COMPUTATIONAL SCIENCES

The School of Computer Science (SoCS) offers an Interdisciplinary PhD degree in Computational Sciences that encompasses multiple Departments/Schools across the University of Guelph. The program provides a unique opportunity for students to study computing within the context of another discipline commensurate with their interests and career goals. Students entering this PhD program perform research that bridges Computer Science with at least one other discipline such as Economics and Finance, Engineering, English and Theatre Studies, Geography, History, Integrative Biology, Mathematics and Statistics, Pathobiology, Population Medicine and Psychology.

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This list may include Regular Graduate Faculty, Associated Graduate Faculty and/or Graduate Faculty from other universities.

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Graduate Faculty

Fattane Zarrinkalam
B.Sc., M.Sc., PhD Ferdowsi University of Mashhad (Iran) - Assistant Professor
Graduate Faculty

PhD Program
Admission Requirements

In addition to the Office of Graduate Studies admission requirements, applicants must submit:

  i. a current CV including research publications; and
  ii. a statement of research (maximum of 1500 words).

The minimum academic requirement for admission to the PhD program is normally a recognized Master's degree that included a thesis or major independent project. We do not require students entering the program to have a credential in Computer Science. Such students are required to identify their experience using computerized techniques and demonstrate that they have the necessary background to complete the tasks outlined in a research proposal.

In exceptional circumstances, a student who has completed an honours undergraduate Computer Science degree (or an equivalent 4-year undergraduate 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.

Prospective students should check the School of Computer Science (SoCs) website (http://www.socs.uoguelph.ca/) for further details, procedures and deadlines.

Program Requirements

The objective of the PhD program is to produce interdisciplinary scholars who are capable of tackling emerging problems in a variety of disciplines through investigation and application of current computer technologies. Students require two co-advisors: one from the School of Computer Science; and the second from another discipline (see Graduate Faculty).

The PhD program requires completion of CIS*6890 Technical Communication and Research Methodology, coupled with any additional courses and/or Computational Learning Modules assigned by the Advisory Committee on entry to the program. To achieve candidacy, students are expected to present a research proposal in a two-part

seminar and successfully complete the Qualifying Examination (QE). Finally, students must present and defend a thesis.

Collaborative Specializations
One Health

Computational Sciences participates in the collaborative specialization in One Health. Master's and Doctoral students wishing to undertake thesis research or their major research paper/project with an emphasis on one health are eligible to apply to register concurrently in Computational Sciences and the collaborative specialization. Students should consult the One Health (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/one-health/) listing for more information.

Courses

CIS*6020 Artificial Intelligence Unspecified [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.
Department(s): School of Computer Science
Location(s): Guelph

CIS*6030 Information Systems Unspecified [0.50]
Relational and other database systems, web information concurrency protocols, data integrity, transaction management, distributed databases, remote access, data warehousing, data mining.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6050 Neural Networks Unspecified [0.50]
Artificial neural networks, dynamical recurrent networks, dynamic input/output sequences, communications signal identification, syntactic pattern recognition.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6060 Bioinformatics Unspecified [0.50]
Data mining and bioinformatics, molecular biology databases, taxonomic groupings, sequences, feature extraction, Bayesian inference, cluster analysis, information theory, machine learning, feature selection.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6070 Discrete Optimization Unspecified [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.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6080 Genetic Algorithms Unspecified [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.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6120 Uncertainty Reasoning in Knowledge Representation Unspecified [0.50]
Representation of uncertainty, Dempster-Schafer theory, fuzzy logic, Bayesian belief networks, decision networks, dynamic networks, probabilistic models, utility theory.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6130 Object-Oriented Modeling, Design and Programming Unspecified [0.50]
Objects, modeling, program design, object-oriented methodology, UML, CORBA, database.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6160 Multiagent Systems Unspecified [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.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6170 Human-Computer Interaction Unspecified [0.50]
This course concentrates on the theoretical and practical issues related to the design and study of interactive technologies for human use. Topics include: general principles of design, qualitative and quantitative research methods, prototyping techniques, theoretical issues underlying designing to individuals and groups, and ethical issues related to conducting research involving humans.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6180 Analysis of Big Data Unspecified [0.50]
This course introduces software tools and data science techniques for analyzing big data. It covers big data principles, state-of-the-art methodologies for large data management and analysis, and their applications to real-world problems. Modern and traditional machine learning techniques and data mining methods are discussed and ethical implications of big data analysis are examined. May be offered in conjunction with DATA*6300.
Offering(s): Odd-numbered years
Restriction(s): Credit may be obtained for only one of CIS*6180 or DATA*6300
Department(s): School of Computer Science
Location(s): Guelph

CIS*6190 Machine Learning for Sequential Data Processing Unspecified [0.50]
This course emphasizes machine learning for sequential data processing. It covers common challenges and pre-processing techniques for sequential data such as text, biological sequences, and time series data. Students are exposed to machine learning techniques, including classical methods and more recent deep learning models, so that they obtain the background and skills needed to confront real-world applications of sequential data processing. May be offered in conjunction with DATA*6400.
Offering(s): Odd- numbered years
Restriction(s): Credit may be obtained for only one of CIS*6190 or DATA*6400
Department(s): School of Computer Science
Location(s): Guelph

CIS*6320 Image Processing Algorithms and Applications Unspecified [0.50]
Brightness transformation, image smoothing, image enhancement, thresholding, segmentation, morphology, texture analysis, shape analysis, applications in medicine and biology.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6420 Soft Computing Unspecified [0.50]
Neural networks, artificial intelligence, connectionist model, back propagation, resonance theory, sequence processing, software engineering concepts.
Offering(s): Odd-numbered years
Department(s): School of Computer Science
Location(s): Guelph

CIS*6510 Cybersecurity and Defense in Depth Fall Only [0.50]
This course provides an overview of concepts and technical measures that are employed to enforce security policies and protect networks and systems from malicious activities. Students will learn how to engineer a secure system and how to secure networks in an ethical manner.
Restriction(s): Restricted to Master of Cybersecurity and Threat Intelligence students.
Department(s): School of Computer Science
Location(s): Guelph

CIS*6520 Advanced Digital Forensics and Incident Response Fall Only [0.50]
This course provides an in-depth understanding of theoretical concepts and practical issues in the field of digital forensics and incident response. Students will develop necessary skills, methodologies, and processes to detect cyber incidents and conduct in-depth computer and network investigation.
Restriction(s): Restricted to Master of Cybersecurity and Threat Intelligence students.
Department(s): School of Computer Science
Location(s): Guelph

CIS*6530 Cyber Threat Intelligence and Adversarial Risk Analysis Winter Only [0.50]

This course provides an in-depth understanding of techniques for detecting, responding to, and defeating Advanced Persistent Threats (APT) and malware campaigns using artificial intelligence and data mining techniques. Students will identify, extract, and leverage intelligence from different types of cyber threat actors.

Restriction(s): Restricted to Master of Cybersecurity and Threat Intelligence students.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6540 Advanced Penetration Testing and Exploit Development Winter Only [0.50]

This course provides an in-depth understanding of techniques for detecting, responding to, and defeating Advanced Persistent Threats (APT) and malware campaigns using artificial intelligence and data mining techniques. Students will identify, extract, and leverage intelligence from different types of cyber threat actors.

Restriction(s): Restricted to Master of Cybersecurity and Threat Intelligence students.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6550 Privacy, Compliance, and Human Aspects of Cybersecurity Unspecified [0.50]

This course provides an in-depth view of the privacy, regulatory, and ethical issues surrounding cybersecurity. It covers methods of mitigating/treating privacy risks associated with emerging technologies that collect, manage, and analyse data. This course also examines data protection regulations and compliance strategies.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6560 Cybersecurity and Threat Intelligence Project Summer Only [1.00]

Students plan, develop, and write an industry- or faculty-led report and produce required tools, services, and software. Projects should advance knowledge or practice, and address an emerging challenge in cybersecurity, cyber threat intelligence, digital forensics and incident response, cyber threat hunting, or a closely related field.

Restriction(s): Instructor consent required.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6570 Advanced Cryptography and Cryptanalysis Unspecified [0.50]

This course provides an in-depth understanding of modern cryptography, with emphasis on practical applications. Topics covered include classical systems, information theory, symmetrical cryptosystems, block ciphers, stream ciphers, DES, AES, asymmetric cryptosystems, ECC, provable security, keyexchange and management, and authentication and digital signatures, among others.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6580 Security Monitoring and Cyber Threat Hunting Unspecified [0.50]

This course provides a comprehensive review of tools, techniques, and procedures for monitoring network events and assets to build a secure network architecture. It trains students in methods for hunting attackers that could bypass designed network defense mechanisms in an enterprise.

Restriction(s): Restricted to Master of Cybersecurity and Threat Intelligence students.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6590 Professional Seminar in Cybersecurity Fall and Winter Reg Required [0.50]

This two-semester course offers a multidisciplinary forum for discussion of topics related to cybersecurity. The seminar fosters professional skills development (academic and industry), promotes collaboration between industry experts and graduate students, facilitates mentoring and project development, and contributes to the transfer of knowledge between industry and academia.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6650 Topics in Computer Science I Unspecified [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.

Offering(s): Odd-numbered years

Department(s): School of Computer Science

Location(s): Guelph

CIS*6660 Topics in Computer Science II Unspecified [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): Instructor consent required.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6670 Special Topics in Cybersecurity Unspecified [0.50]

This course provides an in-depth view of a variety of advanced topics within cybersecurity. Subject areas discussed in any particular semester will depend upon the interests of both the students and the instructor. Students should check with the School of Computer Science to determine what topics will be offered during specific semesters.

Department(s): School of Computer Science

Location(s): Guelph

CIS*6890 Technical Communication and Research Methodology Unspecified [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.

Department(s): School of Computer Science

Location(s): Guelph