FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

COMPUTER SCIENCE & SOFTWARE ENGINEERING (UG) PROGRAM

Date of Review: March 28 – 29, 2023

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 program delivered by the Computer Science & Software Engineering program. This report identifies the significant strengths of the program, 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 Review

In accordance with the Institutional Quality Assurance Process (IQAP), the Faculty of Engineering submitted a self-study in February 2023 to the Vice-Provost (Teaching and Learning) to initiate the cyclical program review of the Computer Science & Software Engineering undergraduate program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis.

Two arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Engineering and selected by the Vice-Provost (Teaching and Learning). The review team reviewed the self-study documentation and then conducted a virtual site visit on March 28 – 29, 2023. The visit included interviews with the Vice-Provost (Teaching and Learning), Deputy Provost, Dean of the Faculty of Engineering, Chair of the Department of Computer Science & Software Engineering, Director of Engineering & Society and Engineering & Management programs, and Acting Associate Dean (Academic) and meetings with groups of current students, full-time faculty, and support staff.

The Dean of the Faculty of Engineering, Chair of the Department of Computer Science & Software Engineering, Associate Chair and Acting Associate Chair (Undergraduate) submitted responses to the Reviewers' Report. The initial response was prepared by the program in May 2023, and finalized by the

Dean in May 2024. Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

Faculty research and especially the training of HQP is very good. The number of graduate students engaged in research appears to be excellent, and undergraduate participation is also high. The course offerings provide a solid foundation in computer science and software engineering and have a good mix of theory and practice.

Administrative staff seem exceptional. It is hard to believe that such a small number of staff members can do all the administrative work for such a rapidly growing department.

Technical staff also seem exceptional. Again, the small number of people who manage the technical needs of a growing department is amazing.

The Engineering & Society and Management programs seem to be quite well managed and useful add-ons.

The supplementary application is a nice approach to increase diversity of the admitted applicants.

Opportunities for Improvement and Enhancement, Including Appropriateness of Resources

The reviewers stated:
The commitment to expanding the faculty and to offering new courses in a variety of (what are called) application areas is another program strength that is in the process of realization. However, that growth and the anticipated increase in the number of students will make the current measures for course delivery and administrative management insufficient. There will be a much greater need for some form of additional staffing to handle the needs of more undergraduates, more graduate students, and more teaching faculty. This is not perhaps an area for enhancement but an area of anticipated need that will allow the department to maintain its current standards while delivering the program with more students and faculty.

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

Recommendation #1: Include estimates of minor student enrollment in course planning.
Department's Response and Actions to be Taken: The minor student number estimation has been included (currently capped at 30) in our course seating projections. But the CS minor as currently implemented puts great strain on our administration resources, and, as a result, the department has formed a committee to study its redesign and feasibility. In response to the high burden that weak students aiming for a CS minor imposed on teaching courses, we strengthened the prerequisites of Level I and II CS courses effective in the academic year 2022-2023. We will be analysing the effects of

this set-up, which should become clearer one the grade-anomalies of the COVID-19 pandemic are not a factor anymore. Further, going forward, enrolment in the CS minor will be by admission only, controlled by the Department. Additional teaching track hire resources are being provided to support the CS Minor enrolment.

Dean's Response:
The Faculty has approved an additional teaching track hire to support CAS, including the CS minor. The minor was restructured during the 2023/24 academic year and approved by all necessary university bodies. The restructured minor, by admission only, will commence in September 2024 with 150 seats.

Recommendation #2: Increase female enrollment by implementing successful methods from other engineering departments.

Department's Response and Actions to be Taken: The department, in coordination with the Faculty Academic Office, will explore best practices by the other departments, and implement those applicable to our programs. Currently the Department works with the Faculty of Engineeing's recruiting office to run the annual *Go Code Girl* event every March for girls in grade 7 to 10 that is offered free of charge.

Dean's Response:
The faculty continues to put significant efforts into increasing diversity across the Faculty. There have been some successes, for example the 2023 incoming B.Eng. cohort was 43% female. However, there is still work to be done across all of our direct entry programs, including CS. As the reviewers noted, the programs offered by some departments, including Software Engineering, are less popular choices for female students in the second year. The Faculty will continue to support all departments in their work to increase diversity, including achieving gender parity, in their programs.

Recommendation #3: Increase and expose coordination between courses.

Department's Response and Actions to be Taken: The department can organize its courses into threads (e.g., Design courses), and implement an instructor meeting at the beginning of each term (September and January) for each thread, so that instructors can coordinate better. Given that this was attempted before the previous IQAP meeting at the granularity level of Learning Outcomes, but failed due to its enormous overhead, the new effort should probably start with only a few threads, and adapt in later years according to the accumulated experience. The new Associate Chair Undergraduate Internal role will be responsible for organizing and coordinating the course delivery in different threads to be determined by the undergraduate curriculum committees.

Dean's Response:
The Faculty supports the Department's proposed approach. Starting with fewer threads and dedicated resources seems more achievable than the previous attempt.

Recommendation #4: Define lab expectations for new hires and include hands-on components where possible.
Department's Response and Actions to be Taken: Hands-on components are already included in most labs (e.g., design courses), since this is a CEAB accreditation requirements for SE (and CS labs are modelled similarly to SE). But there is no explicit lab expectations for new hires. The department will implement a mapping of labs to previous and new instructors, and make sure that the new instructor of a lab course connects with the previous instructor before the beginning of the course term.
Dean's Response: Courses belong to the program, not the instructor. With respect to Software Engineering, any changes to individual courses must be checked against the program's accreditation requirements to ensure compliance. In general, while instructors have flexibility in their pedagogical approaches and assessments, they must propose changes to learning outcomes, contact time, and lab or tutorial components through the curriculum committee (both SE and CS).

Recommendation #5: Set department standards for higher end grades to avoid grade inflation.
Department's Response and Actions to be Taken: We are not sure whether there is indeed grade inflation (we have indications for the opposite), and we have not estimated yet the effects of on-line learning due to the pandemic. Also, the increase of SE grades can be largely attributed to the higher demand for this program, which results in better students entering the program. The department will monitor the grade distributions in order to deduce safer conclusions.
Dean's Response: We agree with the Department that this is not grade inflation. The minimum average high school grade for Level 1 B.Eng. and CS students has significantly increased over the last decade, now nearing the mid-90s. This rise reflects the overall improvement in the quality of our undergraduate population, evidenced by significantly reduced attrition in Level 1. Moreover, Software Engineering is highly competitive, attracting students who compete for seats after Level 1 B.Eng. As a result, those entering Software Engineering tend to be among the highest achievers in an already excellent Level 1 cohort.

Recommendation #6: Hire course coordinators to assist with the administrative overhead imposed by large and multiple-section courses.
Department's Response and Actions to be Taken: We completely agree that this is one of the most urgent priorities for the department. It also requires a very substantial commitment of resources. We copy here the reviewers' comment which describes the set-up of coordinates in the CS dept. at UBC: "The CS department at UBC, with a bit over 2,000 CS undergraduate majors, has 7 course coordinators (and is looking to hire more). Each coordinator is a staff member who works with the instructors of several, typically related, courses to help (a) manage scheduling for TA meetings, office hours, and lab coverage (large courses have well over 20 TAs (mostly undergraduate); our intro programming course has over 50), (b) manage student accommodations for illness, student registration with the accessibility centre, missed exams, etc., (c) provide a conduit to communicate administrative best-practices between instructors and courses, and (d) help new (and old) faculty

navigate the administrative requirements for courses. They usually sit in on TA meetings for their courses. At UBC many of our course coordinators were previously undergraduate and/or graduate TAs for our courses." Our department should move towards this direction. Since on the one hand we have no previous experience in setting-up course coordinators, and on the other hand the need is urgent, we propose the design of the system be completed within the academic year 2023/24, and its implementation start at the beginning of academic year 2024/25. The Department Chair has had initial discussions with the Dean about the need for Instructional Assistants for large, multi-section classes as has been implemented with the large first year Engineering classes. The Dean is supportive of providing such resources to the Department for large classes.

Dean's Response:
The Faculty supports hiring Instructional Assistants (IAs) for larger courses offered by CAS. This practice has precedence in our Experiential Learning Office, where courses have around 1,000 students. However, we caution that instructors can sometimes become less engaged when IAs handle most administrative tasks. Therefore, the Department is encouraged to monitor this to ensure that instructors of courses with IAs remain appropriately engaged.

Recommendation #7: Each section of a class should count as a unit of teaching load.

Department's Response and Actions to be Taken:
Since we started splitting previously co-taught CS and SE courses, each of these separate courses has always counted as one unit of teaching load, and now that we started sectioning large CS courses, we are applying that principle there also: Each **separately-delivered** section counts as one unit of teaching load. Successful recruiting of faculty members has provided the resources required to do this in the majority of courses offered by the Department.

Dean's Response:
University policy dictates the crediting of teaching units for multiple sections. Engineering courses typically carry a three-unit load. When a single instructor teaches multiple separately-delivered sections of the same course simultaneously, they are credited three units for the first section and two units for each additional section.

Recommendation #8: Increase teaching relief for the Department Head and increase the number of Department Associate Heads.

Department's Response and Actions to be Taken:
The Dean has approved full undergraduate teaching release for the CAS Chair going forward. This should provide Chair the required capacity to manage the Faculty's largest Department. Further the Associate Chair Undergraduate role will be split into External and Internal roles, each with one course teaching release. This will allow us to effectively manage the significant demands of having the largest student cohort and multiple programs.

Dean's Response:
Operational excellence is important in our Faculty. Recognizing that CAS is our largest department, we have allocated additional resources to ensure its leadership can focus on both operational and strategic aspects of their roles.

Recommendation #9: Start a Tri-mentoring program.
Department's Response and Actions to be Taken: The reviewers' definition of a Tri-mentoring program is the following: "A tri-mentoring program groups three people together: a 1st or 2nd year student, a 3rd or 4th year student, and an industry or academic professional. The expectation is that the group will meet at least twice during the year in addition to attending the opening and closing events that bring together all groups." As defined, such a program seems like it would be imposing an overhead that will be too hard to accept for our (enlarged) CS and SE programs. But we agree with the reviewers that better connections to industry (and especially our alumni) should be explored and pursued further.
Dean's Response: As our student cohort in industry expands, we will continue to expand our network. The faculty will continue to support CAS as they explore ways to increase their connections to industry.

McMaster University

Implementation Plan

In the chart below, please outline the recommendations made by reviewers, briefly outline the actions you plan to take, who will be responsible for leading the action, and a timeline for completion.

Recommendation	**Action(s) to be Taken**	**Responsibility for Leading Action** (specify the role(s) that will be responsible for each action item e.g. Program Chair.)	**Timeline for Completing Action** (indicate specific timelines (e.g. not 'ongoing') for action)
Include estimates of minor student enrollment in course planning.	The minor student numbers will now be controlled by the Department through an admissions only process after 1st year. The enrolment will be capped at 30 to 150 students depending upon the resources provided to the Department.The current plan is to have 150 student per year supported by the hiring of teaching track faculty and an additional support staff. The CS minor as previously implemented put a great strain on our administration resources, and, as a result, the department redesigned the CS Minor to provide the Department the ability to control enrolment.	Associate Chair Undergraduate	First term of the 2023/24 academic year.
Increase female enrollment by implementing successful	The department, in coordination with the Faculty Academic Office, will explore best practices by the	• Undergraduate Recruitment Cmt.	Academic year 2023/24

methods from other engineering departments.	other departments, and implement those applicable to our programs.	• Representative to the Faculty Cmt. For women in Engineering	
Increase and expose coordination between courses.	The department can organize its courses into threads (e.g., Design courses), and implement an instructor meeting at the beginning of each term (September and January) for each thread, so that instructors can coordinate better. Given that this was attempted before the previous IQAP meeting at the granularity level of Learning Outcomes, but failed due to its enormous overhead, the new effort should probably start with only a few threads, and adapt in later years according to the accumulated experience.	Associate Chair Undergraduate Internal + Curriculum committees for CS, SE, and TRON	Design phase: Academic year 2023/24 Implementation: Academic year 2024/25 and beyond
Define lab expectations for new hires and include hands-on components where possible.	Hands-on components are already included in most labs (e.g., design courses), since this is a CEAB accreditation requirements for SE (and CS labs are modelled similarly to SE). But there is no explicit lab expectations for new hires. The department will implement a mapping of labs to previous and new instructors, and make sure that the new instructor of a lab course connects with the	• Administrators will create and keep updated the mapping between lab courses and previous/new instructors • Undergrad lab committee • Associate Chair Academic Internal will be facilitating the connection between instructors	Implementation: Academic year 2023/24 Recurring every year

	previous instructor before the beginning of the course term.		
Set department standards for higher end grades to avoid grade inflation.	We are not sure whether there is indeed grade inflation (we have indications for the opposite), and we have not estimated yet the effects of on-line learning due to the pandemic. Also, the increase of SE grades can be largely attributed to the higher demand for this program, which results in better students entering the program. The department will monitor the grade distributions in order to deduce safer conclusions.	Curriculum cmts.	The department will continue monitoring the grade distributions for the coming years.
Hire course coordinators to assist with the administrative overhead imposed by large and multiple-section courses.	We copy here the reviewers' comment which describes the set-up of coordinates in the CS dept. at UBC: "The CS department at UBC, with a bit over 2,000 CS undergraduate majors, has 7 course coordinators (and is looking to hire more). Each coordinator is a staff member who works with the instructors of several, typically related, courses to help (a) manage scheduling for TA meetings, office hours, and lab coverage (large courses have well over 20 TAs (mostly undergraduate); our intro	• Program chair • Associate Chair Academic • A committee dedicated to the sole purpose of designing the course coordination scheme • The persons responsible for the maintenance of the scheme every year, as described by the designed scheme	Design: Academic year 2023/24 Implementation: Recurring starting with academic year 2024/25

	programming course has over 50), (b) manage student accommodations for illness, student registration with the accessibility centre, missed exams, etc., (c) provide a conduit to communicate administrative best-practices between instructors and courses, and (d) help new (and old) faculty navigate the administrative requirements for courses. They usually sit in on TA meetings for their courses. At UBC many of our course coordinators were previously undergraduate and/or graduate TAs for our courses." Our department should move towards this direction. Since on the one hand we have no previous experience in setting-up course coordinators, and on the other hand the need is urgent, we propose the design of the system be completed within the academic year 2023/24, and its implementation start at the		

	beginning of academic year 2024/25.		
Each section of a class should count as a unit of teaching load.	Courses have been split and addition sections count as a full additional teaching assignment.	Department Chair	Academic Year 2024/25
Increase teaching relief for the Department Head and increase the number of Department Associate Heads.	2Done. The next Department Chair gets absolute teaching release. The Associate Chair Undergraduate role has been split into External and Internal roles. Each with one course teaching release.	Department Chair	Academic Year 2024/25
Start a Tri-mentoring program.	Better connections to industry (and especially our alumni) should be explored and pursued further, in coordination with the Faculty of Engineering Alumni Relations.	Program Chair	Academic year 2024/25

Quality Assurance Committee Recommendation:

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the June 19, 2024, meeting. The committee recommends that the Computer Science & Software Engineering undergraduate program should follow the regular course of action with an 18-month progress report and subsequent full external cyclical review to be conducted no later than eight years after the start of the last review.