

## FOR APPROVAL

## PUBLIC

## OPEN SESSION

**TO:** UTSC Academic Affairs Committee

**SPONSOR:** Prof. Karin Ruhlandt, Vice-Principal Academic and Dean  
**CONTACT INFO:** [vpdean.utsc@utoronto.ca](mailto:vpdean.utsc@utoronto.ca)

**PRESENTER:** Prof. Katie Larson, Vice-Dean Teaching, Learning & Undergraduate Programs  
**CONTACT INFO:** [vdundergrad.utsc@utoronto.ca](mailto:vdundergrad.utsc@utoronto.ca)

**DATE:** April 22, 2026 for April 29, 2026

**AGENDA ITEM:** 8

### ITEM IDENTIFICATION:

Major Modification: New Stream in Artificial Intelligence and Machine Learning within the Specialist and Specialist (Co-op) in Computer Science (Undergraduate), Department of Computer and Mathematical Sciences, UTSC (for approval)

### JURISDICTIONAL INFORMATION:

The UTSC Academic Affairs Committee (AAC) “is concerned with matters affecting the teaching, learning, and research functions of the campus (AAC *Terms of Reference*, Section 4).” Under Section 5.6 of its *Terms of Reference*, the AAC is responsible for the approval of “major and minor modifications to existing degree programs.”

The AAC has responsibility for the approval of major and minor modifications to existing programs as defined by the [University of Toronto Quality Assurance Process](#) (UTQAP, Sections 3.1 and 3.3).

### GOVERNANCE PATH:

1. UTSC Academic Affairs Committee [For Approval] (April 29, 2026)

### PREVIOUS ACTION TAKEN:

No previous action in governance has been taken on this item.

### HIGHLIGHTS:

The Department of Computer and Mathematical Sciences at UTSC is proposing a new stream in Artificial Intelligence and Machine Learning within the Specialist and Specialist (Co-op) programs in Computer

Science. The proposed stream forms part of a coordinated cluster of AI-related initiatives at UTSC, including the Minor in Artificial Intelligence, Mind and Society (Philosophy) and the Minor in Social Data Science (Sociology).

The Specialist and Specialist (Co-op) in Computer Science currently offer four streams: Comprehensive, Software Engineering, Information Systems, and Entrepreneurship. The proposed Artificial Intelligence and Machine Learning stream would become the fifth stream, responding to growing demand for expertise in these areas and providing students with the knowledge and practical experience to design and implement AI-based systems.

The proposed stream combines a strong foundation in mathematics, statistics, and computer science with specialized study in machine learning, artificial intelligence, deep learning, and data science. In addition to its stream-specific requirements in areas such as Machine Learning and Data Mining, Numerical Algorithms, and Computability and Computational Complexity, students will complete a Technology, Society, and Ethics requirement, with a choice between two designated courses focused on the social impact and ethical dimensions of artificial intelligence.

The new stream will expand program options for students and help alleviate sustained enrolment pressure in the Software Engineering stream, which has been over capacity for several years. The Department anticipates that a portion of students currently enrolled in Software Engineering will opt for the new stream, consistent with strong student interest in AI and machine learning-focused study.

The proposal has benefited from extensive consultation with faculty, students, cognate units including the Departments of Philosophy and Sociology, and the Office of the Registrar within UTSC, as well as engagement with partners across the tri-campus, including the Faculty of Arts & Science, the University of Toronto Mississauga, the Faculty of Applied Science and Engineering, and the Faculty of Information.

Overall, the proposed stream represents a timely enhancement to UTSC's undergraduate Computer Science offerings, expanding opportunities for specialization in AI and machine learning while supporting enrolment management and student demand. The stream is proposed to take effect on September 1, 2026.

## **FINANCIAL IMPLICATIONS:**

There are no significant financial implications to the campus operating budget.

## **RECOMMENDATION:**

Be It Resolved,

THAT a new stream in Artificial Intelligence and Machine Learning within the Specialist and Specialist (Co-op) programs in Computer Science (Undergraduate), in the Department of Computer and Mathematical Sciences, UTSC, as described in the attached proposal, be approved effective September 1, 2026.

**DOCUMENTATION PROVIDED:**

1. Proposal - Major Modification to introduce a new stream in Artificial Intelligence and Machine Learning within the Specialist and Specialist (Co-op) in Computer Science (Undergraduate), Department of Computer and Mathematical Sciences (April 7, 2026)



## University of Toronto

### Major Modification Proposal:

### Add Program Structure (Freestanding Minor, Specialist or Major Where One Exists, Stream, Field or Concentration)

|                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Program being modified:</b><br>Please specify what program and the components being created; e.g., New stream in the Specialist in History called.... | Specialist in Computer Science<br>Specialist (Co-op) in Computer Science                                                                                                                                                                                                                                                              |
| <b>Program of Study Code(s):</b><br><br>Indicate if new POST is needed                                                                                   | New POSTs are needed                                                                                                                                                                                                                                                                                                                  |
| <b>Proposed major modification:</b>                                                                                                                      | Creation of a new stream called Artificial Intelligence and Machine Learning (AI & ML) within both programs                                                                                                                                                                                                                           |
| <b>Department/unit (if applicable):</b>                                                                                                                  | Department of Computer and Mathematical Sciences                                                                                                                                                                                                                                                                                      |
| <b>Faculty/division:</b>                                                                                                                                 | University of Toronto Scarborough (UTSC)                                                                                                                                                                                                                                                                                              |
| <b>Dean's office contact:</b>                                                                                                                            | Professor Maggie Cummings, Special Advisor on Academic Programming & Curriculum Development<br>( <a href="mailto:saprogramming.utsc@utoronto.ca">saprogramming.utsc@utoronto.ca</a> )<br><br>Kevin Mak, Manager, Academic Program Reviews & Quality Assurance<br>( <a href="mailto:kevin.mak@utoronto.ca">kevin.mak@utoronto.ca</a> ) |
| <b>Proponent:</b>                                                                                                                                        | Professor Mike Molloy, Interim Department Chair                                                                                                                                                                                                                                                                                       |

|                                                                  |                                                                        |
|------------------------------------------------------------------|------------------------------------------------------------------------|
|                                                                  | <a href="mailto:mike.molloy@utoronto.ca">(mike.molloy@utoronto.ca)</a> |
| <b>Version date:</b><br>Please update as you edit this proposal. | April 7, 2026                                                          |

## Framework for UTQAP Major Modifications

The [University of Toronto Quality Assurance Process](#) (UTQAP) supports a structured approach for creating, reflecting on, assessing, and developing plans to change and improve academic programs and units in the context of institutional and divisional commitments and priorities.

The University of Toronto (U of T), in its [Statement of Institutional Purpose](#) (1992), articulates its mission as a commitment "to being an internationally significant research university, with undergraduate, graduate, and professional programs of excellent quality." Thus "quality assurance through assessment of new program proposals and review of academic programs and units in which they reside is a priority for the University...."

The quality of the scholarship of the faculty, and the degree to which that scholarship is brought to bear in teaching are the foundations of academic excellence. More generally, all of the factors that contribute to collegial and scholarly life — academic and administrative complement, research and scholarly activity, infrastructure, governance, etc. — bear on the quality of academic programs and the broad educational experience of students. ([Policy for Approval and Review of Academic Programs and Units](#) (2010))

The University's approach to quality assurance is built on two primary indicators of academic excellence: the quality of the scholarship and research of faculty; and the success with which that scholarship and research is brought to bear on the achievement of Degree Level Expectations. These indicators are assessed by determining how our scholarship, research and programs compare to those of our international peer institutions and how well our programs meet their Degree Level Expectations.

The University of Toronto embraces academic change as a critical part of maintaining and enhancing programs of outstanding quality through a process of continuous improvement.

## Major Modification Proposal

A major modification to an existing program is a restructuring of a program, a merger of or the creation of new elements within existing programs, or a renewal of a program in order to keep it current with its academic discipline or improve student academic experience.

This template should be used to bring forward proposals for major modifications for:

- Creation of a new program of specialization where another with the same designation already exists (e.g., a new specialist program where a major with the same designation already exists).
- Addition of a new major or specialist that does not differ substantially in program requirements or learning outcomes from an existing program.
- Merger of two or more existing programs.
- Creation of a minor where there is no existing program of specialization (i.e., a “freestanding minor”).
- Creation of a field or concentration within an existing graduate program.
- Creation of a stream within an existing undergraduate program.

This template aligns with UTQAP requirements and will help to ensure that all evaluation criteria established by the Quality Council are addressed in bringing forward a proposal. Divisions may have additional requirements that should be integrated into the proposal. Examples of major modifications are provided in [UTQAP 3.1](#). See the [VPAP website](#) for more information on major modifications.

| Development and Approval Steps    | Date (e.g., of final sign off, governance meeting, inclusion in reports) |
|-----------------------------------|--------------------------------------------------------------------------|
| Dean’s office sign-off            | [date]                                                                   |
| VPAP sign-off                     | April 6, 2026                                                            |
| Unit-level approval (if required) | June 2025                                                                |
| Faculty/divisional governance     | [date]                                                                   |

|                                                          |        |
|----------------------------------------------------------|--------|
| Faculty/division submits final proposal to VPAP          | [date] |
| Included in Major Modification Report to AP&P            | [date] |
| Included in Major Modification Report to Quality Council | [date] |

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## 1 Executive Summary

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Please provide a brief summary of the change being proposed.

This is a proposal to introduce a new stream in Artificial Intelligence and Machine Learning (AI & ML) to both the Specialist and Specialist Co-op programs in Computer Science (BSc). It is expected that the new stream within the Specialist and Specialist (Co-op) programs in Computer Science will be repointed to the new Bachelor of Computer Science (BCS) degree effective September 1, 2027, pending governance approval of (1) a proposal to introduce the Bachelor of Computer Science as a new four-year degree conferred by the University of Toronto and (2) a separate major modification proposal to repoint the Specialist and Specialist (Co-op) programs in Computer Science to the new BCS degree. The proposed Specialist programs are part of a cluster of proposed new programs at UTSC that address the contemporary relevance of, and student interest in, artificial intelligence from distinct disciplinary perspectives. These include a freestanding minor in Social Data Science (Sociology) and a freestanding minor in Artificial Intelligence, Mind, and Society (Philosophy). These new offerings will be complementary, but each is also unique and approaches the broad issue of artificial intelligence (AI) from a different perspective.

The Specialist/Specialist Co-op programs in Computer Science are long-standing programs housed in the Department of Computer and Mathematical Sciences (CMS) at the University of Toronto Scarborough (UTSC). These programs currently have four streams – Comprehensive, Software Engineering, Information Systems, and Entrepreneurship. With the addition of a stream in Artificial Intelligence and Machine Learning, both the Specialist and Specialist Co-op programs in Computer Science become programs with five streams.

The overarching goal of the Specialist/Specialist Co-op programs is to provide students with a working knowledge of the foundations of computer science, including modern computer software and hardware, theoretical aspects of computer science, and relevant areas of mathematics and statistics. The programs also aim to foster an appreciation of the discipline's transformative impact on science and society. They prepare students for further study at the graduate level and for careers in the computing industry.

We believe that students in top-tier undergraduate programs in Computer Science, such as those offered at UTSC, should have access to a curriculum with a specialization in Machine Learning, Data Science, and Artificial Intelligence. Student demand for content in this area is very high, as evidenced by strong enrolment in related courses and the growing popularity of AI-focused research and career pathways. This proposal delivers a curriculum tailored to the growing interest in these areas.

The proposed streams (Specialist and Specialist Co-op) in Artificial Intelligence and Machine Learning will provide students with a solid foundation in computer science along with the tools and practical experience needed to design and implement systems that employ AI technologies. The proposed streams (Specialist and Specialist Co-op) address the growing demand in the workforce for AI and ML professionals. It prepares students for careers in the rapidly expanding field of AI-driven technologies across a wide range of sectors.

The proposal builds on and leverages the department's strengths in AI & ML research and teaching. Rather than introducing new courses, we propose to use existing courses and faculty resources in a newly structured curriculum, thus helping to meet student demand while ensuring program sustainability. The proposed streams are a key component of the CMS academic plan and will contribute to the development of both mastery in, and a strong culture of, AI & ML innovation in Canada.

## 2 Effective Date

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Please indicate when students may first be enrolled in the new structure and the anticipated date of the first review.

Effective date: September 1, 2026.

Date of first review: The proposed streams (Specialist and Specialist Co-op) will be reviewed with programs administered in the Department of Computer and Mathematical Sciences. A UTQAP review and site visit of the Department and its programs took place in February 2020. The proposed stream would, therefore, be reviewed at the next scheduled review of the unit and programs, which will take place no later than 2027–28.

## 3 Current Calendar Copy with Changes Tracked or Highlighted

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Insert calendar copy, including the program description, with all changes tracked or highlighted.

**SPECIALIST PROGRAM IN COMPUTER SCIENCE – Artificial Intelligence and Machine Learning Stream (SCIENCE) – Subject POST code to be determined**

Insert calendar copy with changes tracked or highlighted here.

*Supervisor of Studies:* R. Pancer (416-287-7679) *Email:* [pancer@utsc.utoronto.ca](mailto:pancer@utsc.utoronto.ca)

### **Program Objectives**

This program provides a working knowledge of the foundations of computer science: modern computer software and hardware, theoretical aspects of computer science, and relevant areas of mathematics and statistics. It also imparts an appreciation of the discipline's transformative impact on science and society. The program prepares

students for further study and for careers in the computing industry. It comprises five streams with different emphases:

**The Artificial Intelligence and Machine Learning (AI & ML) Stream** offers broad and balanced exposure to the discipline, with a strong emphasis on both the theoretical foundations and practical techniques that enable modern AI technologies. Not only can this stream prepare students for graduate-level studies in AI and ML, it equips them with essential skills to excel in a wide range of industries that increasingly make use of AI and ML.

The structure of the program requirements allows one to easily switch streams until relatively late in the program. Consequently, these streams should not be viewed as rigidly separated channels feeding students to different career paths, but as a flexible structure that provides computer science students guidance in their course selection based on their broad (but possibly fluid) interests.

## **Enrolment Requirements**

Enrolment in the Specialist in Computer Science (all streams) is limited. Students may apply to enter the program after completing 4.0 credits, and must meet the requirements described below:

### **1. Students already admitted to the UTSC Year 1 Computer Science admissions category:**

#### *Required Courses:*

Students must have passed the following CSC and MAT courses: CSCA08H3, CSCA48H3, CSCA67H3, MATA22H3, MATA31H3, and MATA37H3.

#### *Required Grades:*

Students who meet all of the following requirements will be admitted to a CS Specialist POST\*:

- a. A cumulative grade point average (CGPA) of at least 2.5 over the following courses: CSCA48H3, CSCA67H3, MATA22H3, and MATA37H3;
- b. A final grade of at least B in CSCA48H3; and

- c. A final grade of at least C- in two of the following: CSCA67H3, MATA22H3, and MATA37H3.

\*Students must select one stream of the CS Specialist as follows:

- a. Students can select the Comprehensive stream or the Software Engineering stream or the Artificial Intelligence and Machine Learning stream.
- b. A limited number of students will be admitted to the Information Systems stream, depending on available space.
- c. Admission to the Entrepreneurship stream will be based in part on submission of a Supplementary Application Form (SAF) available on the Department of Computer and Mathematical Sciences [website](#). Applications for admission will be accepted once per academic year, during the April-May POST admissions round.

## 2. Students admitted to other UTSC Year 1 admissions categories:

Students **who** have been admitted to either the UTSC Year 1 Math or UTSC Year 1 Statistics admissions categories are eligible to apply for the Computer Science Specialist POST. Admission will be based on academic performance in the required A-level courses, identified above. The admission requirements change each year depending on available spaces and the pool of eligible applicants, and students are cautioned that there is no guarantee of admission; as such, students are strongly advised to plan to enroll in backup programs.

Students **who** have not been admitted to a UTSC Year 1 CMS admissions category (Computer Science, Mathematics, or Statistics) must achieve a final grade of at least A- in both MATA31H3 and CSCA67H3 **the first time they complete these courses** in order to be eligible to apply for a CS Specialist POST. **This is a strict requirement.** Admission will be based on academic performance in the required A-level courses, identified above. The admission requirements change each year depending on available spaces and the pool of eligible applicants, and students are cautioned that there is no guarantee of admission; as such, students are strongly advised to plan to enroll in backup programs.

For more information about the admission requirements, please visit the following [CMS webpage](#).

To remain in the program, a student must maintain a CGPA of 2.0 or higher throughout the program.

**Note:** Students admitted to the program after second or third year will be required to pay retroactive deregulated program fees.

### **Program Requirements**

The program requirements comprise a core of 17 courses (8.5 credits), common to all streams and additional requirements which depend on the stream, for a total of 27 courses (13.5 credits) for the **Artificial Intelligence and Machine Learning**, Comprehensive, Software Engineering, and Entrepreneurship streams, and 29 courses (14.5 credits) for the Information Systems stream.

**Note:** Many Computer Science courses are offered across all three U of T campuses: U of T Scarborough, U of T Mississauga, and the St. George campus. When a course is offered at more than one campus, U of T Scarborough students are expected to take that course at U of T Scarborough. The Department of Computer Science at the St. George campus and the Department of Mathematical and Computational Sciences at U of T Mississauga cannot guarantee space for U of T Scarborough students in their courses.

### **Core (8.5 credits)**

#### **1. Writing Requirement (0.5 credit)\***

0.5 credit from the following: ANTA01H3, ANTA02H3, CLAA06H3, (CTLA19H3), CTLA01H3, ENGA10H3, ENGA11H3, ENGB06H3, ENGB07H3, ENGB08H3, ENGB09H3, ENGB17H3, ENGB19H3, ENGB50H3, (ENGB51H3), GGRA02H3, GGRA03H3, GGRB05H3, (GGRB06H3), (HISA01H3), (HLTA01H3), (ACMA01H3), (HUMA01H3), (HUMA11H3), (HUMA17H3), (LGGA99H3), LINA01H3, PHLA10H3, PHLA11H3, WSTA01H3.

**\*Note:** It is recommended that this requirement be satisfied by the end of the second year.

#### **2. A-level courses (3.0 credits)**

CSCA08H3 Introduction to Computer Science I  
CSCA48H3 Introduction to Computer Science II  
CSCA67H3 Discrete Mathematics

MATA22H3 Linear Algebra I for Mathematical Sciences

MATA31H3 Calculus I for Mathematical Sciences

MATA37H3 Calculus II for Mathematical Sciences

### **3. B-level courses (3.5 credits)**

CSCB07H3 Software Design

CSCB09H3 Software Tools and Systems Programming

CSCB36H3 Introduction to the Theory of Computation

CSCB58H3 Computer Organization

CSCB63H3 Design and Analysis of Data Structures

MATB24H3 Linear Algebra II

STAB52H3 Introduction to Probability

### **4. C-level courses (1.5 credits)**

CSCC43H3 Introduction to Databases

CSCC69H3 Operating Systems

CSCC73H3 Algorithm Design and Analysis

## **Artificial Intelligence and Machine Learning Stream**

This stream requires a total of 27 courses (13.5 credits). In addition to the core requirements 1-4 common to all streams, 10 other distinct courses (5.0 credits) must be chosen to satisfy all of the following requirements:

### **5. Technology, Society, and Ethics course (0.5 credit)**

Choose from:

CSCD03H3 Social Impact of Information Technology

PHLB18H3 Ethics of Artificial Intelligence

### **6. Additional required courses (3.0 credits)**

CSCC11H3 Introduction to Machine Learning and Data Mining

CSCC37H3 Introduction to Numerical Algorithms for Computational Mathematics

CSCC63H3 Computability and Computational Complexity

CSCD84H3 Artificial Intelligence

MATB41H3 Techniques of the Calculus of Several Variables I

STAB57H3 An introduction to Statistics

### **7. CSC Electives in Computer Systems and Applications (1.0 credit)**

At least 0.5 credit from:

CSCC10H3 Human-Computer Interaction  
CSCC46H3 Social and Information Networks  
CSCC85H3 Fundamentals of Robotics and Automated Systems  
CSCD18H3 Computer Graphics  
CSCD25H3 Advanced Data Science  
CSCD43H3 Database System Technology  
CSCD71H3 High Performance Computing  
CSC304H1 Algorithmic Game Theory and Mechanism Design  
CSC320H1 Introduction to Visual Computing  
CSC376H5 Fundamentals of Robotics  
CSC401H1 Natural Language Computing  
CSC485H1 Computational Linguistics  
CSC486H1 Knowledge Representation and Reasoning

Additional 0.5 credits from D-level CSC courses not listed in sections 1-6.

### **8. Electives from courses in statistics (0.5 credit)**

Choose from:

STAC58H3 Statistical Inference  
STAC62H3 Probability and Stochastic Processes I  
STAC67H3 Regression Analysis  
STAD68H3 Advanced Machine Learning and Data Mining  
STAD78H3 Machine Learning Theory  
STAD80H3 Analysis of Big Data

**SPECIALIST (CO-OPERATIVE) PROGRAM IN COMPUTER SCIENCE – Artificial Intelligence and Machine Learning (SCIENCE) – Subject POST code to be determined**

Insert calendar copy with changes tracked or highlighted here.

Academic Program Advisor: S. Calanza [susan.calanza@utoronto.ca](mailto:susan.calanza@utoronto.ca) Co-op Program Coordinator: [coopsuccess.utsc@utoronto.ca](mailto:coopsuccess.utsc@utoronto.ca)

This program provides a working knowledge of the foundations of computer science: modern computer software and hardware, theoretical aspects of computer science, and relevant areas of mathematics and statistics. It also imparts an appreciation of the discipline's transformative impact on science and society. The program prepares students for further study and for careers in the computing industry. It comprises five streams with different emphases:

**The Artificial Intelligence and Machine Learning (AI & ML) Stream** offers broad and balanced exposure to the discipline, with a strong emphasis on both the theoretical foundations and practical techniques that enable intelligent systems. It prepares students for graduate-level studies in AI and ML, and equips them with the essential skills needed to pursue careers in the AI industry.

The structure of the program requirements allows one to easily switch streams until relatively late in the program. Consequently, these streams should not be viewed as rigidly separated channels feeding students to different career paths, but as a flexible structure that provides computer science students guidance in their course selection based on their broad (but possibly fluid) interests.

In addition to their academic course requirements, students must successfully complete the additive Arts & Science Co-op Work Term and Course requirements.

### **Enrolment Requirements**

Enrolment in the Specialist (Co-operative) program in Computer Science (all streams) is limited. Students must have completed the required A-level CSC and MAT courses, and achieved the required grades, described in the Enrolment Requirements for the Specialist in Computer Science.

**Note:** Co-op students who started in Co-op prior to Fall 2025 are allowed to follow the calendar requirements in effect at that time.

### **Prospective Co-op Students:**

Students who have not yet been admitted into a Co-op Degree POST must submit a co-op program request through ACORN and ensure they meet the minimum enrolment requirements as noted above. These qualifications may include a higher CGPA specific to the co-op program.

Deadlines follow the Limited Enrolment Program Application Deadlines set by the [Office of the Registrar](#) each year. Failure to submit the program request on ACORN will result in the student's application/request not being considered.

Please note that meeting the minimum qualifications does not guarantee enrolment in the Co-op Program of Study or Degree POST. The required CGPA may be higher than the minimum threshold and is dependent on the applicant pool and number of spaces available.

**Minimum Qualifications for Prospective Co-op Students:**

**Credits:** Minimum of 4.0 credits to a maximum of 10.0 credits

**Required Courses:** As noted in the Enrolment Requirements above

**Cumulative GPA:** 2.75 across all attempted courses.

**Current Co-op Students:**

Students admitted to a Co-op Degree POST must request a Co-op Program of Study through ACORN.

\*Students must select **one** stream of the CS Specialist Co-op. Admission to the Entrepreneurship stream also requires the submission of a Supplementary Application Form available on the Department of Computer and Mathematical Sciences [webpage](#).

**Minimum Qualifications for Current Co-op Students:**

**Credits:** 4.0 credits

**Required Courses:** Program-specific courses described in the Enrolment Requirements above

**Cumulative GPA:** 2.5 across all attempted courses.

**Academic Program Requirements**

Students must complete the program requirements as described in the Specialist Program in Computer Science. To be eligible for their first work term, students must be enrolled in the program, have completed at least 7.0 credits, including all first year required courses (CSCA08H3, CSCA48H3, CSCA67H3, MATA22H3, MATA31H3, MATA37H3), and maintain a CGPA of 2.50 or higher. In addition to their academic courses, students must also complete the required Co-op preparation courses.

### **Planning your Co-op Work Terms & Academics:**

Enrollment in a Co-op program requires careful planning of both academics and work terms. Students should consult their Co-op Program Coordinator and Academic Program Advisors, as well as review the standard co-op sequences and course maps available on the Arts & Science Co-op website and Arts and Science Co-op Compass for guidance.

### **Co-op Work Term Requirements:**

Students must successfully complete three Co-op work terms, totaling 12 months in duration, which can be fulfilled through the following options:

- Three 4-month work terms, or
- One 4-month work term and one 8-month work term, or
- One 12-month work term.

Students must be available for work terms during the Fall, Winter, and Summer semesters, and are required to complete at least one of their work terms in either the Fall or Winter semester. As a result, students must also take courses during the Summer semesters.

### **Co-op Course Requirements:**

Co-op students complete the following Co-op-specific courses as part of their degree

#### **Co-op Preparation Courses (Completed in First Year):**

- COPB50H3
- COPB56H3/(COPB51H3)

#### **Work Term Search Courses:**

- COPB57H3/(COPB52H3) - Completed in the semester prior to the first work term
- COPC98H3 - Taken in the semester prior to the second work term
- COPC99H3 - Taken in the semester prior to the third work term

#### **Co-op Work Term Courses:**

- COPC01H3 - First work term
- COPC02H3 - Second work term

- COPC03H3 - Third work term

### **Additional Work Terms & Courses:**

After successful completion of three required work terms, students interested in additional work terms will require approval from the Arts & Science Co-op Office. Additional course work will also be required.

- COPC04H3 - Fourth work term
- COPC05H3 - Fifth work term

**Note:** Co-op courses are taken alongside a full course load and are recorded on transcripts as Credit/No Credit (CR/NCR). These courses have no credit weight and are considered additional credits beyond the 20.0 required degree credits. No additional course fee is charged, as registration is included in the Co-op Program fee.

For information on course codes, fees, status in Co-op programs, and certification of completion of Co-op programs, see the [Co-operative Programs](#) section and the [Arts and Science Co-op](#) section in the *UTSC Calendar*.

## **4 Academic Rationale and Program Objectives**

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### **4.1 Program Objectives**

- a) State the program's objectives.

This program provides a working knowledge of the foundations of computer science: modern computer software and hardware, theoretical aspects of computer science, and relevant areas of mathematics and statistics. It also imparts an appreciation of the discipline's transformative impact on science and society. The program prepares students for further study and for careers in the computing industry. It comprises five streams with different emphases:

**The Artificial Intelligence and Machine Learning (AI & ML) Stream** offers broad and balanced exposure to the discipline, with a strong emphasis on both the theoretical foundations and practical techniques that enable modern AI technologies. Not only can

this stream prepare students for graduate-level studies in AI and ML, it equips them with essential skills to excel in a wide range of industries that increasingly make use of AI and ML.

The structure of the program requirements allows one to easily switch streams until relatively late in the program. Consequently, these streams should not be viewed as rigidly separated channels feeding students to different career paths, but as a flexible structure that provides computer science students guidance in their course selection based on their broad (but possibly fluid) interests.

## 4.2 Academic Rationale

In a **single** response, please describe the academic rationale for the proposed changes, referring to the calendar copy above, and considering the offering relative to the criteria below.

- a) Discuss the consistency of the program's [objectives](#) with the institution's [mission](#) and U of T's/the division's/unit's [academic plans](#), [priorities](#) and commitments, including consistency with any implementation plans developed following a previous review.
- b) Appropriateness of degree or diploma nomenclature given the program's objectives.
- c) Evidence that the following have been substantially considered in the context of developing the proposed change and its associated resources:
  - i. [Universal design principles](#) and/or the potential need to provide mental or physical disability-related accommodations, reflecting the University's [Statement of Commitment Regarding Persons with Disabilities](#).
  - ii. Support for student well-being and sense of community in the learning and teaching environment, reflecting the work of the [Expert Panel on Undergraduate Student Educational Experience](#) and the commitment to establishing a Culture of Caring and Excellence as recommended by the Presidential and [Provostial Task Force on Student Mental Health](#).
  - iii. Opportunities for removing barriers to access and increasing retention rates for Indigenous students; for integrating Indigenous content into the curriculum in consultation with Indigenous curriculum developers; and for addressing any discipline-specific calls to action, reflecting the commitments made in

[Answering the Call: Wecheehetowin: Final Report of the Steering Committee for the University of Toronto Response to the Truth and Reconciliation Commission of Canada.](#)

- iv. Opportunities for removing barriers to access and increasing retention rates for Black students; for promoting intersectional Black flourishing, fostering inclusive excellence and enabling mutuality in teaching and learning, reflecting the commitments made in the [Scarborough Charter](#) and consistent with the recommendations of the [Anti-Black Racism Task Force Final Report](#).
- v. Opportunities for fostering an equitable, diverse, and inclusive teaching and learning environment, reflecting the values articulated in existing institutional documents such as the [Statement on Equity, Diversity, and Excellence, the Antisemitism Working Group Final Report](#), the aforementioned reports and future institutional reports related to equity, diversity and inclusion.
- d) Where appropriate, discuss unique curriculum or program innovations, creative components, significant high-impact practices relative to the change proposed.
- e) Provide a statement on the way in which the proposed major modification will improve the student experience (required).

This is a proposal to introduce a new stream in Artificial Intelligence and Machine Learning in both the Specialist and Specialist Co-op programs in Computer Science (BSc). The proposed Specialist programs are part of a cluster of proposed new programs at UTSC that address the contemporary relevance of, and student interest in, artificial intelligence from distinct disciplinary perspectives. These include a freestanding minor in Social Data Science (Sociology) and a freestanding minor in Artificial Intelligence, Mind, and Society (Philosophy). These new offerings will be complementary, but each is also unique and approaches the broad issue of artificial intelligence (AI) from a different perspective.

The new stream in Artificial Intelligence and Machine Learning supports the UTSC Strategic Plan 2020–25, [Inspiring Inclusive Excellence](#) (extended to 2030), including strategic direction 1.2 to undertake comprehensive curriculum renewal that enhances top-tier teaching, prepares students for the evolving world of work, and supports innovations in inclusive teaching and learning. This includes developing new programs “with consideration for their responsiveness to developments in relevant fields, transformations in society, and the realization of learning outcomes that give our

graduates the competencies needed to be successful in their careers and to adapt to a dynamic world.”

The Specialist/Specialist Co-op programs in Computer Science are long-standing programs housed in the Department of Computer and Mathematical Sciences (CMS) at the University of Toronto Scarborough (UTSC). These programs currently have four streams – Comprehensive, Software Engineering, Information Systems, and Entrepreneurship.

All streams (Specialist and Specialist Co-op) share a common core of essential computer science courses, corresponding to topics that every graduating student must have been exposed to as they complete their undergraduate degree. However, each stream allows students with different interests to pursue specific areas of computer science in greater depth – typically those areas in which they will pursue further education or careers within industry.

Hence, among our existing streams:

- The Comprehensive streams provide a broad and balanced exposure to computer science as a discipline;
- The Software Engineering streams place a greater emphasis on the topics within computer science that are involved in the design and implementation of large software-based systems, this includes software design, computer systems, and core applications;
- The Information Systems streams provide a core of computer science courses with an emphasis on enterprise software systems, and also exposes students to the principles of business management;
- The Entrepreneurship streams offer a solid core in computer science and software engineering, while introducing students to the frameworks and methodologies for transforming innovative technology ideas into viable commercial opportunities.

Artificial Intelligence (AI) is increasingly integrated into a wide range of domains, transforming industries, economies, and the very nature of work. From generative models such as large language models to autonomous systems and intelligent robotics, AI technologies are driving innovation across numerous sectors including healthcare, education, science and engineering, finance, and the humanities.

The Artificial Intelligence and Machine Learning Stream within the Computer Science Specialist and Computer Science Specialist Co-op programs is designed to meet this rapidly growing demand for professionals with expertise in the field. The Stream provides a strong foundation in computer science and places special emphasis on both the theoretical and practical aspects of artificial intelligence. It prepares students for postgraduate studies and equips them with highly sought-after technical and interdisciplinary skills for careers in AI-related industries.

The rapid expansion of AI and ML programs at peer institutions underscores the urgency and strategic importance of this Stream. Top universities in the world all have dedicated AI & ML curricula and have embedded AI and ML specializations into their core computer science offerings. Examples in the North America are MIT, Stanford, Carnegie Mellon, University of Toronto St. George Campus, McGill, UBC, and the University of Waterloo. By establishing this Stream, UTSC positions itself alongside these institutions at the frontier of computer science education, ensuring that our graduates are equipped with the same depth of theoretical grounding and practical expertise as those emerging from the most competitive programs in the world. Far from following a trend, this Stream represents UTSC's proactive commitment to remaining a leader in computer science education to respond to the evolving field.

The Department of Computer and Mathematical Sciences at UTSC is currently home to several world-renowned AI and ML research faculty including Professors David Fleet and Daniel Roy, who already teach upper-year advanced courses in the field. Two new AI & ML research faculty members have joined the department recently, which will help us staff these courses. We also have several teaching-stream faculty who teach both lower- and upper-year courses related to the area.

The new AI & ML stream will help alleviate pressure on the existing Software Engineering stream, which has been over capacity for several years and has faced significant staffing challenges. Given the high demand for AI-related skills in both academia and industry, we expect the new AI/ML stream to attract many of our Specialist students and ease the burden on the Software Engineering stream.

Across all other streams in the Computer Science Specialist program, Requirement 5 requires a course on Technology, Society, and Ethics, which is currently served by CSCD03H3 (Social Impact of Information Technology). With the proposed creation of the AI & ML stream, Requirement 5 will move from being a common-core requirement

to being a stream-specific requirement. For Requirement 5 of this new stream, students may choose between CSCD03H3 and PHLB18H3 (Ethics of Artificial Intelligence) as both courses address the ethical and societal implications of computing technologies.

PHLB18H3 focuses specifically on ethical issues in AI. CSCD03H3 studies broader societal impacts of information technology, including privacy, automation, governance, and responsible technology development. Since AI is a specialized area within information technology, the ethical frameworks and societal analysis developed in CSCD03H3 are directly applicable to AI/ML practitioners. Therefore, either course fulfills the AI & ML stream's objective of developing awareness of the ethical and social impacts of advanced computing technologies.

Though PHLB18H3 is a B-level course and CSCD03H3 is a D-level course, they deliver comparable learning outcomes to fulfill the program requirements. For the vast majority of its students, CSCD03H3 provides their first exposure to reasoning about societal impact, ethical considerations, and philosophical argumentation. The department designed this course specifically for Computer Science students who are highly trained in technical and mathematical subjects, but have had relatively little practice developing arguments and writing extended prose.

In contrast, PHLB18H3 is designed for a broader, non-technical audience that typically has a prior interest in and some exposure to philosophy, argumentation, exposition, and writing. In terms of learning outcomes, therefore, the two courses are well aligned and appropriately positioned as stated in the stream-specific program requirements.

## 5 Program Design

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### 5.1 Admission Requirements

Please describe any proposed changes to admission requirements by considering the changes tracked in the calendar copy relative to the following:

- a) Discuss the appropriateness of the program's admission requirements as they are articulated in section 3 above, given the program's objectives and program-level learning outcomes.
- b) Provide a sufficient explanation of alternative requirements, if applicable, for admission into a graduate, second-entry or undergraduate program (e.g.,

minimum grade point average, additional languages or portfolios, and how the program recognizes prior work or learning experience).

Admissions requirements will stay the same and mirror existing admissions requirements for all Specialist and Specialist Co-op streams. The addition of the Artificial Intelligence and Machine Learning stream is reflected in the updated calendar copy provided in Section 3.

## 5.2 Program Structure and Requirements

Addressing the prompts below in **one response**, please discuss the proposed changes to requirements, including any changes to milestone assessments, by considering the changes relative to the following criteria:

### 5.3 All Programs

- a) With reference to the change proposed, discuss the appropriateness of the offering's structure and the requirements to meet its objectives and program-level learning outcomes, including the structure and requirements of any identified streams (undergraduate), fields or concentrations (graduate).
- b) Appropriateness of the offering's structure, requirements and program-level learning outcomes in meeting the institution's applicable [undergraduate or graduate Degree Level Expectations](#).
- c) State the mode of delivery and the appropriateness and effectiveness of the mode(s) of delivery (i.e., means or medium used in delivering a program; e.g., lecture format, distance, online, synchronous/asynchronous, problem-based, compressed part-time, flexible-time, multi-campus, inter-institutional collaboration or other non-standard forms of delivery) to facilitate students' successful completion of the program-level learning outcomes.
- d) If the offering's structure will be an online or hybrid mode of delivery, please discuss the following as appropriate:
  - i. Maintenance of and/or changes to the program objectives and program-level learning outcomes
  - ii. Adequacy of the technological platform and tools
  - iii. Sufficiency of support services and training for teaching staff
  - iv. Sufficiency and type of support for students in the new learning environment
  - v. Access

- e) Discuss the ways in which the proposed curriculum addresses the current state of the discipline or area of study and is appropriate for the level of the program.
- f) Please provide details on any experiential learning that is part of the offering, including confirmed and interested partners, duration of experiential learning component in a program, and anticipated number of placements.

### 5.3.1 Program Learning Outcomes

The program learning outcomes are based on the ACM/IEEE-CS/AAAI <sup>1</sup> Computer Science Curricula 2023 (CS2023<sup>2</sup>) (<https://ieeecs-media.computer.org/media/education/reports/CS2023.pdf>). We list seven categories of learning outcomes; the first six are common to all streams in the CS Specialist and Specialist Co-Op programs and the seventh is specific to the AI/ML stream. Please see Appendix B.1 for details.

Upon completion of the Artificial Intelligence and Machine Learning Stream of the Computer Science specialist program, students will be able to:

#### 1 Theoretical and Mathematical Foundations

- 1.1 Apply discrete mathematics, linear algebra, calculus, and probability to analyze computational problems.
- 1.2 Use formal reasoning to analyze algorithms and construct correctness proofs.
- 1.3 Analyze the theoretical limits of computation, including complexity classes and undecidability.
- 1.4 Explain foundational models of computation and their role in programming language and algorithm design.

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<sup>1</sup> ACM stands for Association for Computing Machinery. IEEE-CS stands for Institute of Electrical and Electronics Engineers Computer Society. AAAI stands for Association for the Advancement of AI.

<sup>2</sup> CS2023 is the latest, global “standard curriculum” for undergraduate Computer Science degrees. It is a massive, definitive report released jointly by ACM, IEEE-CS, and AAAI. It is a blueprint that universities around the world use to design their Computer Science majors.

## **2 Data Structures, Algorithms, and Problem Solving**

- 2.1 Design and analyze algorithms using strategies such as divide-and-conquer, greedy methods, and dynamic programming.
- 2.2 Evaluate algorithmic solutions in terms of correctness, efficiency, and scalability.
- 2.3 Implement algorithms using appropriate data structures and programming paradigms.
- 2.4 Apply algorithmic thinking to model and solve real-world problems.

## **3 Software Development and Programming Paradigms**

- 3.1 Design and implement software using procedural, object-oriented, and functional paradigms.
- 3.2 Apply principles of modularity, abstraction, verification, and validation in software development.
- 3.3 Apply appropriate software development tools and practices to effectively manage collaborative projects.
- 3.4 Evaluate trade-offs between programming paradigms and language features.

## **4 Systems and Architecture**

- 4.1 Describe the structure and operation of computer systems, including memory, processors, and I/O.
- 4.2 Implement low-level systems software and understand concurrency and synchronization.
- 4.3 Analyze trade-offs in system design, performance, and energy efficiency.
- 4.4 Apply operating system principles to manage processes, memory, and file systems.

## **5 Data and Information Management**

- 5.1 Design and query relational and non-relational databases using SQL and appropriate data models. Apply principles of data modeling, normalization, and transaction management.
- 5.2 Integrate data management techniques into software systems.
- 5.3 Evaluate performance, security, and privacy in data storage and retrieval.

## 6 Communication, Ethics, and Professional Practice

- 6.1 Communicate technical concepts effectively in written and oral forms.
- 6.2 Collaborate in diverse teams to design, implement, and evaluate computing solutions.
- 6.3 Demonstrate ethical awareness in the design and deployment of computing systems.
- 6.4 Reflect on the societal, environmental, and global impact of computing technologies.

## 7 AI & ML Stream Specific

- 7.1 Apply core AI techniques including search, logic, planning, and agents to model intelligent behavior for solving complex problems.
- 7.2 Apply supervised, unsupervised, and reinforcement learning to solve machine learning problems using real-world dataset.
- 7.3 Apply probabilistic reasoning and statistical methods to evaluate machine learning models, tune the hyperparameters, and support decision-making under uncertainty.
- 7.4 Design and implement deep learning and generative models for solving problems in vision, language, and robotics.
- 7.5 Evaluate fairness, interpretability, and societal impact of AI systems.

The ACM CS2023 curricula has 17 Knowledge Areas (KAs).

### 5.3.2 Curriculum Design and Curriculum Map

The proposed curriculum is informed by curricula of several well-established AI/ML programs in top tier universities, including Carnegie Mellon's BSc in Artificial Intelligence, University of Waterloo's BCS AI Specialization, and U of T St. George Campus' Computer Science Specialist with a Focus in Artificial Intelligence. **Please, consult Appendix C for the Curriculum Map.**

### 5.3.3 Degree Level Expectations, Program Learning Outcomes and Requirements

The tables below align the new Stream with the six Degree Level Expectations (DLE) as defined on the VPAP website.

**Table 1: Program Learning Outcomes and Degree Level Expectations Map**

| DLE ID | Degree Level Expectations Descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Program Learning Outcomes Aligned with DLE                                                                                  |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| D1     | <p><b>Depth of Knowledge:</b><br/>Programs of study will attain depth through a progression of introductory, core and specialized courses. Specialized courses will normally be at the C and D levels. This basic requirement is further refined in the three sections Knowledge of Methodologies, Application of Knowledge and Awareness of Limits of Knowledge.</p> <p><b>Breadth of Knowledge:</b><br/>In the course of their studies, students will gain an appreciation of the variety of modes of thinking, methods of inquiry and analysis, and ways of understanding the world that underpin different intellectual fields. Through courses within or outside of their programs of study, students will be exposed to an appropriate balance of: the arts, literature and history of human cultures, the social and behavioral sciences, the natural sciences, and quantitative reasoning.</p> | 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 5.4, 6.4, 7.1, 7.2, 7.3, 7.4 |
| D2     | <p><b>Knowledge of Methodologies</b><br/>Students will have a working knowledge of different methodologies and approaches relevant to their area of study. They will be able to evaluate the efficacy of different methodologies in addressing questions that arise in their area of study.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 7.3                                                                                           |
| D3     | <p><b>Application of Knowledge</b><br/>Within their area of study students will be able to frame relevant questions for further inquiry. They will be familiar with or will be able to seek the tools with which they can address such questions effectively.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 4.2, 4.4, 5.1, 5.2, 5.3, 7.1, 7.2, 7.3, 7.4                                              |
| D4     | <p><b>Awareness of Limits of Knowledge</b><br/>Students will gain an understanding of the limits to their own knowledge. They will also gain an appreciation of the uncertainty, ambiguity, and limits to our collective knowledge and how these might influence analyses and interpretations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.3, 3.4, 4.3, 5.4, 6.3, 6.4, 7.3, 7.5                                                                                      |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| D5 | <b>Communications Skills</b><br>Students will be able to communicate information, arguments, and analyses accurately and reliably, both orally and in writing. Students will learn to read and to listen critically.                                                                                                                                                                                                                          | 6.1, 6.2                |
| D6 | <b>Autonomy and Professional Capacity</b><br>In a broader context, the education students receive while pursuing their degrees has three further goals: to give students the skills and knowledge they need to become informed, independent and creative thinkers; to instill the awareness that knowledge and its applications are influenced by and contribute to society; and to lay the foundation for learning as a life-long endeavour. | 3.3, 6.2, 6.3, 6.4, 7.5 |

**Table 2: Degree Level Expectation, Curriculum and Program Learning Outcomes Map**

| DLE ID | Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | PLOs                                                                                                                        |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| D1     | CSC304H1, CSC320H1, CSC376H5, CSC401H1, CSC469H1, CSC485H1, CSC486H1, CSC488H1, CSCA08H3, CSCA48H3, CSCA67H3, CSCB07H3, CSCB09H3, CSCB36H3, CSCB58H3, CSCB63H3, CCCC01H3, CCCC09H3, CCCC10H3, CCCC11H3, CCCC24H3, CCCC37H3, CCCC43H3, CCCC46H3, CCCC63H3, CCCC69H3, CCCC73H3, CCCC85H3, CSCD01H3, CSCD03H3, CSCD18H3, CSCD21H3, CSCD25H3, CSCD27H3, CSCD43H3, CSCD58H3, CSCD70H3, CSCD71H3, CSCD84H3, MATA22H3, MATA31H3, MATA37H3, MATB24H3, MATB41H3, STAB52H3, STAB57H3, STAC58H3, STAC62H3, STAC67H3, STAD68H3, STAD78H3, STAD80H3, Writing | 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 5.4, 6.4, 7.1, 7.2, 7.3, 7.4 |
| D2     | CSC401H1, CSC485H1, CSC488H1, CSCA08H3, CSCA48H3, CSCA67H3, CSCB36H3, CSCB63H3, CCCC11H3, CCCC37H3, CCCC63H3, CCCC73H3, CSCD25H3, CSCD84H3, MATA22H3, MATA31H3, MATA37H3, MATB24H3, MATB41H3, STAB52H3, STAB57H3, STAC58H3, STAC62H3, STAC67H3, STAD68H3, STAD78H3, STAD80H3, Writing                                                                                                                                                                                                                                                           | 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 7.3                                                                                           |
| D3     | CSC304H1, CSC320H1, CSC376H5, CSC401H1, CSC469H1, CSC485H1, CSC486H1, CSCA08H3, CSCA48H3, CSCB07H3, CSCB09H3, CSCB58H3, CSCB63H3, CCCC01H3, CCCC09H3, CCCC10H3, CCCC11H3, CCCC37H3, CCCC43H3, CCCC46H3, CCCC63H3, CCCC69H3, CCCC73H3, CCCC85H3, CSCD01H3, CSCD18H3, CSCD25H3, CSCD43H3, CSCD71H3, CSCD84H3, STAB57H3, STAC58H3, STAC62H3, STAC67H3, STAD68H3, STAD78H3, STAD80H3                                                                                                                                                                | 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 4.2, 4.4, 5.1, 5.2, 5.3, 7.1, 7.2, 7.3, 7.4                                              |
| D4     | CSC401H1, CSC485H1, CSC488H1, CSCA48H3, CSCB36H3, CCCC11H3, CCCC24H3, CCCC63H3, CSCD03H3, CSCD21H3, CSCD25H3, CSCD27H3, CSCD43H3, CSCD58H3, CSCD70H3, CSCD71H3, CSCD84H3, PHLB18H3*, STAB57H3, STAC58H3, STAC62H3, STAC67H3, STAD68H3, STAD78H3, STAD80H3                                                                                                                                                                                                                                                                                       | 1.3, 3.4, 4.3, 5.4, 6.3, 6.4, 7.3, 7.5                                                                                      |
| D5     | CCCC10H3, CSCD01H3, Writing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.1, 6.2                                                                                                                    |

|    |                                                                          |                            |
|----|--------------------------------------------------------------------------|----------------------------|
| D6 | CSCA48H3, CSCB07H3, CSCB09H3, CSCC09H3, CSCD01H3, CSCD03H3,<br>PHLB18H3* | 3.3, 6.2, 6.3, 6.4,<br>7.5 |
|----|--------------------------------------------------------------------------|----------------------------|

### **5.3.4 Curriculum Delivery**

There are no new courses in the proposed new stream, and no changes to course delivery. The program is designed to be in-person as all other existing programs in the department.

### **5.3.5 Curriculum Alignment with the Discipline and Program Level**

The proposed Artificial Intelligence/Machine Learning (AI/ML) stream is structured to reflect the dynamic and rapidly evolving nature of the AI discipline. It combines a rigorous foundation in mathematics, statistics, and computer science with specialized coursework in machine learning, artificial intelligence, deep learning, and data science.

This integrated approach ensures that students acquire both the theoretical depth and practical expertise necessary to engage with modern AI technologies.

Core courses such as CSCC11H3 (Introduction to Machine Learning and Data Mining) and CSCD84H3 (Artificial Intelligence) provide exposure to essential machine learning and AI principles and methodologies and ethical considerations in AI system design. As for other required prerequisites MATB41H3 (Techniques of the Calculus of Several Variables I) and STAB57H3 (An Introduction to Statistics), they provide essential mathematical and statistical foundations necessary for understanding and advancing in AI & ML topics. A broad selection of electives ranging from advanced machine learning, data science, robotics, natural language processing, knowledge representation to high-performance computing further supports interdisciplinary learning and reflects the diverse applications of AI in contemporary research and industry.

The curriculum is scaffolded to support progressive learning, beginning with foundational principles and culminating in advanced, research-informed topics appropriate for undergraduate students preparing for graduate studies or careers in the AI industry. This structure ensures the program remains current, comprehensive, and aligned with both academic and professional expectations.

### **5.3.6 Experiential Learning**

Experiential learning is embedded across a wide range of courses, including those in the core AI & ML curriculum. In addition to hands-on assignments and project-based coursework, students may participate in faculty-supervised research and independent study opportunities (CSCD94H3/D95H3), which allow for deeper exploration of specialized topics and the development of advanced technical competencies.

Students enrolled in the Co-op stream will further benefit from structured industry placements, where they can apply their AI & ML expertise in real-world environments, gaining valuable professional experience and contributing meaningfully to the AI sector.

**Table 1: Degree Level Expectations, Program Learning Outcomes and Requirements**

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                                                                                                                                                                                                    | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Expectations: This Specialist in Computer Science is awarded to students who have demonstrated the following program objectives:</b>                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>1. Depth and Breadth of Knowledge</b><br>Depth of Knowledge:<br>Programs of study will attain depth through a progression of introductory, core and specialized courses. Specialized courses will normally be at the C and D levels. This basic requirement is further refined in the three sections Knowledge of Methodologies, Application of Knowledge and Awareness of Limits of Knowledge. | Depth and Breadth of Knowledge is defined in all streams of the Specialist/Specialist Co-op in Computer Science as the acquisition of a strong foundation on the core computer science areas including, but not restricted to theory, systems and software engineering, algorithms and data structures, and applications. Such foundations require in-depth knowledge of related mathematics and statistics topics including calculus, linear algebra, and probability.<br>In the proposed stream in Artificial Intelligence/Machine Learning (non Co-op | The program design and requirement elements in all of our Specialist/Specialist Co-op program streams that ensure these student outcomes for depth and breadth of knowledge are:<br>The course sequence and progression from A- to D-level courses is designed to provide increasing depth and sophistication. At each level, students are expected to engage the material with greater understanding and improved techniques of reasoning. |

| <b><u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u></b>                                                                                                                                                                                                                                                                                                                                                                                    | <b><u>Program Learning Outcomes</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Breadth of Knowledge:<br/>In the course of their studies, students will gain an appreciation of the variety of modes of thinking, methods of inquiry and analysis, and ways of understanding the world that underpin different intellectual fields. Through courses within or outside of their programs of study, students will be exposed to an appropriate balance of: the arts, literature and history of human cultures, the social and behavioral sciences, the natural sciences, and quantitative reasoning.</p> | <p>and Co-op), students will be expected, in addition to the above, to learn the techniques and methodologies involved in designing Intelligent systems. Mastery of the above will be reflected in students who are able to analyze and solve complex computational problems using AI/ML techniques, evaluate model performance, and understand the limitations and ethical implications of intelligent systems. They will also be able to clearly communicate technical findings to both technical and general audiences, through written assignments, and presentations. Graduating students will be well-prepared to pursue careers in AI/M in industry, research, or government, or to continue their studies at the graduate level in computer science, data science, machine learning, or artificial intelligence.</p> | <p>Breadth is provided by ensuring students take courses in a broad spectrum of computer science courses as well as in neighbouring disciplines. In particular, our students are required to cover a minimum of 2.5 credits worth of Mathematics and Statistics courses, including Calculus, Linear Algebra, and Probability and Statistics.</p> <p>A carefully prepared combination of theory and practical, experiential learning provides students with an opportunity to learn, apply, and strengthen their mastery of core computer science topics along with their mathematical and statistical foundations.</p> <p>Additionally, and specific to the Artificial Intelligence/Machine Learning streams (non Co-op and Co-op), the</p> |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                                               | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                         | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                          | additional required and elective courses in statistical inference, calculus, advanced AI/ML topics, as well as upper year courses will equip students with the skills to design and evaluate intelligent systems using techniques such as machine learning, deep learning, and probabilistic reasoning, applied to real-world problems in areas such as computer vision, language, and robotics. |
| <b>2. Knowledge of Methodologies</b><br>Students will have a working knowledge of different methodologies and approaches relevant to their area of study. They will be able to evaluate the efficacy of different methodologies in addressing | Students in any stream of our Specialist/Specialist Co-op programs in Computer Science are taught the methodologies in all core areas of Computer Science as well as closely related areas in Mathematics and Statistics Within the proposed streams in Artificial Intelligence/Machine Learning (non Co-op and Co-op), they will also be taught current | Each sequence of courses in the program is structured so that the students learn and apply the relevant methodologies in the corresponding area of knowledge with increasing depth. For instance, the course sequence: STAB57H3 An Introduction to Statistics, CSCC11H3 Introduction to Machine Learning and Data Mining, and CSCD84H3 Artificial Intelligence,                                  |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u> | <u>Program Learning Outcomes</u>                                                                                                                                                                           | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>questions that arise in their area of study.</p>                                                                             | <p>methodologies and topics in AI and machine learning.</p> <p>Students are expected to master these methodologies and accompanying tools through exercises, problem solving, and guided project work.</p> | <p>provides students with increasing depth and mastery of material related to artificial intelligence and machine learning theory and practice. Similar sequences exist for computational theory, databases, software engineering, algorithms, and the Mathematics and Statistics components of the program.</p> <p>For the Artificial Intelligence and Machine Learning stream, advanced upper year courses in computer science and statistics, focused on machine learning and big data analysis, will widen the students' understanding of designing, implementing and analysing intelligent systems.</p> <p>The sequence of courses is geared toward building maturity and developing a sound understanding of</p> |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                                                              | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | each of the areas of study; developing the skills that will allow students to choose between possible career paths in computer science, or as interdisciplinary professionals leveraging AI/ML technologies.                                                                                                                                                                                                                                                                                                                |
| <b>3. Application of Knowledge</b><br>Within their area of study students will be able to frame relevant questions for further inquiry. They will be familiar with or will be able to seek the tools with which they can address such questions effectively. | Students in every stream of the Specialist/Specialist Co-op programs in Computer Science are expected to have the ability to apply their technical knowledge of a wide range of topics within computer science to solve a problem; be it a research question, an industry need, or a technical issue arising from a novel application of computer science.<br>In addition to this, students in the AI/ML stream will be able to apply artificial intelligence and machine learning principles and techniques to formulate and solve complex problems involving data analysis, prediction, and decision-making. | The program as a whole, and the proposed AI/ML stream, offers a carefully structured sequence of courses designed to develop students' ability to apply theoretical knowledge to practical problems. Students will have opportunities to engage with real-world datasets and implement AI/ML models in courses such as CSCC11H3 Introduction to Machine Learning and Data Mining, CSCD84H3 Artificial Intelligence, and CSCD25H3 Advanced Data Science. In addition, students may enroll in faculty- supervised research or |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                                       | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                             | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                       | They will gain experience selecting appropriate models, training and evaluating models, and interpreting results in practical contexts such as image recognition, natural language processing, and autonomous systems.                                                                                                       | development projects (CSCD94H3/D95H3 Computer Science Project), where they can explore advanced AI/ML topics or apply machine learning techniques to domain-specific challenges. These experiences help students refine their problem-solving skills, evaluate model performance, and communicate their findings effectively, all of which are key skills in both academic and industry settings. |
| <b>4. Awareness of Limits of Knowledge</b><br>Students will gain an understanding of the limits to their own knowledge. They will also gain an appreciation of the uncertainty, ambiguity, and limits to our collective knowledge and | Students in any of the streams of the Specialist/Specialist Co-op programs in Computer Science will, through practical experience in software projects and guided study courses, develop an understanding of the limits of technical solutions. They will be exposed to open problems in multiple areas of computer science. | The program includes several experiential components that allow students to encounter and reflect on the limitations of their knowledge. This is especially evident in courses such as CSCD94H3/D95H3 (Computer Science Project), where students often work with real-world datasets or explore open-ended problems in                                                                            |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u> | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>how these might influence analyses and interpretations.</p>                                                                  | <p>In addition, for the Artificial Intelligence and Machine Learning stream, students will further develop this awareness by examining the limitations of machine learning models and intelligent systems. They will explore issues such as data bias, model interpretability, generalization limitations, and the ethical implications of automated decision-making. These experiences will help students recognize the uncertainty and ambiguity that often accompany AI/ML applications, and prepare them to critically assess the reliability and societal impact of the systems they design.</p> | <p>artificial intelligence and machine learning. These experiences help students recognize the boundaries of current AI/ML techniques and identify areas for further learning and research.</p> <p>In the Artificial Intelligence/Machine Learning stream, students will also be introduced to the complexities of working with uncertain, biased, or incomplete data, and the challenges of building interpretable and reliable models.</p> <p>Courses such as CSCC11H3 (Machine Learning and Data Mining) and CSCD84H3 (Artificial Intelligence) provide opportunities to explore these challenges in depth.</p> <p>Beyond the classroom, students may participate in co-op placements or undergraduate research opportunities</p> |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                         | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | that expose them to real-world AI/ML applications and the limitations of deploying these systems in practice. These experiences reinforce the importance of critical thinking, adaptability, and ethical awareness when working with intelligent technologies and real data.                                                                     |
| <b>5. Communications Skills</b><br>Students will be able to communicate information, arguments, and analyses accurately and reliably, both orally and in writing. Students will learn to read and to listen critically. | Students in all streams of the Specialist/Specialist Co-op program in Computer Science are expected to develop excellent written and oral communication skills. They are able to present their ideas clearly and concisely, adjusting the level of technical detail to suit different audiences, and can collaborate effectively as part of a team to develop and communicate complex solutions.<br>Additionally, in the AI/ML stream, students will learn to effectively communicate data-driven insights and intelligent system | Students will be presented with multiple opportunities to develop their written and presentation skills. Examples include project reports, software documentation, and presentations. Together with the need to work in groups for their course projects, all these factors contribute to developing solid written and oral presentation skills. |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u>                                                                                                                                                                                                                                                                                                                  | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                  | designs through technical reports, visualizations, and presentations. They will practice explaining model strengths, limitations, and ethical implications to both technical and non-technical audiences to support informed decision- making.                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>6. Autonomy and Professional Capacity</b><br>In a broader context, the education students receive while pursuing their degrees has three further goals: to give students the skills and knowledge they need to become informed, independent and creative thinkers; to instill the awareness that knowledge and its applications are influenced by and contribute to society; and to lay the foundation for learning as a life-long endeavour. | Students in all streams of the Specialist/Specialist Co-op programs in Computer Science will have acquired the foundations in computer science that will allow them to pursue a career of their choice within the field. They can, for example, become software developers; or they can choose instead to pursue graduate studies in a computer science topic they find exciting.<br>The proposed Artificial Intelligence and Machine Learning stream will further prepare students for advanced careers in intelligent systems and data-driven technologies as innovators developing | Our Specialist/Specialist Co-op programs in Computer Science will achieve these goals by providing students with an education that is thorough, carefully planned, and carried out by outstanding research and teaching stream faculty.<br>The co-op option will allow students to experience the impact of computer science outside university, and to bring that experience back to students not in the co-op program through their interactions within team projects. Research faculty working at the edge of their field expose students to |

| <u>University of Toronto<br/>Scarborough DLEs (Based on<br/>the Ontario Council of<br/>Academic Vice-Presidents<br/>[OCAV])</u> | <u>Program Learning Outcomes</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>How the Program Design/Structure<br/>of the Required Courses and Other<br/>Learning Activities Supports the<br/>Achievement of Program Learning<br/>Outcomes</b>                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                 | <p>state-of-the-art AI solutions, researchers advancing machine learning methodologies, or professionals leveraging AI techniques to solve complex problems across diverse sectors.</p> <p>The course structure, the qualifications of our faculty, the focus of our Department, and the atmosphere within the student body all contribute toward instilling the desire for learning and for further refinement of student skills.</p> <p>Students will have observed the impact that Artificial Intelligence and Machine Learning have in society, and will have had opportunity to reflect and consider their role as computer science professionals, whatever their career path, toward shaping and improving the society they will be a part of, wherever that may be.</p> | <p>cutting-edge research, and provide them with opportunities to learn the research process.</p> <p>Finally, the required CSCD03H3 (Social Impact of Information Technology) or PHLB18H3 (Ethics of Artificial Intelligence) courses ensure that students have experience applying AI/ML methodologies to solve meaningful real-world problems guided by fairness and ethical principles.</p> |

## 6 Assessment

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- a) Discuss the appropriateness of the methods for assessing student achievement of the program-level learning outcomes and degree level expectations.
- b) Discuss the appropriateness of the plans to monitor and assess the following:
  - i. The overall quality of the offering's structure
  - ii. Whether the program and/or the offering within the program is achieving in practice its proposed objectives
  - iii. Whether its students are achieving the program-level learning outcomes
  - iv. How the resulting information will be documented and subsequently used to inform continuous program improvement.

The proposed stream uses only existing courses and involves no changes to the assessment. Consistent with other computer science streams, assessment for courses specific to the proposed stream include:

- Written assignments consisting of mathematical derivations for formulas and proofs (particularly for courses such as STAB57H3, CSCC37H3, CSCC11H3)
- Implementation assignments requiring students to complete a programming implementation of relevant material (these are common in courses such as CSCC11H3 and CSCD84H3). Depending on the complexity of the implementation, these assignments may involve a teamwork component
- End-of-term projects intended to allow students to demonstrate their mastery of the course material. For example, for CSCC11H3 students are required to implement and compare alternate methods for approaching a particular machine learning problem, such as predicting trends in stocks; or analyzing demographic data available from government sources.
- Practicals and labs, which take place under TA supervision and during which the students get to work on course topics with the help and mentoring of their TA and peers. For example, CSCD84H3 includes weekly problem-solving exercises that are designed to be solved during tutorial at the lab.
- Written in-person tests. This includes both a term test and a final examination.

As noted earlier, these methods of assessment have been in place for some time, and no significant change to them is expected as a result of this proposal.

Table 3 summarizes relationship between PLOs in category 7, which are stream specific PLOs, and the assessments.

**Table 3: AI & ML Stream-Specific PLOs and Assessment Methods**

| <b>PLO</b>                                                                                                                                                              | <b>Assessment Methods</b>        | <b>Representative Coursework</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
| 7.1 Apply core AI techniques including search, logic, planning, and agents to model intelligent behavior for solving complex problems.                                  | Practicals and Labs              | CSCD84H3                         |
| 7.2 Apply supervised, unsupervised, and reinforcement learning to solve machine learning problems using real-world dataset.                                             | Implementation Assignments       | CSCC11H3, CSCD84H3               |
| 7.3 Apply probabilistic reasoning and statistical methods to evaluate machine learning models, tune the hyperparameters, and support decision-making under uncertainty. | Written Mathematical Derivations | STAB57H3, CSCC11H3               |
| 7.4 Design and implement deep learning and generative models for solving problems in vision, language, and robotics                                                     | End-of-Term Project              | CSCC11H3, CSCD25H3, STAD68H3     |
| 7.5 Evaluate fairness, interpretability, and societal impact of AI systems.                                                                                             | Written Tests                    | CSCD03H3, PHLB18H3               |

## 7 Need and Demand

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Provide a brief description of the need and demand for the proposed offering, including information on student demand and internal cognate and external comparator programs as relevant.

Labor market analyses from Statistics Canada presents strong evidence of the importance of Artificial Intelligence (AI) proficiency, with approximately 60% of Canadian jobs facing AI-related transformation. Workers with advanced education, particularly in professional, technical, and scientific sectors are positioned to benefit most from AI integration ([1], [2]). There is a robust and increasing student demand for education in AI and machine learning (ML), driven by both academic interest and recognition of the growing career opportunities in this field. ACM CS2023 curricula also added mandatory AI teaching hours to them.

The proposed AI/ML stream is designed to meet this demand. It aligns with comparable programs at peer institutions, including the University of Waterloo, U of T St. George, and Carnegie Mellon University, while distinguishing itself through a carefully balanced curriculum that combines theoretical foundations, applied skills, and interdisciplinary electives tailored to UTSC's academic strengths.

Over the month of July 2025, we collected feedback from current CMS students via an anonymous online survey. We received a total of 302 responses. To the question "Do you think adding an AI&ML Specialist Program is a good idea?", 72% replied that it was a great idea, 19% said it was a good idea, 8% offered no opinion, and 2% thought it was not a good idea. To the question "If the AI/ML Specialist Program was an option for you, would you choose it?", 63% responded that they would definitely choose it, 26% responded that they would consider choosing it, and 11% said that they would not choose it. Additionally, we received a lot of positive comments, such as "would love this and a lot of my friends would too" or "please create this stream asap so that I can join, I am going to graduate in December, please!!"

[1] Experimental Estimates of Potential Artificial Intelligence Occupational Exposure in Canada, <https://doi.org/10.25318/11f0019m2024005-eng>, September 3, 2024

[2] Exposure to artificial intelligence in Canadian jobs: Experimentalestimates,

<https://doi.org/10.25318/36280001202400900004-eng>, September 25, 2024

## 8 Enrolment

- a) Please provide details regarding the anticipated in-take by year, reflecting the expected increases to reach steady state. Include approximate domestic/international mix. This table should reflect normal estimated program length. (Please adjust the table as necessary.)
- b) Please provide an explanation of the numbers shown and their relationship to the Faculty/division's enrolment plan. Please be specific where this may differ from approved enrolment plans.

**Table 1: AI & ML Stream Enrolment Projections\***

| Year of Study           | 2026-27 | 2027-28                         | 2028-29                          | 2029-30                          | 2030-31                          | 2031-32                          | 2032-33                          |
|-------------------------|---------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Year 1                  |         |                                 |                                  |                                  |                                  |                                  |                                  |
| Year 2<br>(if relevant) |         | 100<br>(70 Co-op, 30 Non Co-op) | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   |
| Year 3<br>(if relevant) |         |                                 | 100<br>(70 Co-op, 30 Non Co-op)  | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   |
| Year 4<br>(if relevant) |         |                                 |                                  | 100<br>(70 Co-op, 30 Non Co-op)  | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   | 75<br>(52 Co-op, 23 Non Co-op)   |
| Total                   |         | 100<br>(70 Co-op, 30 Non Co-op) | 175<br>(122 Co-op, 53 Non Co-op) | 250<br>(174 Co-op, 76 Non Co-op) | 225<br>(156 Co-op, 69 Non Co-op) | 225<br>(156 Co-op, 69 Non Co-op) | 225<br>(156 Co-op, 69 Non Co-op) |

\*Please note when the program expects to reach steady state.

We expect that approximately 50% of students who currently choose the Software Engineering Stream will switch to the new AI/ML Stream. The estimates are based on first-year admission targets into CS of 300 in 2025-26 and 200 in each subsequent year, where 40% students are international students and 60% students are domestic. Please note that Computer Science Specialist students choose their stream at the end of their first year in the program.

According to these projections, we expect the program to reach steady state in 2030-2031.

## 9 Impact of the Change

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- a) Please assess the impact the proposed modification will have on the program's students and/or other units or divisions.

The new Stream will introduce new options for our students. Once the Calendar changes take effect in September 2026, continuing students in a Computer Science Specialist Subject POST will be able to switch into the new Stream. Subsequently, when students apply for a Subject POST in April/August, they will have a choice of five rather than four Streams. The flexible structure of the program requirements allows students to easily switch between Streams relatively late in the program. There is no timing constraint on when they can switch stream.

We estimate that half of the students who are currently choosing the Software Engineering streams of the Specialist/Specialist Co-op programs in Computer Science, will be interested in the proposed AI/ML streams (non Co-op and Co-op). We therefore predict no change in enrolments in the overall enrolment in CS specialist programs, but rather a redistribution of the students into the different streams of those programs. We estimate 40% of students from the existing four streams would switch to AI/ML streams.

## 10 Resources

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### 10.1 Faculty

Table 2 provides faculty complement. The column “Commitment to Other Programs” does not apply. For the column “Nature of Contribution to This Program”, none of the courses in the proposed streams are new and have been taught by faculty in the past.

**Table 2: Faculty Complement (please list alphabetically)**

| <b>Name</b>                          | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs (Please list other programs in which the person routinely teaches/ supervises.)</b> | <b>Nature of Contribution to This Program (Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.)</b> |
|--------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tenure Stream: Full Professor</b> |                                             |                                                           |                                                                                           |                                                                                                                     |                                                                                                                                                                                          |
| Evans, Michael                       | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Full Member                                                         | Grad programs                                                                                                       | CI for C- and D-level Stat courses                                                                                                                                                       |
| Fleet, David                         | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                       | CI for AI, ML, computer vision courses                                                                                                                                                   |
| Hadzilacos, Vassos                   | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                       | CI for algorithm, computing theory courses                                                                                                                                               |
| Koudas, Nick                         | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                       | CI for database courses                                                                                                                                                                  |

| <b>Name</b>                               | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|-------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Molloy, Michael                           | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for computing theory courses                                                                                                                                                             |
| Roy, Daniel                               | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Full Member                                                         | Grad programs                                                                                                          | CI for ML courses                                                                                                                                                                           |
| Schroeder, Bianca                         | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for computer system courses                                                                                                                                                              |
| Virag, Balint                             | CMS-UTSC<br>100%                            |                                                           | Mathematics, Full Member                                                                  | Grad programs                                                                                                          | CI for MATH/STAT courses                                                                                                                                                                    |
| <b>Tenure Stream: Associate Professor</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| Anderson, Ashton                          | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for CSCD25H3 and CSCD46H3                                                                                                                                                                |

| <b>Name</b>                               | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|-------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pekhimenko, Gennady                       | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for compiler and computer system courses                                                                                                                                                 |
| Sun, Qiang                                | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Full Member                                                         | Grad programs                                                                                                          | CI for ML and STAT courses                                                                                                                                                                  |
| Wang, Linbo                               | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Full Member                                                         | Grad programs                                                                                                          | CI for STAT and ML courses                                                                                                                                                                  |
| Wong, Leonard                             | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Full Member                                                         | Grad programs                                                                                                          | CI for STAT courses                                                                                                                                                                         |
| <b>Tenure Stream: Assistant Professor</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| Randrianarisoa, Thibault                  | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences                                                                      | Grad programs                                                                                                          | CI for ML and STAT courses                                                                                                                                                                  |

| <b>Name</b>                                             | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|---------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rudner, Tim                                             | CMS-UTSC<br>100%                            |                                                           | Statistical Sciences, Associate Restricted Member                                         | Grad programs                                                                                                          | CI for ML and STAT courses                                                                                                                                                                  |
| Tell, Roei                                              | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for algorithm and computing theory courses                                                                                                                                               |
| Vijaykumar, Nandita                                     | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for computer systems courses                                                                                                                                                             |
| Zhang, Qizhen                                           | CMS-UTSC<br>100%                            |                                                           | Computer Science, Full Member                                                             | Grad programs                                                                                                          | CI for database courses                                                                                                                                                                     |
| <b>Tenure Stream: Assistant Professor (Conditional)</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
|                                                         |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |

| <b>Name</b>                                                                    | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|--------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| <b>Continuing Stream Teaching Stream: Professor, Teaching Stream</b>           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| Estrada, Francisco                                                             | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for AI, ML, robotics, graphics courses                                                                                                                                                   |
| Harrington, Brian                                                              | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for intro to CS and CSCD03H3 courses                                                                                                                                                     |
| Tafliovich, Anya                                                               | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for programming languages, algorithm and computing theory courses                                                                                                                        |
| <b>Continuing Stream Teaching Stream: Associate Professor, Teaching Stream</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |

| <b>Name</b>                                                                    | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|--------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bretscher, Anna                                                                | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for computing theory, algorithm courses                                                                                                                                                  |
| Cheng, Nick                                                                    | CMS-UTSC<br>67%                             |                                                           |                                                                                           |                                                                                                                        | CI for computing theory courses                                                                                                                                                             |
| Kang, SoHee                                                                    | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for STAT and ML courses                                                                                                                                                                  |
| Pancer, Richard                                                                | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for scientific computing courses                                                                                                                                                         |
| Samarakoon, Mahinda                                                            | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for STAT courses                                                                                                                                                                         |
| Sans, Thierry                                                                  | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for computer systems and cybersecurity courses                                                                                                                                           |
| <b>Continuing Stream Teaching Stream: Assistant Professor, Teaching Stream</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |

| <b>Name</b>                                                                                 | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|---------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Butler, Kenneth                                                                             | CMS-UTSC<br>34%                             | reduced load                                              | Statistical Sciences, Associate Member                                                    |                                                                                                                        | CI for upper year STAT courses                                                                                                                                                              |
| Huang, Yiqing                                                                               | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for ML, AI and system courses                                                                                                                                                            |
| Lee, Edward                                                                                 | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for programming languages and compiler courses                                                                                                                                           |
| Paramonov, Dmitry                                                                           | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for computing theory courses                                                                                                                                                             |
| Ponce, Marcelo                                                                              | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for computer system courses                                                                                                                                                              |
| Shams, Shahriar                                                                             | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for STAT courses                                                                                                                                                                         |
| <b>Continuing Stream Teaching Stream: Assistant Professor, Teaching Stream (Continuing)</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |

| <b>Name</b>                                                                                                               | <b>Unit of Primary Budgetary Appt and %</b> | <b>Unit of Other Budgetary Appt and % (if applicable)</b> | <b>Graduate Faculty Membership Status and Graduate Unit (e.g., EEB, Associate member)</b> | <b>Commitment to Other Programs</b><br>(Please list other programs in which the person routinely teaches/ supervises.) | <b>Nature of Contribution to This Program</b><br>(Course instructor [CI], thesis supervision [TS], clinical or practice supervisor [C/PS]. Please list the courses each member will teach.) |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| <b>Teaching Stream (CLTA, Part-time)</b>                                                                                  |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| Abou Assi, Rawad                                                                                                          | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for software engineering courses                                                                                                                                                         |
| Toledo, Rafael                                                                                                            | CMS-UTSC<br>100%                            |                                                           |                                                                                           |                                                                                                                        | CI for software engineering courses                                                                                                                                                         |
| <b>Non-Tenure Stream (CLTA, Part-time)</b>                                                                                |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| Vinogradov, Vladimir                                                                                                      |                                             |                                                           | Statistics                                                                                | Grad programs                                                                                                          | CI for STAT courses                                                                                                                                                                         |
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| <b>Sessional Lecturer</b>                                                                                                 |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
|                                                                                                                           |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |
| <b>Others (please specify, i.e., adjunct, status only, clinical faculty, visiting or other as per U of T definitions)</b> |                                             |                                                           |                                                                                           |                                                                                                                        |                                                                                                                                                                                             |

| <b>Name</b> | <b>Unit of Primary<br/>Budgetary<br/>Appt and %</b> | <b>Unit of Other<br/>Budgetary<br/>Appt and % (if<br/>applicable)</b> | <b>Graduate<br/>Faculty<br/>Membership<br/>Status and<br/>Graduate Unit<br/>(e.g., EEB,<br/>Associate<br/>member)</b> | <b>Commitment to<br/>Other Programs</b><br>(Please list other<br>programs in which<br>the person routinely<br>teaches/<br>supervises.) | <b>Nature of<br/>Contribution to<br/>This Program</b><br>(Course instructor<br>[CI], thesis<br>supervision [TS],<br>clinical or practice<br>supervisor [C/PS].<br>Please list the<br>courses each<br>member will teach.) |
|-------------|-----------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |                                                     |                                                                       |                                                                                                                       |                                                                                                                                        |                                                                                                                                                                                                                          |
|             |                                                     |                                                                       |                                                                                                                       |                                                                                                                                        |                                                                                                                                                                                                                          |

## 10.2 Resources: All Programs

Given the offering's planned/anticipated class sizes and cohorts as well as its program-level learning outcomes please discuss:

- a) Participation of a sufficient number and quality of core (i.e., appointed) faculty who are competent to teach and/or supervise in and achieve the goals of the offering and foster the appropriate academic environment.

We anticipate that approximately half of the students who currently choose the Software Engineering Stream will opt for the new AI & ML Stream (non Co-op and Co-op). Our faculty are better equipped to teach courses in the AI & ML area than in Software Engineering, where we have had to rely heavily on sessional instructors. We expect to staff most of the AI & ML course sections, including the additional sections, with full-time faculty, from both the tenure and teaching streams. We will continue to rely on sessional instructors to staff all required course sections, but the impact will be less than the current reliance on sessional instructors in Software Engineering.

- b) If applicable, discuss the role and approximate percentage of adjunct and sessional faculty/limited term appointments used in the delivery of the offering and the associated plans to ensure the sustainability of the offering and quality of the student experience.

The introduction of the proposed new stream will not result in an increased enrolment. While the distribution of students across the Computer Science program streams will shift, the overall number of students in the program will remain unchanged. We expect demand for new sections of core AI/ML courses and a decrease in the number of Software Engineering course sections. As a result, we expect a shift in sessional and limited-term teaching appointments from Software Engineering to AI/ML. We expect no budget increase. Rather it is the same amount of budget to allocate to sessional and limited-term teaching appointments with different teaching focuses to adapt to the changes of reduced demand in software engineering and increased demand in AI & ML.

- c) If required, provision of supervision of experiential learning opportunities.

Experiential learning is integral to a large number of our courses, including core AI/ML courses. CSCC11H3 (Introduction to Machine Learning and Data Mining) offers open-ended real-world projects guided by the instructor and teaching assistant team. Additionally, students will be able to enroll in faculty-supervised research and independent study projects (CSCD94H3/D95H3). We have two new AI & ML research faculty joined the department in 2025. Our teaching faculty in AI&ML also offer undergraduate research courses on a continuing basis. Students in the Co-op stream will have ample opportunities to leverage their highly sought AI/ML skills in the AI industry placements with the skills they acquired from this new stream.

- d) Adequacy of the administrative unit's planned utilization of existing human, physical and financial resources.

There are no new courses in the proposed stream and the overall enrolment into the Computer Science Specialist programs is not expected to increase due to the introduction to this new stream. The department already has a good portfolio of faculty members in AI & ML. The department has been supporting the existing four streams successfully. So adding this new stream will not introduce new resource demand to support five streams.

- e) Evidence that there are adequate resources to sustain the quality of scholarship and research activities produced by students, including library support, information technology support, and laboratory access.

The newly proposed streams are to redistribute existing student body to different learning pathways. There are no new courses introduced. There is no increase in the resource usage. The existing resources already suffice to support the proposed stream.

- f) If necessary, additional institutional or divisional resource commitments to support the offering in step with its ongoing implementation.

This one does not apply to the newly proposed stream.

## 11 Consultation

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Describe consultation with internal (faculty, students, cognate units, etc., as appropriate) and external stakeholders (alumni, community, or professional organizations, etc., as appropriate).

We conducted extensive consultations with faculty members from Computer Science, Mathematics, and Statistics at UTSC, as well as at the St. George and Mississauga campuses of the University of Toronto. We also consulted with colleagues in UTSC departments currently developing complementary programs related to AI, and with current CMS students.

Between June 11 and 19, 2025, we circulated a draft of the proposal to CMS faculty members with expertise in Machine Learning and Artificial Intelligence to gather their feedback. The support for the introduction of the new streams was overwhelmingly positive. We incorporated numerous suggestions regarding program requirements, including the distinction between required and elective courses, as well as recommended pathways through the program.

On June 27, we broadened the consultation process by inviting input from the entire department. Over the following weeks, we received and incorporated several suggestions to improve the proposal.

While we were consulting with CMS faculty members, the Associated Chair, Computer Science also shared the proposal with the Associate Chairs of Computer Science at the St. George and Mississauga campuses. These consultations focused on the potential impact of the proposed programs on students and faculty at those campuses, possible enrolment pressures in oversubscribed/popular courses, as well as opportunities for cross-campus course enrolment. After incorporating their suggestions, the proposal received strong support from both St. George and UTM.

On July 2 we met with representatives from the Departments of Philosophy and Sociology, as well as experts from the Dean's Office and the Registrar's Office to discuss the cross- departmental impact of the new programs and potential for collaboration and opening new opportunities for UTSC students. Notably, because of these consultations, students in the new stream will have the opportunity to take a course on Ethics of Artificial Intelligence, offered by the Department of Philosophy.

Over the month of July, feedback was collected from current CMS students via an anonymous online survey regarding the addition of an AI & ML Specialist stream. The survey results indicate strong support.

A draft version of this proposal was presented at the November 20, 2025 meeting of the Tri-campus Deans. The Tri-campus Deans Group of colleagues expressed strong support for the proposal, and appreciation for the contribution this new program cluster that relates to AI will be making at UTSC.

A copy of the revised proposal was shared with the Office of the Registrar, the Arts & Science Co-op Office for review, as well as circulated to the Faculty of Arts & Science and the University of Toronto Mississauga in December 2025 for consultation and feedback. Feedback received from the UTSC Office of the Registrar included revisiting Requirement 5 of the proposed stream in relation to the existing four streams and considering if a new requirement would need be added to require students to complete at least 1.0 credits of CSC courses at the D level. Feedback received from the Faculty of Arts & Science included clarifying the distinctiveness of this stream relative to the existing four streams and expanding on the pedagogical rationale for formalizing this pathway, as well as addressing instructor and resources for key upper-year AI and ML courses. The Faculty Complement table is being revisited based on feedback received from the University of Toronto Mississauga. This version of the proposal incorporates all updates required to address the feedback received.

A copy of this proposal was also shared with the Faculty of Applied Science and Engineering and the Faculty of Information in February 2026 for consultation and feedback. There was no feedback relayed from the Faculty of Applied Science and Engineering. The Faculty of Information expressed their support for this proposal.

## Appendix A: Courses

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Here is a full list of all courses included in the offering. All of these courses are existing courses.

### CSCA08H3 - Introduction to Computer Science I

Programming in an object-oriented language such as Python. Program structure: elementary data types, statements, control flow, functions, classes, objects, methods. Lists; searching, sorting and complexity. This course is intended for students having a serious interest in higher level computer science courses, or planning to complete a computer science program.

**Prerequisite:** Grade 12 Calculus and Vectors and [one other Grade 12 mathematics course or CTL Math Preparedness course with additional resources for CMS students].

**Exclusion:** [CSCA20H3](#), CSC108H, CSC110H, CSC120H. [CSCA08H3](#) may not be taken after or concurrently with [CSCA48H3](#). CSC110H cannot be taken after or concurrently with CSC111H.

**Breadth Requirements:** Quantitative Reasoning

**Note:** This course does not require any prior exposure to computer programming.

### CSCA48H3 - Introduction to Computer Science II

Abstract data types and data structures for implementing them. Linked data structures. Object Oriented Programming. Encapsulation and information-hiding. Testing. Specifications. Analyzing the efficiency of programs. Recursion.

**Prerequisite:** [CSCA08H3](#)

**Exclusion:** CSC148H, CSC111H

**Breadth Requirements:** Quantitative Reasoning

### CSCA67H3 - Discrete Mathematics

Introduction to discrete mathematics: Elementary combinatorics; discrete probability including conditional probability and independence; graph theory including trees, planar graphs, searches and traversals, colouring. The course emphasizes topics of relevance to computer science, and exercises problem-solving skills and proof techniques such as well ordering, induction, contradiction, and counterexample.

Same as [MATA67H3](#)

**Prerequisite:** Grade 12 Calculus and Vectors and one other Grade 12 mathematics course

**Exclusion:** (MATA67H3), (CSCA65H3), CSC165H, CSC240H, MAT102H

**Recommended Preparation:** [CSCA08H3](#) or [CSCA20H3](#)

**Breadth Requirements:** Quantitative Reasoning

### CSCB07H3 - Software Design

An introduction to software design and development concepts, methods, and tools, using a statically-typed object-oriented language such as Java. Topics from: version control, build management, unit testing, refactoring, object-oriented design and development, design patterns and advanced IDE usage.

**Prerequisite:** [CSCA48H3](#) and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** CSC207H

**Breadth Requirements:** Quantitative Reasoning

### CSCB09H3 - Software Tools and Systems Programming

Software techniques in a Unix-style environment, using scripting languages and a machine-oriented programming language (typically C). What goes on in the system when programs are executed. Core topics: creating and using software tools, pipes and filters, file processing, shell programming, processes, system calls, signals, basic network programming.

**Prerequisite:** [CSCA48H3](#) and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** CSC209H

**Breadth Requirements:** Quantitative Reasoning

### CSCB36H3 - Introduction to the Theory of Computation

Mathematical induction with emphasis on applications relevant to computer science. Aspects of mathematical logic, correctness proofs for iterative and recursive algorithms, solutions of linear and divide-and-conquer recurrences, introduction to automata and formal languages.

**Prerequisite:** [CSCA48H3](#) and [(CSCA65H3) or [CSCA67H3](#)] and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** CSC236H, CSC240H

**Breadth Requirements:** Quantitative Reasoning

### CSCB58H3 - Computer Organization

Principles of the design and operation of digital computers. Binary data representation and manipulation, Boolean logic, components of computer systems, memory technology, peripherals, structure of a CPU, assembly languages, instruction execution, and addressing techniques. There are a number of laboratory periods in which students conduct experiments with digital logic circuits.

**Prerequisite:** [[CSCA48H3](#) or [PHYB57H3](#)/(PSCB57H3)] and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** CSC258H

**Breadth Requirements:** Quantitative Reasoning

### CSCB63H3 - Design and Analysis of Data Structures

Design, analysis, implementation and comparison of efficient data structures for common abstract data types. Priority queues: heaps and mergeable heaps. Dictionaries: balanced binary search trees, B-trees, hashing. Amortization: data structures for managing dynamic tables and disjoint sets. Data structures for representing graphs. Graph searches.

**Prerequisite:** [CSCB36H3](#) and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Corequisite:** [STAB52H3](#)

**Exclusion:** CSC263H, CSC265H

**Breadth Requirements:** Quantitative Reasoning

### CSCC10H3 - Human-Computer Interaction

The course will provide an introduction to the field of Human-Computer Interaction (HCI) with emphasis on guidelines, principles, methodologies, and tools and techniques for analyzing, designing and evaluating user interfaces. Subsequent topics include usability assessment of interactive systems, prototyping tools, information search and visualization, mobile devices, social media and social networking, and accessibility factors.

**Prerequisite:** [CSCB07H3](#) and [CGPA 3.5 or enrolment in a CSC Subject POST]

**Exclusion:** CCT380H, CSC318H

**Breadth Requirements:** Quantitative Reasoning

### CSCC11H3 - Introduction to Machine Learning and Data Mining

An introduction to methods for automated learning of relationships on the basis of empirical data. Classification and regression using nearest neighbour methods, decision trees, linear and non-linear models, class-conditional models, neural networks, and

Bayesian methods. Clustering algorithms and dimensionality reduction. Model selection. Problems of over-fitting and assessing accuracy. Problems with handling large databases.

**Prerequisite:** [MATB24H3](#) and [MATB41H3](#) and [STAB52H3](#) and [CGPA of at least 3.5 or enrolment in a CSC Subject POST or enrolment in a non-CSC Subject POST for which this specific course is a program requirement].

**Exclusion:** CSC411H, (CSCD11H3)

**Recommended Preparation:** [CSCC37H3](#)

**Breadth Requirements:** Quantitative Reasoning

CSCC37H3 - Introduction to Numerical Algorithms for Computational Mathematics

An introduction to computational methods for solving problems in linear algebra, non-linear equations, approximation and integration. Floating-point arithmetic; numerical algorithms; application of numerical software packages.

**Prerequisite:** [MATA22H3](#) and [[MATA36H3](#) or [MATA37H3](#)] and [CGPA of at least 3.5 or enrolment in a CSC Subject POST or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** (CSCC36H3), (CSCC50H3), (CSCC51H3), CSC336H, CSC350H, CSC351H, CSC338H

**Breadth Requirements:** Quantitative Reasoning

CSCC43H3 - Introduction to Databases

Introduction to database management systems. The relational data model. Relational algebra. Querying and updating databases: the SQL query language. Application programming with SQL. Integrity constraints, normal forms, and database design. Elements of database system technology: query processing, transaction management.

**Prerequisite:** [CSCB09H3](#) and [CSCB63H3](#) and [CGPA 3.5 or enrolment in a CSC Subject POST]

**Exclusion:** CSC343H

**Breadth Requirements:** Quantitative Reasoning

CSCC46H3 - Social and Information Networks

How networks underlie the social, technological, and natural worlds, with an emphasis on developing intuitions for broadly applicable concepts in network analysis. Topics include: introductions to graph theory, network concepts, and game theory; social networks; information networks; the aggregate behaviour of markets and crowds; network dynamics; information diffusion; popular concepts such as "six degrees of separation", the "friendship paradox", and the "wisdom of crowds".

**Prerequisite:** [CSCB63H3](#) and [STAB52H3](#) and [[MATA22H3](#) or [MATA23H3](#)] and [a CGPA of 3.5 or enrolment in a CSC Subject POST]

**Breadth Requirements:** Quantitative Reasoning

### CSCC63H3 - Computability and Computational Complexity

Introduction to the theory of computability: Turing machines, Church's thesis, computable and non-computable functions, recursive and recursively enumerable sets, reducibility. Introduction to complexity theory: models of computation, P, NP, polynomial time reducibility, NP-completeness, further topics in complexity theory.

**Note:** Although the courses [CSCC63H3](#) and [CSCC73H3](#) may be taken in any order, it is recommended that [CSCC73H3](#) be taken first.

**Prerequisite:** [CSCB36H3](#) and [CSCB63H3](#) and [CGPA of at least 3.5, or enrolment in a CSC Subject POST, or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]]

**Exclusion:** CSC363H, CSC365H, CSC364H

**Breadth Requirements:** Quantitative Reasoning

### CSCC69H3 - Operating Systems

Principles of operating systems. The operating system as a control program and as a resource allocator. The concept of a process and concurrency problem: synchronization, mutual exclusion, deadlock. Additional topics include memory management, file systems, process scheduling, threads, and protection.

**Prerequisite:** [CSCB07H3](#) and [CSCB09H3](#) and [CSCB58H3](#) and [CGPA 3.5 or enrolment in a CSC Subject POST]

**Exclusion:** CSC369H

**Breadth Requirements:** Quantitative Reasoning

### CSCC73H3 - Algorithm Design and Analysis

Standard algorithm design techniques: divide-and-conquer, greedy strategies, dynamic programming, linear programming, randomization, and possibly others.

**Prerequisite:** [CSCB63H3](#) and [STAB52H3](#) and [CGPA of at least 3.5 or enrolment in a CSC Subject POST or enrolment in a non-CSC Subject POST for which this specific course is a program requirement]

**Exclusion:** CSC373H, CSC375H, CSC364H

**Breadth Requirements:** Quantitative Reasoning

### CSCD03H3 - Social Impact of Information Technology

The trade-offs between benefits and risks to society of information systems, and related issues in ethics and public policy. Topics will include safety-critical software; invasion of

privacy; computer-based crime; the social effects of an always-online life; and professional ethics in the software industry. There will be an emphasis on current events relating to these topics.

**Prerequisite:** 14.0 credits and enrolment in a Computer Science Subject POST. Restricted to students in the Specialist/Specialist Co-op programs in Computer Science or in the Specialist/Specialist Co-op programs in Management and Information Technology

**Exclusion:** CSC300H

**Breadth Requirements:** Social and Behavioural Sciences

**Course Experience:** University-Based Experience

### CSCD84H3 - Artificial Intelligence

A study of the theories and algorithms of Artificial Intelligence. Topics include a subset of: search, game playing, logical representations and reasoning, planning, natural language processing, reasoning and decision making with uncertainty, computational perception, robotics, and applications of Artificial Intelligence. Assignments provide practical experience of the core topics.

**Prerequisite:** [STAB52H3](#) and [CSCB63H3](#) and [a CGPA of 3.5 or enrolment in a CSC subject POST]

**Exclusion:** CSC484H, CSC384H

**Breadth Requirements:** Quantitative Reasoning

### CSCC85H3 - Fundamentals of Robotics and Automated Systems

The course introduces the fundamental principles, problems, and techniques involved in the operation of mobile robots and other automated systems. Course topics include: components of automated systems, sensors and sensor management, signal acquisition and noise reduction, principles of robot localization, FSM-based A.I. for planning, fault-tolerance and building fault-tolerant systems, real-time operation and real-time operating systems; and computational considerations such as hardware limitations and code optimization. Ethical considerations in the implementation and deployment of automated systems are discussed. The concepts covered in the course are put in practice via projects developed on a Lego robotic platform.

**Prerequisite:** [CSCB58H3](#) and [CSCB09H3](#) and [CGPA 3.5 or enrolment in a CSC Subject POST]

**Exclusion:** ECE385H

**Recommended Preparation:** [CSCB07H3](#)

**Breadth Requirements:** Quantitative Reasoning

### CSCD18H3 - Computer Graphics

The course will cover in detail the principles and algorithms used to generate high-quality, computer generated images for fields as diverse as scientific data visualization, modeling, computer aided design, human computer interaction, special effects, and video games. Topics covered include image formation, cameras and lenses, object models, object manipulation, transformations, illumination, appearance modeling, and advanced rendering via ray-tracing and path-tracing. Throughout the course, students will implement a working rendering engine in a suitable programming language.

**Prerequisite:** [MATB24H3](#) and [MATB41H3](#) and [[CSCB09H3](#) or proficiency in C] and [CSCC37H3](#) and [a CGPA of at least 3.5 or enrolment in a Computer Science Subject POST]

**Exclusion:** (CSC418H1)/CSC317H1

**Breadth Requirements:** Quantitative Reasoning

#### CSCD25H3 - Advanced Data Science

This course teaches the basic techniques, methodologies, and ways of thinking underlying the application of data science and machine learning to real-world problems. Students will go through the entire process going from raw data to meaningful conclusions, including data wrangling and cleaning, data analysis and interpretation, data visualization, and the proper reporting of results. Special emphasis will be placed on ethical questions and implications in the use of AI and data. Topics include data pre-processing, web scraping, applying supervised and unsupervised machine learning methods, treating text as data, A/B testing and experimentation, and data visualization.

**Prerequisite:** [CSCB63H3](#) and [CSCC11H3](#) and [a CGPA of 3.5 or enrolment in a CSC Subject POST]

**Breadth Requirements:** Quantitative Reasoning

#### CSCD43H3 - Database System Technology

Implementation of database management systems. Storage management, indexing, query processing, concurrency control, transaction management. Database systems on parallel and distributed architectures. Modern database applications: data mining, data warehousing, OLAP, data on the web. Object-oriented and object-relational databases.

**Prerequisite:** [CSCC43H3](#) and [CSCC69H3](#) and [CSCC73H3](#) and [CGPA 3.5 or enrolment in a CSC Subject POST]

**Exclusion:** CSC443H

**Breadth Requirements:** Quantitative Reasoning

#### CSCD71H3 - Topics in Computer Science

A topic from computer science, selected by the instructor, will be covered.

The exact topic will typically change from year to year.

**Prerequisite:** Permission of the instructor and [CGPA 3.5 or enrolment in a CSC Subject POST]. Normally intended for students who have completed at least 8 credits.

## Mathematics

### MATA22H3 - Linear Algebra I for Mathematical Sciences

A conceptual and rigorous approach to introductory linear algebra that focuses on mathematical proofs, the logical development of fundamental structures, and essential computational techniques. This course covers complex numbers, vectors in Euclidean n-space, systems of linear equations, matrices and matrix algebra, Gaussian reduction, structure theorems for solutions of linear systems, dependence and independence, rank equation, linear transformations of Euclidean n-space, determinants, Cramer's rule, eigenvalues and eigenvectors, characteristic polynomial, and diagonalization.

**Prerequisite:** Grade 12 Calculus and Vectors or [Grade 12 Advanced Functions and Introductory Calculus and Geometry and Discrete Mathematics]

**Exclusion:** [MATA23H3](#), MAT223H, MAT240H

**Breadth Requirements:** Quantitative Reasoning

**Note:** Students are cautioned that MAT223H cannot be used as a substitute for [MATA22H3](#) in any courses for which [MATA22H3](#) appears as a prerequisite.

### MATA31H3 - Calculus I for Mathematical Sciences

A conceptual introduction to Differential Calculus of algebraic and transcendental functions of one variable; focus on logical reasoning and fundamental notions; first introduction into a rigorous mathematical theory with applications. Course covers: real numbers, set operations, supremum, infimum, limits, continuity, Intermediate Value Theorem, derivative, differentiability, related rates, Fermat's, Extreme Value, Rolle's and Mean Value Theorems, curve sketching, optimization, and antiderivatives.

**Prerequisite:** Grade 12 Calculus and Vectors

**Exclusion:** (MATA20H3), (MATA27H3), [MATA29H3](#), [MATA30H3](#), (MATA32H3), [MATA34H3](#), MAT123H, MAT124H, MAT125H, MAT126H, MAT133Y, MAT137H5 and MAT139H5, MAT157H5 and MAT159H5, JMB170Y

**Breadth Requirements:** Quantitative Reasoning

### MATA37H3 - Calculus II for Mathematical Sciences

A rigorous introduction to Integral Calculus of one variable and infinite series; strong emphasis on combining theory and applications; further developing of tools for mathematical analysis. Riemann Sum, definite integral, Fundamental Theorem of Calculus, techniques of integration, improper integrals, numerical integration,

sequences and series, absolute and conditional convergence of series, convergence tests for series, Taylor polynomials and series, power series and applications.

**Prerequisite:** [MATA31H3](#) and [(MATA67H3) or [CSCA67H3](#)]

**Exclusion:** (MATA21H3), (MATA33H3), [MATA35H3](#), [MATA36H3](#), MAT123H, MAT124H, MAT125H, MAT126H, MAT133Y, MAT137H5 and MAT139H5, MAT157H5 and MAT159H5, JMB170Y

**Breadth Requirements:** Quantitative Reasoning

### MATB24H3 - Linear Algebra II

Fields, vector spaces over a field, linear transformations; inner product spaces, coordinatization and change of basis; diagonalizability, orthogonal transformations, invariant subspaces, Cayley-Hamilton theorem; hermitian inner product, normal, self-adjoint and unitary operations. Some applications such as the method of least squares and introduction to coding theory.

**Prerequisite:** [MATA22H3](#) or MAT240H

**Exclusion:** MAT224H

**Breadth Requirements:** Quantitative Reasoning

**Note:** Students are cautioned that MAT224H cannot be used as a substitute for [MATB24H3](#) in any courses for which [MATB24H3](#) appears as a prerequisite.

### MATB41H3 - Techniques of the Calculus of Several Variables I

Partial derivatives, gradient, tangent plane, Jacobian matrix and chain rule, Taylor series; extremal problems, extremal problems with constraints and Lagrange multipliers, multiple integrals, spherical and cylindrical coordinates, law of transformation of variables.

**Prerequisite:** [[MATA22H3](#) or [MATA23H3](#) or MAT223H] and [[MATA36H3](#) or [MATA37H3](#)] or [MAT137H5 and MAT139H5] or [MAT157H5 and MAT159H5]

**Exclusion:** MAT232H, MAT235Y, MAT237Y, MAT257Y

**Breadth Requirements:** Quantitative Reasoning

## Statistics

### STAB52H3 - An Introduction to Probability

A mathematical treatment of probability. The topics covered include: the probability model, density and distribution functions, computer generation of random variables, conditional probability, expectation, sampling distributions, weak law of large numbers, central limit theorem, Monte Carlo methods, Markov chains, Poisson processes, simulation, applications. A computer package will be used.

**Prerequisite:** [MATA22H3](#) and [MATA37H3](#)

**Exclusion:** [STAB53H3](#), [PSYB07H3](#), STA107H, STA237H1, STA247H1, STA257H, STA246H5, STA256H5

**Breadth Requirements:** Quantitative Reasoning

#### STAB57H3 - An Introduction to Statistics

A mathematical treatment of the theory of statistics. The topics covered include: the statistical model, data collection, descriptive statistics, estimation, confidence intervals and P-values, likelihood inference methods, distribution-free methods, bootstrapping, Bayesian methods, relationship among variables, contingency tables, regression, ANOVA, logistic regression, applications. A computer package will be used.

**Prerequisite:** [[STAB52H3](#) or [STAB53H3](#)]

**Exclusion:** [MGEB11H3](#), [PSYB07H3](#), [STAB22H3](#), [STAB23H3](#), STA220H1, STA261H

**Breadth Requirements:** Quantitative Reasoning

#### STAC58H3 - Statistical Inference

Principles of statistical reasoning and theories of statistical analysis. Topics include: statistical models, likelihood theory, repeated sampling theories of inference, prior elicitation, Bayesian theories of inference, decision theory, asymptotic theory, model checking, and checking for prior-data conflict. Advantages and disadvantages of the different theories.

**Prerequisite:** [STAB57H3](#) and [STAC62H3](#)

**Exclusion:** STA352Y, STA422H

**Breadth Requirements:** Quantitative Reasoning

#### STAC62H3 - Probability and Stochastic Processes I

This course continues the development of probability theory begun in [STAB52H3](#). Topics covered include finite dimensional distributions and the existence theorem, discrete time Markov chains, discrete time martingales, the multivariate normal distribution, Gaussian processes and Brownian motion.

**Prerequisite:** [MATB41H3](#) and [STAB52H3](#)

**Exclusion:** STA347H1

**Breadth Requirements:** Quantitative Reasoning

#### STAC67H3 - Regression Analysis

A fundamental statistical technique widely used in various disciplines. The topics include simple and multiple linear regression analysis, geometric representation of regression, inference on regression parameters, model assumptions and diagnostics, model

selection, remedial measures including weighted least squares, instruction in the use of statistical software.

**Prerequisite:** [STAB57H3](#)

**Exclusion:** STA302H; [Students who want to complete both [STAC67H3](#) and [MGEB12H3](#), and receive credit for both courses, must successfully complete [MGEB12H3](#) prior to enrolling in [STAC67H3](#); for students who complete [MGEB12H3](#) after successfully completing [STAC67H3](#), [MGEB12H3](#) will be marked as Extra (EXT)]

**Breadth Requirements:** Quantitative Reasoning

#### STAD68H3 - Advanced Machine Learning and Data Mining

Statistical aspects of supervised learning: regression, regularization methods, parametric and nonparametric classification methods, including Gaussian processes for regression and support vector machines for classification, model averaging, model selection, and mixture models for unsupervised learning. Some advanced methods will include Bayesian networks and graphical models.

**Prerequisite:** [CSCC11H3](#) and [STAC58H3](#) and [STAC67H3](#)

**Breadth Requirements:** Quantitative Reasoning

#### STAD78H3 - Machine Learning Theory

Presents theoretical foundations of machine learning. Risk, empirical risk minimization, PAC learnability and its generalizations, uniform convergence, VC dimension, structural risk minimization, regularization, linear models and their generalizations, ensemble methods, stochastic gradient descent, stability, online learning.

**Prerequisite:** [STAB57H3](#) and [STAC62H3](#)

**Recommended Preparation:** [STAC58H3](#) and [STAC67H3](#)

**Breadth Requirements:** Quantitative Reasoning

#### STAD80H3 - Analysis of Big Data

Big data is transforming our world, revolutionizing operations and analytics everywhere, from financial engineering to biomedical sciences. Big data sets include data with high-dimensional features and massive sample size. This course introduces the statistical principles and computational tools for analyzing big data: the process of acquiring and processing large datasets to find hidden patterns and gain better understanding and prediction, and of communicating the obtained results for maximal impact. Topics include optimization algorithms, inferential analysis, predictive analysis, and exploratory analysis.

**Prerequisite:** [STAC58H3](#) and [STAC67H3](#) and [CSCC11H3](#)

**Breadth Requirements:** Quantitative Reasoning

## Anthropology

### ANTA01H3 - Introduction to Anthropology: Becoming Human

An introduction to Biological Anthropology and Archaeology. Concentrates on the origins and evolution of human life, including both biological and archaeological aspects, from the ancient past to the present.

Science credit

**Exclusion:** ANT100Y, ANT101H

**Breadth Requirements:** Natural Sciences

### ANTA02H3 - Introduction to Anthropology: Society, Culture and Language

How does an anthropological perspective enable us to understand cultural difference in an interconnected world? In this course, students will learn about the key concepts of culture, society, and language. Drawing upon illustrations of family, economic, political, and religious systems from a variety of the world's cultures, this course will introduce students to the anthropological approach to studying and understanding human ways of life.

**Exclusion:** ANT100Y, ANT102H

**Breadth Requirements:** Social and Behavioural Sciences

## Classical Studies

### CLAA06H3 - Ancient Mythology II: Greece and Rome

A study of Greek and Roman mythologies. Special attention will be dedicated to the sources through which these representational patterns are documented and to their influence on Mediterranean civilizations and arts.

**Exclusion:** CLA204H, (CLAA02H3), (CLAA03H3)

**Recommended Preparation:** [CLAA05H3](#)

**Breadth Requirements:** History, Philosophy and Cultural Studies

## Centre for Teaching and Learning

### CTLA01H3 - Foundations in Effective Academic Communication

This highly interactive course for English Language Learners who find Academic English a challenge aims to fast-track the development of critical thinking, reading, writing and oral communication skills. Through emphasizing academic writing and rapid expansion of vocabulary, students will gain practical experience with university-level academic texts and assignment expectations.

**Prerequisite:** No more than 10.0 credits completed. Students are required to take a diagnostic test of academic English skills to be conducted by the English Language Development Support, Centre for Teaching and Learning, in advance of the first day of class.

**Breadth Requirements:** Arts, Literature and Language

**Note:** The instructor has the authority to exclude students whose level of proficiency is unsuitable for the course, including those students who meet the prerequisites.

English

ENGA10H3 - Literature and Film for Our Time: Visions and Revisions

An exploration of how literature and film reflect the artistic and cultural concerns that shaped the twentieth century.

**Exclusion:** ENG140Y

**Breadth Requirements:** Arts, Literature and Language

ENGA11H3 - Literature and Film for Our Time: Dawn of the Digital

Building on [ENGA10H3](#), this course considers how literature and film responds to the artistic, cultural, and technological changes of the late twentieth and twenty-first centuries.

**Exclusion:** ENG140Y

**Breadth Requirements:** Arts, Literature and Language

ENGB06H3 - Canadian Literature to 1900

A study of Canadian literature from pre-contact to 1900. This course explores the literatures of the "contact zone", from Indigenous oral and orature, to European journals of exploration and discovery, to the works of pioneer settlers, to the writing of the post-Confederation period.

Pre-1900 course

**Exclusion:** ENG252Y

**Breadth Requirements:** Arts, Literature and Language

ENGB07H3 - Canadian Literature 1900 to Present

A continuation of [ENGB06H3](#) introducing students to texts written from 1900 to the present. Focusing on the development of Canada as an imagined national community, this course explores the challenges of imagining an ethical national community in the context of Canada's ongoing colonial legacy: its multiculturalism; Indigenous and Quebec nationalisms; and recent diasporic and transnational reimaginings of the nation and national belonging.

**Exclusion:** ENG252Y

**Breadth Requirements:** Arts, Literature and Language

ENGB08H3 - American Literature to 1860

An examination of Early American literature in historical context from colonization to the Civil War. This introductory survey places a wide variety of genres including conquest and captivity narratives, theological tracts, sermons, and diaries, as well as classic novels and poems in relation to the multiple subcultures of the period.

Pre-1900 course

**Exclusion:** ENG250Y

**Breadth Requirements:** Arts, Literature and Language

ENGB09H3 - American Literature from the Civil War to the Present

An introductory survey of major novels, short fiction, poetry, and drama produced in the aftermath of the American Civil War. Exploring texts ranging from *The Adventures of Huckleberry Finn* to Rita Dove's *Thomas and Beulah*, this course will consider themes of immigration, ethnicity, modernization, individualism, class, and community.

**Exclusion:** ENG250Y

**Breadth Requirements:** Arts, Literature and Language

ENGB17H3 - Contemporary Literature from the Caribbean

A study of fiction, drama, and poetry from the West Indies. The course will examine the relation of standard English to the spoken language; the problem of narrating a history of slavery and colonialism; the issues of race, gender, and nation; and the task of making West Indian literary forms.

**Exclusion:** ENG264H, ENG270Y, (NEW223Y), (ENG253Y)

**Breadth Requirements:** Arts, Literature and Language

ENGB19H3 - Contemporary Literature from South Asia

A study of literature in English from South Asia, with emphasis on fiction from India. The course will examine the relation of English-language writing to indigenous South Asian traditions, the problem of narrating a history of colonialism and Partition, and the task of transforming the traditional novel for the South Asian context.

**Exclusion:** ENG270Y, (ENG253Y)

**Breadth Requirements:** Arts, Literature and Language

ENGB50H3 - Women and Literature: Forging a Tradition

An examination of the development of a tradition of women's writing. This course explores the legacy and impact of writers such as Christine de Pizan, Julian of Norwich,

Mary Wollstonecraft, Anne Bradstreet, Margaret Cavendish, Jane Austen, Mary Shelley, Emily Dickinson, and Margaret Fuller, and considers how writing by women has challenged and continues to transform the English literary canon.

Pre-1900 course

**Exclusion:** (ENG233Y)

**Breadth Requirements:** Arts, Literature and Language

## Geography

### GGRA02H3 - The Geography of Global Processes

Globalization from the perspective of human geography. The course examines how the economic, social, political, and environmental changes that flow from the increasingly global scale of human activities affect spatial patterns and relationships, the character of regions and places, and the quality of life of those who live in them.

**Exclusion:** GGR107H, (GGR107Y), GGR117Y

**Breadth Requirements:** Social and Behavioural Sciences

### GGRA03H3 - Cities and Environments

An introduction to the characteristics of modern cities and environmental issues, and their interconnections. Linkages between local and global processes are emphasized. Major topics include urban forms and systems, population change, the complexity of environmental issues such as climate change and water scarcity, planning for sustainable cities.

**Exclusion:** GGR107H, (GGR107Y), GGR117Y

**Breadth Requirements:** Social and Behavioural Sciences

### GGRB05H3 - Urban Geography

This course will develop understanding of the geographic nature of urban systems and the internal spatial patterns and activities in cities. Emphasis is placed on the North American experience with some examples from other regions of the world. The course will explore the major issues and problems facing contemporary urban society and the ways they are analysed.

Area of Focus: Urban Geography

**Prerequisite:** Any 4 credits

**Exclusion:** GGR124H, (GGR124Y)

**Breadth Requirements:** Social and Behavioural Sciences

## Linguistics

### LINA01H3 - Introduction to Linguistics

An introduction to the various methods and theories of analyzing speech sounds, words, sentences and meanings, both in particular languages and language in general.

**Exclusion:** (LIN100Y), LIN101H, LIN102H

**Breadth Requirements:** Arts, Literature and Language

### Philosophy

#### PHLA10H3 - Reason and Truth

An introduction to philosophy focusing on issues of rationality, metaphysics and the theory of knowledge. Topics may include: the nature of mind, freedom, the existence of God, the nature and knowability of reality. These topics will generally be introduced through the study of key texts from the history of philosophy.

**Exclusion:** PHL100Y1, PHL101Y1

**Breadth Requirements:** History, Philosophy and Cultural Studies

**Course Experience:** University-Based Experience

#### PHLA11H3 - Introduction to Ethics

Ethics is concerned with concrete questions about how we ought to treat one another as well as more general questions about how to justify our ethical beliefs. This course is an introduction that both presents basic theories of ethics and considers their application to contemporary moral problems.

**Exclusion:** PHL275H, PHL100Y1, PHL101Y1

**Breadth Requirements:** History, Philosophy and Cultural Studies

**Course Experience:** University-Based Experience

#### PHLB18H3 - Ethics of Artificial Intelligence

This course will provide an accessible understanding of AI systems, such as ChatGPT, focusing on the ethical issues raised by ongoing advances in AI. These issues include the collection and use of big data, the use of AI to manipulate human beliefs and behaviour, its application in the workplace and its impact on the future of employment, as well as the ethical standing of autonomous AI systems.

**Prerequisite:** None

**Corequisite:** None

**Exclusion:** None

**Recommended Preparation:** [PHLA10H3](#) or [PHLA11H3](#). These courses provide an introductory background of philosophical reasoning and core background concepts, which would assist students taking a B level course in Philosophy.

**Breadth Requirements:** History, Philosophy and Cultural Studies

**Course Experience:** University-Based Experience

## Women's and Gender Studies

### WSTA01H3 - Introduction to Women's and Gender Studies

This course explores the intersection of social relations of power including gender, race, class, sexuality and disability, and provides an interdisciplinary and integrated approach to the study of women's lives in Canadian and global contexts. There is a strong focus on the development of critical reading and analytic skills.

**Exclusion:** (NEW160Y), WGS160Y, WGS101H

**Breadth Requirements:** Social and Behavioural Sciences

## Computer Science Courses from the Faculty of Arts & Science

### CSC304H1 - Algorithmic Game Theory and Mechanism Design

**Hours:** 24L/12P

A mathematical and computational introduction to game theory and mechanism design. Analysis of equilibria in games and computation of price of anarchy. Design and analysis mechanisms with monetary transfers (such as auctions). Design and analysis of mechanisms without monetary transfers (such as voting and matching). This course is intended for economics, mathematics, and computer science students.

**Prerequisite:** [STA247H1](#)/ [STA255H1](#)/ [STA257H1](#)/ [STA237H1](#)/ [PSY201H1](#)/ [ECO227Y1](#), ( [MAT135H1](#), [MAT136H1](#))/ [MAT137Y1](#)/ [MAT157Y1](#)

**Exclusion:** NOTE: Students not enrolled in the Computer Science Major or Specialist program at A&S, UTM, or UTSC, or the Data Science Specialist at A&S, are limited to a maximum of 1.5 credits in 300-/400-level CSC/ECE courses.

**Recommended Preparation:** [MAT223H1](#), [CSC373H1](#)

**Breadth Requirements:** The Physical and Mathematical Universes (5)

### CSC320H1 - Introduction to Visual Computing

**Hours:** 24L/12T

A first-principles introduction to the acquisition and computational processing of 2D images, aimed at students interested in computer vision, digital photography and computer graphics. The course serves as a stepping stone for tackling more advanced courses in those subjects and covers four broad themes: (1) mathematical and engineering foundations: introducing key concepts from geometry; multivariate calculus; linear algebra; image and signal processing; and human vision, (2) algorithms for low-level computer vision: image warping, morphing and stitching; image enhancement;

image scissoring and inpainting; color image processing and display; face recognition; and 2D image matching, (3) implementing several such tools in Python, and (4) a first taste of vision and graphics research. Understanding how to turn algorithmic descriptions in research papers into working computer vision code—and how to evaluate its performance—will be key skills acquired in the course.

**Prerequisite:** [CSC263H1](#)/ [CSC265H1](#)/ [CSC263H5](#)/ [CSCB63H3](#); [MAT223H1](#)/ [MAT240H1](#); ( [MAT136H1](#) with a minimum mark of 77)/ ( [MAT137Y1](#) with a minimum mark of 73)/ ( [MAT157Y1](#) with a minimum mark of

67)/ [MAT235Y1](#)/ [MAT237Y1](#)/ [MAT257Y1](#) **Prerequisite for Faculty of Applied Science and Engineering**

**students:** [ECE345H1](#)/ [ECE358H1](#)/ [MIE335H1](#); [MAT185H1](#)/ [MAT188H1](#); [MAT291H1](#)/ [MAT292H1](#)

**Exclusion:** [CSC320H5](#). NOTE: Students not enrolled in the Computer Science Major or Specialist program at A&S, UTM, or UTSC, or the Data Science Specialist at A&S, are limited to a maximum of 1.5 credits in 300-/400-level CSC/ECE courses.

**Recommended Preparation:** [MAT235Y1](#)/ [MAT237Y1](#)/ [MAT257Y1](#)/ ( [MAT232H5](#), [MAT236H5](#))/ ( [MAT233H5](#), [MAT236H5](#))/ ( [MATB41H3](#), [MATB42H3](#))

**Breadth Requirements:** The Physical and Mathematical Universes (5)

CSC401H1 - Natural Language Computing

**Hours:** 24L/12T

Introduction to techniques involving natural language processing and speech in applications such as information retrieval, speech recognition and synthesis, machine translation, summarization, and dialogue. N-grams, corpus analysis, neural methods, and information theory. Python and other software.

**Prerequisite:** [CSC207H1](#)/ [CSC209H1](#)/ [CSC207H5](#)/ [CSCB07H3](#)/ [CSC209H5](#)/ [CSCB09H3](#); [STA237H1](#)/ [STA247H1](#)/ [STA255H1](#)/ [STA257H1](#)/ [STAB57H3](#)/ [STAB52H3](#) **Prerequisite for Faculty of Applied Science and Engineering**

**students:** [APS105H1](#)/ [APS106H1](#)/ [ESC180H1](#)/ [CSC180H1](#); [ECE302H1](#)/ [STA286H1](#)/ [CHE223H1](#)/ [CME263H1](#)/ [MIE231H1](#)/ [MIE236H1](#)/ [MSE238H1](#)/ [ECE286H1](#)

**Exclusion:** NOTE: Students not enrolled in the Computer Science Major or Specialist program at A&S, UTM, or UTSC, or the Data Science Specialist at A&S, are limited to a maximum of 1.5 credits in 300-/400-level CSC/ECE courses.

**Recommended Preparation:** [CSC311H1](#), [MAT221H1](#)/ [MAT223H1](#)/ [MAT240H1](#) is strongly recommended

**Breadth Requirements:** The Physical and Mathematical Universes (5)

CSC485H1 - Computational Linguistics

**Hours:** 36L

Computational linguistics and the processing of language by computer. Topics include: context-free grammars; chart parsing, statistical parsing; semantics and semantic interpretation; ambiguity resolution techniques; reference resolution. Emphasis on statistical learning methods for lexical, syntactic, and semantic knowledge.

**Prerequisite:** [CSC209H1](#)/ [CSC209H5](#)/ [CSCB09H3](#); [STA237H1](#)/ [STA247H1](#)/ [STA255H1](#)/ [STA257H1](#) **Prerequisite for Faculty of Applied Science and Engineering**

**students:** [APS105H1](#)/ [APS106H1](#)/ [ESC180H1](#)/ [CSC180H1](#); [ECE302H1](#)/ [STA286H1](#)/ [CHE223H1](#)/ [CME263H1](#)/ [MIE231H1](#)/ [MIE236H1](#)/ [MSE238H1](#)/ [ECE286H1](#)

**Exclusion:** NOTE: Students not enrolled in the Computer Science Major or Specialist program at A&S, UTM, or UTSC, or the Data Science Specialist at A&S, are limited to a maximum of 1.5 credits in 300-/400-level CSC/ECE courses.

**Recommended Preparation:** [CSC311H1](#), [CSC324H1](#)/ [CSC384H1](#)

**Breadth Requirements:** The Physical and Mathematical Universes (5)

CSC486H1 - Knowledge Representation and Reasoning

**Hours:** 24L/12T

Representing knowledge symbolically in a form suitable for automated reasoning, and associated reasoning methods. Topics from: first-order logic, entailment, the resolution method, Horn clauses, procedural representations, production systems, description logics, inheritance networks, defaults and probabilities, tractable reasoning, abductive explanation, the representation of action, planning.

**Prerequisite:** [CSC384H1](#)/ [CSC384H5](#)/ [CSCD84H3](#) **Prerequisite for Faculty of Applied Science and Engineering students:** [ROB311H1](#)

**Exclusion:** NOTE: Students not enrolled in the Computer Science Major or Specialist program at A&S, UTM, or UTSC, or the Data Science Specialist at A&S, are limited to a maximum of 1.5 credits in 300-/400-level CSC/ECE courses.

**Breadth Requirements:** The Physical and Mathematical Universes (5)

Computer Science Courses from the University of Toronto Mississauga

CSC376H5 • Fundamentals of Robotics

An introduction to robotics covering basic methodologies, tools, and concepts to build a foundation for advanced topics in robotics. The course covers robot manipulators; kinematics; motion planning; and control. Topics covered in lecture will be implemented and explored in a practical environment using robots from different application domains.

**Prerequisites:** ([MAT223H5](#) or [MAT240H5](#)) and [CSC209H5](#) and [CSC258H5](#)

**Recommended Preparation:** [CSC338H5](#)

**Enrolment Limits:** Priority is given to students enrolled in Computer Science Specialist,

Information Security Specialist, Bioinformatics Specialist or Computer Science Major programs.

**Distribution Requirement:** Science

## Appendix B: Mapping of Program Learning Outcomes to ACM Knowledge Areas

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The Program Learning Outcomes in Appendix B.1 is based on the ACM CS2023 Curricula, which has 17 Knowledge Areas (KAs), and they are

- AI Artificial Intelligence
- AL Algorithmic Foundations
- AR Architecture and Organization
- DM Data Management
- FPL Foundations of Programming Languages
- GIT Graphics and Interactive Techniques
- HCI Human-Computer Interaction
- MSF Mathematical and Statistical Foundations
- NC Networking and Communication
- OS Operating Systems
- PDC Parallel and Distributed Computing
- SDF Software Development Fundamentals
- SE Software Engineering
- SEC Security
- SEP Society, Ethics, and the Profession
- SF Systems Fundamentals
- SPD Specialized Platform Development

In Table B.2.1, we show how the Program Learning Outcomes (see Appendix B.1) is mapped to the ACM CS2023 KAs. Note that for those KAs where we do not have a learning outcome to map to, they are covered by the learning outcomes of electives.

**Table B.2.1 Program Learning Outcomes to ACM CS2023 Knowledge Areas Mapping**

| PLO ID   | ACM KAs             | AI | AL | AR | DM | FPL | GIT | HCI | MSF | NC | OS | PDC | SDF | SE | SEC | SEP | SF | SPD |
|----------|---------------------|----|----|----|----|-----|-----|-----|-----|----|----|-----|-----|----|-----|-----|----|-----|
| <b>1</b> | <b>AL; FPL; MSF</b> |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 1.1      | MSF                 |    |    |    |    |     |     |     | X   |    |    |     |     |    |     |     |    |     |
| 1.2      | AL; MSF             |    | X  |    |    |     |     |     | X   |    |    |     |     |    |     |     |    |     |
| 1.3      | AL                  |    | X  |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 1.4      | AL; FPL             |    | X  |    |    | X   |     |     |     |    |    |     |     |    |     |     |    |     |
| <b>2</b> | <b>AL, SDF</b>      |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 2.1      | AL                  |    | X  |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 2.2      | AL                  |    | X  |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 2.3      | AL; SDF             |    | X  |    |    |     |     |     |     |    |    |     | X   |    |     |     |    |     |
| 2.4      | AL                  |    | X  |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| <b>3</b> | <b>FPL; SDF; SE</b> |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 3.1      | FPL; SDF            |    |    |    |    | X   |     |     |     |    |    |     | X   |    |     |     |    |     |
| 3.2      | SDF; SE             |    |    |    |    |     |     |     |     |    |    |     | X   | X  |     |     |    |     |
| 3.3      | SE                  |    |    |    |    |     |     |     |     |    |    |     |     | X  |     |     |    |     |
| 3.4      | FPL                 |    |    |    |    | X   |     |     |     |    |    |     |     |    |     |     |    |     |
| <b>4</b> | <b>AR; OS; SF</b>   |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 4.1      | AR; SF              |    |    | X  |    |     |     |     |     |    |    |     |     |    |     |     | X  |     |
| 4.2      | OS; SF              |    |    |    |    |     |     |     |     |    | X  |     |     |    |     |     | X  |     |
| 4.3      | AR; SF              |    |    | X  |    |     |     |     |     |    |    |     |     |    |     |     | X  |     |
| 4.4      | OS                  |    |    |    |    |     |     |     |     |    | X  |     |     |    |     |     |    |     |
| <b>5</b> | <b>DM; SE; SEC</b>  |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 5.1      | DM                  |    |    |    | X  |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 5.2      | DM                  |    |    |    | X  |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 5.3      | DM; SE              |    |    |    | X  |     |     |     |     |    |    |     |     | X  |     |     |    |     |
| 5.4      | DM; SEC             |    |    |    | X  |     |     |     |     |    |    |     |     |    | X   |     |    |     |

| PLO ID   | ACM KAs             | AI | AL | AR | DM | FPL | GIT | HCI | MSF | NC | OS | PDC | SDF | SE | SEC | SEP | SF | SPD |
|----------|---------------------|----|----|----|----|-----|-----|-----|-----|----|----|-----|-----|----|-----|-----|----|-----|
| <b>6</b> | <b>SEP</b>          |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 6.1      | SEP                 |    |    |    |    |     |     |     |     |    |    |     |     |    |     | X   |    |     |
| 6.2      | SEP                 |    |    |    |    |     |     |     |     |    |    |     |     |    |     | X   |    |     |
| 6.3      | SEP                 |    |    |    |    |     |     |     |     |    |    |     |     |    |     | X   |    |     |
| 6.4      | SEP                 |    |    |    |    |     |     |     |     |    |    |     |     |    |     | X   |    |     |
| <b>7</b> | <b>AI; MSF; SEP</b> |    |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 7.1      | AI                  | X  |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 7.2      | AI                  | X  |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 7.3      | AI; MSF             | X  |    |    |    |     |     |     | X   |    |    |     |     |    |     |     |    |     |
| 7.4      | AI                  | X  |    |    |    |     |     |     |     |    |    |     |     |    |     |     |    |     |
| 7.5      | AI; SEP             | X  |    |    |    |     |     |     |     |    |    |     |     |    |     | X   |    |     |

## Appendix C: Curriculum Map

| AIMLSP | Course Code | 1.1 | 1.2 | 1.3 | 1.4 | 2.1 | 2.2 | 2.3 | 2.4 | 3.1 | 3.2 | 3.3 | 3.4 | 4.1 | 4.2 | 4.3 | 4.4 | 5.1 | 5.2 | 5.3 | 5.4 | 6.1 | 6.2 | 6.3 | 6.4 | 7.1 | 7.2 | 7.3 | 7.4 | 7.5 | Summary |   |   |
|--------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|---|---|
|        |             | I   | D   | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |         |   |   |
| X      | CSCA08H3    |     |     |     |     |     | I   | I   |     | I   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 4       | 0 | 0 |
| X      | CSCA48H3    |     |     |     |     | I   | I   | D   |     | D   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     | I   |     |     |     |     |     | 4       | 2 | 0 |
| X      | CSCA67H3    | D   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1       | 1 | 0 |
| X      | CSCB07H3    |     |     |     |     |     |     |     |     | D   | D   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1       | 2 | 0 |
| X      | CSCB09H3    |     |     |     |     |     |     |     |     |     |     | I   |     |     | D   |     | I   |     |     |     |     |     |     |     |     |     |     |     |     |     | 2       | 1 | 0 |
| X      | CSCB36H3    |     | D   | I   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 2       | 1 | 0 |
| X      | CSCB58H3    |     |     |     |     |     |     |     |     |     |     |     |     | D   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1       | 1 | 0 |
| X      | CSCB63H3    |     |     |     |     | D   | D   | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 2 | 1 |
| Z      | CSCC01H3    |     |     |     |     |     |     |     |     | D   | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 2 | 0 |
| Z      | CSCC09H3    |     |     |     |     |     |     |     |     | I   |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1       | 1 | 0 |
| Z      | CSCC10H3    |     |     |     |     |     |     |     | I   |     |     |     |     |     |     |     |     |     |     |     |     | I   |     |     |     |     |     |     |     |     | 2       | 0 | 0 |
| X      | CSCC11H3    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   | D   |     |     | 0       | 3 | 0 |
| Z      | CSCC24H3    |     |     |     |     |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 1 | 0 |
| X      | CSCC37H3    | P   |     |     |     | D   | I   |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1       | 2 | 1 |
| X      | CSCC43H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   | D   | D   |     |     |     |     |     |     |     |     |     |     | 0       | 3 | 0 |
| Y      | CSCC46H3    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   |     |     |     |     | 0       | 2 | 0 |
| X      | CSCC63H3    |     | D   | P   | D   |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 3 | 1 |
| X      | CSCC69H3    |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 0 | 2 |
| X      | CSCC73H3    |     |     |     |     | P   | P   |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0       | 1 | 2 |
| Y      | CSCC85H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | I   |     |     | D   |     | 1       | 1 | 0 |
| Z      | CSCD01H3    |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     | 0       | 1 | 1 |
| X      | CSCD03H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   |     |     |     |     | I   | 1       | 0 | 2 |
| Y      | CSCD18H3    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | I   |     | 1       | 1 | 0 |
| Z      | CSCD21H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     | 0   | 1       | 0 |   |

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| AIMLSP | Course Code | 1.1 | 1.2 | 1.3 | 1.4 | 2.1 | 2.2 | 2.3 | 2.4 | 3.1 | 3.2 | 3.3 | 3.4 | 4.1 | 4.2 | 4.3 | 4.4 | 5.1 | 5.2 | 5.3 | 5.4 | 6.1 | 6.2 | 6.3 | 6.4 | 7.1 | 7.2 | 7.3 | 7.4 | 7.5 |   |   |   |
|--------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|
| Y      | CSCD25H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   | D   |     | 0 | 1 | 2 |
| Z      | CSCD27H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     | 0   | 0 | 1 |   |
| Y      | CSCD43H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     | D   | P   |     |     |     |     |     |     |     |     | 0   | 1 | 2 |   |
| Z      | CSCD58H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 0 | 1 |   |
| Z      | CSCD70H3    |     |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 0 | 1 |   |
| Y      | CSCD71H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   | D   |     |     | I   |     |     |     |     |     |     |     |     |     | 1   | 2 | 0 |   |
| X      | CSCD84H3    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | I   | D   | D   | 1   | 3 | 1 |   |
| Y      | CSC304H1    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   |     |     |     | 0   | 2 | 0 |   |
| Y      | CSC320H1    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     | 0   | 1 | 1 |   |
| Y      | CSC376H5    |     |     |     |     |     |     |     | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     | 0   | 1 | 1 |   |
| Y      | CSC401H1    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   | P   |     | 0   | 1 | 1 |   |
| Z      | CSC469H1    |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     | P   |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 0 | 2 |   |
| Y      | CSC485H1    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   |     | 0   | 0 | 2 |   |
| Y      | CSC486H1    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     | 0   | 0 | 1 |   |
| Z      | CSC488H1    |     |     |     | D   |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 1 | 1 |   |
|        |             |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |   |   |   |
| X      | MATA22H3    | D   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1   | 1 | 0 |   |
| X      | MATA31H3    | I   | I   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 2   | 0 | 0 |   |
| X      | MATA37H3    | D   | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 2 | 0 |   |
| X      | MATB24H3    | P   | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 1 | 1 |   |
| X      | MATB41H3    | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 1 | 0 |   |
| X      | PHLB18H3*   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     |     |     | D   | 0   | 1 | 1 |   |
|        |             |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |   |   |   |
| X      | STAB52H3    | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 0   | 1 | 0 |   |
| X      | STAB57H3    | D   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | D   |     |     | 0   | 2 | 0 |   |
| Y      | STAC58H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     | 0   | 0 | 1 |   |
| Y      | STAC62H3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     | 0   | 0 | 1 |   |
| Y      | STAC67H3    |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   |     |     | 0   | 0 | 2 |   |

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| AIMLSP | Course Code | 1.1 | 1.2 | 1.3 | 1.4 | 2.1 | 2.2 | 2.3 | 2.4 | 3.1 | 3.2 | 3.3 | 3.4 | 4.1 | 4.2 | 4.3 | 4.4 | 5.1 | 5.2 | 5.3 | 5.4 | 6.1 | 6.2 | 6.3 | 6.4 | 7.1 | 7.2 | 7.3 | 7.4 | 7.5 |   |   |   |
|--------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|
| Y      | STAD68H3    |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   | D   |     | 0 | 1 | 3 |
| Y      | STAD78H3    |     | P   |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   |     |     | 0 | 0 | 4 |
| Y      | STAD80H3    |     |     |     |     |     |     |     | P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | P   | P   |     | 0 | 0 | 3 |
|        |             |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |   |   |   |
| X      | Writing     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | I   |     |     |     |     |     |     |     |     | 1 | 0 | 0 |

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 1 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 2 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| D | 6 | 4 | 0 | 2 | 2 | 2 | 1 | 9 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 4 | 4 | 1 |   |
| P | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 4 | 0 | 0 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 3 | 8 | 5 | 0 |

X: Required

Y: Electives where minimum 0.5 credit is required

Z: Other Electives

## Appendix D: Relationship between Degree Level Expectations, Program Learning Outcomes, and Curriculum

Table D.1 maps the Program Learning Outcomes to Degree Level Expectations.

**Table D.1 Program Learning Outcomes and Degree Level Expectations Map**

| PLO/DLE ID         | D1 | D2 | D3 | D4 | D5 | D6 | Num of DLEs |
|--------------------|----|----|----|----|----|----|-------------|
| 1.1                | X  | X  |    |    |    |    | 2           |
| 1.2                | X  | X  |    |    |    |    | 2           |
| 1.3                | X  | X  |    | X  |    |    | 3           |
| 1.4                | X  | X  |    |    |    |    | 2           |
| 2.1                | X  | X  | X  |    |    |    | 3           |
| 2.2                | X  | X  | X  |    |    |    | 3           |
| 2.3                | X  |    | X  |    |    |    | 2           |
| 2.4                | X  |    | X  |    |    |    | 2           |
| 3.1                | X  |    | X  |    |    |    | 2           |
| 3.2                | X  |    | X  |    |    |    | 2           |
| 3.3                | X  |    | X  |    |    | X  | 3           |
| 3.4                | X  |    |    | X  |    |    | 2           |
| 4.1                | X  |    |    |    |    |    | 1           |
| 4.2                | X  |    | X  |    |    |    | 2           |
| 4.3                | X  |    |    | X  |    |    | 2           |
| 4.4                | X  |    | X  |    |    |    | 2           |
| 5.1                | X  |    | X  |    |    |    | 2           |
| 5.2                | X  |    | X  |    |    |    | 2           |
| 5.3                | X  |    | X  |    |    |    | 2           |
| 5.4                | X  |    |    | X  |    |    | 2           |
| 6.1                |    |    |    |    | X  |    | 1           |
| 6.2                |    |    |    |    | X  | X  | 2           |
| 6.3                |    |    |    | X  |    | X  | 2           |
| 6.4                | X  |    |    | X  |    | X  | 3           |
| 7.1                | X  |    | X  |    |    |    | 2           |
| 7.2                | X  |    | X  |    |    |    | 2           |
| 7.3                | X  | X  | X  | X  |    |    | 4           |
| 7.4                | X  |    | X  |    |    |    | 2           |
| 7.5                |    |    |    | X  |    | X  | 2           |
| <b>Num of PLOs</b> | 25 | 7  | 16 | 8  | 2  | 5  |             |

Table C.3 maps each course in the curriculum the Program Learning Outcomes and the Degree Expectations.

**Table D.2 Curriculum, Degree Level Expectations and Program Learning Outcomes Map**

| Course Code | PLO ID | DLEs       | Course Code | PLO ID | DLEs           | Course Code | PLO ID | DLEs           |
|-------------|--------|------------|-------------|--------|----------------|-------------|--------|----------------|
| CSCA08H3    | 2.2    | D1, D2, D3 | CSCC46H3    | 2.4    | D1, D3         | CSC376H5    | 2.4    | D1, D3         |
| CSCA08H3    | 2.3    | D1, D3     | CSCC46H3    | 7.1    | D1, D3         | CSC376H5    | 7.4    | D1, D3         |
| CSCA08H3    | 3.1    | D1, D3     | CSCC63H3    | 1.2    | D1, D2         | CSC401H1    | 7.3    | D1, D2, D3, D4 |
| CSCA08H3    | 3.2    | D1, D3     | CSCC63H3    | 1.3    | D1, D2, D4     | CSC401H1    | 7.4    | D1, D3         |
| CSCA48H3    | 2.1    | D1, D2, D3 | CSCC63H3    | 1.4    | D1, D2         | CSC469H1    | 4.2    | D1, D3         |
| CSCA48H3    | 2.2    | D1, D2, D3 | CSCC63H3    | 2.2    | D1, D2, D3     | CSC469H1    | 4.4    | D1, D3         |
| CSCA48H3    | 2.3    | D1, D3     | CSCC69H3    | 4.2    | D1, D3         | CSC485H1    | 7.3    | D1, D2, D3, D4 |
| CSCA48H3    | 3.1    | D1, D3     | CSCC69H3    | 4.4    | D1, D3         | CSC485H1    | 7.4    | D1, D3         |
| CSCA48H3    | 3.2    | D1, D3     | CSCC73H3    | 2.1    | D1, D2, D3     | CSC486H1    | 7.1    | D1, D3         |
| CSCA48H3    | 6.4    | D1, D4, D6 | CSCC73H3    | 2.2    | D1, D2, D3     | CSC488H1    | 1.4    | D1, D2         |
| CSCA67H3    | 1.1    | D1, D2     | CSCC73H3    | 2.4    | D1, D3         | CSC488H1    | 3.4    | D1, D4         |
| CSCA67H3    | 1.2    | D1, D2     | CSCC85H3    | 7.1    | D1, D3         | MATA22H3    | 1.1    | D1, D2         |
| CSCB07H3    | 3.1    | D1, D3     | CSCC85H3    | 7.4    | D1, D3         | MATA22H3    | 1.2    | D1, D2         |
| CSCB07H3    | 3.2    | D1, D3     | CSCD01H3    | 3.3    | D1, D3, D6     | MATA31H3    | 1.1    | D1, D2         |
| CSCB07H3    | 3.3    | D1, D3, D6 | CSCD01H3    | 6.2    | D5, D6         | MATA31H3    | 1.2    | D1, D2         |
| CSCB09H3    | 3.3    | D1, D3, D6 | CSCD03H3    | 6.3    | D4, D6         | MATA37H3    | 1.1    | D1, D2         |
| CSCB09H3    | 4.2    | D1, D3     | CSCD03H3    | 6.4    | D1, D4, D6     | MATA37H3    | 1.2    | D1, D2         |
| CSCB09H3    | 4.4    | D1, D3     | CSCD03H3    | 7.5    | D4, D6         | MATB24H3    | 1.1    | D1, D2         |
| CSCB36H3    | 1.2    | D1, D2     | CSCD18H3    | 2.4    | D1, D3         | MATB24H3    | 1.2    | D1, D2         |
| CSCB36H3    | 1.3    | D1, D2, D4 | CSCD18H3    | 7.4    | D1, D3         | MATB41H3    | 1.1    | D1, D2         |
| CSCB36H3    | 1.4    | D1, D2     | CSCD21H3    | 5.4    | D1, D4         | PHLB18H3*   | 6.3    | D4, D6         |
| CSCB58H3    | 4.1    | D1         | CSCD25H3    | 7.2    | D1, D3         | PHLB18H3*   | 7.5    | D4, D6         |
| CSCB58H3    | 4.2    | D1, D3     | CSCD25H3    | 7.3    | D1, D2, D3, D4 | STAB52H3    | 1.1    | D1, D2         |
| CSCB63H3    | 2.1    | D1, D2, D3 | CSCD25H3    | 7.4    | D1, D3         | STAB57H3    | 1.1    | D1, D2         |
| CSCB63H3    | 2.2    | D1, D2, D3 | CSCD27H3    | 5.4    | D1, D4         | STAB57H3    | 7.3    | D1, D2, D3, D4 |
| CSCB63H3    | 2.3    | D1, D3     | CSCD43H3    | 5.1    | D1, D3         | STAC58H3    | 7.3    | D1, D2, D3, D4 |
| CSCC01H3    | 3.1    | D1, D3     | CSCD43H3    | 5.3    | D1, D3         | STAC62H3    | 7.3    | D1, D2, D3, D4 |
| CSCC01H3    | 3.2    | D1, D3     | CSCD43H3    | 5.4    | D1, D4         | STAC67H3    | 2.4    | D1, D3         |
| CSCC09H3    | 3.1    | D1, D3     | CSCD58H3    | 4.3    | D1, D4         | STAC67H3    | 7.3    | D1, D2, D3, D4 |
| CSCC09H3    | 3.3    | D1, D3, D6 | CSCD70H3    | 3.4    | D1, D4         | STAD68H3    | 2.4    | D1, D3         |
| CSCC10H3    | 2.4    | D1, D3     | CSCD71H3    | 4.3    | D1, D4         | STAD68H3    | 7.2    | D1, D3         |
| CSCC10H3    | 6.1    | D5         | CSCD71H3    | 4.4    | D1, D3         | STAD68H3    | 7.3    | D1, D2, D3, D4 |
| CSCC11H3    | 2.4    | D1, D3     | CSCD71H3    | 5.3    | D1, D3         | STAD68H3    | 7.4    | D1, D3         |
| CSCC11H3    | 7.2    | D1, D3     | CSCD84H3    | 2.4    | D1, D3         | STAD78H3    | 1.2    | D1, D2         |

|          |     |                |          |     |                |          |     |                |
|----------|-----|----------------|----------|-----|----------------|----------|-----|----------------|
| CSCC11H3 | 7.3 | D1, D2, D3, D4 | CSCD84H3 | 7.1 | D1, D3         | STAD78H3 | 2.4 | D1, D3         |
| CSCC24H3 | 3.4 | D1, D4         | CSCD84H3 | 7.2 | D1, D3         | STAD78H3 | 7.2 | D1, D3         |
| CSCC37H3 | 1.1 | D1, D2         | CSCD84H3 | 7.3 | D1, D2, D3, D4 | STAD78H3 | 7.3 | D1, D2, D3, D4 |
| CSCC37H3 | 2.1 | D1, D2, D3     | CSCD84H3 | 7.4 | D1, D3         | STAD80H3 | 2.4 | D1, D3         |
| CSCC37H3 | 2.2 | D1, D2, D3     | CSC304H1 | 2.4 | D1, D3         | STAD80H3 | 7.3 | D1, D2, D3, D4 |
| CSCC37H3 | 2.4 | D1, D3         | CSC304H1 | 7.1 | D1, D3         | STAD80H3 | 7.4 | D1, D3         |
| CSCC43H3 | 5.1 | D1, D3         | CSC320H1 | 2.4 | D1, D3         | Writing  | 1.1 | D1, D2         |
| CSCC43H3 | 5.2 | D1, D3         | CSC320H1 | 7.4 | D1, D3         | Writing  | 6.1 | D5             |
| CSCC43H3 | 5.3 | D1, D3         | N/A      |     |                | N/A      |     |                |

Table D.3 maps Program Learning Outcome to courses in the curriculum and Degree Level Expectations.

**Table D.3 Program Learning Outcomes, Curriculum, and Degree Level Expectations Map**

| PLO ID | Courses                                                                                                                                    | DLEs           |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.1    | CSCA67H3, CSCC37H3, MATA22H3, MATA31H3, MATA37H3, MATB24H3, MATB41H3, STAB52H3, STAB57H3, Writing                                          | D1, D2         |
| 1.2    | CSCA67H3, CSCB36H3, CSCC63H3, MATA22H3, MATA31H3, MATA37H3, MATB24H3, STAD78H3                                                             | D1, D2         |
| 1.3    | CSCB36H3, CSCC63H3                                                                                                                         | D1, D2, D4     |
| 1.4    | CSCB36H3, CSCC63H3, CSC488H1                                                                                                               | D1, D2         |
| 2.1    | CSCA48H3, CSCB63H3, CSCC37H3, CSCC73H3                                                                                                     | D1, D2, D3     |
| 2.2    | CSCA08H3, CSCA48H3, CSCB63H3, CSCC37H3, CSCC63H3, CSCC73H3                                                                                 | D1, D2, D3     |
| 2.3    | CSCA08H3, CSCA48H3, CSCB63H3                                                                                                               | D1, D3         |
| 2.4    | CSCC10H3, CSCC11H3, CSCC37H3, CSCC46H3, CSCC73H3, CSCD18H3, CSCD84H3, CSC304H1, CSC320H1, CSC376H5, STAC67H3, STAD68H3, STAD78H3, STAD80H3 | D1, D3         |
| 3.1    | CSCA08H3, CSCA48H3, CSCB07H3, CSCC01H3, CSCC09H3                                                                                           | D1, D3         |
| 3.2    | CSCA08H3, CSCA48H3, CSCB07H3, CSCC01H3                                                                                                     | D1, D3         |
| 3.3    | CSCB07H3, CSCB09H3, CSCC09H3, CSCD01H3                                                                                                     | D1, D3, D6     |
| 3.4    | CSCC24H3, CSCD70H3, CSC488H1                                                                                                               | D1, D4         |
| 4.1    | CSCB58H3                                                                                                                                   | D1             |
| 4.2    | CSCB09H3, CSCB58H3, CSCC69H3, CSC469H1                                                                                                     | D1, D3         |
| 4.3    | CSCD58H3, CSCD71H3                                                                                                                         | D1, D4         |
| 4.4    | CSCB09H3, CSCC69H3, CSCD71H3, CSC469H1                                                                                                     | D1, D3         |
| 5.1    | CSCC43H3, CSCD43H3                                                                                                                         | D1, D3         |
| 5.2    | CSCC43H3                                                                                                                                   | D1, D3         |
| 5.3    | CSCC43H3, CSCD43H3, CSCD71H3                                                                                                               | D1, D3         |
| 5.4    | CSCD21H3, CSCD27H3, CSCD43H3                                                                                                               | D1, D4         |
| 6.1    | CSCC10H3, Writing                                                                                                                          | D5             |
| 6.2    | CSCD01H3                                                                                                                                   | D5, D6         |
| 6.3    | CSCD03H3, PHLB18H3*                                                                                                                        | D4, D6         |
| 6.4    | CSCA48H3, CSCD03H3                                                                                                                         | D1, D4, D6     |
| 7.1    | CSCC46H3, CSCC85H3, CSCD84H3, CSC304H1, CSC486H1                                                                                           | D1, D3         |
| 7.2    | CSCC11H3, CSCD25H3, CSCD84H3, STAD68H3, STAD78H3                                                                                           | D1, D3         |
| 7.3    | CSCC11H3, CSCD25H3, CSCD84H3, CSC401H1, CSC485H1, STAB57H3, STAC58H3, STAC62H3, STAC67H3, STAD68H3, STAD78H3, STAD80H3                     | D1, D2, D3, D4 |
| 7.4    | CSCC85H3, CSCD18H3, CSCD25H3, CSCD84H3, CSC320H1, CSC376H5, CSC401H1, CSC485H1, STAD68H3, STAD80H3                                         | D1, D3         |
| 7.5    | CSCD03H3, PHLB18H3*                                                                                                                        | D4, D6         |