1. Minutes of the Faculty Council meeting held February 23, 2020 (attached)
2. Report on election of Faculty Council Chair – B. Ferguson
3. Report from the Dean – M. Giesbrecht
4. Report from the Associate Dean, Undergraduate Studies - B. Charbonneau (attached)
   Motion group 1. New Courses
   • 1.1. CS 136L Report #86 (Feb. 22nd)
   Motion group 2. Course Changes
   • 2.1. AMATH 342 Report #84 (March 29th)
   • 2.2. CS 241 Report #86 (Feb. 22nd)
   • 2.3. CS 241E Report #86 (Feb. 2nd)
   • 2.4. CS 246 Report #86 (Feb. 22nd)
   • 2.5. CS 246E Report #86 (Feb. 22nd)
   • 2.6. MTHEL 199 Report # 85 (March 29th)
   • 2.7. STAT 321 Report #86 (Feb. 22nd)
   • 2.8. STAT 331 Report #86 (Feb. 22nd)
   Motion group 3. Plan Changes
   • 3.1. Applied Mathematics Minor (March 29th)
   • 3.2. Applied Mathematics Engineering Specialization (March 29th)
   • 3.3. Applied Mathematics Engineering Specializations: Fluids and Heat (March 29th)
   • 3.4. Applied Mathematics Engineering Specializations: Communication and Control (March 29th)
   • 3.5. Applied Mathematics Engineering Specializations: Heat and Mass Transfer (March 29th)
   • 3.6. Computer Science Double Degree Overview (Feb. 22nd)
   • 3.7. Computer Science Double Degree Notes (Feb. 22nd)
   • 3.8. Math Business CPA Finance Specialization (March 29th)
   • 3.9. Math Business Double Degree Notes (Feb. 22nd)

Information: ELAS to BASE transition
5. Faculty of Math Campaign Report – C. Harrington
6. Faculty Council meeting dates for 2021/2022
7. Other business
Minutes of the Mathematics Faculty Council held Tuesday, February 23, 2021 at 3:30 p.m. via Webex. There were 67 attendees.

1. The minutes of the Faculty Council meeting held November 17, 2020 were approved.

2. Report from the Associate Dean, Undergraduate Studies - B. Charbonneau
   - Updates
     - The current practice regarding the release of final exams will remain unchanged.
   - Motion Group 2. New Courses
     - Motion carried
   - Motion Group 3: Course Changes
     - Motion carried
   - Motion Group 4: Plan Changes
     - Motion carried

3. Report from the Associate Dean, Graduate Studies - A. Kolkiewicz
   - Motion Group 1: Combinatorics and Optimization
     - Motion carried
   - Motion Group 2. Computer Science
     - Motion carried
   - Motion Group 3: MMT
     - Motion carried
   - Motion Group 4: Pure Mathematics
     - Motion carried
   - Motion Group 5: Statistics and Actuarial Science
     - Motion carried

4. Report from the Dean – Mark Giesbrecht
   - The Dean noted that we have been almost a year working from home. The Dean thanked everyone for their efforts, and encouraged people who need support to reach out to the numerous resources available to support our employees.
   - The Math Employee Health and Well-being Committee has been formed, and is focused on informing and directing our faculty-wide efforts to improve health and well-being.
• Budget update:
  • In May 2020, there was a 15% budget holdback applied – 12% of that holdback has now been returned; the remaining 3% will be held by the centre.
  • We are in a continuity budget which means that the increases associated with additional tuition and grant revenues did not automatically flow to the Faculty. However, we are receiving approvals for many additional hires.
  • The budget outlook for the University is stable but still somewhat concerning; domestic tuition is expected to be frozen for an additional 2 years, and there continues to be a risk associated with our ability to attract and admit international students.
  • Faculty hiring in all units of Math is ongoing and we have had a number of acceptances.
  • For Spring term, we expect a fully online delivery of undergrad programs. There will be some capacity for in-person grad programs and meetings, if health conditions permit. For Fall term, there are demands on the part of students to have an on-campus delivery; this demand will be balanced against our ability to do so safely.
  • The Math 4 project has received approval at Board of Governors; consultations will be starting with all stakeholders.
  • Sabbatical relocation - requests for relocation for essential sabbatical purposes require approval from the Dean and Provost. All other University-sanctioned international travel remains suspended.
  • Strategic Plan Implementation Schedule
    • March 4: MSPC will meet to establish priorities
    • Spring 2021: Working groups will generate ideas and develop proposals
    • Fall 2021: MSPC will meet to prioritize implementation and develop resource requirements.

5. Report from the Associate Dean, Undergraduate Admissions and Outreach - T. Vasiga
   • Undergraduate applications for Math closed on February 1, 2021. We continue to have very strong applications, particularly in Computer Science and our Business programs. A full breakdown is provided in the attachment.
   • Outreach and Recruitment Activities
     • Waterloo Virtual Open House will be held Saturday March 20th
     • Recruitment activities are focused on individual applicant counseling and webinars.
     • Both CEMC and UAO continue to run virtual school visits

6. Notice of election for Chair of Faculty Council – B. Ferguson
   • The call for nominations will be sent via email with exact dates
7. Next meeting is Tuesday, April 20 at 3:30PM.
8. Other business
   • None.

The meeting adjourned at 5:03 PM.
Faculty of Mathematics Council
Faculty Council
Dean’s Report

Presented by: Mark Giesbrecht, Dean of Mathematics
Presented to: Faculty of Mathematics Faculty Council
Date: February 23, 2021
State of the Pandemic University

- It’s been almost a year working from home: Friday, March 13, 2020 was the last time we were all on campus, following the provincewide state of emergency in response to the pandemic.

- I am appreciative of every one of you for giving so much to the Faculty during these challenging times.

- Your enormous efforts are building a strong foundation for the future of the Faculty of Math and the University through the rest of the pandemic and beyond.

- I hope you share my cautious optimism about a coming end to the pandemic but recognize there are still difficult days ahead.

- We also need to think about how to carrying forward the great work we have done into the post-COVID academy

- All of us need help sometimes, and I encourage you to reach out – to your supervisors, Occupational Health, Human Resources, the Employee Assistance Program, FAUW, UWSA, or your Dean – should you need assistance or guidance, personally or professionally

- The [Math Employee Health and Well-being Committee](#) will focus on informing, directing, and monitoring our faculty-wide efforts to improve health and well-being for all employees (i.e., postdocs, staff, and faculty members).
Budget Update

- The University of Waterloo is still officially on continuity budget from 2019-2020 carried forward
  - There was a 15% holdback in May 2020 plus a “soft freeze” on hiring; 80% of the holdback has now been passed on automatically
  - Most projects which remained relevant during COVID have now been funded
  - Continuity means that the “true ups” did not arrive automatically
  - Many approvals on hiring and significant expenditures still require Provost approval
- Budget outlook for the university is stable but still somewhat concerning
  - Domestic tuition: expected to be frozen for an additional 2 years (on top of 10% cut + freeze in 2019)
  - Considerable COVID-related expenses
  - Risk/vulnerability on international students
- Math Faculty Budgeting is ongoing by all units under “normal” funding assumptions
  - Faculty hiring in all units of Math is ongoing and we have had a number of offers accepted
  - We have also had the ability to over-offer to some extent
  - You have my commitment, and I believe a strong institutional commitment, to hiring faculty in support of our strong student numbers
Outlook for now, spring and fall

Waterloo is back in the Red Zone

- As of yesterday (Feb 22) the university is open in a limited capacity as before the new year break
- Teaching of Math 136/138 is going on in reduced capacity classrooms
- DC and M3 are open while MC remains closed
- For access to your offices and labs please go through your department/school process as previously defined

Outlook for Spring

- Expectations are for a fully online delivery of undergrad programs
- Some capacity for in person grad programs and meetings is available with approval

Outlook for Fall

- Expectations and planning are for a significant on-campus and online component
- This presents a number of new logistical challenges
- Actual delivery choices will be adapted to the conditions as soon as we have sufficient information
Data Innovation Hub
- 142,000 sq. ft
- 5 floors
- Estimated cost of $90m
- “Math only”
- Expect groundbreaking in 2022, completion in 2024
- Will be reaching out to units, faculty, staff and students for consultation over coming few months
Faculty & Staff Comings and goings

**Martin Lysy** (Statistics and Actuarial Science) is now Associate Dean for Computing and head of MFCF as of January 1, 2021

**Bertrand Guenin** (Combinatorics and Optimization) incoming as Associate Dean for Graduate Studies and succeeding Adam Kolkiewicz on July 1, 2021

**Troy Vasiga** (Computer Science) continuing as Associate Dean Admissions & Outreach, renewed for 3 years from July 1, 2021

**Ian VanderBurgh** (CEMC) will be continuing as Director of the Centre for Education in Mathematics and Computing, renewed for 3 years from July 1, 2021

**Lori Case** (Computer Science) is continuing as Associate Dean Co-Op, for 3 years from July 1, 2021

**Diana Skrzydlo** (Statistics & Actuarial Sciences) will serve as Teaching Fellow starting from July 1, 2021, succeeding Brian Forrest

**Steve Vavasis** (Combinatorics & Optimization) will serve as Interim Director of the MDSAI program from January 1, 2021 through August 31, 2021.

**Anar Jahangirli** will join as Math Director of Communications starting March 8, 2021, replacing Jodi Szimanski
Sabbatical and Research Visits

- UW has suspended all University-sanctioned international travel until further notice.
- Requests for relocation from faculty members for essential sabbatical purposes require approval from the Dean & Provost.
  - This is separate from having your sabbatical approved at some location.
- Travel for sabbatical purposes is defined as temporarily relocation for several months to one location.
- No short-term or series of multiple trips will be approved.
- Please contact the Dean’s office for the full policy and application for Provostial approval.
- Please do not book any travel until it is approved explicitly.
  - Failure to do could easily result in no reimbursement.
MARCH 4
MSPC meets to establish priorities and framework.

SPRING
IWGs generate implementation ideas and develop proposals.

FALL
MSPC evaluates proposals and provides advice to the Dean.

WINTER
Select proposals are approved and funded for 2022/23.
STRATEGIC PLAN IMPLEMENTATION INITIATIVES

Ongoing

- Community engagement coordinator (student and employee wellbeing)
- Increases to top-end undergraduate scholarships
- Graduate student funding (Math IMAE and PhD entrance scholarship)
- MMT scholarships for Indigenous teachers
- Professional development support for teaching

Beginning in 2021/22

- Instructional support roles (MUO)
- Prestigious postdoctoral fellowships (hiring for 2022/23)
- Enhance assessment practices
- Faculty of Mathematics mental health training
- Staff professional development fund
STRATEGIC PLAN IMPLEMENTATION WORKING GROUPS

- People
- Undergraduate Recruitment & Admissions
- Undergraduate Studies
- Graduate Studies
- Research
- Innovation & Entrepreneurship
- Outreach
ENGAGE WITH THE STRATEGIC PLAN

Visit [https://uwaterloo.ca/math/about/strategic-plan-2018](https://uwaterloo.ca/math/about/strategic-plan-2018) to:

- Read the Faculty of Mathematics Strategic Plan 2018
- Submit an idea for an implementation initiative
- Read the annual progress report

- Contact Martha Foulds, Director of Planning ([mfoulds@uwaterloo.ca](mailto:mfoulds@uwaterloo.ca)) to:
  - Ask questions
  - Share your feedback with MSPC
QUESTIONS?
Report from the Associate Dean,
Undergraduate Admissions and Outreach

Troy Vasiga

February 22, 2021
Admissions Update for Fall 2021: Business and Accounting

Faculty application numbers as of February 19, 2021. (Note: These numbers are “final”, in the sense that Math (and Engineering) closed applications on February 1, 2021.)

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<tbody>
<tr>
<td>Accounting</td>
<td>55</td>
<td>343</td>
<td>379</td>
<td>416</td>
<td>357</td>
<td>389</td>
<td>457</td>
<td>397</td>
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<tr>
<td>DD (Math/Bus)</td>
<td>70</td>
<td>662</td>
<td>785</td>
<td>810</td>
<td>805</td>
<td>784</td>
<td>793</td>
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<td>FARM - Reg</td>
<td>10</td>
<td>134</td>
<td>163</td>
<td>164</td>
<td>186</td>
<td>173</td>
<td>128</td>
<td>144</td>
<td>131</td>
<td>104</td>
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<tr>
<td>FARM - Co-op</td>
<td>125</td>
<td>1403</td>
<td>1384</td>
<td>1571</td>
<td>1589</td>
<td>1521</td>
<td>1472</td>
<td>1194</td>
<td>1006</td>
<td>910</td>
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<tr>
<td>FARM - Online - Reg</td>
<td>1</td>
<td>9</td>
<td>4</td>
<td>23</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
</tr>
<tr>
<td>FARM - Online - Co-op</td>
<td>4</td>
<td>25</td>
<td>25</td>
<td>–</td>
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<tr>
<td>Math Bus - Reg</td>
<td>20</td>
<td>90</td>
<td>76</td>
<td>94</td>
<td>96</td>
<td>110</td>
<td>93</td>
<td>115</td>
<td>87</td>
<td>62</td>
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<tr>
<td>Math Bus - Co-op</td>
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<td>532</td>
<td>525</td>
<td>535</td>
<td>598</td>
<td>670</td>
<td>424</td>
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<td>Total (Bus-Acc)</td>
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<td>3341</td>
<td>3613</td>
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<td>3647</td>
<td>3367</td>
<td>2898</td>
<td>2668</td>
<td>2477</td>
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Faculty application numbers as of February 19, 2021. (Note: These numbers are “final”, in the sense that Math (and Engineering) closed applications on February 1, 2021.)

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<tr>
<td>CS - Reg</td>
<td>10</td>
<td>709</td>
<td>593</td>
<td>639</td>
<td>577</td>
<td>506</td>
<td>478</td>
<td>381</td>
<td>297</td>
<td>242</td>
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<td>CS - Co-op</td>
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<td>6065</td>
<td>6146</td>
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<td>4483</td>
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<td>DD (CS/Bus)</td>
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<td>1269</td>
<td>1102</td>
<td>1031</td>
<td>1048</td>
<td>854</td>
<td>906</td>
<td>662</td>
<td>572</td>
<td>466</td>
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<tr>
<td>Total (CS)</td>
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<td>9286</td>
<td>7760</td>
<td>7816</td>
<td>7386</td>
<td>5843</td>
<td>5171</td>
<td>4034</td>
<td>3429</td>
<td>2522</td>
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Admissions Update for Fall 2021: Math (and Summary)

Faculty application numbers as of February 19, 2021. (Note: These numbers are “final”, in the sense that Math (and Engineering) closed applications on February 1, 2021.)

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<tbody>
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<td>Math - Reg</td>
<td>170</td>
<td>626</td>
<td>635</td>
<td>644</td>
<td>445</td>
<td>395</td>
<td>499</td>
<td>443</td>
<td>403</td>
<td>421</td>
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<tr>
<td>Math - Co-op</td>
<td>395</td>
<td>3735</td>
<td>3841</td>
<td>3807</td>
<td>3346</td>
<td>2666</td>
<td>2629</td>
<td>2173</td>
<td>2030</td>
<td>1687</td>
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<tr>
<td>Total (Math)</td>
<td>565</td>
<td>4361</td>
<td>4476</td>
<td>4451</td>
<td>3791</td>
<td>3061</td>
<td>3128</td>
<td>2616</td>
<td>2433</td>
<td>2108</td>
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<tr>
<td>Total Faculty</td>
<td>1285</td>
<td>16926</td>
<td>15577</td>
<td>15880</td>
<td>13865</td>
<td>11807</td>
<td>11779</td>
<td>9609</td>
<td>8665</td>
<td>7187</td>
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<tr>
<td># Unique Apps</td>
<td>13436</td>
<td>12095</td>
<td>12461</td>
<td>10829</td>
<td>9171</td>
<td>8627</td>
<td>7590</td>
<td>6873</td>
<td>5659</td>
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Admissions Update for Fall 2021: Other Statistics

<table>
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<tr>
<th>Location</th>
<th>OSS</th>
<th>NOSS</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>7178 (42.4%)</td>
<td>2404 (14.2%)</td>
<td>9582 (56.6%)</td>
</tr>
<tr>
<td>Visa</td>
<td>2096 (12.4%)</td>
<td>5248 (31.0%)</td>
<td>7344 (43.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>9274 (54.8%)</td>
<td>7652 (35.2%)</td>
<td>16926</td>
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</table>

Historical Location Percentages

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<tr>
<td>OSS</td>
<td>55%</td>
<td>54%</td>
<td>55%</td>
<td>62%</td>
<td>63%</td>
<td>69%</td>
<td>72%</td>
<td>75%</td>
</tr>
<tr>
<td>Visa</td>
<td>49%</td>
<td>52%</td>
<td>51%</td>
<td>45%</td>
<td>43%</td>
<td>38%</td>
<td>34%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Overall, 28.7% of applicants identified their gender as female, 2.9% did not identify their gender.
Admissions Update for Fall 2021: Other Programs

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<tr>
<td>CFM</td>
<td>45</td>
<td>1161</td>
<td>863</td>
<td>898</td>
<td>900</td>
<td>734</td>
<td>606</td>
<td>412</td>
<td>381</td>
<td>302</td>
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<tr>
<td>SE</td>
<td>125</td>
<td>1921</td>
<td>1517</td>
<td>1359</td>
<td>1550</td>
<td>1486</td>
<td>1224</td>
<td>1002</td>
<td>866</td>
<td>685</td>
</tr>
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</table>
Recruitment & Outreach Activities

▶ The next recruitment event is the March Virtual Open House (Saturday March 20).
▶ Recruitment activities are focused on individual applicant counselling, webinars, and unrelenting email questions.
▶ The moving of March Break to April has disrupted the original date for the Fryer, Galois, and Hypatia contests. Like all pandemic-related things, the CEMC is adapting and flexing to accommodate schools to write in a wider window. Thankfully, the date of Euclid has not been affected by the shift in March Break.
▶ Both CEMC and UAO continue to run virtual “school visits”.
▶ The UAO office has two new faces:
  ▶ Heather Steinmetz is an Undergraduate Recruitment & Admission Officer, filling in on secondment while Amelia Burton is in the Student Success Office.
  ▶ Leanne Zonneveld is the Undergrad Recruitment Coordinator, the role previously held by Jake Riesenkonig.
Report of Undergraduate Affairs Committee to Mathematics Faculty Council

This report contains several motions from the Mathematics Undergraduate Affairs Committee (UAC) to be voted on at this Faculty Council meeting. These motions were adopted by UAC during its meeting on 22 February 2021 and 29 March 2021.

New Courses
  1.1. CS 136L Report #86 (Feb. 22nd)
2. Course Changes
  2.1. AMATH 342 Report #84 (March 29th)
  2.2. CS 241 Report #86 (Feb. 22nd)
  2.3. CS 241E Report #86 (Feb. 2nd)
  2.4. CS 246 Report #86 (Feb. 22nd)
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  3.7. Computer Science Double Degree Notes (Feb. 22nd)
  3.8. Math Business CPA Finance Specialization (March 29th)
  3.9. Math Business Double Degree Notes (Feb. 22nd)
4. Information
  4.1. ELAS to BASE transition
NEW COURSES  (for approval)

Computer Science - David R. Cheriton School of

Effective  01-SEP-2022

CS  136L  ( 0.25 )  LAB Tools and Techniques for Software Development

This course introduces students to tools and techniques useful in the software development lifecycle. Students learn to navigate and leverage commands and utilities in the Linux Command Line Shell. Students gain experience in Version Control Software, writing scripts to automate tasks and creating effective test cases to identify bugs. Tracing and debugging strategies are discussed. Students also gain experience in using built-in support for version control, testing, debugging, build automation etc. in Integrated Development Environments (IDEs).

Requisites : Prerequisites: At least 90% in CS 115 or at least 70% in CS 116 or at least 60% in CS 135 or CS 145. Corequisites: CS136 or CS 146

Rationale : In the first two years of the CS program, students take four consecutive programming-intensive courses with a strong focus on the design of algorithms and the translation of algorithms into programs. However, efficient and productive software development also requires many additional skills and best practices. Historically we expected students to pick these skills up on their own, which has not always been successful. CS136L is a lab course where these skills will be covered. Offered whenever CS 136 and CS 146 are offered. Grading Basis is CR/NCR.
COURSE CHANGES  (for approval)

Applied Mathematics

Current Catalog Information
AMATH 342 (0.50)  LAB, LEC  Computational Methods for Differential Equations
An introduction to numerical methods for ordinary and partial differential equations.
Ordinary differential equations: multistep and Runge-Kutta methods; stability and
convergence; systems and stiffness; boundary value problems. Partial differential
equations: finite difference methods for elliptic, hyperbolic and parabolic
equations; stability and convergence. The course focuses on introducing widely used
methods and highlights applications in the natural sciences, the health sciences,
engineering, and finance. [Offered: F,W]
No Special Consent Required

Effective 01-SEP-2022
Requisite Change:
Prereq: AMATH 242/CS 371 and (One of AMATH 250, 251, 350 or MATH 218, 228)
Prereq: (AMATH 242/CS 371 or CS 370) and (One of AMATH 250, 251, 350 or
MATH 218, 228)

Rationale:
This will make the course accessible to students in several plans which
require CS 370. The instructor has been signing several course overrides
each term for such students. It is important to note that CS 370 is an antireq to CS
371.
Current Catalog Information
CS  241  ( 0.50 )  LAB, LEC, TST, TUT  Foundations of Sequential Programs
The relationship between high-level languages and the computer architecture that
underlies their implementation, including basic machine architecture, assemblers,
specification and translation of programming languages, linkers and loaders,
block-structured languages, parameter passing mechanisms, and comparison of
programming languages. [Note: Enrolment is restricted; see Note 1 above. Lab is not
scheduled and students are expected to find time in open hours to complete their
work. CS 251 is a recommended corequisite. Offered: F,W,S]
No Special Consent Required
Requisites :
Prereq: (CS 138 or 246) or (a grade of 85% or higher in one of CS 136 or
146); Computer Science and BMath (Data Science) students only. Antireq: CS
230, ECE 351
Effective  01-SEP-2022
Requisite Change :
Prereq: (CS 138 or (246 and CS136L)) or (CS 136L and a grade of 85% or
higher in one of CS 136 or 146)); Computer Science and BMath (Data Science)
students only. Antireq: CS 230, ECE 351
Rationale :
Rationale: CS246/CS246E and CS241/CS241E will require the skills that are
covered in CS136L. CS241/CS241E already assumes that students have these
skills. CS246/CS246E has, over the years, needed to cover these skills. The
existence of CS136L will allow CS246/CS246E regain focus on its core
subject, namely object-oriented programming.

Current Catalog Information
CS  241E  ( 0.50 )  LAB, LEC, TST, TUT  Foundations of Sequential Programs (Enriched)
Enriched version of CS 241. [Note: See notes 1 and 9 above. CS 241E may be
substituted for CS 241 wherever the latter is a requirement. Enrolment is restricted.
Lab is not scheduled and students are expected to find time in open hours to
complete their work. CS 251 is a recommended corequisite. Offered: As permitted
by demand and available resources]
No Special Consent Required
Requisites :
Prereq: A grade of 85% or higher in one of CS 136, 138, or 146; Computer
Science and BMath (Data Science) students only. Antireq: CS 230, GENE
344
Effective  01-SEP-2022
Requisite Change :
Prereq: (CS136L and a grade of 85% or higher in one of CS 136 or CS 146),
or a grade of 85% or higher in CS138; Computer Science and BMath (Data
Science) students only.
Rationale :
Antireq: CS 230, GENE 344
CS246/CS246E and CS241/CS241E will require the skills that are covered in
CS136L. CS241/CS241E already assumes that students have these skills.
CS246/CS246E has, over the years, needed to cover these skills. The
existence of CS136L will allow CS246/CS246E regain focus on its core
subject, namely object-oriented programming.
Current Catalog Information

CS  246   ( 0.50 )   LAB, LEC, TST, TUT   Object-Oriented Software Development
Introduction to object-oriented programming and to tools and techniques for software development. Designing, coding, debugging, testing, and documenting medium-sized programs; reading specifications and designing software to implement them; selecting appropriate data structures and control structures; writing reusable code; reusing existing code; basic performance issues; debuggers; test suites. [Note: Enrolment is restricted; see Note 1 above. Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: F,W,S]

No Special Consent Required

Requisites :
Prereq: CS 146 or a grade of 60% or higher in CS 136 or 138; Honours Mathematics students only. Antireq: CS 247, MSCI 342, SYDE 322

Effective  01-SEP-2022
Requisite Change :
Prereq: (CS 146 and CS136L) or (a grade of 60% or higher in CS 138) or (CS 136L and a grade of 60% or higher in CS 136) Honours Mathematics students only.
Antireq: CS 247, MSCI 342, SYDE 322
Rationale :
CS246/CS246E and CS241/CS241E will require the skills that are covered in CS136L. CS241/CS241E already assumes that students have these skills. CS246/CS246E has, over the years, needed to cover these skills. The existence of CS136L will allow CS246/CS246E regain focus on its core subject, namely object-oriented programming.

Current Catalog Information

CS  246E   ( 0.50 )   LAB, LEC, TST, TUT   Object-Oriented Software Development (Enriched)
Enriched version of CS 246. [Note: See notes 1 and 9 above. CS 246E may be substituted for CS 246 wherever the latter is a requirement. Enrolment is restricted. Lab is not scheduled and students are expected to find time in open hours to complete their work. Offered: As permitted by demand and available resources.]

No Special Consent Required

Requisites :
Prereq: A grade of 85% or higher in one of CS 136 or 146; Honours Mathematics students only. Antireq: SYDE 322

Effective  01-SEP-2022
Requisite Change :
Prereq: CS136L AND a grade of 85% in either CS 136 or CS146; Honours Mathematics students only; Antireq: SYDE 322
Rationale :
CS246/CS246E and CS241/CS241E will require the skills that are covered in CS136L. CS241/CS241E already assumes that students have these skills. CS246/CS246E has, over the years, needed to cover these skills. The existence of CS136L will allow CS246/CS246E regain focus on its core subject, namely object-oriented programming.
COURSE CHANGES  (for approval)

Dean of Mathematics

Current Catalog Information

MTHEL  199  (0.25)  LEC  Special Topics
Special topics course as announced by the Faculty. [Note: This course will be graded on a Credit/No-Credit basis.]
No Special Consent Required
Effective  01-MAY-2021

Subject/Catalog Nbr Change:  MTHEL  99
Title Change:  First-Year Mathematics Readiness
Description Change:  A skills-based course designed to help the incoming university student refresh their knowledge of secondary school mathematics. It includes extra practice with the following topics: Inequalities and Absolute Values, Radicals and Rational Expressions, Trigonometry, Exponential and Logarithmic Functions, Polynomials, and Introductory Calculus.

Rationale :  When MTHEL 199 was created last year as an emergency motion for our response to the Covid 19 pandemic. The Math Faculty was exploring ways to provide remedial mathematics to our incoming high school class whose senior mathematics courses were disrupted by the COVID crisis. One option was to provide a remedial course covering key high school topics. The course itself had not been designed by the time the MTHEL 199 vessel was created, and it was not even fully decided if there would be such a course. It was thus reasonable at the time to make it a generic topics course. There was a strong desire in the Faculty of Mathematics that this course, should it be offered, would not increase student tuition because it covers high school material. During July 2020, the course was shaped. For students taking less than 2.5 units, there was a lot of MUO manual work in fall 2020 to prevent students being charged tuition. By January 2021, the course had now been coded so that tuition would not be triggered. Since the course now exists and is coded to avoid tuition, we should prevent the possibility that other topics could be taught through it, hence the new title and description. The RO has suggested that renumbering from 199 to 99 because of the level of the material. Permission for 2021 effective date obtained from RO.

End of Report
Statistics & Actuarial Science

Current Catalog Information

STAT  321 ( 0.50 )  LEC, TUT  Regression and Forecasting (Non-Specialist Level)
Modeling the relationship between a response variable and several explanatory variables via regression models. Model diagnostics and improvement. Using regression models for forecasting, Exponential smoothing. Simple time series modeling.

[Offered: W]
No Special Consent Required

Requisites :
Prereq: (MATH 225 or 235 or 245) and (STAT 221 or 231 or 241). Antireq: ECON 321, STAT 331, 371, 373, 443

Effective  01-SEP-2022
Requisite Change :
Prereq: (MATH 225 or 235 or 245) and (STAT 221 or 231 or 241). Antireq: ECON 321, STAT 331, 371, 373, 443
Rationale :
ECON updated their courses and removed ECON 321 in the 2019/2020 calendar and the course is no longer being offered.

Current Catalog Information

STAT  331 ( 0.50 )  LEC, TUT  Applied Linear Models

No Special Consent Required

Requisites :
Prereq: MATH 235 or 245, (STAT 231 with a grade of at least 60%) or STAT 241 or (SYDE 212 with a grade of at least 70%). Antireq: ECON 321, 421, STAT 321, 371, 373, SYDE 334

Effective  01-SEP-2022
Requisite Change :
Prereq: MATH 235 or 245, (STAT 231 with a grade of at least 60%) or STAT 241 or (SYDE 212 with a grade of at least 70%). Antireq: ECON 421, STAT 321, 371, 373, SYDE 334
Rationale :
ECON updated their courses and removed ECON 321 in the 2019/2020 calendar and the course is no longer being offered.
Motion 3.1 Effective Sept 1, 2022, update the description section of the Degree Requirements for Applied Mathematics Minor as prescribed below to make the minor available to students outside of the Faculty of Mathematics (except as noted). It also makes the course selection more flexible and reduces the number of required courses by one, making this plan more consistent with other minors.

Current Catalogue Information

Applied Mathematics Minor

This minor is only open to students within the Faculty of Mathematics.

All of

MATH 237 Calculus 3 for Honours Mathematics or MATH 247 Calculus 3 (Advanced Level)
AMATH 231 Calculus 4
AMATH 251 Introduction to Differential Equations (Advanced Level) Note: AMATH 250 can be substituted with consent of the department.
AMATH 351 Ordinary Differential Equations 2
AMATH 353 Partial Differential Equations 1

Three additional 300- or 400-level AMATH courses.

Effective 01-SEP-2022

Applied Mathematics Minor

One of

MATH 103 Introductory Algebra for Arts and Social Science
MATH 106 Applied Linear Algebra 1
MATH 114 Linear Algebra for Science
MATH 115 Linear Algebra for Engineering
MATH 136 Linear Algebra 1 for Honours Mathematics
MATH 146 Linear Algebra 1 for Honours Mathematics (Advanced Level)

One of

MATH 104 Introductory Calculus for Arts and Social Science
MATH 116 Calculus 1 for Engineering
MATH 117 Calculus 1 for Engineering
MATH 127 Calculus 1 for the Sciences
MATH 137 Calculus 1 for Honours Mathematics
MATH 147 Calculus 1 for Honours Mathematics (Advanced Level)

One of
MATH 118 Calculus 2 for Engineering
MATH 119 Calculus 2 for Engineering
MATH 128 Calculus 2 for the Sciences
MATH 138 Calculus 2 for Honours Mathematics
MATH 148 Calculus 2 for Honours Mathematics (Advanced Level)

One of
MATH 212/ECE 206 Advanced Calculus 2 for Electrical Engineers
MATH 217 Calculus 3 for Chemical Engineering
MATH 227 Calculus 3 for Honours Physics
MATH 237 Calculus 3 for Honours Mathematics
MATH 247 Calculus 3 for Honours Mathematics (Advanced Level)

One of
AMATH 250 Introduction to Differential Equations
AMATH 251 Introduction to Differential Equations (Advanced Level)
MATH 211/ECE 205 Advanced Calculus 1 for Electrical and Computer Engineers
MATH 213 Advanced Mathematics for Software Engineers
MATH 218 Differential Equations for Engineers
MATH 228 Differential Equations for Physics and Chemistry

2.5 additional units of AMATH courses at least 1.5 of which are at the 300- or 400-level

Notes
1. The Applied Mathematics Minor is not available to students outside the Faculty of Mathematics pursuing Mathematical Physics or a Joint Honours academic plan with Mathematics or a Mathematics Minor.
2. Other Linear Algebra, Calculus and Differential Equations courses than those listed above may be used to satisfy the "One of" requirements above, with approval of the Applied Mathematics advisor.
**Motions 3.2-3.5**: Effective 1 Sept 2021, create an Applied Mathematics Engineering Specialization with three themes and to inactivate three add-on plans created in error; these motions are needed in order to correct academic plan motions previously approved (September 1, 2019).

**Corrections:**

1. Plan to be updated: Engineering Specialization. This is an add-on plan to Honours Applied Mathematics. The new Plan description is below, effective 01-SEP-2021:

   Enrolment in this Specialization is limited; a minimum cumulative average of 70% is strongly recommended.
   The Engineering Specialization has three theme areas: Fluids and Heat, Communication and Control, Heat and Mass Transfer. Students must choose one. The Engineering Specialization has the same requirements as Honours Applied Mathematics, with the constraints on course selection for each theme as given below:
   - Theme 1: Fluids and Heat
   - Theme 2: Communication and Control
   - Theme 3: Heat and Mass Transfer

2. Inactivate plans that should not have been created:
   - Engineering Specialization: Fluids and Heat
   - Engineering Specialization: Communication and Control
   - Engineering Specialization: Heat and Mass Transfer

3. Undergraduate Calendar clean up:
   - 2021-22 Calendar: The 3 pages to be consolidated to one page listing the correct name of the single new Specialization with 3 theme areas.
   - 2020-21 and 2019-20 Calendars: A note will be added to each of the three Specializations pages to indicate the plan was inactivated and to see the 2021-22 Calendar for up-to-date information.

**Background and rationale:**

**Discovery of correction needed**: In January 2021, when it came time to grant the first specialization to a graduating student, it was discovered that what was approved (and listed in the Undergraduate Calendar) had never been the original intention, which was to keep it as a single Specialization (it was a single Option), but with a new name, that could be completed three different ways/theme areas, instead of two.

**A bit about the previous submissions**: At October 2018 Senate Undergraduate Council, the following motion was submitted and approved effective September 1, 2019, for appearance in the 2019-20 Undergraduate Calendar [note, other plans have been removed from the original motion as they do not pertain to this correction].

**New Plans**

2. **Plan Changes**
   2.1. **Applied Mathematics**
   2.1.1. **Effective September 1, 2019**
   
   To change the following Applied Mathematics plans to a Plan 10 (Applied Mathematics) and a Plan 20 (option/specialization). The structure changes are as follows:
<table>
<thead>
<tr>
<th>Current Structure</th>
<th>Existing Plan 10</th>
<th>Structure – Plan 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Mathematics with Engineering Electives</td>
<td>Applied Mathematics</td>
<td>Engineering Specialization: Fluids and Heat</td>
</tr>
<tr>
<td>(name change of plan – to be inactivated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied Mathematics with Engineering Electives</td>
<td>Applied Mathematics</td>
<td>Engineering Specialization: Communication and Control</td>
</tr>
<tr>
<td>(name change of plan – to be inactivated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(name change of plan)</td>
<td></td>
<td>(new specialization)</td>
</tr>
</tbody>
</table>

**Rationale:** Changing Applied Mathematics Option plans to a Plan 10 (Applied Mathematics) and a Plan 20 (options and specialization) to simplify plans in the Faculty. Students can choose which calendar they would like to follow. We have spoken with Engineering and they support the name change since this plan is based in Math and is only open to math students.

**RO action:** change to Plan 10/20 – new plan codes

**MUO action:** AA, AP, co-op chart, list of plans, Combination page

Note that the plans were accidentally delayed being sent to Senate and went to the September 2019 meeting, with an amendment to change the type of credential from Options to Specializations, to meet the new common language and plan definition requirements.

Motion 5, to inactivate the plans in the left column and create new plans in the third column:

<table>
<thead>
<tr>
<th>Current Structure</th>
<th>Existing Plan 10</th>
<th>Structure – Plan 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Mathematics with Engineering Electives</td>
<td>Honours Applied Mathematics</td>
<td>• Fluids and Heat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Communication and Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heat and Mass Transfer</td>
</tr>
</tbody>
</table>

- **Engineering Specialization:** Fluids and Heat (new page will be created)
- **Engineering Specialization:** Communication and Control (new page will be created)

And motion 8 (creation of new specialization)

- **Engineering Specialization:** Heat and Mass Transfer (new specialization and new page)

**Interpretation of approved motions (as above):** Due to how the motions were presented and terminology used throughout, the motions were understood by all, during and after the approval process, to represent:

- the inactivation if the existing Applied Mathematics with Engineering Electives Option, which could be completed either by the Fluids and Heat or the Communication and Control “specializations” within the Option; **and**
- the relabeling of the old option into 3 separate incarnations of the Engineering specialization:
  - Engineering Specialization: Fluids and Heat
  - Engineering Specialization: Communication and Control
  - Engineering Specialization: Heat and Mass Transfer (new “specialization”)

-
CS Double Degree Plan Changes

**Motion 3.6:** Effective 1 September 2022, replace the sentence “The double degree program cannot be combined with any other major, minor, option, or specialization.” with “The double degree program cannot be combined with any other major.” in the calendar of the overview of the BBA/BCS program. This change removes contradicting text. The program may not be combined with another major, although minors, options, and specializations are permitted.


**Calendar text:**

Students can earn both a computer science and business degree in five years by enrolling in this double degree program. Students receive an Honours Bachelor of Computer Science (BCS) from the University of Waterloo and an Honours Bachelor of Business Administration (BBA) from Wilfrid Laurier University and are invited to both universities' convocation ceremonies for graduation.

- At the David R. Cheriton School of Computer Science, students gain an understanding of software, algorithms, programming, and their mathematical foundations.
- At the Lazaridis School of Business and Economics, students develop an understanding of a variety of areas of business, such as brand communication, accounting, human resource management, marketing, and finance. Students can specialize in these and other areas to focus their studies.

Enrolment in this double degree program is restricted and students are normally admitted for the fall term of their first year.

Students may apply to Waterloo, Laurier, or both. Students select their "home school" by accepting an admissions offer from one of the two universities. The home school provides most student support services, such as co-op, scholarships, and housing. The choice of home school also identifies the university from which students receive the co-op designation on their degree. Students usually cannot change their home school without leaving the double degree program.

The double degree program cannot be combined with any other major, minor, option, or specialization.

The double degree program cannot be combined with any other major.

The program requires the following:

- Nine or more full-time academic study terms.
- Successful completion of a minimum of 52 one-term courses (26 units). Students take 24 specified courses (12 units) at Waterloo and 24 specified courses (12 units) at Laurier, and four elective courses (two units), which may be taken at either university.
- Students whose home school is Waterloo: Completion of four or five co-op work terms intermixed with study terms. The first work term occurs during the spring term of Year One. The co-op sequence for these students is listed in the Co-op Regulations section of this Calendar. Students in this program will be required to pay six co-op fees, which are usually assessed in the first three years of study.
• Students whose home school is Laurier: Completion of three or four co-op work terms intermixed with study terms. The first work term occurs during the winter term of Year Two. After this term, Laurier and Waterloo students have co-op terms at the same time. Students can only change their co-op term sequences in their first three years if they have especially mitigating circumstances, and with the approval of both universities. This type of change may delay graduation.

All double degree students must follow the policies, procedures, regulations, and requirements of both Waterloo and Laurier in regards to course selection, academic performance, and academic conduct. Students who fail to do so are normally required to withdraw from the double degree program. These students may be able to enrol in a (single degree) plan at Waterloo (Bachelor of Mathematics (BMath) or BCS) or Laurier (BBA) depending upon their individual circumstances. Such students may not be eligible to continue in co-op in their new plan.

**Motion 3.7:** Effective 1 September 2022, edit note 3 and add three notes to the Notes section of the Degree Requirements for the BBA/BCS program as prescribed below to clarify that students in the program may have minors or specializations etc. and to make consistent with changes in the notes of the BBA/BMATH program.

**Notes**

1. For details about the various Laurier Honours Bachelor of Business Administration (BBA) policies, procedures, regulations, and requirements that apply to this double degree plan, please consult the Laurier Calendar and/or one of the plan's academic advisors at Laurier.

2. W courses are offered by Laurier. See the Laurier Calendar for course details.

3. Students may be allowed can have to have additional designations (e.g., minors or options) on their Waterloo diploma and transcript. Such designations must be approved by the academic unit offering the minor, or option or specialization and the double degree advisors from both Waterloo and Laurier. The designations must not be similar to any designations on the student's Laurier academic record and must be in disciplines offered outside of the Lazaridis School of Business and Economics at Laurier.

4. The degrees in the double degree program must be completed simultaneously.

5. Students admitted by Wilfrid Laurier University to the Business Administration and Computer Science Double Degree program are not eligible to transfer to single degree programs at the University of Waterloo until completion of the first year of the Business Administration and Computer Science double degree program. Eligible students must be in good financial standing with Wilfrid Laurier University, be academically eligible to transfer, and meet the University of Waterloo admission standards. Admission to co-op at Waterloo is not guaranteed.

6. Admission to the Double Degree program is direct-entry. The Double Degree program is a restricted-enrolment plan and Year 2 transfer to the program is not possible.
Mathematics/Chartered Professional Accountancy - Finance Specialization

**Motion 3.8:** Effective 1 September 2022, change catalog number from AFM 492 to AFM 276 and add AFM 326, AFM 333, AFM 426, SFM 310, and SFM 412 to the description section of the Degree Requirements for the MATH/CPA Finance Specialization as prescribed below due to amendments made by the School of Finance and Accounting. Note 2 is removed as it is already noted in Math/CPA requirements. Sustainable and Financial Management (SFM) is the new joint ARTS/ENV program that will come into existence in September 2022.

**Current Calendar:**

This plan has the same requirements as **Honours Mathematics/Chartered Professional Accountancy**, with the following additional requirements:

**ACTSC 231** Introductory Financial Mathematics

Three of

- **AMATH 350** Differential Equations for Business and Economics
- CS 335 Computational Methods in Business and Finance
- CO 372 Portfolio Optimization Models
- **MATBUS 470** Derivatives
- **MATBUS 471** Fixed Income Securities
- **MATBUS 472** Risk Management
- **STAT 334** Probability Models for Business and Accounting
- **STAT 341** Computational Statistics and Data Analysis

Two of

- **AFM 492** AFM 276 Financial Statement Analysis
- AFM 321 Personal Financial Planning
- AFM 322 Derivative Securities
- AFM 324 Wealth Management
- AFM 326 and AFM 426 Student Venture Fund (0.25 credits each)
- AFM 328 and AFM 329, or AFM 328 and AFM 428, or AFM 329 and AFM 429 Investment Management (0.25 unit each)
- **AFM 333** International Business
- **AFM 334** International Study Experience
- **AFM 377** Private Equity and Venture Capital
- **AFM 415** Special Topics or **AFM 416** Special Topics in Finance or **AFM 417** Special Topics in Accounting
- **AFM 423** Topics in Financial Econometrics
- **AFM 424** Equity Investments
- **AFM 434** Governance and Enterprise Risk Management for Global Organizations
- **AFM 470** Financial Management of High Growth Companies
- **AFM 477** Mergers and Acquisitions
AFM 478 International Financial Management
SFM 310 Sustainability in Capital Markets
SFM 412 Investor Behaviour

Two additional math courses (1.0 unit).

Notes

1. Additional CO courses may be required to meet CO 372 prerequisite.
2. In order to meet the requirements of both the Faculty of Mathematics and the School of Accounting and Finance, the Mathematics/CPA – Finance Specialization requires the successful completion of 42 courses.
Business Administration and Mathematics Double Degree

Motion 3.9: Effective Sept 1 2022, add notes 6, 7, and 8 to the Notes section of the Degree requirements as prescribed below. Notes 6 and 7 are required due to amendments to the BBA/BMath plan on the WLU side by the Laurier School of Business and Economics. Note 8 clarifies that in order to qualify to take a UW course, Laurier students are required to complete a minimum of 3.0 credits at Laurier (transfer credits excided) which means that Laurier students cannot take UW courses in first year. It is also very difficult for UW students to complete Laurier first year required courses during Year 1. In general, the whole process requires a substantial time commitment for advisors. Laurier School of Business and Economics.

Notes

... 

6. Double degree program must be completed simultaneously, and one degree cannot be delayed as a sequential degree.

7. Students admitted by Laurier to this program are not eligible to transfer to any single degree program at UW until after completion of the first year of the program to which they were admitted. Students must be in good financial standing with Laurier to be eligible to transfer programs. Eligible students must meet UW admission standards and be in good or excellent academic standing. Admission to co-op at Waterloo is not guaranteed.

8. Admission to the Double Degree program is direct-entry. The Double Degree program is a restricted-enrolment plan and Year 2 transfer to the program is not possible.
ELAS to BASE transition

Prospective students who do not meet the minimum English language proficiency requirement can be provisionally admitted provided they complete successfully a term of remedial English that brings them to the appropriate level. Operationally, we have enrolled a number of students over the past three decades in a non-degree term during which most have taken Math 137 and English classes at Conestoga College. This has been advertised as the Math/English as a Second Language (Math/ELAS) program has been integral to our students’ success for more than three decades.

Conestoga College has been an incredible partner in preparing math and computer science students for their time at Waterloo. However, as our current contract comes to an end, we have identified an opportunity to leverage a University of Waterloo-based program that has proven successful for the other faculties.

Beginning Spring 2021, we will partner with Renison University College to provide on-campus English language education to support our incoming Faculty of Mathematics students. They would still be enrolled in a non-degree term, and still take Math 137 for the most of them, but the provider is now Bridge to Academic Success in English (BASE) instead of ELAS.
1 Course Syllabus

1.1 Rationale

Undergraduate computer science majors take four consecutive programming-intensive courses in the span of the first two years. In first year, the focus is on the design of algorithms and the translation of these algorithms into programs. However, efficient and productive software development requires a programmer to learn many soft skills that are usually learned through experience. Currently, the 2A course, CS246 (Object-Oriented Software Development) takes on the task of introducing students to these skills (writing scripts for automation, using memory error detectors and debuggers, separate compilation, build automation etc.). This results in valuable time taken away from the primary purpose of the course; an introduction to object-oriented programming which in itself is a vast field. Splitting the focus of the course leads to a superficial treatment of most course content. Additionally, this transition from a sheltered software development environment in first year to a more real-world environment in second year comes as a shock to many students. The disconnect adds to student struggles in second year and some never recover.

There is general consensus that students should be taught these practical programming soft skills but it has been hard to find a spot for them. However, there is a need for these skills and to be introduced sooner rather than later. This is especially true for our computer science coop students who are expected to know things like version control software, debuggers, writing scripts etc at their coop placements. Since the skills we aim to impart are best learned through hands-on experience, rather than lecture-style delivery, CS136L will be a 0.25 credit lab course taken alongside CS136. Students will be expected to come prepared after reading required readings and/or watching prepared videos. During the lab, students will work through crafted activities to complete tasks that exercise the content being taught.

The knowledge acquired in CS136L is essential for a successful programmer. In the past, we have expected students to pick up these skills on their own. The course will provide content that students can use throughout their undergraduate studies and use it as a reference during their coop placements. An additional benefit will be easing the transition for computer science majors into second year and allowing the Object-Oriented Programming course to regain focus on the subject it is meant to teach.
1.2 Course Description

This course introduces students to tools and techniques useful in the software development lifecycle. Students learn to navigate and leverage commands and utilities in the Linux Command Line Shell. Students gain experience in Version Control Software, writing scripts to automate tasks and creating effective test cases to identify bugs. Tracing and debugging strategies are discussed. Students also gain experience in using built-in support for version control, testing, debugging, build automation etc. in Integrated Development Environments (IDEs).

Course Credit Weight: 0.25  
Grading Basis: Credit (CR) / No Credit (NCR)  
Structure: 1 x 80-min LAB (scheduled)  
Resource/staffing Requirements: ISG supported course. Regular ISA/IA/TA support.

Prerequisite Courses: At least 90% in CS 115 or at least 70% in CS 116 or at least 60% in CS 135 or CS 145.  
Corequisite Courses: CS136 or CS146  
First Offering: To be determined  
Audience: Available to all students  
Availability: Whenever CS136 and CS146 are offered [ F,W,S ]

Courses requiring prerequisite changes: CS246, CS246E, CS 241, CS241E

1.3 Delivery and Assessment

The course will be delivered as an in-person LAB course using an active learning style. It is our belief that the benefits of a hands-on approach outweigh any resource constraints. The course is intended to be a practical way for students to learn productivity tools and techniques. An online environment or a lecture-style presentation of material is not conducive to this sort of learning. Students will prepare for labs in advance using material created by the instructor. During lab hours, TAs will provide support to students to complete “lab reports”. These labs will be used to assess student progress in the course. While some scheduled physical labs will be needed (for students who do not have laptops), other lab hours can be scheduled in regular classrooms with the students instructed to bring their own laptops.

A Credit/No-Credit assessment model is proposed for the course. A Credit will be granted based on sufficient demonstrated knowledge, through the filled lab reports.

1.4 Required Preparation

At the start of the course, students should have:

- experience in designing and implementing small programs in any programming language
1.5 Intended Learning Outcomes

On successful completion of the course, students will be able to:

- Interact with the Linux Operating System using a command line shell and gain familiarity with commands, utilities and tools.
- Create scripts to automate tasks and increase productivity while working on a software project.
- Design test cases and automate the testing process to check a program for functional correctness and incorrect memory usage.
- Use version control systems to share, contribute, manage and track code.
- Separately compile code modules and leverage build automation tools to do so efficiently.
- Effectively trace and debug software to identify sources of errors.
- Work with Integrated Development Environments and use supported features such as debugging, version control, build automation etc.

2 Outline

1. Linux Command Line shell [2 weeks]
   - Command line shell basics
   - Tools and utilities e.g. egrep, scp, ssh, awk, sed, cut, join, tr, time
   - File permissions
   - Command line arguments versus standard input

2. Integrated Development Environments [1 week]
   - Code Refactoring. When to refactor.
   - Code Linters. Analyze source code for errors, bugs, stylistic issues etc.

3. Version Control Software [1 week]
   - Create and share a project under version control
   - Track and contribute to existing projects
   - Work with project branches
   - Resolve conflicts while contributing to a project
   - Recover previous versions of a project
   - Explore IDE support for Version Control Software
4. Testing Programs [2 weeks]
   - Different forms of testing
   - Write input/output (I/O) test cases to test functionality
   - Perform regression testing
   - Explore IDE support for Testing Programs

5. Shell Scripting [2 weeks]
   - Use basic commands, tools and utilities as building blocks for more complex tasks
   - Write simple scripts to automate tasks e.g. automate testing

6. Memory Errors and Debugging [2 week]
   - Trace through a program using print statements
   - Trace through a program using a debugger
   - Use memory error detectors to identify memory errors e.g. memory leaks, invalid reads/writes, uninitialized memory etc.
   - Explore IDE support for debugging and detecting memory errors

7. Build automation [1 week]
   - Project management using build automation tools
   - Writing programs as small components that can be compiled separately
   - Explore IDE support for build automation

8. C/C++ Preprocessor [1 weeks]
   - Learn the behaviour of the C Preprocessor
   - Learn to use macros, include guards etc.