2008-2009 Graduate Calendar

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2008-2009 academic years, including the Summer Semester 2008, the Fall Semester 2008 and the Winter Semester 2009.

For your convenience the Graduate Calendar is available in PDF format.

If you wish to link to the Graduate Calendar please refer to the Linking Guidelines.

The University is a full member of:

• The Association of Universities and Colleges of Canada

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Disclaimer

The Office of Graduate Program Services has attempted to ensure the accuracy of this on-line Graduate Calendar. However, the publication of information in this document does not bind the university to the provision of courses, programs, schedules of studies, fees, or facilities as listed herein.

Limitations

The University of Guelph reserves the right to change without notice any information contained in this calendar, including any rule or regulation pertaining to the standards for admission to, the requirements for the continuation of study in, and the requirements for the granting of degrees or diplomas in any or all of its programs.

The university will not be liable for any interruption in, or cancellation of, any academic activities as set forth in this calendar and related information where such interruption is caused by fire, strike, lock-out, inability to procure materials or trades, restrictive laws or governmental regulations, actions taken by the faculty, staff or students of the university or by others, civil unrest or disobedience, or any other cause of any kind beyond the reasonable control of the university.

The University of Guelph reaffirms section 1 of the Ontario Human Rights Code, 1981, which prohibits discrimination on the grounds of race, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, handicap, age, marital status or family status.

The university encourages applications from women, aboriginal peoples, visible minorities, persons with disabilities, and members of other under-represented groups.

Introduction

Collection, Use and Disclosure of Personal Information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90f31_e.htm. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. Certain personal information is disclosed to external agencies, including the Ontario Universities Application Centre, the Ministry of Training, Colleges and Universities, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registrarial Services Departmental Policy on the Release of Student Information. For details on the use and disclosure of this information call the Office of Registrarial Services at the University at (519) 824-4120 or see http://www.uoguelph.ca/registrar/registrar/index.cfm?index.

Statistics Canada - Notification of Disclosure

For further information, please see Statistics Canada's web site at http://www.statcan.ca and Section XIV Statistics Canada.

Address for University Communication

Depending on the nature and timing of the communication, the University may use one of these addresses to communicate with students. Students are, therefore, responsible for checking all of the following on a regular basis:

Email Address

The University issued email address is considered an official means of communication with the student and will be used for correspondence from the University. Students are responsible for monitoring their University-issued email account regularly.

Home Address

Students are responsible for maintaining a current mailing address with the University. Address changes can be made, in writing, through Graduate Program Services.

Name Changes

The University of Guelph is committed to the integrity of its student records, therefore, each student is required to provide either on application for admission or on personal data forms required for registration, his/her complete, legal name. Any requests to change a name, by means of alteration, deletion, substitution or addition, must be accompanied by appropriate supporting documentation.

Student Confidentiality and Release of Student Information Policy Excerpt

The University undertakes to protect the privacy of each student and the confidentiality of his or her record. To this end the University shall refuse to disclose personal information to any person other than the individual to whom the information relates where disclosure would constitute an unjustified invasion of the personal privacy of that person or of any other individual. All members of the University community must respect the confidential nature of the student information which they acquire in the course of their work.

Complete policy at http://www.uoguelph.ca/policies.

Table of Contents

Computing and Information Science

The Department of Computing and Information Science offers a program of study leading to the MSc and PhD in Computer Science degrees.

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MSc in Applied Computer Science Program

The MSc program emphasizes research that can potentially contribute to industry and government. The Department of Computing and Information Science offers the MSc degree in Computer Science in the fields of applied modelling, artificial intelligence, distributed computing, and human computer interaction as detailed below:

1. **Applied Modelling (AM):** Students working in this field will engage in research on topics such as graph theory and algorithms, formal specifications, hardware-software co-design, and interdisciplinary work in environmental modeling and disease spread modeling.

2. **Artificial Intelligence (AI):** Students working in this field will engage in research on topics such as Bayesian techniques, artificial neural networks, evolutionary computation, fuzzy systems, datamining, pattern recognition, intelligent agents.

3. **Distributed Computing (DC):** Students working in this field will engage in research on topics such as parallel computing, distributed systems, embedded systems, multi-agent systems, mobile computing, wireless networks, and ad hoc networks.

4. **Human Computer Interaction (HCI):** Students working in this field will engage in research on topics context-aware systems, usability, interface design, mobile and ubiquitous computing.

Admission Requirements

Most spaces are filled in March for entry the following September, and in October for entry the following January. Prospective students should check the department website http://www.cis.uoguelph.ca/ for admission procedures and deadlines.

General Requirements

To be considered for admission, applicants must have a four-year honours degree in computer science, or a four-year honours degree in another discipline with a minor in computer science. Applicants must meet the minimum admission requirements of both the university and the department, including at least a 75% average during the previous two years of full-time university study for a degree.

Course Requirement

Entrants who do not have a four-year honours degree in computer science from a recognized university are expected to have taken at least 12 computer science courses as described below. University of Guelph equivalents are given for comparison.

(A) Seven prescribed courses:
   - An introductory programming course (like CIS*1500).
   - An intermediate programming course (like CIS*2500).
   - An object-oriented programming course (like CIS*2430).
   - A software systems development course (like CIS*2750)
   - A course on data structures (like CIS*2520)
   - A course on discrete structures (like CIS*1910 or CIS*2910)
   - A mathematics course.

(B) Three core courses at the second-year or higher level selected from the following:
   - A course on hardware and/or assembly language (like CIS*2030).
   - A course on digital systems (like CIS*3120).
   - A course on simulation and/or modelling (like CIS*2460).
   - A database course (like CIS*3530)
   - An operating systems course (like CIS*3110).
   - A computer algorithms course (like CIS*3490).
   - A course on automata theory (like CIS*3620).
   - A statistics course.

(C) Two elective courses at the third-year or higher level:
   - These courses should be related to the applicant's proposed research area. They can be from a discipline other than computing and information science if deemed relevant by the proposed supervisor.
   - Applicants who meet requirements (A) and (C) but who do not meet requirement (B) may be granted provisional admission, i.e., they may be granted admission with the provision that they take specified courses within a specified time and achieve grades above a specified threshold.

English Proficiency

A test of English proficiency is required of all applicants whose first language is not English. Required scores are shown below:
   - Paper-based TOEFL- 600.
   - Internet-based TOEFL- 100, 26 speaking and writing.
   - Computer-based TOEFL- 250 with 5.0 essay rating.
   - IELTS- 7.5.
   - MELAB- 90, speaking 3, no score lower than 80.
   - CAEL- 70 overall, 70 writing and speaking, no score lower than 60.
   - University of Guelph English Language Certificate at the Advanced Level.

The proof of English proficiency requirement may be waived in exceptional circumstances (e.g., applicants who have studied full-time for two years in a country where English is the native language AND in a university where English is the language of instruction). Graduate Committee approval required.

Degree Requirements

Once a student has been admitted to the MSc program, the following components are required for the successful completion of the MSc degree:

Completing the Technical Communication and Research Methodology course (CIS*6890) and at least four other graduate courses

Completing the seminar requirement.

An accepted thesis.

There is no qualifying exam or second-language requirement. Supplementary program information is available to students via the department website http://www.cis.uoguelph.ca/

Degree requirements include the Technical Communication and Research Methodology course (CIS*6890), at least four other graduate-level courses, a research seminar and a master's thesis. There is no qualifying exam or second-language requirement. Supplementary program information is available to students via the department website http://www.cis.uoguelph.ca/

Duration of the Program

Heavy emphasis is placed on the thesis, which usually requires at least two semesters. Students should plan on spending at least four full-time semesters in the program assuming adequate preparation for graduate work. Normally, students are expected to fulfill all the requirements in six semesters.

Advisory Committee

Each MSc candidate conducts thesis research by working closely with a thesis advisor. The advisor is a member of the CIS regular graduate faculty who provides academic guidance and interacts regularly with the student. Moreover, the student is required to have an Advisory Committee consisting of at least two graduate faculty members (in the selection of whom the student normally participates). The student's advisor chairs the committee. Graduate faculty members from other academic units can sit on the committee.

Course Requirement

An MSc student is required to take the Technical Communication and Research Methodology course CIS*6890 and at least four other graduate courses. Of these four courses, at least two should be outside of the student's thesis topic area. This area and the courses which fall outside of this area are identified by the student's advisor and Advisory Committee. In exceptional cases, one graduate course requirement may be met by an approved 0.5-credit graduate course from another department or by two approved 400-level 0.5-credit courses which have not already been taken for credit. At most one reading course (CIS*6660) can count towards the course requirement.

Seminar Requirement

An MSc student must give one publicly announced research seminar on his/her MSc thesis research. The student will be allocated times and dates for the seminar. It should be attended by the student's advisor and at least one other member of the student's Advisory Committee. The quality of the presentation is graded on a pass/fail basis. The MSc seminar requirement is intended for students to practice presentation and communication skills and to participate in the process of knowledge dissemination as part of the academic life.

Thesis Defence

Arrangements for the MSc thesis defence should be made at least 4 weeks prior to the anticipated date of the defence, and the student must submit his/her MSc thesis to the Examination Committee at least 2 weeks prior to the defence. The examination consists of an oral presentation by the student followed by questions from the Examination Committee.

PhD in Computer Science Program

The Department of Computing and Information Science offers the PhD degree in Computer Science in the fields of applied modelling, artificial intelligence, distributed computing, and human computer interaction as detailed below:

1. **Applied Modelling (AM):** Students working in this field will engage in research on topics such as graph theory and algorithms, formal specifications, hardware-software co-design, and interdisciplinary work in environmental modeling and disease spread modeling.
2. **Artificial Intelligence (AI):** Students working in this field will engage in research on topics such as Bayesian techniques, artificial neural networks, evolutionary computation, fuzzy systems, datamining, pattern recognition, intelligent agents
3. **Distributed Computing (DC):** Students working in this field will engage in research on topics such as parallel computing, distributed systems, embedded systems, multi-agent systems, mobile computing, wireless networks, and ad hoc networks.
4. **Human Computer Interaction (HCI):** Students working in this field will engage in research on topics context-aware systems, usability, interface design, mobile and ubiquitous computing.

Admission Requirements

Most spaces are filled in March for entry the following September, and in October for entry the following January. Prospective students should check the department website http://www.cis.uoguelph.ca/ for admission procedures and deadlines.

General Requirements

Admission to the PhD program in CIS will normally require a recognized master's degree in Computer Science or a closely related discipline obtained with high academic standing. Entrants are expected to have previously studied the following areas in Computer Science:
- Advanced Programming
- Computer Architecture
- Data Structures
- Operating Systems
- Databases
- Software Engineering
- Discrete Mathematics
- Algorithms
- Computer Networks

and the following areas in Mathematics and Statistics:
- Calculus
- Linear Algebra
- Probability and Statistics
- Numerical Analysis

Students who lack sufficient breadth may be required to complete specific courses as a condition of admission. Students entering the program are expected to have demonstrated good research potential, an ability to critically evaluate experimental or theoretical results, and strong communication skills. Evidence for these are normally provided by scholarly publications during and immediately following the master's degree.

English Proficiency

A test of English proficiency is required of all applicants whose first language is not English. Required scores are shown below:
- Paper-based TOEFL- 600.
- Internet-based TOEFL- 100, 26 speaking and writing.
- Computer-based TOEFL- 250 with 5.0 essay rating.
- IELTS- 7.5.
- MELAB- 90, speaking 3, no score lower than 80.
- CAEL- 70 overall, 70 writing and speaking, no score lower than 60.
- University of Guelph English Language Certificate at the Advanced Level.

The proof of English proficiency requirement may be waived in exceptional circumstances (e.g., applicants who have studied full-time for two years in a country where English is the native language AND in a university where English is the language of instruction). Graduate Committee approval required.

GRE Tests

Students who have obtained a Masters degree from a university outside of Canada are encouraged to supply GRE scores (GRE General and/or GRE Subject in CS).

Admission without an MSc Degree

A student who has achieved excellent standing in an honours Computer Science degree (or an equivalent 4-year Computer Science degree) and who wishes to proceed to doctoral study may enrol, in the first instance, in the MSc program. If the student achieves a superior academic record and shows a particular aptitude for research, the student may be transferred into the PhD program without completing the MSc degree. The application for transfer must be made between the end of the second semester and the end of the fourth semester.

In exceptional circumstances, a student who has completed an honours Computer Science degree (or an equivalent 4-year Computer Science degree) may apply for direct admission to the PhD program. The successful applicant must have an outstanding academic record, breadth of knowledge in Computer Science, demonstrated research accomplishments, and strong letters of recommendation. Contact the department for additional information.

Transfer From Another PhD Program

A student who wishes to transfer from another closely related PhD program at the University of Guelph into the CIS PhD program should submit:
- a program transfer application form;
- original transcripts from all past programs; and
- a written description of the progress in the previous program including copies of qualifying examination documents or thesis proposal where available.

Part-Time Study

Students may not enter the CIS PhD program as part-time. A full-time PhD student may apply for part-time studies only after the minimum duration for the degree has been completed. The application will not be granted unless the candidate has completed the qualifying exam and the thesis research is well established.

Degree Requirements

Once a student has been admitted to the PhD program, the following components are required for the successful completion of the PhD degree:
- Completing the minimum specified duration of the program.
- Completing the Technical Communication and Research Methodology course CIS*6890 (unless the student has taken an equivalent course in the MSc program) and at least four other graduate courses with an overall average of at least 70%. Students who are admitted without an appropriate MSc are required to take the Technical Communication and Research Methodology course CIS*6890 and at least eight other graduate courses with an overall average of at least 70%.
- Satisfying the breadth requirement.
- Completing the seminar requirement.
- A successfully completed Qualifying Examination.
- An accepted thesis and the successful completion of a final oral examination.

Duration of the Program

At least 5 semesters of full-time study must be completed in the doctoral program following completion of a recognized master's degree in Computer Science or a related discipline. At least 7 semesters are required for those who are permitted to proceed from the honours baccalaureate without completing a master's degree. The actual length of the program depends on the academic preparation of the student and the choice of research topic. A typical PhD student (after an MSc) is expected to complete the program in 12 semesters.

A PhD student, following the completion of a recognized master's degree in Computer Science or related discipline, is required to take the Technical Communication and Research Methodology course CIS*6890 (unless the student has taken an equivalent course in the MSc program) and at least four other graduate courses with an overall average of at least 70%. Of these four courses, at most one may be cross-listed (that is, a combined graduate/undergraduate course), at most one may be a reading course CIS*6660 and at most one may be taken from departments other than CIS.

A PhD student admitted without an appropriate MSc is required to take the Technical Communication and Research Methodology course CIS*6890 and at least eight graduate courses with an overall average of at least 70%. Out of these eight courses, at most two may be cross-listed, at most two may be reading courses CIS*6660, and at most two may be taken from departments other than CIS.

Breadth Requirement

For breadth requirement purposes, the subject matter of computer science is divided into three broad categories, and each category is subdivided into two to three areas:

Systems (category S)
- Software Engineering (area S1)
- Programming Languages (area S2)
- Computer Architecture and System Software (area S3)

Mathematics of Computation (category M)
- Algorithms and Complexity (area M1)
- Scientific and Symbolic Computing (area M2)

Applications (category A)
- Artificial Intelligence (area A1)
- Databases (area A2)
- Graphics, Imaging and User Interfaces (area A3)

Each CIS graduate courses falls into one of the eight areas. A student must have sufficient background in five of these areas, including at least one from each category.

A student has gained sufficient background in an area if the student:
- has taken a CIS graduate** course in the area (with grade of at least 70%), or
- has taken an equivalent course in the MSc program, or
- has extensive industrial experience in the area (approval required), or
- has written an MSc thesis in the area (approval required).

**At most one reading course may be counted towards fulfilling breadth requirements.

A student must satisfy the breadth requirement no later than the fourth semester after entering the program, otherwise the student may be required to withdraw from the program. The student, therefore, should develop a plan of study no later than the end of the second semester, and seek approval from the Graduate Co-ordinator.

Seminar Requirement

A PhD student should give two publicly announced research seminars on his/her PhD thesis research. The first seminar must be presented prior to the Qualifying Examination. The second seminar must be presented prior to the thesis defence. The student will be allocated times and dates for the seminars. Each seminar should be attended by the student's advisor and at least one other member of the student's Advisory Committee. The quality of the presentation is graded on a pass/fail basis. The PhD seminar requirement is intended for students to practice presentation and communication skills and to participate in the process of knowledge dissemination as part of the academic life.

Qualifying Examination

The student must satisfy the breadth requirement before the Qualifying Examination (QE). The QE must be completed no later than the final semester of the minimum duration for the degree (either 5 or 7 semesters). The focus of the examination is to assess the candidate's ability and promise in the selected research area.

Arrangements for the QE should be made at least 4 weeks prior to the anticipated date of the QE oral presentation, and the student must submit a research proposal to the Examination Committee at least 2 weeks prior to the QE. The research proposal should contain the following items:
- A survey of appropriate background literature.
- A description of the proposed area of research.
- A statement describing the merits and scholarly value of the proposed research.
- A schedule of the research program that the candidate will follow, including a sequence of milestones and objectives.

The examination consists of an oral presentation by the student followed by questions from the Examination Committee.

Advisory Committee

Each PhD candidate conducts thesis research by working closely with a thesis advisor. The advisor is a member of the CIS regular graduate faculty who provides academic guidance and interacts regularly with the student. Moreover, the student is required to have an Advisory Committee consisting of at least three graduate faculty members (in the selection of whom the student normally participates). The student's advisor chairs the committee. At least one of the committee members must be from another department.

Course Requirement

A PhD student, following the completion of a recognized master's degree in Computer Science or related discipline, is required to take the Technical Communication and Research Methodology course CIS*6890 (unless the student has taken an equivalent course in the MSc program) and at least four other graduate courses with an overall average of at least 70%. Of these four courses, at most one may be cross-listed (that is, a combined graduate/undergraduate course), at most one may be a reading course CIS*6660 and at most one may be taken from departments other than CIS.

Thesis Defence

Arrangements for the PhD thesis defence should be made 8 weeks prior to the anticipated date of the defence, and the student must submit his/her PhD thesis to the Examination Committee at least 4 weeks prior to the defence. The examination consists of an oral presentation by the student followed by questions from the Examination Committee.

Courses

CIS*6000 Distributed Systems U [0.50]

The evolution of distributed computer systems. Models for distributed processing. Taxonomy of multiprocessor systems. Interconnection networks. Memory and I/O for distributed architectures. Performance of distributed systems. Architectural issues of distributed systems

CIS*6020 Artificial Intelligence U [0.50]

An examination of Artificial Intelligence principles and techniques such as: logic and rule based systems; forward and backward chaining; frames, scripts, semantic nets and the object-oriented approach; the evaluation of intelligent systems and knowledge acquisition. A sizeable project is required and applications in other areas are encouraged.

CIS*6030 Information Systems U [0.50]

Relational and other database systems, web information concurrency protocols, data integrity, transaction management, distributed databases, remote access, data warehousing, data mining.

CIS*6040 Advanced Image Analysis U [0.50]

An insight into advanced topics in image processing and analysis. A study of methods for analyzing and interpreting information from two and three-dimensional images obtained from a variety of medical and biological imaging modalities.

CIS*6050 Advanced Neural Networks: Dynamical Recurrent Networks U [0.50]

Artificial neural networks, dynamical recurrent networks, dynamic input/output sequences, communications signal identification, syntactic pattern recognition.

CIS*6060 Bioinformatics U [0.50]

Data mining and bioinformatics, molecular biology databases, taxonomic groupings, sequences, feature extraction, Bayesian inference, cluster analysis, information theory, machine learning, feature selection.

CIS*6070 Discrete Optimization U [0.50]

This course will discuss problems where optimization is required and describes the most common techniques for discrete optimization such as the use of linear programming, constraint satisfaction methods, and genetic algorithms.

CIS*6080 Genetic Algorithms U [0.50]

This course introduces the student to basic genetic algorithms, which are based on the process of natural evolution. It is explored in terms of its mathematical foundation and applications to optimization in various domains.

CIS*6090 Hardware/Software Co-design of Embedded Systems U [0.50]

Specification and design of embedded systems, system-on-a-chip paradigm, specification languages, hardware/software co-design, performance estimation, co-simulation and validation, processes architectures and software synthesis, retargetable code generation and optimization.

CIS*6100 Parallel Processing Architectures U [0.50]

Parallelism in uniprocessor systems, parallel architectures, memory structures, pipelined architectures, performance issues, multiprocessor architectures.

CIS*6120 Uncertainty Reasoning in Knowledge Representation U [0.50]

Representation of uncertainty, Dempster-Schafer theory, fuzzy logic, Bayesian belief networks, decision networks, dynamic networks, probabilistic models, utility theory.

CIS*6130 Object-Oriented Modeling, Design and Programming U [0.50]

Objects, modeling, program design, object-oriented methodology, UML, CORBA, database

CIS*6140 Software Engineering U [0.50]

This course will discuss problems where optimization is required and describes the most common techniques for discrete optimization such as the use of linear programming, constraint satisfaction methods, and meta-heuristics.

CIS*6150 Complexity of Parallel Computation U [0.50]

Computing models, sequential model, complexity models, evolution of parallelism, parallel complexity, P-completeness, survey of P and NC, open problems.

CIS*6160 Multiagent Systems U [0.50]

Intelligent systems consisting of multiple autonomous and interacting subsystems with emphasis on distributed reasoning and decision making. Deductive reasoning agents, practical reasoning agents, probabilistic reasoning agents, reactive and hybrid agents, negotiation and agreement, cooperation and coordination, multiagent search, distributed MDP, game theory, and modal logics.

CIS*6200 Design Automation in Digital Systems U [0.50]

Techniques and software tools for design of digital systems. Material covered includes high-level synthesis, design for testability, and FPGAs in design and prototyping.

CIS*6320 Image Processing Algorithms and Applications U [0.50]

Brightness transformation, image smoothing, image enhancement, thresholding, segmentation, morphology, texture analysis, shape analysis, applications in medicine and biology.

CIS*6420 Soft Computing U [0.50]

Neural networks, artificial intelligence, connectionist model, back propagation, resonance theory, sequence processing, software engineering concepts.

CIS*6450 Software Systems Development and Integration U [0.25]

Techniques and tools used in the development of large software systems. Methods for organizing and constructing modular systems, manipulating files, an introduction to interface design, and use of databases. Software tools for managing projects, database connectivity, configuration management, and system application programmer interfaces.

CIS*6490 Analysis and Design of Computer Algorithms U [0.25]

The design and analysis of efficient computer algorithms: standard methodologies, asymptotic behaviour, optimality, lower bounds, implementation considerations, graph algorithms, matrix computations (e.g. Strassen's method), NP-completeness.

CIS*6650 Topics in Computer Science I U [0.50]

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

CIS*6660 Topics in Computer Science II U [0.50]

This is a reading course. Its aim is to provide background knowledge to students who need to get a head-start in their thesis research fields early during their program while no suitable regular graduate courses are offered. Admission is under the discretion of the instructor.

Restriction(s):   Requires instructor's signature.

CIS*6890 Technical Communication and Research Methodology U [0.50]

This course aims to develop students' ability in technical communication and general research methodology. Each student is expected to present a short talk, give a mini lecture, review a conference paper, write a literature survey and critique fellow students' talks and lectures.