Ottawa-Carleton Institute for Computer Science

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The Institute

Director of the Institute: S.P. Dandamudi Associate Director of the Institute: S.J. Matwin

Students who wish to pursue studies in computer science leading to an M.C.S. or a Ph.D. degree can do so in a joint program offered by the Department of Computer Science at the University of Ottawa and the School of Computer Science at Carleton University under the auspices of the Ottawa-Carleton Institute for Computer Science. The Institute is responsible for supervising the program and for providing a framework for interaction between the two departments at the research level. In addition to the faculty members from the two computer science departments the Institute also has members with computer science expertise from other departments.

Requests for information, and completed applications, should be sent to the director or associate director of the Institute. A joint admissions committee examines all applications and assigns students to the most appropriate campus and supervisor.

Members of the Institute

The "home" department of each member is indicated by (CSI) for the Department of Computer Science, University of Ottawa, (ELG) for the Department of Electrical Engineering, University of Ottawa, (ADM) for Faculty of Administration, University of Ottawa, (MCG) for the Department of Mechanical Engineering, University of Ottawa, (SCS) for the School of Computer Science, Carleton University, (MAT) for the Department of Mathematics and Statistics, Carleton University, (SCE) for the Department of Systems and Computer Engineering, Carleton University, (C) for the Department of Civil Engineering, Carleton University, (BUS) for the School of Business, Carleton University.

M.D. Atkinson, (SCS), Complexity, Algorithms, Computational Algebra

L.G. Birta, (CSI), Simulation, Optimization, Numerical Algorithms

Sylvia Boyd, (CSI), Optimization, Combinatorics

R.J. Buhr, (SCE), Software Design, Design Visualization, Real-Time and Distributed Systems, Object-Oriented Systems

T.-Y. Cheung, (CSI), *Distributed Computing, Optimization, Databases*

J.W. Chinneck, (SCE), *Operations Research, Applied Optimization*

J.-P. Corriveau, (SCS), Cognitive Science, Natural Language Understanding, CASE Tools

S.P. Dandamudi, (SCS), Parallel and Distributed Systems, Database Systems, Performance Evaluation, Computer Architecture, Operating Systems N.W. Dawes, (SCE), Diagnosis and Pattern Recog-

nition Frank Dehne, (SCS), Computational Geometry, VLSI Algorithms

J.D. Dixon, (MAT), *Algorithms, Algebra, Number Theory*

A.E.F. Fahim, (MCG), Nonlinear Optimization, CAD/CAM Methodology and Software, FMC Control Environment, Robot Control, Expert Systems for Design and Manufacturing

Frantisek Fiala, (SCS), *Optimization, Combinatorics* N.D. Georganas, (ELG), *Computer Communica*-

tions, Mobile Radio Morris Goldberg, (ELG), Image Processing, Pattern

Recognition

R.C. Holte, (CSI) Artificial Intelligence, Machine Learning, Knowledge Compilation

N.M. Holtz, (C) Computer-aided Structural Engineering

G.M. Karam, (SCE), Concurrent and Real-Time Systems, Software Engineering, Communications Software

A.R. Kaye, (SCE), Broadband Networks, BISDN, ATM, Performance Evaluation, Traffic Management and Design

G.F. Kersten, (BUS), Knowledge-based Systems, Intelligent Decision Support, Problem Structuring and Representation

Evangelos Kranakis, (SCS), Cryptography, Computational Number Theory, Combinatorial Analysis, Computational Geometry, Distributed Computing, Mathematical Logic

Moshe Krieger, (ELG), Computer Architecture Danny Krizanc, (SCS), Parallel and Distributed Computing, Analysis of Algorithms and Use of Randomization in Computation

W.R. LaLonde, (SCS), *Object-Oriented Systems*, *Design and Analysis Tools, Animation Systems* Luigi Logrippo, (CSI), *Software Methodology, Communications Protocols* 182 Joint Program for Computer Science

S.A. Mahmoud, (SCE), Wireless Communication Systems, Protocols for High Speed Networks,

Speech Processing and Computer Network Design S.J. Matwin, (CSI), Programing Languages, Expert Systems

A. Mili, (CSI), Formal Specification, Program Transformation

L.R. Morris, (SCE), *Signal Processing, Speech Analysis, Graphics*

B.C. Mortimer, (MAT), *Combinatorics, Algorithms, Groups Theory*

J. E. Neilson, (SCS), Distributed and Parallel Computing (including Operating Systems, Performance Models, and Applications), Simulation and Prototyping Methodology, Computer Systems Performance Engineering

L.D. Nel, (SCS), Network Reliability and Performance, Digital Signal Processing, Computer Music J.B. Oommen, (SCS), Learning Systems, Stochastic Automata, Pattern Recognition, Image Processing, Adaptive Data Structures

Franz Oppacher, (SCS), Artificial Intelligence, Genetic Algorithms, Evolutionary Computing, Machine Learing

T.I. Oren, (CSI), *Simulation, Modelling* R.B. Osborne, (SCS), *Speculative Computation*,

Parallel Processing, Programing Languages E.J. Otoo, (SCS), Databases, Algorithms

Bernard Pagurek, (SCE), Queuing, Databases

R.L. Probert, (CSI), Communications, Expert Systems J.R. Pugh, (SCS), Object-Oriented Programing Systems, User Interfaces, Computer Graphics

Jacques Raymond, (CSI), *Computer Architecture, Graphics*

Irwin Reichstein, (SCS), *Numerical Applications, Microcomputers*

Ivan Rival, (CSI), Combinatorics, Optimization, Algorithms

J.-R. Sack, (SCS), Algorithms and Complexity, Sequential and Parallel Computing, Computational Geometry, Geographic Information Systems, Medical Computing

Nicola Santoro, (SCS), *Distributed Computing*, *Fault-Tolerance*, *Discrete Chaos*, *Reactive Environments*

Philip Scott, (CSI), *Logic, Theoretical Computer Science, Category Theory*

J.B. Sidney, (ADM), *Combinatorics, Complexity, Computational Geometry*

D.R. Skuce, (CSI), Artificial Intelligence, Logic Programing

Ivan Stojmenovic, (CSI), *Computational Geometry, Multiple-valued Logics, Parallel Computing*

Stan Szpakowicz, (CSI), Logic Programing, Computational Linguistics

D.A. Thomas, (SCS), Artificial Intelligence, Fifth Generation Machines Hasan Ural, (CSI), Software Reliability and Testing, Data Communication Protocols, Applications of Logic Programing Jorge Urrutia, (CSI), Algorithms, Combinatorics, Geometry And Algorithms Rémi Vaillancourt, (CSI), Numerical Methods G.M. White, (CSI), Networking, Office Automation C.M. Woodside, (SCE), Performance Modelling, Performance of Distributed Software, Software Design, Queuing Theory Negib Zaguia, (CSI), Optimization, Theory of Algorithms, Theory of Ordered Sets

Master of Computer Science

Admission Requirements

Applicants should have an honours bachelor's degree in computer science or equivalent, with at least high honours standing. By *equivalent* is meant an honours degree in a program which includes at least twelve computer science half courses, two of which must be at the fourth-year level, as well as eight half courses in mathematics, one of which must be at the third- or fourth-year level. These courses must include the topics indicated below:

Computer Science

Data structures/file management, operating systems, computer architecture, algorithm design and analysis, assembly language and two high-level languages

Mathematics

Calculus, linear algebra, algebraic structures or discrete mathematics, probability and statistics, numerical analysis. Applicants who have a general (pass) bachelor's degree, or who otherwise lack the required undergraduate preparation, may be admitted to a qualifying-year program. Refer to the general section of this calendar for regulations governing the qualifying year.

Program Requirements

The program includes graduate study and research in four broad areas identified as follows:

• Programing Systems and Languages

Database systems, operating systems, software methodology, software translators, language design

• Theory of Computing

Analysis of algorithms, automata theory, formal languages, complexity, computability, logic and program schemata

• Computer Applications

Artifical intelligence, graphics, picture and signal processing, modelling and simulation, numerical analysis, optimization

• Computer Systems

Computer architecture, networks and distributed processing, computer communications, mini- and microcomputers

Within these areas, the program emphasizes problems of current practical significance and has close links to the scientific and industrial communities.

Normally, students in the program will be expected to complete a thesis; however, students who have substantial relevant work experience may be permitted to take the non-thesis option, which must include a graduate research project course. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.

Students in the thesis option must take five half courses or equivalent, fulfil the graduate seminar requirement, and complete a thesis. Students in the non-thesis option must take ten half courses, and fulfil the graduate seminar requirement. The course selections must be approved by the student's academic adviser, and must include at least:

- One half course in programing systems and languages
- One half course in the theory of computing
- One half course in either computer applications or computer systems

The graduate seminar requirement includes a seminar presentation and participation in at least thirteen seminars in the Joint Graduate Student Seminar Series.

Both course and thesis work may be completed either by full-time or part-time study.

A candidate may be permitted to carry out thesis work off campus provided that suitable arrangements are made for supervision and experimental work, and prior approval is given by the Institute.

Doctor of Philosophy

Admission Requirements

A Master's degree in Computer Science (or equivalent) with high second-class standing is normally required for admission into the Ph.D. program. Students who are currently registered in the M.C.S. program may, in exceptional cases, be permitted to transfer into the Ph.D. program if they have completed all course requirements with at least high second-class standing and demonstrate significant promise for advanced research.

Program Requirements

• A minimum of five half courses, or equivalent, at the graduate level which must include: one half course in programing systems and languages; one half course in the theory of computing; one half course in either computer applications or computer systems

- Presentation of at least two seminars in the Computer Science Institute seminar series
- A comprehensive examination involving breadth and depth components
- A written thesis proposal defended at an oral examination
- A research thesis, defended at an oral examination

Residence Requirement

Students must fulfil a residence requirement of at least four terms of full-time study.

Graduate Courses

The courses in the following list are offered by various departments indicated by the prefix of the course code as follows:

Carleton University

- 70 Department of Mathematics and Statistics
- 94 Department of Systems and Computer Engineering
- 95 School of Computer Science

University of Ottawa

- CSI Department of Computer Science
- ELG Department of Electrical Engineering
- MAT Department of Mathematics

Programing Systems and Languages

94.480		Software Engineering
95.404		Systems Software
95.490		Advanced Topics in
		Computer Science
94.531	(ELG6131)	System Design with Ada
94.573	(CSI5115)	Integrated Database
		Systems
94.579	(CSI5112)	Advanced Topics in
		Software Engineering
95.501	(CSI5113)	Foundations of
		Programing Languages
95.502	(CSI5119)	User-Interface Facilities
95.514	(CSI5314)	Object-oriented Systems
95.516	(CSI5123)	Languages for Parallel
		Computing
CSI5107	(95.569)	Program Construction
		and Fault Tolerance
CSI5111	(95.551)	Software Testing: Theory
		and Practice
CSI5118	(95.578)	Design of Compilers and
		Translators
CSI5184	(95.584)	Logic Programing

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CSI5507	(95.569)	La Construction et la Tolérance aux Fautes des Programmes	CSI51747	Г(95.564)	Specification and Validation of Communication Software
CSI5518	(95.578)	Conception des compilateurs et traducteurs	CSI5507	(95.569)	La Construction et la Tolérance aux Fautes de Programmes
CSI5584	(95.584)	Programmation logique	CSI5508	(95.570)	Spécification et
<i>Theory of</i> 70.482	Computing	Introduction to Mathematical Logic	CSI5509	(95.571)	Méthodes Algébriques pour la Spécification de Systemes Répartis
70/95.483	}	Topics in Applied Logic Design and Analysis of Algorithms	CSI5510	(95.577)	Principes de développement formel de logiciels
70/95.485 70/95.486	5	Theory of Automata Numerical Linear Analysis	CSI5565	(95.579)	Algorithmes Combinatoires
95.409		Introduction to Parallel and Systolic Computing	<i>Computer</i> 70/95.486	r Applications 5	Numerical Linear Algebra
70.565 70.585	(MAT5165) (MAT5308)	Theory of Automata Topics of Algorithm	94.405		Its Applications Computer Graphics
95.503	(CSI5308)	Design Principles of Distributed	95.403		Transaction Processing Systems
95.504	(CSI5305)	Topics in Arithmetic Complexity	95.405		First Course in Robotics and Computer Vision
95.505	(CSI5390)	Automata Models of Learning Systems	70 569	(MAT5301)	Intelligence Topics in Combinatorial
95.508 95.522	(CSI5164) (CSI5172)	Computational Geometry Network Reliability	70.501	(11115501)	Mathematics
95.528	(CSI5167)	Complexity of Boolean	/0.581	(MA15505/AL	Linear Optimization
95.573	(CSI5163)	Algorithm Analysis and	70.583	(MAT5304/AI	OM6386) Nonlinear Optimization
95/70.587	(CSI5104)	Formal Language and	70.584	(MAT5307/A)	DM6387) Topics in Operations
95.662	(CSI7170)	Advanced Topics in	70.586	(MAT5180)	Research Numerical Analysis
CSI5101	(95.561)	Formal Models of	70.588	(MAT5305)	Combinatorial Optimization I
CSI5107	(95.569)	Program Construction	70.589	(MAT5306)	Combinatorial Optimization II
CSI5108	(95.570)	and Fault Tolerance Software Specification	94.501	(CSI5120)	Simulation and Modelling
CSI5109	(95.571)	and Verification Algebraic Specification Methods for Distributed	94.504	(ADM6371)	Mathematical Programing for Engineering Applications
CSI5110	(95.577)	Systems Principles of Formal Software Development	94.505	(CSI5150)	Optimization Theory and Methods
CSI5162	(95.572)	Topics in the Theory of Computing	94.534 94.535	(ELG6134) (ELG6135)	Mini-Micro Applications Representations and Methods in Design Tools
CSI5165 CSI5166	(95.579) (95.585)	Combinatorial Algorithms			for Concurrent Systems
2515100	(20.000)	Combinatorial Optimization	94.542	(ELG6142)	Advanced Dynamics with Applications to Robots
			94.553	(ELG6153)	Stochastic Processes

95.506	(CSI5306)	Natural Language Understanding	94.576	(ELG6176)	Analytical Performance Models of Computer
95/94.50 95.510	7 (CSI5307) (CSI5180)	Expert Systems Topics in Artificial Intelligence	94.577	(ELG6177)	Systems Teleprocessing Software Design
95.513 95.520	(CSI5313) (CSI5182)	Cryptography Cerebral Computations	94.581	(ELG6181)	Advanced Topics in Computer
95.524	(CSI5124)	Computational Aspects of Geographic	95.503	(CSI5308)	Communications Principles of Distributed
95.526	(CSI5183)	Information Systems Genetic Algorithms and Artificial Life	95.509	(CSI5141)	Computing Associative Data Structures and Advanced
CSI5114	(95.554)	Automated Office Systems	95.511	(CSI5311)	Databases Distributed Databases
CSI5161	(95.566)	Topics in System Simulation and		(,	and Transaction Processing Systems
CSI5181	(95.575)	Optimization Artificial Intelligence	95.512	(CSI5312)	Distributed Operating Systems
		Applications in Software Development	95.515	(CSI5132)	Systems
CSI5304 CSI5386	(95.562) (95.555)	Knowledge Engineering Natural Language	95.574	(CSI5131)	Parallel Algorithms and their VLSI
CSI5387	(95.576)	Concept Learning Systems	95.610	(CSI7131)	Advanced Parallel and Systolic Algorithms
CSI5514 CSI5580	(95.554) (95.510)	Bureautique Sujet en intelligence	95.662	(CSI7170)	Advanced Topics in Distributed Computing
CSI5581	(95.575)	artificielle	97.587	(ELG6387)	Microprocessor Flectronics
C515561	(95.575)	l'intelligence artificielle dans le développement	CSI5114	(95.554)	Automated Office Systems
CSI5787	(95.576)	des systèmes Apprentissage	CSI5133	(95.568)	Simulation and Testing of Logic Circuits
ELG5119	9 (92.519)	Symbolique Automatique Stochastic Processes	CSI5135	(95.565)	High Level Language Machines
Compute	r Systems	Introduction to the	CSI5170	(95.580)	Distributed Data Processing
94.437		Architecture of Computer	CSI5171	(95.583)	Software for Communication Networks
94.470		Introduction to Telecommunications	CSI5388	(95.581)	Topics in Machine Learning
95.408		Performance Modelling	CS15514	(95.554)	Bureautique
94.511	(ELG6111)	Computer System Design for Performance		(95.505)	niveau
94.519	(ELG6119)	Teletraffic Engineering	ELG5192	2 (92.577)	Microprocessor-based Systems
94.321	(ELG0121)	Communications	ELG5193	8 (92.578)	Multi-microprocessor Systems
94.527	(ELG6127)	Distributed Processing Systems	ELG5374	4 (92.567)	Computer-Communication Networks
94.538	(ELG6138)	Computer Architecture and Parallel Processing	ELG5378	3TH	Image Processing
94.558	(ELG6158)	Digital Systems Architecture		(74.337)	Techniques and Image
94.571	(CSI5117)	Operating System Methods for Real-Time Applications			Communications

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Theses, Projects and Topics

95.590	(CSI5140)	Selected Topics in
		Computer Science
95.591	(CSI5901)	Directed Studies (M.C.S.)
95.592	(CSI5900)	Graduate Project (M.C.S.)
95/70/94.	595	
	(CSI7999)	M.C.S. Thesis
95.661	(CSI7160)	Advanced Topics in the
		Theory of Computing
95.662	(CSI7170)	Advanced Topics in
		Distributed Computing
95.663	(CSI7161)	Advanced Topics in
		Programing Systems and
		Languages
95.664	(CSI7162)	Advanced Topics in
		Computer Applications
95.665	(CSI7163)	Advanced Topics in
		Computer Systems
95.691	(CSI7901)	Directed Studies (Ph.D.)
95.692	(CSI7900)	Graduate Project (Ph.D)
95.699	(CSI9999)	Ph.D. Thesis
CSI9998		Examen général de
		doctorat/Ph.D.
		Comprehensive
		Examination