2006-2007 Graduate Calendar

The information published in this Graduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2006-2007 academic years, including the Summer Semester 2006, the Fall Semester 2006, the Winter Semester 2007 and the Summer 2007.

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:

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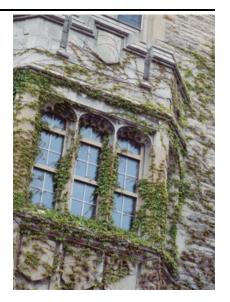
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Disclaimer

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.

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Computing and Information Science

The Department of Computing and Information Science offers a program of study leading to the MSc in Applied Computer Science 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. Interaction with other disciplines is encouraged. The fields of study offered by the program are: (1) parallel and distributed computing, (2) interactive software environments, and (3) artificial intelligence. Research in distributed systems includes distributed databases, VLSI design automation, computer architecture and networks, and parallel processing. Research in interactive software environments includes human-computer interaction, user-interface software and hypertext. Research in artificial intelligence includes uncertainty management, knowledge acquisition, expert systems, image processing, neural networks and pattern recognition. Applied research is carried out in areas such as information management, including geographical information systems, statistical databases, and office information systems.

Admission Requirements

Most available spaces are filled in March for entry the following September. A limited amount of spaces are filled 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 previously taken 12 relevant courses from University of Guelph (or equivalent courses from other recognized universities):

(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

The TOEFL is required of all applicants whose first language is not English. For the Internet-Based TOEFL the applicant's overall score should be at least 89, with no individual component less than 21. For the Computer-Based TOEFL the score should be at least 250, and for the Paper-Based TOEFL it should be at least 600. The TOEFL requirement can be waived in exceptional circumstances only (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).

Degree Requirements

Degree requirements include a 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. As a complement to the information below, the CIS Departmental Handbook for Graduate Students and other documents are available on the department website http://www.cis.uoguelph.ca/?q=graduate#forms

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 fulfil 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 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. The student's

advisor chairs the committee. Graduate faculty members from other academic units can sit in the committee.

Course Requirement

An MSc student is required to take 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 seminar must be presented before the final semester of the candidate, and no earlier than the third semester after entering the program. It should be attended by the student's advisor and at least one other CIS faculty 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 candidates 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 5 weeks prior to the anticipated date of the defence, and the student must submit his/her MSc thesis to the Advisory Committee at least 3 weeks prior to it (see the CIS Departmental Handbook for Graduate Students). The examination consists of an oral presentation by the candidate 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, data and knowledge management, distributed computing, and natural computation as detailed below:

1. **Applied Modelling (AM):** Students working in this field will engage in research on topics such as environmental modelling, optimization algorithms, performance analysis, and simulation.

2. **Data and Knowledge Management (DKM):** Students working in this field will engage in research on topics such as bioinformatics and biocomputing, data mining and machine learning, geographic information systems, image analysis, information retrieval, relational and deductive database systems, uncertain inference and decision support systems.

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

4. **Natural Computation (NC):** Students working in this field will engage in research on topics such as genetic algorithms and neural networks.

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

The TOEFL is required of all applicants whose first language is not English. For the Internet-Based TOEFL the applicant's overall score should be at least 89, with no individual component less than 21. For the Computer-Based TOEFL the score should be at least 250, and for the Paper-Based TOEFL it should be at least 600. The TOEFL requirement can be waived in exceptional circumstances only (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).

GRE Tests

Students who have obtained a Masters degree from a university outside of Canada are required to supply GRE scores (GRE General and/or GRE Subject in CS). Applicants with high GRE scores will be considered favourably in the admission process.

Admission without an MSc Degree

A student who has achieved excellent standing in an honours Computer Science degree (or an equivalent 4-year CS 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.

A student who has completed an honours Computer Science degree (or an equivalent 4-year CS 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, demonstration of research promise, and strong letters of recommendation.

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
- transcripts from all past programs
- a written description summarizing the progress in the previous program including the qualifying examination.

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 course requirements 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 CIS*6890 and at least eight other graduate courses.
- 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.

As a complement to the information below, the CIS Departmental Handbook for Graduate Students and other documents are available on the department website http://www.cis.uoguelph.ca/?q=graduate#forms

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.

Advisory Committee

Each PhD candidate conducts thesis research by working closely with a thesis advisor. The advisor is a member of the CIS graduate faculty who provides academic guidance and interacts regularly with the student. Moreover, the student is required to have an Advisory Committee containing no few than three members of the graduate faculty (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 CIS*6890 (unless the student has taken an equivalent course in the MSc program) and at least four other graduate courses. Of these four courses, at most one may be co-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 CIS*6890 and at least eight graduate courses. Out of these eight courses, at most two may be co-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 (see http://www.cis.uoguelph.ca/?q=graduate#forms). 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, or
- has written an MSc thesis in the area.

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 Coordinator (see the CIS Departmental Handbook for Graduate Students).

Seminar Requirement

A PhD student should give two publicly announced research seminars on his/her PhD thesis research. The first seminar must be presented before the semester when the Qualifying Examination is completed, and no earlier than the third semester after entering the program. The second seminar must be presented after the semester when the Qualifying Examination is completed, during the final year but before the final semester of the candidate. Each seminar should be attended by the student's advisor and at least one other CIS faculty 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 candidates 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 6 weeks prior to the anticipated date of the QE oral presentation, and the student must submit a research proposal to the Advisory Committee at least 3 weeks prior to it (see the CIS Departmental Handbook for Graduate Students). 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 candidate followed by questions from the Examination Committee.

Thesis Defence

Arrangements for the PhD thesis defence should be made 12 weeks prior to the anticipated date of the defence, and the student must submit his/her PhD thesis to the Advisory Committee at least 6 weeks prior to it (see the CIS Departmental Handbook for Graduate Students). The examination consists of an oral presentation by the candidate followed by questions from the Examination Committee.

Courses

CIS*6000 Distributed Systems U [0.50]

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.

CIS*6020 Knowledge Representation and Expert Systems U [0.50]

The major features of expert systems today: a discussion of logic and rule-based systems; forward and backward chaining; frames, scripts, semantic nets and the object-oriented approach; the evaluation of expert systems and knowledge acquisition. A sizeable project is required and applications in other areas are encouraged.

CIS*6030 Advanced Database Systems U [0.50]

Relational database systems, advanced features of database management, concurrency protocols, data integrity, transaction management, distributed databases, remote access, data warehousing, data mining, and deductive databases.

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]

An introduction to the field of software engineering. Course covers issues such as requirements analysis, specifications, software architectures, quality assurance, and software metrics.

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 Artificial Neural Networks 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.