

**CARLETON UNIVERSITY COMMITTEE ON
QUALITY ASSURANCE
Cyclical Review of the Graduate Programs
in Computer Science
Executive Summary and Final Assessment Report**

This Executive Summary and Final Assessment Report of the cyclical review of Carleton and the University of Ottawa's joint graduate programs in Computer Science are provided pursuant to the provincial Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP).

EXECUTIVE SUMMARY

The graduate programs in Computer Science reside in the Ottawa-Carleton Institute for Computer Science, a unit administered by the School of Computer Science at Carleton University and the School of Electrical and Computer Engineering at the University of Ottawa.

As a consequence of the review, the programs were categorized by Carleton University's Senate Quality Assurance and Planning Committee (SQAPC) as being of good quality. (Carleton's IQAP 7.2.13).

The External Reviewers' report offered a very positive assessment of the programs. Within the context of this positive assessment, the report nonetheless made a number of recommendations for the continuing enhancement of the programs. These recommendations were productively addressed by the Director of the School of Computer Science, the Dean of the Faculty of Science and the Dean of the Faculty of Graduate and Postdoctoral Affairs at Carleton University and the Director and Associate Graduate Directors of the School of Electrical and Computer Engineering and the Dean of the Faculty of Engineering at the University of Ottawa in a response to the External Reviewers' report and Implementation on Plan that was submitted to SQAPC on August 26th, 2021.

**School of Computer Science
Unit Response to External Reviewers' Report & Implementation Plan
Programs Being Reviewed: Graduate Programs**

Note: This document is forwarded to Senate, the Quality Council and posted on the Vice- Provost's external website.

**Ottawa-Carleton Joint Programs in Computer Science (OCICS)
Master's of Computer Science (MCS)
PhD of Computer Science**

Introduction & General Comments

The School of Computer Science (SCS) and School of Electrical Engineering and Computer Science (EECS) were very pleased to receive the Reviewers' very positive External Reviewers' report January 2021. This report was shared with our faculty and staff. We are committed to the continual improvement of our programs to enhance the student, staff, and faculty experience. This document contains both a response to the External Reviewers' Report and an Implementation Plan. They have been created in consultation with the Deans of both institutions.

For each recommendation one of the following responses has been selected:

- Agreed to unconditionally:** used when the unit agrees to and is able to take action on the recommendation without further consultation with any other parties internal or external to the unit.
- Agreed to if additional resources permit:** used when the unit agrees with the recommendation, however action can only be taken if additional resources are made available. Units must describe the resources needed to implement the recommendation and provide an explanation demonstrating how they plan to obtain those resources. In these cases, discussions with the Deans will normally be required and therefore identified as an action item.
- Agreed to in principle:** used when the unit agrees with the recommendation, however action is dependent on something other than resources. Units must describe these dependencies and determine what actions, if any, will be taken.
- Not agreed to:** used when the unit does not agree with the recommendation and therefore will not be taking further action. A rationale must be provided to indicate why the unit does not agree (no action should be associated with this response).

Response to External Reviewers' Report Committee

The response to the external reviewers' report was prepared by a committee comprising the following members:

School of Computer Science, Carleton University

Michel Barbeau, Director

Olga Baysal, Graduate Director (Recruitment and Admissions)

Jit Bose, Graduate Director (Program Management) & Director of the Ottawa-Carleton Institute for Computer Science

School of Electrical Engineering and Computer Science, University of Ottawa

Claude d'Amours, Director

Paola Flocchini, Past Graduate Associate Director

Jochen Lang, Graduate Associate Director

UNIT RESPONSE AND IMPLEMENTATION PLAN					
Programs Being Reviewed: Master's of Computer Science (MCS) and PhD of Computer Science					
Prepared by: Michel Barbeau, Director, School of Computer Science					
External Reviewer Recommendation & Categorization	Unit Response: 1- Agreed to unconditionally 2- Agreed to if additional resources permit (describe resources) 3- Agreed to in principle 4- Not agreed to Rationales are required for categories 2, 3 & 4	Action Item	Owner	Timeline	Will the action described require calendar changes? (Y or N)
Concern: Review and realign the OCICS admission process practices between the two organisations.	1- <i>Agreed to unconditionally</i>	<i>We have reviewed and aligned the OCICS admission process. Starting from Fall 2020, we have implemented a uniform admission process. See Appendix A for the details.</i>	<i>EECS' Graduate Associate Director SCS' Graduate Director (Recruitment and Admissions)</i>	<i>Implemented for the Fall 2021 admission cycle</i>	<i>N</i>

<p>Concern: Include EDI priorities in the admission process.</p>	<p>1- <i>Agreed to unconditionally</i></p>	<p><i>We are committed to continuous progress towards full participation in our joint programs for all groups of individuals. Everyone should feel welcome to apply and join our graduate programs. We need all perspectives and all viewpoints.</i></p> <p><i>In the School of Computer Science, moving towards gender equity is a priority. Carleton's Faculty of Science, comprising the School of Computer Science, has planned, and started initiatives to help encourage and support female students, and to address gender imbalance at the graduate level. These initiatives include the ACE (Awareness, Collaboration and Engagement) EDI event series, development of inclusivity training to the faculty, inclusive hiring practices and outreach visits to elementary and high school classrooms by female scientists and professors and by inviting students to university labs. The School of Computer Science has its own EDI committee. Current activities include the design of computer science specific EDI statements, inclusive computer science teaching, hiring policies, student code of conduct and a research project to develop teaching and mentoring approaches aiming to significantly improve experience for students from under-represented minorities in computer science.</i></p> <p><i>Both institutions support societies that encourage women in computer science, including Women in Computer Science</i></p>	<p><i>EECS' Graduate Associate Director SCS' Graduate Director (Recruitment and Admissions)</i></p>	<p><i>Ongoing</i></p>	<p><i>N</i></p>
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		<i>(WiCS), Women in Science and Engineering (WISE), Tecnolgap and coding groups.</i>			
Opportunity: Put in place a system to track the graduated M.Sc. and Ph.D. students. It is highly recommended to implement this as an “exit survey” for graduating students.	1- <i>Agreed to unconditionally</i>	<i>This an excellent idea. This data is of great value internally, and possibly for recruitment. We will develop an online exit questionnaire. We will provide access to students to the exit questionnaire when they complete their thesis defense.</i>	<i>Director of OCICS EECS’ Graduate Associate Director SCS’ Graduate Director SCS’ Graduate Director (Program Management)</i>	<i>Form designed and implemented in the upcoming academic year</i>	<i>N</i>
Opportunity: Put in place a system to track (i) the cross-organisational co-supervisions of the graduate students between the two organisations, and (ii) the cross-organisational statistics on the course enrolments.	1- <i>Agreed to unconditionally</i>	<i>Very good idea! This data will be useful for planning the offered courses and track collaboration in the context of the joint programs. We will review the current information collection process to make sure this data is collected in the future.</i>	<i>EECS’ Director SCS’ Director Director of OCICS EECS’ Graduate Associate Director SCS’ Graduate Director SCS’ Graduate Director (Program Management)</i>	<i>Upcoming academic year</i>	<i>N</i>
Opportunity: Plan and advertise the graduate courses on a two-year horizon.	3- <i>Agreed to in principle</i> <i>Good idea, but details need to be worked out. The key issue that needs to be addressed is the logistic behind the coordination of a two year plan of the two institutions.</i>	<i>We will investigate the possibility to announce a tentative 2nd year schedule.</i>	<i>EECS’ Director SCS’ Director</i>	<i>Fall 2021 and Winter 2022</i>	<i>N</i>

<p>Opportunity: Put in place a mechanism to review new courses at OCICS BOM level.</p>	<p>1- <i>Agreed to unconditionally</i></p>	<p><i>The process for the introduction of new courses has been reviewed. It is detailed in Appendix B.</i></p>	<p><i>EECS' Graduate Associate Director SCS' Graduate Director (Program Management) Director of OCICS</i></p>	<p><i>Effective Winter 2021</i></p>	<p><i>N</i></p>
<p>Concern: Reevaluate the long-term purpose of the joint programs.</p>	<p>1- <i>Agreed to unconditionally</i></p>	<p><i>The review committee examined the long-term purpose of the joint programs. The review committee is in the opinion that the joint program has considerable benefits including 1) the access for the graduate students to a large selection of pooled courses and 2) the availability of a wide range of skills for the constitution of thesis examination committees. Graduate students seamlessly register and follow courses in the other institution, no need for a course equivalence recognition mechanism.</i></p> <p><i>Moreover, this environment promotes the creation of research collaborations. In the last five years, researchers from the two institutions have co-signed a good number of joint publications. For example, during the last five years co-authors include Barbeau-Nayak, Bose-Morin-Dujmovic, Flocchini-Kranakis, and Flocchini-Santoro. The review committee is in the opinion that this aspect can be further developed in the future. There are also some co-supervisions of graduate students and PDFs. In the past, we co-organized</i></p>	<p><i>EECS' Director SCS' Director Director of OCICS EECS' Graduate Associate Director SCS' Graduate Director (Recruitment and Admissions) SCS' Graduate Director (Program Management)</i></p>	<p><i>Done</i></p>	<p><i>N</i></p>

		<p>conferences, workshops and schools, where members of both the institutions participated, including the funding applications.</p> <p>The two institutions are not competitors but rather allies that work together to offer in the Ottawa area the best possible graduate programs in computer science.</p>			
Concern: Create a joint (“curriculum”?) program committee, including current students, graduates of the program and industrial contacts.	1- Agreed to unconditionally	We understand that this refers to the creation of a Program Advisory Board (PAC). We will create a PAC comprising the Directors, Graduate Directors and representative from industry, government, and academia.	Director of OCICS	1 st meeting expected Fall 2021	N
Opportunity: Promote success stories (especially in the fourth year of the bachelor program) of the accelerated stream to MSc programs.	1- Agreed to unconditionally	We will reach out supervisors and graduates to collect success stories and testimonies. We will integrate success stories in open house, poster day, OCICS web site, viewbooks and graduate study booklets.	Director of OCICS EECS’ Graduate Associate Director SCS’ Graduate Director (Recruitment and Admissions) SCS’ Graduate Director (Program Management)	Fall (Carleton), Winter (uOttawa)	N
Concern: Review the course offerings to reduce the size of popular courses (possibly offering some courses more frequently than others).	3- Agreed to in principle We to examine and take into constraints of faculty workloads.	Look at graduate course enrolment. Consider offering certain courses twice a year. Low enrolment offered every other year.	EECS’ Director SCS’ Director	Upcoming academic year	N

<p>Opportunity: Evaluate the benefit of creating a methodology course for the M.Sc. and Ph.D. programs.</p>	<p>3- <i>Agreed to in principle</i> <i>We will examine this opportunity and the many ways it can be implemented in the upcoming year.</i></p>	<p><i>The board of management will explore this opportunity.</i></p>	<p><i>Board of Management</i></p>	<p><i>Upcoming academic year</i></p>	<p><i>N</i></p>
<p>Weakness: Evaluate the sustainability of the project-based M. Sc., which depends mainly on one of the two organisations and, even then, on only few professors supervising such projects.</p>	<p>1- <i>Agreed to unconditionally</i></p>	<p><i>See Appendix C</i></p>	<p><i>EECS' Director SCS' Director Director of OCICS EECS' Graduate Associate Director SCS' Graduate Director (Recruitment and Admissions) SCS' Graduate Director (Program Management)</i></p>	<p><i>Done</i></p>	<p><i>N</i></p>
<p>Weakness: Reevaluate the purpose of the joint programs. They were essential in 1982, are they still necessary?</p>	<p>1- <i>Agreed to unconditionally</i></p>	<p><i>This echoes the concern "Reevaluate the long-term purpose of the joint programs." The review committee reevaluated the purpose of the joint programs. In addition to the benefits listed above, it can be said that OCICS now comprises close to 73 faculty members. In size, the joint institute is comparable to other large computer science graduate programs in Canada, such as programs offered by Toronto and McGill.</i></p>	<p><i>EECS' Director SCS' Director Director of OCICS EECS' Graduate Associate Director SCS' Graduate Director (Recruitment and Admissions) SCS' Graduate Director</i></p>	<p><i>Done</i></p>	<p><i>N</i></p>

			<i>(Program Management)</i>		
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Appendix A: Review of the OCICS admission process practices between the two organizations

The admission process has been reviewed in both institutions. It is effective for the current admission cycle, i.e., students admitted for Fall 2021. The processes are very similar in both organizations, with slight differences due to different student evaluation scales. The processes are outlined in the sequel.

School of Computer Science, Carleton University

The admission process is managed by the Graduate Director (Recruitment and Admissions), two Graduate Administrators and a Graduate Admission Committee, consisting of four faculty members. The Graduate Administrators pre-screen applications by calculating GPA averages. Then, the Graduate Admissions Committee evaluates each application and offers their recommendations (including comments on applications). The committee considers the applicant's overall academic standing, publication record, recommendation letters, relevant work experience, language proficiency, etc. The recommendations are then shared with faculty for further assessment. Faculty then express their interest in admitting students based on the committee's recommendation, as well as their own communication (email or interview) with the potential student (a common practice). No PhD/thesis-based Master's students are admitted without a supervisor. Project based MCS are typically self-funded. We accept a small percentage of project based MCS.

The actual admission's averages for OCICS programs at Carleton University based on pre-COVID-19 admission's data are listed in Table I. Carleton University uses a scale out of 12 and 11.0 corresponds to A, while 10.0 corresponds to A-.

Table I: Actual Admission's Averages for OCICS Programs at Carleton University.

Program	Average Entrance GPA
PhD - Domestic	11.6
PhD - International	10.5
MSC - Domestic	10.0
MSC - International	10.8

A threshold is enforced for international MCS applications, which is a minimum GPA of B+ (9.0). However, due to the highly competitive nature of the program A- (10.0) is required in practice.

School of Electrical Engineering and Computer Science, University of Ottawa

The process at EECS is as follows. The applications are processed by the staff in the graduate office of the Faculty of Engineering. A staff member calculates the admission's average which is a credit-weighted average of the 20 last courses taken by an applicant. When an applicant fails to meet the admission averages for the respective program, the file is rejected. We may exceptionally look at PhD applicants and thesis Master's students with identified supervisor. All files that pass the initial screening are reviewed by two members of the admission's committee. The committee considers preparation as indicated by completion of core CS courses, recommendation letters, quality of undergraduate education, work experience, level of English (or French). Then, the Graduate Director makes a decision to either recommend admission, circulate the file if no supervisor is identified or reject. No thesis-based student is admitted without supervisor. We apply the same general process for all programs except that applicants to the project-based programs do not require a supervisor for admissions.

The admission cut-off averages that are currently in place at the University of Ottawa are given in Table II. The University of Ottawa uses a scale out of 10 and the corresponding levels are 8.0 (A-), 7.5 (B+) and 7.0 (B). It should be noted that the averages listed in Table II are minimum admission's standard and in practice students with much higher admission's averages are admitted.

Table II: Admission's Cut-off Averages for OCICS Programs at the University of Ottawa.

Admission Cut-Off Average	CSI
Ph.D.	8.0
Master's Thesis CDN/PR	7.0
Master's Thesis Int.	7.5
Master Project CDN/PR	8.0
Master Project Int.	8.0

Appendix B: Mechanism to review new courses at OCICS BOM level

The process for the introduction of new courses has been reviewed. Here are the details.

Topics Courses

A faculty member of one institute that wishes to introduce a new topics course contacts the director of the OCICS graduate program within their institution. To initiate the process, the member must provide a course outline of the proposed course for feedback, highlight potential overlap with existing OCICS graduate courses and must identify the area of the course with a justification. A course is deemed to fall within an area provided that at least 40% of the course content falls within that area. A single area is preferred but up to two areas are accepted in exceptional circumstances. The application is then circulated to members with related research or teaching interests. Collegial feedback is incorporated and then the course outline is communicated to the OCICS director of the other institution for further feedback. The topics course is then approved to be scheduled if resources are available to offer the course. The topics course receives a course code in both institutions to easily allow graduate students from both institutions to take the course. A topics course is offered two to three times to gauge interest by students, receive feedback from students and ensure the course is sustainable. The next step is an application to make the course a permanent OCICS course.

Permanent Courses

Permanent courses have their own dedicated course code in both institutions. To establish a permanent course, the proposed course has to be offered as a topics course at least two or three times with good student enrolment, i.e., enrolment in-line with other OCICS graduate courses. The faculty member proposing to convert a topics course into a permanent course then forwards the application to the OCICS director in their institution. The application includes an up-to-date course outline, an identification of the area the course falls in and a list of potential overlap with existing graduate courses. The application is then brought to OCICS BoM for discussion and possible approval. The BoM may seek additional clarification and feedback from other faculty members in both institutions. The BoM then decides if the course should be given a permanent course code. When the course is approved by BoM, the process to acquire permanent course codes for new courses at both universities is initiated.

Permanent courses may be removed if they are not offered for several years, the description of the course becomes dated or there is no OCICS member that can teach the course. Removal of

the course requires the approval of the BoM and of both the universities.

Appendix C: Sustainability of the Project-Based MCS Program

Enrolment Trends: No Increase in Recent Years

The project-based Master's program in computer science at the University of Ottawa has stable enrolment. The program is extremely popular and receives many applications. For the Fall 2021, we have received 1525 applications for the project-based Master's as of Feb. 22, 2021. This number represents an increase of 145 applications from the year before despite the impact of Covid-19. Nevertheless, the number of admitted student have been kept stable at a level which can be well-managed given the resources in the School of EECS at the University of Ottawa and within OCICS. This is managed by increasing admission requirements to maintain enrolment at manageable levels.

In the Fall 2019, 42 students registered for the course-based program while in the Fall 2020, 38 students registered. Only a small number of students start their studies in the Winter. There was a small drop due to COVID-19 but the numbers are relatively stable since at least the Fall 2018. The goal for this year is again to keep enrolment stable.

Range of Supervisors

Several OCICS members chose to supervise MCS project-based student. In the Winter 2021, the following members supervise at least one project: Drs. Diana Inkpen, Burak Kantarci, WonSook Lee, Lucia Moura, Jochen Lang and Hussein Mouftah. In previous terms, additional OCICS members outside the School of EECS have (co-)supervised projects including Dr. Oliver van Kaick from Carleton University or Dr. Pascal Fallavollita from the Faculty of Health Sciences at the University of Ottawa, who is cross appointed to the School of EECS. Members chose to supervise projects for various reasons. Some projects explore a topic related to but not central to current research, some projects explore a preliminary research idea, others focus on implementation of research and yet others are part of a larger team effort.

Benefits of the Project-Based MCS Program

The project-based program clearly fills a need as evidenced by the large number of applications. It attracts applications by international students but also by a considerable number of local applicants. It attracts applicants that are focused on a career in industry or government but even students interested in research sometimes chose this route to enter their graduate studies. Some project-based students transition into the thesis-based program after 1 or 2 semesters. The students also provide a benefit to industry in the Ottawa area as can be seen by the considerable number of Co-Op terms offered to project-based Master's student by local industry and government. The program is also beneficial for OCICS as a whole. Project-based student are required to take 8 courses and as such they increase enrolment and allow OCICS to offer more and a wider variety of courses to all graduate students. Furthermore, the international students often come from first class universities around the world bringing a different focus and outlook to the courses in OCICS and enriching the experience for all students. Finally, faculty members benefit by supervising projects but also by having a potential pool of students that they may attract to their own research.