MSc(CompSc) List of courses offered in 2019-2020

(The list below is NOT finalized)

COMP7103. Data mining (6 credits)

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).

COMP7104. Advanced database systems (6 credits)

The course will study some advanced topics and techniques in database systems, with a focus on the aspects of big data analytics, algorithms, and system design & organisation. It will also survey the recent development and progress in selected areas. Topics include: query optimization, spatial-spatiotemporal data management, multimedia and time-series data management, information retrieval and XML, data mining.

COMP7201. Analysis and design of enterprise applications in UML (6 credits)

This course presents an industrial-strength approach to software development based on the object-oriented modelling of business entities. Topics include: overview of software engineering and object-oriented concepts; unified process and Unified Modelling Language (UML); use-case modelling and object modelling; dynamic modelling using sequence diagrams and state machines; object-oriented design; user interface design; introducing design patterns and enterprise applications; shortcomings of UML and remedies. 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.

COMP7305. Cluster and cloud computing (6 credits)

This course offers an overview of current cloud technologies, and discusses various issues in the design and implementation of cloud systems. Topics include cloud delivery models (SaaS, PaaS, and IaaS) with motivating examples from Google, Amazon, and Microsoft; virtualization techniques implemented in Xen, KVM, VMWare, and Docker; distributed file systems, such as Hadoop file system; MapReduce and Spark programming models for large-scale data analysis, networking techniques in hyper-scale data centers. The students will learn the use of Amazon EC2 to deploy applications on cloud, and implement a novel cloud computing application on a Xen-enabled PC cluster as part of their term project.
Prerequisites: The students are expected to install various open-source cloud software in their Linux cluster, and exercise the system configuration and administration. Basic understanding of Linux operating system and some programming experiences (C/C++, Java, or Python) in a Linux environment are required.

**COMP7308. Introduction to unmanned systems (6 credits)**

To study the theory and algorithms in unmanned systems. Topics include vehicle modelling, vehicle control, state estimation, perception and mapping, motion planning, and deep learning related techniques.

**COMP7309. Quantum computing and artificial intelligence (6 credits)**

This course offers an introduction to the interdisciplinary fields of quantum computation and quantum AI. The focus will lie on an accessible introduction to the elementary concepts of quantum mechanics, followed by a comparison between computer science and information science in the quantum domain. The theoretical capability of quantum computers will be illustrated by analyzing fundamental algorithms of quantum computation and its potential applications in AI. Finally, the ethics of quantum computation and the potential impact of quantum computers on society will be discussed.

**COMP7404. Computational intelligence and machine learning (6 credits)**

This course will teach a broad set of principles and tools that will provide the mathematical, algorithmic and philosophical framework for tackling problems using Artificial Intelligence (AI) and Machine Learning (ML). AI and ML are highly interdisciplinary fields with impact in different applications, such as, biology, robotics, language, economics, and computer science. AI is the science and engineering of making intelligent machines, especially intelligent computer programs, while ML refers to the changes in systems that perform tasks associated with AI. Ethical issues in advanced AI and how to prevent learning algorithms from acquiring morally undesirable biases will be covered.

Topics may include a subset of the following: problem solving by search, heuristic (informed) search, constraint satisfaction, games, knowledge-based agents, supervised learning, unsupervised learning; learning theory, reinforcement learning and adaptive control and ethical challenges of AI and ML.

Pre-requisites: Nil, but knowledge of data structures and algorithms, probability, linear algebra, and programming would be an advantage.

**COMP7405. Techniques in computational finance (6 credits)**

This course introduces the major computation problems in the field of financial derivatives and various computational methods/techniques for solving these problems. The lectures start with a short introduction on various financial derivative products, and then move to the derivation of the mathematical models employed in the valuation of these products, and finally come to the solving techniques for the models.

Pre-requisites: No prior finance knowledge is required. Students are assumed to have basic competence in calculus and probability (up to the level of knowing the concepts of random
variables, normal distributions, etc.). Knowledge in at least one programming language is required for the assignments/final project.

COMP7407. Securities transaction banking (6 credits)
The course introduces the business and technology scenarios in the field of Transaction Banking for financial markets. It balances the economic and financial considerations for products and markets with the organizational and technological requirements to successfully implement a banking function in this scenario and is a crossover between studies of economics, finance and information technology.

COMP7408. Distributed ledger and blockchain technology (6 credits)
In this course, students will learn the key technical elements behind the blockchain (or in general, the distributed ledger) technology and some advanced features, such as smart contracts, of the technology. Variations, such as permissioned versus permissionless and private blockchains, and the available blockchain platforms will be discussed.

Students will also learn the following issues: the security, efficiency, and the scalability of the technology. Cyber-currency (e.g. Bitcoin) and other typical application examples in areas such as finance will also be introduced.

Prerequisites: COMP7906 Introduction to cyber security or ICOM6045 Fundamentals of e-commerce security

COMP7502. Image processing and computer vision (6 credits)
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 (6 credits)
This course presents fundamental concepts and emerging technologies for multimedia computing. Students are expected to learn how to develop various kinds of media communication, presentation, and manipulation techniques. At the end of course, students should acquire proper skill set to utilize, integrate and synchronize different information and data from media sources for building specific multimedia applications. Topics include media data acquisition methods and techniques; nature of perceptually encoded information; processing and manipulation of media data; multimedia content organization and analysis; trending technologies for future multimedia computing.

COMP7506. Smart phone apps development (6 credits)
Smart phones have become very popular in recent years. According to a study, by 2020, 70% of the world's population is projected to own a smart phone, an estimated total of almost 6.1 billion smartphone users in the world. 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. Various modern smart phone apps development environments and programming techniques (such as Java for Android phones and Swift for iPhones) will also be introduced to facilitate students to develop their own apps.

Students should have basic programming knowledge.

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**COMP7507. Visualization and visual analytics (6 credits)**

This course introduces the basic principles and techniques in visualization and visual analytics, and their applications. Topics include human visual perception; color; visualization techniques for spatial, geospatial and multivariate data, graphs and networks; text and document visualization; scientific visualization; interaction and visual analysis.

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**COMP7606. Deep learning (6 credits)**

Machine learning is a fast growing field in computer science and deep learning is the cutting edge technology that enables machines to learn from large-scale and complex datasets. Ethical implications of deep learning and its applications will be covered first and the course will focus on how deep neural networks are applied to solve a wide range of problems in areas such as natural language processing, image processing, financial predictions, game playing and robotics. Topics covered include linear and logistic regression, artificial neural networks and how to train them, recurrent neural networks, convolutional neural networks, deep reinforcement learning, and unsupervised feature learning. Popular deep learning software, such as TensorFlow, will also be introduced.

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**COMP7801. Topic in computer science (6 credits)**

Selected topics that are of current interest will be discussed.

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**COMP7802. Introduction to financial computing (6 credits)**

This course introduces the students to different aspects of financial computing in the investment banking area. The topics include yield curve construction in practice, financial modelling and modern risk management practice, etc. Financial engineering is an area of growing demand. The course is a combination of financial product knowledge, financial mathematics and computational techniques. This course will be suitable for students who want to pursue a career in this fast growing area.

Prerequisites: This course does not require any prior knowledge in the area of finance. Basic calculus and numeric computational techniques are useful. Knowledge in Excel spreadsheet operations is required to complete the assignments and final project.
COMP7901. Legal protection of digital property (6 credits)

This course introduces computer professionals to the various legal means of protecting digital property including computer software, algorithms, and any work or innovation in digital form. Focus is on the main issues in protecting digital property arising from developments in information technology, and their legal solutions. Topics covered include, but are not limited to, the following: 1) Copyright protection of software and websites, 2) Patent protection of software and algorithms, 3) Criminal sanctions against offences involving the digital technology.

Mutually exclusive with: ECOM6004 Legal aspects of IT and e-commerce

COMP7903. Digital investigation and forensics (6 credits)

This course introduces the fundamental principles of digital investigation and forensics. The course starts with a brief introduction to common computer crimes and digital evidence, and then moves on to the computer basics and network basics pertaining to digital forensics, and finally comes to the techniques for digital investigation and forensic examination.

COMP7904. Information security: attacks and defense (6 credits)

This is an ethical hacking course. In this course, we will teach students how to conduct ethical hacking so as to better protect a computer system in a company. Topics include physical security, password cracking, network hacking, operating system hacking, and application hacking. The course will also discuss R&D problems related to hacking and defense. The course will try to strike a balance between theory and practice so that students can understand the theories behind the hacking process as well as get enough hands-on exercises to perform ethical hacking and defense.

Prerequisites: Students are expected to have knowledge in university level mathematics and systems plus experience in programming.

COMP7905. Reverse engineering and malware analysis (6 credits)

This course provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases and hand-on analysis of malware samples. It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks. Various malware incidents will be covered, such as cases in Ransomware, banking-trojan, state-sponsored and APT attacks, cases in Stuxnet and malicious software attacks on Industrial Control System and IoT devices. With the experience of studying these cases and analyzing selected samples, the students will be able to understand the global cyber security landscape and its future impact. Hands-on exercises and in-depth discussion will be provided to enable students to acquire the required knowledge and skill set for defending and protecting an enterprise network environment.

Students should have programming/development skills (Assembly, C, C++, Python) and knowledge in Operating System and computer network.
COMP7906. Introduction to cyber security (6 credits)

The aim of the course is to introduce different methods of protecting information and data in the cyber world, including the privacy issue. Topics include introduction to security; cyber attacks and threats; cryptographic algorithms and applications; network security and infrastructure.

Mutually exclusive with: ICOM6045 Fundamentals of e-commerce security

COMP7704. Dissertation (24 credits)

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

COMP7705. Project (12 credits)

Candidate will be required to carry out independent work on a major project under the supervision of individual staff member. A written report is required.