expected to complete a context-aware mobile application in a J2ME or Android platform.

Prerequisites: Students are required to have at least one course in networking and operating systems. Programming experience in Java is required.

COMP7303. High-performance computing

This module offers an overview of state-of-the-art parallel architectures and programming languages. The students will learn the issues related to the performance of parallel algorithms, and how to design efficient parallel algorithms for parallel machines. Topics include milestones in the history of HPC and its applications; high-performance computing architectures; performance law; modern CPU design; interconnection network and routing techniques; memory hierarchy and cache coherence protocol; parallel algorithm design; parallel programming models and case studies of supercomputers.

COMP7304. The wireless Internet and mobile network

This module offers students an opportunity to understand the principles and technologies behind data services in a wireless, mobile environment. It introduces the developing areas of mobile computing technology and applications. Topics include key features of 1G, 2G, and 3G mobile technology; wireless LANs; personal area networks and Bluetooth; ad hoc networks; mobile IP, DHCP, IPv6; TCP over wireless; proxy systems; web surfing and WAP; mobile file systems; privacy, authentication, security; mobility and location-dependent/personalized wireless applications.

COMP7305. Cluster and cloud computing

This module offers an overview of current cluster and cloud technologies, and discusses various issues in the design and implementation of cluster and cloud systems. Topics include cluster hardware architecture (e.g., multicore, GPU, high-speed network), middleware design for realizing the concept of single system image (e.g., software distributed shared memory, cluster file systems) and virtualization techniques (e.g., Xen, KVM, Hyper-V) used in current data centers. We will also discuss three types of Cloud computing platforms, including SaaS, PaaS, and IaaS, by providing
motivating examples from companies such as Google, Amazon, and Microsoft; and introduce Map/Reduce programming paradigm for large-scale data analysis. Students will be organized into groups for their project work and in-class presentations.

Prerequisites: The students are expected to exercise the systems configuration and administration under a Linux cluster. Basic understanding of Linux operating system and some experiences in system level programming (C/C++ or Java) are required.

COMP7306. Web technologies

This course aims to give students a basic understanding of various Web technologies and their industry applications. Fundamental XML concepts and techniques, such as XML Schema, XSLT, SAX, and DOM, will be introduced. New technologies related to Web 2.0, web services, service oriented architecture (SOA), and cloud computing will be studied, including RSS, ATOM, Ajax, SOAP, WSDL, ebXML.

Prerequisites: basic web programming knowledge, e.g. HTML, JavaScript, and Java.

COMP7307. Advanced real-time embedded systems and applications

This module’s objective is to introduce advanced real-time scheduling techniques, design and implementation considerations for Embedded Systems. It covers topics on real-time scheduling algorithms, microcontroller architecture, Digital Signal Processors (DSP) architecture, System-on-Chips (SoC), real-time operating systems, and case studies on real-time applications.

Prerequisites: COMP0230 “Operating systems” or equivalent

COMP7403. Computational molecular biology

To introduce computational methods for analyzing DNA, RNA and protein sequences. Topics include basics of molecular biology; biological sequence analysis; physical mapping; gene finding; gene rearrangement; secondary structure prediction and phylogeny.

COMP7502. Image processing and computer vision

To study the theory and algorithms in image processing and computer vision. Topics include image representation; image enhancement; image restoration; mathematical morphology; image compression; scene understanding and motion analysis.

COMP7503. Multimedia technologies

To study selected topics of multimedia technologies in depth. Topics vary, and may include compression algorithms, psychoacoustics, psychovision, storage systems, and media streaming.
COMP7504. Pattern recognition and applications

To study techniques in pattern recognition. Topics include statistical decision theory; density estimation; dimension reduction; discriminant functions; unsupervised classification and clustering; neural network; hidden Markov model; and selected applications in pattern recognition such as characters and speech recognition.

COMP7505. User interface design and development

For technology products and services, the user experience is the key to success. With the advanced development of processors, sensors, devices, algorithms and software tools, more possibilities of user interface can be created to improve or solve the human machine interface and operations. The course will study various input and output devices, software and hardware considerations, use case investigations.

COMP7506. Smart phone apps development

Smart phones have become very popular in recent years. For iPhones alone, 50,000,000 pieces were sold worldwide in 2009. In addition to iPhones, there are also Android phones, Symbian phones as well as Windows phones. Smart phones play an important role in mobile communication and applications.

Smart phones are powerful as they support a wide range of applications (called apps). Most of the time, smart phone users just purchase their favorite apps wirelessly from the vendors. There is a great potential for software developer to reach worldwide users.

This course aims at introducing the design issues of smart phone apps. For examples, the smart phone screen is usually much smaller than the computer monitor. We have to pay special attention to this aspect in order to develop attractive and successful apps. Different smart phone apps development environments and programming techniques (such as Objective-C for iPhones and Java for Android) will be introduced to facilitate students to develop their own apps.

COMP7601. Algorithms

To provide students a deep understanding of the techniques for algorithm design and analysis. Typical topics include advanced data structures, design techniques like recursion; dynamic programming and greedy algorithms; correctness and analysis of algorithms; NP-completeness; randomized algorithms; online algorithms and approximation algorithms.

COMP7702. Project (4 modules)

Candidate will be required to carry out independent work on a major project that will culminate in the writing of a dissertation.

COMP7801. Topic in computer science
Selected topics that are of current interest will be discussed.

COMP7802. Introduction to financial computing

This module introduces the students to various different aspects of financial computing in the investment banking area. The topics include financial modeling, real time risk management, and from Excel to multi-tier financial system. Financial engineering is an area of growing demand. The module is a combination of financial knowledge, mathematics and computational techniques. This module will be suitable for students who want to pursue a career in this fast growing area.

This is a very practical course. There is no assignment and final exam. You will be expected to complete a final project, to be done individually or as a group.

Prerequisites: This module does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in at least one object-oriented programming language/system is required to complete the final project.

COMP7804. E-commerce security cases and technologies

This module provides students knowledge about modern e-commerce security, through the study of various cases. It covers fundamental concepts in security technology so as to equip the students with enough background knowledge in security, and then covers the impact of the modern e-commerce environment to the changing demand of security. After that a bundle of cases will be covered, including cases in communication security, cases in Internet security, cases in data security including personal data protection in both client-side and server-side, and application security cases. With the experience of studying these cases, the students will be asked to assess or design security solutions to some given e-commerce security problems, so as to acquire the ability to apply the learnt security technology to real-life cases.

Research Oriented Courses

The exact topics and contents of these modules may vary from year to year. Interested students should refer to the programme's online pages (http://www.cs.hku.hk/msc) for further information.

COMP8101. Advanced topics in data engineering

This course will discuss and study research topics and current problems of interest in the field of data engineering.

COMP8201. Advanced topics in software engineering

This course will discuss and study research topics and current problems of interest in the field of software engineering.

Prerequisite: A course in object-oriented programming.

COMP8301. Advanced topics in computer systems

This course will discuss and study research topics and current problems of interest in the field of
computer systems.

COMP8501. Advanced topics in computer graphics

This course will discuss and study research topics and current problems of interest in the field of computer graphics. The emphasis is put on geometric modeling and applications of geometry in computer graphics.

COMP8502. Advanced topics in pattern recognition

This course will discuss and study research topics and current problems of interest in the field of pattern recognition.

COMP8503. Advanced topics in visual analytics

This course presents the theory, algorithms and applications of visual analysis and information visualization. Main topics to be included: basic charts and graphs; hierarchical structure visualization; graph drawing; network visualization; focus+context; database visualization; clustering; multidimensional scaling; manifold learning; anomaly detection.

COMP8601. Advanced topics in theoretical computer science

This course will discuss and study research topics and current problems of interest in theoretical computer science.

COMP8801. Advanced topics in computer forensics and security

This course is concerned with advanced technologies in computer forensics and security. Students will learn about the similarities and differences between computer forensics and computer security; current issues in different security technologies, as well as the application of those techniques and others to various kinds of computer forensics related problems.

Pre-requisites:
(1) COMP0327 "Computer and network security" or equivalent
(2) COMP0230 "Principles of operating systems" or equivalent