FINAL ASSESSMENT REPORT
Institutional Quality Assurance Program (IQAP) Review
Computer Science
Undergraduate Program

Date of Review: March 28 – March 29, 2016

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response and assessments of the undergraduate programs delivered by the ***Department of Computing and Software****. This report identifies the significant strengths of the programs, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.*

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Cyclical Program Review of the Undergraduate Computer Science Program

In accordance with the Institutional Quality Assurance Process (IQAP), the Department of Computing and Software submitted a self-study in January 2016 to the Associate Vice-President, Faculty to initiate the cyclical program review of its undergraduate programs. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained all course outlines associated with the program and the CVs for each full-time member in the department.

One arm's length external reviewer from the Ontario and one internal reviewer were endorsed by the Dean, Faculty of Engineering, and selected by the Associate Vice-President, Faculty. The review team reviewed the self-study documentation and then conducted a site visit to McMaster University on March 28 – March 29, 2016. The visit included interviews with the Provost and Vice-President (Academic); Associate Vice-President, Dean and Associate Dean of the Faculty of Engineering, Faculty, Chair of the department and meetings with groups of current undergraduate students, full-time faculty and support staff.

The Chair of the department and the Dean of the Faculty of Engineering submitted responses to the Reviewers' Report (January 2017). Specific recommendations were discussed and clarifications and corrections were presented. Follow-up actions and timelines were included.

The Final Assessment Report was prepared by the Quality Assurance Committee to be submitted to Undergraduate Council and Senate (December 2017).

Strengths

The main strengths of the Computer Science program are the following:

- The program has a solid curriculum with a mixture of fundamental courses, experiential learning courses, and electives (10 open and 6 technical). The current curriculum was introduced in 2013/14. It helped reduce the Level 1 to Level 2 attrition from over 50% to about 3%. We expect that the 5 new experiential learning courses (called *practice and experience courses*) will have a major positive impact on the student learning experience. We are still in the process of finding the best way to deliver these innovative courses. The 16 open and technical electives allow our Computer Science students to develop a tailored program that is built on a solid computing foundation. We are encouraging our students to develop (1) program plans for combining computer science with their interests and career aspirations using the electives and (2) portfolios that showcase the work they produce by implementing their program plans.
- The program is attracting well-prepared and highly motivated students.

In their report (April 2016), the Review Team highlighted the additional following strengths of the program:

- The program's "focused approach to training the practice of computer programming and software design".
- The program faculty and staff are concerned with "how the [students] are taught and how they learn".
- The experiential *practice and learning courses* that provide students with hands-on experience with computer programming are "well thought out and offers a forward thinking approach to engaging [the] students in their education".
- The program prepares students both for employment immediate after graduation and for graduate studies in computing.
- The program faculty are actively reaching out to industry and local schools.
- The program is supported by a faculty that includes "some very strong researchers, in a variety of research areas".
- The program faculty are rich in international diversity.
- The program has a deep candidate pool.
- The Computer Science program is being monitored by the same learning-outcomes process used for the Department's Mechatronics and Software Engineering programs.

Areas for Improvement and/or Enhancement

The main areas for improvement of the program are the following:

- Some of the required courses in the Computer Science program must be combined with required courses of the Software Engineering program. In 2015/16 there were 11 of these combined courses of these combined required courses with 200-300 students. Not only are these courses very large, they include two very different cohorts of students. The CS students have a higher admission average than SE students, take three computing courses in Level 1 versus the single course SE students take in Level 1, and have a lower course load than SE students (5 versus 6-7 course per term). As a result, the CS students are under challenged, while the SE students are over challenged. This is directly reflected in the course evaluations: An instructor who teaches a combined required course nearly always receives a significantly higher rating from the CS student than from the SE students with a CS Question 1 mean that is often 1 – 2 points higher than the SE Question 1 mean. 7 of the 11 combined required CS and SE courses will be taught separately in 2017/17 at the price of hiring more sessional lecturers.
- The Department's undergraduate student to faculty ratio is 34.4. As a result, nearly all the courses in the CS program are large. The combined required CS and SE courses mentioned above usually have about 240 students; uncombined CS required courses have about 80 students; and most technical electives have about 50 students.
- The department does not have a sufficient number of technical electives in the application areas of computer science. The department does not have the expertise in the Department faculty to teach important application courses like computer graphics, machine learning, and artificial intelligence, nor does the Department have the teaching capacity to deliver a larger number and range of technical electives.
- The student experience is being diminished by the large number of courses that are being taught by sessional lecturers: 6 required courses and 6 technical electives in the CS program will be taught by sessional lecturers in 2016/17.

The Review Team noted some other following areas for improvement in the program:

- The main areas for improvement expressed in the report are the "lack of applications of computing topics" and research activities to "entice and attract students to seek graduate studies".
- The program should provide the students more opportunities to do cutting edge research as part of their undergraduate experience.
- The preparation of the Computer Science students is not in alignment with the preparation of Software Engineering students, which causes a "limit to the depth that more advanced material can be covered for computer science students."
- The heavy use of sessional lecturers "on an ad hoc basis signals a unit that is stretched and has challenges in teaching its programs."

Summary of the Reviewers' Recommendations with the Department's and the Dean's Responses

Recommendations

Recommendation	Proposed Follow-Up	Responsibility for Leading Follow-Up	Timeline for Addressing Recommendation
More of an effort to include undergraduate students in research, coupled with more incentives to attract students into graduate studies.	The Faculty is working on this for all of its undergraduate programs. We are working on implementing a portfolio program for Computer Science students, which could include a research component when appropriate.	CAS Associate Chair for Undergraduate Studies.	March 2017
A more visible and prominent approach to internationalization	The Faculty is working on this for the entire Faculty. We could include an internationalization component in the CS portfolio program that capitalizes on the rich international diversity of the CAS faculty and the high number of foreign students in McMaster's CS program. (25% of the CS students entering Computer Science 1 next fall are from outside of Canada).	CAS Associate Chair for Undergraduate Studies	March 2017
The enrolment is capped at 50 students for CS. If the department wishes and has the resources an increase in the number of CS students may be appropriate	We do not have the teaching capacity to raise the Computer Science enrolment without decreasing the enrolment of our other undergraduate programs. We would like to put our Computer Science and Software Engineering programs into balance by increasing the CS intake per year from 50 to 90 and decreasing the SE intake per year	CAS Chair	March 2017

	from 130 to 90.		
A recommendation in the previous cycle was to align the CS curriculum more closely with the SE curriculum. This remains an issue.	The CS and SE curricula have been as closely aligned as they can be at Levels 2 – 4. Alignment is needed at Level 1, but this is impossible since SE students begin in the Engineering 1 program.	Done	
A comment that has been raised repeatedly by faculty is the lack of sufficient teaching assistant support. This appears to be an area where a modest investment in additional teaching assistants would ease the stresses of holding large classes.	The Faculty has significantly increased the Department's TA budget so that we will be able to hire 115 graduate and 52 undergraduate TAs in 2016/17. (We hired 103 graduate and 27 undergraduate TAs in 2015/16). It will be very challenging to find appropriate students to fill all of these TA positions. For that reason, a further increase of the TA budget will likely not have much of an impact.	Done.	
The use of sessional instructors on an ad-hoc basis should be closely monitored to ensure quality and consistency.	Every sessional lecturer will be assigned a full-time faculty member of the Department to serve as a teaching mentor. Moreover, the Department's Undergraduate Curriculum and Policy Committee will monitor the delivery of the courses at the end of each term and give feedback to the sectional lecturers.	CAS Chair	September 2016
Programming courses	This has already been	Done	

should be sectioned so that CS students could be instructed at their appropriate level.	done for the 7 of the 11 combined required Computer Science and Software Engineering courses. To section the remaining 4 courses would require hiring 4 more sessional lecturers so that we have 26 instead of the current 22.		

Faculty Response:

As detailed in the Chair's response, the recommendations in the review have led to a series of discussions within the Department of Computing and Software (CAS) and the Faculty focused on such items as reduction of class sizes or splitting of the current combined CompSci and Software Engineering course, expansion of the program due to its high demand, the incorporation of undergraduate students in research, internationalization, TA support, and issues with a large number of sessional instructors. The vast majority of the recommendations are currently being addressed or have been completed by the Department and include such items as the splitting of combined CompSci and Software Engineering courses and closer monitoring of session faculty to ensure a high quality of instruction. Unfortunately, some of the recommendations, such as increasing the alignment between the Level 2 CompSci and Software Engineering student backgrounds, cannot be implemented due to the common Engineering 1 entry year at McMaster.

Overall, the dean satisfied with the replies of the Department to the concerns raised by the IQAP reviewers.

Quality Assurance Committee Recommendation

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation and the committee recommends that the program should follow the regular course of action with an 18-month progress report and a subsequent full external cyclical review to be conducted no later than 8 years after the start of the last review.