

FACULTY OF COMPUTER SCIENCE
AND INFORMATION TECHNOLOGY
UNIVERSITI PUTRA MALAYSIA



POSTGRADUATE PROGRAMMES BY RESEARCH

MASTER OF SCIENCE
DOCTOR OF PHILOSOPHY



Introduction

The Master of Science (MSc.) and Doctor of Philosophy (PhD) programmes provide students with specialisation education in the various fields of computer science. This is achieved through the completion of academic coursework in the major fields with an independent research project. A student pursuing a Master of Science programme may complete the programme after a minimum period of one year and a maximum period of three years, while a PhD student may complete the programme after a minimum period of two years and a maximum period of five years.

Fields of Study

1. Computer Graphics
2. Computer Networks
3. Computer Vision
4. Data Science
5. Database Systems
6. Human Computer Interaction
7. Information Retrieval
8. Information Systems
9. Intelligent Systems
10. Multimedia Computing
11. Parallel and Distributed Computing
12. Security in Computing
13. Software Engineering

Entrance Requirements

a) Master of Science programme:

- i. Bachelor's degree or equivalent, in computing, science and technology or related to computing, with a minimum CGPA 3.00; or
- ii. Bachelor's degree or equivalent, in computing, science and technology or related to computing with a CGPA of 2.75 – 2.99 may be considered based on a minimum of 3 years of work experience in the related field; or
- iii. Bachelor's degree or equivalent, in computing, science and technology or related to computing with a CGPA of 2.000 – 2.749 may be considered based on a minimum of 5 years of work experience in the related field

b) Doctor of Philosophy programme:

The applicant should possess:

- i. A Master's Degree or its equivalent in the field related to the field of PhD applied for AND candidates must have completed at least one (1) of their earlier Degrees (Master's or Bachelor's) in Computing or related to computing; or
- ii. Bachelor's degree with a minimum CGPA 3.75 or equivalent to a First Class Bachelor's Degree and passed a rigorous internal assessment.

English Language Requirement

International applicants must have obtained a minimum score of 550 for the TOEFL Paper-based Test (Academic Version) or Band 6.0 for IELTS (Academic Training), or 79-80 for TOEFL Internet-based Test (Academic Version) or Level 109 for CIEP at ELS Language Centre.

Programmes Offered by Semester

First and Second Semester of every year.

a) Credit Requirements for **Master of Science** programme

A master student is required to register and pass six (6) credit hours of courses:

- i. A research methodology course; and
- ii. Any course listed by the Faculty.

Other Requirements

1. SPS5903 Seminar

- A Master student is required to take the SPS5903 course, which is a presentation of a research proposal (1 credit).
- The course should be registered at least on or before the 2nd semester.
- Each student is required to present his/her research proposal at the 'Proposal Defense Seminar'.
- The supervisory committee and an independent member will evaluate the proposal.
- The proposal report and similarity report (generated by Turnitin) should be sent to the supervisory committee not later than two (2) weeks before the date of presentation.
- The seminar will be held not later than the 15th week of a semester.
- This course will be evaluated as satisfactory (M) or unsatisfactory (TM) grade.

2. SPS5999 Master Research

A Master student is required to register the SPS5999 Master Research every semester. This is a research project whereby at the end of the study period the candidate will submit a thesis. The thesis will be examined, and a viva voce will be conducted to determine the student's competency in the field of study.

3. Literature Review Seminar

- The seminar will be held not later than the 15th week of a semester.
- Advisor / supervisor and at least one appointed assessor will evaluate the presentation.
- Students must produce a manuscript report on Literature Review and submit to the advisor/supervisor not later than one week after the date of presentation.
- Students are also required to submit the similarity report (generated using the plagiarism checking software such as Turnitin) together with the manuscript.
- Advisor / supervisor will evaluate the suitability of a manuscript to be sent at least to an international conference.
- Failure to present and / or submit the manuscript report on Literature Review shall result in an unsatisfactory (TM) grade for the SPS5999.

b) Credit Requirements for a **Doctor of Philosophy** programme

A PhD student is required to register and pass nine (9) credit hours of courses:

- i. A research methodology course; and
- ii. Any two (2) course listed by the Faculty.

Other Requirements

1. SPS6903 Seminar

- A PhD student is required to take the SPS6903 course, which is a presentation of a research proposal (1 credit).
- The course should be registered at least on or before the 2nd semester.
- Each student is required to present his/her research proposal at the 'Proposal Defense Seminar'.
- The supervisory committee and an independent member will evaluate the proposal.
- The proposal report and similarity report (generated by Turnitin) should be sent to the supervisory committee not later than two (2) weeks before the date of presentation.
- The seminar will be held not later than the 15th week of a semester.
- This course will be evaluated as satisfactory (M) or unsatisfactory (TM) grade.

2. Comprehensive Examination

Students pursuing a doctoral programme must pass the comprehensive examination (both written and oral examinations), which should be taken only after completion of all coursework required for the programme, within four semesters.

3. SPS6999 Doctoral Research

The PhD candidate is required to register the SPS6999 Doctoral Research every semester. This is a research project whereby at the end of the study period, the candidate will submit a thesis. The thesis will be examined, and a viva voce will be conducted to determine the student's competency in the field of study.

4. Literature Review Seminar

- The seminar will be held not later than the 15th week of a semester.
- Advisor /supervisor and at least one appointed assessor will evaluate the presentation.
- Students must produce a manuscript report on Literature Review and submit to the advisor/supervisor not later than one week after the date of presentation.
- Students are also required to submit the similarity report (generated using the plagiarism checking software such as Turnitin) together with the manuscript.
- Advisor /supervisor will evaluate the suitability of a manuscript to be sent at least to an international conference.
- Failure to present and / or submit the manuscript report on Literature Review shall result in an unsatisfactory (TM) grade for the SPS6999.



Computer Graphics

Computer graphics is a sub-field of Computer Science which studies methods for digitally synthesizing and manipulating visual content. Although the term often refers to the study of three-dimensional computer graphics, it also encompasses two-dimensional graphics and image processing. Computer graphics studies the manipulation of visual and geometric information using computational techniques. It focuses on the mathematical and computational foundations of image generation and processing rather than purely aesthetic issues. Computer graphics is often differentiated from the field of visualization, although the two fields have many similarities. Connected studies include:

- Applied mathematics
- Computational geometry
- Image processing
- Information visualization
- Science visualization

Applications of computer graphics include:

- Digital Art
- Special effects
- Video games
- Visual effects
- Augmented Reality
- Virtual Reality

Computer Networks

This area encompasses research areas governing various domains of computer networks which include real-time systems, advanced computer networks, performance modeling of communication networks, network security, mobile and wireless, internetworking, network management, network design, satellite communication and optical communication.

Computer Vision

Computer vision is an interdisciplinary field that deals with how computers can be made for gaining high-level understanding from digital images or videos. From the perspective of Computer Science, it seeks to automate tasks that the human visual system can do. Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of a theoretical and algorithmic basis to achieve automatic visual understanding. As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

Connected studies include:

- Image processing
- Image analysis
- Pattern Recognition

Applications of computer vision include:

- Biometrik
- Industrial Robot
- Autonomous Vehicle
- Medical imaging
- Surveillance
- Camera tracking

Data Science

Data science is an emerging research area concerned with extracting knowledge and value from data. Data science employs techniques and theories drawn from many fields within the broad areas of mathematics, statistics, information science, and computer science, including signal processing, probability models, machine learning, statistical learning, data mining, database, data engineering, pattern recognition and learning, visualization, predictive analytics, uncertainty modeling, data warehousing, data compression, computer programming, artificial intelligence, and high performance computing. Methods that scale to big data are of particular interest in data science, although the discipline is not generally considered to be restricted to such big data, and big data solutions are often focused on organizing and preprocessing the data instead of analysis. Whilst data engineering is an established research area concerned with data intensive systems and algorithms, e.g., practical solutions for big data, it is a core discipline of data science, and as such is facing many new challenges, both in leveraging existing techniques in the context of classical data analytics, as well as in developing new techniques for the novel types of analytics that have become possible because of increased data storage.

Database Systems

A database has always been a crucial component in any information system. Current trends have shown the transition from the traditional centralized-relational database approach to more advanced databases. Research in database includes the following leading sub-areas: semantic web; database (centralised, distributed, parallel, mobile, multimedia, bio-medical); data quality; data warehouse; query formulation, processing and optimisation; integrity, integration, privacy and security in databases; applications, models and frameworks for e-commerce, e-governance; and ontology management.

Human-Computer Interaction

Human-Computer Interaction focuses on the models, theories and practical insights of human-human interaction, human-computer interaction and system development. This area also addresses world issues and the interaction of technology and capacity to identify the needs of specific user groups such as the elderly, the disabled and children other than general users. The core areas include design methodologies (e.g. user-centered design, activity theory, design principle and guidelines, software engineering methods); usability studies and evaluation (e.g. usability metrics; web usability); user experience (e.g. human psychology and behaviour, accessibility and enjoyability); social interaction design (e.g. computer-supported collaborative work); ubiquitous computing (e.g. haptic interaction, wearable computing, mixed reality); innovative learning (e.g. mobile learning, active learning, blended learning); multimodal interaction (e.g. data handling or exchange, tangible interfaces, gesture and sign languages in interaction, gaze/eye-movement interaction); interactive technology (e.g. tabletops and interactive surfaces, tablets, smart devices); web hypermedia technology and applications (e.g. web personalisation, user profiling and modeling, navigation and hyperlink, web interaction design); ethics and safety issues in Human-Computer Interaction.

Information Retrieval

This research area focuses on the theory and foundation, techniques and applications of information retrieval (IR). It includes researches on document representation and content analysis/modeling, queries and relevance feedback, users and interactive IR, retrieval models and ranking, search engine architecture and scalability issues, information filtering and recommendation, evaluation aspect of IR, social media search and Web IR, XML and semantic search, and other application of IR such as digital libraries, mobile search and online advertising. This area will also cover a variety of search-related research topics applied to a broad range of unstructured data including text, images, video, audio, and recorded speech.

Connected studies include:

- Sentiment Analysis
- Text Mining
- Multimedia Analytics
- Natural Language Processing
- Semantic Technology
- Multimedia Information Retrieval
- Search Engine Architecture
- Recommendation System

Information Systems

This area focuses on studies that are related to information systems environment in the organization by emphasising on core aspects such as strategic information systems planning, web-based information systems, knowledge management systems, management and enterprise information systems, information systems and business intelligence, e-commerce, techniques and methods of integrated information systems development, management of information technology, data warehousing and data mining.

Intelligent Systems

Intelligent Systems seeks to undertake research in the theory, design, implementation, and application of intelligent computing. This includes establishing new techniques that can intelligently transform massive data into useful information and knowledge; surveying techniques in genetic algorithms, swarm optimization theory, ant colony optimization; demonstrating their uses and capabilities; studying agent semantics and ontology; interacting within multi-agent systems, mobile computation, social networking and knowledge sharing; research in text mining, semantics, and natural language processing which focuses on intelligent content analysis by developing efficient algorithms to process texts and to make their information understandable across computer application;

developing and applying state-of-the-art mathematical and computer science techniques to problems now arising in the life sciences, particularly those now appearing in the post-genomic era. Intelligent systems also pursue research on finding methods for implementation of an intelligent solution for embedded systems that can be utilized in robotics and smart devices. Research in intelligent systems covers the following sub-areas: data mining, intelligent agents, evolutionary computation and optimisation, computational linguistics, bioinformatics, semantics, text mining, natural language processing, and embedded systems.

Multimedia Computing

This research area covers research on algorithm for enriching, accessing, and searching large quantities of data. The algorithm focuses on the core of the search engine and the predetermined scale-oriented system based on user needs and solves the problems faced by providers and services. This field also includes the analysis of multimedia data required in various fields such as health, telecom and geoscience, technology development for optimum iterations with a large collection of multimedia data (eg, images, videos and music) in a real-world context. Research activities will involve a combination of mathematical models, machine learning techniques, and practical skills in algorithm development and evaluation. Current research activities include image / video content analysis such as object detection and identification, for example, brands and products in social networks, human parsing in image / video / sensor signals such as generating world-class athletes estimates, learning machines for multi-modal data, and replacements automatic shredded documents, which should deal with image, textual and other content.

Related studies include:

- Access of Multimedia Information
- Interaction with Multimedia Content
- Multimedia Content Management

The Multimedia Compilation App includes:

- Semantic extraction of multimedia data
- Collaboration backup system
- Prediction of query failure

Parallel and Distributed Computing

This area encompasses various domains which include Peer to Peer (P2P) systems, online social networks, massive multiplayer online games, grids and clouds, multicore architecture, parallel programming, performance modeling, real-time systems, advanced distributed systems, distributed databases and various areas of High-Performance Computing (HPC).

Security in Computing

This research area addresses the principles of security in computing. Research in this area covers sub-areas in computer and system security, including cryptography and protocols, access control, quantum key distribution, information hiding (such as steganography, watermarking), multimedia information security, operating system security, computer forensics, intrusion detection systems, network and communication security, software security, malware analysis and information security management. In addition, this programme offers the necessary knowledge to apply cryptography in real life applications and services such as authenticity, integrity, non-repudiation and secrecy.

Software Engineering

Software Engineering is an engineering discipline that is concerned with every aspect of software production from early stages of software requirement specification through to maintaining the software after it has gone into use. The investigations cover systematic, disciplined, quantifiable techniques and methods in designing, development, implementation, and maintenance of quality software. Issues related to theoretical and formal aspects of software engineering, software architecture, software web services, software modeling, software quality, software engineering management, enterprise software engineering and integration, green software engineering, component-based software engineering, search-based software engineering, software measurement, estimation and metrics are among the popular topics in this research. In addition, research is also carried out in the area of special-purpose embedded software engineering which involves multidisciplinary research disciplines such as educational study, agricultural science, and health science.



TUITION FEES

Applicable to all new students enrolled beginning First Semester 2021/2022 onwards.

MASTER OF SCIENCE

FEES IN RINGGIT MALAYSIA (RM)

SEMESTER	1 st SEMESTER (Pay during the registration)	2 nd - 3 rd SEMESTERS	4 th SEMESTER	5 th AND SUBSEQUENT SEMESTERS	STUDY COST FOR MAXIMUM 2 YEARS	STUDY COST FOR MAXIMUM 3 YEARS
LOCAL STUDENTS	2,250.00	2,000.00	1,500.00	2,000.00	7,750.00	11,750.00
INTERNATIONAL STUDENTS	6,700.00	4,450.00	3,950.00	4,200.00	19,550.00	27,950.00

Note:

1. If the thesis is submitted **BEFORE** the deadline the student is required to register and pay **RM500 (local) /RM550 (International)** only for the next semester.
2. If you have to resubmit your thesis, your thesis re-submission fee is **RM1,500**.

NOTE: The fee amount is subject to change from time to time WITHOUT prior notice by the University. Prospective and current students are advised to check the SGS website for any fee changes not earlier than one (1) month before the start of each semester/new students' registration. All fees must be paid upon registration.

OTHER COST: Please refer to School of Graduate Studies website at <http://www.sgs.upm.edu.my>

DOCTOR OF PHILOSOPHY

FEES IN RINGGIT MALAYSIA (RM)

SEMESTER	1 st SEMESTER (Pay during the registration)	2 nd - 4 th SEMESTERS	5 th AND 6 th SEMESTERS	7 th AND SUBSEQUENT SEMESTERS	STUDY COST FOR MAXIMUM 4 YEARS	STUDY COST FOR MAXIMUM 5 YEARS
LOCAL STUDENTS	2,812.50	2,562.00	2,000.00	3,000.00	20,500.00	26,500.00
INTERNATIONAL STUDENTS	7,312.50	5,362.50	4,800.00	5,300.00	43,600.00	54,200.00

Note:

1. If the thesis is submitted **BEFORE** the deadline the student is required to register and pay **RM500 (local) /RM550 (International)** only for the next semester.
2. If you have to resubmit your thesis, your thesis re-submission fee is **RM2,250**.

NOTE: The fee amount is subject to change from time to time WITHOUT prior notice by the University. Prospective and current students are advised to check the SGS website for any fee changes not earlier than one (1) month before the start of each semester/new students' registration. All fees must be paid upon registration.

OTHER COST: Please refer to School of Graduate Studies website at <http://www.sgs.upm.edu.my>



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For further information on academic programmes, please contact:

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