



Faculty of Science

Computer Science Undergraduate Program

Major Program Modification

November 2017

**Prepared by:
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Motion: That CPRC recommend to Academic Council the approval of the proposed modifications to the 3rd and 4th year Computer Science major requirements, including in the Data Science and Digital Media specializations.

Proposal Brief

1. SUMMARY OF PROPOSED CHANGE

The following proposal will affect the following programs:

- Bachelor of Science Computer Science (regular and co-operative education streams)
- Bachelor of Science Computer Science – Digital Media Specialization (regular and co-operative education streams)
- Bachelor of Science Computer Science – Data Science Specialization (regular and co-operative education streams)
- Bachelor of Science and Management – Computer Science (all specializations and streams)
- Computer Science Advanced Entry programs for Computer Engineering Technology diploma graduates, and Computer Programmer Analyst diploma graduates.

Presently, year 3 and 4 of the Computer Science program/specializations have 15-16 prescribed Computer Science courses (including Computer Science electives). We propose that the two upper years of the programs be modified to include the following breakdown of credit hours, of which Computer Science courses are selected from specified course groups. Years 1 and 2 of the program/specializations will remain the same. In general, these changes will reduce the number of prescribed core courses in favour of a model where students complete their program requirements via courses selected from amongst set subject areas.

	Major program	Data Science	Digital Media
Required courses [1]	6 credit hours	18 credit hours	18 credit hours
Area requirements [2]	15 credit hours	15 credit hours	15 credit hours
Senior CS electives [4a]	12 credit hours	0 credit hours	0 credit hours
Thesis/CS electives [3]	6 credit hours	6 credit hours	6 credit hours
Electives [4b]	21 credit hours	21 credit hours	21 credit hours
Total	60 credit hours	60 credit hours	60 credit hours

[1] Required courses

3rd and 4th year Computer Science students will be required to take the following courses:

- CSCI 3070U – Analysis and Design of Algorithms
- CSCI 4040U – Ethics, Law and the Social Impacts of Computing

Students in the Data Science Specialization must meet the above major program requirements, plus the following:

- CSCI 4030U – Big Data Analytics
- CSCI 4050U – Machine Learning, Theory and Application
- CSCI 4210U – Information Visualization
- One of:
 - CSCI 3010U – Simulation and Modelling
 - CSCI 4220U – Computer Vision
 - CSCI 4610U – Artificial Intelligence

Students in the Digital Media Specialization must meet the above major program requirements, plus the following:

- CSCI 3090U – Computer Graphics and Visualization
- CSCI 4110U – Advanced Graphics
- One of:
 - CSCI 4160U – Interactive Media
 - CSCI 4620U – Human Computer Interaction
- One of:
 - CSCI 3230U – Web Application Development
 - CSCI 4100U – Mobile Devices
 - CSCI 4210U – Information Visualization
 - CSCI 4220U – Computer Vision

[2] Area requirements

3rd and 4th year Computer Science courses have been divided into the following areas:

Area	Courses
Data	CSCI 3010U – Simulation and Modelling CSCI 3030U – Database Systems and Concepts CSCI 4030U – Big Data Analytics CSCI 4050U – Machine Learning, Theory and Application CSCI 4610U – Artificial Intelligence
Graphics	CSCI 3090U – Computer Graphics and Visualization CSCI 4110U – Advanced Computer Graphics CSCI 4210U – Information Visualization CSCI 4220U – Computer Vision
Media	CSCI 3230U – Web Application Development CSCI 3220U – Digital Media Production CSCI 4100U – Mobile Devices CSCI 4160U – Interactive Media CSCI 4620U – Human-Computer Interaction
Software	CSCI 3055U – Programming Languages CSCI 3060U – Software Quality Assurance

	CSCI 4020U – Compilers CSCI 4060U – Multicore and Many-core Programming
Systems	CSCI 3020U – Operating Systems CSCI 3050U – Computer Architecture II CSCI 3150U – Computer Networks CSCI 3310U – Systems Programming (new course) CSCI 4310U – Advanced Operating Systems Project (new course) CSCI 4640U – Distributed Computing CSCI 4630U – High Performance Computing

Each program/specialization will require that the student take a set number of courses from each of these subject areas.

Students in the Computer Science major program will be required to complete the following as part of their 3rd and 4th years:

	Data	Graphics	Media	Software	Systems
Minimal Credit Hours	3	3	3	3	3

[3] - Thesis/CS electives

- In their 4th year, students are expected to take the following courses:
 - CSCI 4410U Computer Science Thesis Project I
 - CSCI 4420U Computer Science Thesis Project II
 - Alternatively, students can take two senior Computer Science electives (6 credit hours)
- These requirements are unchanged from the existing programs

[4a] and [4b] – Computer Science Electives and general Elective requirements:

Computer Science Major (Comprehensive):

Students must complete a total of 45 credit hours such that the following elective requirements are satisfied:

- 27 credit hours must be in courses offered by the Faculty of Science, of which at least 12 credit hours must be in Senior Computer Science Electives, with no more than 15 credit hours being in Computer Science.
- 12 credit hours must be in courses from outside the Faculty of Science, among which at least 3 credit hours must be in business electives**, and at least 3 credit hours in communication electives***.
- 6 credit hours in general electives (offer by the Faculty of Science or outside the Faculty of Science)
 - Business Electives**
 - BUSI 1020U Business Communications
 - BUSI 1600U Management of the Enterprise.

- BUSI 1700U Introduction to Entrepreneurship.
- BUSI 2000U Collaborative Leadership.
- Communication Electives***
 - COMM 1100U Introduction to Communication
 - COMM 1050U Technical Communications
 - COMM 1310U Fundamentals of Professional Writing.
 - COMM 1320U Oral Communication and Public Speaking.
 - COMM 1610U Interpersonal Communication

Note: Students are required to complete at least 12 credit hours in Computer Science courses at the 4000-level

Data Science & Digital Media:

Students must complete a total of 30 credit hours such that the following elective requirements are satisfied:

- 18 credit hours must be in courses offered by the Faculty of Science, with no more than 6 credit hours being in Computer Science.
- 12 credit hours must be in courses from outside the Faculty of Science, among which at least 3 credit hours must be in business electives**, and at least 3 credit hours in communication electives***.
 - Business Electives**
 - BUSI 1020U Business Communications
 - BUSI 1600U Management of the Enterprise.
 - BUSI 1700U Introduction to Entrepreneurship.
 - BUSI 2000U Collaborative Leadership.
 - Communication Electives***
 - COMM 1100U Introduction to Communication
 - COMM 1050U Technical Communications
 - COMM 1310U Fundamentals of Professional Writing.
 - COMM 1320U Oral Communication and Public Speaking.
 - COMM 1610U Interpersonal Communication

Note: Students are required to complete at least 12 credit hours in Computer Science courses at the 4000-level

2. BACKGROUND

In the current program, students currently have very little (or no) choice with electives. Our specialization students end up taking almost identical courses to comprehensive students. Offering more choice allows our students to customize their program to their own interests and career goals. A previous Faculty of Science strategic plan (2012, section 1.3) outlined program map rigidity as an opportunity for improvement:

“Improve flexibility in course selection. Our programs maps are very restrictive. We are

proposing to offer greater flexibility in a number of programs to allow students greater flexibility in course selection and with a clear idea of their possible academic paths.”

The 2013 Computing Science program review highlighted the large scope of computing science, indicating that any program in that field must decide what to include:

“The modern computing science curriculum is extremely broad and diverse. It would be impossible to fully reflect the entire discipline in a single program. Thus, choices have to be made in each program about areas of focus and emphasis.”

As an example, our current 3rd year students have to take 9 required Computer Science courses (27 credit hours), even if they are taking one of the specializations.

With changes to the required courses, we give students additional flexibility to adapt their program to their interests and goals, while still preserving the required learning outcomes by requiring that courses be chosen from a list of courses that contain related learning objectives.

These changes bring our program in line other well-known Computer Science programs across Canada, which typically have fewer required courses (e.g. at the University of Toronto, students are only required to take 4 required courses) and a greater number of Computer Science electives. The changes will greatly improve the marketability of the Computer Science program. We believe that the new program preserves the learning outcomes beneficial to Computer Science graduates, and yet provides the degree of flexibility in Years 3 and 4 to meet students’ individual interests.

Our course offering, and thus teaching allocation, is extremely rigid. When faculty leaves occur, it can be difficult to accommodate this rigid course list, while maintaining the quality in other years. Adding flexibility could allow for teaching allocation for sessional instructors, making up for the faculty leaves, to be dedicated to courses where the effect of being taught by non-permanent faculty will have reduced impact.

With a rapidly growing program, it may be required to split courses into multiple sections, which would have an impact on our teaching allocation. The 2013 Computing Science program review mentioned the typical class sizes in the Computing Science program (since renamed Computer Science) being a significant advantage to the sort of students that the program attracts:

“The relatively small class size, with target enrolments of 60-70 students in each year, allows all faculty to be involved in first or second year teaching. This allows the students in the program to get to know the faculty and the faculty usually know each student, and their capabilities, by the time the students reach third year. This creates a student cohort that is comfortable interacting with faculty members and who are encouraged to seek advice and guidance in planning their programs.”

The existing Computer Science program includes a number of required courses presently offered by other Faculties. Dependence upon specific courses, taught and controlled outside of the Faculty of Science, could mean that those courses aren’t scheduled or designed in such a way that suits our students. These concerns are echoed in the 2013 Computing Science program review:

"A curricular concern that is potentially much more challenging is the ownership of the computing science curriculum at UOIT. Although not exclusively true anywhere, it is generally true that the computing science department provides the leadership in all areas of computing science. However, at UOIT, it became clear quickly that other units exclusively hold critical elements of computing science. Courses in areas such as software engineering, computer networks, artificial intelligence, and even operating systems are taught by other Faculties, many of which are not even cross-listed as computing science courses. It also appears that the Computing Science Department is not even eligible to teach some of the courses in these areas as there is no infrastructure (such as hardware labs and system support) available in the department to support them and the areas mentioned above are not even a part of a computing science course.

Students are allowed to take these courses from other Faculties (Engineering and Business) as a part of their program and there was no indication that access to them was problematic but the Computing Science Department has no control over their curriculum or even when they might be scheduled. It was quite a surprise to the reviewers that this was the case and having substantial experience with the way these courses are delivered by Engineering and Business faculties when they are offered by them elsewhere, it is extremely unlikely that the courses are being delivered in the way a computing science student would normally need to see the material for the CS discipline. This comment should not be viewed as pejorative to Business or Engineering, they will deliver them in an "application-oriented" way while a computing scientists needs to approach them as a field of study in and of themselves. Generally it is possible to move from them as a "field of study" to an understanding of how to apply them but going in the opposite direction is often a substantial challenge."

Combined with a review of upper-year pre-requisites, these changes should make it easier to accommodate both pathways students, off-map students, and co-op students. The choices available for courses in each area should require fewer pre-requisites for pathways students. Historically, pathways students need to take, or get credit transfer for, all of the required courses since the upper-year courses had 1st or 2nd year courses as pre-requisites. Even if this is still the case, having the choice between a few courses in the same area may allow a pathways student to choose a course where they hold the pre-requisites.

Students not following the program map, and co-op students, potentially gain flexibility of being able to take their area courses in whichever semester they study. With a required course that is only offered once per year, this doesn't always happen. Offering a choice allows students to take alternative courses when their schedule permits. These concerns were raised in the 2013 Computing Science program review:

"One concern raised by the students was the challenges associated with participating in the co-op program. Students have to take courses in a very prescribed sequence and most of the courses are only offered once per year. This severely restricts the scheduling of work terms that are required in a co-op program."

Process of consultation with other units if the change(s) involves students, staff, and/or faculty from other programs or courses

The number of courses required from other faculties, or from other units within the Faculty of Science, has remained unchanged. The specific courses required, such as those within business and communications, also remain unchanged.

3. DEGREE REQUIREMENTS

a) Program learning outcomes

1. A good understanding of the basic principles of computer science including algorithms, data structures, computability, computer architecture and software development.
2. The ability to apply this understanding of the basic principles to solving problems in computer science.
3. A good command of at least one major programming language and fluency in several others.
4. The ability to critically evaluate existing systems and the design of new systems. Apply appropriate evaluation techniques to determine the effectiveness of these systems and their weaknesses.
5. A broad understanding of the world in general along with other scientific disciplines and business practices.
6. Communicate effectively in written, spoken and visual format with both technical experts and members of the general public on a range of issues, including those related to the discipline of computer science.
7. Examine the social, cultural, ethical, environmental, safety and economic consequences of developments in computer science, in local, national and global contexts.
8. Contribute as effective participant in multi-disciplinary and multi-cultural teams, in both membership and leadership roles.
9. Recognize and value the alternative outlooks that people from various social, ethnic and religious backgrounds may bring to endeavours in computer science and its fields of application.

b) Admission Requirements

Requirements for admission into these programs will remain unchanged.

c) Program Structure

Computer Science – Comprehensive:

Program Map:

Year 1

Semester 1 (15 credit hours)

- Elective*
- CSCI 1030U – Introduction to Computer Science
- CSCI 1060U – Programming Workshop I

One of:

- MATH 1000U – Introductory Calculus+ OR
- MATH 1010U – Calculus I+

One of:

- PHY 1010U – Physics I+ OR
- PHY 1030U – Introductory Physics+

+ All student who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.

Semester 2 (15 credit hours)

- Elective*
- CSCI 1061U – Programming Workshop II
- CSCI 2050U – Computer Architecture I
- MATH 1020U – Calculus II
- PHY 1020U – Physics II

Year 2:

Semester 1 (15 credit hours)

- Elective*
- CSCI 2000U – Scientific Data Analysis
- CSCI 2010U – Data Structures
- CSCI 2110U – Discrete Mathematics for Computer Scientists
- STAT 2010U – Statistics and Probability for Physical Science

Semester 2 (15 credit hours)

- Elective*
- CSCI 2020U – Software Systems and Development and Integration
- CSCI 2040U – Software Design and Analysis
- CSCI 2072U – Computational Science I
- MATH 2050U – Linear Algebra

Years 3 & 4 (60 credit hours):

- Seven Electives*
- CSCI 3070U – Analysis and Design of Algorithms
- CSCI 4040U – Ethics, Law and the Social Impacts of Computing
- Four Senior Computer Science Electives*

One of:

- CSCI 3010U – Simulation and Modelling
- CSCI 3030U – Database Systems and Concepts
- CSCI 4030U – Big Data Analytics
- CSCI 4050U – Machine Learning, Theory and Application
- CSCI 4610U – Artificial Intelligence

One of:

- CSCI 3090U – Computer Graphics and Visualization

- CSCI 4110U – Advanced Computer Graphics
- CSCI 4210U – Information Visualization
- CSCI 4220U – Computer Vision

One of:

- CSCI 3220U – Digital Media Production
- CSCI 3230U – Web Application Development
- CSCI 4100U – Mobile Devices
- CSCI 4160U – Interactive Media
- CSCI 4620U – Human-Computer Interaction

One of:

- CSCI 3055U – Programming Languages
- CSCI 3060U – Software Quality Assurance
- CSCI 4020U – Compilers
- CSCI 4060U – Multicore and Many-core Programming

One of:

- CSCI 3020U – Operating Systems
- CSCI 3050U – Computer Architecture II
- CSCI 3150U – Computer Networks
- CSCI 3310U – Systems Programming (new course)
- CSCI 4310U – Advanced Operating Systems Project (new course)
- CSCI 4630U – High Performance Computing
- CSCI 4640U – Distributed Computing

One of:

- CSCI 4410U – Computer Science Thesis I** OR
- Senior Computer Science Elective**

One of:

- CSCI 4420U – Computer Science Thesis II** OR
- Senior Computer Science Elective**

Note: No more than 42 credit hours may be taken at the first-year level. **Students are required to complete at least 12 credit hours in Computer Science courses at the 4000-level.**

***Elective and breadth requirements:**

Students must complete a total of 45 credit hours such that the following elective requirements are satisfied:

- 27 credit hours must be in courses offered by the Faculty of Science, of which at least 12 credit hours must be in Senior Computer Science Electives, with no more than 15 credit hours being in Computer Science.
- 12 credit hours must be in courses from outside the Faculty of Science, among which at least 3 credit hours must be in business electives++, and at least 3 credit hours in communication electives+++.
- 6 credit hours in general electives (offer by the Faculty of Science or outside the Faculty of Science)
 - Business Electives++

- BUSI 1020U Business Communications
- BUSI 1600U Management of the Enterprise.
- BUSI 1700U Introduction to Entrepreneurship.
- BUSI 2000U Collaborative Leadership.
- Communication Electives+++
 - COMM 1100U Introduction to Communication Studies
 - COMM 1050U Technical Communications
 - COMM 2311U Writing and Publishing in the Digital Age
 - COMM 1320U Public Speaking
 - COMM 2620U Interpersonal Communication

****Thesis Project or Senior Computer Science electives**

Students in clear academic standing who have completed 90 credit hours of their program and six third-year required courses may optionally apply to take a two-course sequence consisting of CSCI 4410U – Computer Science Thesis Project I and CSCI 4420U – Computer Science Thesis Project II. Students not accepted to take the thesis courses must complete two additional Senior Computer Science electives instead. **A Senior Computer Science Elective is defined as a 3000- or 4000- level Computer Science courses.** A student meeting the above requirements who does not take CSCI 4410U and CSCI 4420U may optionally apply to take CSCI 4430U – Directed Studies in Computer Science as one the required computer science electives. Opportunities for the Thesis Project and Directed Studies courses are limited; students must apply through Science Advising by March 30 following completion of the first three years of the program.

Computer Science – Data Science:

Program Map:

Year 1

Semester 1 (15 credit hours)

- Elective*
- CSCI 1030U – Introduction to Computer Science
- CSCI 1060U – Programming Workshop I

One of:

- MATH 1000U – Introductory Calculus+ OR
- MATH 1010U – Calculus I+

One of:

- PHY 1010U – Physics I+ OR
- PHY 1030U – Introductory Physics+

+ All student who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.

Semester 2 (15 credit hours)

- Elective*
- CSCI 1061U – Programming Workshop II
- CSCI 2050U – Computer Architecture I
- MATH 1020U – Calculus II
- PHY 1020U – Physics II

Year 2:**Semester 1 (15 credit hours)**

- Elective*
- CSCI 2000U – Scientific Data Analysis
- CSCI 2010U – Data Structures
- CSCI 2110U – Discrete Mathematics for Computer Scientists
- STAT 2010U – Statistics and Probability for Physical Science

Semester 2 (15 credit hours)

- CSCI 2020U – Software Systems and Development and Integration
- CSCI 2040U – Software Design and Analysis
- CSCI 2072U – Computational Science I
- CSCI 2160U – Digital Media
- MATH 2050U – Linear Algebra

Years 3 & 4 (60 credit hours):

- Seven Electives*
- CSCI 3070U – Analysis and Design of Algorithms
- CSCI 4040U – Ethics, Law and the Social Impacts of Computing
- CSCI 4030U – Big Data Analytics
- CSCI 4050U – Machine Learning, Theory and Application
- CSCI 4210U – Information Visualization

One of:

- CSCI 3010U – Simulation and Modelling
- CSCI 4220U – Computer Vision
- CSCI 4610U – Artificial Intelligence

One of:

- CSCI 3010U – Simulation and Modelling
- CSCI 3030U – Database Systems and Concepts
- CSCI 4610U – Artificial Intelligence

One of:

- CSCI 3090U – Computer Graphics and Visualization
- CSCI 4110U – Advanced Computer Graphics
- CSCI 4220U – Computer Vision

One of:

- CSCI 3220U – Digital Media Production
- CSCI 3230U – Web Application Development
- CSCI 4100U – Mobile Devices
- CSCI 4160U – Interactive Media

- CSCI 4620U – Human-Computer Interaction

One of:

- CSCI 3055U – Programming Languages
- CSCI 3060U – Software Quality Assurance
- CSCI 4020U – Compilers
- CSCI 4060U – Multicore and Many-core Programming

One of:

- CSCI 3020U – Operating Systems
- CSCI 3050U – Computer Architecture II
- CSCI 3150U – Computer Networks
- CSCI 3310U – Systems Programming (new course)
- CSCI 4310U – Advanced Operating Systems Project (new course)
- CSCI 4630U – High Performance Computing
- CSCI 4640U – Distributed Computing

One of:

- CSCI 4410U – Computer Science Thesis I** OR
- Senior Computer Science Elective

One of:

- CSCI 4420U – Computer Science Thesis II** OR
- Senior Computer Science Elective

Note: No more than 42 credit hours may be taken at the first-year level. **Students are required to complete at least 12 credit hours in Computer Science courses at the 4000-level.**

***Elective and breadth requirements:**

Students must complete a total of 30 credit hours such that the following elective requirements are satisfied:

- 18 credit hours must be in courses offered by the Faculty of Science, with no more than 6 credit hours being in Computer Science.
- 12 credit hours must be in courses from outside the Faculty of Science, among which at least 3 credit hours must be in business electives++, and at least 3 credit hours in communication electives+++.

- Business Electives++
 - BUSI 1020U Business Communications
 - BUSI 1600U Management of the Enterprise.
 - BUSI 1700U Introduction to Entrepreneurship.
 - BUSI 2000U Collaborative Leadership.
- Communication Electives+++
 - COMM 1100U Introduction to Communication Studies
 - COMM 1050U Technical Communications
 - COMM 2311U Writing and Publishing in the Digital Age
 - COMM 1320U Public Speaking

- COMM 2620U Interpersonal Communication

****Thesis Project or Senior Computer Science electives**

Students in clear academic standing who have completed 90 credit hours of their program and six third-year required courses may optionally apply to take a two-course sequence consisting of CSCI 4410U – Computer Science Thesis Project I and CSCI 4420U – Computer Science Thesis Project II. Students not accepted to take the thesis courses must complete two additional Senior Computer Science electives instead. **A Senior Computer Science Elective is defined as a 3000- or 4000- level Computer Science courses.** A student meeting the above requirements who does not take CSCI 4410U and CSCI 4420U may optionally apply to take CSCI 4430U – Directed Studies in Computer Science as one the required computer science electives. Opportunities for the Thesis Project and Directed Studies courses are limited; students must apply through Science Advising by March 30 following completion of the first three years of the program.

Computer Science – Digital Media:

Program Map:

Year 1

Semester 1 (15 credit hours)

- Elective*
- CSCI 1030U – Introduction to Computer Science
- CSCI 1060U – Programming Workshop I

One of:

- MATH 1000U – Introductory Calculus+ OR
- MATH 1010U – Calculus I+

One of:

- PHY 1010U – Physics I+ OR
- PHY 1030U – Introductory Physics+

+ All student who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.

Semester 2 (15 credit hours)

- Elective*
- CSCI 1061U – Programming Workshop II
- CSCI 2050U – Computer Architecture I
- MATH 1020U – Calculus II
- PHY 1020U – Physics II

Year 2:

Semester 1 (15 credit hours)

- Elective*

- CSCI 2000U – Scientific Data Analysis
- CSCI 2010U – Data Structures
- CSCI 2110U – Discrete Mathematics for Computer Scientists
- STAT 2010U – Statistics and Probability for Physical Science

Semester 2 (15 credit hours)

- CSCI 2020U – Software Systems and Development and Integration
- CSCI 2040U – Software Design and Analysis
- CSCI 2072U – Computational Science I
- CSCI 2160U – Digital Media
- MATH 2050U – Linear Algebra

Years 3 & 4 (60 credit hours):

- Eight Electives*
- CSCI 3070U – Analysis and Design of Algorithms
- CSCI 3090U – Computer Graphics and Visualization
- CSCI 4040U – Ethics, Law and the Social Impacts of Computing
- CSCI 4110U – Advanced Graphics
- One of:
 - CSCI 4160U – Interactive Media
 - CSCI 4620U – Human Computer Interaction
- One of:
 - CSCI 3230U – Web Application Development
 - CSCI 4100U – Mobile Devices
 - CSCI 4210U – Information Visualization
 - CSCI 4220U – Computer Vision

One of:

- CSCI 3010U – Simulation and Modelling
- CSCI 3030U – Database Systems and Concepts
- CSCI 4030U – Big Data Analytics
- CSCI 4050U – Machine Learning, Theory and Application
- CSCI 4610U – Artificial Intelligence

One of:

- CSCI 4210U – Information Visualization
- CSCI 4220U – Computer Vision

One of:

- CSCI 3220U – Digital Media Production
- CSCI 3230U – Web Application Development
- CSCI 4100U – Mobile Devices
- CSCI 4160U – Interactive Media
- CSCI 4620U – Human-Computer Interaction

One of:

- CSCI 3055U – Programming Languages
- CSCI 3060U – Software Quality Assurance
- CSCI 4020U – Compilers
- CSCI 4060U – Multicore and Many-core Programming

One of:

- CSCI 3020U – Operating Systems
- CSCI 3050U – Computer Architecture II
- CSCI 3150U – Computer Networks
- CSCI 3310U – Systems Programming (new course)
- CSCI 4310U – Advanced Operating Systems Project (new course)
- CSCI 4630U – High Performance Computing
- CSCI 4640U – Distributed Computing

One of:

- CSCI 4410U – Computer Science Thesis I** OR
- Senior Computer Science Elective

One of:

- CSCI 4420U – Computer Science Thesis II** OR
- Senior Computer Science Elective

Note: No more than 42 credit hours may be taken at the first-year level. Students are required to complete at least 12 credit hours in Computer Science courses at the 4000-level.

***Elective and breadth requirements:**

Students must complete a total of 30 credit hours such that the following elective requirements are satisfied:

- 18 credit hours must be in courses offered by the Faculty of Science, with no more than 6 credit hours being in Computer Science.
- 12 credit hours must be in courses from outside the Faculty of Science, among which at least 3 credit hours must be in business electives++, and at least 3 credit hours in communication electives+++.

Business Electives++

- BUSI 1020U Business Communications
- BUSI 1600U Management of the Enterprise.
- BUSI 1700U Introduction to Entrepreneurship.
- BUSI 2000U Collaborative Leadership.

Communication Electives+++

- COMM 1100U Introduction to Communication Studies
- COMM 1050U Technical Communications
- COMM 2311U Writing and Publishing in the Digital Age
- COMM 1320U Public Speaking
- COMM 2620U Interpersonal Communication

****Thesis Project or Senior Computer Science electives**

Students in clear academic standing who have completed 90 credit hours of their program and six third-year required courses may optionally apply to take a two-course sequence consisting

of CSCI 4410U – Computer Science Thesis Project I and CSCI 4420U – Computer Science Thesis Project II. Students not accepted to take the thesis courses must complete two additional Senior Computer Science electives instead. **A Senior Computer Science Elective is defined as a 3000- or 4000- level Computer Science courses.** A student meeting the above requirements who does not take CSCI 4410U and CSCI 4420U may optionally apply to take CSCI 4430U – Directed Studies in Computer Science as one the required computer science electives. Opportunities for the Thesis Project and Directed Studies courses are limited; students must apply through Science Advising by March 30 following completion of the first three years of the program.

d) Program Content

Attached documents:

CSCI 4410U_Course Change_Nov 2017.docx

CSCI 3310U_New Course_Nov 2017.docx

CSCI 4310U_New Course_Nov 2017.docx

4. RESOURCE REQUIREMENT

a) Faculty members

Faculty teaching within the Computer Science program:

- **Jeremy Bradbury** (Associate Professor) – Software engineering, systems
- **Christopher Collins** (Associate Professor and Canada Research Chair in Linguistic Information Visualization) – Human computer interaction, information visualization
- **Mark Green** (Professor and Associate Dean) – Computer graphics, interactive media
- **Randy Fortier** (Senior Lecturer) – Programming, algorithms, data structure
- **Ken Pu** (Associate Professor) – Databases, machine learning, compilers
- **Faisal Qureshi** (Associate Professor) – Computer vision, simulation and modeling
- **Jaroslav Szlichta** (Assistant Professor) – Data science, databases, data analytics

b) Additional academic and non-academic human resources

Due to the less predictable nature of the proposed program, academic advising may be required to handle more questions from students planning their schedules. Furthermore, it may be required to plan teaching allocations/course offerings further in advance to ensure that students will always have adequate courses to meet their program requirements.

c) Physical resource requirements

The existing growth in enrollment in the Computer Science program has identified a need for additional undergraduate teaching lab space as the current cohorts move through the

program. The program changes proposed in this document take these needed resources in to account, and do not add additional resource requirements.

5. BUSINESS PLAN

a) Statement of funding requirements

These program changes were designed to be cost neutral, since the number of courses offered each year within Computer Science should remain unchanged. Furthermore, we expect enrolment to be unaffected, since the changes are limited to the 3rd and 4th years.

b) Statements of resource availability

The current program's space requirements are somewhat strained. However, as the new program does not add any additional courses being taught from year to year, the space requirements remaining unchanged outside from the additional undergraduate lab resources that have already been identified.

The current program's personnel requirements are somewhat strained. As with space, since the number of courses being taught is not expected to change with the new program, the personnel requirements should remain unchanged

6. TIMELINE OF IMPLEMENTATION & TRANSITION PLAN (Include semester of implementation)

Proposed Implementation Date (state term, e.g. Fall 2017)

Fall 2018

Transition Plan (include a plan for all current students in the program, by year level)

Students beginning in Fall 2018 and later will follow the new program. Any students who started prior to Fall 2018 will follow the existing program.

It may be possible for existing students to switch to the new program, subject to the availability of courses, we intend to schedule courses in accordance with the expected program of the students taking each course. This means that until the Fall 2018 students make their way into 3rd and 4th year, the courses being scheduled will need to accommodate the existing program.

APPROVAL DATES

Curriculum Committee Approval	November 15, 2017
Faculty Council Approval	December 6, 2017
CPRC or GSC Approval	19 January 2018

Academic Council Approval	
Report to Board of Governors	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Science			
Full Course Title: Systems Programming			
Short Form Course Title (max 30 characters): Systems Programming			
Subject Code and Course number: CSCI 3310U	Cross-listings:	<input checked="" type="checkbox"/> Core <input checked="" type="checkbox"/> Elective	Credit weight: 3 cr. hrs
Contact hours (please indicate number of total hours for each component): <input checked="" type="checkbox"/> Lecture __3hrs__ <input checked="" type="checkbox"/> Lab __1.5hrs__ <input type="checkbox"/> Tutorial ____ <input type="checkbox"/> Other ____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and place the Calendar copy for each here (e.g. in a list of electives tied to a specific program).]

Computer Science – all undergraduate streams (included in the major program modifications package)
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CALENDAR DESCRIPTION

CSCI 3310U Systems Programming This course is an introduction to the basic concepts of operating systems and networking along with how to effectively use them in application development. Topics include resource management, concurrency, processes, memory management, file systems, network architectures and network based applications. 3cr. 3lec. 1.5lab
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Prerequisites	CSCI 2020U, CSCI 2050U
Co-requisites	
Credit restrictions	CSCI 3020U, CSCI 3150U
Equivalency courses	
Grading scheme	<input checked="" type="checkbox"/> letter grade <input type="checkbox"/> pass/fail

LEARNING OUTCOMES (this section is required)

<ul style="list-style-type: none"> • An appreciation of resource sharing in modern operating systems include processes, memory and file systems • A basic understanding of concurrency and the techniques used to manage it. • The ability to write applications that directly interact with the underlying operating system • An understanding of network architectures and the different components of a computer network • Programming models for network programming, such as sockets and RPC • The ability to implement network based applications

COURSE INSTRUCTIONAL METHOD

- (check all that may apply) CLS (in-class) HYB (in-class and online)
 IND (individual studies) OFF (off-site)
 WB1 (synchronous online delivery)
 WEB (asynchronous online delivery)

TEACHING AND ASSESSMENT METHODS

Conceptual material will be presented in lecture format along with an introduction to implementation techniques. The laboratory will be used to further develop the implementation techniques and develop practical skills.

Assessment will take the form of assignments, laboratory exercises a mid-term examination and a final examination.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

This course could replace the need for CSCI 3020U and CSCI 3150U. Both CSCI 3020U and CSCI 3150U are currently taught by FEAS and crosslisted with SOFE courses, as part of a course offering/teaching arrangement between Computer Science and Software Engineering. As such, offering CSCI 3310U would require an additional course assignment from Science, and well as additional TA resources.

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2018

APPROVAL DATES

Curriculum Committee approval	<i>November 15, 2017</i>
Faculty Council approval	<i>December 6, 2017</i>
Submission to CPRC/GSC	19 January 2018

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Science			
Full Course Title: Advanced Operating Systems Project			
Short Form Course Title (max 30 characters): Adv. Operating Systems Project			
Subject Code and Course number: CSCI 4310U	Cross-listings:	<input type="checkbox"/> Core <input checked="" type="checkbox"/> Elective	Credit weight: 3 cr. hrs
Contact hours (please indicate number of total hours for each component): <input checked="" type="checkbox"/> Lecture __1.5hrs__ <input checked="" type="checkbox"/> Lab __3hrs__ <input type="checkbox"/> Tutorial ____ <input type="checkbox"/> Other ____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and place the Calendar copy for each here (e.g. in a list of electives tied to a specific program).]

Elective course for all undergraduate Computer Science streams (included in the major program modification package)

CALENDAR DESCRIPTION

CSCI 4310U Operating Systems Project This course is a detailed examination of the implementation of a particular operating system. Students are expected to become familiar with the source code for the operating system and be able to add or modify functionality. Topics covered could include device drivers, system calls, inter process communications and network implementation. 3cr. 1.5lec. 3lab.

Prerequisites	CSCI 3020U or CSCI 3310U
Co-requisites	
Credit restrictions	
Equivalency courses	
Grading scheme	<input checked="" type="checkbox"/> letter grade <input type="checkbox"/> pass/fail

LEARNING OUTCOMES (this section is required)

<ul style="list-style-type: none"> • Develop a detailed understanding of operation system concepts and implementation techniques. • Understand how to achieve optimal performance from an operating system. • Show competence in the development of device drivers and operating system components • Understand the issues involved in operating systems development and deployment

COURSE INSTRUCTIONAL METHOD

(check all that <u>may</u> apply) <input checked="" type="checkbox"/> CLS (in-class) <input type="checkbox"/> HYB (in-class and online)
<input type="checkbox"/> IND (individual studies) <input type="checkbox"/> OFF (off-site)

- WB1 (synchronous online delivery)**
- WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

Most of the learning in this course will take place in the laboratory with the lectures used to provide background material and guidance for the laboratory exercises.

Course assessment is based on assignments, laboratory exercises and a final project.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

This course would be added to the elective options for the Computer Science program (Systems grouping), and as such may not be offered every year depending upon student demand. Its offering would fall into the normal complement of Computer Science electives provided annually.

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2018

APPROVAL DATES

Curriculum Committee approval	<i>November 15, 2017</i>
Faculty Council approval	<i>December 6, 2017</i>
Submission to CPRC/GSC	19 January 2018

COURSE CHANGE TEMPLATE

For new courses see New Course Template

Faculty: Science	
Program: Computer Science	
Subject Code and Course Number: CSCI 4410U	Current Full Course Title: Computer Science Thesis Project I
<input checked="" type="checkbox"/> Core <input type="checkbox"/> Elective	Current Short-Form Course Title (max. 30 characters): Computer Science Thesis Proj I

COURSE CHANGES (check all that apply)

<input type="checkbox"/>	Course title	<input type="checkbox"/>	Credit weighting
<input type="checkbox"/>	Course description	<input type="checkbox"/>	Contact hours
<input type="checkbox"/>	Course number	<input checked="" type="checkbox"/>	Prerequisites
<input type="checkbox"/>	Subject code	<input type="checkbox"/>	Co-requisites
<input type="checkbox"/>	Grade Mode (N – alpha grade, P – Pass/Fail)	<input type="checkbox"/>	Cross-listings
<input type="checkbox"/>	Learning outcomes	<input type="checkbox"/>	Credit restrictions
<input type="checkbox"/>	Course Instructional Method (CLS, HYB, WB1, WEB)	<input type="checkbox"/>	Equivalency Courses
<input type="checkbox"/>	Delete course from Academic Calendar	<input type="checkbox"/>	Delete course from Program only (attach this form to program modification)
<input type="checkbox"/>	Supplementary Fees	<input type="checkbox"/>	Teaching and assessment methods
<input type="checkbox"/>	Other (please specify)	<input type="checkbox"/>	Term Change

DESCRIPTION AND/OR REASON FOR CHANGE AND WAYS IN WHICH IT MAINTAINS/ENHANCES COURSE/PROGRAM OBJECTIVES

<p>Proposed program changes would mean that a student’s standing in the fourth year of their program is not as clearly defined. The pre-requisites have thus been re-worded to ensure that the student has completed 3 years of their program in order to qualify to take the thesis course.</p>
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CHANGE TO CALENDAR DESCRIPTION (if required)

Current	Proposed
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<p>CSCI 4410U – Computer Science Thesis Project I</p> <p>The thesis project provides students with the opportunity, under the supervision of a faculty member, to integrate and synthesize knowledge gained throughout their program of study and to satisfy specific objectives and requirements. The project may comprise an individual or group design project or an individual research project that has been approved by the supervising faculty member. Once all work has been completed, each student must submit a thesis and make a presentation based on their project in the following semester.</p> <p>Credit hours: 3 Other hours: 9 Prerequisite(s): Clear standing in fourth year of the Computer Science program. Student must also obtain prior consent of a faculty member. Note(s): Students are expected to take CSCI 4420U in the following semester.</p>	<p>CSCI 4410U – Computer Science Thesis Project I</p> <p>The thesis project provides students with the opportunity, under the supervision of a faculty member, to integrate and synthesize knowledge gained throughout their program of study and to satisfy specific objectives and requirements. The project may comprise an individual or group design project or an individual research project that has been approved by the supervising faculty member. Once all work has been completed, each student must submit a thesis and make a presentation based on their project in the following semester.</p> <p>Credit hours: 3 Other hours: 9 Prerequisite(s): Completed 90 credit hours of their program and six third-year courses. Student must also obtain prior consent of a faculty member. Note(s): Students are expected to take CSCI 4420U in the following semester.</p>
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CHANGE TO CONTACT HOURS (if applicable):

Lecture	Lab
Tutorial	Other

OTHER CHANGES (if applicable)

Prerequisites	Completed 90 credit hours of their program and six third-year courses. Student must also obtain prior consent of a faculty member
Co-requisites	
Credit restrictions	
Credit exemptions	
Grading scheme	<input type="checkbox"/> letter grade <input type="checkbox"/> pass/fail

CHANGES TO LEARNING OUTCOMES (if applicable)

N/A

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

No consultation required.

EFFECTIVE SEMESTER (Specify Term e.g. Fall 2017)

Fall 2018

APPROVAL DATES

Faculty Curriculum Committee approval	November 15, 2017
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Faculty Council approval	December 6, 2017
Reported to CPRC	19 January 2018