



Four Year Report (2023)

Computer Science Graduate and Undergraduate Programs (reviewed 2018-19)

A. Summary of Review

1. This review was conducted under the terms and conditions of the IQAP approved by Senate on May 25, 2016.
2. The academic programs offered by the Department of Computer Science which were examined as part of the review were:

MSc
BSc (Honours)
BSc (Honours) co-op
BSc (Honours) combined
BSc (Honours) combined co-op
BSc (Honours) Computing and Network Communications
BSc (with Major)
BCB Computing and Business
Minor in Applied Computing

3. The Review Committee consisted of two external reviewers: Marcus Santos (Ryerson) and Ali Ghorbani (University of New Brunswick) and an internal reviewer, Ernest Biktimirov (Brock University).
4. The site visit occurred on March 12-14, 2019.
5. The Final Assessment Report was approved by Senate on October 9, 2020.

6. The reviewers assigned the programs the following outcome categories:

Program(s)	Excellent Quality	Good Quality	Good Quality with Concerns	Non-Viable
MSc		X		
BSc (Honours)		X		
BSc (Honours) co-op			X	
BSc (Honours) combined		X		
BSc (Honours) combined co-op			X	
BSc (Honours) Computing and Network Communications	<i>The quality of the courses offered by the Sheridan College are unknown.</i>			
BSc (with Major)		X		
Minor in Applied Computing		X		
BCB Computing and Business	<i>The details of the Business component of the program were not included in the review, nor did we meet course instructors from the Goodman School of Business.</i>			

7. The next review of the undergraduate and graduate programs in the Department of Computer Science will be in 2026/27.

B: Recommendations

Recommendation #1

The de facto admission average needs to be raised to 80%.

ARC Disposition of the Recommendation

ARC considers the recommendation to be not accepted. The de facto admission average is not under the sole control of the Department and cannot be set at a certain level in contradiction to provisions in the Faculty Handbook or university enrolment targets. ARC encourages the Department to investigate other measures (such as 2nd year entry) to address concerns of competitiveness and student quality as well as retention and student success.

Implementation Plan

Recommendation not accepted.

Explanation of Actions Taken, Status and Results:

As stated above, admission averages are not under the control of the Department. However, Section 7.1 (B) of the Faculty Handbook states, "departments [...] may choose to administer their own literacy and numeracy assessments and **requirements**" (boldface added). The Department is currently considering whether increasing the mathematics requirements for admission is necessary. Students whose high school mathematics performance is inadequate are not served well in choosing computer science as a major. It is our ethical obligation to communicate realistic admission requirements that better prepare students for success.

Recommendation #2

Infusion of PLO 3b across program courses

ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation. The Committee believes the Department is best-positioned to determine how to incorporate PLO 3b across program courses.

Implementation Plan (2nd Priority)

Responsible for approving: Department
 Responsible for resources: Department
 Responsible for implementation: Department
 Timeline: Dean of Mathematics and Science to report by the end of academic year 2020/21

Actions Taken	Year Action Started	Year Action Completed
Action #1 Identify appropriate technologies and resources appropriate to the goals studied in various artificial intelligence courses (and others).	2020	Ongoing

Explanation of Actions Taken, Status and Results:

The ultimate responsibility for course content is the instructor. Instructors introduce technologies and resources for their courses as they deem appropriate. Recent hires have introduced new courses in artificial intelligence, and corresponding new technologies will be introduced as befits the subject, whether in AI or otherwise. This will continue as new hires join the Department in the future.

Recommendation #3

Inclusion of a required “Communication Skills for the Computer Scientist” workshop course

ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted for consideration. The Committee believes the Department is best-positioned to determine how to incorporate communication skills into the curriculum, in conjunction with relevant campus resources.

Implementation Plan (2nd Priority)

Responsible for approving: Department
 Responsible for resources: Department
 Responsible for implementation: Department
 Timeline: Dean of Mathematics and Science to report by the end of academic year 2020/21

Actions Taken	Year Action Started	Year Action Completed
Action #1 The department will discuss this item at the next department retreat, tentatively planned sometime during 2020-21.	2020	2022

Explanation of Actions Taken, Status and Results:

The Department has decided that it is not practical to change our curriculum to require a new course in scientific communication.

Instead, in 2021, a faculty member started a Scientific Communication Workshop. This 4-hour workshop was open to participation by year 4 undergraduates and graduate students in computer science. Topics included academic writing, grant proposals for students, and the structure of scientific papers. A total of 20 students attended, which included almost all our graduate students, and a number of interested senior undergraduates. By all accounts, it was a great success. We will now offer this workshop annually. New topics are planned, for example, presentation skills. We may also offer a second annual workshop for students from all departments in the Faculty of Mathematics & Science.

This extracurricular workshop is an excellent resource for students, and we feel it is the best way to address this recommendation. A voluntary workshop is preferable to a mandatory offering. Students who are interested in the topic will attend, and we do not have to keep records of attendance that would be necessary for a mandatory course. Besides this workshop, many of our upper-year undergraduate and graduate courses have class seminars, as communication skills are intrinsic to our program. Brock's Career Zone and A-to-Z Learning have many special presentations and workshops throughout the year. Therefore, there are ample opportunities for students to improve their communication skills, and we will encourage them to take advantage of the many resources available.

Recommendation #4

Hiring of new faculty members.

ARC Disposition of the Recommendation

ARC considers the recommendation to be not accepted as it lies outside of the Committee's jurisdiction. The Committee expects that the Department will proceed through normal channels of advocacy for these faculty resources.

Implementation Plan

Recommendation not accepted.

Please see comments for Recommendation #7.

Recommendation #5

Renovation of the department's teaching lab space, equipment, and software.

ARC Disposition of the Recommendation

ARC recognizes the necessity of ongoing renovation of lab space, equipment and software, however the Committee considers the recommendation to be not accepted as it lies outside of its jurisdiction. The Committee expects that the Department will proceed through normal channels of advocacy for these resources.

Implementation Plan

Recommendation not accepted.

Explanation of Actions Taken, Status and Results:

Although this recommendation was not accepted, it highly impacts the quality of the program (along with Recommendation #7). Since the time of the cyclic review, the Dean of FMS contributed funding to renew all the Department's computer lab hardware used for undergraduate teaching, as well as replace the Department's file server and high-performance cluster. In addition, the VP Research contributed funds to replenish our graduate student workstations, as well as renew our computer research cluster. These contributions are greatly appreciated.

Unfortunately, our request for the renovation of our undergraduate labs was denied. We were told that renovation would not be considered for at least 9 years. These labs remain in the original state they were in over 25 years ago. They compare poorly to those found elsewhere in Ontario, and they are not a promotional highlight of our program.

Recommendation #6

Development of a comprehensive plan for graduate training, research, and funding opportunities.

ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted and in the process of implementation.

Implementation Plan (1st Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Science to report by the end of academic year 2019/20

Actions Taken	Year Action Started	Year Action Complete
Action #1 The department will hold a retreat to fully consider this recommendation.	Delayed	Delayed
Action #2 The department's plan for a future Centre of Intelligent Systems [now referred to as Centre of Artificial Intelligence] will be a means for supporting graduate training, research, and funding opportunities.	2020	Ongoing

Explanation of Actions Taken, Status and Results:

Unfortunately, the ongoing pandemic continues to prevent the Department from holding a Department retreat. We will try to have one during the summer of 2023.

The Department's new PhD in Intelligent Systems and Data Science (jointly offered with the Department of Mathematics and Statistics) was given final budgetary approval in 2022, and the program will begin in Winter 2023. With our recent hires over the past few years, new research grants are being obtained, and funding and training of graduate students is growing. A Centre of Artificial Intelligence housed in the Faculty of Mathematics and Science is under development. A department member has been appointed a CRC Tier 2 (jointly with the Department of Biological Sciences). All these developments are increasing the momentum to the Department's graduate programs and funding opportunities.

Recommendation #7

Highlighting the strategic importance of Computer Science.	
<p>ARC Disposition of the Recommendation ARC considers the recommendation to be accepted and in the process of implementation. The Committee also recognizes the reviewers' recommendation in the contextual comments, to develop a long-term plan for faculty renewal. The Committee understands that advocacy for future faculty resources will need to proceed through normal channels.</p>	
<p>Implementation Plan (1st Priority) Responsible for approving: Department Responsible for resources: Department Responsible for implementation: Department Timeline: Dean of Mathematics and Science to report by the end of academic year 2019/20.</p>	

Actions Taken	Year Action Started	Year Action Completed
<p>Action #1</p> <p>The department successfully promotes our undergraduate programs at institutional and regional university fairs (OUF). Our intake of domestic and international students into our programs continues to grow. Interest in our MSc program also continues to be strong, especially amongst international applicants.</p>	2020	Ongoing
<p>Action #2</p> <p>The department continues to prepare for the new BSc in Data Science and Analytics program (jointly offered with Mathematics & Statistics, and Fac of Business). Progress in the joint PhD in Intelligent Systems and Data Science is also progressing. Both initiatives have the full support of the Dean.</p>	2020	2022
<p>Action #3</p> <p>The department is planning the creation of a Centre of Intelligent Systems [now referred to as Centre of Artificial Intelligence]. Detailed planning will commence once the PhD proposal has been approved by ARC. The Centre will be a means for promoting the department's research, and the department's strategic importance to Brock.</p>	2020	Ongoing

Explanation of Actions Taken, Status and Results:

The Department promotes the strategic importance of computer science whenever possible. We are grateful that our Dean and others have supported this effort. This has resulted in a number of positive outcomes:

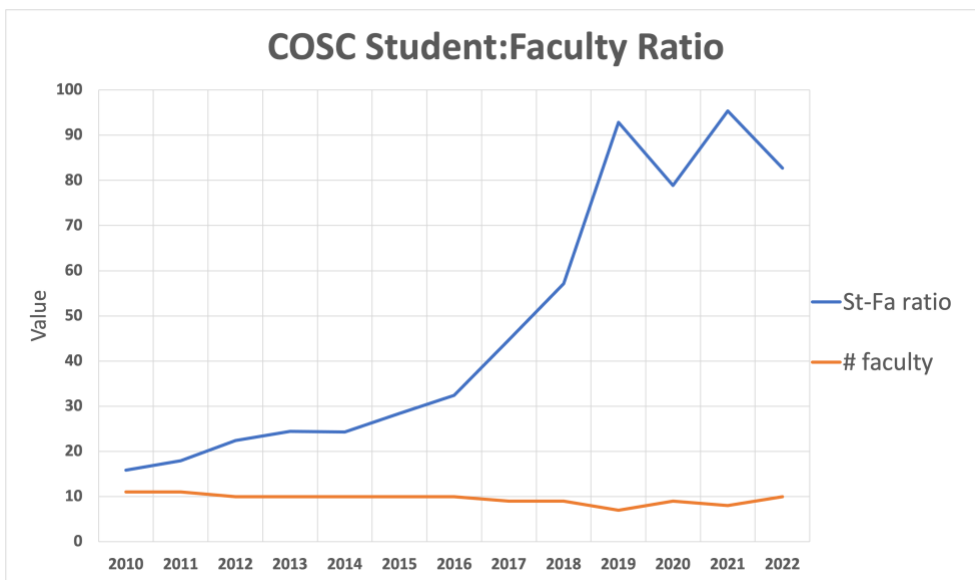
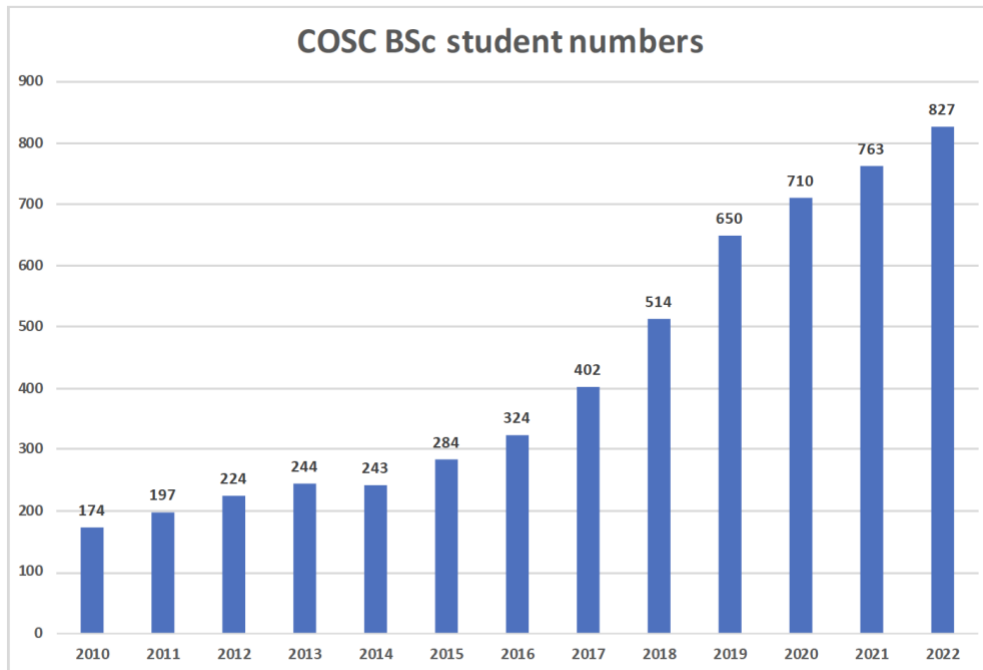
- Funding from the Dean of FMS and VP Research to renew the Department's computer resources for teaching and research (see Recommendation #5).
- Final budgetary approval of the PhD in Intelligent Systems and Data Science in 2022. The program begins in Winter 2023.
- We have hired faculty to replace retirements, and a new growth hire will join us in 2023.
- In 2022, an Assistant Professor was appointed Canada Research Chair Tier II.

The Department has done all it can to highlight its strategic importance. Unfortunately, the Department does not feel that it is a strategic priority of the University. Consider the following (including graphs at bottom):

- **High revenue generation:** Computer Science students pay an additional 25% in tuition (professional fees) compared to other science students. Also, 27% of our

undergraduates are students with international visas, who pay four times the tuition/fees as domestic students.

- **High student growth:** In 2022, our programs have 653 more students than in 2010. This is a 475% increase.
- **Over a decade of stagnant faculty growth:** In 2010, we had 11 faculty members (as well as an ILTA and non-BUFA instructor). In 2022, we have 9 dedicated faculty, 2 faculty shared with other departments, 1 ILTA, and one non-BUFA instructor. We will have a new hire join us in 2023.
- **One of the highest undergraduate student-to-faculty ratios in all computer science departments in Canada:** In 2022, our student-to-faculty ratio is 83:1. In comparison, a 2019 survey of Canadian computer science departments showed an average ratio is 44:1 (and 32:1 after two anomalies are adjusted for). This problem is due to excessive admission of students to our program, concurrently with zero growth in faculty numbers. This high ratio is enormously detrimental to the quality of our program, as evidenced by reduced course offerings, overly large class sizes, high attrition rates, rampant academic misconduct, and frequent mental health crises for many students. Naturally, because faculty must deal with all these issues caused by large classes, research productivity is adversely affected.
- **Inadequate part-time budget to handle high student numbers:** We had to cut our part-time budget in 2022-23, despite having more students. There is now pressure to do so again for 2023-24, despite the likelihood of more COSC students, including new students in the BSc in Data Science and Analytics degree (starting Fall 2023). Our part-time budget formula is the most optimal and economical ones in FMS, if not the University. Unfortunately, this efficiency means that we are especially punished when cost-cutting is required.
- **The Department's dedicated research labs are threatened:** We had a modest allocation of research lab space for the Department when we moved into the Mackenzie Chown J-block in the 1990's. Since that time, without any prior consultation and against our objections, this space has been redesignated as "office space" by the University. We are now being asked to use it as offices for new faculty hires. We do not accept this redefinition of our research space. However, if this is forced upon us, then we are the only Department in the Faculty of Mathematics & Science without dedicated research space. Most computer science departments in Canada have research space.
- **Staff are over-worked:** The workload of all staff members has increased significantly with the high number of students.



Recommendation #8

Grow the Department's graduate program.

ARC Disposition of the Recommendation

ARC considers the recommendation be accepted and in the process of implementation. The Committee recognizes that a Program Proposal Brief for a new PhD program is in the final stages of development.

Implementation Plan (1st Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Science to report by the end of academic year 2019/20

Actions Taken	Year Action Started	Year Action Completed
Action #1 Two new faculty have joined the department in January 2020, and both members are research active and are admitting new MSc students. New hires, including a CRC Tier II, are expected in 2020-21. All these hires will result in growth to the existing graduate program.	2020	2023
Action #2 The PhD in Intelligent Systems and Data Science (jointly with Dept of Mathematics and Statistics) is nearing submission to ARC.	2020	2022
Action #3 A planned Centre of Intelligent Systems [now referred to as Centre of Artificial Intelligence] will help promote the graduate programs (see items #6 and #7)	2020	Ongoing

Explanation of Actions Taken, Status and Results:

Our MSc student numbers have grown commensurate with the hiring of new research-active faculty. The PhD in Intelligent Systems and Data Science will begin in winter 2023. Research grants have also increased in number and amount, due to our new hires. The new CRC Tier 2 position has increased the opportunities for graduate students. Preparations for a new Centre of Artificial Intelligence are underway, and this Centre will promote graduate research and funding opportunities. Therefore, the Department's graduate programs are growing at an impressive rate.

One factor that limits increasing graduate student intake is the fixed (and decreasing) part-time teaching budget (see Recommendation #7), which limits the Department's ability to give TA stipends to full-time graduate students.

Recommendation #9

CIPS accreditation.

ARC Disposition of the Recommendation

ARC considers the recommendation to be accepted for consideration.

Implementation Plan (3rd Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Science to report by the end of academic year 2021/22.

Actions Taken	Year Action Started	Year Action Completed
Action #1 Discussion of curriculum revisions will be an item of discussion at future department retreat.	2020	2021

Explanation of Actions Taken, Status and Results:

This issue was discussed at a Department meeting in 2021. The decision was that we will not consider CIPS accreditation at this time. Factors leading to this conclusion include a shortfall of resources, and especially faculty numbers, as well as the loss of flexibility in our undergraduate curriculum that comes with CIPS accreditation. We may reconsider this idea in the future.

Recommendation #10

Intra-department collaborations.

ARC Disposition of the Recommendation

ARC understands the recommendation to be referring to “inter” departmental collaborations from the context provided in the Reviewers’ Report. The Committee considers the recommendation to be accepted and in the process of implementation. To an extent, this is already current practice as described by the Department in its response.

Implementation Plan (1st Priority)

Responsible for approving:	Department
Responsible for resources:	Department
Responsible for implementation:	Department
Timeline:	Dean of Mathematics and Science to report by the end of academic year 2019/20.

Actions Taken	Year Action Started	Year Action Completed
Action #1 New and future hires (including CRC Tier II with Dept of Biological Sciences) will encourage interdepartmental collaboration.	2020	2022
Action #2 Future Centre of Intelligent Systems [now referred to as Centre of Artificial Intelligence] will further promote collaborative research with other departments.	2020	Ongoing

Explanation of Actions Taken, Status and Results:

Research collaboration is ultimately one of academic freedom, as it is a personal decision of individual faculty. However, the research climate of the Department strongly supports interdepartmental interactions. Our new CRC Tier 2 is now collaborating with the Department of Biological Sciences. New hires are also beginning research collaborations with the nascent Yousef Haj-Ahmad Department of Engineering. There are possibilities of further interdepartmental collaborations arising from the PhD in Intelligent Systems and Data Science, as well as the future Centre of Artificial Intelligence (participation in the Centre is open to all researchers at Brock who do fundamental research in AI and related applications).

C. Unit Summative Analysis and Evaluation

1. To what extent has the Department achieved the improvements suggested by the reviewers?

The Department has addressed the reviewers' recommendations as well as possible. Unfortunately, critically important recommendations involving resources (#1, #4, #5) are by definition beyond the purview of the Department and ARC.

2. What overall impact has it had on the Department's programs?

We have appreciated the reviewers' supportive comments and constructive recommendations. We are especially pleased that there are no significant weaknesses in our programs, according to the reviewers' comments. We also appreciate the reviewers' recognition of the struggles our Department has faced, and continues to experience.

3. Is the Department adopting a process of continuous quality improvement for its programs?

The Department has always embraced a process of continuous monitoring of our program quality, and improving the program when feasible.

4. How well do the programs now align with Brock University strategic priorities?

Our programs have never conflicted with Brock's strategic priorities. For example, our degrees have always addressed the career needs of students. This is evidenced by the high numbers of domestic and international students admitted to our programs. Our research capacity is growing at a great rate, and our new CRC Tier II, new PhD in Intelligent Systems and Data Science, and planned Centre of AI, are expanding our research infrastructure. Our program addresses the economic needs of Niagara, Canada, and beyond, given the need for computer science professionals in government and industry. Our student population is highly diverse, with a large percentage of international students, as inclusivity has always been a valued goal of our program.

5. How does this review and its results position the programs as the Department moves into the next review cycle?

Presumably the next cyclic review will identify new issues of concern, and new recommendations to address them. However, we expect that many of the problems discussed in Recommendations #1, 4, 5 and 7 will reappear in the next cyclic review, as they have in this and previous reviews.

D. ARC Final Summary

In final summary of the 2018-2019 cyclical academic review of the programs offered by the Department of Computer Science, ARC has determined the following:

1. That the Reviewers' Recommendations have been addressed satisfactorily.
2. That the Department has established a direction for next steps as it prepares for the next review cycle.
3. That the Department has achieved a broad-based, reflective and forward-looking self-assessment.