

Final Assessment Report for the 2019-2020 Cyclical Program Review of Physics and Computer Science

INTRODUCTION

In accordance with Laurier's Institutional Quality Assurance Procedures ([Policy 2.1](#)), this Final Assessment Report provides a summary of the review process for the Department of Physics and Computer Science prepared by the Quality Assurance Office, along with an identification of strengths of the program(s) under review authored by the Dean of Science and Dean of the Faculty of Graduate and Postdoctoral Studies. All recommendations made by the external review committee are listed in order, followed by a summary of the department's response, and the relevant decanal responses. Recommendations not approved for implementation have been identified, and those that have been prioritized are listed in the Implementation Plan.

The Final Assessment Report is reviewed and approved by the Vice-Provost: Teaching and Learning and the Provost and Vice-President: Academic. Following completion of the Final Assessment Report, it is approved by the Program Review Sub-Committee and Senate Academic Planning Committee. Approval dates are listed at the end of this report. Final Assessment Reports are submitted to Senate as part of an annual report on cyclical reviews, and to the Ontario Universities Council on Quality Assurance for information. Final Assessment Reports and Implementation Reports are posted on the public-facing page of the [Quality Assurance Office](#) website.

The Implementation Plan for the recommendations prioritized in the Final Assessment Report can be found at the end of this report. Units will submit their first Implementation Report two years following approval of the Final Assessment Report at Senate. The Implementation Report will include comments from the unit on actions taken toward the completion of recommendations, comments from the relevant Dean(s) related to the progress made, and comments from the Program Review Sub-Committee, which is responsible for approving the Implementation Report and deciding if further reports are required. The Senate Academic Planning Committee will also approve the Implementation Report.

SUMMARY OF REVIEW PROCESS

The Department of Physics and Computer Science offers undergraduate programs in both Physics and Computer Science, as well as a Master's program offered in both intramural and online formats. The undergraduate programs were last reviewed in 2012-2013, and this was the first cyclical review of the Master of Applied Computing program.

The Self-Study was authored by Dr Chinh Hoang, Chair of the Department of Physics and Computer Science, with input and feedback from department faculty. In addition to the Self-Study (Volume I), the department also submitted a copy of faculty curricula vita (Volume II), a volume of course syllabi, and a list of proposed external

reviewers (Volume III). A draft of the Self-Study was reviewed by the Quality Assurance Office, the Dean of Science, and the Dean of the Faculty of Graduate and Postdoctoral Studies prior to submission of the final version.

As per Laurier's IQAP, the external review committee for the review consisted of two external reviewers from outside the university, and one internal reviewer from Laurier but outside of the department. The review committee was selected by the Program Review Sub-Committee on October 22, 2019. An in-person site visit was scheduled for April 2020, but was shifted in both date and mode due to the pandemic. A remote external review took place during the week of May 25-29, 2020.

The review committee consisted of Dr. Ning Tang from the Lazaridis School of Business and Economics at Wilfrid Laurier, Dr. Ken Barker from the Department of Computer Science at the University of Calgary, and Dr. Jeffrey Hutter from the Department of Physics and Astronomy at Western University. During the external review, the review committee met with the following individuals and groups:

- Dr. Maureen Mancuso, Interim Provost and Vice-President: Academic and Dr. Kristiina Montero, Interim Associate Vice-President, Teaching and Learning
- Dr. Chinh Hoang, Chair of the Department of Physics and Computer Science
- Ms. Kelly Kuepfer-Crane, Department of Physics and Computer Science Administrative Assistant
- Dr. Anthony Clarke, Dean of the Faculty of Science
- Dr. Douglas Deutschman, Associate Vice-President and Dean, Faculty of Graduate and Postdoctoral Studies
- Full-Time Faculty from the Department of Physics and Computer Science
- Undergraduate students
- Master of Applied Computing students
- Lab instructors
- Dr. Alexei Kaltchenko, Undergraduate Officer and Dr. Li Wei, Graduate Officer
- Ms. Charlotte Innerd, Head of Collections and Acquisitions and Ms. Debbie Chaves, Faculty of Science Liaison Librarian

The review committee submitted their completed report on April 13, 2020. The executive summary from the report is provided below.

External Reviewers' Report Executive Summary

The Department of Physics and Computer Science at Wilfrid Laurier University represents an unusual combination of disciplines in a single department. The undergraduate Computer Science programs have seen strong growth over the past few years, matching that seen at other institutions and placing significant strain on departmental resources. By contrast, Physics enrolment has been low and flat. This, too, is not abnormal relative

to Physics programs elsewhere, but adds a unique challenge, in that, it is difficult to justify allocating resources to enhancing and growing the Physics program when the same resources might realize larger gains in computer science. To thrive in such an environment, Physics programming will likely need to be in combination with other disciplines (i.e., combined degrees) or capitalize on the combination of disciplines in the Department (e.g., Computer Science and Physics). In general, the undergraduate programs in both disciplines are well constructed, well taught, and offer the expected disciplinary core, albeit with few opportunities for electives, especially in Physics. Students appear satisfied with their program and are generally successful in seeking employment.

The recent introduction of a Master of Applied Computing has been successful in attracting students and motivating research-oriented faculty to contribute to Laurier's transition to a comprehensive university. Given the high undergraduate teaching loads, further growth of this research-based degree – or, indeed, the extension to a PhD – will be difficult without additional resources.

Critical needs of the Department are (a) increased staff support in recognition of the unprecedented growth in undergraduate enrolment and (b) increased faculty resources to ensure a higher proportion of classes are taught by full-time faculty members and to facilitate regular curricular review. Without such support, the current programs are barely sustainable, and the projected growth in both undergraduate and graduate enrolment will be problematic.

RECOMMENDATIONS AND RESPONSES

The External Reviewers' Report included 19 recommendations, which have been listed verbatim below, followed by a summary of the program's response, and the decanal responses relevant to the recommendation.

Recommendation #1: The general undergraduate Computer Science program could benefit from a professional accreditation review by the Computer Science Accreditation Council (www.cips.ca/accreditation). The approach uses an outcomes-based model and would facilitate a curriculum review and potentially motivate careful consideration of the goals of each of the programs being offered by the Department.

Unit Response: In the past, the department has been divided about the value of accreditation for our Computer Science programs. One of the reasons for this is there are many well known computer science departments in Canada that have chosen not to seek accreditation (e.g. University of Toronto and University of British Columbia), or to let their accreditations lapse (e.g. the University of Guelph, McGill University, and University of Waterloo). Some of the faculty members who were not in favor of accreditation have now retired from the university. At this point in time, the department is open to accreditation and we will discuss it further with the Dean of Science. We will also review the process for accreditation, so that we know what would be involved in pursuing it.

Dean of Science Response: The merits of accreditation of the Computer Science program(s) are not apparent. Given this, the Department is advised to focus their attention and energy on the other recommendations made to enhance their programming and activities. Because this recommendation is not considered a priority at this time, this has been noted in the Implementation Plan.

Recommendation #2: With a six-fold increase in enrolment over the past five years, and relatively constant faculty resources, managing enrolment growth, probably by enforcing higher admission cut-offs for Computer Science programs is advisable.

Response: The department is very much concerned that the large increase in enrolment could negatively impact the student experience. The department supports slightly increasing the cut off admission averages. However, the department does not set the admission cut-offs. We will discuss this recommendation with the Dean of Science and seek his input on the implementation of this recommendation.

Dean of Science Response: We, the Department and the Dean's Office, will work with the Office of Recruitment and Admissions to be more selective in granting admission to students with stronger backgrounds in mathematics. Such action would better serve the program and assist with student retention, and in addition likely address the issue of unmanageable student enrolments.

Recommendation #3: The range of programs is extremely broad with nearly 11 different distinct undergraduate Computer Science degree forms. Although these are being delivered, there is overhead associated with operating this diversity and this requires administrative overhead (i.e., curriculum updates, calendar updates, student advising, scheduling challenges, sessional expertise, etc.). Additional support could be provided to support this diversity or a new structure could be developed to allow students to explore diverse interests without identifying unique degree forms.

Response: The most costly overhead for providing many degree forms are faculty's time and the administrative assistant's time. The undergraduate officer has to handle two different disciplines: Physics, and Computer Science. He receives two course reductions. Due to the tremendous growth in computer science enrolment, his work is becoming more and more difficult. He also liaises with the co-op office. The administrative assistant has helped in answering students' queries. This issue is related to Recommendation #8, which advocates for additional administrative support, which the department agrees with.

Dean of Science Response: With the recent expansion of the Office of Student Services within the Faculty of Science, there will be future action to centralize more of the student advising activities. This centralization should provide some assistance to the Department. If this action is not sufficient in relieving the existing tensions, then we will also investigate the possibility of supporting two undergraduate advisors, one "full-time" for computer science programs, and one "part-time" for Physics.

Recommendation #4: Course offerings should be produced, announced, and adhered to at least one academic year in advance as apparently required by Laurier. Note: This does not require teaching assignments but rather a commitment to the term in which the course will be offered to allow for students to plan their program. Both graduate and undergraduate students expressed concerns that courses appear to be available, but there is ultimately a much more limited offering available.

Response: Due to limited resources, the department does not offer all courses listed in the academic calendar every year. This problem is most pronounced for our graduate programs. In particular, the Master of Computer Science (MCS) students have repeatedly complained to the department chair about the lack of course options available to them. We need to add/create additional online MCS courses to better serve our students. We would also have the option of offering these online course to our MAC students in the Spring semester. The department offers every year most of its listed undergraduate courses. We added a statement to our website to indicate that “courses may not be offered every year”. The department has (undergraduate) courses that we offer every second year. A notice about this is also posted on our website. In response to this recommendation, the department will start sending course announcements to our graduate students as soon as we accept their applications. We note that the course scheduling across the university is not done a year in advance, but each winter prior to the upcoming academic year. Class schedules are typically produced in March for the coming academic year that starts in September.

Dean of Science Response: It is apparent that the Department is aware of this shortcoming, and has already taken appropriate action to remedy the situation.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: As detailed by the external reviewers, the progress of graduate students is hampered by the limited number of course offerings. The Department is aware of these issues and has outlined steps to provide a wider range of courses each term. It is important that the Department build course schedules that address the different needs and different registration status of its MAC and MCS students.

Recommendation #5: Offering a single set of Physics labs rather than differentiating them between calculus and non-calculus streams would decrease the support needed for the lab program allowing resources to be allocated elsewhere.

Response: The department does not agree with the implementation of this recommendation at this time. Due to the nature of the calculus and non-calculus Physics courses, the two labs are different, they cover different topics. We are dealing with two sets of students with different Math skills. One challenge is that even without using calculus, the non-calculus students tend to be weak in algebra, so they will find the same labs more challenging. The department feels we need to maintain both calculus and non-calculus labs for student retention. Changing the math component might compromise the integrity of the program as the content of the courses is not equal and needs to suit the targeted students.

Dean of Science Response: The Department is advised to reconsider this recommendation, especially if and when resourcing of faculty and staff time becomes an issue.

Recommendation #6: Investigate replacing some traditional Physics labs with additional computational labs. This could modernize the program, allow for efficiencies, and attract more students into double degrees with Physics.

Response: We note our new Physics and Computer Science double major program has been successful (in our context) in attracting students. Its first year intake is double that of the single major Physics program. We used to have a lab exercise that used a spreadsheet to do a simulation of an object in free fall. The difficulty is that for most Physics students even making simple modifications to formulas and so on is a challenge. Our first year labs are bi-weekly and so there is very little flexibility. Some of our second year weekly labs already offer simulations. Lab content must also be appropriate for students taking Physics minors. Some of them may not have appropriate mathematical background for the computational labs. Due to Covid-19, we are currently teaching physics labs with simulations. If this practice is successful, it can be continued post-Covid.

Dean of Science Response: As with Recommendation #5, the Department is advised to consider applying the recommendation if and when resourcing becomes an issue. Adopting this recommendation would (likely) realize savings without compromising the overall learning experience.

Recommendation #7: A complete Computer Science curriculum update is necessary, including the goal of understanding how defined learning outcomes are assessed both within courses and across the program. This could be undertaken in conjunction with an accreditation review and should be done primarily by full-time tenure-track faculty members. This can only be meaningfully achieved if sufficient time is made available for them to do this work and adequate administrative support is provided to allow it to be done cost effectively.

Response: The department agrees that a review of the Computer Science curriculum should be undertaken. If the department seeks accreditation (Recommendation #1), a curriculum update will be required as part of this process.

Dean of Science Response: The Department is strongly advised to conduct this review and address the issue of learning outcomes assessment.

Recommendation #8: Administrative support in the Department is currently minimal and probably insufficient. There is very little meaningful backup and much of this work is currently being done by much more highly paid administrators and faculty members, which undoubtedly impacts on their potential effectiveness. The Department needs a second administrative support person both due to the current workload and for meaningful backup.

Response: The department concurs with this recommendation. Since the last review, the department has added a graduate program offered in two modes of delivery (intramural and online) and a new collaborative undergraduate program (Data Science, jointly with the department of Mathematics), which has understandably increased the workload of the department's single administrative assistant. Having a second administrative support person (full or part-time) will improve students' experience and the functions of the department. Currently, whenever the only support person takes a leave, the department gets a "floater" from HR to take over administrative functions. However, this person does not know the department well enough to provide meaningful support. Additional administrative staff support could also take on some of the administrative tasks for the undergraduate and graduate officers.

Dean of Science Response: In addition to the centralization of some student advising activities within the Faculty (see Response to Recommendation #3), a review of staffing will be conducted by the Dean's Office.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: FGPS acknowledges that the rapid growth of its graduate programs puts significant strain on faculty and staff. FGPS has no role in staff hiring or assignment but we are supportive of the review being conducted by the Dean of Science.

Recommendation #9: The faculty complement is highly supplemented by sessional instructors. Concerns about this approach are detailed in the report but given the expanding graduate program, the desire to become a comprehensive research university/department, and a substantially growing undergraduate body, it is critical that additional faculty be recruited. Failure to do so may cause current faculty to become a target for recruitment and if these are successful, the problem will only be exacerbated in a negative cycle.

Response: We agree with this recommendation but recognize that the hiring of additional faculty members is outside of the scope of the cyclical review process. The computer science enrolment has tripled in the last six years, and more courses have to be offered. The department relies on sessional instructors to fulfill its teaching obligations. To support enrolment growth, we do need more faculty positions. We are aware many computer science departments are hiring. The competition to hire and to retain faculty will be intense. Currently, the department is spread so thin that administrative positions, such as undergraduate advisors, cannot be filled without a great deal of persuasion from the chair. The department desires to expand its graduate programs to improve its research output.

Dean of Science Response: This issue is recognized and appreciated, and the Faculty budget plan for 21/22 will include the proposal for a new faculty position in the Department.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: Some applied graduate programs like Computer Science and Business can benefit from instructors that come from outside the university. As a result, the best mix of instructors may differ from some of the other graduate programs. Nevertheless, FGPS acknowledges that the rapid growth of its graduate programs stretches the tenure / tenure-track faculty. FGPS has no role in faculty hiring but we note that the Dean of Science supports the hiring of a new faculty member.

Recommendation #10: Many research active faculty members receive external funding and the Department has recently brought some new young researchers on board. However, the success rate with external funding has decreased over time and based on comments from both faculty and administrators, we believe a mentoring program to assist faculty members in how to best present undergraduate HQP in NSERC applications would be beneficial. This could be done by recruiting more senior successful researchers or by finding innovative ways to draw on expertise from other schools in the area.

Response: Laurier has an existing university wide mentoring program. The department is offering support to help newly hired researchers in writing their NSERC applications. There are senior faculty who read and comment on their NSERC applications, if requested by the junior faculty. The department indeed has

mechanisms to produce undergraduate HQP. Junior members are encouraged to participate in this endeavour. We also agree that the department needs to recruit more senior researchers. Faculty in other departments, in particular Chemistry and Mathematics, are members of our graduate programs.

Dean of Science Response: The Department appears to recognize this issue and is prepared to provide appropriate assistance. In addition, plans are underway for the development of an Office of Associate Dean, Research and Graduate Studies whose mandate will be to address this, and related issues for the entire Faculty of Science.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: Graduate students benefit from faculty members who are active researchers in their field. Graduate students also contribute to the research enterprise of the university. FGPS is supportive of collaboration and mentorship opportunities that may increase research funding in the department.

Recommendation #11: A systematic internal grant application review process should be developed and to the greatest extent possible made mandatory. There appear to be some processes in place at Laurier but it is not always followed and/or may not be considered a serious requirement.

Response: Laurier does have a number of internal grants, at the faculty and university levels. The internal grants' monetary amounts are usually not significant. Typically, they pay for the cost of attending a conference. Emails are sent from the faculty and the Research Office about the grants and their deadlines. Applications are made to the faculty and the Office of Research Services. The department will encourage its members to apply for these internal grants.

Dean of Science Response: I believe the Reviewer's were referring to the establishment of an internal process for the review of applications for external funding. Indeed, such has proven to be highly successful elsewhere, and this will be one of the first "projects" for the new Assoc. Dean, Research and Graduate Studies.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: FGPS is not involved in the grant application process for faculty. We do offer training and support to graduate students applying for external scholarships/fellowships. External research grants submitted by graduate students should be managed by the Department and the Faculty of Science.

Recommendation #12: As a part of the curricular review, it is strongly recommended that the use of TA/IA resources should be considered. Both graduate students and faculty members indicate that these resources could be better used and would provide an important part of the overall training of young scholars.

Response: The department has traditionally hired undergraduate students for TA/IA positions. With the recent addition of a graduate program, there are now qualified graduate students for these positions as well. Graduate student TAs could be deployed in 3rd and 4th year courses such as Algorithms, and Theory of Computing. We agree that this will provide graduate students with valuable training for academic careers. A discussion of how

TA and IA positions are distributed will be incorporated into a curriculum review. We will consider which courses currently use TAs and IAs and what duties are assigned to them.

Dean of Science Response: The Dean acknowledges that the Department will be addressing this issue appropriately.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: FGPS concurs that TA'ships can be a valuable part of the training of young scholars. This is particularly true in thesis-based research programs. In many applied programs, the benefit of being a TA may be limited to the financial support a student receives. In fact, practicums, internships, and co-op options may be more important for MAC or MCS students.

Recommendation #13: Mechanisms to recognize success in grant competitions, publications, external awards should be noted and highlighted. This includes career accomplishments but equally importantly finding opportunities to recognize departmental faculty members through internal awards. By establishing an award nomination committee, the faculty members successes can be brought to the attention of various stakeholders at Laurier so the Department's contributions are fully recognized.

Response: The department annually elects an Appointment and Promotion Committee as required by the collective agreement. The recommendation to nominate department members for internal awards will be forwarded to them. This will give better exposure for faculty members' research and better promotion of opportunities for funding.

Dean of Science Response: The Dean acknowledges that the Department will be addressing this issue appropriately.

Recommendation #14: Growth in the current Master programs, particularly the research-based Master of Applied Computing, should be carefully managed and should only grow as the faculty resources available to supervise these students is made available. The program is relatively new and faculty members should be cautious to only take on the number of students that they can manage within their other obligations. It is strongly recommended that the growth be incremental until sufficient experience is in place in the department to know the program being delivered is of high quality.

Response: There are three degree completion options in the MAC program: course work, co-op, and thesis. The department accepts thesis students only when we can find a suitable faculty advisor for them. This places a limit on the growth of the thesis option. Indeed, the growth of thesis students is slow. The first two cohorts we produced are of high quality; their theses have been published in good journals (e.g. IEEE Trans. Intelligent Transportation Systems, World Wide Web, and IEEE/WIC/ACM International Conference on Web Intelligence). The department currently can manage the thesis students. Growth in research students will need to be followed by growth in faculty members.

Dean of Science Response: The Dean acknowledges that the Department will continue to address this issue appropriately.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: Across the university, there has been growth in the proportion of students that opt to complete a coursework or co-op graduate degree. These do not require the time commitment needed to supervise a thesis student. FGPS agrees with the Department's view that growth in thesis students will be related to the number of research-active faculty available to supervise students.

Recommendation #15: Clarify and document regulations concerning student funding as it relates to student's ability to work beyond the duties associated with receiving this support. This includes both on-campus and off-campus work for both Canadian and international students. Ensure students and supervisors clearly understand these regulations and conform to them.

Response: We believe this recommendation relates to graduate students. The Faculty of Graduate and Postdoctoral Studies makes clear the regulations around graduate student work [on their website](#). We will consult with the Faculty of Graduate and Postdoctoral Studies to put together information on working regulations to include in a welcome document that will be sent to students when they accept our offer of admissions.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: It is unclear what exactly is being referenced in this recommendation. The university has clear guidelines about student funding – both in terms of scholarships as well as opportunities for employment earnings (TA or RA). FGPS works with each program when funding offers are made to a student. We will continue to work with department and can provide whatever support students need to understand their offers of admission.

Recommendation #16: The need for and motivation behind a BA in Computer Science does not appear to justify the addition of a new degree program. By addressing the challenges associated with math and based on feedback received, we believe offering the BSc in Computer Science is sufficient. Thus, we do not recommend offering a BA at this time.

Response: We do not agree with this recommendation. The addition of a standalone BA in Computer Science does not require additional resources, but it may increase enrolment and serve some students better. Many universities have Bachelor of Arts in Computer Science programs. The BA in Computer Science typically requires less math and more liberal arts credits. The program appeals to students who have interest in the arts and humanities and have a desire to bring computer science skills to solve problems in these disciplines. The department actually offers an [Honours BA Computer Science in Combination with another Honours BA program](#). The program requires 8 Computer Science credits among these at least 7 credits must be at a senior level. The program also has 12 credits that can be counted toward the second BA major. So, the department does not need to create a new BA degree. Creating a standalone single honours BA in Computer Science degree could be accomplished by an internal Major Modification curriculum change.

Dean of Science Response: The Department is encouraged to pursue this proposal, but with a clear articulation of resource and time commitments for its successful management and delivery. Since the recommendation

made by the review committee is against pursuing a standalone BA program, it has been noted in the Implementation Plan that the recommendation is not prioritized.

Recommendation #17: Offering a new online minor does not appear to be a high value initiative for the Department. If the University determines that this is of sufficient value, it should ensure additional resources are provided to allow the Department to offer a high quality online experience to non-Computer Science majors. Thus, we do not recommend offering an on line-minor in Computer Science at this time.

Response: We disagree with the review committee about the value of a fully online Minor in Computer Science, the courses for which could serve students at both Laurier campuses, as well as the department's own students. In the current Covid-19 pandemic, the university has placed a high priority on developing online courses. Online courses were in much demand for the Spring 2020 semester. We have received funding to develop online versions of CP104, CP164, and CP213; some of these courses are part of the requirements for other programs outside of the department. We have already developed CP264 and CP312 for the qualifying year of the Master of Computer Science program. Thus, the department needs only one more online course for an online minor in Computer Science. Laurier is a multi-campus university. Students at the Brantford campus may be interested in completing a Minor in Computer Science if all of the courses are available online. Since the courses that would comprise the Minor are already created, offered, and staffed, we see no risk or disadvantage to offering this adjunct credential. All online courses are developed through the Centre for Online Learning and Teaching and Learning to ensure that they use the latest educational technologies and that the learning outcomes, course content, and assessments are aligned.

Dean of Science Response: As recommended by the Reviewers, pursuing the development of this new online minor should only be conducted with a clear understanding and approval of resource implications. Similar to Recommendation #16, as this is a negative recommendation (i.e. not to pursue an online Minor) that the department disagrees with, it has been noted in the Implementation Plan that this recommendation is not being prioritized.

Recommendation #18: To maintain the viability of Physics programming, the Department should seek programs that differentiate them from Physics programs available elsewhere, but which can be mounted with the limited teaching resources available in Physics. Because of the unique combination of Physics and Computer Science in a single department, one possibility would be a program that emphasizes computational techniques. This needn't be exclusive to Physics students, but would likely attract students with interests in the physical sciences.

Response: The department agrees with the reviewers that a program emphasizing computational techniques would be a welcomed opportunity for our department. We would like to proceed, however we need additional resources to pursue this opportunity. Additional resources would include new courses as well as additional faculty and lab positions. The department is considering launching a Quantum Computer concentration for Physics majors. This concentration will fit nicely with the double major Physics and Computer Science program.

Six core courses will be needed (however not all courses would need to be newly developed). The department will launch the concentration only if additional resources are provided by the university.

Dean of Science Response: Given the resource implications recognized by all, the Department is encouraged to investigate the possibility of modifying the existing Physics BSc along the lines suggested by the Reviewers as opposed to adding a new distinct program.

Recommendation #19: The external reviewers were explicitly asked for a recommendation about undertaking a PhD program in Computer Science. We cannot, at this time, recommend that the Department start a doctoral program. The Masters programs are still in their infancy, the undergraduate student support is growing, and some additional resources are already needed to deliver the current programs. Thus, we believe that the department should demonstrate strong success with the current programs and incorporate undergraduate students into their research agendas to help build success in grant competitions.

Response: We agree with this recommendation. The department will focus on building on the strength of its Master's program and will consider a PhD program later. The department has already been very successful in engaging undergraduate programs in research with publications in established journals.

Dean of Science Response: The Department is encouraged to pursue the development of a doctoral program only after achieving sustained success with their thesis-based master's program. Since this is a negative recommendation not to pursue a doctoral program, no further action is required, which has been noted in the Implementation Plan.

Dean of the Faculty of Graduate and Postdoctoral Studies Response: FGPS agrees that the department is not able to launch a PhD program at this time. Although it is a laudable goal, a PhD program will only make sense when the MAC and MCS program are in steady state and there are a sufficient number of very research-active faculty members.

STRENGTHS OF THE PROGRAM(S)

Dean of the Faculty of Science: The Department offers both undergraduate and graduate programs in computer science and only undergraduate programs in physics. With respect to computer science, a strength is the ability of the Department to offer 11 undergraduate programs that are centered around a general Honours BSc in Computer Science. This provides the opportunity for students to gain a strong foundation in computer science and training in a specific associated area despite the limitations of the Department's size. These programs have proven to be attractive as student enrolments have grown considerably over recent years. Another strength of the undergraduate programming is its partnership/collaboration with both mathematics and business. The Department recently developed a Master of Applied Computing program with a co-op option and an on-line, course-based Master of Computer Science program, both of which have proven to be successful.

Dean of the Faculty of Graduate and Postdoctoral Studies: The Department has been proactive in developing and delivering two applied computer graduate degrees; the Master of Applied Computing (MAC) and the Master of Computer Science (MSC). Applications for the two programs have grown 300% in the past three years. These programs allow students to choose the path that best fits their interests.

OPPORTUNITIES FOR IMPROVEMENT AND ENHANCEMENT

Dean of the Faculty of Science: The Department continues to struggle with attracting students with strong/appropriate backgrounds in mathematics to many of its undergraduate programs. The Department is aware of this shortcoming and is in discussions with the Department of Mathematics to address the issue. The faculty members teaching the physics program remain committed and dedicated. However, while reaching a high during the period 2013-2015, registrations in the physics programs have been declining steadily ever since; current registrations are now similar to those of a decade ago. Without a reversal of this trend, coupled with the lack of a graduate program, the sustainability of physics programming would become a serious issue. Lastly, external research funding to the departmental faculty members has been declining, and this trend also needs to be reversed.

Dean of the Faculty of Graduate and Postdoctoral Studies: Registration in the MAC and MCS have more than tripled in the past three years. The biggest challenge for the Department is to manage the rapid growth in these programs.

SIGNATURES

Dr. Mary Wilson

February 18, 2021



Dr. Anthony Vannelli

March 1, 2021



Approved by Program Review Sub-Committee:

March 12, 2021

**Approved by Senate Academic Planning
Committee:**

March 23, 2021

Submitted to Senate (for information):

April 12, 2021

Implementation Report Due Date:

April 12, 2023

RECOMMENDATIONS PRIORITIZED FOR IMPLEMENTATION AND ACTION PLAN

The following Implementation Plan was created by the Dean of Science and Dean of the Faculty of Graduate and Postdoctoral Studies as part of the Decanal Response.

Recommendation to be Implemented	Responsibility for Implementation	Responsibility for Resourcing (if applicable)	Anticipated Completion Date	Additional Notes
Recommendation #1: The general undergraduate Computer Science program could benefit from a professional accreditation review by the Computer Science Accreditation Council (www.cips.ca/accreditation). The approach uses an outcomes-based model and would facilitate a curriculum review and potentially motivate careful consideration of the goals of each of the programs being offered by the Department.	Not applicable.			Not prioritized.
Recommendation #2: With a six-fold increase in enrolment over the past five years, and relatively constant faculty resources, managing enrolment growth, probably by enforcing higher admission cut-offs for Computer Science programs is advisable.	Department, Office of the Dean of Science, Recruitment and Admissions	n/a	September 2021	
Recommendation #3: The range of programs is extremely broad with nearly 11 different distinct undergraduate Computer Science degree forms. Although these are	Departmental and Faculty curriculum committees	n/a	August 2022	Integrated planning will help address this recommendation

<p>being delivered, there is overhead associated with operating this diversity and this requires administrative overhead (i.e., curriculum updates, calendar updates, student advising, scheduling challenges, sessional expertise, etc.). Additional support could be provided to support this diversity or a new structure could be developed to allow students to explore diverse interests without identifying unique degree forms.</p>				
<p>Recommendation #4: Course offerings should be produced, announced, and adhered to at least one academic year in advance as apparently required by Laurier. Note: This does not require teaching assignments but rather a commitment to the term in which the course will be offered to allow for students to plan their program. Both graduate and undergraduate students expressed concerns that courses appear to be available, but there is ultimately a much more limited offering available.</p>	<p>Department, Office of the Dean of Science</p>	<p>n/a</p>	<p>August 2021</p>	
<p>Recommendation #5: Offering a single set of Physics labs rather than differentiating them between calculus and non-calculus streams would decrease the support needed for the lab program allowing resources to be</p>	<p>Department</p>	<p>n/a</p>	<p>August 2021</p>	

allocated elsewhere.				
Recommendation #6: Investigate replacing some traditional Physics labs with additional computational labs. This could modernize the program, allow for efficiencies, and attract more students into double degrees with Physics.	Department	n/a	August 2021	
Recommendation #7: A complete Computer Science curriculum update is necessary, including the goal of understanding how defined learning outcomes are assessed both within courses and across the program. This could be undertaken in conjunction with an accreditation review and should be done primarily by full-time tenure-track faculty members. This can only be meaningfully achieved if sufficient time is made available for them to do this work and adequate administrative support is provided to allow it to be done cost effectively.	Department	n/a	August 2022	
Recommendation #8: Administrative support in the Department is currently minimal and probably insufficient. There is very little meaningful backup and much of this work is currently being done by much more highly paid administrators and faculty members, which undoubtedly impacts on	Office of the Dean of Science	Office of the Dean of Science	August 2021	

<p>their potential effectiveness. The Department needs a second administrative support person both due to the current workload and for meaningful backup.</p>				
<p>Recommendation #9: The faculty complement is highly supplemented by sessional instructors. Concerns about this approach are detailed in the report but given the expanding graduate program, the desire to become a comprehensive research university/department, and a substantially growing undergraduate body, it is critical that additional faculty be recruited. Failure to do so may cause current faculty to become a target for recruitment and if these are successful, the problem will only be exacerbated in a negative cycle.</p>	<p>Dean of Science</p>	<p>Faculty of Science, Office of the Provost and Vice-President: Academic</p>	<p>July 1, 2022</p>	
<p>Recommendation #10: Many research active faculty members receive external funding and the Department has recently brought some new young researchers on board. However, the success rate with external funding has decreased over time and based on comments from both faculty and administrators, we believe a mentoring program to assist faculty members in how to best present undergraduate HQP in NSERC applications would be beneficial. This could be done by</p>	<p>Department, Office of the Dean of Science</p>	<p>n/a</p>	<p>August 2022</p>	<p>To coincide with the planned restructuring of the Office of the Dean of Science</p>

recruiting more senior successful researchers or by finding innovative ways to draw on expertise from other schools in the area.				
Recommendation #11: A systematic internal grant application review process should be developed and to the greatest extent possible made mandatory. There appear to be some processes in place at Laurier but it is not always followed and/or may not be considered a serious requirement.	Department, Office of the Dean of Science	n/a	August 2022	To coincide with the planned restructuring of the Office of the Dean of Science
Recommendation #12: As a part of the curricular review, it is strongly recommended that the use of TA/IA resources should be considered. Both graduate students and faculty members indicate that these resources could be better used and would provide an important part of the overall training of young scholars.	Department	n/a	For September 2021	
Recommendation #13: Mechanisms to recognize success in grant competitions, publications, external awards should be noted and highlighted. This includes career accomplishments but equally importantly finding opportunities to recognize departmental faculty members through internal awards. By establishing an award nomination committee, the faculty members	Department	Dean of Science	August 2022	To coincide with the planned restructuring of the Office of the Dean of Science

<p>successes can be brought to the attention of various stakeholders at Laurier so the Department's contributions are fully recognized.</p>				
<p>Recommendation #14: Growth in the current Master programs, particularly the research-based Master of Applied Computing, should be carefully managed and should only grow as the faculty resources available to supervise these students is made available. The program is relatively new and faculty members should be cautious to only take on the number of students that they can manage within their other obligations. It is strongly recommended that the growth be incremental until sufficient experience is in place in the department to know the program being delivered is of high quality.</p>	<p>Department, Faculty of Science</p>	<p>n/a</p>	<p>August 2022</p>	<p>To coincide with the planned restructuring of the Office of the Dean of Science</p>
<p>Recommendation #15: Clarify and document regulations concerning student funding as it relates to student's ability to work beyond the duties associated with receiving this support. This includes both on-campus and off-campus work for both Canadian and international students. Ensure students and supervisors clearly understand these regulations and conform to them.</p>	<p>Department, in consultation with the Faculty of Graduate and Postdoctoral Studies</p>	<p>n/a</p>	<p>Immediately</p>	

<p>Recommendation #16: The need for and motivation behind a BA in Computer Science does not appear to justify the addition of a new degree program. By addressing the challenges associated with math and based on feedback received, we believe offering the BSc in Computer Science is sufficient. Thus, we do not recommend offering a BA at this time.</p>				<p>Not prioritized.</p>
<p>Recommendation #17: Offering a new online minor does not appear to be a high value initiative for the Department. If the University determines that this is of sufficient value, it should ensure additional resources are provided to allow the Department to offer a high quality online experience to non-Computer Science majors. Thus, we do not recommend offering an on line-minor in Computer Science at this time.</p>				<p>Not prioritized.</p>
<p>Recommendation #18: To maintain the viability of Physics programming, the Department should seek programs that differentiate them from Physics programs available elsewhere, but which can be mounted with the limited teaching resources available in Physics. Because of the unique combination of Physics and Computer Science in a single department, one possibility</p>	<p>Department</p>	<p>n/a</p>	<p>August 2022</p>	<p>To coincide with Recommendation #7</p>

<p>would be a program that emphasizes computational techniques. This needn't be exclusive to Physics students, but would likely attract students with interests in the physical sciences.</p>				
<p>Recommendation #19: The external reviewers were explicitly asked for a recommendation about undertaking a PhD program in Computer Science. We cannot, at this time, recommend that the Department start a doctoral program. The Masters programs are still in their infancy, the undergraduate student support is growing, and some additional resources are already needed to deliver the current programs. Thus, we believe that the department should demonstrate strong success with the current programs and incorporate undergraduate students into their research agendas to help build success in grant competitions.</p>				<p>No further action is required.</p>