

MEMORANDUM

October 25, 2018

The Faculty of Mathematics endorses this two year progress report for the BCS, BMath (CS), MMath and PhD programs, as revised August 2018. Two of the five recommendations are now complete. The nature of the other three recommendations (develop a hiring plan, promote the CS graduate program and increase the number of lecturers) are very long term projects, and have now commenced. They will be ongoing projects well into the future, as is appropriate given the recommendations.

Regards,



Stephen M. Watt
Dean, Faculty of Mathematics



Two Year Progress Report

BCS, BMath(CS), MMath, and PhD

June 2016 (revised August 2018)

Background:

The last cyclical review was completed in January 2014. The School undertook a major self-study of all its programs (266 pages), and invited Dr. Anne Condon (University of British Columbia), and Dr. Ken Jackson (University of Toronto) to be the external reviewers. As noted in the report, the Cheriton School of Computer Science is one of the strongest in the world, currently ranked #31 in the QS world rankings. It is also very large, with over 3600 undergraduate students, over 400 graduate students, and more than 80 faculty members. The self-study and external review were very effective in identifying the strengths and challenges for the School in the coming years. The reviewers made a number of very appropriate recommendations. In response the School made a number of action steps in a two-year progress report that was originally submitted in June 2016. However delays in both in the School and in the Quality Assurance Office warranted revisions to the 2016 draft and the current document was resubmitted in August 2018.

Progress on Implementation Plan:

Recommendations

1. Develop a hiring plan that takes into account what research areas are priorities for the School as well as how hiring more women faculty members might improve the learning environment for women students and how hiring more lecturers might reduce the need to hire as many sessional instructors and might also reduce class sizes.

Status: In progress, and ongoing

Details: In 2013-2014 and 2014-2015 the School conducted open hires in all areas of Computer Science. This was determined to be the most adaptable approach to hiring a large number of faculty members (4 positions in each year), as well as potentially be proactive in hiring women. The plan was successful in hiring 8 new faculty members (2 of them women) and one Cheriton Chair. In May 2015 we surveyed the School regarding the recent hiring approach, priority areas for research, and the appropriate balance of professorial and lecturer faculty. As a result, for 2015-2016 we identified three target research areas (Systems & Networking, Software Engineering, and Machine Learning) as well as advertising one position for strategic hires in any area of computer science. This was necessary to address the research and teaching imbalance due to some retiring and departing faculty. While this round of hiring was successful, and 4 faculty members were hired, all of them were male. The top candidates in both Systems & Networking and Software Engineering were both female, and were made competitive offers, but both of them ultimately decided to go elsewhere. In both cases we were very proactive in

reaching out to the candidates to encourage them to apply. This pattern has continued for the past two years, though indeed we have had notable successes: in addition to generally hiring quite successfully, the School also has hired a female assistant professor, Dr. Xi He, who will arrive soon. Still, our new hires barely keep up with retirements and faculty leaving for chairs and other positions outside Waterloo, and our number of students has skyrocketed.

The issue of the balance of lecturers and professors is an on-going discussion, and has been addressed in each year's post-hiring-round survey. While no firm resolutions have been made in this regard, seven new lecturers have been hired over the past four years (two female), and there is an expectation to hire more in coming years. The quality of applicants varies year over year. A very competitive industrial market, as well as strong hiring of faculty at good second-tier CS departments with some research component are posited as reasons.

At this point, we plan annually our faculty hiring, partly because there is so much unpredictability in the success of each year's hiring: in particular, in 2017-2018, we hired seven new professors (including two senior hires from Western University) and two new lecturers; the previous year's hiring was much less successful. A long-term hiring plan seems unlikely at this time; additionally, faculty retirements have proven very difficult to plan for. A particular challenge with long-term faculty planning for our School is the dramatic changes in our field: just since the 2014 review, the rise of artificial intelligence as a key area in CS has hastened to a level that could not have been predicted then. As such, we expect that a longer-term prioritization project to identify areas for growth is unlikely to work as well as the more organic model we have been following. We may have a CS retreat organized around other long-term School structural issues in 2019, and we would include this topic.

Since the 2014 program review, our undergraduate enrolment dramatically increased, and as such, the issue of balancing lecturers and professors has been less of a worry than the issue of balancing lecturers and sessionals. Consistently we have not been able to fill all existing lecturer openings, and the ones we have been producing have consistently kept the number of lecturers at approximately 17% of the School faculty complement.

2. Appoint a senior faculty member to work closely with the Directors in developing bold new strategies to attract women at the undergraduate, graduate, postdoctoral and faculty levels.

Status: Completed

Details: In July 2015 we created the position of Director of Women in Computer Science with the mandate to provide a strong and active voice on the CS Executive Committee (and hence providing input into all School operations, including admissions), and to lead all manner of activities regarding women in CS, from K-12 to undergraduate and graduate education through development and recruitment of research faculty. The position has teaching relief and a significantly increased budget for a number of new activities aimed at outreach, recruitment, retention, and post-graduate success of students. This has been extremely successful and Prof. Jo Atlee, Director of Women in CS has been active in leading a number of new initiatives at the

School and Faculty levels. She has also worked closely with fundraising staff in the Math Faculty to bring in support for initiatives that she has begun.

Current outreach initiatives are two programs. Technovation Challenge is a world-wide competition for girls 10-18, for which our Women in CS program is the Waterloo Region ambassador. Girlsmarts4tech is an annual one-day event for girls in grades 6 and 7.

On campus, we offer a half-day orientation event for new students, a peer mentorship program (Big CSters), Lean-In circles, technical interview preparation workshops, career panels, and workshops on responding to sexism for students; we also send students to conferences focused on women in technology, such as the Grace Hopper Celebration of Women in Computing.

Future programs include more technical programs for senior university students, an expansion in the Technovation Challenge project, and a focus on environmental sustainability for WiCS events.

The number of women accepted into Computer Science programs rose from 16% to 25% from 2014 to 2015, and sustained these levels in 2016 through 2018. While we cannot claim a direct connection, it is felt that new programs and publicity are having a very positive effect.

While we mark this item as “completed”, in that the position of Director of Women in CS has been successfully created, the project itself, and the problem it addresses, is far from gone and we expect to be dealing actively with this for the indefinite future.

3. Step up efforts to promote the CS graduate program at Waterloo, and to ensure timely and smooth communication with prospective and accepted graduate students. Consider introducing an alternative pathway for excellent students from other disciplines to transition into the graduate program.

Status: In progress

Details: The School introduced a number of new measures for graduate student recruitment over the past 4 years.

First and foremost is the very successful Undergraduate Research Opportunities Conference (UROC) which brings in senior undergraduate students from all over Canada for 3 days of intensive research projects lead by a research faculty. Since beginning UROC in 2015, we have had 128 students attend in four years, of whom 18 have joined us as graduate students in the first three years. We reduced the size of UROC in September 2018, to 26, to focus on students whom we expect are bound for graduate school.

We are also developing a new Master’s degree in Data Science and Artificial Intelligence (MDSAI) with the Department of Statistics and Actuarial Science. This will provide a path for students with a strong computer science or statistics background to obtain a Master’s in this exciting area of computing. A Data Science option for the CS and Statistics Master’s programs

was rolled out to the first students in Fall 2017, and the full MDSAI program is going through the approval processes, with an expected start date of Fall 2019.

The School (and University) could still improve with respect to timely and smooth communication with prospective and incoming graduate students. In particular, there are still lags at a number of levels (between faculty members indicating that they have accepted students and the formal offers going out), and the finances in offer letters are somewhat complicated, especially for international students (high tuition fees are usually compensated for by large scholarships and TAs, but the net income may be difficult to discern). A recent initiative has been an e-newsletter for applicants, students who have been accepted, and those who have decided to attend Waterloo.

As well, the offers themselves are often at a lower financial level than competing schools, especially those in the US. UW support packages, as of 2018, are approximately \$3000 less than comparable funding packages in CS at the University of Toronto, though obviously the cost of living in different places (e.g. Toronto) plays a significant role. Top US School regularly offer up to \$10,000 more than this in take-home pay (though this information is somewhat anecdotal, and difficult to verify).

Our Grad Visit Day in the winter, where we bring in accepted students from near and far, and also strong domestic applicants who have not yet been accepted, has grown in the past few years: approximately 25 students attend per year, of whom half subsequently enroll (13 in each of 2017 and 2018). Many new students cite it as a big factor in their decision to come here.

4. Increase the number of lecturers, as a means of reducing the number of sessionals. Ensure that lecturers and faculty in the professorial ranks strengthen their partnership in advancing and delivering the curriculum, are supported in adopting and assessing new practices pertaining to curriculum or pedagogy and extracurricular enrichment, and avail of professional development opportunities, e.g., through participation in the Association for Computing Machinery's Special Interest Group in Computer Science Education.

Status: In progress

Details: The School has hired seven new definite term lecturers over the past four years. It is expected that we will hire at least one more lecturer in the coming year. As well, the School has been proactive in encouraging strong lecturers to apply for Continuing status. Finally, Lecturers (especially Continuing Lecturers) are becoming more involved in the leadership of the School, with two of them serving sometimes as chair of School committees: the Outreach Committee (which has done computer science outreach to K-12 students through open courseware, on campus events and School visits) and the Commons Committee, (whose goal is to encourage the social and scientific commons of the School).

Senior lecturers have taken a leading role in the Undergraduate Curriculum Committee. A 2014 subcommittee report led by one senior lecturer on CS minor programs has led to substantial changes in this aspect of our curriculum (see recommendation 5 below). The Undergraduate

Academic Plans Committee (UAPC – the undergraduate curriculum committee), has a long tradition of being an exciting and dynamic body for curriculum development and has always had strong participation from lecturers.

There has been little recent engagement in SIGCSE by the lecturer group, though there has been in the past. This has more to do with their other current non-teaching engagements, including completing their PhDs and other research endeavours, involvement in Centre for Education in Mathematics and Computing and the International Olympiad in Informatics, the Canadian Computing Competition, other conferences, and deep contributions into the advising and data collection infrastructure through the development of the Online Advisor Tool (OAT). One interesting change has been the increase in the number of lecturers in CS who have a non-zero research appointment; one of our lecturers currently holds an NSERC discovery grant, and another will apply in the 2018-2019 competition.

As noted above, the market for hiring lecturers is very tight, and we were unsatisfied with the quality and depth of the applicant pool in recent hiring rounds, though we have made good hires. We will continue to try and recruit top-quality lecturers, in particular by developing lecturers from those already teaching sessionals and from our graduate students who prefer a teaching-oriented career. Nonetheless, we expect these difficulties with overall lecturer hiring to continue.

With respect to new models of curriculum and pedagogy, two recent developments are relevant. First, following on the successful introduction of enriched sections in first year courses, in the past four years the School has successfully introduced enriched sections of four of its second-year core courses. The intent of these courses is to deliver an enriched (as opposed to accelerated) version of the material which can be taught to 10% of the students, or approximately 50 per year, per course. These courses go deeper into particular topics to provide challenges to strong students and to encourage them towards research and exploring their own new ideas. The second curriculum innovation is in the development of online graduate courses for CS non-major students. Three such courses have been developed and now delivered, in Networking, Databases and Security. These were originally developed as Computer Science courses in the Masters of Health Informatics (now hosted by Applied Health Sciences), but the plan is to use them in other programs, as well as for the senior non-major undergraduate program (see 5 below). We will be developing some other undergraduate non-major courses in the next few years as part of the Math Online project.

5. Review the non-majors undergraduate program in CS in light of increasing enrollments in the School and changes in CS curriculum at peer institutions.

Status: Completed

Details: In March 2014 the CS Minor subcommittee reported back with a proposal for a complete revision of the minor programs in Computer Science. This involved the creation of a greatly strengthened Computer Science minor, which is a proper subset of a full CS degree, and also a Computing Option (briefly named Computing Technology), available broadly throughout

the University to provide a less intense, but still valuable exposure to computing. This minor and option were formally introduced in late 2015, and should provide more possibilities for involvement in Computer Science for non-major students both inside and outside the Faculty of Mathematics.

Address any significant developments or initiatives that have arisen since the program review process, or that were not contemplated during the review:

The School of Computer Science has seen enormous growth in both undergraduate applications and in the program size itself. The number of students in CS has grown from around 2000 students in 2011 to over 3600 students in 2018 with essentially the same faculty complement of 80 faculty members. A considerable amount of this growth has been through transfers into the program after first year, largely from within the Faculty of Math. This has led to significant stresses on the teaching environment, where we now have over 80 sessionals per year and regular faculty have “taught ahead” more than 100 courses. There is an expectation that this “teaching debt” owed to the regular faculty members will be slowly paid back (by these faculty members teaching less in some future years), introducing an even greater need for sessionals. This has also significantly stressed resources, especially with respect to developing new courses. It is forcing the choice of hiring more lecturers, even in a tough market, and sapping resources for graduate growth. New policies have been put into place (in fall 2017) to limit transfers into CS, but some of these late transfers are women who are not drawn to CS in high school, but discover it after first year university. The new transfer policy into CS is being monitored very closely to ensure it does not introduce any new biases, or entrench undesirable old biases, in our student population.

Updated Implementation Plan:

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Develop a hiring plan that takes into account what research areas are priorities for the School as well as how hiring more women faculty members might improve the learning environment for women students and how hiring more lecturers might reduce the need to hire as many sessional instructors and might also reduce class sizes.	1. Develop a 5-year hiring plan to accommodate predicted faculty losses due to retirement and attrition, and to accommodate the current number of student. In practice, this has been done <i>ad hoc</i> each year, with an emphasis on each year's appropriate hiring priorities. We have hired two new female assistant professors since 2014.	Director of SCS, with Chair of School Advisory Committee on Appointments	Ongoing
2.	Appoint a senior faculty member to work closely with the Directors in developing bold new strategies to attract women at the undergraduate, graduate, postdoctoral and faculty levels.	2a. Continue to develop the office of Women in CS. 2b. Establish external funding for Women in CS to allow for larger-scale projects	Director of Women in CS Director of SCS	Completed Fall 2017
3.	Step up efforts to promote the CS graduate program at Waterloo, and to ensure timely and smooth communication with prospective and accepted graduate students. Consider introducing an alternative pathway for excellent students from other disciplines to transition into the graduate program.	3a. Complete implementation of Masters of Data Science Approval process still in progress. 3b. Work to reduce lags in offering times, and improve clarity of communications with prospective students We have worked both within CS and outside to improve this process.	Director of Graduate Studies	For recommendation 3a, Fall 2018. Other recommendations are ongoing

		3c. Improve financial packages to be competitive with peer institutions. Largely outside our control: other universities (particularly those in the US) consistently have deeper pockets than we do.		
4.	Increase the number of lecturers, as a means of reducing the number of sessionals. Ensure that lecturers and faculty in the professorial ranks strengthen their partnership in advancing and delivering the curriculum, are supported in adopting and assessing new practices pertaining to curriculum or pedagogy and extracurricular enrichment, and avail of professional development opportunities, e.g., through participation in SIGCSE.	4a. Establish realistic balance of lecturers and professorial faculty to accommodate current student numbers. 4b. Continue to recruit and develop high quality lecturers. We are specifically hiring only PhD holders as new lecturers, and many of them are choosing to have a research component, though mostly this is not in educational research.	Director of SCS Chair of Lecturer hiring committee	Ongoing
5.	Review the non-majors undergraduate program in CS in light of increasing enrollments in the School and changes in CS curriculum at peer institutions.	5. Develop Computing Option for non-majors in collaboration with external units	Director of Undergraduate Studies	Completed Fall 2015

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for monitoring the Implementation Plan.



Date of next program review: 2022-2023
Date

Signatures of Approval:

2018-08-22

Chair/Director

Date

2018-10-29

Faculty or Administrative Dean

Date

Stephen M. Watt

Yanis Crigler

August 28, 2018

Associate Vice-President, Academic
(For undergraduate and augmented programs)

Date

Jeffrey M. Coakle

August 29, 2018

Associate Provost, Graduate Studies
(For Graduate and augment programs)

Date