

# COMPUTER SCIENCE

## CURRICULUM

### Master of Computer Science

#### DEGREE REQUIREMENTS

	Credits
Master's Thesis	(Milestone)
CP8101 Research Methods	Pass/Fail
CP8102 Computer Science Seminar (Master's)	Pass/Fail
2 Core courses (minimum)	2
3 Non-core courses (minimum)	3

#### Core Courses

	Credits
CP8201 Algorithms and Computability	1
CP8202 Advanced Software Engineering	1
CP8203 Advanced Database Systems	1
CP8204 Advanced Programming Languages	1
CP8205 Adv Human-Computer Interaction	1
CP8206 Soft Computing and Machine Intel	1
CP8207 Special Topics: Core Computer Sci	1

#### Non-Core Courses

	Credits
CP8301 Secure Computing	1
CP8302 Software Metrics	1
CP8303 Collaborative Computing	1
CP8304 Distributed Systems	1
CP8305 Knowledge Discovery	1
CP8306 Presence	1
CP8307 Image Analysis	1
CP8308 Visualization	1
CP8309 Special Topics: Emerging Comp Sci	1
CP8310* Directed Studies in Computer Sci	1
CP8311 Genetic Programming	1
CP8314 Advanced Artificial Intelligence	1

### Doctor of Philosophy

First Offered Fall 2011

#### DEGREE REQUIREMENTS

	Credits
Doctoral Candidacy Examination	(Milestone)
Doctoral Dissertation	(Milestone)
CP8101 Research Methods <sup>1</sup>	Pass/Fail
CP9101 Method of Instruction	1
CP9102 Doctoral Seminar	Pass/Fail
4 courses (minimum) - Two courses from each Field	4

#### Field I: Intelligence and Robotics

	Credits
CP8206 Soft Computing and Machine Intel	1
CP8303 Collaborative Computing	1
CP8305 Knowledge Discovery	1
CP8306 Presence Through Robotic Interaction	1
CP8307 Image Analysis	1

<sup>1</sup> The requirement to take this course may be waived at the discretion of the program director should a candidate provide evidence of having taken a substantially similar course in the past.

CP8308	Visualization	1
CP8311	Genetic Programming	1
CP8312*	Directed Studies-Intelligence and Robotics	1
CP8315	Special Doctoral Topics – AI & R	1

<b>Field Two: Networks</b>		<b>Credits</b>
CP8201	Algorithms and Computability	1
CP8202	Advanced Software Engineering	1
CP8203	Advanced Database Systems	1
CP8301	Secure Computing	1
CP8303	Collaborative Computing	1
CP8304	Distributed Systems	1
CP8313*	Directed Studies-Networks	1
CP8316	Special Doctoral Topics – Networks	1

\*Directed Studies courses may not be repeated for credit

## **COURSE LISTING**

### **Doctoral Candidacy Examination**

Each student is required to complete a Candidacy Examination. The examination is normally conducted during a candidate's fourth term of residence, and must be held no later than 20 months from the date of initial registration. The examination consists of two parts: a written examination of three hours duration, the questions to be set by the student's Supervisory Committee; and an oral defense of the written examination and of the dissertation proposal. This is a Milestone. Pass/Fail

### **Doctoral Dissertation**

The culmination of each student's work within the Doctoral program is the Doctoral Dissertation or Thesis. The dissertation is the written record of the student's original and significant research. The PhD student is required to conduct advanced research related to one (or more) of the following fields: Intelligence and Robotics, or Computer Communication Networks. Other areas may be considered if appropriate expertise exists among the faculty members associated with this program. The research topic is selected in consultation with the student's supervisor(s). The approval process for proposed work on a dissertation involves two steps: the student must present a written research proposal to a Dissertation Supervisory Committee to ensure that the proposal has merit and can be achieved and the student must pass a candidacy exam. The research itself is carried out under the direction of the student's supervisor(s) and monitored by the Supervisory Committee. When the research is complete, the results are submitted in written format in the form of a Thesis as specified by program guidelines. The thesis must receive the approval of the student's supervisor(s) and the members of the Dissertation Supervisory Committee as described by the appropriate policies of the Yeates School of Graduate Studies before the work can undergo examination. When the thesis is approved, the student's supervisor will convene a public oral examination conducted according to the policies of the Yeates School of Graduate Studies. Through the thesis, and their Oral Defence of it, the student is expected to provide evidence of competence in carrying out original and independent research, a sound understanding of the material associated with it and a broad grasp of the discipline of Computer Science. Each student is required to pass the final Defence Examination of their dissertation. This is a Milestone.

### **Master's Thesis**

The thesis embodies the results of the student's research program and exposes the work to scholarly criticism. It must represent a single body of work, with integrated material, and should not be solely a collection of published articles. This is a "Milestone." Pass/Fail

### **CP8101 Research Methods**

This course is intended as a transition to research-based learning for computer science graduate students. It is designed to assist students in developing skills necessary to design and execute a research protocol. The course is intended to complement the specific research programs devised by the student and his/her advisors. The course covers the following topics: nature of scientific inquiry, library skills, formulation and testing of hypotheses, experimental design, statistical analysis of data, human subjects, use of humans and animals in research, and professional responsibility in research. 1 Credit  
Pass/Fail

### **CP8102 Computer Science Seminar (Master's)**

A regular weekly seminar presenting research problems currently under investigation. Each Master's student is expected to regularly attend for four semesters and to present one of the talks. Pass/Fail

### **CP8201 Algorithms and Computability**

The concepts of algorithms and computability together with techniques for analysis of the efficiency and complexity of algorithms are studied. Logical formalisms and their application in computing environments and the use of logical reasoning in establishing the correctness of implementations of algorithms are discussed. Abstract models are discussed with respect to advanced computational models. 1 Credit

#### **CP8202 Advanced Software Engineering**

Modern approaches to software development are studied including requirements analysis, system design techniques, formal description techniques, implementation, testing, debugging, metrics, human factors, quality assurance, cost estimation, maintenance, and tools. 1 Credit

#### **CP8203 Advanced Database Systems**

Object-Oriented and Object-Relational Database Systems; Distributed and Multi-database Systems; Advanced Database Applications: Web-Based Database Access, Data Warehouses. 1 Credit

#### **CP8204 Advanced Programming Languages**

A study of the principles, concepts, and mechanisms of computer programming languages - their syntax, semantics, and pragmatics; the processing and interpretation of computer programs; programming paradigms; and language design. Additional topics will include language design principles and models of language implementation. 1 Credit

#### **CP8205 Advanced Human-Computer Interaction**

Current trends in user interface technology; topics include alternative interaction devices, user interface tools, and interface modeling techniques. Usability testing and human factors. 1 Credit

#### **CP8206 Soft Computing and Machine Intelligence**

Introduction to basic concepts and techniques of soft computing including: neural, fuzzy, evolutionary computation and their applications. 1 Credit

#### **CP8207 Special Topics: Core of Computer Science**

This special topics course examines selected, advanced topics in areas related to the core areas of computer science series that are not covered by existing courses. The topic(s) will vary depending on the need and the instructor. 1 Credit

#### **CP8301 Secure Computing**

The importance of security for computer systems: protection, access control, distributed access control, Unix security, applied cryptography, network security, firewalls, secure coding practices, safe languages, mobile code. Computer and network forensics techniques. Computer security techniques. Legal and Ethical issues. Topics may include cryptographic protocols, privacy, anonymity, and/or other topics as time permits. 1 Credit

#### **CP8302 Software Metrics**

The theory of measurement, experimental design, software metrics collection, statistics for analyzing measurement data, software size and software structure, resource measurement, prediction of software characteristics, planning software measurement, software quality and reliability. 1 Credit

#### **CP8303 Collaborative Computing**

Technical and societal perspective on technology enhanced collaboration. Multicasting, Groupware, Computer Supported Cooperative Work, Web technologies and services to support collaboration, social networking environments and the protocols driving them, coordination frameworks, agents to support collaborative activities, and implied security concerns. 1 Credit

#### **CP8304 Distributed Systems**

The evolution of high-performance distributed computer systems. Models for distributed processing. Taxonomy and performance evaluation of multiprocessor systems. Interconnection networks. Memory and I/O system for multiprocessor architectures. Performance of distributed systems. Architectural issues of distributed database systems. 1 Credit

#### **CP8305 Knowledge Discovery**

Steps in the process of knowledge discovery: data preprocessing, data mining, post-processing and knowledge utilization. Preprocessing: data cleaning, integration, transformation and reduction. Data mining methods: association rules, classification and clustering. Post-processing: knowledge evaluation, interpretation, presentation and visualization. Knowledge discovery and data management. Possibly other selected topics in knowledge discovery. 1 Credit

#### **CP8306 Presence Through Robotic Interaction**

Teleoperators, telepresence, telebotics. Remote interaction and manipulation. Environmental, societal and personal presence. Factors influencing presence and the concept of "situation awareness". The course is highly interactive and will involve the creation of mechanisms for the remote interaction with real remote environments in order to establish a sense of presence. Participants will be expected to create robotic presence systems as well as critically examine systems described in the literature. 1 Credit

#### **CP8307 Image Analysis**

Continuous, variable and discrete variable imaging. Continuous and discrete transforms. Image enhancement. Image analysis including multidimensional edge-primitive theories, shape analysis. Multispectral imaging and applications. Image modeling. Syntactical analysis, aspects of image database theories. 1 Credit

**CP8308 Visualization**

Use of computer graphics to understand patterns, relationships and trends in scientific and information systems data. Topics include: historical overview, fundamental concepts, scientific visualization techniques for scalar and vector data, visualization systems, interaction with 2D/3D graphical interfaces, web-based visualization and collaborative visualization over the internet, software visualization, information visualization. 1 Credit

**CP8309 Special Topics: Emerging Computer Science**

This special topics course examines selected, advanced topics in areas related to emerging areas of computer science that are not covered by existing courses. The topic(s) will vary depending on the need and the instructor. 1 Credit

**CP8310 Directed Studies in Computer Science**

This course is for Master's students who wish to gain knowledge in a specific area for which no graduate level classes are offered. Students wishing to take the class would be assigned a suitable class advisor most familiar with the specific area of interest. Students are required to present the work of one term (not less than 90 hours in the form of directed research, tutorials and individual study) in an organized format. 1 Credit

**CP8311 Genetic Programming**

The focus of the course is on genetic programming (GP), a subfield of evolutionary computation. GP is a computational technique that harnesses the mechanisms of natural evolution -- including genetic recombination, mutation, and selection - to synthesize computer programs automatically from input/output specifications. The goal of the course is to prepare and engage the student as quickly as possible in original research in this field. 1 Credit

**CP8312 Directed Studies: Intelligence and Robotics**

This course explores theoretical, practical and experimental (if applicable) problems in great depth in the areas of intelligence and robotics with emphasis on the aspects of Intelligence and Robotics and their application related to the discipline of Computer Science. Doctoral students must present their findings in a formal report. 1 Credit

**CP8313 Directed Studies: Networks**

This course explores theoretical, practical and experimental (if applicable) problems in great depth in areas of computer and communication networks with emphasis on the aspects of computer networking and its application related to the discipline of Computer Science. Doctoral students must present the findings in a formal report. 1 Credit

**CP8314: Advanced Artificial Intelligence:**

The course will focus on the theory and implementation of dynamical systems from the perspective of artificial intelligence. The emphasis will be on the compromises involved in providing useful logical representations that allow reasoning about actions to remain tractable. The course will show how these research issues are relevant for many applications beyond the traditional area of artificial intelligence. 1 Credit

**CP8315: Special Doctoral Topics-AI & Robotics:**

This special topics course will present material that is not currently part of the regular computer science doctoral program but are of interest to faculty and students in the field of Artificial Intelligence and Robotics. 1 Credit.

**CP8316: Special Doctoral Topics-Networks:**

This special topics course will present material that is not currently part of the regular computer science doctoral program but are of interest to faculty and students in the field of Networking. 1 Credit

**CP9101 Method of Instruction**

Students will learn to select appropriate teaching methods; establish goals and performance objectives and construct lesson plans. Students will be shown classroom management and presentation techniques. In addition, students will be introduced to the principles of learning and instruction. Student will learn to formulate questions and employ good questioning technique. Each student will be given opportunities to prepare and present short lessons. Each student will be required to prepare and present at least two five-minutes lessons based on computer science related topics. Student lessons will be evaluated by the student, class members and the instructor. 1 Credit

**CP9102 Doctoral Seminar**

The purpose of the Doctoral Seminar is to provide students exposure to the latest research, issues and findings related to the discipline of Computer Science. The seminar will consist of invited guests and talks by experts from industry, academia and graduate students themselves. Students will have an opportunity to improve their writing and critical thinking skills through assigned work associated with the seminar topics. All students are required to attend and actively participate in seminars every semester for a total of six semesters. A doctoral candidate must give two publicly announced research seminars on his/her thesis research. The student's supervisor(s) and at least one other member of the student's Dissertation Supervisory Committee must attend this seminar. The quality of the student's presentation will be graded on a Pass/Fail basis. Each student will be required to pass each research seminar presentation. Pass/Fail.