AGENDA ITEM NO: 14.2

UNIVERSITY COUNCIL

ACADEMIC PROGRAMS COMMITTEE

REPORT FOR INFORMATION

PRESENTED BY: Susan Detmer, Chair, Academic Programs Committee

DATE OF MEETING: May 20, 2021

SUBJECT: **Bachelor of Science in Applied Computing**

COUNCIL ACTION: **For Information Only**

SUMMARY:

The College of Arts and Science submitted a proposal to introduce a major in Applied Computing for its Bachelor of Science degree program. With this proposal, the College also proposed to delete the existing majors in Bioinformatics and in Interactive Systems Design.

The deleted majors will be represented as concentrations under the new Applied Computing major, in addition to three other concentrations: Business, Data Analytics, and Geomatics.

The new degree program adheres to College of Arts and Science degree templates and will be available as a four-year or a four-year honours degree. The new program will ensure that students have appropriate breadth and depth of knowledge in both computer science and in related disciplines and cognate areas to be successful post graduation. The new program, with its concentrations, will encourage interdisciplinary crossover and prepare students for a variety of careers and/or areas of research.

Students in the existing programs that are being deleted will be permitted to complete their degree programs, or may transfer into the new program.

The Academic Programs Committee considered this proposal and passed the following motion at its April 14, 2021 meeting:
It is recommended that the Academic Programs Committee approve the Bachelor of Science (B.Sc.) in Applied Computing in the College of Arts and Science and the associated program deletions, effective May 2022

UNIVERSITY OF SASKATCHEWAN

Proposal for Academic or Curricular Change

PROPOSAL IDENTIFICATION

Title of proposal: Introduction of Major in Applied Computing; Deletion of Majors in Bioinformatics and in Interactive Systems Design

Degree(s): Bachelor of Science

Field(s) of Specialization: Applied Computing

Level(s) of Concentration: Honours, Four-year

Option(s): Bioinformatics, Business, Data Analytics, Geomatics, Interactive Systems Design
Professional Internship Option

Degree College: Arts and Science

Contact person(s) (name, telephone, fax, e-mail):

Kevin Stanley
Department Head, Computer Science
kstanley@cs.usask.ca
306-966-6747

Proposed date of implementation: May 2022

Executive Summary

The Need

Computing is permeating modern life and data is the new resource that industries around the world are chasing. Better data can lead to faster, better decisions, more efficient processes, and more reliable outcomes. However, data analytics or applied computing cannot be taught in isolation. When applied to a particular problem or domain, knowledge of computing and the domain itself are required to effectively achieve insight. Traditional industries such as mining and agriculture have joined the ranks of more established technology users in IT, medicine, business and design. There is a clear need for graduates with knowledge in both computing and domains of application.

The Problem

Offering interdisciplinary degrees is a reoccurring challenge for universities. Degree stewardship and administration can be hard to assign, classes difficult to schedule, and faculty resourcing uncertain. This has led to interdisciplinary programs languishing. It is even more difficult to offer interdisciplinary programming in the context of an accredited program like Computer Science, where external agencies constrain potential choices and require more depth in the primary subject than might be required for an interdisciplinary practitioner. Determining a course of study in interdisciplinary majors is an issue for students who must not only understand the content of individual courses, but how that content meshes with that covered in other disciplines.

The Program

To address stakeholders' need for graduates with both computing and domain expertise while operating under the constraints of university structure and governance, we propose a new model for interdisciplinary programming. In this model, a primary unit proscribes a major requiring the minimum number of disciplinary credit units for that college (in Arts and Science 36), leaving space for minor-like ensembles of courses in cognate disciplines. However, few combinations of courses for majors and cognate minors lead to combined knowledge that is directly actionable in practice. Meaningful degrees, particularly those focused on data analysis require curated combinations of classes that can be synthesized into functional knowledge. To avoid credential bloat and associated administrative cost, these curated packages of courses can be instantiated as named concentrations within an overarching degree, for example a degree in Applied Computing in Bioinformatics, or a degree in Applied Computing in Geomatics. Because these concentrations are curated, scheduling conflicts can be encoded and avoided using established software. Similarly, credentialing can happen automatically, as there are clear course packages required to graduate.

Computer Science is willing to take the lead in developing this kind of programming, particularly to address the need for students trained in data analytics and applied computing. We have identified a core program of existing computer science courses and a single new course on data analytics that could be packaged into a 12-course core, and several cognate areas which could be combined to form synthesized knowledge which would be directly applicable to stakeholders in the community. By employing this model, unlike a more traditional Degree in Data Analytics, we obtain the flexibility to grow programming to meet the needs of local stakeholders with reduced overhead.

Proposed Undergraduate Applied Computing Concentrations

We propose to terminate two existing programs, and reconstitute them as concentrations under the Applied Computing degree. We further propose to instantiate three additional concentrations in areas of Applied Computing which meet emerging needs and opportunities.

Bioinformatics (Cognate areas: Biology, Biochemistry)

Bioinformatics is an established but niche program in the college. Adding this program to Applied Computing would allow for a reimagining of content and greater accessibility.

Business (Cognate areas: Marketing, Entrepreneurship

The is a significant industrial demand for graduates who understand computing, data, and business processes. We anticipate that this will be a popular concentration.

Data Analytics (Cognate areas: Math, Statistics)

This program would focus on training general purpose data scientists. What they would lose in domain knowledge they would gain in mathematical rigor. This degree would be of interest to those who have a cognate degree already, as well as those interested in analytical mechanics.

Geomatics (Cognate area: Geography)

Understanding geographically anchored data is important in areas such as mining, agriculture, and city planning. This program would focus on the programmatic use of GIS and satellite-based systems in water management, agriculture, mining, and civic planning.

Interactive System Design (Cognate areas: Art and Art History, Psychology)

The ISD program is an established B.A.&Sc program with solid enrolments, which trains graduates to work on front end computing and interactive system design.

Graduate Degrees in Applied Computing

Interdisciplinary graduate work is becoming more common in the Department of Computer Science at the University of Saskatchewan. However, students receiving Computer Science graduate degrees are expected to be able to teach in accredited Computer Science programs, putting unnecessary strain on students transferring in from other disciplines. A non-accredited program would allow students to receive interdisciplinary training with fewer disciplinary constraints. Our current plan for MScs and PhDs in Applied Computing follow our current graduate program structure at the MSc and PhD levels, but relaxes entry requirements, allows up to half the committee members to be from outside Computer Science, and permits up to half of the courses to be from outside of Computer Science.

Rationale:

Problem: Because accredited computer science degrees require substantial topical breadth and depth in the discipline, few credits remain for students to obtain cognate minors except in closely related disciplines such as mathematics. While the breadth and depth requirements produce excellent computer scientists, it prevents students from pursuing careers where targeted computer science knowledge, along with cognate understanding of breadth areas are required. While pursuing post-graduate certificates in those cognate areas is an option, most students in possession of a degree in Computer Science opt for employment in software development. This leaves key roles in the developing economy underfilled or filled by inappropriately trained workers. Either cognate areas or software development must be learned on the fly in the job context, leading to mixed results. A degree program which curated a mixture of computer science and cognate courses targeted at specific learning and qualification outcomes could address this problem. However, the curation of courses would depend on the target outcomes and would not be broadly generalizable. A degree program with sufficient flexibility to pair computer science and cognate courses, and specificity to constrain those courses into coherent outcomes is required.

At the graduate level, students with a strong background in a relevant cognate area are prevented from pursuing graduate studies within the department by substantial remedial course requirements. While students could conduct meaningful research at the graduate level on interdisciplinary projects under the supervision of a faculty member in Computer Science, they are prevented from doing so by the Department's need to maintain the brand integrity of the MSc and particularly PhD in Computer Science. Given that a PhD graduate could reasonably be expected to teach in an accredited computer science program, they should have a sufficient depth and breadth of knowledge in the discipline. Creating a new graduate degree program to accommodate students with interdisciplinary interests provides a path to graduation without impacting the exiting graduate programs in computer science.

Core Approach: The core approach at both the graduate and undergraduate levels is the creation of an unaccredited degree which provides a smaller, more targeted computer science curriculum, leaving space for cognate disciplines. At the graduate level, these cognate requirements are set by the advisory committee during the approval of the course of study; at the undergraduate level, these cognate requirements are largely proscribed by the concentration within the program that the student wishes to complete.

Undergraduate Program: While graduate studies naturally lend themselves to student-by-student customization, undergraduate degrees need clear programs of study for scalability. This can range from general credit number and level counts in classic liberal arts degrees to specified course requirements in professional colleges. Interdisciplinary degrees draw from specific subsets of offerings in different departments – not all courses from two departments necessarily mesh into a cohesive program of study. Well-designed interdisciplinary programs can be similar in curricular design to professional degrees in that specific subsets of courses should be specified for each degree. A curated set of courses across departments leading to a defined skill set is the first pillar of our approach.

Because baskets of courses would be different for different target skill areas, each group of courses would naturally lead to a different degree. However, this threatens degree bloat with the associated overhead expense and brand dilution. This is a classic conundrum in interdisciplinary programming. How does one provide the flexibility to take courses across disciplines and the structure to ensure that those courses meaningfully coexist? A classic approach is to designate an interdisciplinary degree which can be individually curated as with the graduate degrees described above. However, this simply pushes the overhead expense from support units on to faculty, and maximizes brand dilution, as the interdisciplinary degree literally represents everything. These degrees also offer little guidance to students as to what combinations of courses lead to interesting outcomes, and therefore have limited uptake. To address this conundrum, we propose to leverage an existing, but seldom used, structure within the University of Saskatchewan's pedagogical portfolio: the named concentration. Named concentration allow a single

umbrella degree to have multiple paths to completion, where each path has a name. The single umbrella degree limits degree bloat. The concentration provide the opportunity to structure baskets of courses targeting specific outcomes. The naming of concentration provides specific and obvious branding, preventing brand dilution and providing clear outcomes for students. Providing each logical collection of courses with a named concentration is the second pillar of this approach.

As noted in the Problem Statement, it is difficult to pair cognate areas with a degree in an accredited Computer Science program because of the additional breadth requirements in the subject area demanded by accreditation bodies. However, within the College of Arts and Science, a BSc degree can be conferred with as few as 36 CUs in the major, leaving ample room for cognate areas. Furthermore, because computer science requires substantial early instruction on fundamental coding and algorithmic skills, a substantial portion of those credits would be in common across all concentration s, and in common with those required for computer science majors, making movement between programs feasible in the first two years. A new non-accredited degree program is the third pillar of this approach.

In summary, the undergraduate approach is composed of a new non-accredited degree program which assigns a named concentration to a set of curated classes in computer science and selected cognate disciplines around a minimal viable core of computer science classes.

Undergraduate Degree and Concentrations

The undergraduate program is composed of a single degree split into multiple concentrations. We name the degree a Bachelor of Science in Applied Computing. The degree has a common foundation of introductory computer science classes covering the fundamentals of coding, algorithms and software design. Bundles of curated advanced computer science classes and classes from cognate disciplines (often based upon existing certificates or minors) are added to the foundation to produce named concentrations. In this proposal we have identified five named concentrations: two existing degree programs that can be rolled into concentrations of Applied Computing and three new concentrations proposed based on industry demand and existing programming within the university. A fourth new program -- Public Health Informatics -- was envisioned, but has been temporarily shelved due to commitments of the principal participants to the COVID19 response.

Distribution Requirements and Electives: As a BSc degree in Arts and Science, Applied Computing will have to adhere to existing distribution requirements for that degree. In the C1 College requirement, students will be required to take a writing course, an indigenous studies course and MATH 164 (required for all Applied Computing Programs). In the C2 College requirement, students will be required to take a second writing course, in keeping with existing BSc requirements, and a social science course. The C3 requirement will include MATH 163, STAT 245 (or equivalent), PHIL 232 (Ethics for Computer Scientists) and three introductory science classes not in Computer Science. At least five electives will be allotted to the C5 slot. This course distribution covers all college requirements outside of the major for a BSc.

Foundation in Computer Science and Mathematics: A student completing a degree in Applied Computing should understand the fundamentals of algorithms (expressing solutions as a series of discrete steps), coding (expressing those discrete steps in a computer language) and software design (combining several algorithms to solve a larger problem and testing to see if the code actually does so). These foundational aspects of computer science are already part of our BSc in Computer Science, and are well covered in existing courses at the first and second year levels. In addition, foundational knowledge in logic, linear algebra and statistics is necessary for all concentrations within the degree, and to navigate prerequisites within the computer science curriculum. The courses in the common foundation are listed in the following table, and are required for all concentrations.

Table 1: Common Computer Science Fundamentals Courses

Number	Name	Rationale
CMPT 141	Introduction to Computer Science	Provides first introduction to coding concepts
CMPT 145	Principles of Computer Science	Continues introduction to coding concepts and introduces development practices
CMPT 260	Mathematical Logic and Computing	Provides the theoretical underpinnings for understanding logic and algorithms
CMPT 270	Developing Object Oriented Systems	Cover the design and implementation of object oriented programming, the dominant paradigm in practice. Introduces software engineering concepts.
CMPT 280	Intermediate Data Structures and Algorithms	Introduces key data structures for encoding data and their relationships, and fundamental algorithms for the construction and manipulation of those structures.
MATH 163	Introduction to Mathematical Reasoning	Introduces fundamentals of proof and logic.
MATH 164	Introduction to Linear Algebra	Matrices and vectors are fundamental data types. Understanding their mathematical properties is key to many computer science problems.
STAT 245*	Introduction to Statistical Methods	Fundamentals of statistics. Important for any quantitative work relating to uncertain measurements
PHIL 232	Ethics and Professional Responsibility in Computer Science	Fundamental ethics course required for all Computer Science BScs.

* Many functionally equivalent courses or groups of courses exist across the university. STAT245 is used as a shorthand for STAT245 or any of its equivalents

As noted above MATH 164 is used to partially satisfy the C1 requirement in the BSc program. MATH 163, STAT 245 and PHIL 232 partially satisfy the Cognate requirement. Five CMPT courses are common across all concentrations. The remaining seven are selected from second and third year classes depending on the concentration.

Concentration in Bioinformatics

The B.Sc. in Bioinformatics (BINF) degree is the other interdisciplinary degree largely overseen by the Department of Computer Science. Bioinformatics focusses on the role of DNA and its associated biomolecules in encoding and regulating cellular processes which eventually manifest as heritable traits. Bioinformatics uses sophisticated computing techniques to model genetic behavior. Because the processes encoded in DNA are fundamentally information processes, bioinformatics also convers aspects of biological processes as computing mechanisms. Degrees in bioinformatics train students to work in industry, typically in agribusiness, or in health.

The program currently has both undergraduate and graduate portions, but the graduate degrees are offered as MSc and PhDs in Computer Science. The undergraduate degree combines biology, biomedical science and computer science. Currently, four BINF courses are offered: a second year service course, a second year course for majors, a third year reading course, and a fourth year project course. While the graduate degree is healthy, and has had meaningful impact on research in Medicine, Biology and Agriculture, the undergraduate program has a history of low enrolments (but superb graduates). We propose to move the existing BINF degree under the Applied Computing umbrella to perform a strategic refactoring of the undergraduate Bioinformatics program.

The current undergraduate program has a number of issues related to recruitment and retention, which we hope to address through the redesign of the courses and curriculum:

- **Terminal service course**: The current service course has a low conversion rate into majors or other computational courses as it is a stand alone course introducing bioinformatic software tools
- **Limited reach of service course**: Currently, students in the service course are largely limited to BMSC students, even though it has substantial benefit for students in other biosciences.
- **Long prerequisite pathway:** Because of the prerequisite structure, students must invest significant effort into the biological and computational prerequisites before being able to take courses in the target area.
- **"Difficult" intro course:** Many of the students outside of computer science can be intimidated by the perceived difficulty of the subject area. This is particularly true of students attempting to enter medical professions, who are often driven by grade point average.
- **Inconsistent structure:** Within computer science, a fairly standard paired structure of introductory and advanced courses has evolved. The current bioinformatics offerings are inconsistent with this structure.

We hope to address these shortcomings through a redesign of the courses and curriculum. The two existing courses for majors, BINF 200 and BINF 300 will be revised into BINF 351 and CMPT 451, respectively. The service course BINF 210 will be deprecated, and replaced with a new first year course, BINF 151. The Honours project course BINF 400 will be deprecated (Honours students will take the Honours course CMPT 407 serving all of Applied Computing). Hence, the three resulting classes are

- BINF 151: Computing in the Biological Sciences
- BINF 351: Introduction to Bioinformatics
- CMPT 451: Modelling and Algorithms for Biological Systems

The content of these courses have been adjusted to provide a smooth program of learning, and clear pedagogical outcomes and progress. The proposed first year course, BINF 151, will combine elements of our successful introductory CMPT 140 course with the existing BINF 210 curriculum. Students will leave the course knowing both scripting in Python for biological data analysis and the fundamentals of bioinformatics. The course will serve as a prerequisite for CMPT 141, providing a clear path into the program and removing some of the difficulty stigma attached to computer science. This course will also be designed to be broadly accessible to students in the biosciences. The outcomes of the course includes a knowledge of programming (as opposed to the existing course BINF 210 which does not teach it), and this opens up many possibilities for using bioinformatics and computing generally. Most should be able to take the course in the second semester of their first year (in contrast to BINF 210 which students often reserved for later in their programs). Students would take the common Applied Computing core, and would have access to BINF 351 in third year, and CMPT 451 in fourth year. BINF 200 will transition into BINF 351, and it will alter the prerequisites to be more accessible to Biology students rather than Biomedical Sciences students. BINF 300 will transition into CMPT 451. CMPT 451 has a substantial algorithmic component, and the prerequisites have been opened to make it easier for CMPT majors to take it as a senior elective. CMPT 451 will be cross-listed as a new graduate course, CMPT 841, in keeping with the course structure typical in Computer Science.

In addition to the common computer science curriculum, students are required to take a substantial number of biology and biochemistry courses. Students in the Bioinformatics concentration are encouraged, but not required to take STAT 246 in place of STAT 245.

Table 2: Required CMPT, BINF, BIOC, BIOL, BMSC, and STAT courses for the Concentration in Bioinformatics

Number	Name	Rationale
CHEM 112	General Chemistry	Fundamental chemistry prerequisite (in C3)
CHEM 250	Introduction to Organic Chemistry	Fundamental chemistry prerequisite (in C3)
BIOL 120	The Nature of Life	Fundamental biology prerequisite (in C3)
BIOL 121	The Diversity of Life	Second fundamental biology prerequisite
BINF 151	Computing in Biological Systems	Introduction to both coding and principles of bioinformatics. **Recommended for students with a limited CS background but not explicitly required for degree**. Similar to CMPT140 in ISD
BMSC 200	Biomolecules	Fundamental biomolecular knowledge
BMSC 240 **Or** **BIOL 226**	Laboratory Techniques Genes to Genomics	Understanding of preparation of DNA or other samples, and role in signal output Mendelian genetics, DNA structure and replication, gene function
STAT 246	Introduction to Biostatistics	Fundamental statistical methods for biological systems. Can be taken in place of STAT245
CMPT 318	Data Analytics	Bioinformatics is inherently data driven. Understanding proper pipeline construction will prevent erroneous conclusions.
CMPT 353	Full Stack Web	Covers database basics which is crucial for practical bioinformatics systems. Provides tools for moving data across the web
CMPT 360	Machines and Algorithms	Theoretical basis for advanced bioinformatics algorithms.
BMIS 340 **Or** **BIOL 316**	Introductory Molecular Biology Molecular Genetics of Eukaryotes	Core molecular biology processes underlying the function of DNA Covers epigenetics, RNA interference and other advanced topics in molecular genetics
BINF 351	Introduction to Bioinformatics	Core course in the program covering fundamentals of bioinformatics
CMPT 451	Algorithms and Modeling in Bioinformatics	Advanced topics in bioinformatics, with a focus on the efficient computational solution to common problems

Students in Bioinformatics have a choice of several Computer Science electives to complete their degrees. Students must take two of the following, loosely grouped into pairs. The simulation option would appeal to students interested in health and low-level processing. The theory option would be of interest to students targeting algorithm development. The AI option would be interesting to students wishing to apply machine learning techniques to bioinformatic problems. The visualization option would be interesting to students wishing to render complex biological data in a meaningful way. BSc recipients can take any two courses listed below. It is recommended that honours students complete all courses in an option.

Table 3: Optional CMPT courses for the Concentration in Bioinformatics organized by option

Number	Name	Rationale
Simulation Option		
CMPT 214	Programming Principles and Practice	Covers low-level C++ programming and command line scripting and automation. Necessary for high performance systems
CMPT 394	Simulation Principles	Efficient implementation of simulations, particularly Monte Carlo simulation.
AI Option		
CMPT 317	Introduction to Artificial Intelligence	Classic search and AI techniques useful for inferring bioinformatic effects
CMPT 423	Machine Learning	Machine learning techniques for learning models from data. Commonly employed in bioinformatic systems.
Theory Option		
CMPT 364	Automata and Formal Languages	Further theoretic underpinnings to complement CMPT360, necessary for algorithm development
CMPT 463	Advanced Algorithms	Further exploration of algorithms
Visualization Option		
CMPT 384	Information Visualization	Fundamentals of data visualization and presentation. Useful for representing complex data.
CMPT 484	Graph Drawing and Network Visualization	Advanced interactive visualization techniques focusing on visualizing how things are related, for example gene expression networks

Students in bioinformatics can choose between general biology, biomedical systems, or plant and agricultural biology as a focus for their cognate areas. While students have some flexibility within these specializations, the prerequisite structure does require some depth. Students must take seven of the following courses. All students in the concentration must complete seven courses from this list, and Honours students must also have at least one at the 400-level. Any course counted in another list above cannot be counted in this list as well.

Table 4: Optional SCB, ANBI, ANSC, BIOC, BIOL, BMSC, CHEM, MCIM and PLSC courses for the Concentration in Bioinformatics

Number	Name	Rationale
ACB 331	Methods in Cell and Developmental Biology	Laboratory techniques relevant to bioinformatics
ANBI 470	Applied Animal Biotechnology	Application of bioinformatic techniques in an animal context
ANSC 313	Animal Breeding and Genetics	Biological context for bioinformatics knowledge.
BIOC 405	Structure and Function of Biomolecules	Biological behavior of bioinformatic entities
BIOC 436	Advanced Molecular Biology	Biological manipulation of nucleic acids. Application of bioinformatics
BIOL 222	The Living Plant	Fundamental knowledge of plant physiology. Prerequisite for PLSC416
BIOL 226	Genes to Genomics	How genes are manifested through DNA. Core BIOL

		prerequisite
BIOL 316	Molecular Genetic of Eukaryotes	More advanced topics in genetics.
BIOL 325	Plant Cells and Tissues	Fundamental plant cellular biology. Prerequisite for BIOL420
BIOL 420	Molecular Biology of Plants	Necessary for bioinformatics analysis and manipulation of plants
BIOL 421	Functional Genomics	Biological perspective on bioinformatics
BMSC 210	Microbiology	Covers genetics and behavior of microorganisms. Prerequisite for BMSC320
BMSC 220	Cell Biology	Covers fundamentals of cell biology. Prerequisite for BMSC320
BMSC 240	Laboratory Techniques	Laboratory techniques in biochemistry, cell biology, and microbiology
BMSC 320	Nucleic Acids from Central Dogma to Human Disease	This is the central dogma of the degree
BMIS 340	Introductory Molecular Biology	Core molecular biology processes underlying the function of DNA
CHEM 255	Bio Organic Chemistry	Laboratory class focused on biochemistry
MCIM 417	Molecular Virology	Molecular biology of viruses. Useful if interested in health bioinformatics
MCIM 487	Microbial Genetic Systems	The interaction of genes and biological processes in microbial life. Useful for many areas of bioinformatics
PLSC 317	Plant Metabolism	Photosynthetic and mitochondrial metabolic processes. Prerequisite for PLSC416.
PLSC 411	Plant Breeding	Applied plant genetics. Often used in conjunction with bioinformatic processes
PLSC 416	Applied Plant Biotechnology	Applied use of bioinformatic techniques amongst others in plant biotech
STAT 241	Probability Theory	Foundational knowledge for working with data and statistical techniques relevant to bioinformatics
STAT 345	Design and Analysis of Experiments	Understanding how different statistical operations are more or less valid given the structure of the data collection

To complete an Honours degree in the Bioinformatics concentration, students must complete CMPT 407. Students must complete at least one 400 level course from the Life Sciences portion of the degree (Table 17). Students must maintain a CGPA of at least 70 across all major courses and 70 overall.

Concentration in Business

The IT sector is one of the fastest growing industries in Saskatchewan and around the world. Demand for qualified coders and software engineers has driven demand for graduates from Computer Science. However, IT enterprises are also businesses and require students with a background in commerce to relate to clients, drive sales, and manage human resources. People filling these roles should also have an understanding of the core IT business at a technical level so that they do not make impossible promises to clients or fail to integrate with software engineering teams. Concentrations which were composed primarily of commerce degrees with some computer science, or computer science with some commerce were the primary request from our industrial stakeholders for new programming. As a Department of Computer Science we cannot propose a degree in Commerce, so this proposal focusses on a degree primarily in Computer Science with substantial contributions from the Edwards School of Business. We do note that our existing Certificate in Computer Science could be used to help accommodate the former.

Students in the Business concentration will need to complete the foundations of computer science course list, two required software engineering classes, any calculus class (MATH 110, 121, 123, 125, 133, or 176) and an extended version of ESB's Certificate in Business. Students must take five of fourteen CMPT electives organized into three options. For the four year degree the options are recommendations only, and students can combine courses from any option. Options available include software engineering, analytics, and user interfaces and the web. Students take seven COMM courses and have the option of selecting and additional two from a list of six.

Table 5: Required CMPT and COMM courses for Concentration in Business

Number	Name	Rationale
CMPT 370	Intermediate Software Engineering	Software engineering principles and tools. Necessary for working on projects involving more than a few coders
CMPT 371	Software Management	Software engineering practice with a focus on team dynamics and project tracking
COMM 100	Business Communication I	Effective business communication is critical and continues to be one of the most requested additional competencies from our industrial stakeholders
COMM 101	Introduction to Business	Fundamental prerequisite and foundational business knowledge
COMM 105	Introduction to Organizational Behavior	Fundamental knowledge of the company as an organization, prerequisite
COMM 201	Introduction to Financial Accounting	Financial literacy. Necessary for account management
COMM 204	Introduction to Marketing	Fundamentals of marketing. Understanding business processes as a function of client demand
COMM 306	Ethics and Strategic Decision Making	Business ethics to complement ethics fundamentals taught in PHIL232

Many options are open to a student with a background in both computer science and commerce. Students could focus on business process and software engineering with an eye towards leadership, students could turn their computer science training on the business and its customers and provide data analytic insights, students could focus on users and clients and their experiences with the products, or any combination of these outcomes. To accommodate the wide array of possible outcomes, students in the business concentration are free to choose five of fourteen senior electives.

Table 6: Optional CMPT courses for the Concentration in Business organized by option

Number	Name	Rationale
Software Engineering Option		
CMPT 214	Programming Principles and Practice	Covers low-level C++ programming and command line scripting and automation. Prerequisite for CMPT340
CMPT 340	Programming Language Paradigms	Covers the three main programming language paradigms used in industry. Introduces parallel programming
CMPT 353	Full Stack Web Programming	Programming for web based applications. Linking web apps to databases
CMPT 436	Mobile and Cloud Computing	Programming across multiple platforms with seamless connectivity enabled through middleware

CMPT 470	Advanced Software Engineering	Advanced and automated techniques for software engineering
Analytics Option		
CMPT 317	Introduction to Artificial Intelligence	Links statistics and computer science to solve problems. Prerequisite for CMPT423
CMPT 318	Data Analytics	An introduction to data analysis pipelines and practices. Potentially useful to analyze business data
CMPT 384	Information Visualization	Fundamentals of data visualization and presentation. Useful for creating visualization of business data
CMPT 423	Machine Learning	Survey course on machine learning methods and algorithms with a focus on application. Necessary for advanced business data analytics
CMPT 489	Deep Learning and Applications	Deep learning employs large neural networks and datasets for difficult AI tasks, currently a hot area in business analytics
User and Web Option		
CMPT 281	Website Design and Development	Creation of websites using standard web languages
CMPT 353	Full Stack Web Programming	Programming for web based applications. Linking web apps to databases, prerequisite for CMPT412
CMPT 381	Implementation of Graphical User Interfaces	How to build user friendly and effective interfaces. Good for spatial app development
CMPT 412	Social Computing and Participative Web	Social web based interactions are at the core of many new business trends such as influencers, social network advertising and customer modeling
CMPT 481	Human Computer Interaction	How people interact with machines and how to test to determine if those interactions are effective

Students must complete two of six business courses to complete their business requirements. Selections broadening their base of business knowledge or specializations in entrepreneurship or marketing are available.

Table 7: Optional COMM courses for the Concentration in Business

Number	Name	Rationale
COMM 203	Introduction to Finance	Provides the ability to interact with financial planning and reporting with greater sophistication. Prerequisite for COMM349
COMM 205	Introduction to Operations Management	Introduction to the quantitative aspect of product planning, potentially of interest to Applied Computing students
COMM 348	Leadership	Covers fundamentals of leadership. Useful for students targeting team or product leads as a career outcome.
COMM 349	Introduction to Entrepreneurship	Introduces how new ventures and entrepreneurs are evaluated. General introduction to starting a new venture. Useful for students thinking of a tech start-up as a career path
COMM 352	Marketing Strategy	Analyzing market environments and building a strategy. Meshes well with courses in Analytics and Users and Web options

COMM 354	Consumer Behavior	Models of consumer behavior. Combines well with COMM352 and courses from the Analytics and Users and Web options
COMM 357	Marketing Research	Identifying markets and market segments. Combines well with COMM352 and courses from the Analytics and Users and Web options

To complete the Honours degree students must complete at least two courses at the fourth year level from Table 9. Students must complete CMPT 407. Students must maintain a CGPA of at least 70 across all major courses and 70 overall. It is recommended that honours students complete all courses in an option.

Concentration in Data Analytics

Data analytics has become a major growth area of IT, penetrating many more traditional industries with the promise of increased efficiency. Whether it is modeling customers for business, crops for agriculture, or voting intensions for politicians, data analytics has changed the way that we measure, model and understand the world we live in. Most comparator and U15 universities have introduced programming around data analytics, most commonly as post graduate certificates. Data analytics is an area of potential growth for the Department of Computer Science and university.

Data analytics requires significant cross training in computer science, mathematics and statistics, as well as some domain knowledge. Obtaining all three elements in a single degree is difficult. The Geomatics and Bioinformatics concentrations focus on providing computational and domain knowledge at the cost of statistical depth. The Data Analytics concentration focusses on computational and statistical knowledge at the cost of domain specialization. Graduates of the Data Analytics concentration would have a strong foundational knowledge of data analytics, and would work with domain experts in the field to obtain insight.

The Data Analytics concentration is an intensive combination of a thin major in Computer Science with large minors in Mathematics and Statistics. It would not be possible for a student to complete in conjunction with the current BSc in Computer Science without taking additional credits. Students must complete the computer science core, and complete four required and four optional courses drawn from a list of seven in Computer Science. Students complete six required courses in Math and two required courses in Statistics, and must complete two additional courses in Math and two additional courses in Statistics drawn from curated lists. Students will have to complete one additional course in Math or Statistics drawn from either curated list.

Table 8: Required CMPT, MATH and STAT courses for the Concentration in Data Analytics

Number	Name	Rationale
CMPT 317	Introduction to Artificial Intelligence	Links statistics and computer science to solve problems. Prerequisite for CMPT423
CMPT 318	Data Analytics	An introduction to data analysis pipelines and practices, and is core to this program
CMPT 384	Information Visualization	Fundamentals of data visualization and presentation, core to the program
CMPT 423	Machine Learning	Creating models from data, core to the program
MATH 110/176	Calculus I	Differentiation. Core prerequisite.
MATH 116/177	Calculus II	Integration. Core prerequisite.
MATH 211	Numerical Analysis I	Algorithms and solutions for mathematical equations in software, foundational

MATH 266	Linear Algebra II	Most machine learning and data analytics algorithms have linear algebra at their core. This course provides added depth on the topic.
STAT 241	Probability Theory	Foundational knowledge for working with data and statistical techniques
STAT 242	Statistical Theory and Methodology	Foundational knowledge. Core prerequisite.

Students must complete four of eight senior Computer Science courses related to Data Analytics. Students can opt for additional courses in theory, software engineering, simulation and machine learning. Students must take at least one at the 400 level.

Table 9: Optional CMPT courses for Concentration in Data Analytics

Number	Name	Rationale
CMPT 214	Programming Principles and Practice	Covers low-level C++ programming and command line scripting and automation. Useful for processing large datasets and writing efficient code
CMPT 353	Full Stack Web Programming	Programming for web based applications. Linking web apps to databases
CMPT 360	Machines and Algorithms	Fundamentals of algorithms and algorithm design. Optional prerequisite for 484
CMPT 370	Intermediate Software Engineering	Software engineering principles and tools. Necessary for working on projects involving more than a few coders
CMPT 394	Simulation Principles	Efficient implementation of simulations, particularly Monte Carlo simulation.
CMPT 484	Graph Drawing and Network Visualization	Advanced interactive visualization techniques focusing on visualizing how things are related
CMPT 489	Deep Learning and Applications	Deep learning employs large neural networks and datasets for difficult AI tasks. Cutting edge of machine learning practice

Students must complete a total of five MATH and STAT classes from a list of recommended courses. Student must complete two MATH courses, two STAT courses, and one of either subject.

Table 10: Optional MATH and STAT courses for Concentration in Data Analytics

Number	Name	Rationale
MATH 238	Introduction to Differential Equations	Fundamentals of differential equations. Form the basis for many models data is representing. Prerequisite for MATH 314
MATH 313	Numerical Linear Algebra	Many machine learning algorithms rely on fast and accurate linear algebraic manipulations
MATH 314	Numerical Solutions of Ordinary Differential Equations	Solving systems of equations numerically on a computer. Useful when data analytics is used to estimate form or parameters of equations
MATH 325	Introduction to Optimization	Many machine learning algorithms rely on optimization to generate a solution. This course provides a firm foundation for their study

MATH 327	Graph Theory	Many common data analytic tasks (e.g. social networks) can be represented as graphs. Matches well with CMPT484
STAT 344	Applied Regression Analysis	Regression is a core method in extracting meaning from data
STAT 345	Design and Analysis of Experiments	Understanding how different statistical operations are more or less valid given the structure of the data collection
STAT 346	Multivariate Analysis	Analysis of higher dimensional data using statistical methods

To complete the Honours degree students must complete CMPT 360 and STAT 344, 345, and 346. Students must complete at least one course at the fourth year level from Table 6. Students must complete one of CMPT 407 or MATH 402. Students must maintain a CGPA of at least 70 across all major courses and 70 overall.

Concentration in Geomatics

Geomatics is the quantitative study of relationships pertaining to the Earth's surface, particularly focused on the analysis of satellite or drone images of the Earth or in GPS tracking across the Earth's surface. Geomatics has applications to civic planning, land and water management, agriculture, and business. Increasingly, firms are making decisions about investments based on satellite telemetry. In the field of Geomatics, computer science provides the tools for analyzing data and geography provides the social and physical theoretical constructs which provide meaning to the data and analysis.

The computer science component of the Concentration in Geomatics adds data analytic, visualization and image processing courses to the fundamentals listed above, providing students with the tools they need to analyze and present spatial data. Students must take four additional courses from a list of ten senior computer science courses. These courses are roughly grouped into a software engineering option for students who wish to build geomatic software systems, an analytics option focused on AI and machine learning, and a user interface and visualization options for student who want to create interactive spatial tools. The options are voluntary, and students can mix and match as they deem appropriate. The geography concentration draws heavily on the Geomatics minor from Geography and planning. Students take one introductory Geography course, followed by a four course core set of geographic principles, covering what spatial relationships exist and how they are encoded. Students must then choose two of a list of six courses covering senior geography and planning electives. Taking all required courses into account, students are left with eight electives which could be used to provide further breadth, for example in the social sciences for students interesting in human geography, or in geology or hydrology for students interested in physical geography.

Table 11: Required CMPT and GEOG courses for the Concentration in Geomatics

Number	Name	Rationale
CMPT 318	Data Analytics	An introduction to data analysis pipelines and practices, particularly useful when dealing with the output of computer vision analysis or directly with GPS analysis
CMPT 384	Information Visualization	Fundamentals of data visualization and presentation. Particularly important in Geomatics as the output of analysis is often an annotated map
CMPT 487	Image Processing and Computer Vision	Requirement for the automatic processing of satellite or drone data. Fundamentals of traditional image processing techniques.

Intro GEOG	One of GEOG120, 125, 130	While not strictly required for entry into senior Geography courses, an introduction to the concepts and vocabulary of geography as a discipline is important
GEOG 222	Introduction to Geomatics	Covers core geographic concepts in geomatics
GEOG 322	Introduction to Geographic Information Systems	GIS systems are the core of spatial analysis and the key technical link between the computer science algorithms and geographic interpretation
GEOG 302	Quantitative Methods in Geography	Provides the link between algorithmically measured values and geographic conclusions through spatial statistics
GEOG 323	Remote Sensing	Remote sensing in this context refers to the acquisition and interpretation of aerial or satellite imagery

Students are provided with a list of ten further courses in Computer Science, of which they must select four, including one at the 400 level. The courses are grouped into three options: Software Engineering, Analytics, and Users and Visualization. These options are for advising purposes only; students are free to select any four courses according to their interests and goals.

Table 12: List of optional CMPT courses for the Concentration in Geomatics

Number	Name	Rationale
Software Engineering Option		
CMPT 214	Programming Principles and Practice	Covers low-level C++ programming and command line scripting and automation. Useful for processing large datasets
CMPT 353	Full Stack Web Programming	Programming for web based applications. Linking web apps to databases
CMPT 370	Intermediate Software Engineering	Software engineering principles and tools. Necessary for working on projects involving more than a few coders
Analytics Option		
CMPT 317	Introduction to Artificial Intelligence	Fundamentals of AI including data representation, searching and constraint based solutions. Prerequisite for CMPT423 and CMPT489
CMPT 360	Machines and Algorithms	Fundamentals of algorithms and algorithm design. Useful if designing new spatial analysis algorithms is goal, rather than application of existing ones
CMPT 423	Machine Learning	Survey course on machine learning methods and algorithms with a focus on application. Necessary for advanced spatial data analytics
CMPT 489	Deep Learning and Applications	Deep learning employs large neural networks and datasets for difficult AI tasks. Most recent advances in image processing have employed deep learning techniques

User Interface and Visualization Option		
CMPT 360	Machines and Algorithms	Fundamentals of algorithms and algorithm design. Optional prerequisite for CMPT484
CMPT 381	Implementation of Graphical User Interfaces	How to build user friendly and effective interfaces. Good for spatial app development. Optional prerequisite for CMPT484
CMPT 481	Human Computer Interaction	How people interact with machines and how to test to determine if those interactions are effective
CMPT 484	Graph Drawing and Network Visualization	Advanced interactive visualization techniques focusing on visualizing how things are related

Students are required to complete two of six senior geography classes grouped into Geography or Planning options. As with the Computer Science options, these options are only for advising, and students are free to select any courses based on interest and availability.

Table 13: List of Optional PLAN and GEOG courses for the Concentration in Geomatics

Number	Name	Rationale
Planning Option		
PLAN 350	Transportation Planning and Geography	Application area of geomatics related to civic planning
PLAN 360	Urban Data Analysis and Visualization	Application of geomatics techniques to urban planning (ECON 211 required)
PLAN 390	Research and Field Methods in Planning	Techniques for acquiring data for urban planning
Geography Option		
GEOG 420	Cartography and Professional Communication	Advanced maps and mapping. Meshes well with CMPT384 and 484.
GEOG 423	Advanced Remote Sensing	Advanced topics in satellite image analysis

To complete an Honours degree in the Concentration in Geomatics, students must complete at least one course at the fourth year level from Table 3 or Table 4. Students must complete one of CMPT 407, GEOG 490 or PLAN 490. Students must maintain a CGPA of at least 70 across all major courses and 70 overall.

Concentration in Interactive System Design

The basis for the Concentration in Interactive System Design is the existing, successful interdisciplinary program in Arts and Science, currently offered as a B.A.&Sc. This concentration will train students with the computer science, design and psychology skills necessary to build effective, aesthetically pleasing, functional, front ends for apps, websites and games. The current program already trains students to work in technology, advertising and digital design, and students find placements at firms in the city and around the world. Because of its current stable and successful instantiation, only minor changes to the ISD area have been proposed as it becomes part of the Applied Computing program.

The ISD concentration will adopt the Applied Computing first and second year core programming, to facilitate movement between Applied Computing disciplines. In particular, this introduces the new Mathematics and Ethics requirements (MATH 163/164, PHIL 232) and adds CMPT 260. The second

change is the addition of a digital design course to the curriculum, as an option for completing the ART component of the degree.

Table 14: Required CMPT, ARTH and PSY courses for the Concentration in ISD

Number	Name	Rationale
ARTH 120	Art and Visual Culture I	Fundamentals of Art History introducing key concepts, and early art periods, Prerequisite for ARTH 250/251
ARTH 121	Art and Visual Culture II	Fundamentals of Art History introducing key concepts, and later art periods, Prerequisite for ARTH 250/251
ART 1XX		Basic proficiency in Art. Any introductory studio class is a prerequisite for senior studio classes
PSY 120	Biological and Cognitive Bases of Psychology	Fundamentals of individual psychology.
PSY 121	Social Clinical Cultural and Developmental Behaviour	Fundamentals of social and clinical psychology
CMPT 281	Website Design and Development	Fundamentals of how web pages work. Design principles for websites.
CMPT 370	Intermediate Software Engineering	Software engineering principles and tools. Necessary for working on projects involving teams
CMPT 381	Implementation of Graphical User Interfaces	Core technical skills to build interactive systems
CMPT 481	Human Computer Interaction	How to measure and model users' interactions with computer systems.

Students must either take a game design or information visualization specialization..

Table 15: Optional CMPT courses for the Concentration in ISD

Number	Name	Rationale
Game Design Option		
CMPT 306	Game Mechanics	Game development principles and algorithms.
CMPT 406	Game Design Workshop	Game design in teams.
Information Visualization Option		
CMPT 384	Information Visualization	Principles of information visualization.
CMPT 484	Graph Drawing and Network Visualization	Advanced visualization techniques for visualizing large amounts of data

Students must take one third year elective from the following list. Students can take the third year course from the options above as their third year elective. That is, students opting for the game option could take CMPT 384 as their third year course, and students taking the Information Visualization Option could take CMPT 306.

Table 16: Optional Third Year CMPT courses for the Concentration in ISD

Number	Name	Rationale
CMPT 306	Game Mechanics	Game development principles and algorithms.
CMPT 318	Data Analytics	Useful for students who want to incorporate web or user analytics into systems
CMPT 353	Full Stack Web Programming	Useful for students who wish to specialize in web development.
CMPT 360	Machines and Algorithms	Necessary prerequisite for students wishing to take the CMPT384/484 option.
CMPT 371	Software Management	Software engineering practice with a focus on team dynamics and project tracking
CMPT 384	Information Visualization	Principles of information visualization.

Students may choose further study in a number of Art and Art History related subjects, in part to facilitate student interest, and in part to accommodate larger student cohorts.

Table 17: Optional ART/design and ARTH courses for the Concentration in ISD

Number	Name	Rationale
Art History Options (Choose one)		
ARTH 250	Introduction to Visual Culture	Interaction between visual art forms and culture
ARTH 251	Art of the Internet	Investigates how the Internet has changed and shaped art forms
Art Options (Choose two)		
ART 231	Animation and Digital Space	Principles of digital animation
ART 235	Digital Imagery	Use of computer systems to create or enhance images
ART 236	Digital and Integrated Practice IIA	Creation of works of art using digital technologies
ART 237	Digital and Integrated Practice IIB	Creation of works of art using digital technologies
ART 331	Animation and Digital Space II	Advanced animation
INTS 111	Design and Society	Fundamental knowledge of design

In addition to computer science and art courses which teach students how to build interactive media that are functional and aesthetically pleasing, students take psychology courses to understand how people perceive and interact with information. The courses in the psychology portion of the proposed ISD program remain unchanged from the current program. Students must choose three courses from the list below.

Table 18: Optional PSY courses for the Concentration in ISD

Number	Name	Rationale
PSY 213	Child Development	Useful is students wish to work on educational or developmental software
PSY 214	Adolescent Development	Useful is students wish to work on educational or developmental software
PSY 216	Psychology of Aging	Useful for students targeting apps at the elderly
PSY 226	Social Psychology	Useful for students building social media, advertising or groupware apps
PSY 252	Perceptual Processes	Useful for understanding how people perceive interfaces, particularly information visualization or productivity interfaces
PSY 253	Introduction to Cognitive Psychology	Useful for understanding how people perceive interfaces, particularly information visualization or productivity interfaces
PSY 255	Human Memory	Useful for building interfaces in general, and for information visualization
PSY 256	Psychology of Language	Useful for understanding how people perceive the written and spoken word, fundamental to a number of interactive systems

To complete an Honours degree in the ISD concentration, students must complete CMPT 407 and one of CMPT 406 or CMPT 484. CMPT 407 may be taken in place of or in addition to CMPT 406 or CMPT 484. Students must maintain a CGPA of at least 70 across all major courses and 70 overall.

Professional Internship Option

Students in the Applied Computing program will be eligible to participate in the existing Professional Internship Option offered by the department of Computer Science, which was previously available to students in the Bioinformatics and Interactive Systems Design programs. These students will be required to meet the same entry requirements as Computer Science students, as noted in the Catalogue.

Demand and Enrolment

Predicting demand for new programs is problematic, as student program intentions exist in an intersection of economic conditions, university marketing, and cultural zeitgeist, all of which are volatile on the timescale of degree approval. However, potentially actionable insight may be inferred from existing programs, industrial demand, and similar offerings at comparator institutions. Bioinformatics and Interactive System Designs are existing interdisciplinary degree programs within the College of Arts and Science and are meeting established needs. Geomatics meets a need for students to support the research and industrial development around remote monitoring, particularly for water and food security, and was discussed as a potential strategic area at the 2019 College of Arts and Science retreat. The Business concentration meets a clear need as articulated by our industrial stakeholders. Data analytics is a rapidly growing industry touching not just the IT sector, but traditional economic sectors like mining and agriculture, and is offered in some form at most of our comparator institutions. We are already training interdisciplinary students at the graduate level and struggling to adapt their needs to existing degree programs. All elements of this program are inherently needs-driven.

Computer Science has seen a dramatic year on year increase in enrollments, echoed by Bioinformatics and Interactive System Design. This increase in enrolments is happening worldwide, and is driven by a societal perception, largely born out in practice, that jobs in the twenty-first century will involve the

application of information technology to many fields. The last four years of enrolment data for Bioinformatics, Computer Science, and Interactive System Design are shown in Table 1. These numbers are underestimates of the totals for the programs, as approximately half the students in Arts and Science do not declare a major for a significant portion of their degree. However, in this case the trend is more important than the absolute numbers.

Student demand for the last five years for Computer Science, Bioinformatics and Interactive Systems Design.

	2016	*2017*	*2018*	*2019*	*2020*
Bioinformatics	9	13	16	20	20
Computer Science	533	638	734	806	862
Interactive Systems Design	61	66	68	70	72

Dalhousie is the comparator institution with the closest program. Their Bachelor of Applied Computer Science program has a similar intent and scope, but slightly different specializations. When they introduced their Bachelor of Applied Computer Science, their existing interdisciplinary degree programs accounted for 10% of their total enrollments, approximately the same in our department. After adding the BACS degree four years ago, their enrollments in the core Computer Science programming grew at the same rate as ours, but their BACS enrollments grew faster, reaching 20% of total enrollments and 250 students. Given the comparable sizes, and programs, we hope to experience the same growth as Dalhousie.

Explicit projections for the three new concentrations – Geomatics, Data Analytics, and Business – have not been performed. As these programs are based to a large extent on industry pull rather than student or academic push, we anticipate that they will be as popular as the ISD program once students recognize their post-graduation potential.

Strategic Alignment

The proposed program is intrinsically aligned with the University and College strategic priority for interdisciplinarity. While this program is aligned with strategic goals, it did not arise from their calls to action. This program does align with elements of the Computer Science strategic plan, articulated at the June 2017 departmental retreat, which called for a greater impact of computer science as a department and discipline across campus to reflect its growing importance to society.

Interdisciplinarity: The undergraduate proposal clearly addresses the interdisciplinary component of the university and college plans. By creating interdisciplinary programs within the context of existing course offerings and degree frameworks, we can move the interdisciplinary vision of the university and college forward with limited risk. This program provides clear ownership of degrees (the Department of Computer Science within the College of Arts and Science), clear paths to graduation though concentration-specific curation of synergistic courses, and limited cost growth through the leveraging of existing course offerings. This program makes high-demand interdisciplinary degrees possible and provides graduates with appropriately named degrees by curating existing courses and expertise in interesting and useful ways.

Each program was either reviewed (ISD, Bioinformatics), or created (Geomatics, Data Analytics, Business) by a joint committee consisting of the Computer Science Undergraduate Committee, and ad-hoc committee members proposed by the collaborating departments (Math and Stats, Geography, Art and Art History, Biology, and Edwards). These programs are not only interdisciplinary but were created by interdisciplinary teams. As the primary collaborators were involved in crafting the programs, the consultation with them is explicit. The Department Head of Computer Science also met with

representatives from Plant Science, Geology, Public Health, and Economics to discuss the potential for inclusion, and the impact of the program.

Internationalization: This program does not explicitly address internationalization; however, there are aspects of it within the programs. The student body of the graduate program in Computer Science is predominantly international. We expect this trend to continue in the graduate level Applied Computing program. At the undergraduate level, Computer Science has a disproportionate number of international students compared to other units, particularly from East Asia and South Asia.

Indigenization: Indigenization within this program, and Computer Science in general, will focus on access and impact. The Data Analytics and Geomatics concentrations would be of potential interest to indigenous students as they speak directly to data sovereignty, which is a core component of many issues facing indigenous communities including land claims, environmental assessments and water rights. Training indigenous students in these disciplines would allow them to perform their own analysis of data collected on their traditional territories, enabling more fulsome participation in conversations about land use and impact.

Indigenization is a college-level priority in Arts and Science, and we intend to leverage existing College programs. STEM education in remote communities and on reserve is a concern, limiting Indigenous students' access to careers in Information Technology. This problem is common across rural Saskatchewan, and the Department of Computer Science has already created a course – CMPT 140: Creative Computing – to act as a bridge for students entering our program with limited Computer Science background. Indigenous students will have the option of entering the undergraduate degree through the Arts and Science Indigenous Student Achievement Pathways program. We will work with the College to include CMPT140: Creative Computing in this program, and will allocate a specific tutorial section for ISAP students within that program.

Relationships to Other Programs

Programs in Bioinformatics and Interactive System Design are already offered by the College of Arts and Science. These programs will be deleted and brought into Applied Computing. There are no similar programs on campus for the Geomatics, Data Analytics and Business concentrations; however, the non-Computer Science portion of these concentrations closely mirrors the minor in Geographic Information Systems, and the Certificate in Business. Enrollments may shift subtly, but it is difficult to accurately predict. The most likely short-term outcome is an increase in CS headcount, but a decrease in relative CS 3CUEs, as we will attract and retain additional students, but those students will take fewer Computer Science classes than their peers in the existing BSc in Computer Science.

The undergraduate program described here is innovative within Arts and Science and the University of Saskatchewan, in that it embeds interdisciplinary programming within disciplinary oversight. We are willing to develop this kind of programming, so that other units can follow suit. Computer Science remains open to similar programming from other departments incorporating computer science as a cognate topic. For example, a major in Commerce, with Computer Science as a cognate area, could be useful for someone wishing to work in IT Marketing; similarly, a major in Plant Science with Computer Science and Geography as cognate areas could provide an agriculturist with some geomatics training.

Impact on Students

Overall, we anticipate the impact on students to be largely positive. We hope to increase the number, diversity, and academic breadth of students in Computer Science. By widening the scope of our offerings through collaborating with other departments we aim to provide more options to more students. Because these options have been curated, we expect students in Applied Computing should have access to similar employment outcomes as their peers doing the traditional BSc in Computer Science. Increased enrolment implies larger classes, which could negatively impact student experience. However, most Computer

Science classes are already characterized by large sections, so the incremental impact will not be significant. The increased enrolment will require additional lab and tutorial sections, as noted in resources, potentially benefitting some students by opening additional time slots for tutorials.

Applied Computing could be more complex to navigate, particularly for students transferring in from other institutions. Closely working with collaborating departments to establish transfer credits will be necessary. While the structure of Applied Computing facilitates movement between concentrations or into or out of the BSc in Computer Science for the first two years of the program, transfer becomes more difficult starting in third year. This will have to be clearly communicated to students in advising literature and sessions.

Impact on the Department

As with student impact, we anticipate the increase in diversity to be a positive impact on the department. There is extraordinarily little additional curriculum introduced as part of this program, given it's scope. Only one new course, Data Analytics, will be introduced. The Bioinformatics courses are evolving from the existing program leading to no additional courses required. Named courses in degrees have precedence during assignment of duties, and care should be taken to ensure that the number of courses does not constrain the ability of the department to offer programming with its existing complement. Applied Computing adds four new courses to the list of courses which must be offered beyond the existing lists for the BSc in Computer Science, BSc in Bioinformatics, B.A.&Sc in Interactive System Design, and the Honours BSc in Software Engineering. These courses are CMPT 318 (Data Analytics, Bioinformatics, Geomatics), CMPT 384 (Data Analytics, Geomatics, Interactive System Design), CMPT 423 (Data Analytics), CMPT 487 (Geomatics). As these courses have traditionally been offered every term, and each have at least two faculty members who can teach them, we do not believe that the four additional courses will unduly constrain departmental resources.

The limited impact on the department assumes that incremental tuition revenues brought in by students will be used to hire incremental tutorial leaders, markers, and sessional lecturers to accommodate the growth.

Governance

As a degree in Applied Computing, the BSc, BSc Honours, MSc and PhD are administered by the Department of Computer Science, under the oversight of the College of Arts and Science or College of Graduate and Postdoctoral Studies. All routine administrative functions associated with the navigation of students through these degrees will be initially the domain of the Department of Computer Science. However, these degree programs are also inherently interdisciplinary. Some decisions, for example course equivalencies or course substitutions, cannot be made by Computer Science faculty or staff for all required courses in the program. Where possible, Computer Science faculty and staff will make decisions based on precedent (for example in allowing one of the many established equivalencies to STAT 245). When no precedent exists, Computer Science staff or faculty will contact the Head (or designate) of the relevant department to establish precedent. Cognate departments are required to nominate a contact (by default the Department Head) to handle equivalency determination and other student issues. As most departments already have a faculty member dedicated to this role (such as an Undergraduate Chair) this should not be burdensome. All curriculum level amendments are subject to College review and will necessarily involve the Heads or delegates of departments in the impacted concentrations.

Resource Requirements

One of the elegant properties of this proposal is the way it leverages existing resources in new ways to create cohesive and impactful programs. There is only one totally new course proposed in this program: Data Analytics. The Dean has expressed that this topic is a priority for the college, and Computer Science likely would have offered a course regardless. Bioinformatics will technically offer one new undergraduate

course (BINF151), but one undergraduate course (BINF 210) in the BINF program will be removed to make way. Although BINF 300 has been recently offered as a reading course as teaching overload, by modifying BINF 300 into CMPT 451 and making it cross-listed as a graduate class, a faculty member can teach CMPT 451 as their normal graduate course. We will create a new Honours thesis course for Applied Computing, but it will be offered in conjunction with our current Honours thesis course and will only have separate numbering to accommodate different evaluation criteria for interdisciplinary projects. No new courses (aside from the cross-listed course) are required at the graduate level. Four fiscal scenarios using the format recommended by Integrated Planning and Assessment (IPA) spreadsheet format are available upon request from the program coordinator.

Named courses in degrees have precedence during assignment of duties, and care should be taken to ensure that the number of courses does not constrain the ability of the department to offer programming with its existing complement. Applied Computing adds four new courses to the list of courses which must be offered beyond the existing lists for the BSc in Computer Science, BSc in Bioinformatics, B.A.&Sc in Interactive System Design, and the Honours BSc in Software Engineering. These courses are CMPT 318 (Data Analytics, Bioinformatics, Geomatics), CMPT 384 (Data Analytics, Geomatics, Interactive System Design), CMPT 423 (Data Analytics), CMPT 487 (Geomatics). While the bioinformatics courses are new, they replace existing courses and therefore do not change the total count. As these courses have traditionally been offered every term, and each have at least two faculty members who can teach them, we do not believe that the four additional courses will unduly constrain departmental resources.
We have received commitments from all involved departments that spaces in required classes outside of Computer Science are available for students in this program. Computer Science did a strategic review of undergraduate programming two years ago and streamlined the BSc degree to allow double sectioning of upper year courses. This streamlining, combined with additional resources provided by the Dean and Provost, have provided us with a window of opportunity to entertain new programs. If the Computer Science growth rate continues as it has over the last decade, or potentially even accelerates following the Dalhousie example, Computer Science would be projected to run out of capacity again in 3-8 years. Growth may also create issues in other popular courses and program such as first year Biology, core Commerce courses, and senior Planning courses. Similar to Computer Science, we anticipate sufficient initial capacity in these disciplines, which will have to be re-evaluated as numbers increase. When enrolments reach saturation, the Provost and affected Deans will have to make a strategic decision to invest in additional growth or to cap enrollments.

Computer Science manages its own IT assets and has its own IT support. As such the impact on institutional ICT should be low for most of the offerings. There could be some impact on centrally administered products such as ArcGIS in the Geomatics concentration. This proposal does assume that the College continues to support Computer Science’s computer renewal plans at the current level, and the university continues to support the renewal of licenses for software assets used in the Business and Geomatics concentrations. Computer Science has used innovative approaches to leverage its existing infrastructure to accommodate its expansion and will continue to do so. As classes continue to grow, Computer Science will continue to have to compete for the larger classrooms on campus. If this program increases the growth rate, as in the Dalhousie example, then this competition will become acute earlier. The competition for larger classroom spaces continues to be an issue across campus and is not unique to this program. Computer Science has recently completed an extensive set of renovations and a space reallocation exercise to accommodate its large thesis-based graduate program. As the graduate program is not expected to impact enrolments, it is not expected to create additional demands on the space.

Risks

The undergraduate program was driven by demand from industry and other units on campus. Expectations for growth in the program are predicated on industry demand for graduates creating desirable employment opportunities, and by extension driving student uptake. It is a risk that the anticipated demand might fail to materialize or might disappear due to external economic drivers. However, given that the anticipated start date is September 2022, the first full undergraduate cohort from this program would not be expected until May 2027. People with the ability to accurately predict economic

conditions seven years in the future tend to be employed in more lucrative professions than academia. This risk will have to be actively measured and managed as the program rolls out.

Although we have received assurances from all impacted Dean's offices that spaces will be made available for this program, those assurances are not necessarily binding, and could be withdrawn at some point in the future. This risk exists for all interdisciplinary undergraduate programs, and will have to be actively managed by senior academic leadership if the University's goal of interdisciplinarity is to be achieved.

The fiscal risk associated with the project is limited. If the program proves too popular, this could put strain on some courses, in particular the cognate courses in Edwards, and second and third year Computer Science courses which are required in the BSc in Computer Science. Given growth projections, we would not expect this to be an issue until 2025 at the earliest. This could be managed through either additional investment in faculty positions, justified by the enrollments, through expanded use of sessional lecturers, or through capping enrollments in the program. Strain on first and second year Computer Science classes that all Computer Science and Applied Computing concentrations share could be managed by adding additional sections of those classes taught by sessional lecturers, at a substantially lower cost than the additional revenues driving the multiple sections. In a related vein, this program has the potential benefit of directing more students into Geography and senior Math and Statistics classes, which do have capacity. Four fiscal scenarios using the format recommended by Integrated Planning and Assessment (IPA) spreadsheet format are presented below.

The fiscal risk associated with support is also limited. Course scheduling will be somewhat more complex, as cross departmental class schedule coordination will be required. For students entering a concentration in first year, and progressing through the recommended course progression, this should be solvable and maintainable. For students transferring into a concentration from another concentration or degree, who might be taking some courses outside the proscribed sequence, this will be more complex, and may require additional administrative support and software assistance. However, this risk is not unique to this program and will have to be adequately addressed, regardless, if the university is serious about its interdisciplinary vision.
There is some risk in not offering this program at this time. Most of our Canadian comparator institutions have a form of Data Analytics programming. Failing to implement our own puts us at a competitive disadvantage. We are already engaged in substantial collaborative and interdisciplinary research at the graduate level. Failing to create the graduate level Applied Computing degrees will place an unnecessary impediment on the functioning and growth of the department's research effort.

Budget Scenarios

A spreadsheet with the details of these scenarios was submitted with this document.

Understanding the potential financial impact of the introduction of new programs is important. While as noted in the risk assessment in the main document, we expect the incremental impact to be limited, some quantitative analysis of potential revenues and expenses is warranted. Using the Integrated Planning and Assessment template, we have projected four enrollment scenarios over a five-year time horizon. Numbers assume that students are taking a full 15 credit load per term. Total tuition to the university is calculated. No incremental graduate students are assumed. We assume attrition is zero, which is bold, but adding another parameter would expand the search space substantially. These numbers are meant to demonstrate potential trends and should not be taken as definitive projections.

The enrolment model anticipates an initial bump in enrolments above historic norms, followed by geometric growth at a specific rate. In the weak assumption, only an average of one incremental student is recruited during the initial bump. In subsequent models an initial burst of an average of 10 incremental students per concentration is posited. This incremental baseline is held constant across the first four years of the program (10 incremental students continue to second year, joined by 10 new incremental students in first year). In the fifth year, the incremental bump from the first year is deducted from the enrolment, as they have been assumed to have graduated. Three growth rates are modeled: 1% (lower

than College averages), 10% (higher than college averages, and comparable to Computer Science) and 20% (higher than Computer Science, but consistent with Dalhousie's Applied Computing). Two teaching assistants (one TA and one marker) are added for every 30 incremental students. Two to four sessional lecturers are added in year three onward in all but the weak growth scenario.

Substantial profits to the university are posited in all but the weak growth scenario. In the weak growth scenario, a profit to the university is realized, but is too small to be significant. In the worst case, we introduce novel interdisciplinary programming with only modest returns. In the strong and very strong growth scenarios, substantial increased revenues are realized. In both those cases, Computer Science, and departments associated with concentrations contributing to the growth would have strong cases for incremental faculty positions to support the success of the programming. In the moderate case, Computer Science, and the departments associated with concentration contributing to the growth would have a strong case for maintaining current faculty complements.

UNIVERSITY OF SASKATCHEWAN

Report Form for Program Termination

Program(s) to be deleted: Bioinformatics - Bachelor of Science Honours and Four-year

Effective date of termination: May 2022

1. List reasons for termination and describe the background leading to this decision.

The Department of Computer Science is proposing a new program called Applied Computing, with a variety of named concentrations, in order to offer interdisciplinary programming with a common foundation. The existing Bioinformatics program will be deleted, and a new named concentration of the Applied Computing program in Bioinformatics will be created. We are taking the opportunity to revise the dedicated bioinformatics courses in order to revitalize the program.

2. Technical information.

2.1 Courses offered in the program and faculty resources required for these courses.

The dedicated course offerings in the bioinformatics program are BINF 200, BINF 210, BINF 300, BINF 400, which are each offered once each year.

BINF 200 and BINF 210 are each taught by one instructor in Computer Science. BINF 300 has been offered as a reading course, and has been taught as teaching overload for a number of years. BINF 400 is the Honours project course, and is taught as an administrative duty.

2.2 Other resources (staff, technology, physical resources, etc) used for this program.

BINF 200 has labs that use the standard computer science computer labs maintained by the tech staff of the Department of Computer Science. BINF 210 uses the standard Arts & Science computer labs.

2.3 Courses to be deleted, if any.

BINF 210, BINF 400

2.4 Number of students presently enrolled.

Total: 13 students were enrolled as of the Fall Term Census Headcount.

2.5 Number of students enrolled and graduated over the last five years.

Total number of students enrolled over last 4 years is 41 in the Bioinformatics program.
2015/2016: 6
2016/2017: 9
2017/2018: 13
2018/2019: 17
2019/2020: 16

Total number of graduates over last 5 years is 15 students.
Breakdown:
2016: 1
2017: 2
2018: 3
2019: 6
2020: 4

---

3. Impact of the termination.
Internal

3.1 What if any impact will this termination have on undergraduate and graduate students? How will they be advised to complete their programs?

Students currently enrolled in the Bioinformatics program can remain in the existing program. BINF 400, a required course for the Honours program, is being deleted, but students will be able to take the proposed Applied Computing Honours project class (CMPT 407), as a substitution. As the course deletions/revisions do not take effect until May 2022, the department will continue to offer the current courses in 2021-22.

3.2 What impact will this termination have on faculty and teaching assignments?

There will be no changes to the number of courses taught by faculty from the previous bioinformatics courses to the new ones, for the following reasons:

- BINF 200 is proposed to be relabeled to BINF 351, both of which require one instructor per year.
- BINF 210 is proposed to be eliminated, and replaced by BINF 151, both of which require one instructor per year.
- BINF 300 is proposed to be relabeled to CMPT 451, and it will be cross-listed with a new graduate course, CMPT 841. BINF 300 was offered as a reading course for several years as teaching overload and CMPT 451/CMPT 831 will not be. However, it is standard in the Department of Computer Science for each faculty member in the department to teach exactly one graduate course per year, and CMPT 451/CMPT831 would serve as that graduate course for one member of the Department of Computer Science. The result of this change will be that one of the other graduate courses currently taught will not be taught every year, but will instead be offered in rotation. This allows CMPT 451 to be taught "for free" using the standard graduate teaching assignment, and improves the experience for students taking CMPT 451.

3.3 Will this termination affect other programs, departments or colleges?

No other departments are affected by the deletion of the program.

3.4 If courses are also to be deleted, will these deletions affect any other programs?

The Department of Biochemistry, Microbiology and Immunology will be directly affected by the deletion of BINF 210. Students in their B.Sc. (BMSC) program currently have a requirement to take either BINF 210 or BINF 200. Communication with the Undergraduate Affairs Committee of the Department of Biochemistry, Microbiology and Immunology indicated that they will replace their requirement with another to require “either BINF 151 or BINF 351”. They were enthusiastic about the new course and revision.

Although BINF 200 is not being deleted and is being revised into BINF 351, the Department of Biology has a C4 Major requirement where they list 21 courses from which 33 CUs must be taken, with BINF 200 being an option. Communication with the head of the Department of Biology indicated that they will likely replace BINF 200 with the equivalent BINF 351 in their list of possible courses to fulfill this requirement.

3.5 Is it likely, or appropriate, that another department or college will develop a program to replace this one?

Yes, the Department of Computer Science is developing a stream in Bioinformatics to replace this program.

3.6 Is it likely, or appropriate, that another department or college will develop courses to replace the ones deleted?

Yes, the Department of Computer Science is developing BINF 151 to replace BINF 210, and BINF 400 will be replaced with CMPT 407 that serves all Applied Computing students.

3.7 Describe any impact on research projects.

There will be no impact on research projects, due to the new stream in Bioinformatics.

3.8 Will this deletion affect resource areas such as library resources, physical facilities, and information technology?

Due to the deletion of BINF 210, the Arts and Science computer lab will no longer be necessary for the lab component of BINF 210 (the new course BINF 151 created in its place will use the Department of Computer Science's computer labs due to the programming content of the course).

3.9 Describe the budgetary implications of this deletion.

There will be no changes in terms of the courses taught. There will however be a reduction in administrative duties required by faculty involved in the program. BINF 300 will no longer be

taught as overload by a faculty member each year. Furthermore, the BINF 400 Honours project course will no longer require a separate administrative responsibility.

External

3.10 Describe any external impact (e.g. university reputation, accreditation, other institutions, high schools, community organizations, professional bodies).

There will be no impact on accreditation or professional bodies. However, we do believe that there is a positive external impact to renaming the program from Bioinformatics to Applied Computing with a Bioinformatics stream. Indeed, students in high school usually do not have any idea about bioinformatics at all, affecting recruitment and students enrolment in the program. The Bioinformatics name faces similar issues after graduation from the program, as it can be deceptive to those in industry hiring graduates of Bioinformatics that they are fully trained in Applied Computing, and graduates could risk being pigeonholed into only biological areas.

3.11 Is it likely or appropriate that another educational institution will offer this program if it is deleted at the University of Saskatchewan?

The Department of Computer Science will offer it as a stream.

Other

3.12 Are there any other relevant impacts or considerations?

None.

3.13 Please provide any statements or opinions received about this termination.

There were discussions with both the Department of Biochemistry, Microbiology and Immunology and the Department of Biology regarding the termination of the program, and the creation of the new similar program with a stream. Communication regarding the course changes has been sent.

UNIVERSITY OF SASKATCHEWAN

Report Form for Program Termination

Program(s) to be deleted: Interactive Systems Design – Bachelor of Arts and Science Four-year

Effective date of termination: May 2022

1. List reasons for termination and describe the background leading to this decision.

The Department of Computer Science is proposing a new Applied Computing program. As part of that proposal, Interactive Systems Design will become a named concentration in Applied Computing, rather than a stand-alone major.

2. Technical information.

2.1 Courses offered in the program and faculty resources required for these courses.

All courses designed for this program will be used in the new Applied Computing program, Interactive System Design stream.

2.2 Other resources (staff, technology, physical resources, etc.) used for this program.

These resources used for this program will continue to be used in the proposed Applied Computing program.

2.3 Courses to be deleted, if any.

N/A

2.4 Number of students presently enrolled.

62 students were enrolled at the time of the Fall Term Census Headcount. As many students in Arts & Science do not declare a major in their first and sometimes second years, this number is likely low.

2.5 Number of students enrolled and graduated over the last five years.

Enrolments:

2015/2016: 61
2016/2017: 66
2017/2018: 68
2018/2019: 70
2019/2020: 72

Graduates:
2016: 6
2017: 2
2018: 6
2019: 13
2020: 6

---

3. Impact of the termination.
Internal

3.1 What if any impact will this termination have on undergraduate and graduate students? How will they be advised to complete their programs?

This program is being replaced by an almost identical program in Applied Computing. Existing students can complete the BA&Sc in Interactive System Design or switch to the BSc in Applied Computing with a concentration in Interactive System Design.

3.2 What impact will this termination have on faculty and teaching assignments?

There will be no net impact on teaching assignments

3.3 Will this termination affect other programs, departments or colleges?

No.

3.4 If courses are also to be deleted, will these deletions affect any other programs?

N/A

3.5 Is it likely, or appropriate, that another department or college will develop a program to replace this one?

No, the program is replaced by the proposed Applied Computing major.

3.6 Is it likely, or appropriate, that another department or college will develop courses to replace the ones deleted?

N/A

3.7 Describe any impact on research projects.

No impact.

3.8 Will this deletion affect resource areas such as library resources, physical facilities, and information technology?

N/A

3.9 Describe the budgetary implications of this deletion.

None, all resources used for this program will be used in the Applied Computing major.

External

3.10 Describe any external impact (e.g. university reputation, accreditation, other institutions, high schools, community organizations, professional bodies).

Some effort will have to be made with educational and industrial stakeholders to establish that the program is not gone, just rebranded. This effort is already underway as part of the Applied Computing consultation process.

3.11 Is it likely or appropriate that another educational institution will offer this program if it is deleted at the University of Saskatchewan?

N/A

Other

3.12 Are there any other relevant impacts or considerations?

N/A

3.13 Please provide any statements or opinions received about this termination.

N/A

College Statement

From Gordon DesBrisay, Vice Dean Academic

I am pleased to confirm that the College of Arts and Science supports the proposed Major in Applied Computing with named concentrations in Bioinformatics, Business, Data Analytics, Geomatics, and Interactive Systems Design, which will replace, reconfigure, and add to, the existing programs in Bioinformatics and Interactive Systems Design. I am also pleased to note that the Professional Internship Option will be retained and available to students in Applied Computing.

The College of Arts and Science is working to provide innovation program options that meet student need and demand. The new program will allow students to build a solid foundation of computer science, and add to that an applied area of interest. This will enhance their opportunities for future employment in the designated area, and for admission to graduate school as interdisciplinary students.

The Academic Programs Committee (BSc) approved the proposal for the new program in Applied Computing and the proposal to delete Bioinformatics, and the Academic Programs Committee (BA&Sc) approved the proposal to delete Interactive Systems Design, on January 15, 2021. Each of these proposals were approved by the College Faculty Council on February 24, 2021.

Applied Computing – Notice of Intent

Introduction and Program Description

Traditionally, computer science was taught as a single discipline, producing experts in creating software, who then worked with domain experts to craft solutions to particular problems. However, as computer science has become more sophisticated and widespread there is increasing demand within industry for graduates who have knowledge of computer science and a domain area. Traditional industries such as mining and agriculture have joined the ranks of more established technology users in IT, alongside medicine, business and design. There is a need for graduates with knowledge in both computing and domains of application.

Offering interdisciplinary degrees is a reoccurring challenge for universities. Degree stewardship and administration can be hard to assign, classes difficult to schedule, and faculty resourcing uncertain. This has led to interdisciplinary programs languishing. It is even more difficult to offer interdisciplinary programming in the context of an accredited program like Computer Science, where external agencies constrain potential choices and require more depth in the primary subject than might be required for an interdisciplinary practitioner. While students have some freedom to form an ad hoc interdisciplinary study plan by combining an existing majors program with a selection of courses from other field, such ad hoc combinations create challenges for students who must understand not only the content of individual courses, but also how that content meshes with other disciplines.

To address stakeholders' need for graduates with both computing and domain expertise while operating under the constraints of university structure and governance, we propose a new model for interdisciplinary programming, which we term the skinny major. In a skinny major model, a primary unit composes a core major program requiring the minimum number of disciplinary credit units for that college (in Arts and Science 36), leaving space in standard 120cu degree programs for minor-like ensembles of courses in cognate disciplines. This space is filled with carefully curated combinations of courses, in collaboration with colleagues from cognate disciplines, leading students away from ad hoc interdisciplinary choices. To avoid credential bloat and associated administrative cost, these curated packages of courses can be instantiated as named streams within an overarching degree, for example a Degree in Applied Computing in Bioinformatics, or a Degree in Applied Computing in Geomatics. Because these streams are curated, scheduling conflicts can be encoded and avoided using established software. Similarly, credentialing can happen automatically, as there are clear course packages required to graduate.

Computer Science is willing to take the lead in developing skinny major interdisciplinary programming. This proposal identifies a core program of existing courses from the Computer Science degree programs (with courses from Computer Science, Math and Philosophy) that would form the basis of a skinny major. When combined with carefully chosen courses from other fields, this degree program can form synthesized knowledge directly applicable to stakeholders in the community. By employing a skinny major, we obtain the flexibility to grow programming to meet the needs of local stakeholders with reduced overhead.

Proposed Undergraduate Applied Computing Streams

We propose to terminate two existing programs and replace with streams within the Applied Computing degree. We further propose to instantiate three additional programs in areas of Applied Computing which meet emerging needs and opportunities. Students would receive either four-year Bachelor of Science (BSc) or Bachelor of Science Honours (BSc Hon) credentials.

Bioinformatics (Cognate areas: Biology, Biochemistry) Bioinformatics is an established, but niche, program in the college. Adding this program to Applied Computing would allow for a reimagining of content and broader reach.

Interactive System Design (Cognate areas: Art, Psychology) The ISD program is an established BASc program with solid enrolments, which trains graduates to work on front end computing and interactive system design.

Data Analytics (Cognate areas: Mathematics, Statistics) This program would focus on training general purpose data scientists, without a specific application domain. What they would lose in domain knowledge they would gain in mathematical rigor. This degree would be of interest to those who have a cognate degree already, as well as those interested in analytical mechanics.

Geomatics (Cognate area: Geography) Understanding geographically anchored data is important in areas such as mining, agriculture, and city planning. This program would focus on the programmatic use of GIS and satellite-based systems and data in water management, agriculture, mining and civic planning.

Business (Cognate areas: General Business and Marketing) There is a significant industrial demand for graduates who understand computing, data, and business processes. We anticipate that this will be a popular stream.

Graduate Degrees in Applied Computing

Interdisciplinary graduate work is becoming more common in the Department of Computer Science at the University of Saskatchewan. However, students receiving graduate degrees in Computer Science are expected to be able to teach in accredited Computer Science programs, putting additional strain on students transferring in from other disciplines. A program that would allow students to receive interdisciplinary training with fewer disciplinary constraints would remove this strain. Our current plan for MSc and PhD in Applied Computing follows our current graduate program structure at the MSc and PhD levels, but relaxes entry requirements, allows up to half the committee members to be from outside Computer Science, and permits up to half of the courses to be from outside of Computer Science.

Demand and Enrolment

Predicting demand for new programs is problematic, as student program intentions exist in an intersection of economic conditions, university marketing, and cultural zeitgeist, all of which are volatile on the timescale of degree approval. However, potentially actionable insight may be inferred from existing programs, industrial demand, and similar offerings at comparator institutions. Bioinformatics and Interactive System Designs are existing interdisciplinary degree programs within the College of Arts and Science and are meeting established needs. Geomatics meets a need for students to support the research and industrial development around remote monitoring, particularly for water and food security, and was discussed as a potential strategic area at the 2019 College of Arts and Science retreat. The business stream meets a clear need as articulated by our industrial stakeholders. Data analytics is a rapidly growing industry touching not just the IT sector, but traditional economic sectors like mining and agriculture, and is common in some form at our comparator institutions. We are already training interdisciplinary students at the graduate level and struggling to adapt their needs to existing degree programs. All elements of this program are inherently needs-driven.

Computer Science has seen a dramatic year on year increase in enrollments, echoed by Bioinformatics and Interactive System Design. This increase in enrolments is happening worldwide, and is driven by a societal perception, largely born out in practice, that jobs in the twenty-first century will involve the application of information technology to many fields. The last four years of enrolment data for Bioinformatics, Computer Science, and Interactive System Design are shown in Table 1. These numbers are underestimates of the totals for the programs, as approximately half the students in Arts and Science do not declare a major for a significant portion of their degree. However, in this case the trend is more important than the absolute numbers.

Table 1: Student demand for the last five years for Computer Science, Bioinformatics and Interactive Systems Design.

	2016	*2017*	*2018*	*2019*	*2020*
Bioinformatics	9	13	16	20	20
Computer Science	533	638	734	806	862
Interactive Systems Design	61	66	68	70	72

Dalhousie is the comparator institution with the closest program. Their Bachelor of Applied Computer Science program has a similar intent and scope, but slightly different specializations. Dalhousie's Computer Science program is approximately the same size as ours. When they introduced their Bachelor of Applied Computer Science, their existing interdisciplinary degree programs accounted for 10% of their total enrollments, approximately the same in our department. After adding the BACS degree four years ago, their enrollments in the core Computer Science programming grew at the same rate as ours, but their BACS enrollments grew faster, reaching 20% of total enrollments and 250 students. Given the comparable sizes, and programs, we hope to experience the same growth as Dalhousie.

Explicit projections for the three new streams – Geomatics, Data Analytics, and Business – have not been performed. As these programs are based to a large extent on industry pull rather than student or academic push, we anticipate that they will be as popular as the ISD program once students recognize their post-graduation potential.

Graduate program

We currently have the largest research-intensive graduate program at the university. Almost all our graduate students are funded, and the majority through grants held by professors. Our current program is limited by faculty time and financial resources, and we are near capacity now. Adding an MSc and PhD in Applied Computing will not change this fundamental calculus. Our current program is also characterized by substantial interdisciplinary research. For example, our world leading Human Computer Interaction and Software Engineering groups have substantial collaborations across the university (Social Sciences and SENS) and with industry. Our Bioinformatics group collaborate with life scientists in Health, Biology and Agriculture. Image processing and data analytics research is core to P2IRC. Because of the scope of our collaborative activities, we attract a diverse group of graduate students. Instead of changing the number of graduate students in the program, the changes will allow us to more adroitly accommodate students from non-traditional computing backgrounds. We anticipate that the proposed degree will change the disciplinary breadth and diversity of our graduate program, rather than the overall numbers.

Strategic Alignment

The proposed program is intrinsically aligned with the University and College strategic priority for interdisciplinarity. While this program is aligned with strategic goals, it did not arise from their calls to action. This program does align with elements of the Computer Science strategic plan, articulated at the June 2017 departmental retreat, which called for a greater impact of computer science as a department and discipline across campus to reflect its growing importance to society.

Undergraduate Program Interdisciplinarity

The undergraduate proposal clearly addresses the interdisciplinary component of the university and college plans. By creating interdisciplinary programs within the context of existing course offerings and degree frameworks, we can move the interdisciplinary vision of the university and college forward with limited risk. This program provides clear ownership of degrees (the Department of Computer Science within the College of Arts and Science), clear paths to graduation though stream-specific curation of synergistic courses, and limited cost growth through the leveraging of existing course offerings. This program makes high-demand interdisciplinary degrees possible and provides graduates with appropriately named degrees by curating existing courses and expertise in interesting and useful ways.

Each program was either reviewed (ISD, Bioinformatics), or created (Geomatics, Data Analytics, Business) by a joint committee consisting of the Computer Science Undergraduate Committee, and ad-hoc committee members proposed by the collaborating departments (Math and Stats, Geography, Art and Art History, Biology, and Edwards). These programs are not only interdisciplinary but were created by interdisciplinary teams. As the primary collaborators were involved in crafting the programs, the consultation with them is explicit. The Department Head of Computer Science also met with representatives from Plant Science, Geology, Public Health, and Economics to discuss the potential for inclusion, and the impact of the program.

Graduate Program Interdisciplinarity

At the graduate level, the simple relaxation of the requirement that graduates must be able to teach an accredited program in computer science removes many of the issues facing interdisciplinary graduate students. The further relaxation of course requirements (up to half outside Computer Science), and committee membership (the committee may be composed of the supervisor, a Computer Science faculty member and a faculty member from outside the department) removes barriers to effective interdisciplinary program creation. Unlike the undergraduate degrees, which have a number of self-directed streams with proscribed programming, research intensive graduate degrees are curated at the individual student level by the supervisory committee. This curation is already part of most research-intensive degrees, although typically within a discipline. In many ways the program is catching up with the reality of the research we are doing, particularly in collaboration with industry (SOAR CREATE), the social sciences (SWaGUR CREATE), agriculture and biosciences (P2IRC) and water security (GIWS), to name just the major collaborative grants. Many smaller, but still significant, collaborations exist between faculty in the department and industry, branches of government, health authorities and other departments on campus. The breadth of collaboration has attracted graduate students with more diverse backgrounds to our department. Because this program would be unique nationally – other Applied Computing programs are not research based – we have an excellent opportunity to attract strong interdisciplinary students from across Canada and around the world.

Internationalization

This program does not explicitly address internationalization; however, there are aspects within the programs. The student body of the graduate program in Computer Science is predominantly international. We expect this trend to continue in the graduate level Applied Computing program. At the undergraduate level, Computer Science has a disproportionate number of international students compared to other units, particularly from East Asia and South Asia.

Indigenization

Indigenization within this program, and Computer Science in general will focus on access and impact. The Data Analytics and Geomatics streams would be of potential interest to indigenous students as they speak directly to data sovereignty, which is a core component of many issues facing indigenous communities including land claims, environmental assessments and water rights. Training indigenous students in these disciplines would allow them to perform their own analysis of data collected on their traditional territories, enabling more fulsome participation in conversations about land use and impact.

Indigenization is a college-level priority in Arts and Science, and we intend to leverage existing College programs. STEM education in remote communities and on reserve is a concern, limiting Indigenous students' access to careers in Information Technology. This problem is common across rural Saskatchewan, and the Department of Computer Science has already created a course -- CMPT140: Creative Computing – to act as a bridge for students entering our program with limited Computer Science background. CMPT140 is a course designed to introduce coding concepts gradually, as there is limited opportunity for students outside of the major urban centers to take either grade 11 or 12 Computer Science in high school. Indigenous students will have the option of entering the undergraduate degree through the Arts and Science Indigenous Student Achievement Pathways program. We will work with the College to include CMPT140: Creative Computing in this program, and will allocate a specific tutorial section for ISAP students within that program.

Relationships to Other Programs

Undergraduate Program

Programs in Bioinformatics and Interactive System Design are already offered by the College of Arts and Science. These programs will be deleted and brought into Applied Computing. There are no similar programs on campus for the Geomatics, Data Analytics and Business streams; however, the non-Computer Science portion of these streams closely mirrors the minor in Geographic Information Systems, and the Certificate in Business. Enrollments may shift subtly, but it is difficult to accurately predict. The most likely short-term outcome is an increase in CS headcount, but a decrease in relative CS 3CUEs, as we will attract and retain additional students, but those students will take fewer Computer Science classes than their peers in the existing BSc in Computer Science.

The undergraduate program described here is innovative within Arts and Science and the University of Saskatchewan, in that it embeds interdisciplinary programming within disciplinary oversight. We are willing to develop this kind of programming, so that other units can follow suit. Computer Science remains open to similar programming from other departments incorporating computer science as a cognate topic. For example, a skinny major in Commerce, with Computer Science as a cognate area, could be useful for someone wishing to work in IT Marketing; similarly, a skinny major in Plant Science with Computer Science and Geography as cognate areas could provide an agriculturist with some geomatics training.

Graduate Program

The graduate program is most related to the MSc and PhD programs in Computer Science. Introducing the new program will benefit the existing programs by creating separate entry and degree requirements for disciplinary and interdisciplinary students in our programs. This will allow us to maintain our current degree programs and their existing entry requirements for disciplinary students, while offering more appropriate requirements for interdisciplinary students. This will be better for students and take pressure off our departmental graduate committee who must make difficult decisions when admitting students with a non-traditional background, who would undoubtably be able to undertake research in the department.

Resource Requirements

One of the elegant properties of this proposal is the way it leverages existing resources in new ways to create cohesive and impactful programs. There is only one totally new course proposed in this program: Data Analytics. The Dean has expressed that this topic is a priority for the college, and Computer Science likely would have offered a course regardless. Bioinformatics will technically offer four new courses, but four courses in the BINF program will be removed to make way. We will create a new honors thesis for Applied Computing, but it will be offered in

conjunction with our current honors thesis and will only have separate numbering to accommodate different evaluation criteria for interdisciplinary projects. No new courses are required at the graduate level.
We have received commitments from all involved departments that spaces in required classes outside of Computer Science are available for students in this program. Computer Science did a strategic review of undergraduate programming two years ago and streamlined the BSc degree to allow double sectioning of upper year courses. This streamlining, combined with additional resources provided by the Dean and Provost, have provided us with a window of opportunity to entertain new programs. If the Computer Science growth rate continues as it has over the last decade, or potentially even accelerates following the Dalhousie example, Computer Science would be projected to run out of capacity again in 3-8 years. Growth may also create issues in other popular courses and program such as first year Biology, core Commerce courses and senior Planning courses. Similar to Computer Science, we anticipate sufficient initial capacity in these disciplines, which will have to be re-evaluated as numbers increase. When enrolments reach saturation, the Provost and affected Deans will have to make a strategic decision to invest in additional growth or to cap enrollments.
Computer Science manages its own IT assets and has its own IT support. As such the impact on institutional ICT should be low for most of the offerings. There could be some impact on centrally administered products such as ArcGIS in the Geomatics stream. This proposal does assume that the College continues to support Computer Science's computer renewal plans at the current level, and the university continues to support the renewal of licenses for software assets used in the Business and Geomatics streams. Computer Science has used innovative approaches to leverage its existing infrastructure to accommodate its expansion and will continue to do so. As classes continue to grow, Computer Science will continue to have to compete for the larger classrooms on campus. If this program increases the growth rate, as in the Dalhousie example, then this competition will become acute earlier. The competition for larger classroom spaces continues to be an issue across campus and is not unique to this program. Computer Science has recently completed an extensive set of renovations and a space reallocation exercise to accommodate its large thesis-based graduate program. As the graduate program is not expected to impact enrolments, it is not expected to create additional demands on the space.

Risks

At the graduate level there are limited institutional risks, as the graduate program is largely based on our existing programming, streamlined for collaboration and interdisciplinarity. Some care will have to be taken with communications, particularly for PhD graduates seeking academic appointments. Future employers will have to understand the interdisciplinary nature of the degrees. Participants' breadth will likely extend beyond computer science, making graduates more specialized within computer science than their colleagues with a graduate degree in Computer Science. This specialization within computer science, and breadth outside will need to be accurately rendered in communications with other institutions and employers. Our experience with communications around the Bioinformatics and ISD programs gives us confidence we will be able to successfully manage communications regarding Applied Computing.
The undergraduate program was driven by demand from industry and other units on campus. Expectations for growth in the program are predicated on industry demand for graduates creating desirable employment opportunities, and by extension driving student uptake. It is a risk that the anticipated demand might fail to materialize or might disappear due to external economic drivers. However, given that the anticipated start date is September 2022, the first full undergraduate cohort from this program would not be expected until May 2027. People with the ability to accurately predict economic conditions seven years in the future tend to be employed in more lucrative professions than academia. This risk will have to be actively measured and managed as the program rolls out.
Although we have received assurances from all impacted Dean's offices that spaces will be made available for this program, those assurances are not necessarily binding, and could be withdrawn at some point in the future. This risk exists for all interdisciplinary undergraduate programs, and will have to be actively managed by senior academic leadership if the University's goal of interdisciplinarity is to be achieved.
The fiscal risk associated with the project is limited. If the program proves too popular, this could put strain on some courses, in particular the cognate courses in Edwards, and second and third year Computer Science courses which are required in the BSc in Computer Science. Given growth projections, we would not expect this to be an issue until 2025 at the earliest. This could be managed through either additional investment in faculty positions, justified by the enrollments, through expanded use of sessional lecturers, or through capping enrollments in the program. Strain on first and second year Computer Science classes that all Computer Science and Applied Computing streams share could be managed by adding additional sections of those classes taught by sessional lecturers, at a

substantially lower cost than the additional revenues driving the multiple sections. In a related vein, this program has the potential benefit of directing more students into Geography and senior Math and Statistics classes, which do have capacity.

The fiscal risk associated with support is also limited. Course scheduling will be somewhat more complex, as cross departmental class schedule coordination will be required. For students entering a stream in first year, and progressing through the recommended course progression, this should be solvable and maintainable. For students transferring into a stream from another stream or degree, who might be taking some courses outside the proscribed sequence, this will be more complex, and may require additional administrative support and software assistance. However, this risk is not unique to this program and will have to be adequately addressed, regardless, if the university is serious about its interdisciplinary vision.

There is some risk in not offering this program at this time. Most of our Canadian comparator institutions have a form of Data Analytics programming. Failing to implement our own puts us at a competitive disadvantage. We are already engaged in substantial collaborative and interdisciplinary research at the graduate level. Failing to create the graduate level Applied Computing degrees will place an unnecessary impediment on the functioning and growth of the department's research effort.

Timing

This program is anticipated to start September, 2022. This is the earliest feasible start date given the many levels of approval that this program needs to navigate. The current timeline provides for PPC/IPC approval in November, submission to the Arts and Science APC in December, submission to University APC in February, and final approval at University Council in the Spring. Although it is feasible to approve the program for March, assuming the smooth passage through all stage gates, this will miss the cut off for inclusion in the University Calendar, forcing a start date of September 2022. This will provide ample time for Student Information Services and other support organizations a year to prepare for the launch. It will similarly allow sufficient time to advertise the new program to existing and entering students.

UNIVERSITY OF SASKATCHEWAN

MEMORANDUM

TO: Kevin Stanley, Head, Department of Computer Science
Gordon DesBrisay, Associate Dean, College of Arts & Science
Alexis Dahl, Director, Academic Programs, College of Arts & Science

FROM: Darrell Mousseau, Chair, Planning and Priorities Committee of Council

DATE: November 23, 2020

RE: **Feedback on the Program Proposals in Applied Computing**

On behalf of the Planning and Priorities Committee (PPC) of Council, thank you for attending the meeting of November 18, 2020 to discuss the proposed programming in Applied Computing in the College of Arts & Science.

At the meeting, the Committee passed a motion to forward the proposal to the Academic Programs Committee for decision.

Please do not hesitate to contact me if you have any questions.

Kind regards,

Darrell Mousseau
Chair, Planning and Priorities Committee
University of Saskatchewan
tel: (306) 966-8824

BE WHAT THE WORLD NEEDS

c. Melissa Just, Interim Provost and Vice-President Academic
Russ Isinger, University Registrar
Chelsea Willness, University Secretary and Chief Governance Officer
Susan Detmer, Chair, Academic Programs Committee of Council

Record of Consultation

Geomatics:

From: Aitken, Alec <alec.aitken@usask.ca>
Sent: Wednesday, January 6, 2021 6:28 AM
To: Stanley, Kevin <kgs325@mail.usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>
Subject: Program proposal in Applied Computing

Good morning Kevin and Alexis,

I am writing in support of the program proposal in Applied Computing, especially the Geomatics stream within this program. Kevin has insured that the department of Geography and Planning was consulted on several occasions over the past year about the proposed curricula. These consultations involved direct engagement with Geography and Planning faculty who will instruct the courses in the Geomatics stream (Scott Bell, Krystopher Chutko, Ehab Diab, Xulin Guo). There is enrolment capacity in all of the geography and planning courses identified in the Geomatics stream and we look forward to working with Computing Science students in our course offerings. I recommend approval of this innovative program.

Sincerely,

Alec Aitken
Professor and Head
Geography and Planning

Bioinformatics

From: McQuillan, Ian <mcquillan@cs.usask.ca>
Sent: Wednesday, January 6, 2021 2:37 PM
To: challenge.coordinator@artsandscience.usask.ca
Subject: Fwd: Bioinformatics courses and program

To whom it may concern,

This email is to accompany the proposal to create a new course BINF 151 (and the deletion of BINF 210) for the January 2021 Challenge period. The email indicates that the Department of Biochemistry, Microbiology and Immunology will change their undergraduate program requirement from requiring "either BINF 210 or BINF 200" to "either BINF 151 or BINF 351".

Sincerely,
Ian

Ian McQuillan
Professor of Computer Science

mcquillan@cs.usask.ca
ianmcquillan.com
Department of Computer Science
The University of Saskatchewan
Saskatoon, Canada

Begin forwarded message:

From: "Anderson, Kyle" <kyle.anderson@usask.ca>
Subject: RE: Bioinformatics courses and program
Date: December 18, 2020 at 10:38:45 AM CST
To: "McQuillan, Ian" <mcquillan@cs.usask.ca>
Cc: "Bull, Harold" <hjb133@mail.usask.ca>

Hi Ian,
Thanks for taking the time to meet with Harold and I a few weeks ago to discuss the proposed changes to the bioinformatics courses offered through computer science and answer our questions. I shared the details of the proposal at the December BMI departmental meeting and we are in support of the changes that are proposed. Having BINF 151 and 351 clearly differentiated (compared to the old 200/210) will give clarity to our students taking these courses, and better demonstrate a course-sequence for them to follow if they wish to extend their understanding of bioinformatics. When the time comes, we will be updating our programs to reflect this welcome change.

Thanks again for making these improvements that will benefit our students.

Kyle Anderson, Ph.D.
Assistant Professor and Undergraduate Chair of Biochemistry
Department of Biochemistry, Microbiology and Immunology
College of Medicine
University of Saskatchewan
Rm 3D30.1 Health Sciences

UNIVERSITY OF SASKATCHEWAN
College of
Arts and Science
DEPARTMENT OF BIOLOGY
ARTSANDSCIENCE.USASK.CA

Department of Biology
112 Science Place Saskatoon SK S7N 5E2 Canada
Telephone: (306) 966-4399 Facsimile: (306) 966-4461
Email: biology.dept@usask.ca Web: www.artsandscience.usask.ca/biology

January 5, 2020

Kevin Stanley
Department Head
Department of Computer Science
College of Arts and Science

Dear Kevin,

I am writing in support of the Department of Computer Science's proposal for an Applied Computing program, and for the Bioinformatics stream in particular.

I appreciate the consultation that occurred with Biology in drafting the proposal and in your Department's willingness to consider and incorporate suggestions received. In my opinion, the proposed course changes, and changes to the program as a whole, will benefit students. I see this as providing increased flexibility for individuals not initially considering Bioinformatics as their area of focus to access this program and complete it in a timely manner. Likewise, I expect it will increase access to some of these courses for students in cognate disciplines like Biology or the Biomedical Sciences.

Thank you for the opportunity to provide feedback.

Sincerely,

Christopher Todd
Head, Department of Biology

Letter to Support Applied Computing Proposal

Dear Committee Members:

This letter is to inform you that, as the Department Head for Management and Marketing at the Edwards School of Business, I was consulted by Kevin Stanley on the Applied Computing Proposal. This consultation included having multiple opportunities to provide feedback and ideas in the construction of the degree. Associate Dean Noreen Mahoney from the Edwards School of Business was also consulted in this process.

After conducting analysis, our College concluded that there are spaces available in the classes listed from the Edwards School of Business in the proposal. We also anticipate that students can reasonably be expected to complete the program. In short, we see no issues with allowing computer science students into these courses.

I would also like you to know that I support the intent of the program which is to address the needs of employers for computer science students to have and be able to integrate both data analytics and applied computing skills. The skinny major model from which this degree was derived will allow students to take a minimum number of disciplinary credit units in computer science along with courses in other disciplines that can help round out their skills and abilities. Overall, the combination of courses included in this degree will synthesize knowledge for students in a way that will be valuable throughout their careers.

Thank you,

Vince Bruni-Bossio
Department Head and Associate Professor,
Management and Marketing, Edwards School of Business

Data Analytics

From: Sowa, Artur <sowa@math.usask.ca>
Sent: Sunday, January 10, 2021 1:49 PM
To: Dahl, Alexis <alexis.dahl@usask.ca>
Cc: Stanley, Kevin <kgs325@mail.usask.ca>
Subject: Program in Applied CS: Data Analytics

Dear Alexis,

I am writing to let you know that my Department has been consulted with regards to creation of the new program titled Applied Computer Science: Data Analytics. We have discussed the proposal with a group of faculty in Math & Stats, in particular with the Undergraduate Committee co-chairs, Prof. Juxin Liu and Dr. Christopher Duffy. I am happy to say that we support the initiative and view it as valuable all-around.

Since the program incorporates only existing mathematics and statistics courses the pressure on our resources is not going to shift significantly. A sensitive point is the need to provide a sufficient number of seats in Math 164. However, this is a challenge that we hope to be able to meet. Therefore I see no obstacles to launching the program.

We welcome further discussion on the College forum as to the structure of credit sharing between CS and Math & Stats. One possibility is to ensure that the bulk of program graduates obtain a companion three-year degree in Mathematics or Applied Mathematics. Another is through creation of appropriate certificates. My department will address these questions and undertake appropriate steps in near future.

Please do let me know if you have any questions or advice.

Sincerely yours,
Artur

Artur Sowa, Ph.D.
Professor & Department Head
Department of Mathematics and Statistics
University of Saskatchewan

106 Wiggins Road, Saskatoon, SK S7N 5E6, CANADA
Home page: https://math.usask.ca/~sowa/

UNIVERSITY OF SASKATCHEWAN
College of
Arts and Science
DEPARTMENT OF ART AND ART HISTORY
ARTSANDSCIENCE.USASK.CA

Murray Building, 3 Campus Drive
Saskatoon SK S7N 5A4 Canada
Telephone: 306-966-6185
Facsimile: 306-966-4266
Email: art.arthistory@usask.ca
Web: artsandscience.usask.ca/art

May 11, 2020

To whom it may concern,

This letter is to confirm that faculty in the Department of Art and Art History have been consulted and are supportive of the Applied Computing programs being proposed. In particular, both I and Prof. Lisa Birke are happy to see that the revised Interactive System Design stream still contains significant course requirements from both Studio Art and Art History, as we feel that was one of the strengths of the original Interactive Systems Design program.

I can be reached at jon.bath@usask.ca or (306)966-4213 if you have any questions.

Sincerely,

Dr. Jon Bath
Associate Professor
Art and Art History

Catalogue Entry

The goal of this program is to train students in core areas of Computer Science enhanced by curated specializations in Computer Science and relevant cognate areas. Computers are ubiquitous in life, society and the economy, and their application to new domains and tasks is continually growing. To help drive the application to new domains and maintain systems in those domains, knowledge of both computer science and the domain is required. This program is divided into a number of concentrations which provide curated course packages in computer science and other disciplines which complement each other and when synthesized coherent expertise.

Students who complete the program will be in demand in several industry sectors. The combined training in computer science and the diverse disciplines in the various concentrations will train students to work in sectors as diverse as mining and video games, agriculture and banking.

Please see the descriptions of each concentration for more details.

Major Average

The major average in Applied Computing Science programs includes the grades earned in:

- All courses listed in the Major Requirement C4

Residency Requirements in the Major

To receive a degree in Applied Computing, students must complete at least two-thirds of the following coursework (to the nearest highest multiple of 3 credit units) from the University of Saskatchewan:

- Minimum requirements in Major Requirement C4.

See **Residency** for additional details.

Applied Computing - Bioinformatics

There has been an exponential growth in molecular biological knowledge in recent years, thanks to genome sequencing projects and technologies for determining gene expression and protein structures. The tremendous volume and complexity of data has necessitated the development of specialized computational techniques for storing, visualizing, and analyzing them. Certain techniques also require computational techniques in the derivation of data. Such techniques all fall into the realm of Bioinformatics. Bioinformatics is the interdisciplinary meeting point for computer science and molecular biology. It requires understanding of the knowledge domains of biology, chemistry, computer science, mathematics, and probability and statistics. Students in Bioinformatics can find opportunities in most life sciences fields such as medicine or agriculture.

	Bachelor of Science Four-year (B.Sc. Four-year) – Applied Computing – Bioinformatics	**Bachelor of Science Honours (B.Sc. Honours) – Bioinformatics**
	No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.	Students interested in entering an Honours program should consult advisors in the department concerned before registering for

		their second year. Of the 120 credit units required for the B.Sc. Honours degree, at least 66 credit units must be at the senior level. Application for admission to Honours is not considered until successful completion of at least 60 credit units with a Cumulative Weighted Average of at least 70% overall and at least 70% in the subject of Honours. For further details, please see the Academic Information and Policies section. No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.
C1 College Requirement (15 credit units)	**English Language Writing** Choose **6 credit units** from the following: • *Full list* **Indigenous Learning** Choose **3 credit units** from the following: • *Full list* **Quantitative Reasoning** • MATH 163.3 Introduction to Mathematical Reasoning • MATH 164.3 Introduction to Linear Algebra	
C2 Breadth Requirement (6 credit units)	Choose **6 credit units** from the following areas: Fine Arts Humanities Social Sciences Courses with No Program Type	
C3 Cognate Requirement (6 credit units)	**(6 credit units)** • CHEM 112.3 • PHIL 232.3 Ethics and Professional Responsibility in Computer Science	
C4 Major Requirement	**(81 credit units)** • BINF 151.3 Computing in Biology • BINF 351.3 Introduction to Bioinformatics • BINF 451.3 Algorithms and Modeling in Bioinformatics • BIOL 120.3 The Nature of Life • BIOL 121.3 The Diversity of Life • BMSC 200.3 Biomolecules • CHEM 250.3 Introduction to Organic Chemistry • CMPT 141.3 Introduction to Computer Science • CMPT 145.3 Principles of Computer	**(83 credit units)** • BINF 151.3 Computing in Biology • BINF 351.3 Introduction to Bioinformatics • BINF 451.3 Algorithms and Modeling in Bioinformatics • BIOL 120.3 The Nature of Life • BIOL 121.3 The Diversity of Life • BMSC 200.3 Biomolecules • CHEM 250.3 Introduction to Organic Chemistry • CMPT 141.3 Introduction to Computer Science • CMPT 145.3 Principles of Computer

	Science • CMPT 260.3 Mathematical Logic and Computing • CMPT 270.3 Developing Object Oriented Systems • CMPT 280.3 Intermediate Data Structures and Algorithms • CMPT 318.3 Data Analytics • CMPT 353.3 Full Stack Web Programming • CMPT 360.3 Introduction to Artificial Intelligence Choose **3 credit units** from the following: • BMSC 240.3 Laboratory Techniques • BIOL 226.3 Genes to Genomics Choose **3 credit units** from the following: • BMIS 340.3 Introductory Molecular Biology • BIOL 316.3 Molecular Genetics of Eukaryotes Choose **3 credit units** from the following: • STAT 245.3 Introduction to Statistical Methods • STAT 246.3 Introduction to Biostatistics Choose **6 credit units** from the following, from any of the areas listed: Simulation: • CMPT 214.3 Programming Principles and Practice • CMPT 394.3 Simulation Principles Artificial Intelligence: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 423.3 Machine Learning Theory: • CMPT 364.3 Automata and Formal	Science • CMPT 260.3 Mathematical Logic and Computing • CMPT 270.3 Developing Object Oriented Systems • CMPT 280.3 Intermediate Data Structures and Algorithms • CMPT 318.3 Data Analytics • CMPT 353.3 Full Stack Web Programming • CMPT 360.3 Introduction to Artificial Intelligence • CMPT 407.3 Research Topics in Applied Computing Choose **3 credit units** from the following: • BMSC 240.3 Laboratory Techniques • BIOL 226.3 Genes to Genomics Choose **3 credit units** from the following: • BMIS 340.3 Introductory Molecular Biology • BIOL 316.3 Molecular Genetics of Eukaryotes Choose **3 credit units** from the following: • STAT 245.3 Introduction to Statistical Methods • STAT 246.3 Introduction to Biostatistics Choose one of the following areas (**6 credit units**): Simulation: • CMPT 214.3 Programming Principles and Practice • CMPT 394.3 Simulation Principles Artificial Intelligence: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 423.3 Machine Learning

	Languages • CMPT 463.3 Advanced Algorithms Visualization: • CMPT 384.3 Information Visualization • CMPT 484.3 Graph Drawing and Network Visualization Choose **21 credit units** from the following: • ACB 331.3 Methods in Cell and Developmental Biology • ANBI 470.3 Applied Animal Biotechnology • ANSC 313.3 Animal Breeding and Genetics • BIOC 405.3 Structure and Function of Biomolecules • BIOC 436.3 Advanced Molecular Biology • BIOL 222.3 The Living Plant • BIOL 325.3 Plant Cells and Tissues • BIOL 420.3 Molecular Biology of Plants • BIOL 421.3 Functional Genomics • BMSC 210.3 Microbiology • BMSC 220.3 Cell Biology • BMSC 230.3 Metabolism • BMSC 320.3 Nucleic Acids from Central Dogma to Human Disease • CHEM 255.3 Bio Organic Chemistry • MCIM 417.3 Molecular Virology • MCIM 487.3 Microbial Genetic Systems • PLSC 317.3 Plant Metabolism • PLSC 411.3 Plant Breeding • PLSC 416.3 Applied Plant Biotechnology	Theory: • CMPT 364.3 Automata and Formal Languages • CMPT 463.3 Advanced Algorithms Visualization: • CMPT 384.3 Information Visualization • CMPT 484.3 Graph Drawing and Network Visualization Choose **21 credit units** from the following, with at least 3 credit units at the 400-level: • ACB 331.3 Methods in Cell and Developmental Biology • ANBI 470.3 Applied Animal Biotechnology • ANSC 313.3 Animal Breeding and Genetics • BIOC 405.3 Structure and Function of Biomolecules • BIOC 436.3 Advanced Molecular Biology • BIOL 222.3 The Living Plant • BIOL 325.3 Plant Cells and Tissues • BIOL 420.3 Molecular Biology of Plants • BIOL 421.3 Functional Genomics • BMSC 210.3 Microbiology • BMSC 220.3 Cell Biology • BMSC 230.3 Metabolism • BMSC 320.3 Nucleic Acids from Central Dogma to Human Disease • CHEM 255.3 Bio Organic Chemistry • MCIM 417.3 Molecular Virology • MCIM 487.3 Microbial Genetic Systems • PLSC 317.3 Plant Metabolism • PLSC 411.3 Plant Breeding • PLSC 416.3 Applied Plant Biotechnology
C5 Electives Require-ment	**(12 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Four-year program, of which at least 66 must be at the 200-level or higher.	**(9 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Honours program, of which at least 66 must be at the 200-level or higher.

Applied Computing - Business

The goal of this program is to train students computer programming and business practices. The information technology sector continues to be one of the fastest growing in the world, and needs not only skilled computer programmers, but businesspeople who understand both coding and business practice. Leading software project teams, managing relationships with clients, and making strategic decisions about product development are all best undertaken by experts who understand both the potential and limitations of software and the imperatives and processes of business practice. This program combines courses Computer Science and Commerce to provide knowledge and skills in several critical areas: fundamentals of computer programming and practice, the fundamentals of business practice, marketing, and software development principles.

<table>
<tr><td></td><td><u>Bachelor of Science Four-year (B.Sc. Four-year) – Applied Computing - Business</u>

No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.</td><td><u>Bachelor of Science Honours (B.Sc. Honours) – Business</u>

Students interested in entering an Honours program should consult advisors in the department concerned before registering for their second year. Of the 120 credit units required for the B.Sc. Honours degree, at least 66 credit units must be at the senior level. Application for admission to Honours is not considered until successful completion of at least 60 credit units with a Cumulative Weighted Average of at least 70% overall and at least 70% in the subject of Honours. For further details, please see the Academic Information and Policies section.

No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.</td></tr>
<tr><td>C1 College Requirement (15 credit units)</td><td colspan="2">English Language Writing
Choose 6 credit units from the following:
• Full list

Indigenous Learning
Choose 3 credit units from the following:
• Full list

Quantitative Reasoning
• MATH 163.3 Introduction to Mathematical Reasoning
• MATH 164.3 Introduction to Linear Algebra</td></tr>
<tr><td>C2 Breadth Requirement (6 credit units)</td><td colspan="2">Choose 6 credit units from the following areas:

Fine Arts
Humanities
Social Sciences
Courses with No Program Type</td></tr>
<tr><td>C3 Cognate Requirement (12 credit</td><td colspan="2">(12 credit units)
Junior course requirements:
Choose 9 credit units from the following:
Biology
• BIOL 120.3</td></tr>
</table>

<table>
<tr><td>units)</td><td colspan="2">
BIOL 121.3
Chemistry
CHEM 112.3
CHEM 115.3
CHEM 250.3
Earth Science
GEOG 120.3
GEOL 121.3
GEOL 122.3
Physics & Astronomy
ASTR 113.3
PHYS 115.3
PHYS 117.3 or PHYS 125.3
Senior course requirements:
PHIL 232.3 Ethics and Professional Responsibility in Computer Science
</td></tr>
<tr><td>C4 Major Require-ment</td><td>(66 credit units)

CMPT 141.3 Introduction to Computer Science
CMPT 145.3 Principles of Computer Science
CMPT 260.3 Mathematical Logic and Computing
CMPT 270.3 Developing Object Oriented Systems
CMPT 280.3 Intermediate Data Structures and Algorithms
CMPT 370.3 Intermediate Software Engineering
CMPT 371.3 Software Management
COMM 100.3 Business Communication I
COMM 101.3 Introduction to Business
COMM 105.3 Introduction to Organizational Behavior
COMM 201.3 Introduction to Financial Accounting
COMM 204.3 Introduction to Marketing
COMM 306.3 Ethics and Decision Making
STAT 245.3 Introduction to Statistical Methods

Choose 15 credit units from the following, from any of the three areas:

Software Engineering:
CMPT 214.3 Programming Principles and Practice
</td><td>(69 credit units)

CMPT 141.3 Introduction to Computer Science
CMPT 145.3 Principles of Computer Science
CMPT 260.3 Mathematical Logic and Computing
CMPT 270.3 Developing Object Oriented Systems
CMPT 280.3 Intermediate Data Structures and Algorithms
CMPT 370.3 Intermediate Software Engineering
CMPT 371.3 Software Management
CMPT 407.3 Research Topics in Applied Computing
COMM 100.3 Business Communication I
COMM 101.3 Introduction to Business
COMM 105.3 Introduction to Organizational Behavior
COMM 201.3 Introduction to Financial Accounting
COMM 204.3 Introduction to Marketing
COMM 306.3 Ethics and Decision Making
STAT 245.3 Introduction to Statistical Methods

Choose 15 credit units from the following, from any of the three areas, including at least 3 credit units at the 400-level:

Software Engineering:
</td></tr>
</table>

	• CMPT 340.3 Programming Language Paradigms • CMPT 353.3 Full Stack Web Programming • CMPT 436.3 Mobile and Cloud Computing • CMPT 470.3 Advanced Software Engineering Analytics: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 318.3 Data Analytics • CMPT 384.3 Information Visualization • CMPT 423.3 Machine Learning • CMPT 489.3 Deep Learning and Applications User and Web: • CMPT 281.3 Website Design and Development • CMPT 353.3 Full Stack Web Programming • CMPT 381.3 Implementation of Graphical User Interfaces • CMPT 412.3 Social Computing and Participative Web • CMPT 481.3 Human Computer Interaction Choose **9 credit units** from the following: • COMM 203.3 Introduction to Finance • COMM 205.3 Introduction to Operations Management • COMM 348.3 Leadership • COMM 349.3 Introduction to Entrepreneurship • COMM 352.3 Marketing Strategy • COMM 354.3 Consumer Behavior • COMM 357.3 Marketing Research	• CMPT 214.3 Programming Principles and Practice • CMPT 340.3 Programming Language Paradigms • CMPT 353.3 Full Stack Web Programming • CMPT 436.3 Mobile and Cloud Computing • CMPT 470.3 Advanced Software Engineering Analytics: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 318.3 Data Analytics • CMPT 384.3 Information Visualization • CMPT 423.3 Machine Learning • CMPT 489.3 Deep Learning and Applications User and Web: • CMPT 281.3 Website Design and Development • CMPT 353.3 Full Stack Web Programming • CMPT 381.3 Implementation of Graphical User Interfaces • CMPT 412.3 Social Computing and Participative Web • CMPT 481.3 Human Computer Interaction Choose **9 credit units** from the following: • COMM 203.3 Introduction to Finance • COMM 205.3 Introduction to Operations Management • COMM 348.3 Leadership • COMM 349.3 Introduction to Entrepreneurship • COMM 352.3 Marketing Strategy • COMM 354.3 Consumer Behavior • COMM 357.3 Marketing Research
C5 Electives Require-ment	**(21 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Four-year program, of which at least 66 must be at the 200-level or higher.	**(18 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Honours program, of which at least 66 must be at the 200-level or higher.

Applied Computing - Data Analytics

The goal of this program is to train students in the mathematical theory, and computational tools and techniques of data analysis. Data is now a core business commodity used to analyze everything from stock market performance, to the voting intentions of particular groups, to the conservation status of protected species. Underlying these complex analyses are mathematical and computational tools that allow the manipulation of large amounts of data to extract meaning. This program combines courses Computer Science and Mathematics and Statistics to provide knowledge and skills in several critical areas: fundamentals of computer programming and practice, the fundamentals of data analytics, mathematical fundamentals for modelling, statistical measurement and reasoning, and machine learning.

Data analytics is a dynamic discipline that impacts all sectors of the economy. Graduates could work for technology companies developing and deploying the latest analytic techniques or in more traditional industries providing insight from data in mining, agriculture, or business.

<table>
<tr><td></td><td><u>Bachelor of Science Four-year (B.Sc. Four-year) – Applied Computing – Data Analytics</u>

No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.</td><td><u>Bachelor of Science Honours (B.Sc. Honours) – Data Analytics</u>

Students interested in entering an Honours program should consult advisors in the department concerned before registering for their second year. Of the 120 credit units required for the B.Sc. Honours degree, at least 66 credit units must be at the senior level. Application for admission to Honours is not considered until successful completion of at least 60 credit units with a Cumulative Weighted Average of at least 70% overall and at least 70% in the subject of Honours. For further details, please see the Academic Information and Policies section.

No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.</td></tr>
<tr><td>C1 College Requirement (15 credit units)</td><td colspan="2">English Language Writing
Choose 6 credit units from the following:
• Full list

Indigenous Learning
Choose 3 credit units from the following:
• Full list

Quantitative Reasoning
• MATH 163.3 Introduction to Mathematical Reasoning
• MATH 164.3 Introduction to Linear Algebra</td></tr>
<tr><td>C2 Breadth Requirement (6 credit units)</td><td colspan="2">Choose 6 credit units from the following areas:

Fine Arts
Humanities
Social Sciences
Courses with No Program Type</td></tr>
</table>

<table>
<tr><td>C3 Cognate Requirement (12 credit units)</td><td colspan="2">(12 credit units)

Junior course requirements:
Choose 9 credit units from the following:
Biology
• BIOL 120.3
• BIOL 121.3
Chemistry
• CHEM 112.3
• CHEM 115.3
• CHEM 250.3
Earth Science
• GEOG 120.3
• GEOL 121.3
• GEOL 122.3
Physics & Astronomy
• ASTR 113.3
• PHYS 115.3
• PHYS 117.3 or PHYS 125.3

Senior course requirements:
• PHIL 232.3 Ethics and Professional Responsibility in Computer Science</td></tr>
<tr><td>C4 Major Requirement</td><td>(72 credit units)

• CMPT 141.3 Introduction to Computer Science
• CMPT 145.3 Principles of Computer Science
• CMPT 260.3 Mathematical Logic and Computing
• CMPT 270.3 Developing Object Oriented Systems
• CMPT 280.3 Intermediate Data Structures and Algorithms
• CMPT 317.3 Introduction to Artificial Intelligence
• CMPT 318.3 Data Analytics
• CMPT 384.3 Information Visualization
• CMPT 423.3 Machine Learning
• MATH 211.3 Numerical Analysis
• MATH 266.3 Linear Algebra II
• STAT 241.3 Probability Theory

Choose 3 credit units from the following:

• MATH 110.3 Calculus I
• MATH 176.3 Advanced Calculus I

Choose 3 credit units from the following:

• MATH 116.3 Calculus II
• MATH 177.3 Advanced Calculus II</td><td>(75 - 78 credit units)

• CMPT 141.3 Introduction to Computer Science
• CMPT 145.3 Principles of Computer Science
• CMPT 260.3 Mathematical Logic and Computing
• CMPT 270.3 Developing Object Oriented Systems
• CMPT 280.3 Intermediate Data Structures and Algorithms
• CMPT 317.3 Introduction to Artificial Intelligence
• CMPT 318.3 Data Analytics
• CMPT 360.3 Machines and Algorithms
• CMPT 384.3 Information Visualization
• CMPT 423.3 Machine Learning
• MATH 211.3 Numerical Analysis
• MATH 266.3 Linear Algebra II
• STAT 241.3 Probability Theory
• STAT 344.3 Applied Regression Analysis
• STAT 345.3 Design and Analysis of Experiments
• STAT 346.3 Multivariate Analysis

Choose 3 credit units from the following:

• MATH 110.3 Calculus I
• MATH 176.3 Advanced Calculus I</td></tr>
</table>

	Choose **3 credit units** from the following: • STAT 242.3 Statistical Theory and Methodology • STAT 245.3 Introduction to Statistical Methods Choose **12 credit units** from the following: • CMPT 214.3 Programming Principles and Practice • CMPT 353.3 Full Stack Web Programming • CMPT 360.3 Machines and Algorithms • CMPT 370.3 Intermediate Software Engineering • CMPT 394.3 Simulation Principles • CMPT 484.3 Graph Drawing and Network Visualization • CMPT 489.3 Deep Learning and Applications Choose **6 credit units** from the following: • MATH 238.3 Introduction to Differential Equations • MATH 313.3 Numerical Linear Algebra • MATH 314.3 Numerical Solutions of Ordinary Differential Equations • MATH 325.3 Introduction to Optimization • MATH 327.3 Graph Theory Choose **6 credit units** from the following: • STAT 344.3 Applied Regression Analysis • STAT 345.3 Design and Analysis of Experiments • STAT 346.3 Multivariate Analysis Choose **3 credit units** from the following: • MATH 238.3 Introduction to Differential Equations • MATH 313.3 Numerical Linear Algebra • MATH 314.3 Numerical Solutions of Ordinary Differential Equations • MATH 325.3 Introduction to Optimization	Choose **3 credit units** from the following: • MATH 116.3 Calculus II • MATH 177.3 Advanced Calculus II Choose **3 credit units** from the following: • STAT 242.3 Statistical Theory and Methodology • STAT 245.3 Introduction to Statistical Methods Choose one of the following (**0 – 3 credit units**): • CMPT 409 • MATH 402.0 Honours Thesis in Mathematics Choose **12 credit units** from the following, with at least one course at the 400-level: • CMPT 214.3 Programming Principles and Practice • CMPT 353.3 Full Stack Web Programming • CMPT 370.3 Intermediate Software Engineering • CMPT 394.3 Simulation Principles • CMPT 484.3 Graph Drawing and Network Visualization • CMPT 489.3 Deep Learning and Applications Choose **6 credit units** from the following: • MATH 238.3 Introduction to Differential Equations • MATH 313.3 Numerical Linear Algebra • MATH 314.3 Numerical Solutions of Ordinary Differential Equations • MATH 325.3 Introduction to Optimization • MATH 327.3 Graph Theory

	• MATH 327.3 Graph Theory • STAT 344.3 Applied Regression Analysis • STAT 345.3 Design and Analysis of Experiments • STAT 346.3 Multivariate Analysis	
C5 Electives Requirement	**(15 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Four-year program, of which at least 66 must be at the 200-level or higher.	**(9 - 12 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Honours program, of which at least 66 must be at the 200-level or higher.

Applied Computing - Geomatics

The goal of this program is to train students in the theory, tools, and techniques of spatial data analysis. Satellite, drone, and GPS data have revolutionized how we capture, analyze, and interpret spatially anchored data, such as the distribution and health of crops or the weekly shopping habits of individuals. This program combines courses Computer Science and Geography and Planning to provide knowledge and skills in several critical areas: fundamentals of computer programming and practice, the acquisition and analysis of spatial data using Geographic Information Systems, the interpretation of spatial data given existing theory, the fundamentals of data analytics, and the fundamentals of image processing.

Geomatic analysis is an emerging area in business intelligence, agriculture, mining, and civic planning. Graduates from this program will be in demand in those sectors.

	Bachelor of Science Four-year (B.Sc. Four-year) – Applied Computing - Geomatics	**Bachelor of Science Honours (B.Sc. Honours) – Applied Computing**
	No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.	Students interested in entering an Honours program should consult advisors in the department concerned before registering for their second year. Of the 120 credit units required for the B.Sc. Honours degree, at least 66 credit units must be at the senior level. Application for admission to Honours is not considered until successful completion of at least 60 credit units with a Cumulative Weighted Average of at least 70% overall and at least 70% in the subject of Honours. For further details, please see the Academic Information and Policies section. No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.
C1 College Requirement	**English Language Writing** Choose **6 credit units** from the following: • *Full list*	**Indigenous Learning** Choose **3 credit units** from the following: • *Full list*

<table>
<tr><td>(15 credit units)</td><td colspan="2">Quantitative Reasoning

• MATH 163.3 Introduction to Mathematical Reasoning
• MATH 164.3 Introduction to Linear Algebra</td></tr>
<tr><td>C2 Breadth Requirement (6 credit units)</td><td colspan="2">Choose 6 credit units from the following areas:

Fine Arts
Humanities
Social Sciences
Courses with No Program Type</td></tr>
<tr><td>C3 Cognate Requirement (12 credit units)</td><td colspan="2">(12 credit units)

Junior course requirements:
Choose 9 credit units from the following:
Biology
• BIOL 120.3
• BIOL 121.3
Chemistry
• CHEM 112.3
• CHEM 115.3
• CHEM 250.3
Earth Science
• GEOG 120.3
• GEOL 121.3
• GEOL 122.3
Physics & Astronomy
• ASTR 113.3
• PHYS 115.3
• PHYS 117.3 or PHYS 125.3

Senior course requirements:

• PHIL 232.3 Ethics and Professional Responsibility in Computer Science</td></tr>
<tr><td>C4 Major Requirement</td><td>(60 credit units)

• CMPT 141.3 Introduction to Computer Science
• CMPT 145.3 Principles of Computer Science
• CMPT 260.3 Mathematical Logic and Computing
• CMPT 270.3 Developing Object Oriented Systems
• CMPT 280.3 Intermediate Data Structures and Algorithms
• CMPT 318.3 Data Analytics
• CMPT 384.3 Information Visualization
• CMPT 487.3 Image Processing and</td><td>(63 credit units)

• CMPT 141.3 Introduction to Computer Science
• CMPT 145.3 Principles of Computer Science
• CMPT 260.3 Mathematical Logic and Computing
• CMPT 270.3 Developing Object Oriented Systems
• CMPT 280.3 Intermediate Data Structures and Algorithms
• CMPT 318.3 Data Analytics
• CMPT 384.3 Information Visualization
• CMPT 487.3 Image Processing and</td></tr>
</table>

	Computer Vision • GEOG 222.3 Introduction to Geomatics • GEOG 322.3 Introduction to Geographic Information Systems • GEOG 302.3 Quantitative Methods in Geography • GEOG 323.3 Remote Sensing • STAT 245.3 Introduction to Statistical Methods Choose **3 credit units** from the following: • GEOG 120.3 Introduction to Global Information Systems • GEOG 125.3 Environmental Science and Society • GEOG 130.3 Environment Health and Planning Choose **12 credit units** from the following, from any of the three areas: Software Engineering: • CMPT 214.3 Programming Principles and Practice • CMPT 353.3 Full Stack Web Programming • CMPT 370.3 Intermediate Software Engineering Analytics: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 360.3 Machines and Algorithms • CMPT 423.3 Machine Learning • CMPT 489.3 Deep Learning and Applications User Interface and Visualization: • CMPT 360.3 Introduction to Artificial Intelligence • CMPT 381.3 Implementation of Graphical User Interfaces • CMPT 481.3 Human Computer Interaction • CMPT 484.3 Graph Drawing and Network Visualization Choose **6 credit units** from the following, from any of the two areas:	Computer Vision • GEOG 222.3 Introduction to Geomatics • GEOG 322.3 Introduction to Geographic Information Systems • GEOG 302.3 Quantitative Methods in Geography • GEOG 323.3 Remote Sensing • STAT 245.3 Introduction to Statistical Methods Choose **3 credit units** from the following: • GEOG 120.3 Introduction to Global Information Systems • GEOG 125.3 Environmental Science and Society • GEOG 130.3 Environment Health and Planning Choose **3 credit units** from the following: • CMPT 407.3 Research Topics in Applied Computing • GEOG 490.3 Honours Thesis in Hydrology or Geomatics • PLAN 490.3 Senior Planning Studio Choose **12 credit units** from the following, from any of the three areas, with at least one course at the 400-level: Software Engineering: • CMPT 214.3 Programming Principles and Practice • CMPT 353.3 Full Stack Web Programming • CMPT 370.3 Intermediate Software Engineering Analytics: • CMPT 317.3 Introduction to Artificial Intelligence • CMPT 360.3 Machines and Algorithms • CMPT 423.3 Machine Learning • CMPT 489.3 Deep Learning and Applications User Interface and Visualization: • CMPT 360.3 Introduction to Artificial Intelligence • CMPT 381.3 Implementation of Graphical User Interfaces

	Planning: • PLAN 350.3 Transportation Planning and Geography • PLAN 360.3 Urban Data Analysis and Visualization • PLAN 390.3 Research and Field Methods in Planning Geography: • GEOG 420.3 Cartography and Professional Communication • GEOG 423.3 Advanced Remote Sensing	• CMPT 481.3 Human Computer Interaction • CMPT 484.3 Graph Drawing and Network Visualization Choose **6 credit units** from the following, from any of the two areas: Planning: • PLAN 350.3 Transportation Planning and Geography • PLAN 360.3 Urban Data Analysis and Visualization • PLAN 390.3 Research and Field Methods in Planning Geography: • GEOG 420.3 Cartography and Professional Communication • GEOG 423.3 Advanced Remote Sensing
C5 Electives Require-ment	**(27 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Four-year program, of which at least 66 must be at the 200-level or higher.	**(24 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Honours program, of which at least 66 must be at the 200-level or higher.

Applied Computing - Interactive System Design

The goal of this program is to train students in all aspects of the design and development of interactive systems. Interactive systems are now a ubiquitous part of people's lives - from web applications to games to embedded devices - and the design and usability of these systems is having an increasingly large effect on the quality of people's relationship to technology. This program combines courses in Art and Art History, Psychology, and Computer Science, and these courses will provide knowledge and skills in several critical areas: principles of visual communication; critical approaches to visual systems; fundamentals of human perception, memory, and cognition; and the principles of computation and programming needed to design, build, and evaluate games and interactive systems.

Students who complete the program will be in demand in several industry sectors. The combined training in art, psychology, and computer science prepares students well for jobs in web design, interface development, game design, usability testing, and front-end requirements analysis.

	Bachelor of Science Four-year (B.Sc. Four-year) – Applied Computing – Interactive Systems Design	**Bachelor of Science Honours (B.Sc. Honours) – Applied Computing – Interactive Systems Design**

	No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.	Students interested in entering an Honours program should consult advisors in the department concerned before registering for their second year. Of the 120 credit units required for the B.Sc. Honours degree, at least 66 credit units must be at the senior level. Application for admission to Honours is not considered until successful completion of at least 60 credit units with a Cumulative Weighted Average of at least 70% overall and at least 70% in the subject of Honours. For further details, please see the Academic Information and Policies section. No more than 6 credit units from one subject may be used in Requirements C1, C2, and the Junior Course Requirements in C3.
C1 College Requirement (15 credit units)	**English Language Writing** Choose **6 credit units** from the following: • *Full list* **Indigenous Learning** Choose **3 credit units** from the following: • *Full list* **Quantitative Reasoning** • MATH 163.3 Introduction to Mathematical Reasoning • MATH 164.3 Introduction to Linear Algebra	
C2 Breadth Requirement (6 credit units)	Choose **6 credit units** from the following areas: Fine Arts Humanities Social Sciences Courses with No Program Type	
C3 Cognate Requirement (12 credit units)	**(12 credit units)** **Junior course requirements:** Choose **9 credit units** from the following: *Biology* • BIOL 120.3 • BIOL 121.3 *Chemistry* • CHEM 112.3 • CHEM 115.3 • CHEM 250.3 *Earth Science* • GEOG 120.3 • GEOL 121.3 • GEOL 122.3 *Physics & Astronomy*	

<table>
<tr><td></td><td colspan="2">

- ASTR 113.3
- PHYS 115.3
- PHYS 117.3 or PHYS 125.3

Senior course requirements:

- PHIL 232.3 Ethics and Professional Responsibility in Computer Science

</td></tr>
<tr><td>C4 Major Requirement</td><td>

(72 credit units)

- ARTH 120.3 Art and Visual Culture I
- ARTH 121.3 Art and Visual Culture I
- CMPT 141.3 Introduction to Computer Science
- CMPT 145.3 Principles of Computer Science
- CMPT 260.3 Mathematical Logic and Computing
- CMPT 270.3 Developing Object Oriented Systems
- CMPT 280.3 Intermediate Data Structures and Algorithms
- CMPT 281.3 Website Design and Development
- CMPT 370.3 Intermediate Software Engineering
- CMPT 381.3 Implementation of Graphical User Interfaces
- CMPT 481.3 Human Computer Interaction
- PSY 120.3 Biological and Cognitive Bases of Psychology
- PSY 121.3 Social Clinical Cultural and Developmental Behaviour
- STAT 245.3 Introduction to Statistical Methods

Choose **3 credit units** from the following:

- 100-level ART courses numbered 111 or higher

Choose **6 credit units** from the following, from any of the areas:

Game Design:

- CMPT 306.3 Game Mechanics
- CMPT 406.3 Game Design Workshop

Information Visualization:

- CMPT 384.3 Information Visualization
- CMPT 484.3 Graph Drawing and Network Visualization

</td><td>

(75 credit units)

- ARTH 120.3 Art and Visual Culture I
- ARTH 121.3 Art and Visual Culture I
- CMPT 141.3 Introduction to Computer Science
- CMPT 145.3 Principles of Computer Science
- CMPT 260.3 Mathematical Logic and Computing
- CMPT 270.3 Developing Object Oriented Systems
- CMPT 280.3 Intermediate Data Structures and Algorithms
- CMPT 281.3 Website Design and Development
- CMPT 370.3 Intermediate Software Engineering
- CMPT 381.3 Implementation of Graphical User Interfaces
- CMPT 407.3 Research Topics in Applied Computing
- CMPT 481.3 Human Computer Interaction
- PSY 120.3 Biological and Cognitive Bases of Psychology
- PSY 121.3 Social Clinical Cultural and Developmental Behaviour
- STAT 245.3 Introduction to Statistical Methods

Choose **3 credit units** from the following:

- 100-level ART courses numbered 111 or higher

Choose **6 credit units** from the following, from any of the areas, with at least 3 credit units at the 400-level:

Game Design:

- CMPT 306.3 Game Mechanics
- CMPT 406.3 Game Design Workshop

Information Visualization:

- CMPT 384.3 Information Visualization

</td></tr>
</table>

	Choose **3 credit units** from the following: • CMPT 306.3 Game Mechanics • CMPT 318.3 Data Analytics • CMPT 353.3 Full Stack Web Programming • CMPT 360.3 Machines and Algorithms • CMPT 371.3 Software Management • CMPT 384.3 Information Visualization Choose **3 credit units** from the following: • ARTH 250.3 Introduction to Visual Culture • ARTH 251.3 Art of the Internet Choose **6 credit units** from the following: • INTS 111.3 Design and Society • ART 231.3 Animation and Digital Space • ART 235.3 Digital Imagery • ART 236.3 Digital and Integrated Practice IIA • ART 237.3 Digital and Integrated Practice IIB • ART 331.3 Animation and Digital Space II Choose **9 credit units** from the following: • PSY 213.3 Child Development • PSY 214.3 Adolescent Development • PSY 216.3 Psychology of Aging • PSY 226.3 Social Psychology • PSY 252.3 Perceptual Processes • PSY 253.3 Introduction to Cognitive Psychology • PSY 255.3 Human Memory • PSY 256.3 Psychology of Language	• CMPT 484.3 Graph Drawing and Network Visualization Choose **3 credit units** from the following: • CMPT 306.3 Game Mechanics • CMPT 318.3 Data Analytics • CMPT 353.3 Full Stack Web Programming • CMPT 360.3 Machines and Algorithms • CMPT 371.3 Software Management • CMPT 384.3 Information Visualization Choose **3 credit units** from the following: • ARTH 250.3 Introduction to Visual Culture • ARTH 251.3 Art of the Internet Choose **6 credit units** from the following: • INTS 111.3 Design and Society • ART 231.3 Animation and Digital Space • ART 235.3 Digital Imagery • ART 236.3 Digital and Integrated Practice IIA • ART 237.3 Digital and Integrated Practice IIB • ART 331.3 Animation and Digital Space II Choose **9 credit units** from the following: • PSY 213.3 Child Development • PSY 214.3 Adolescent Development • PSY 216.3 Psychology of Aging • PSY 226.3 Social Psychology • PSY 252.3 Perceptual Processes • PSY 253.3 Introduction to Cognitive Psychology • PSY 255.3 Human Memory • PSY 256.3 Psychology of Language
C5 Electives Require-ment	**(21 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Four-year program, of which at least 66 must be at the 200-level or higher.	**(18 credit units)** Arts and Science courses, or those from other Colleges that have been approved for Arts and Science credit, to complete the requirements for 120 credit unit Honours program, of which at least 66 must be at the 200-level or higher.

Applied Computing

Professional Internship Option

In the Applied Computing Professional Internship Option, students typically complete 16 consecutive months of supervised work experience with a sponsoring employer in addition to the requirements for an Applied Computing program. Normally, the work placement commences after the student has completed three years of a four-year degree program in Applied Computing. The placement lasts from May 1 of one year to August 31 of the next year. Twelve-month internship placements are also allowed. However, only in exceptional circumstances (e.g. for medical reasons) will a shorter duration work period be permitted. Students should note that an internship is NOT a summer work program.

Benefits to Students: For students who go on internship placements, there are several benefits: (1) acquiring practical training and valuable experience in their prospective career area, adding strength to their résumé, and thus improving their job prospects upon graduation; (2) getting the "inside track" on fulltime employment opportunities with the same company in which the student interned, through established professional contacts; and (3) earning an income to help finance the final year of their university education.

Only a limited number of internship placements will be available in a given year. Eligibility for an internship placement will be decided by the Internship Coordinator in the Department of Computer Science, while hiring decisions for internship students are made by the employers.

Students are required to apply by September 30 for admission to an internship in May of the following year. If selected for an internship placement, students must complete all degree requirements, and the following courses:

- **CMPT 401.0** Professional Internship I
- **CMPT 402.0** Professional Internship II
- **CMPT 403.0** Professional Internship III
- **CMPT 404.0** Professional Internship IV (only for students pursuing a 16-month internship)

A student must successfully complete all requirements of the internship option in order to receive the Professional Internship designation on the University transcript.

Interested students are encouraged to contact the Internship Coordinator in the Department of Computer Science for further details about internship opportunities.

The prerequisite for the internship option is permission of the internship coordinator. Internship typically occurs after the third year of study.

Record of Consultation

Geomatics:

From: Aitken, Alec <alec.aitken@usask.ca>
Sent: Wednesday, January 6, 2021 6:28 AM
To: Stanley, Kevin <kgs325@mail.usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>
Subject: Program proposal in Applied Computing

Good morning Kevin and Alexis,

I am writing in support of the program proposal in Applied Computing, especially the Geomatics stream within this program. Kevin has insured that the department of Geography and Planning was consulted on several occasions over the past year about the proposed curricula. These consultations involved direct engagement with Geography and Planning faculty who will instruct the courses in the Geomatics stream (Scott Bell, Krystopher Chutko, Ehab Diab, Xulin Guo). There is enrolment capacity in all of the geography and planning courses identified in the Geomatics stream and we look forward to working with Computing Science students in our course offerings. I recommend approval of this innovative program.

Sincerely,

Alec Aitken
Professor and Head
Geography and Planning

Bioinformatics

From: McQuillan, Ian <mcquillan@cs.usask.ca>
Sent: Wednesday, January 6, 2021 2:37 PM
To: challenge.coordinator@artsandscience.usask.ca
Subject: Fwd: Bioinformatics courses and program

To whom it may concern,

This email is to accompany the proposal to create a new course BINF 151 (and the deletion of BINF 210) for the January 2021 Challenge period. The email indicates that the Department of Biochemistry, Microbiology and Immunology will change their undergraduate program requirement from requiring "either BINF 210 or BINF 200" to "either BINF 151 or BINF 351".

Sincerely,
Ian

Ian McQuillan
Professor of Computer Science

mcquillan@cs.usask.ca
ianmcquillan.com
Department of Computer Science
The University of Saskatchewan
Saskatoon, Canada

Begin forwarded message:

From: "Anderson, Kyle" <kyle.anderson@usask.ca>
Subject: RE: Bioinformatics courses and program
Date: December 18, 2020 at 10:38:45 AM CST
To: "McQuillan, Ian" <mcquillan@cs.usask.ca>
Cc: "Bull, Harold" <hjb133@mail.usask.ca>

Hi Ian,
Thanks for taking the time to meet with Harold and I a few weeks ago to discuss the proposed changes to the bioinformatics courses offered through computer science and answer our questions. I shared the details of the proposal at the December BMI departmental meeting and we are in support of the changes that are proposed. Having BINF 151 and 351 clearly differentiated (compared to the old 200/210) will give clarity to our students taking these courses, and better demonstrate a course-sequence for them to follow if they wish to extend their understanding of bioinformatics. When the time comes, we will be updating our programs to reflect this welcome change.

Thanks again for making these improvements that will benefit our students.

Kyle Anderson, Ph.D.
Assistant Professor and Undergraduate Chair of Biochemistry
Department of Biochemistry, Microbiology and Immunology
College of Medicine
University of Saskatchewan
Rm 3D30.1 Health Sciences

Data Analytics

From: Sowa, Artur <sowa@math.usask.ca>
Sent: Sunday, January 10, 2021 1:49 PM
To: Dahl, Alexis <alexis.dahl@usask.ca>
Cc: Stanley, Kevin <kgs325@mail.usask.ca>
Subject: Program in Applied CS: Data Analytics

Dear Alexis,

I am writing to let you know that my Department has been consulted with regards to creation of the new program titled Applied Computer Science: Data Analytics. We have discussed the proposal with a group of faculty in Math & Stats, in particular with the Undergraduate Committee co-chairs, Prof. Juxin Liu and Dr. Christopher Duffy. I am happy to say that we support the initiative and view it as valuable all-around.

Since the program incorporates only existing mathematics and statistics courses the pressure on our resources is not going to shift significantly. A sensitive point is the need to provide a sufficient number of seats in Math 164. However, this is a challenge that we hope to be able to meet. Therefore I see no obstacles to launching the program.

We welcome further discussion on the College forum as to the structure of credit sharing between CS and Math & Stats. One possibility is to ensure that the bulk of program graduates obtain a companion three-year degree in Mathematics or Applied Mathematics. Another is through creation of appropriate certificates. My department will address these questions and undertake appropriate steps in near future.

Please do let me know if you have any questions or advice.

Sincerely yours,
Artur

_____
Artur Sowa, Ph.D.
Professor & Department Head
Department of Mathematics and Statistics
University of Saskatchewan

106 Wiggins Road, Saskatoon, SK S7N 5E6, CANADA
Home page: https://math.usask.ca/~sowa/
_____

New Courses

UNIVERSITY OF SASKATCHEWAN	**New Course Proposal & Creation Form**

1**. Approval by Department Head or Dean**

1.1 College or School with academic authority: Arts and Science
1.2 Department with academic authority: Computer Science
1.3 Term from which the course is effective: 202205

2. **Information required for the Catalogue**

2.1 Label & Number of course: BINF 151
2.2 Academic credit units: 3

2.3 Course Long Title (maximum 100 characters): Computing in the Biological Sciences
Course Short Title (maximum 30 characters): Computing in Biology

2.4 Total Hours: **39** Lecture Seminar **18** Lab Tutorial Other

2.5 Weekly Hours: **3** Lecture Seminar **1.5** Lab Tutorial Other

2.6 Term in which it will be offered: T1 T2 T1 or T2 T1 and T2

2.7 Prerequisite: **One of BIOL 120.3 or BIOL 121.3 or BMSC 200.3**

If there is a prerequisite waiver, who is responsible for signing it?
D – Instructor/Dept Approval
H – Department Approval
I – Instructor Approval

2.8 Catalogue description (150 words or less):

This course offers a gently-paced introduction to concepts in computing such as algorithms, problem solving, and programming, with particular focus on their applications in the life sciences. Basic skills in problem solving, programming, as well as in accessing, storing, and manipulating biological data are developed. The course will consist of two components. First, basic concepts in computing will be explored using introductory programming techniques. Second, select bioinformatics programs and databases currently utilized in the life sciences will be introduced, including resources for sequence similarity search, sequence alignment, and inferring phylogeny. Hands-on exercises will provide students with the opportunity to apply basic computing skills to specific tasks in biology.

2.9 Do you allow this course to be repeated for credit? No.

3. **Please list rationale for introducing this course:**

There is an existing course, BINF 210, that teaches some bioinformatics concepts and bioinformatics tools and databases (on the web) primarily targeting to students in the life and health sciences. The vast majority of its enrolments are from the Department of Biochemistry, Microbiology and Immunology who require their students to take it (or another more advanced bioinformatics course). However, the course does not teach any programming. The lack of programming is very limiting in terms of the tools that are available to them as most are available within programming languages, and it is also not helpful in terms of taking further computational or bioinformatics courses, which all require programming. Also, most students take it too late in their program, making it difficult to take any further computational or bioinformatics courses.
The proposed new course, BINF 151, similarly assumes no programming background which is important for students in the biological or health science. But it teaches an introduction to programming in Python (the most common language in bioinformatics) along with some basic bioinformatics analysis mostly within the Python programming language itself. Indeed, this will be significantly more helpful in terms of taking further computational and bioinformatics courses. The programming material overlaps quite a bit with the existing Computer Science course CMPT 140: Introduction to Creative Computing. It can also serve as a prerequisite for the follow-on course to CMPT 140, which is CMPT 141. We expect students to take it earlier in their programs as it is a first year course with less restrictive prerequisites. Taking BIOL 120 in T1 of first year followed by BINF 151 in T2 of first year should be common.

4. **Please list the learning objectives for this course:**

See syllabus.

5. **Impact of this course**

Are the programs of other departments or Colleges affected by this course?
If so, were these departments consulted? (Include correspondence)
Were any other departments asked to review or comment on the proposal?

Email discussions with the Department Head Dr. Christopher Todd in the Department of Biology indicated that they are keen to list BINF 151 in their C3 Cognate Junior course requirement (within a list of courses from which 18CUs must be taken).

Communication with Dr. Kyle Anderson and Dr. Harold Bull of the Undergraduate Affairs Committee of the Department of Biochemistry, Microbiology and Immunology indicated that they plan to make “either BINF 151 or BINF 351” a requirement of their program (replacing their existing requirement “either BINF 210 or BINF 200”). Email communication will be provided.

6. **Other courses or program affected** (please list course titles as well as numbers)

6.1 Courses to be deleted? BINF 210
6.2 Courses for which this course will be a prerequisite? CMPT 141 will list BINF 151 as a possible prerequisite.
6.3 Is this course to be required by your majors, or by majors in another program? Will be required for Applied Computing with a concentration in Bioinformatics.

7. **Course outline**

(Weekly outline of lectures or include a draft of the course information sheet.)

See syllabus.

8. **Enrolment**

8.1 Expected enrollment: 100
8.2 From which colleges? 80 from Arts & Science; 20 from other colleges.

9. **Student evaluation**
Give approximate weighting assigned to each indicator (assignments, laboratory work, mid-term test, final examination, essays or projects, etc.)

See syllabus.

9.1 How should this course be graded?
N – Numeric/Percentage
(Grade options for instructor: grade of 0% to 100%, IP in Progress)

9.2 Is the course exempt from the final examination? No.

10. **Required text**
Include a bibliography for the course.

See syllabus.

11. **Resources**
11.1 Proposed instructor: **Lingling Jin, Ian McQuillan**
11.2 How does the department plan to handle the additional teaching or administrative workload? **Teaching and other course expenses will be accommodated within the departmental budget.**
11.3 Are sufficient library or other research resources available for this course? **Yes**
11.4 Are any additional resources required (library, audio-visual, technology, etc.)? **The course will require the use of the labs which are already run by the Department of Computer Science.**

12. **Tuition**
12.1 Will this course attract tuition charges? If so, how much? (use tuition category) **Yes, TC03**
12.2 Does this course require non-standard fees, such as materials or excursion fees? If so, please include an approved "Application for New Fee or Fee Change Form" http://www.usask.ca/sesd/info-for-instructors/program-course-preparation.php#course-fees **No additional fees are required.**

Detailed Course Information

1. Schedule Types
Please choose the Schedule Types that can be used for sections that fall under this course:

Code	Description
LEC	Lecture
PRA	Practicum

2. Course Attributes
Please highlight the attributes that should be attached to the course (they will apply to all sections):

2.1 NOAC No Academic Credit **N/A**

2.2 For the College of Arts and Science only: To which program type does this course belong?

FNAR	Fine Arts
HUM	Humanities
SCIE	Science
SOCS	Social Science
ARNP	No Program Type (Arts and Science)

Does this course satisfy one of the official college requirements: **No**

3. Registration Information (Note: multi-term courses cannot be automated as corequisites)

3.1 Permission Required: **N/A**
3.2 Restriction(s): course only open to students in a specific college, program/degree, major, year in program **N/A**
3.3 Prerequisite(s): course(s) that must be completed prior to the start of this course
Prerequisite(s): One of BIOL 120.3 or BIOL 121.3 or BMSC 200.3
3.4 Prerequisite(s) or Corequisite(s): course(s) that can be completed prior to or taken at the same time as this course **N/A**
3.5 Corequisite(s): course(s) that must be taken at the same time as this course **N/A**
3.6 Notes: recommended courses, repeat restrictions/content overlap, other additional information
Note: Students may receive credit for only one of CMPT 140.3 or BINF 151.3. BINF 151 can be taken for credit after the completion of CMPT 100, but CMPT 100 cannot be taken for credit after completion of BINF 151. Students with credit for CMPT 141, CMPT 105, CMPT 111, CMPT 113, or CMPT 116 cannot obtain credit for BINF 151.

4. List Equivalent Course(s) here: N/A

5. List Mutually-Exclusive Course(s) here: CMPT 140.3

6. Additional Notes: N/A

BINF 151: Computing in the Biological Sciences

Class Location: TBD Class
Time: TBD

Ian McQuillan
Office: Spinks S423
email mcquillan@cs.usask.ca

Catalogue Description

This course offers a gently-paced introduction to concepts in computing such as algorithms, problem solving, and programming, with particular focus on their applications in the life sciences. Basic skills in problem solving, programming, as well as in accessing, storing, and manipulating biological data are developed. The course will consist of two components. First, basic concepts in computing will be explored using introductory programming techniques. Second, select bioinformatics programs and databases currently utilized in the life sciences will be introduced, including resources for sequence similarity search, sequence alignment, and inferring phylogeny. Hands-on exercises will provide students with the opportunity to apply basic computing skills to specific tasks in biology.

Prerequisite(s): One of BIOL 120.3 or BIOL 121.3 or BMSC 200.3.

Class Time and Location: 3 hours per week, class time and location

TBD.

Lab Time and Location: 1.5 hours per week, lab time and location

TBD.

Website: [on Canvas, URL TBD]

Note: Students may receive credit for only one of CMPT 140.3 or BINF 151.3. BINF 151 can be taken for credit after the completion of CMPT 100, but CMPT 100 cannot be taken for credit after completion of BINF 151. Students with credit for CMPT 141, CMPT 105, CMPT 111, CMPT 113, or CMPT 116 cannot obtain credit for BINF 151.

Learning Outcomes

By the end of this course, students will be expected to:

- Design and implement simple Python programs from scratch.
- Test and debug simple Python programs.
- Employ conditionals and loops in simple Python programs.
- Employ variables and lists in simple Python programs.
- Define and call Python functions in Python programs.
- Trace through the execution of simple Python programs by hand.
- Implement simple numerical algorithms, such as computing the average of a list of numbers, finding the *min*, *max* of a list.
- Demonstrate the effective use of biological databases.

- Manipulate biological sequence information in different file formats using Biopython.
- Perform similarity search, sequence alignments and create phylogenetic trees, while interpreting results and generating conclusions.
- Apply various bioinformatics programs to compare biological sequences.
- Assess the effects of parameters for various bioinformatics programs.
- Justify the interplay between biology, algorithms, and mathematics.

Student Evaluation

Grading Scheme

Assignments (five @ 6% each)	30%
Labs Exercises or Quizzes (ten @ 1% each)	10%
Midterm Exam	20%
Final Exam	40%
Total	100%

Final Exam Scheduling

Midterm and final examinations must be written on the date scheduled. Final examinations may be scheduled at any time during the examination period; students should therefore avoid making prior travel, employment, or other commitments for this period. If a student is unable to write an exam through no fault of his or her own for medical or other valid reasons, documentation must be provided and an opportunity to write the missed exam may be given. Students are encouraged to review all examination policies and procedures: http://students.usask.ca/academics/exams.php

Textbook Information

There is no required textbook. However, there will be reading material posted on the course website before each lecture. Lecture notes will be available on the course website after each lecture.

Lecture Schedule

Topics overview and time allocation:

Topic Order	**Topic**	Class Time
1	Algorithms and How to Think Like a Computer	1 hour
2	Abstraction and Encapsulation	1 hour
3	Data, expressions, variables	3 hour

4	Control Flow: Conditional Branching	2 hour
5	Control Flow: Repetition	2 hour
6	Control Flow: Nesting Constructs and Problem Solving	2 hour
7	Functions Part 1: Calling and defining functions, parameters	2 hour
8	Functions Part 2: Return values, nested function calls	3 hour
9	Lists	3 hour
10	File I/O	1 hour
11	Sequence Database (NCBI)	3 hours
12	Sequence Alignments, BLAST	5 hours
13	Python Modules (Biopython)	2 hour
14	Phylogenetic Trees	4 hours
	Total	34 hours

University of Saskatchewan Grading System (for undergraduate courses)

Exceptional (90-100) A superior performance with consistent evidence of

- a comprehensive, incisive grasp of the subject matter;
- an ability to make insightful critical evaluation of the material given;
- an exceptional capacity for original, creative and/or logical thinking;
- an excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently.

Excellent (80-90) An excellent performance with strong evidence of

- a comprehensive grasp of the subject matter;
- an ability to make sound critical evaluation of the material given;
- a very good capacity for original, creative and/or logical thinking;
- an excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently.

Good (70-79) A good performance with evidence of

- a substantial knowledge of the subject matter;
- a good understanding of the relevant issues and a good familiarity with the relevant literature and techniques;
- some capacity for original, creative and/or logical thinking;
- a good ability to organize, to analyze and to examine the subject material in a critical and constructive manner.

Satisfactory (60-69) A generally satisfactory and intellectually adequate performance with evidence of

- an acceptable basic grasp of the subject material;
- a fair understanding of the relevant issues;
- a general familiarity with the relevant literature and techniques;
- an ability to develop solutions to moderately difficult problems related to the subject material;
- a moderate ability to examine the material in a critical and analytical manner.

Minimal Pass (50-59) A barely acceptable performance with evidence of

- a familiarity with the subject material;
- some evidence that analytical skills have been developed;
- some understanding of relevant issues;
- some familiarity with the relevant literature and techniques;
- attempts to solve moderately difficult problems related to the subject material and to examine the material in a critical and analytical manner which are only partially successful.

Failure <50 An unacceptable performance

Course Overview

- As this is a reading course, the class will meet weekly at a time that is mutually agreeable to everyone.

- Every week, there will be a set of notes distributed for the upcoming week, and an assignment for the next week (on the same topic as the notes). We will discuss any problem areas or questions from the previous week, as well as hand-in the assignment from the previous week.

Policies:

Late Assignments

Extensions on assignments will be granted only by the course instructor. Individual requests for extensions will only be granted for extraordinary circumstances out of the student's control (such as significant illness or death in the family). Suitable documentation may be required to support your request for an extension.

Missed Examinations

http://artsandscience.usask.ca/undergraduate/advising/strategies.php

1. Students who miss an exam should contact the instructor as soon as possible. If it is known in advance that an exam will be missed, the instructor should be contacted before the exam.

2. "A student who is absent from a final examination due to medical, compassionate, or other valid reasons, may apply to the College of Arts and Science Undergraduate Students Office for a deferred exam. Application must be made within three business days of the missed examination and be accompanied by supporting documents."

Incomplete Course Work and Final Grades

"When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may

be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination.

Extensions past the final examination date for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the class which factors in the incomplete coursework as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade.

In the case where the student has a passing percentile grade but the instructor has indicated in the course outline that failure to complete the required coursework will result in failure in the course, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised assigned final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed.

A student can pass a course on the basis of work completed in the course provided that any incomplete course work has not been deemed mandatory by the instructor in the course outline and/or by College regulations for achieving a passing grade." (http://policies.usask.ca/policies/academic-affairs/academiccourses.php)

For policies governing examinations and grading, students are referred to the Assessment of Students section of the University policy "Academic courses: class delivery, examinations, and assessment of student learning" (http://policies.usask.ca/policies/academic-affairs/academic-courses.php)

Copyright

Course materials are provided to you based on your registration in a class, and anything created by your professors and instructors is their intellectual property, unless materials are designated as open education resources. This includes exams, PowerPoint/PDF slides and other course notes. Additionally, other copyright protected materials created by textbook publishers and authors may be provided to you based on license terms and educational exceptions in the Canadian Copyright Act (see http://laws-lois.justice.gc.ca/eng/acts/C-42/index.html).

Before you copy or distribute others' copyright-protected materials, please ensure that your use of the materials is covered under the University's Fair Dealing Copyright Guidelines available at https://library. usask.ca/copyright/general-information/fair-dealing-guidelines.php. For example, posting others' copyright-protected materials on the open web is not covered under the University's Fair Dealing Copyright Guidelines, and doing so requires permission from the copyright holder.

For more information about copyright, please visit https://library.usask.ca/copyright/index.php where there is information for students available at https://library.usask.ca/copyright/students/rights.php, or contact the University's Copyright Coordinator at mailto:copyright.coordinator@usask.ca or 306-9668817.

Examinations with Access and Equity Services (AES)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates. In order to access AES programs and supports, students must follow AES policy and procedures. For more information or advice, visit https://students.usask.ca/health/centres/access-equity-services.php, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

For information on AES services and remote learning please visit https://updates.usask.ca/info/current/accessibility.php#AccessandEquityServices

Student Supports

Academic Help for Students

The University Library offers a range of learning and academic support to assist USask undergrad and graduate students. For information on specific services, please see the Learning page on the Library web site https://library.usask.ca/support/learning.php.

Remote learning support information https://students.usask.ca/remote-learning/index.php

Class and study tips https://students.usask.ca/remote-learning/class-and-study-tips.php

Remote learning tutorial https://libguides.usask.ca/remote_learning

Study skills materials for online learning https://libguides.usask.ca/studyskills

A guide on netiquette, principles to guide respectful online learning interactions https://teaching.usask.ca/remoteteaching/netiquette.php

Teaching, Learning and Student Experience

Teaching, Learning and Student Experience (TLSE) provides developmental and support services and programs to students and the university community. For more information, see the students' web site http://students. usask.ca.

College Supports

Students in Arts & Science are encouraged to contact the Undergraduate Student Office and/or the Trish Monture Centre for Success with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and

procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources. Contact information is available at: (http://artsandscience.usask.ca/undergraduate/advising/)

Financial Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central (https://students.usask.ca/student-central.php).

Aboriginal Students' Centre

The Aboriginal Students' Centre (ASC) is dedicated to supporting Aboriginal student academic and personal success. The centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The centre is also dedicated to intercultural education, brining Aboriginal and non-Aboriginal students together to learn from, with and about one another in a respectful, inclusive and safe environment. Students are encouraged to visit the ASC's Facebook page (https://www.facebook.com/ aboriginalstudentscentre/) to learn more.

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success in their international education experiences at the U of S and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and English as a Second Language students and their families in their transition to the U of S and Saskatoon. ISSAC offers advising and support on all matters that affect international students and their families and on all matters related to studying abroad. . Please visit students.usask.ca or updates.usask.ca for more information.

Land Acknowledgement

As we engage in Remote Teaching and Learning, I would like to acknowledge that the Saskatoon campus of the University of Saskatchewan is on **Treaty Six Territory** and the **Homeland of the Métis**. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. I would also like to recognize that some may be attending this course from other traditional Indigenous lands. I ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.

UNIVERSITY OF SASKATCHEWAN	**New Course** **Proposal & Creation Form**

1**. Approval by Department Head or Dean**

1.1 College or School with academic authority: Arts and Science
1.2 Department with academic authority: Computer Science
1.3 Term from which the course is effective: 202205

2. **Information required for the Catalogue**

2.1 Label & Number of course: CMPT 318
2.2 Academic credit units: 3

2.3 Course Long Title (maximum 100 characters): **Data Analytics**
Course Short Title (maximum 30 characters): **Data Analytics**

2.4 Total Hours: **39** Lecture Seminar **16.5** Lab Tutorial Other

2.5 Weekly Hours: **3** Lecture Seminar **1.5** Lab Tutorial Other

2.6 Term in which it will be offered: T1 T2 T1 or T2 T1 and T2

2.7 Prerequisite: **CMPT 270, and MATH164, and STAT 245 or equivalent**

If there is a prerequisite waiver, who is responsible for signing it?
D – Instructor/Dept Approval
H – Department Approval
I – Instructor Approval

2.8 Catalogue description (150 words or less):

Introduces computational tools for the analysis of data. This course will focus on the design and implementation of data analytic pipelines, and the appropriate interpretation of the results of that analysis.

2.9 Do you allow this course to be repeated for credit? No.

3. **Please list rationale for introducing this course:**

This course is being created to meet a competitive and industry need. Computer technology now permeates society. Much of the recent growth in Computer Science has been driven by more traditional sectors of the economy such as retail, mining, agriculture and hospitality leveraging the data they collect to increase efficiency and decrease costs. This data revolution is unlikely to abate any time soon as most organizations have substantial data reserves, and little capacity to exploit them. Most of our comparator institutions offer some form of Data Analytics programming. As we see increasing demand for students with a Data Analytics background, the university must either offer this type of programming or lose

students to nearby institutions such as the Universities of Alberta or Manitoba.
Computer Science at the University of Saskatchewan currently offers courses in Machine Learning and Deep Learning at the fourth year level, but has no course that covers the fundamentals of data analytics from a computational perspective. Courses in Statistics cover aspects of analytic pipeline design, but do not address the pipeline in its entirety or the efficient and maintainable construction of code to perform the analysis. Some of the advanced labs in the natural and social sciences cover discipline or inquiry specific pipelines, but do not cover how to create new pipelines for new problems, which is the major focus of the course. It should be noted that Data Analytics typically focusses on practical data tasks and computational efficiency, whereas Data Science focusses on the fundamentals of data and statistics and is typically taught in Mathematics departments.

4. **Please list the learning objectives for this course:**

See syllabus.

5. **Impact of this course**

Are the programs of other departments or Colleges affected by this course?
If so, were these departments consulted? (Include correspondence)
Were any other departments asked to review or comment on the proposal?

No changes to curriculum to any other unit are required.

The broader impact is reflected in the creation of the new programs in Data Analytics, Geomatics, ISD, and Bioinformatics. Consultation occurred in conjunction with the creation of these programs.

6. **Other courses or program affected** (please list course titles as well as numbers)

6.1 Courses to be deleted? **None.**
6.2 Courses for which this course will be a prerequisite? **N/A**
6.3 Is this course to be required by your majors, or by majors in another program? Will be required for Applied Computing with a concentration in Data Analytics.

7. **Course outline**

(Weekly outline of lectures or include a draft of the course information sheet.)

See syllabus.

8. **Enrolment**

8.1 Expected enrollment: 90
8.2 From which colleges? 70 from Arts & Science; 20 from other colleges.

9. **Student evaluation**

Give approximate weighting assigned to each indicator (assignments, laboratory work, mid-term test, final examination, essays or projects, etc.)

See syllabus.

9.1 How should this course be graded?
N – Numeric/Percentage

(Grade options for instructor: grade of 0% to 100%, IP in Progress)

9.2 Is the course exempt from the final examination? No.

10. **Required text**
Include a bibliography for the course.

See syllabus.

11. **Resources**
    11.1 Proposed instructor: **Kevin Stanley**
    11.2 How does the department plan to handle the additional teaching or administrative workload? **Initial offerings of the course will be accommodated within the existing departmental budget. Should the course provide popular and grow the student base additional TA supports might be necessary, which should be reflected through the annual budgeting exercise with the college.**
    11.3 Are sufficient library or other research resources available for this course? **Yes**
    11.4 Are any additional resources required (library, audio-visual, technology, etc.)? **No**

12. **Tuition**
    12.1 Will this course attract tuition charges? If so, how much? (use tuition category) **Yes, TC03**
    12.2 Does this course require non-standard fees, such as materials or excursion fees? If so, please include an approved "Application for New Fee or Fee Change Form" http://www.usask.ca/sesd/info-for-instructors/program-course-preparation.php#course-fees **No additional fees are required.**

Detailed Course Information

1. Schedule Types
Please choose the Schedule Types that can be used for sections that fall under this course:

Code	Description
LEC	Lecture
PRA	Practicum

2. Course Attributes
Please highlight the attributes that should be attached to the course (they will apply to all sections):

2.1 NOAC No Academic Credit **N/A**

2.2 For the College of Arts and Science only: To which program type does this course belong?

FNAR	Fine Arts
HUM	Humanities
SCIE	Science
SOCS	Social Science
ARNP	No Program Type (Arts and Science)

Does this course satisfy one of the official college requirements: **No**

3. Registration Information (Note: multi-term courses cannot be automated as corequisites)

3.1 Permission Required: **N/A**

3.2 Restriction(s): course only open to students in a specific college, program/degree, major, year in program **N/A**

3.3 Prerequisite(s): course(s) that must be completed prior to the start of this course

Prerequisite(s): CMPT 270, and MATH 164, and STAT 245 or equivalent

3.4 Prerequisite(s) or Corequisite(s): course(s) that can be completed prior to or taken at the same time as this course **N/A**

3.5 Corequisite(s): course(s) that must be taken at the same time as this course **N/A**

3.6 Notes: recommended courses, repeat restrictions/content overlap, other additional information

Note: CMPT 280.3 is recommended as a pre- or co-requisite. Any calculus course is recommended as a prerequisite.

4. List Equivalent Course(s) here: N/A

5. List Mutually-Exclusive Course(s) here: N/A

6. Additional Notes: N/A

COURSE SYLLABUS

CMPT 318.3: Data Analytics

Someday, sometime

Dr. Kevin Stanley
Office: Thorv ???
306-966-6747
kevin.stanley@usask.ca

Office hours: 2:00-3:00 pm Fridays, or by appointment

Catalogue Description

Introduces computational tools for the analysis of data. This course will focus on the design and implementation of data analytic pipelines, and the appropriate interpretation of the results of that analysis.

Prerequisite(s): CMPT 270, and MATH 164, and STAT 245 or equivalent

Note: CMPT 280 and any calculus class are recommended.

Learning Outcomes

By the completion of this course, students will be expected to:

1. Explain a data analytic design pattern and how it can be applied to a specific data analytic problem
2. Create data analytic pipelines using the scikit family of Python libraries and SQL scripts
3. Filter static and time varying data according to rules
4. Meaningfully aggregate data, and describe the impact of the aggregation on the statistical properties of the data and their potential interpretation
5. Appropriately identify and implement solutions for regression, classification and clustering problems
6. Create narratives corresponding to the data analytic pipeline, and the outcomes observed
7. Extend in-memory scale analysis to larger Big Data Analysis using Dask

Course Overview

Data Analytics comprises the tools and techniques to extract meaning from data, usually obtained in an unstructured rather than experimental environment. This course will teach the fundamentals of designing data analytic pipelines for canonical classes of data. We will begin with simple tabular data, small enough

to be manipulated in memory, and study the fundamental processes of filtering, stratification and aggregation, and their effect on downstream classification or regression models. We will then study the use of metrics or features, and how pipelines can be chained together to derive higher-order insights. In streaming data, each analysis step can often be performed in memory, but the overall stream size can too large to accommodate in its entirety. Meaningful information is expected from sequential relationships between the data points as well as the datapoints themselves. Finally, we will introduce the concepts surrounding Big Data, and provide an overview of techniques required to manage and manipulate data too large for memory. Most of the course will rely on the Python programming language and the scikit family of data libraries. The final section of the course will cover Dask, which provides scikit-like abstractions over big data frameworks like Spark and Hadoop. The architectures of these frameworks will be introduced, but not covered in detail. The course evaluation will be comprised of a number of small lab assignments, four substantial assignments, and a final exam covering all course content. Lectures will cover the major topics in the course, and underlying theory. Labs will focus on scikit tool tutorials and provide small worked problems.

Class Schedule

Week 1: What is Data Analytics and Data Analytics Design Patterns

Week 2: Tabular Data in Python

Week 3: Data Pipelines for Classification and Regression of Tabular Data

Week 4: Statistical and Aggregate Metrics, Assignment 1

Week 5: Graph and Tree Metrics

Week 6: Streaming Data in Python, Assignment 2

Week 7: Common String Analysis Algorithms

Week 8: Data Pipelines for Classification or Clustering of Streaming Data

Week 9: Big Data in Dask, Assignment 3

Week 10: Schedulers for handling big data

Week 11: Big Data case study

Week 12: Putting it all together, data analytics as data narratives, Assignment 4

Week 13: Review and special topics

Midterm and Final Examination Scheduling

Midterm and final examinations must be written on the date scheduled.

Final examinations may be scheduled at any time during the examination period (INSERT FIRST AND LAST DAY OF CURRENT EXAM PERIOD); students should therefore avoid making prior travel, employment, or other commitments for this period. If a student is unable to write an exam through no fault of his or her own for medical or other valid reasons, documentation must be provided and an opportunity to write the missed exam may be given. Students are encouraged to review all examination policies and procedures:

http://students.usask.ca/academics/exams.php

Length and Mode of Final Examination

A three hour final exam will be administered containing a mixture of multiple choice, short answer, and coding and design problems.

Required Resources

Readings/Textbooks

Textbooks are available from the University of Saskatchewan Bookstore:

www.usask.ca/consumer_services/bookstore/textbooks

Required Text
Grus, J. (2019). *Data science from scratch: first principles with python*. O'Reilly Media.

Optional Text
Daniel, J. C. (2019). *Data science with Python and Dask*.

Other Required Materials

Electronic Resources

This course will make use of Python and the scikit family of libraries available on all Computer Science servers and laboratory computers. We will use both Jupyter notebooks and PyCharm (Jetbrains) as interfaces. The scikit family of libraries can be downloaded using anaconda.

Grading Scheme

Assignments	52
Labs	11
Final Exam	37
Total	100%

Evaluation Components

Assignment 1: Tabular Data and Classification

Value: 13% of final grade

Duration: 2 weeks

Introduces using data analytic design patterns to cluster data. Students will employ Python and associated scikit libraries to implement a data analytic pipeline, and cluster the results using k-means or a comparable algorithm. Written documentation will describe the results.

Assignment 2: Tabular Data and Metrics

Value: 13% of final grade

Duration: 2 weeks

Introduces the idea of aggregate measures using graph or tree constructs. Students will create Python and SQL scripts and written documentation that implements a measure on a graph or tree construct created from the data then run one or more clustering algorithms on that construct. Students will comment on the properties of the resulting clusters.

Assignment 3: Streaming Data

Value: 13% of final grade

Duration: 2 weeks

Texts, DNA and temporal measurements have a built in direction which streams data towards an outcome. Students will build a data analytics pipeline for streaming data in Python. The results of the analysis will be used to inform a network routing or similar problem.

Assignment 4: Big Data

Value: 13% of final grade

Duration: 2 weeks

Some datasets are distinguished not by their complexity but their size. This assignment will introduce students to data where scale is a factor. Common examples include search engine data, image repositories or video or audio streaming service records. Students will learn how to adapt pipelines to handle data volume.

Lab Assignments

Value: 1% of final grade each, total of 11%

Duration: 30 minutes

The lab assignments are meant to introduce practical data analytic coding concepts in small doses and can easily be completed during the lab period. They are meant to provide practice using the tools leading to the assignments. Grades are provided more to encourage participation than for evaluation.

Final Exam

Value: 37% of final grade

Length: 3 hours

Type: Comprehensive, Invigilated, no electronic devices

Information on literal descriptors for grading at the University of Saskatchewan can be found at: http://students.usask.ca/academics/grading/grading-system.php

Please note: There are different literal descriptors for undergraduate and graduate students.

More information on the Academic Courses Policy on course delivery, examinations and assessment of student learning can be found at: http://policies.usask.ca/policies/academic-affairs/academic-courses.php

The University of Saskatchewan Learning Charter is intended to define aspirations about the learning experience that the University aims to provide, and the roles to be played in realizing these aspirations by students, instructors and the institution. A copy of the Learning Charter can be found at: http://www.usask.ca/university_secretary/LearningCharter.pdf

Submitting Assignments

Assignments will be submitted through Canvas.

Late Assignments

Late assignments are not accepted. Students with a valid reason (medical, personal) may receive an extension individually.

Criteria That Must Be Met to Pass

Students must complete three of four assignments and pass the final exam to be eligible to pass the course.

Recording of the Course

Recording of the course will only be allowed in certain circumstances. Please see the instructor for information on how to receive approval.

Copyright

Materials posted on Canvas or distributed in class will be made available in accordance with Canadian copyright laws. Students are reminded of their obligation to also abide by this legislation.

Integrity Defined (from the Office of the University Secretary)

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php#IXXIIAPPEALS)

For more information on what academic integrity means for students see the Academic Integrity section of the University Library Website at: https://library.usask.ca/academic-integrity#AboutAcademicIntegrity

You are encouraged to complete the Academic Integrity Tutorial to understand the fundamental values of academic integrity and how to be a responsible scholar and member of the USask community - https://library.usask.ca/academic-integrity.php#AcademicIntegrityTutorial

Access and Equity Services (AES) for Students

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates. In order to access AES programs and supports, students must follow AES policy and procedures. . In order to access AES programs and supports, students must follow AES policy and procedures. For more information or advice, visit https://students.usask.ca/health/centres/access-equity-services.php, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

Student Supports

Student Learning Services

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site https://library.usask.ca/studentlearning/.

Teaching, Learning and Student Experience

The Teaching, Learning and Student Experience Unit (TLSE) focuses on providing developmental and support services and programs to students and the university community. For more information, see https://students.usask.ca/.

College Supports

Students in Arts & Science are encouraged to contact the Undergraduate Student Office and/or the Trish Monture Centre for Success with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources. Contact information is available at: (http://artsandscience.usask.ca/undergraduate/advising/)

UNIVERSITY OF SASKATCHEWAN	**New Course** **Proposal & Creation Form**

1**. Approval by Department Head or Dean**

1.1 College or School with academic authority: Arts and Science
1.2 Department with academic authority: Computer Science
1.3 Term from which the course is effective: 202205

2. **Information required for the Catalogue**

2.1 Label & Number of course: CMPT 407
2.2 Academic credit units: 3

2.3 Course Long Title (maximum 100 characters): **Research Topics in Applied Computing**
Course Short Title (maximum 30 characters): **Research in Applied Computing**

2.4 Total Hours: Lecture **39** Seminar Lab Tutorial **65** Other: **Research**

2.5 Weekly Hours: Lecture **1.5** Seminar Lab Tutorial **2.5** Other: **Research**

2.6 Term in which it will be offered: T1 T2 T1 or T2 T1 and T2

2.7 Prerequisite: **In the final year of Honours program in Applied Computing; or a cumulative percentage of at least 70% in 24 credit units of courses in the C4 Major Requirement (for the chosen concentration) and written permission of the department.**

If there is a prerequisite waiver, who is responsible for signing it?
D – Instructor/Dept Approval
H – Department Approval
I – Instructor Approval

2.8 Catalogue description (150 words or less):

Senior students will be introduced to research in an advanced area of Applied Computing under the supervision of a faculty member specializing in the area, often with co-supervision with another faculty member in a cognate department.

2.9 Do you allow this course to be repeated for credit? No.

3. **Please list rationale for introducing this course:**

This course will serve as the Honours thesis for all concentrations in the Applied Computing program. The syllabus is virtually identical to CMPT 400, the Honours thesis in Computer Science. This course is being proposed to facilitate book keeping between the different Honours programs.

4. **Please list the learning objectives for this course:**

See syllabus.

5. **Impact of this course**

Are the programs of other departments or Colleges affected by this course?
If so, were these departments consulted? (Include correspondence)
Were any other departments asked to review or comment on the proposal?

No changes to curriculum to any other unit are required.

Students in this program may work on research projects that involve other departments. See letters of support for the program concentrations.

6. **Other courses or program affected** (please list course titles as well as numbers)

6.1 Courses to be deleted? **None.**
6.2 Courses for which this course will be a prerequisite? **N/A**
6.3 Is this course to be required by your majors, or by majors in another program? Will be required for Applied Computing at the Honours level.

7. **Course outline**

(Weekly outline of lectures or include a draft of the course information sheet.)

See syllabus.

8. **Enrolment**

8.1 Expected enrollment: 10
8.2 From which colleges? 10 from Arts & Science

9. **Student evaluation**

Give approximate weighting assigned to each indicator (assignments, laboratory work, mid-term test, final examination, essays or projects, etc.)

See syllabus.

9.1 How should this course be graded?
N – Numeric/Percentage
(Grade options for instructor: grade of 0% to 100%, IP in Progress)

9.2 Is the course exempt from the final examination? No.

10. **Required text**

Include a bibliography for the course.

See syllabus.

11. **Resources**
    11.1 Proposed instructor: **Ian Stavness**
    11.2 How does the department plan to handle the additional teaching or administrative workload? **Teaching and other course expenses will be accommodated within the departmental budget.**
    11.3 Are sufficient library or other research resources available for this course? **Yes**
    11.4 Are any additional resources required (library, audio-visual, technology, etc.)? **No**

12. **Tuition**
    12.1 Will this course attract tuition charges? If so, how much? (use tuition category) **Yes, TC03**
    12.2 Does this course require non-standard fees, such as materials or excursion fees? If so, please include an approved "Application for New Fee or Fee Change Form" http://www.usask.ca/sesd/info-for-instructors/program-course-preparation.php#course-fees **No additional fees are required.**

Detailed Course Information

1. Schedule Types
Please choose the Schedule Types that can be used for sections that fall under this course:

Code	Description
SEM	Seminar
RES	Research

2. Course Attributes
Please highlight the attributes that should be attached to the course (they will apply to all sections):

2.1 NOAC No Academic Credit **N/A**

2.2 For the College of Arts and Science only: To which program type does this course belong?

FNAR	Fine Arts
HUM	Humanities
SCIE	Science
SOCS	Social Science
ARNP	No Program Type (Arts and Science)

Does this course satisfy one of the official college requirements: **No**

3. Registration Information (Note: multi-term courses cannot be automated as corequisites)
    3.1 Permission Required: **N/A**
    3.2 Restriction(s): course only open to students in a specific college, program/degree, major, year in program **Restricted to students in Applied Computing**
    3.3 Prerequisite(s): course(s) that must be completed prior to the start of this course
    Prerequisite(s): In the final year of Honours program in Applied Computing; or a cumulative percentage of at least 70% in 24 credit units of courses in the C4 Major Requirement (for the chosen concentration) and written permission of the department.

3.4 Prerequisite(s) or Corequisite(s): course(s) that can be completed prior to or taken at the same time as this course **N/A**

3.5 Corequisite(s): course(s) that must be taken at the same time as this course **N/A**

3.6 Notes: recommended courses, repeat restrictions/content overlap, other additional information

Note: Students in the Geomatics Stream may take GEOG 490.3 or PLAN 490.3 in place of CMPT 407.3. Students in the Data Analytics Stream may take MATH 402.0 in place of CMPT 407.3. Students cannot count more than one of these courses toward a degree in Applied Computing.

4. List Equivalent Course(s) here: N/A

5. List Mutually-Exclusive Course(s) here: CMPT 400.3, CMPT 405.3

6. Additional Notes: N/A

CMPT 407.3

Research Topics in Applied Computing

Coordinator: I. Stavness

Course Description

Senior students will be introduced to research in an advanced area of Applied Computing under the supervision of a faculty member specializing in the area, often with co-supervision with another faculty member in a cognate department.

Prerequisites: In the final year of an Honours program in Applied Computing

The course involves three main phases:

1. An introduction to Computer Science Research and Development (see Moodle for more details);
2. The individual directed project work under the guidance of a faculty advisor (weekly meetings with faculty advisor);
3. The presentation of the research results to an audience consisting of all students in CMPT 400 and CMPT 405 and their supervisors, and the production of a report or paper summarizing the work (at the end of the course).

CMPT 407 has the additional requirement that students must attend and critically review two presentations in the Computer Science Seminar Series.

Permission to Enroll

CMPT 407 provides access to a variety of different and independent topics, registering involves more than just completing traditional course enrollment procedures. A special registration form has been provided to facilitate this. Students should complete this form as soon as possible. **Once permission has been granted, students can register for the course via PAWS. Remember, CMPT 407 is a two-term 3 credit unit class.**

Additional notes include:

- The course is designed for students in their "fourth year";
- The course requires a faculty supervisor in the area of the student's project work. Efforts will be made to match students with their choice of projects or specific supervisor; however, this cannot be guaranteed. These matches are open to negotiation between individual students and faculty members;
- Group work may be permitted in 407. Department experience has found that group size, if allowed, should be limited to a maximum of 2 students;

- The "independent" nature of these courses may pose new challenges in personal time management to many students. Students are not permitted to register in 400, 405 or 407 simultaneously.

Project Topic Areas

- The objectives for the courses include providing the students with an in-depth understanding of a selected area of applied computing:
    - beyond that available from other undergraduate courses
    - at or near the state of the art
    - under the guidance of an active researcher in the area
- CMPT 407 is not designed to replace any existing CMPT courses. Rather they are designed either for more concentrated study in some area or for study of some area not covered by an existing CMPT course.
- Students are encouraged to propose their own projects or at least to consider what type of project they want to undertake. Faculty can be called upon to provide suggestions and may have a set of potential project topics available for students to consider.
- Students may wish to consider the following in selecting a project:
    - their personal interest in a topic
    - the resources (including supervisor and clients) available to help with the project
    - the value that completing the project may add to the student potential job skills.
    - the potential workload required to complete the project.

Specific project topics will be approved by the supervisor in consultation with the course coordinator to ensure that they contain appropriate academic content commensurate with a 4xx level course.

Student Evaluation

The method of student evaluation for both courses is:

2 Seminar Reviews:	5%
Ideas Presentation:	5%
Proposal Presentation:	10%
Final Project presentation:	20%
Attendance (Final Project Presentation):	5%
Final project paper:	55%

Learning Contract

A learning contract must be prepared by the student in consultation with the supervisor and signed by both parties. A copy should be given to the course coordinator prior to the end of September.

It is suggested that the learning contract will identify:

- The objectives of the project;
- The resources needed for the project and how they will be obtained;
- The phases of the project, represented by at least two milestones of identified accomplishments;
- The final artifacts of the project;
- The proportion of the project mark allotted to each artifact.

The exact form of the contract depends on the project.

Evaluation processes for each project deliverable will be provided in discussions with the faculty supervisor and course coordinator.

Example Checkpoints for 2020-2021

Week of Sept. 30, 2020	Final agreement of faculty member to supervise a student; upload to Moodle and inform coordinator by email (with cc to supervisor).
Week of Oct. 28, 2020	Completed/signed learning contract.
Week of Nov. 4, 2020	Project Idea Presentation: video presentation of the idea you have for the project; uploaded to Moodle
Week of Nov. 18, 2020	1st Progress Report – milestones met? (see Learning Contract)
Week of Nov. 25, 2020	Project proposal due to supervisor
Week of Jan. 20, 2021	Project Proposal Presentation: video presentation of your detailed project proposal for the project;
Week of Feb. 3, 2021	2nd Progress Report – milestones met? (see Learning Contract)
Feb. 26, 2021	Abstract for final presentation uploaded to Moodle
March 3, 10, 17, 24, 31	Final presentation of project
April 7, 2021 Deadline	*Final written report submitted to supervisor (with copy to coordinator) for marking. *Last date for submitting two seminar reviews to Moodle. Reviews must be signed by supervisor to indicate approval.

Schedule of Class Sessions

- Project activity and weekly interaction with faculty advisor is to be arranged between the student and advisor at a time convenient to both parties.
- The Wednesday, 3:30 - 4:50 p.m timeslot is reserved for course activity. This will primarily be the final course projects in March. Attendance at all student final presentation sessions is required and part of the final course grade
- All course announcements will be provided via the LMS, so it is your responsibility to monitor class pages for announcements.

Computer Science Seminars

All students in CMPT 407 must review two Computer Science Seminars of their choice during the year. The choice of seminars should be approved by the faculty advisor.

After viewing the seminar a written review should be prepared. A draft copy of your review should be approved by your supervisor; a good copy is then uploaded to moodle. The coordinator will be keeping track of these reviews and assign final grades to them; the reviews will be graded on an acceptable/not acceptable basis.

You may use the follow the following format for your seminar review:

Each review should be approximately 1 page long and must be printed on 8.5" by 11" paper. Identify the following at the top:

Student Name, NSID and Student Number
Speaker Name
Title
Date and Time

An *example format* of a report is the following. You may deviate from this format upon approval from your supervisor.

The content of the review should be divided into two paragraphs. In the first paragraph you should describe in your own words what the seminar was about as you understood it. What was the speaker trying to accomplish?

In the second paragraph you should evaluate the seminar from your own viewpoint. How well was it delivered? How good were the overheads or displays? What did you learn from it? Be honest! If you learned little from it, explain why.

PDF is the only acceptable format.

Project Presentations/Report

1) Project Idea Presentation: you will give a very brief presentation in mid-November of the idea you've decided to pursue on your project. This presentation is to be recorded by video and uploaded to the LMS along with a PDF of the slides.

2) Project Proposal Presentation: you will give a detailed presentation in early January of the project you are pursuing. This presentation is to be recorded by video and uploaded to Moodle along with a PDF of the slides.

3) Final Project Presentation: A Schedule for your final project presentation will be released around the end of February; the actual presentation period is each Wednesday in March. You will be required to submit a title for your presentation at the time the schedule is developed. The presentations will be delivered live.

4) Final Project Report: The **deadline** for submission of your final written reports **to your supervisor by email** (and **uploaded to Moodle**) is XX. The final report will be 4000-8000 words, demonstrating that a project has been completed (not a literature review), and that you have learned something about the topic you proposed.

All students registered in CMPT 407 are required to attend all of the Final Presentations; attendance will be taken and will be factored into your final mark!

Learning Objectives

The starting point in developing the learning contract for either class is to identify a number of learning objectives, typically at least four. These learning objectives will specify what you plan to accomplish as part of the course. Academically, they provide evidence of suitable fourth year level academic work.

Learning objectives should be as concrete or objective as possible in the accomplishments they specify.

The learning objectives for each course should reflect the "research" orientation of CMPT 407.

Each CMPT 407 project normally involves:

- Identifying project objectives, their importance, and how they relate to current research or practice in the field in question.
- Elaborating on the objectives by exploring relevant research literature
- Presenting a unique view of the topic via synthesis or further exploration
- Presenting conclusions, including an analysis of accomplishments and future directions

Typical learning objectives suitable for CMPT 400 might make use of the following wordings:

- identify and compare ....
- determine which ..... are more efficient in terms of _____
- develop changes or additions to improve .....
- evaluate alternate methods to .....
- synthesize various recommendations on the design of .....
- design and conduct an experiment on .....
- evaluate the results of an experiment on .....
- develop recommendations for .....
- develop a new technique for .....
- apply ..... technique(s) to _____

Students in CMPT 407 are expected to go beyond summarizing instances of existing information in their project paper. Students are expected to demonstrate their understanding of the material by techniques such as: comparing, contrasting, synthesizing, hypothesizing, and evaluating. Additionally students may wish to utilize experiments to test their ideas or to gain knowledge in areas lacking in or beyond published information.

In addition to the above project-based Learning Outcomes, all students will be expected to:

1. Utilize research techniques from at least one subdomain of computer science or a cognate discipline

2. Articulate a research question and discuss its validity

3. Write a paper in a format consistent with a subdomain of computer science or a cognate discipline

4. Present research findings and answer questions related to the findings and process of obtaining them

Land Acknowledgement

As we engage in Remote Teaching and Learning, I would like to acknowledge that the Saskatoon campus of the University of Saskatchewan is on ***Treaty Six Territory*** and the ***Homeland of the Métis***. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. I would also like to recognize that some may be attending this course from other traditional Indigenous lands. I ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.

Remote Learning Context

I acknowledge the complex circumstances in which the course is taking place. The remote teaching and learning context is new to most, and that all participations in the course should interact with empathy and care.

Criteria That Must Be Met to Pass

The Final Project Presentation and the Final Project Report are required to be completed in order to pass the course.

Attendance Expectations (for synchronous components)

Attendance is required for the Final Project Presentations. Regular remote meeting with faculty advisor is required.

Late submissions

Students will receive a zero grade for late submission of project deliverables unless they have written confirmation of an extension from their faculty supervisor and course coordinator. Students must provide presentation deliverables on the date specified, or will receive a zero grade on that deliverable.

Use of video and recording of the course:

Video conference sessions in this course, including your participation, will be recorded and made available only to students in the course for viewing via Moodle after each session. This is done, in part, to ensure that students unable to join the session (due to, for example, issues with their internet connection) can view the session at a later time. This will also provide you the opportunity to review any material discussed.

Please remember that course recordings belong to your instructor, the University, and/or others (like a guest lecturer) depending on the circumstance of each session, and are protected by copyright. Do not download, copy, or share recordings without the explicit permission of the instructor.

For questions about recording and use of sessions in which you have participated, including any concerns related to your privacy, please contact your instructor. More information on class recordings can

be found in the Academic Courses Policy https://policies.usask.ca/policies/academic-affairs/academic-courses.php#5ClassRecordings.

Required video use:

At times in this course you will be required to have your video on during video conferencing sessions. It will be necessary for you to use of a webcam built into or connected to your computer. Video is required for you to participate in presentation discussions and Q&A sessions. For questions about use of video in your sessions, including those related to your privacy, contact your instructor.

Copyright

Course materials are provided to you based on your registration in a class, and anything created by your professors and instructors is their intellectual property, unless materials are designated as open education resources. This includes exams, PowerPoint/PDF slides and other course notes. Additionally, other copyright-protected materials created by textbook publishers and authors may be provided to you based on license terms and educational exceptions in the Canadian Copyright Act (see http://laws-lois.justice.gc.ca/eng/acts/C-42/index.html).

Before you copy or distribute others' copyright-protected materials, please ensure that your use of the materials is covered under the University's Fair Dealing Copyright Guidelines available at https://library.usask.ca/copyright/general-information/fair-dealing-guidelines.php. For example, posting others' copyright-protected materials on the open web is not covered under the University's Fair Dealing Copyright Guidelines, and doing so requires permission from the copyright holder.

For more information about copyright, please visit https://library.usask.ca/copyright/index.phpwhere there is information for students available at https://library.usask.ca/copyright/students/rights.php, or contact the University's Copyright Coordinator at mailto:copyright.coordinator@usask.ca or 306-966-8817.

Integrity in a Remote Learning Context

Although the face of teaching and learning has changed due to covid-19, the rules and principles governing academic integrity remain the same. If you ever have questions about what may or may not be permitted, ask your instructor. Students have found it especially important to clarify rules related to exams administered remotely and to follow these carefully and completely.

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php#IXXIIAPPEALS)

For more information on what academic integrity means for students see the Academic Integrity section of the University Library Website at: https://library.usask.ca/academic-integrity#AboutAcademicIntegrity

You are encouraged to complete the Academic Integrity Tutorial to understand the fundamental values of academic integrity and how to be a responsible scholar and member of the USask community - https://library.usask.ca/academic-integrity.php#AcademicIntegrityTutorial

Examinations with Access and Equity Services (AES)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals at any time. Those students who are registered with AES with mental health disabilities and who anticipate that they may have responses to certain course materials or topics, should discuss course content with their instructors prior to course add / drop dates. In order to access AES programs and supports, students must follow AES policy and procedures. For more information or advice, visit https://students.usask.ca/health/centres/access-equity-services.php, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

For information on AES services and remote learning please visit https://updates.usask.ca/info/current/accessibility.php#AccessandEquityServices

Student Supports

Academic Help for Students

The University Library offers a range of learning and academic support to assist USask undergrad and graduate students. For information on specific services, please see the Learning page on the Library web site https://library.usask.ca/support/learning.php.

Remote learning support information https://students.usask.ca/remote-learning/index.php

Class and study tips https://students.usask.ca/remote-learning/class-and-study-tips.php

Remote learning tutorial https://libguides.usask.ca/remote_learning

Study skills materials for online learning https://libguides.usask.ca/studyskills

A guide on netiquette, principles to guide respectful online learning interactions https://teaching.usask.ca/remote-teaching/netiquette.php

Teaching, Learning and Student Experience

Teaching, Learning and Student Experience (TLSE) provides developmental and support services and programs to students and the university community. For more information, see the students' web site http://students.usask.ca.

College Supports

Students in Arts & Science are encouraged to contact the Undergraduate Student Office and/or the Trish Monture Centre for Success with any questions on how to choose a major; understand program requirements; choose courses; develop strategies to improve grades; understand university policies and procedures; overcome personal barriers; initiate pre-career inquiries; and identify career planning resources. Contact information is available at: (http://artsandscience.usask.ca/undergraduate/advising/)

Financial Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central (https://students.usask.ca/student-central.php).

Aboriginal Students' Centre

The Aboriginal Students' Centre (ASC) is dedicated to supporting Aboriginal student academic and personal success. The centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The centre is also dedicated to intercultural education, brining Aboriginal and non-Aboriginal students together to learn from, with and about one another in a respectful, inclusive and safe environment. Students are encouraged to visit the ASC's Facebook page (https://www.facebook.com/aboriginalstudentscentre/) to learn more.

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success and facilitates international education experiences at USask and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and English as a Second Language students in their transition to the University of Saskatchewan and to life in Canada. ISSAC offers advising and support on matters that affect international students and their families and on matters related to studying abroad as University of Saskatchewan students. Please visit students.usask.ca or updates.usask.ca for more information.

Recommended Technology for Remote Learning

Students are reminded of the importance of having the appropriate technology for remote learning. The list of recommendations can be found at https://students.usask.ca/remote-learning/tech-requirements.php.

Remember, there are many supports available to help you thrive in the remote learning context.

Course Deletions

BINF 210.3 Introduction to Bioinformatics Applications
Rationale: The Bioinformatics program is being proposed to be deleted and replaced as a new Concentration in Bioinformatics within a new Applied Computing program. The department is taking this opportunity to try to revitalize the dedicated Bioinformatics courses which will be taught for the Bioinformatics concentration.
BINF 210 was created approximately 7 years ago, well after the Bioinformatics program was created. The intention at the time was to create a course that did not require any computer programming background, which would be more appropriate for students in the Biochemistry program or in other life or health science departments. Instead of teaching programming, it used bioinformatics tools only on the web. Although we believe that not requiring any prior programming experience is important for students in these programs, we now believe it would be superior to teach programming within the class. The former approach was essentially a "service terminal course" in that it did not effectively lead into other computational courses. Furthermore, its appeal was largely limited to BMSC students. Also, requiring BMSC 200 made the ramp-up time too lengthy, and most students ended up taking it in the later years of their program. We believe that offering it as a first year course (BINF 151.3) that combines an introduction to programming (with overlap with the course CMPT 140: Introduction to Creative Computing) will significantly improve its reach. Discussions with various members of life science and health science programs supports this thinking. We believe that enrolment in the newer class will end up being higher, and the course will have a greater impact on its students.

BINF 400.3 Advanced Techniques in Bioinformatics
Rationale: BINF 400 is currently required for Honours program in Bioinformatics students, which is being proposed for deletion. The concentration in Bioinformatics in the Applied Computing program will use the proposed CMPT 407 course instead. Students who remain in the old Bioinformatics program will be allowed to substitute CMPT 407 for BINF 400 to complete their program requirements.

Minor Course Revisions

BINF 200.3 Introduction to Bioinformatics
Prerequisite change:
Old prerequisite: BMSC 200.3 or equivalent
New prerequisite: BIOL 121.3 or BMSC 200.3; and one of CMPT 145.3 or (BINF 151.3 with permission of the department).
New Note: Students with credit for BINF 200.3 may not take this course for credit.
New course number: **BINF 351.3**
New course description: This course introduces core bioinformatic competencies and resources. Topics include algorithms for sequence alignment, genome assembly, phylogenetics, structure prediction, functional genomics, sequence motifs and proteomics. Students will also learn to use major proteomic and genomic databases, to utilize bioinformatics software toolboxes, and to write simple bioinformatics programs in a scripting language.
Rationale: With the deletion of the existing Bioinformatics program, and making the new Applied Computing program with a Concentration in Bioinformatics, we took the opportunity to examine paths into the bioinformatics program and consistency within the computer science department. Overall, the material is more appropriate for a third year course. It also provides more opportunity to discover bioinformatics within the first two years of a four year degree in order to take this course, vs a second year class. The material taught in the class is nearly identical to that of BINF 200. Lastly, this course would be quite useful for graduate students who need to apply bioinformatics in their research, and therefore it is more useful as a third year class versus a second year course.

BINF 300.3 Algorithms in Bioinformatics
Old prerequisite: CMPT 280.3, BINF 200.3, and one of BIOC 300.3, BIOL 226.3, or MCIM 326.3
New prerequisite: CMPT 280.3, and one of BIOL 120.3 or BMSC 200.3
New Note: Students with credit for BINF 300.3 may take this course for credit.
New subject code and course number: **CMPT 451.3**
New course title: Modelling and Algorithms for Biological Systems
New short title: Algorithms in Biology
New course description: This course focusses on mathematical and computational modelling of various real world processes, with the main focus on biological systems. Using discrete models, algorithmic strategies will be explored including exact algorithms, approximation algorithms, heuristic algorithms, and evolutionary algorithms. The algorithms and models used will involve sets, graphs, strings, trees, machines, and grammars. For each algorithmic technique, we will study applications from biological systems and bioinformatics, including biomolecule string matching, sequence alignment, sequence assembly, gene finding, structure prediction, gene expression data analysis, phylogeny, genome rearrangement, and simulations of molecular evolution.
Rationale: As part of the transition from the existing Bioinformatics to the Bioinformatics concentration of Applied Computing, the department proposes to reinvigorate the program. Enrolment in BINF 300 has always been quite limited, usually between 3-5 students. As such, it has been run as a reading course (and taught with teaching overload) for a number of years. Essentially, the prerequisites are such that it is only possible to take the class if a student is in the Bioinformatics degree program. We are attempting to improve this in two ways.
1) We are changing the prerequisite structure to more accurately reflect the material taught in the class. The class teaches bioinformatics problems, builds models for the problems, and then analyzes different algorithmic techniques to solve the problems, paying particular focus to the complexity and accuracy of the algorithms to determine the best options. These can be taught with significantly less biological prerequisites, and in fact, independently from BINF 351 (formerly BINF 200). To reflect this, we are changing the subject code to be CMPT so that it is more likely for computer science students to take the class without fear of their lack of biological background.
2) The course will become cross-listed with a new graduate Computer Science class proposed for creation to CGPS, CMPT 841, open to all Computer Science graduate students. By cross-listing the class, enrolment between the two will naturally be significantly higher combined (as Computer Science has the largest thesis-based graduate program at U of S). This also is another advantage of reducing the undergraduate biological prerequisites, as it becomes more feasible for computer science graduate students to take the course. Lastly, it is standard for each faculty member in Computer Science to teach one graduate course, for which this cross-listed course will count. Therefore, by making this course a fourth year course and making it cross-listed, the undergraduate students can be taught "for free" in terms of the assignment of duties. The course will also be a much better experience for students in this class versus having a reading class, and it significantly solidifies the Bioinformatics concentration.

CMPT 140.3 Introduction to Creative Computing
Change to Note:
Old Note: Recommended for students who do not have Computer Science 30. CMPT 140 can be taken for credit after the completion of CMPT 100, but CMPT 100 cannot be taken for credit after completion of CMPT 140. Students with credit for CMPT 105, CMPT 111, CMPT 113, or CMPT 116 cannot obtain credit for CMPT 140. Students majoring the Interactive Systems Design, Computer Science, and Bioinformatics programs may not use CMPT 140 as a course in their major, but may count it as a junior elective.
New Note: Recommended for students who do not have Computer Science 30. CMPT 140 can be taken for credit after the completion of CMPT 100, but CMPT 100 cannot be taken for credit after completion of CMPT 140. Students with credit for CMPT 105, CMPT 111, CMPT 113, or CMPT 116 cannot obtain credit for CMPT 140. Students majoring the Computer Science and Applied Computing programs may not use CMPT 140 as a course in their major, but may count it as a junior elective. Students may receive credit for only one of CMPT 140 or BINF 151.
New restriction: CMPT 140 will be mutually exclusive with BINF 151.
Rationale: Interactive Systems Design and Bioinformatics are both being removed, and replaced with separate concentrations in Applied Computing, along with other concentrations. CMPT 140 and BINF 151 overlap significantly in content, and should not both be taken for credit.

CMPT 141.3 Introduction to Computer Science
Prerequisite change:
Old prerequisite: One of (Computer Science 30, CMPT 105, CMPT 140) and one of (Mathematics B30, Foundations of Mathematics 30, Pre-Calculus 30); or MATH 110, MATH 123, or MATH 176 (can be taken concurrently).
New prerequisite: One of (Computer Science 30, CMPT 105.3, CMPT 140.3, BINF 151.3) and one of (Mathematics B30, Foundations of Mathematics 30, Pre-Calculus 30); or MATH 110.3, MATH 123.3, MATH 133.4 or MATH 176.3 (can be taken concurrently).
Change to Note:
Old Note: Recommended for students with Computer Science 30, CMPT 140 or CMPT 105, or for students in programs that require MATH 110 (or equivalent). Students with credit for CMPT 115 or CMPT 117 cannot take this course for credit. Students may not take CMPT 100 or 120 for credit concurrently with or after CMPT 141.
New Note: Recommended for students with Computer Science 30, CMPT 140, BINF 151, or CMPT 105, or for students in programs that require MATH 110 (or equivalent). Students with credit for CMPT 115 or CMPT 117 cannot take this course for credit. Students may not take CMPT 100 or 120 for credit concurrently with or after CMPT 141.
Rationale: A new course is being created, BINF 151: Computing in the Biological Sciences. This course will teach the basics of programming, with a focus towards biological applications. This course will be especially appropriate for students interested in the life or health sciences, or agriculture. But it opens up the possibility of taking further computational courses, such as CMPT 141. BINF 151 will absolutely provide sufficient programming to take CMPT 141.

CMPT 381.3 Implementation of Graphical User Interfaces
Prerequisite change:
Old prerequisite: CMPT 270
New prerequisite: CMPT 280.3
Rationale: CMPT 280 has been added to the Interactive System Design Program as part of the Applied Computing proposal. More rigorous knowledge of data structures will be beneficial to students entering CMPT 381.

From: Warrington, Seanine <seanine.warrington@usask.ca>
Sent: Tuesday, March 9, 2021 2:27 PM
To: Isinger, Russ <russell.isinger@usask.ca>; DesBrisay, Gordon <gordon.desbrisay@usask.ca>; Vuong, Lucy <lucy.vuong@usask.ca>
Cc: Doell, Jason <jason.doell@usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>; Zagiel, Eileen <eileen.zagiel@usask.ca>
Subject: Consultation with the Registrar (CWR) Forms - College of Arts and Science proposals for 2022-23

Good afternoon,

I've attached four completed CWR Forms for the following proposals going forward for implementation in the upcoming 2022-23 academic catalogue year:

1. A new field of study in Applied Computing for the B.Sc. 4-Year and Honours programs, including 5 new concentrations, as follows: Bioinformatics; Interactive Systems Design; Data Analytics; Geomatics; Business
2. Termination of the field of study in Bioinformatics (related to the above)
3. Termination of the field of study in Interactive Systems Design (related to the above)
4. Termination of the Minor in Digital Culture and New Media (unrelated to the above)

The proposals here follow standard setup and standard tuition, so an in-person meeting was not felt to be necessary; however, if anyone would like a meeting, I would be happy to book one!

Russ, Gordon, and Lucy, please "reply-all" with your confirmation that the details in the forms are correct. Your confirmation email will replace a signature of approval in the midst of the coronavirus pandemic (COVID-19) disruptions.

Thank you,

Seanine

Seanine Warrington, M.A.
Senior Editor and Coordinator
Catalogue and Academic Programs
Registrarial Services
University of Saskatchewan
Teaching, Learning and Student Experience
Ph: 306-966-1874

From: Vuong, Lucy <lucy.vuong@usask.ca>
Sent: Tuesday, March 9, 2021 2:39 PM
To: Warrington, Seanine <seanine.warrington@usask.ca>; Isinger, Russ <russell.isinger@usask.ca>; DesBrisay, Gordon <gordon.desbrisay@usask.ca>

Cc: Doell, Jason <jason.doell@usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>; Zagiel, Eileen <eileen.zagiel@usask.ca>
Subject: Re: Consultation with the Registrar (CWR) Forms - College of Arts and Science proposals for 2022-23

Approved. Thanks. L

From: Isinger, Russ <russell.isinger@usask.ca>
Sent: Tuesday, March 9, 2021 2:50 PM
To: Vuong, Lucy <lucy.vuong@usask.ca>; Zagiel, Eileen <eileen.zagiel@usask.ca>; Warrington, Seanine <seanine.warrington@usask.ca>; DesBrisay, Gordon <gordon.desbrisay@usask.ca>
Cc: Doell, Jason <jason.doell@usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>
Subject: RE: Consultation with the Registrar (CWR) Forms - College of Arts and Science proposals for 2022-23

Approved.

Russell Isinger, BA, MA
University Registrar
Professional Affiliate, Department of Political Studies, College of Arts and Science
University Registrar's Office
Teaching, Learning and Student Experience
Room E-34, 105 Administration Place
University of Saskatchewan
Saskatoon, Saskatchewan, Canada
S7N 5A2
Office: 306-966-6723
Cell: 306-280-6178
Fax: 306-966-6730

From: DesBrisay, Gordon <gordon.desbrisay@usask.ca>
Sent: Tuesday, March 9, 2021 2:51 PM
To: Warrington, Seanine <seanine.warrington@usask.ca>; Isinger, Russ <russell.isinger@usask.ca>; Vuong, Lucy <lucy.vuong@usask.ca>
Cc: Doell, Jason <jason.doell@usask.ca>; Dahl, Alexis <alexis.dahl@usask.ca>; Zagiel, Eileen <eileen.zagiel@usask.ca>
Subject: Re: Consultation with the Registrar (CWR) Forms - College of Arts and Science proposals for 2022-23

Hi Seanine,

I am happy to approve these forms and the details that sail in them.

Cheers,
Gordon

Gordon DesBrisay, Ph.D.
Associate Professor and Vice-Dean, Academic
College of Arts & Science
University of Saskatchewan
Saskatoon SK
Phone: (306) 966-4315
https://artsandscience.usask.ca/

Consultation with the Registrar Form

This form is to be completed by the Registrar (or his/her designate) during an in-person consultation with the faculty member responsible for the proposal. Please consider the questions on this form prior to the meeting.

Section 1: New Degree / Diploma / Certificate Information or Renaming of Existing

1 Is this a new degree, diploma, or certificate? Yes [ ] No [X]

Is an existing degree, diploma, or certificate being renamed? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new degree, diploma, or certificate?

3 What is the credential of this new degree, diploma, or certificate? [Example - D.M.D. = Doctor of Dental Medicine]

4 If you have renamed an existing degree, diploma, or certificate, what is the current name?

5 Does this new or renamed degree / diploma / certificate require completion of degree level courses or non-degree level courses, thus implying the attainment of either a degree level or non-degree level standard of achievement?

6 If this is a new degree level certificate, can a student take it at the same time as pursuing another degree level program? Yes [ ] No [ ]

7 If YES, a student attribute will be created and used to track students who are in this certificate alongside another program. The attribute code will be:

8 Which College is responsible for the awarding of this degree, diploma, or certificate?

9 Is there more than one program to fulfill the requirements for this degree, diploma, or certificate? If yes, please list these programs.

10 Are there any new majors, minors, or concentrations associated with this new degree / diploma / certificate? Please list the name(s) and whether it is a major, minor, or concentration, along with the sponsoring department.

One major is required on all programs [4 characters for code and 30 characters for description]

11 If this is a new graduate degree, is it thesis-based, course-based, or project-based?

Section 2: New / Revised Program for Existing or New Degree / Diploma / Certificate Information

1 Is this a new program? Yes [ ] No [X]

Is an existing program being revised? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 If YES, what degree, diploma, or certificate does this new/revised program meet requirements for?

3 What is the name of this new/revised program?

4 What other program(s) currently exist that will also meet the requirements for this same degree(s)?

5 What College/Department is the academic authority for this program?

6 Is this a replacement for a current program? Yes [ ] No [ ]

7 If YES, will students in the current program complete that program or be grandfathered?

8 If this is a new graduate program, is it thesis-based, course-based, or project-based?

9 If this is a new non-degree or undergraduate level program, what is the expected completion time?

Section 3: Mobility

Mobility is the ability to move freely from one jurisdiction to another and to gain entry into an academic institution or to participate in a learning experience without undue obstacles or hindrances.

1 Does the proposed degree, program, major, minor, concentration, or course involve mobility? Yes [ ] No [X]

If yes, choose one of the following?

Domestic Mobility (both jurisdictions are within Canada) [ ]

International Mobility (one jurisdiction is outside of Canada) [ ]

2 Please indicate the mobility type (refer to Nomenclature for definitions).

Joint Program [ ]

Joint Degree
Dual Degree
Professional Internship Program
Faculty-Led Course Abroad
Term Abroad Program

3 The U of S enters into partnerships or agreements with external partners for the above mobility types in order to allow students collaborative opportunities for research, studies, or activities. Has an agreement been signed? Yes [ ] No [ ]

4 Please state the full name of the agreement that the U of S is entering into.

5 What is the name of the external partner?

6 What is the jurisdiction for the external partner?

Section 4: New / Revised Major, Minor, or Concentration for Existing Degree Information (Undergraduate)

1 Is this a new or revised major, minor, or concentration attached to an existing degree program? Yes [X] No [ ]

If you've answered NO, please continue on to the next section.

2 If YES, please specify whether it is a major, minor, or concentration. If it is more than one, please fill out a separate form for each.

Major - Applied Computing (ACPG) - suggested new Banner code
- Concentration - Bioinformatics (BINF)
- Concentration - Interactive Systems Design (ISDE)
- Concentration - Data Analytics (DTAN) - suggested new Banner code
- Concentration - Geomatics (GEOM)
- Concentration - Business (BUES)
- Concentration - Professional Internship Option (BPIO)

3 What is the name of this new / revised major, minor, or concentration?

See above

4 Which department is the authority for this major, minor, or concentration? If this is a cross-College relationship, please state the Jurisdictional College and the Adopting College.

Computer Science (CMPT)

5 Which current program(s), degree(s), and/or program type(s) is this new / revised major, minor, or concentration attached to?

Bachelor of Science (4 Yr) (BSC4Y) and Bachelor of Science (Honours) (BSCHON)

Section 5: New / Revised Disciplinary Area for Existing Degree Information (Graduate)

1 Is this a new or revised disciplinary area attached to an existing graduate degree program? Yes [ ] No [X]

If you've answered NO, please continue on to the next section.

2 If YES, what is the name of this new / revised disciplinary area?

3 Which Department / School is the authority for this new / revised disciplinary area? (NOTE - if this disciplinary area is being offered by multiple departments see question below.)

4 Which **multiple** Departments / Schools are the authority for this new / revised disciplinary area?

4a Of the **multiple** Departments / Schools who are the authority for this new / revised disciplinary area and what allocation percentage is assigned to each? (Note - must be whole numbers and must equal 100.)

4b Of the **multiple** Departments / Schools who is the primary department? The primary department specifies which department / school policies will be followed in academic matters (ex. late adds, re-read policies, or academic misconduct). If no department / school is considered the primary, please indicate that. (In normal circumstances, a department / school with a greater percentage of responsibility - see question above - will be designated the primary department.)

5 Which current program(s) and / or degree(s) is this new / revised disciplinary area attached to?

Section 6: New College / School / Center / Department or Renaming of Existing

1 Is this a new college, school, center, or department? Yes [ ] No [X]

Is an existing college, school, center, or department being renamed? Yes [ ] No [X]

Is an existing college, school, center, or department being deleted? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new (or renamed or deleted) college, school, center, or department?

3 If you have renamed an existing college, school, center, or department, what is the current name?

4 What is the effective term of this new (renamed or deleted) college, school, center, or department?

5 Will any programs be created, changed, or moved to a new authority, removed, relabelled?

6 Will any courses be created, changed, or moved to a new authority, removed, relabelled?

7 Are there any ceremonial consequences for Convocation (ie. New degree hood, adjustment to parchments, etc.)?

Section 7: Course Information

1 Is there a new subject area(s) of course offering proposed for this new degree? If so, what is the subject area(s) and the suggested four (4) character abbreviation(s) to be used in course listings?

No

2 If there is a new subject area(s) of offerings what College / Department is the academic authority for this new subject area?

N/A

3 Have the subject area identifier and course number(s) for new and revised courses been cleared by the Registrar?

N/A

4 Does the program timetable use standard class time slots, terms, and sessions? Yes [X] No [ ]

If NO, please describe.

5 Does this program, due to pedagogical reasons, require any special space or type or rooms? Yes [X] No [ ]

If YES, please describe.

Some courses will be scheduled in department lab space.

NOTE: Please remember to submit a new "Course Creation Form" for every new course required for this new program / major. Attached completed "Course Creation Forms" to this document would be helpful.

Section 8: Admissions, Recruitment, and Quota Information - AS PER CURRENT SET-UP

1 Will students apply on-line? If not, how will they apply?

2 What term(s) can students be admitted to?

3 What is the application deadline for each term(s) students can be admitted to?

4 For undergraduate programs, will students be admitted to one of the approved majors or an undeclared major?

5 For undergraduate programs, if there's more than one degree proposed (ex. 3Y and 4Y), which program/degree will students be admitted to?

6 Does this impact enrollment?

7 How should Marketing and Student Recruitment handle initial inquiries about this proposal before official approval?

8 Can classes towards this program be taken at the same time as another program?

9 What is the application deadline?

10 What are the admission qualifications? (IE. High school transcript required, grade 12 standing, minimum average, any required courses, etc.)

11 What is the selection criteria? (IE. If only average then 100% weighting; if other factors such as interview, essay, etc. what is the weighting of each of these in the admission decision.)

12 What are the admission categories and admit types? (IE. High school students and transfer students or one group? Special admission? Aboriginal equity program?)

13 What is the application process? (IE. Online application and supplemental information (required checklist items) through the Admissions Office or sent to the College/Department?)

14 Who makes the admission decision? (IE. Admissions Office or College/Department/Other?)

15 Letter of acceptance - are there any special requirements for communication to newly admitted students?

16 Will the standard application fee apply?

17 Will all applicants be charged the fee or will current, active students be exempt?

18 Are international students admissible to this program? Yes [ ] No [ ]

If YES, what is the tuition amount for the first 12 months for a full-time international student? This information is required for the Immigration, Refugees and Citizenship Canada [IRCC] form (this form is for students who need to get a visa to study here).

Section 9: Government Loan Information - AS PER CURRENT SET-UP

NOTE: Federal / provincial government loan programs require students to be full-time in order to be eligible for funding. The University of Saskatchewan defines full-time as enrollment in a minimum of 9 credit units (operational) in the fall and/or winter term(s) depending on the length of the loan.

1 If this is a change to an existing program, will the program change have any impact on student loan eligibility?

2 If this is a new program, do you intend that students be eligible for student loans?

Section 10: Convocation Information (only for new degrees) - NOT APPLICABLE

1 Are there any 'ceremonial consequences' of this proposal (ie. New degree hood, special convocation, etc.)?

2 If YES, has the Office of the University Secretary been notified?

3 When is the first class expected to graduate?

4 What is the maximum number of students you anticipate/project will graduate per year (please consider the next 5-10 years)?

Section 11: Schedule of Implementation Information

1 What is the start term?

202205 (May 2022)

2 Are students required to do anything prior to the above date (in addition to applying for admission)? Yes [ ] No [X]

If YES, what and by what date?

Section 12: Registration Information - AS PER CURRENT SET-UP

1 What year in program is appropriate for this program (NA or a numeric year)?
(General rule = NA for programs and categories of students not working toward a degree level qualification; undergraduate degree level certificates will use numeric year.)

2 Will students register themselves? Yes ☐ No ☐

If YES, what priority group should they be in?

Section 13: Academic History Information - AS PER CURRENT SET-UP

1 Will instructors submit grades through self-serve? Yes ☐ No ☐

2 Who will approve grades (Department Head, Assistant Dean, etc.)?

Section 14: T2202 Information (tax form) - AS PER CURRENT SET-UP

1 Should classes count towards T2202s? Yes ☐ No ☐

Section 15: Awards Information

1 Will terms of reference for existing awards need to be amended? Yes ☐ No ☒

2 If this is a new undergraduate program, will students in this program be eligible for College-specific awards?

Section 16: Government of Saskatchewan Graduate Retention (Tax) Program - AS PER CURRENT SET-UP

1 Will this program qualify for the Government of Saskatchewan graduate retention (tax) program? Yes ☐ No ☐

To qualify the program must meet the following requirements:

- be equivalent to at least 6 months of full-time study, and
- result in a certificate, diploma, or undergraduate degree.

Section 17: Program Termination

1 Is this a program termination? Yes [ ] No [X]

If yes, what is the name of the program?

[ ]

2 What is the effective date of this termination?

[ ]

3 Will there be any courses closed as a result of this termination? Yes [ ] No [ ]

If yes, what courses?

[ ]

4 Are there currently any students enrolled in the program? Yes [ ] No [ ]

If yes, will they be able to complete the program?

[ ]

5 If not, what alternate arrangements are being made for these students?

[ ]

6 When do you expect the last student to complete this program?

[ ]

7 Is there mobility associated with this program termination? Yes [ ] No [ ]

If yes, please select one of the following mobility activity types.

- Dual Degree Program [ ]
- Joint Degree Program [ ]
- Internship Abroad Program [ ]
- Term Abroad Program [ ]
- Taught Abroad Course [ ]
- Student Exchange Program [ ]

Partnership agreements, coordinated by the International Office, are signed for these types of mobility activities. Has the International Office been informed of this program termination? Yes [ ] No [ ]

Section 18: Proposed Tuition and Student Fees Information - AS PER CURRENT SET-UP

1 How will tuition be assessed?

- Standard Undergraduate per credit [ ]
- Standard Graduate per credit [ ]
- Standard Graduate per term [ ]
- Non standard per credit* [ ]

Non standard per term* ☐
Other * ☐
Program Based* ☐

* See attached documents for further details

2 If fees are per credit, do they conform to existing categories for per credit tuition? If YES, what category or rate?

3 If program based tuition, how will it be assessed? By credit unit? By term? Elsehow?

4 Does proponent's proposal contain detailed information regarding requested tuition? Yes ☐ No ☐

If NO, please describe.

5 What is IPA's recommendation regarding tuition assessment? When is it expected to receive approval?

6 IPA Additional comments?

7 Will students outside the program be allowed to take the classes?

8 If YES, what should they be assessed? (This is especially important for program based.)

9 Do standard student fee assessment criteria apply (full-time, part-time, on-campus versus off-campus)?

10 Do standard cancellation fee rules apply?

11 Are there any additional fees (e.g. materials, excursion)? If yes, see NOTE below.

12 Are you moving from one tuition code (TC) to another tuition code? Yes ☐ No ☐

If YES, from which tuition code to which tuition code?

13 Are international students admissible to the program? If yes, will they pay the international tuition differential?

NOTE: Please remember to submit a completed "Application for New Fee or Fee Change Form" for every new course with additional fees.

Section 19: TLSE - Information Dissemination (internal for TLSE use only)

1	Has TLSE, Marketing and Student Recruitment, been informed about this new / revised program?	Yes		No	
2	Has TLSE, Admissions, been informed about this new / revised program?	Yes		No	
3	Has TLSE, Student Finance and Awards, been informed about this new / revised program?	Yes		No	
4	Has CGPS been informed about this new / revised program?	Yes		No	
5	Has TLSE, Transfer Credit, been informed about any new / revised courses?	Yes		No	
6	Has ICT-Data Services been informed about this new or revised degree / program / major / minor / concentration?	Yes		No	
7	Has the Library been informed about this new / revised program?	Yes		No	
8	Has ISA been informed of the CIP code for new degree / program / major?	Yes		No	
9	Has Room Scheduling/Scheduling Hub/Senior Coordinator of Scheduling been informed of unique space requirements for the new courses and/or informed of program, course, college, and department changes?	Yes		No	
10	Has the Convocation Coordinator been notified of a new degree?	Yes		No	

11 What is the highest level of financial approval required for this submission? Check all that apply.

a. None - as it has no financial implications ☐

OR

b. Fee Review Committee ☐

c. Institutional Planning and Assessment (IPA) ☐

d. Provost's Committee on Integrated Planning (PCIP) ☐

e. Board of Governors ☐

f. Other ☐

SIGNED

Date:

Registrar (Russell Isinger):

College Representative(s):

IPA Representative(s):

Consultation with the Registrar Form

This form is to be completed by the Registrar (or his/her designate) during an in-person consultation with the faculty member responsible for the proposal. Please consider the questions on this form prior to the meeting.

Section 1: New Degree / Diploma / Certificate Information or Renaming of Existing

1 Is this a new degree, diploma, or certificate? Yes [ ] No [X]

Is an existing degree, diploma, or certificate being renamed? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new degree, diploma, or certificate?

3 What is the credential of this new degree, diploma, or certificate? [Example - D.M.D. = Doctor of Dental Medicine]

4 If you have renamed an existing degree, diploma, or certificate, what is the current name?

5 Does this new or renamed degree / diploma / certificate require completion of degree level courses or non-degree level courses, thus implying the attainment of either a degree level or non-degree level standard of achievement?

6 If this is a new degree level certificate, can a student take it at the same time as pursuing another degree level program? Yes [ ] No [ ]

7 If YES, a student attribute will be created and used to track students who are in this certificate alongside another program. The attribute code will be:

8 Which College is responsible for the awarding of this degree, diploma, or certificate?

9 Is there more than one program to fulfill the requirements for this degree, diploma, or certificate? If yes, please list these programs.

10 Are there any new majors, minors, or concentrations associated with this new degree / diploma / certificate? Please list the name(s) and whether it is a major, minor, or concentration, along with the sponsoring department.

One major is required on all programs [4 characters for code and 30 characters for description]

11 If this is a new graduate degree, is it thesis-based, course-based, or project-based?

Section 2: New / Revised Program for Existing or New Degree / Diploma / Certificate Information

1 Is this a new program? Yes [ ] No [X]

Is an existing program being revised? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 If YES, what degree, diploma, or certificate does this new/revised program meet requirements for?

3 What is the name of this new/revised program?

4 What other program(s) currently exist that will also meet the requirements for this same degree(s)?

5 What College/Department is the academic authority for this program?

6 Is this a replacement for a current program? Yes [ ] No [ ]

7 If YES, will students in the current program complete that program or be grandfathered?

8 If this is a new graduate program, is it thesis-based, course-based, or project-based?

9 If this is a new non-degree or undergraduate level program, what is the expected completion time?

Section 3: Mobility

Mobility is the ability to move freely from one jurisdiction to another and to gain entry into an academic institution or to participate in a learning experience without undue obstacles or hindrances.

1 Does the proposed degree, program, major, minor, concentration, or course involve mobility? Yes [ ] No [X]

If yes, choose one of the following?

Domestic Mobility (both jurisdictions are within Canada) [ ]

International Mobility (one jurisdiction is outside of Canada) [ ]

2 Please indicate the mobility type (refer to Nomenclature for definitions).

Joint Program [ ]

Joint Degree
Dual Degree
Professional Internship Program
Faculty-Led Course Abroad
Term Abroad Program

3 The U of S enters into partnerships or agreements with external partners for the above mobility types in order to allow students collaborative opportunities for research, studies, or activities. Has an agreement been signed? Yes [ ] No [ ]

4 Please state the full name of the agreement that the U of S is entering into.

5 What is the name of the external partner?

6 What is the jurisdiction for the external partner?

Section 4: New / Revised Major, Minor, or Concentration for Existing Degree Information (Undergraduate)

1 Is this a new or revised major, minor, or concentration attached to an existing degree program? Yes [ ] No [X]

If you've answered NO, please continue on to the next section.

2 If YES, please specify whether it is a major, minor, or concentration. If it is more than one, please fill out a separate form for each.

3 What is the name of this new / revised major, minor, or concentration?

4 Which department is the authority for this major, minor, or concentration? If this is a cross-College relationship, please state the Jurisdictional College and the Adopting College.

5 Which current program(s), degree(s), and/or program type(s) is this new / revised major, minor, or concentration attached to?

Section 5: New / Revised Disciplinary Area for Existing Degree Information (Graduate)

1 Is this a new or revised disciplinary area attached to an existing graduate degree program? Yes [ ] No [X]

If you've answered NO, please continue on to the next section.

2 If YES, what is the name of this new / revised disciplinary area?

3 Which Department / School is the authority for this new / revised disciplinary area? (NOTE - if this disciplinary area is being offered by multiple departments see question below.)

4 Which **multiple** Departments / Schools are the authority for this new / revised disciplinary area?

4a Of the **multiple** Departments / Schools who are the authority for this new / revised disciplinary area and what allocation percentage is assigned to each? (Note - must be whole numbers and must equal 100.)

4b Of the **multiple** Departments / Schools who is the primary department? The primary department specifies which department / school policies will be followed in academic matters (ex. late adds, re-read policies, or academic misconduct). If no department / school is considered the primary, please indicate that. (In normal circumstances, a department / school with a greater percentage of responsibility - see question above - will be designated the primary department.)

5 Which current program(s) and / or degree(s) is this new / revised disciplinary area attached to?

Section 6: New College / School / Center / Department or Renaming of Existing

1 Is this a new college, school, center, or department? Yes [ ] No [X]

Is an existing college, school, center, or department being renamed? Yes [ ] No [X]

Is an existing college, school, center, or department being deleted? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new (or renamed or deleted) college, school, center, or department?

3 If you have renamed an existing college, school, center, or department, what is the current name?

4 What is the effective term of this new (renamed or deleted) college, school, center, or department?

5 Will any programs be created, changed, or moved to a new authority, removed, relabelled?

6 Will any courses be created, changed, or moved to a new authority, removed, relabelled?

7 Are there any ceremonial consequences for Convocation (ie. New degree hood, adjustment to parchments, etc.)?

Section 7: Course Information - NOT APPLICABLE

1 Is there a new subject area(s) of course offering proposed for this new degree? If so, what is the subject area(s) and the suggested four (4) character abbreviation(s) to be used in course listings?

2 If there is a new subject area(s) of offerings what College / Department is the academic authority for this new subject area?

3 Have the subject area identifier and course number(s) for new and revised courses been cleared by the Registrar?

4 Does the program timetable use standard class time slots, terms, and sessions? Yes ☐ No ☐

If NO, please describe.

5 Does this program, due to pedagogical reasons, require any special space or type or rooms? Yes ☐ No ☐

If YES, please describe.

NOTE: Please remember to submit a new "Course Creation Form" for every new course required for this new program / major. Attached completed "Course Creation Forms" to this document would be helpful.

Section 8: Admissions, Recruitment, and Quota Information - NOT APPLICABLE

1 Will students apply on-line? If not, how will they apply?

2 What term(s) can students be admitted to?

3 What is the application deadline for each term(s) students can be admitted to?

4 For undergraduate programs, will students be admitted to one of the approved majors or an undeclared major?

5 For undergraduate programs, if there's more than one degree proposed (ex. 3Y and 4Y), which program/degree will students be admitted to?

6 Does this impact enrollment?

7 How should Marketing and Student Recruitment handle initial inquiries about this proposal before official approval?

8 Can classes towards this program be taken at the same time as another program?

9 What is the application deadline?

10 What are the admission qualifications? (IE. High school transcript required, grade 12 standing, minimum average, any required courses, etc.)

11 What is the selection criteria? (IE. If only average then 100% weighting; if other factors such as interview, essay, etc. what is the weighting of each of these in the admission decision.)

12 What are the admission categories and admit types? (IE. High school students and transfer students or one group? Special admission? Aboriginal equity program?)

13 What is the application process? (IE. Online application and supplemental information (required checklist items) through the Admissions Office or sent to the College/Department?)

14 Who makes the admission decision? (IE. Admissions Office or College/Department/Other?)

15 Letter of acceptance - are there any special requirements for communication to newly admitted students?

16 Will the standard application fee apply?

17 Will all applicants be charged the fee or will current, active students be exempt?

18 Are international students admissible to this program? Yes ☐ No ☐

If YES, what is the tuition amount for the first 12 months for a full-time international student? This information is required for the Immigration, Refugees and Citizenship Canada [IRCC] form (this form is for students who need to get a visa to study here).

Section 9: Government Loan Information - NOT APPLICABLE

NOTE: Federal / provincial government loan programs require students to be full-time in order to be eligible for funding. The University of Saskatchewan defines full-time as enrollment in a minimum of 9 credit units (operational) in the fall and/or winter term(s) depending on the length of the loan.

1 If this is a change to an existing program, will the program change have any impact on student loan eligibility?

2 If this is a new program, do you intend that students be eligible for student loans?

Section 10: Convocation Information (only for new degrees) - NOT APPLICABLE

1 Are there any 'ceremonial consequences' of this proposal (ie. New degree hood, special convocation, etc.)?

2 If YES, has the Office of the University Secretary been notified?

3 When is the first class expected to graduate?

4 What is the maximum number of students you anticipate/project will graduate per year (please consider the next 5-10 years)?

Section 11: Schedule of Implementation Information - NOT APPLICABLE

1 What is the start term?

2 Are students required to do anything prior to the above date (in addition to applying for admission)? Yes ☐ No ☐

If YES, what and by what date?

Section 12: Registration Information - NOT APPLICABLE

1 What year in program is appropriate for this program (NA or a numeric year)?
(General rule = NA for programs and categories of students not working toward a degree level qualification; undergraduate degree level certificates will use numeric year.)

2 Will students register themselves? Yes ☐ No ☐

If YES, what priority group should they be in?

Section 13: Academic History Information - NOT APPLICABLE

1 Will instructors submit grades through self-serve? Yes ☐ No ☐

2 Who will approve grades (Department Head, Assistant Dean, etc.)?

Section 14: T2202 Information (tax form) - NOT APPLICABLE

1 Should classes count towards T2202s? Yes ☐ No ☐

Section 15: Awards Information - NOT APPLICABLE

1 Will terms of reference for existing awards need to be amended? Yes ☐ No ☐

2 If this is a new undergraduate program, will students in this program be eligible for College-specific awards?

Section 16: Government of Saskatchewan Graduate Retention (Tax) Program - NOT APPLICABLE

1 Will this program qualify for the Government of Saskatchewan graduate retention (tax) program? Yes ☐ No ☐

To qualify the program must meet the following requirements:

- be equivalent to at least 6 months of full-time study, and
- result in a certificate, diploma, or undergraduate degree.

Section 17: Program Termination

1 Is this a program termination? Yes ☒ No ☐

If yes, what is the name of the program?

Bioinformatics (BINF) major and Professional Internship Option (BPIO) concentration
These are available on the BSC4Y and BSCHON programs

2 What is the effective date of this termination?

202209 (September 2022)

3 Will there be any courses closed as a result of this termination? Yes [X] No [ ]

If yes, what courses?

BINF 210.3
BINF 400.3

4 Are there currently any students enrolled in the program? Yes [X] No [ ]

A search in Degree Works for active students in the Bioinformatics major returns 15 students

If yes, will they be able to complete the program?

Students enrolled at the time of the deletion will be allowed to complete to the 10 year time limit

5 If not, what alternate arrangements are being made for these students?

6 When do you expect the last student to complete this program?

All students must complete by 2030-2031 at the latest

7 Is there mobility associated with this program termination? Yes [ ] No [X]

If yes, please select one of the following mobility activity types.

- Dual Degree Program [ ]
- Joint Degree Program [ ]
- Internship Abroad Program [ ]
- Term Abroad Program [ ]
- Taught Abroad Course [ ]
- Student Exchange Program [ ]

Partnership agreements, coordinated by the International Office, are signed for these types of mobility activities. Has the International Office been informed of this program termination? Yes [ ] No [ ]

Section 18: Proposed Tuition and Student Fees Information - NOT APPLICABLE

1 How will tuition be assessed?

- Standard Undergraduate per credit [ ]
- Standard Graduate per credit [ ]
- Standard Graduate per term [ ]
- Non standard per credit* [ ]
- Non standard per term* [ ]

Other * ☐

Program Based* ☐

* See attached documents for further details

2 If fees are per credit, do they conform to existing categories for per credit tuition? If YES, what category or rate?

3 If program based tuition, how will it be assessed? By credit unit? By term? Elsehow?

4 Does proponent's proposal contain detailed information regarding requested tuition? Yes ☐ No ☐

If NO, please describe.

5 What is IPA's recommendation regarding tuition assessment? When is it expected to receive approval?

6 IPA Additional comments?

7 Will students outside the program be allowed to take the classes?

8 If YES, what should they be assessed? (This is especially important for program based.)

9 Do standard student fee assessment criteria apply (full-time, part-time, on-campus versus off-campus)?

10 Do standard cancellation fee rules apply?

11 Are there any additional fees (e.g. materials, excursion)? If yes, see NOTE below.

12 Are you moving from one tuition code (TC) to another tuition code? Yes ☐ No ☐

If YES, from which tuition code to which tuition code?

13 Are international students admissible to the program? If yes, will they pay the international tuition differential?

NOTE: Please remember to submit a completed "Application for New Fee or Fee Change Form" for every new course with additional fees.

Section 19: TLSE - Information Dissemination (internal for TLSE use only)

1 Has TLSE, Marketing and Student Recruitment, been informed about this new / revised program? Yes ☐ No ☐

2	Has TLSE, Admissions, been informed about this new / revised program?	Yes		No	
3	Has TLSE, Student Finance and Awards, been informed about this new / revised program?	Yes		No	
4	Has CGPS been informed about this new / revised program?	Yes		No	
5	Has TLSE, Transfer Credit, been informed about any new / revised courses?	Yes		No	
6	Has ICT-Data Services been informed about this new or revised degree / program / major / minor / concentration?	Yes		No	
7	Has the Library been informed about this new / revised program?	Yes		No	
8	Has ISA been informed of the CIP code for new degree / program / major?	Yes		No	
9	Has Room Scheduling/Scheduling Hub/Senior Coordinator of Scheduling been informed of unique space requirements for the new courses and/or informed of program, course, college, and department changes?	Yes		No	
10	Has the Convocation Coordinator been notified of a new degree?	Yes		No	

11 What is the highest level of financial approval required for this submission? Check all that apply.

a. None - as it has no financial implications ☐

OR

b. Fee Review Committee ☐

c. Institutional Planning and Assessment (IPA) ☐

d. Provost's Committee on Integrated Planning (PCIP) ☐

e. Board of Governors ☐

f. Other ☐

SIGNED

Date:

Registrar (Russell Isinger):

College Representative(s):

IPA Representative(s):

Consultation with the Registrar Form

This form is to be completed by the Registrar (or his/her designate) during an in-person consultation with the faculty member responsible for the proposal. Please consider the questions on this form prior to the meeting.

Section 1: New Degree / Diploma / Certificate Information or Renaming of Existing

1 Is this a new degree, diploma, or certificate? Yes [ ] No [X]

Is an existing degree, diploma, or certificate being renamed? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new degree, diploma, or certificate?

3 What is the credential of this new degree, diploma, or certificate? [Example - D.M.D. = Doctor of Dental Medicine]

4 If you have renamed an existing degree, diploma, or certificate, what is the current name?

5 Does this new or renamed degree / diploma / certificate require completion of degree level courses or non-degree level courses, thus implying the attainment of either a degree level or non-degree level standard of achievement?

6 If this is a new degree level certificate, can a student take it at the same time as pursuing another degree level program? Yes [ ] No [ ]

7 If YES, a student attribute will be created and used to track students who are in this certificate alongside another program. The attribute code will be:

8 Which College is responsible for the awarding of this degree, diploma, or certificate?

9 Is there more than one program to fulfill the requirements for this degree, diploma, or certificate? If yes, please list these programs.

10 Are there any new majors, minors, or concentrations associated with this new degree / diploma / certificate? Please list the name(s) and whether it is a major, minor, or concentration, along with the sponsoring department.

One major is required on all programs [4 characters for code and 30 characters for description]

11 If this is a new graduate degree, is it thesis-based, course-based, or project-based?

Section 2: New / Revised Program for Existing or New Degree / Diploma / Certificate Information

1 Is this a new program? Yes [ ] No [X]

Is an existing program being revised? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 If YES, what degree, diploma, or certificate does this new/revised program meet requirements for?

3 What is the name of this new/revised program?

4 What other program(s) currently exist that will also meet the requirements for this same degree(s)?

5 What College/Department is the academic authority for this program?

6 Is this a replacement for a current program? Yes [ ] No [ ]

7 If YES, will students in the current program complete that program or be grandfathered?

8 If this is a new graduate program, is it thesis-based, course-based, or project-based?

9 If this is a new non-degree or undergraduate level program, what is the expected completion time?

Section 3: Mobility

Mobility is the ability to move freely from one jurisdiction to another and to gain entry into an academic institution or to participate in a learning experience without undue obstacles or hindrances.

1 Does the proposed degree, program, major, minor, concentration, or course involve mobility? Yes [ ] No [X]

If yes, choose one of the following?

Domestic Mobility (both jurisdictions are within Canada) [ ]

International Mobility (one jurisdiction is outside of Canada) [ ]

2 Please indicate the mobility type (refer to Nomenclature for definitions).

Joint Program [ ]

Joint Degree
Dual Degree
Professional Internship Program
Faculty-Led Course Abroad
Term Abroad Program

3 The U of S enters into partnerships or agreements with external partners for the above mobility types in order to allow students collaborative opportunities for research, studies, or activities. Has an agreement been signed? Yes [ ] No [ ]

4 Please state the full name of the agreement that the U of S is entering into.

5 What is the name of the external partner?

6 What is the jurisdiction for the external partner?

Section 4: New / Revised Major, Minor, or Concentration for Existing Degree Information (Undergraduate)

1 Is this a new or revised major, minor, or concentration attached to an existing degree program? Yes [ ] No [X]

If you've answered NO, please continue on to the next section.

2 If YES, please specify whether it is a major, minor, or concentration. If it is more than one, please fill out a separate form for each.

3 What is the name of this new / revised major, minor, or concentration?

4 Which department is the authority for this major, minor, or concentration? If this is a cross-College relationship, please state the Jurisdictional College and the Adopting College.

5 Which current program(s), degree(s), and/or program type(s) is this new / revised major, minor, or concentration attached to?

Section 5: New / Revised Disciplinary Area for Existing Degree Information (Graduate)

1 Is this a new or revised disciplinary area attached to an existing graduate degree program? Yes [ ] No [X]

If you've answered NO, please continue on to the next section.

2 If YES, what is the name of this new / revised disciplinary area?

3 Which Department / School is the authority for this new / revised disciplinary area? (NOTE - if this disciplinary area is being offered by multiple departments see question below.)

4 Which **multiple** Departments / Schools are the authority for this new / revised disciplinary area?

4a Of the **multiple** Departments / Schools who are the authority for this new / revised disciplinary area and what allocation percentage is assigned to each? (Note - must be whole numbers and must equal 100.)

4b Of the **multiple** Departments / Schools who is the primary department? The primary department specifies which department / school policies will be followed in academic matters (ex. late adds, re-read policies, or academic misconduct). If no department / school is considered the primary, please indicate that. (In normal circumstances, a department / school with a greater percentage of responsibility - see question above - will be designated the primary department.)

5 Which current program(s) and / or degree(s) is this new / revised disciplinary area attached to?

Section 6: New College / School / Center / Department or Renaming of Existing

1 Is this a new college, school, center, or department? Yes [ ] No [X]

Is an existing college, school, center, or department being renamed? Yes [ ] No [X]

Is an existing college, school, center, or department being deleted? Yes [ ] No [X]

If you've answered NO to each of the previous two questions, please continue on to the next section.

2 What is the name of the new (or renamed or deleted) college, school, center, or department?

3 If you have renamed an existing college, school, center, or department, what is the current name?

4 What is the effective term of this new (renamed or deleted) college, school, center, or department?

5 Will any programs be created, changed, or moved to a new authority, removed, relabelled?

6 Will any courses be created, changed, or moved to a new authority, removed, relabelled?

7 Are there any ceremonial consequences for Convocation (ie. New degree hood, adjustment to parchments, etc.)?

Section 7: Course Information - NOT APPLICABLE

1 Is there a new subject area(s) of course offering proposed for this new degree? If so, what is the subject area(s) and the suggested four (4) character abbreviation(s) to be used in course listings?

2 If there is a new subject area(s) of offerings what College / Department is the academic authority for this new subject area?

3 Have the subject area identifier and course number(s) for new and revised courses been cleared by the Registrar?

4 Does the program timetable use standard class time slots, terms, and sessions? Yes ☐ No ☐

If NO, please describe.

5 Does this program, due to pedagogical reasons, require any special space or type or rooms? Yes ☐ No ☐

If YES, please describe.

NOTE: Please remember to submit a new "Course Creation Form" for every new course required for this new program / major. Attached completed "Course Creation Forms" to this document would be helpful.

Section 8: Admissions, Recruitment, and Quota Information - NOT APPLICABLE

1 Will students apply on-line? If not, how will they apply?

2 What term(s) can students be admitted to?

3 What is the application deadline for each term(s) students can be admitted to?

4 For undergraduate programs, will students be admitted to one of the approved majors or an undeclared major?

5 For undergraduate programs, if there's more than one degree proposed (ex. 3Y and 4Y), which program/degree will students be admitted to?

6 Does this impact enrollment?

7 How should Marketing and Student Recruitment handle initial inquiries about this proposal before official approval?

8 Can classes towards this program be taken at the same time as another program?

9 What is the application deadline?

10 What are the admission qualifications? (IE. High school transcript required, grade 12 standing, minimum average, any required courses, etc.)

11 What is the selection criteria? (IE. If only average then 100% weighting; if other factors such as interview, essay, etc. what is the weighting of each of these in the admission decision.)

12 What are the admission categories and admit types? (IE. High school students and transfer students or one group? Special admission? Aboriginal equity program?)

13 What is the application process? (IE. Online application and supplemental information (required checklist items) through the Admissions Office or sent to the College/Department?)

14 Who makes the admission decision? (IE. Admissions Office or College/Department/Other?)

15 Letter of acceptance - are there any special requirements for communication to newly admitted students?

16 Will the standard application fee apply?

17 Will all applicants be charged the fee or will current, active students be exempt?

18 Are international students admissible to this program? Yes ☐ No ☐

If YES, what is the tuition amount for the first 12 months for a full-time international student? This information is required for the Immigration, Refugees and Citizenship Canada [IRCC] form (this form is for students who need to get a visa to study here).

Section 9: Government Loan Information - NOT APPLICABLE

NOTE: Federal / provincial government loan programs require students to be full-time in order to be eligible for funding. The University of Saskatchewan defines full-time as enrollment in a minimum of 9 credit units (operational) in the fall and/or winter term(s) depending on the length of the loan.

1 If this is a change to an existing program, will the program change have any impact on student loan eligibility?

2 If this is a new program, do you intend that students be eligible for student loans?

Section 10: Convocation Information (only for new degrees) - NOT APPLICABLE

1 Are there any 'ceremonial consequences' of this proposal (ie. New degree hood, special convocation, etc.)?

2 If YES, has the Office of the University Secretary been notified?

3 When is the first class expected to graduate?

4 What is the maximum number of students you anticipate/project will graduate per year (please consider the next 5-10 years)?

Section 11: Schedule of Implementation Information - NOT APPLICABLE

1 What is the start term?

2 Are students required to do anything prior to the above date (in addition to applying for admission)? Yes ☐ No ☐

If YES, what and by what date?

Section 12: Registration Information - NOT APPLICABLE

1 What year in program is appropriate for this program (NA or a numeric year)?
(General rule = NA for programs and categories of students not working toward a degree level qualification; undergraduate degree level certificates will use numeric year.)

2 Will students register themselves? Yes ☐ No ☐

If YES, what priority group should they be in?

Section 13: Academic History Information - NOT APPLICABLE

1 Will instructors submit grades through self-serve? Yes ☐ No ☐

2 Who will approve grades (Department Head, Assistant Dean, etc.)?

Section 14: T2202 Information (tax form) - NOT APPLICABLE

1 Should classes count towards T2202s? Yes ☐ No ☐

Section 15: Awards Information - NOT APPLICABLE

1 Will terms of reference for existing awards need to be amended? Yes ☐ No ☐

2 If this is a new undergraduate program, will students in this program be eligible for College-specific awards?

Section 16: Government of Saskatchewan Graduate Retention (Tax) Program - NOT APPLICABLE

1 Will this program qualify for the Government of Saskatchewan graduate retention (tax) program? Yes ☐ No ☐

To qualify the program must meet the following requirements:

- be equivalent to at least 6 months of full-time study, and
- result in a certificate, diploma, or undergraduate degree.

Section 17: Program Termination

1 Is this a program termination? Yes ☒ No ☐

If yes, what is the name of the program?

Interactive Systems Design (ISDE) Major
This is available in the BASC4Y program only

2 What is the effective date of this termination?

202209 (September 2022)

3 Will there be any courses closed as a result of this termination? Yes [ ] No [X]

If yes, what courses?

4 Are there currently any students enrolled in the program? Yes [X] No [ ]

A search in Degree Works for active students in the Interactive Systems Design major returns 80 students

If yes, will they be able to complete the program?

Students enrolled at the time of the deletion will be allowed to complete to the 10 year time limit

5 If not, what alternate arrangements are being made for these students?

6 When do you expect the last student to complete this program?

All students must complete by 2030-2031 at the latest

7 Is there mobility associated with this program termination? Yes [ ] No [X]

If yes, please select one of the following mobility activity types.

- Dual Degree Program [ ]
- Joint Degree Program [ ]
- Internship Abroad Program [ ]
- Term Abroad Program [ ]
- Taught Abroad Course [ ]
- Student Exchange Program [ ]

Partnership agreements, coordinated by the International Office, are signed for these types of mobility activities. Has the International Office been informed of this program termination? Yes [ ] No [ ]

Section 18: Proposed Tuition and Student Fees Information - NOT APPLICABLE

1 How will tuition be assessed?

- Standard Undergraduate per credit [ ]
- Standard Graduate per credit [ ]
- Standard Graduate per term [ ]
- Non standard per credit* [ ]
- Non standard per term* [ ]

Other *

Program Based*

* See attached documents for further details

2 If fees are per credit, do they conform to existing categories for per credit tuition? If YES, what category or rate?

3 If program based tuition, how will it be assessed? By credit unit? By term? Elsehow?

4 Does proponent's proposal contain detailed information regarding requested tuition? Yes No

If NO, please describe.

5 What is IPA's recommendation regarding tuition assessment? When is it expected to receive approval?

6 IPA Additional comments?

7 Will students outside the program be allowed to take the classes?

8 If YES, what should they be assessed? (This is especially important for program based.)

9 Do standard student fee assessment criteria apply (full-time, part-time, on-campus versus off-campus)?

10 Do standard cancellation fee rules apply?

11 Are there any additional fees (e.g. materials, excursion)? If yes, see NOTE below.

12 Are you moving from one tuition code (TC) to another tuition code? Yes No

If YES, from which tuition code to which tuition code?

13 Are international students admissible to the program? If yes, will they pay the international tuition differential?

NOTE: Please remember to submit a completed "Application for New Fee or Fee Change Form" for every new course with additional fees.

Section 19: TLSE - Information Dissemination (internal for TLSE use only)

1 Has TLSE, Marketing and Student Recruitment, been informed about this new / revised program? Yes No

2	Has TLSE, Admissions, been informed about this new / revised program?	Yes		No	
3	Has TLSE, Student Finance and Awards, been informed about this new / revised program?	Yes		No	
4	Has CGPS been informed about this new / revised program?	Yes		No	
5	Has TLSE, Transfer Credit, been informed about any new / revised courses?	Yes		No	
6	Has ICT-Data Services been informed about this new or revised degree / program / major / minor / concentration?	Yes		No	
7	Has the Library been informed about this new / revised program?	Yes		No	
8	Has ISA been informed of the CIP code for new degree / program / major?	Yes		No	
9	Has Room Scheduling/Scheduling Hub/Senior Coordinator of Scheduling been informed of unique space requirements for the new courses and/or informed of program, course, college, and department changes?	Yes		No	
10	Has the Convocation Coordinator been notified of a new degree?	Yes		No	

11 What is the highest level of financial approval required for this submission? Check all that apply.

a. None - as it has no financial implications ☐

OR

b. Fee Review Committee ☐

c. Institutional Planning and Assessment (IPA) ☐

d. Provost's Committee on Integrated Planning (PCIP) ☐

e. Board of Governors ☐

f. Other ☐

SIGNED

Date:

Registrar (Russell Isinger):

College Representative(s):

IPA Representative(s):