

**Faculty of Science** 

Office of the Dean St. John's, NL Canada A1B 3X7 Tel: 709 864 8154 Fax: 709 864 3316 deansci@mun.ca www.mun.ca/science

## MEETING OF THE FACULTY COUNCIL OF THE FACULTY OF SCIENCE

A regular meeting of the Faculty Council of the Faculty of Science will be held on Wednesday, November 17, 2021, at 1:00 p.m. by Webex.

#### AGENDA

- 1. Regrets
- 2. Adoption of the Minutes of October 20, 2021, and October 29, 2021
- 3. Business Arising from the Minutes
- 4. Correspondence: None
- 5. Reports of Standing Committees:
  - A. Undergraduate Studies Committee:
    - **a.** Department of Ocean Sciences, proposal to amend program regulations for a Major in Ocean Sciences (Environmental Systems), Paper 5.A.a. (pages 9 to18)
    - b. Department of Psychology, proposal to amend suggested course sequence for Table 3 B.A. (Honours) in Psychology (Co-operative); Table 4 B.Sc. (Honours) in Psychology (Co-operative); and Table 6 B.Sc. (Honours) in Behavioural Neuroscience (Co-operative), Paper 5.A.b. (pages 19 to 36)
    - **c.** Department of Psychology, proposal to amend requirements for a Major in Behavioural Neuroscience, Paper 5.A.c. (pages 37 to 47)
    - **d.** Department of Psychology, proposal to amend Psychology Work Term Descriptions, Paper 5.A.d. (pages 48 to 60)
    - e. Department of Psychology, proposal to amend Other Requirements for Psychology 3800, Psychology 3820 and Psychology 4870, Paper 5.A.e. (pages 61 to 72)
    - **f.** Department of Earth Sciences, proposal to amend Earth Sciences 3170 and 3172, Paper 5.A.f. (pages 73 to 81).
  - B. Graduate Studies Committee:
    - **a.** Department of Computer Science, proposal for a new joint graduate program with the Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science, Master of Applied Science in Software Engineering (brought forward from the Special Meeting held on October 29, 2021) Paper 5.B.a. (pages 82 to 155)

- **b.** Department of Computer Science, proposal for a new joint graduate program with the Department of Electrical and Computer Engineering, Faculty of Engineering, Master of Artificial Intelligence (brought forward from the Special Meeting held on October 29, 2021) Paper 5.B.b. (pages 156 to 239)
- C. Library Committee: No business
- 6. Reports of Delegates from Other Councils
- 7. Report of the Dean
- 8. Question Period
- 9. Adjournment

Travis Fridgen, Ph.D. Acting Dean of Science



**Faculty of Science** 

Office of the Dean St. John's, NL Canada A1B 3X7 Tel: 709 864 8154 Fax: 709 864 3316 deansci@mun.ca www.mun.ca/science

#### FACULTY OF SCIENCE FACULTY COUNCIL OF SCIENCE Minutes of Meeting of October 20, 2021

A meeting of the Faculty Council of the Faculty of Science was held on Wednesday, October 20, 2021, at 1:00 p.m. using Webex.

#### FSC 2868 Present

#### **Biochemistry**

M. Berry, D. Hunt, M. Longjohn, S. Mayengbam, M. Mulligan

#### Biology

E. Edinger, E. Vander Wal, Y. Wiersma

#### Chemistry

C. Bottaro, H. Grover, M. Katz, F. Kerton, C. Kozak, S. Pansare, D. Stirling

#### **Computer Science**

S. Bungay, C. Dohey, M. Emshey, C. Hyde, O. Meruvia-Pastor

#### Earth Sciences

J. Alsafwani, G. Dunning, A. Langille, G. Layne, M. Miskell

#### **Economics**

K. Chu

#### **Mathematics & Statistics**

C. Evans, D. Harvey, R. Haynes, J.C. Loredo-Osti, D. Pike, T. Sheel, M. Strong, S. Sullivan, H. Usefi, A. Variyath

**Ocean Sciences** D. Nichols, C. Parrish

#### **Physics & Physical Oceanography**

V. Booth, S. Curnoe, E. Demirov, M. Geng, E. Hayden, M. Morrow, J. Munroe, I. Saika-Voivod, A. Yethiraj, L. Zedel

#### Psychology

J. Lamarre, C. Thorpe, C. Walsh

#### **Dean of Science Office**

N. Bishop, J. Blundell, S. Dufour, K. Foss, T. Fridgen, G. Jackson, J. Kavanagh, G. Kenny, T. Mackenzie, V. MacNab, R. Newhook,

#### **Guests:**

A. Farrell

#### **Student Representatives:**

A. Alfosool, A. Meyer

#### FSC 2869 Regrets:

D. Boyce, L. Dunn, S. MacLachlan, A. Malcolm, S. Mantyka, K. Poduska, N. Ryan, R. Sipler, N. Vanasse, J. Whalen.

#### FSC 2870 Adoption of Minutes

**Moved:** Minutes of the meeting of September 15, 2021, be adopted. (Sullivan/Berry) **Carried** 

FSC 2871 Business Arising: None

#### FSC 2872 Committees of Science Faculty Council – Matrix

Suzanne Dufour: Composition of the committees circulated with agenda. (Dufour/Sullivan) **Carried** Updates on the staff, graduate and undergraduate representatives to FSFC is being worked on will be presented at the next meeting of Faculty Council.

**FSC 2873** Research Data Management – Presentation by Alison Farrell, Research Data Management and Public Services Librarian, Health Sciences Library Correction to the agenda: Alison Farrell presented, not Alison Randell. Ms. Farrell gave a very brief overview of research data management at Memorial. Tri-council agencies will require institutional strategies on RDM by March 1, 2023, and will require data management plans for some specific grant applications by Spring 2022. The goal is to ensure proper processes are in place and data is stored appropriately.

#### FSC 2874 Communities of Practice

An email will be coming soon that will introduce communities of practice on approaches with learners. One will be on indigenization and decolonization, and another will be on laboratory instruction.

#### FSC 2875 Research Week Activities

The Faculty of Science will have 3MT (Three Minute Thesis) for graduate students on Monday, Nov. 22, and this will be in person this year. The Facult of Science will be participating in the research forum by the VPR targeted around Mental Health research. On Wednesday, November 24, the Faculty of Science will host an On The Menu on Mitacs. The Mitacs group has been invited, as well as RGCS and the Grants Facilitation team from the Dean of Science Office to answer questions. There will also be a faculty-wide social, the details of which are being finalised.

#### FSC 2876 Correspondence: None

#### FSC 2877 Reports of Standing Committees:

#### A. Undergraduate Studies Committee:

Presented by Shannon Sullivan, Chair, Undergraduate Studies Committee:
a. Department of Physics and Physical Oceanography, calendar change to amend pre-requisites for PHYS 1021 (Sullivan/Zedel) Carried

#### B. Graduate Studies Committee:

- **a.** Department of Computer Science, proposal for a new course-based M.Sc. route (Layne/Sheel) **Carried** with 3 abstentions (2 plus James Munroe)
- C. Library Committee:

#### FSC 2878 Reports of Delegates from Other Councils: None

#### FSC 2879 Report of the Dean

Presented by Dr. Travis Fridgen, Acting Dean

#### 1. Dean's Award Ceremony

Last night we hosted the Dean's Awards ceremony in the Whale Pavilion. I think it was a great success, and it was really nice to see so many students again in one place. It was live streamed through Facebook live and the recording is on the Faculty of Science webpage. I think the ceremony went off very well thanks to everyone in the Dean of Science office, but especially Melanie Fitzpatrick and Kelly Foss who took the lead on organizing the entire evening.

#### 2. Special Meetings of Faculty Council

We will probably be calling two special meetings of faculty council. One to approve a pair of joint programs in Computer Science and Computer Engineering and a second to have the VPA and Provost, Dr. Florentine Strzelczyk, come and address council.

#### 3. Strategic Planning

In order to begin the consultation process, I have forwarded to departments a draft strategic plan, as well as a Powerpoint slide, that was presented at a strategic planning retreat with Heads and Deputy Heads from each department. Another important document to look at is the University's strategic plan. I look forward to discussing ideas with faculty and staff in each of the departments over the next month or so. As we discuss and eventually propose a forward-thinking strategic plan, I would like us all to keep open minds so we don not limit ourselves to the way we have approached education and programming in the past.

#### 4. A Whale of a Time

You may have seen on social media that the Faculty of Science and Landwash Brewery are collaborating on a special product. The brew is a Dry Hopped Saison that is hopped

with Saaz and an Experimental Hop, HC 586. This project is aimed at bringing Science and Science is Everything to the forefront and will be called Whale of a Time. There should be more social media communications soon, with the label being announced and canning occurring mid-November. Hopefully this will coincide with some of our activities that are being planned for research week.

#### 5. Winter Semester

As you have undoubtedly seen, the University has announced that the Winter Semester will be back to more nomal operations. This simply means that there will be no restrictions on class sizes and that we go back two broad modes of instruction, inperson and online. That means that we will have face-to-face contact time with our students. I would like to encourage people to evolve their modes of teaching by using techniques that worked during the pandemic. One mode of instruction is a blended model that has been around for decades, where content is delivered to students through short recordings or readings and then class time is used to work with the content, i.e. problem solving and class discussions. I really urge people to not fall back to simply lecturing to deliver content to our students.

#### FSC 2880 Question Period

There was discussion about the challenges experienced by researchers who were scheduled to move to the CSF. If, as a result of the commissioning process of CSF, researchers are experiencing delays that impact research and graduate student research, the Acting Dean encourages them to speak with their department Head about the specifics of those delays. With regard to space in the Science and Chemistry/Physics buildings, HSS departments will move into the Chemistry/Physics building permanently. The timing for these moves is unknown, but the renovation tenders for Chemistry/Physics have been done.

#### FSC 2881 Adjournment

The meeting adjourned at 2:01 p.m.



**Faculty of Science** 

Office of the Dean St. John's, NL Canada A1B 3X7 Tel: 709 864 8154 Fax: 709 864 3316 deansci@mun.ca www.mun.ca/science

#### FACULTY OF SCIENCE FACULTY COUNCIL OF SCIENCE Minutes of Special Meeting of October 29, 2021

A special meeting of the Faculty Council of the Faculty of Science was held on Friday, October 29, 2021, at 1:00 p.m. using Webex.

#### FSC 2882 Present

**Biochemistry** M. Berry, J. Brunton, P. Kakumani

#### **Biology**

E. Edinger

#### Chemistry

C. Bottaro, H. Grover, M. Katz, E. Merschrod, S. Pansare,

#### **Computer Science**

S. Anthony, E. Brown, S. Bungay, D. Churchill, O. Combden, C. Dohey, M. Emshey, J. Gagne, M. Hamilton, B. Hynes, O. Meruvia-Pastor, G. Miminis, L. Peña-Castillo, K. Popuri, V. Prado da Fonseca, A. Soares, T. Tricco

#### Earth Sciences A. Langille, G. Layne

**Economics** K. Chu

#### **Mathematics & Statistics**

A. Bihlo, I. Booth, D. Dyer, R. Haynes, J.C. Loredo-Osti, E. Martinez-Pedroza, T. Stuckless, A. Variyath,

**Ocean Sciences** C. Parrish

**Physics & Physical Oceanography** E. Demirov, M. Evstigneev, E. Hayden, J. Munroe, I. Saika-Voivod, A. Yethiraj, L. Zedel

**Psychology** C. Thorpe

#### **Dean of Science Office**

N. Bishop, J. Blundell, M. Fizpatrick, K. Foss, T. Fridgen, G. Jackson, J. Kavanagh, G. Kenny, T. Mackenzie, R. Newhook, J. Whalen

#### **Student Representatives:**

A. Meyer

#### FSC 2883 Regrets:

S. Dufour, F. Kerton, V. MacNab, D. McIlroy, N. Ryan, D. Stirling, A. Vardy, Y. Wiersma

#### FSC 2884 Reports of Standing Committee:

#### A. Graduate Studies Committee:

Presented by Dr. Sharene Bungay, Head, Department of Computer Science

**a.** Department of Computer Science, proposal for a new joint graduate program with the Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science, Master of Artificial Intelligence (Miminis/Bungay). **Defeated** 

Discussion on the motion overwhelmingly centered on the short timeframe for review and most felt there was not enough consultation. Item to be re-introduced at the regular November 17, 2021, meeting after time for consultation.

 b. Department of Computer Science, proposal for a new joint graduate program with the Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science, Master of Applied Science in Software Engineering (Miminis/Bungay). Defeated

Discussion on the motion overwhelmingly centered on the short timeframe for review and most felt there was not enough consultation.

Item to be re-introduced at the regular November 17, 2021, meeting after time for consultation.

#### FSC 2885 Adjournment

The meeting adjourned at 2:15 p.m.



#### Office of the Registrar

St. John's, NL Canada A1C 5S7 Tel: 709 864 8260 Fax: 709 864 2337 www.mun.ca

#### November 8, 2021

- TO: All Members of Faculty Council, Faculty of Science
- FROM: Tracey Edmunds, Secretary, Faculty of Science Committee on Undergraduate Studies

#### SUBJECT: Proposals for Calendar Changes

A virtual meeting held on November 4th, 2021, the Faculty of Science Committee on Undergraduate Studies agreed that the following item should be forwarded to Faculty Council for approval:

#### 1. Department of Ocean Sciences

(a) Amend program regulations for a Major in Ocean Sciences (Environmental Systems)

#### 2. Department of Psychology

- (a) Amend Suggested Course Sequence for Table 3 B.A. (Honours) in Psychology (Co-operative), Table 4 - B.Sc. (Honours) in Psychology (Co-operative), and Table 6 - B.Sc. (Honours) in Behavioural Neuroscience (Co-operative)
- (b) Amend requirements for a Major in Behavioural Neuroscience
- (c) Amend Psychology Work Term Descriptions

(d) Amend Other Requirements for Psychology 3800, Psychology 3820 and Psychology 4870

#### 3. Department of Earth Sciences

(a) Amend Earth Sciences 3170 and 3172

Tracey Edmundo

Tracey Edmunds

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- $\Box$  Amended or deleted course(s):
- □ New program(s):
- Amended or deleted program(s): Major in Ocean Sciences (Environmental Systems)
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

#### ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council: \_\_\_\_\_

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses

#### **PROGRAM TITLES**

BSc with Major in Ocean Sciences (Environmental Systems)

## RATIONALE

We wish to add another course (Geography 4190 Coastal Geomorphology) to the list among which students may choose "at least 9 credit hours at the 3000 and/or 4000 level". After reviewing the syllabus, we found it suitable to the program. We are also removing a Geography course that is no longer being offered (GEOG 3905).

#### **CALENDAR CHANGES under 11.9 Ocean Sciences**

**11.9.3.3 Program Regulations for the Major in Ocean Sciences (Environmental Systems)** Students must successfully complete:

- 1. the 30 credit hours required under Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems);
- 2. Statistics 2550 or any of the courses listed in the credit restrictions of Statistics 2550;
- 3. Physics 1021 or 1051;
- 4. Geography 1050, and at least two of Geography 2102, 2195, or 2425;
- 5. Earth Sciences 1002, 2502;
- 6. at least 9 credit hours at the 3000 and/or 4000 level chosen from:
  - a. Geography 3120, 3140, 3250, 3425, 3510, <u>3905,</u> 4050, 4060, <u>4190,</u> 4250, 4917; and
  - b. Earth Sciences 3600, 4605, 4903.
- 7. a minimum of 30 credit hours in Ocean Sciences, including:
  - a. Ocean Sciences 2000 (or Biology 3710), 2001, 2100 and 2500. Ocean Sciences 1000, successfully completed under Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems), will count as 3 of the required 30 credit hours in Ocean Sciences;
  - b. at least 9 credit hours in Ocean Sciences courses at the 3000 and/or 4000 level.
- 8. elective courses as necessary to make up the total of 120 credit hours.

#### CALENDAR CHANGES under 11.9 Ocean Sciences (clean version)

**11.9.3.3 Program Regulations for the Major in Ocean Sciences (Environmental Systems)** Students must successfully complete:

- 1. the 30 credit hours required under Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems);
- 2. Statistics 2550 or any of the courses listed in the credit restrictions of Statistics 2550;
- 3. Physics 1021 or 1051;
- 4. Geography 1050, and at least two of Geography 2102, 2195, or 2425;
- 5. Earth Sciences 1002, 2502;

- 6. at least 9 credit hours at the 3000 and/or 4000 level chosen from:
  - a. Geography 3120, 3140, 3250, 3425, 3510, 4050, 4060, 4190, 4250, 4917; and
  - b. Earth Sciences 3600, 4605, 4903.
- 7. a minimum of 30 credit hours in Ocean Sciences, including:
  - a. Ocean Sciences 2000 (or Biology 3710), 2001, 2100 and 2500. Ocean Sciences 1000, successfully completed under Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems), will count as 3 of the required 30 credit hours in Ocean Sciences;
  - b. at least 9 credit hours in Ocean Sciences courses at the 3000 and/or 4000 level.
- 8. elective courses as necessary to make up the total of 120 credit hours.

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page

From	<b>Response Received</b>
Grenfell campus	Yes
Faculty of Business Administration	Yes
Faculty of Education	No
Faculty of Engineering & Applied Science	Yes
Faculty of Humanities & Social Sciences	Yes
Faculty of Medicine	Yes
Faculty of Science	Yes
Department of Biochemistry	
Department of Biology	
Department of Chemistry	
Department of Computer Sciences	
Department of Earth Sciences	
Department of Economics	
Department of Geography	Х
Department of Mathematics and Statistics	
Department of Physics and Physical Oceanography	
Department of Psychology	
Marine Institute	No
School of Human Kinetics and Recreation	No
School of Music	Yes
School of Nursing	No
School of Pharmacy	Yes
School of Social Work	Yes

#### LIBRARY REPORT

Not applicable.

**RESOURCE IMPLICATIONS** None.

#### **1. CONSULTATION REQUEST**

From: Annie Mercier <a mercier@mun.ca>
Date: September 24, 2021 at 11:00:38 AM NDT
To: Faculty of Humanities and Social Sciences <<u>hss@mun.ca</u>>, "Shannahan, Rachelle"
<rshannahan@mun.ca>, "Furey, Edith" <<u>efurey@mun.ca</u>>, Engineering
<<u>engrconsult@mun.ca</u>>, HKR Dean <<u>hkrdean@mun.ca</u>>, Medicine
<<u>deanofmedicine@med.mun.ca</u>>, School of Science Environm Grenfell
<<u>ssedean@grenfell.mun.ca</u>>, MI UG Consultation <<u>miugconsultations@mi.mun.ca</u>>, Ashlee
Cunsolo <<u>ashlee.cunsolo@mun.ca</u>>, Karen Bulmer <<u>kbulmer@mun.ca</u>>, DeanNurse
<<u>DeanNurse@mun.ca</u>>, Pharmacy <<u>pharminfo@mun.ca</u>>, Dean of Science <<u>deansci@mun.ca</u>>, adeanugradswk <<u>adeanugradswk@mun.ca</u>>, Ken Jacobson <<u>kjacobse@grenfell.mun.ca</u>>, Todd
Henessey <<u>THENNESSEY@grenfell.mun.ca</u>>
Subject: Consultation on calendar change in Ocean Sciences

Greetings everyone:

We are welcoming feedback on a minor proposed change to the calendar description of the Major in Ocean Sciences (Environmental Systems). See attached. Please return your comments and feedback to me, if possible by October 15. All the best, Annie

Annie Mercier, PhD Professor and Deputy Head UG Department of Ocean Sciences Memorial University 709-864-2011 amercier@mun.ca

#### 2. FEEDBACK RECEIVED

On 2021-09-24 11:28 a.m., Giwa, Sulaimon wrote:

Morning, Annie, I hope you are well. I had a chance to review the minor calendar change and observed no issue with the proposed changes. All the best,

Dr. Sulaimon Giwa Assistant Professor Associate Dean of Undergraduate Programs Cross-Appointed to the Department of Sociology, Police Studies School of Social Work, J-3002 Memorial University of Newfoundland and Labrador 230 Prince Philip Drive St. John's, NL A1C 5S7 709-864-7940

Endowed Chair in Criminology and Criminal Justice Department of Criminology and Criminal Justice St. Thomas University Fredericton, NB E3B 5G3

http://www.mun.ca/socwrk/about/people/faculty/DrSulaimonGiwa.php https://scholar.google.ca/citations?user=ypwEMY8AAAAJ&hl=en http://mun.academia.edu/SulaimonGiwa https://name-coach.com/sulaimon?preview=on

On 2021-10-11 10:47 a.m., Annie Mercier wrote:

Hi Norm: Many thanks - will do. All the best, Annie

Annie Mercier, PhD Professor and Deputy Head UG Department of Ocean Sciences Memorial University 709-864-2011 amercier@mun.ca

On 2021-09-27 11:35 a.m., Catto, Norm wrote:

Dear Annie:

Geog 3905 no longer exists, being replaced by 4050.

Take care and best wishes Norm

Norm Catto Department of Geography Memorial University St. John's NL A1B 3X9 Canada Fax 1-709-864-3119 Home 368-3024 Office 864-8412

On 2021-09-27 3:58 p.m., Oldford, Erin wrote:

Hi Dr. Mercier,

We have no comments to add.

Best wishes, Erin

Dr. Erin Oldford Interim Associate Dean, Undergraduate Programs Faculty of Business Administration Memorial University of Newfoundland

On 2021-09-28 9:19 a.m., Davis, Erin wrote:

Hi Annie,

Pharmacy has no concerns with the proposed change, we don't anticipate it will affect our students. Thank you for the opportunity to review and comment on it!

Erin

Erin Davis, PharmD Associate Dean Undergraduate Studies Associate Professor Memorial University School of Pharmacy T 709 864 8815 E <u>emdavis@mun.ca</u>

On 2021-09-28 11:41 a.m., DeanofMedicine@med.mun.ca wrote:

Thank you for the opportunity to review the minor change proposal for the Ocean Sciences program. I have read the document and have no concerns wrt FoM. Best Dolores

On 2021-09-28 2:09 p.m., Hennessey, Todd wrote:

Hi Annie Thanks for this; Fine Arts has no feedback for you at this time.

Cheers Todd

TODD HENNESSEY, PhD (Birmingham) | DEAN

School of Fine Arts Grenfell Campus, Memorial University Corner Brook, Newfoundland O: 709.637.6277 C: 709.640.5695 www.grenfell.mun.ca

On 2021-09-28 2:16 p.m., McKeen, Dolores Madeline wrote: Dr. Mercier, I have read the document and have no concerns from the Faculty of Medicine's perspective. Thank you for the opportunity to review the change proposal for the Ocean Sciences program. Best Dolores

Dolores M McKeen MD FRCPC MSc CCPE Vice Dean | Education & Faculty Affairs Professor | <u>Memorial University of Newfoundland</u> President | <u>Canadian Anesthesiologists' Society</u> @dolores\_mckeen

Faculty of Medicine

Memorial University of Newfoundland Faculty of Medicine Building | Rm 2M315 300 Prince Philip Drive St. John's NL CA A1B 3V6 T: 709 864 6417 | F: 709 864 6336

On 2021-09-29 2:41 p.m., Hoff, Shannon wrote:

Hello Annie,

The proposed change looks like a good one.

Shannon

Shannon Hoff Associate Professor of Philosophy Acting Associate Dean (Curriculum and Programs) Faculty of Humanities and Social Sciences Memorial University St. John's, NL A1C 5S7 https://www.mun.ca/faculty/shoff/

On 2021-10-01 4:22 p.m., Karen Bulmer wrote:

The School of Music has no issue with the proposed changes. Sincerely,

Dr. Karen Bulmer I Acting Dean (she/her) School of Music Memorial University St. John's, NL 709 864 7486 www.mun.ca/music I www.facebook.com/musicatmemorial I @musicatmemorial

On 2021-10-08 2:32 p.m., Bailey, Robert F. wrote:

Dear Annie,

The proposed Calendar change from your department have been forwarded to me. I have consulted with the chairs of the Environmental Science and the Environment and Sustainability programs, and we find that this change will have no impact on programs in the School of Science and the Environment at Grenfell Campus. We are happy to support this.

Thank you for the opportunity to comment on these proposals.

\_\_\_\_\_

Regards, Robert Bailey Chair, Committee on Academic Programming School of Science and the Environment

Dr. Robert Bailey Associate Professor, Mathematics Chair, General Science program School of Science and the Environment

Grenfell Campus Memorial University of Newfoundland Corner Brook, NL A2H 6P9, Canada

Office: AS 3022 Phone: +1 (709) 637-6293 Web: <u>https://www2.grenfell.mun.ca/rbailey/</u>

On 2021-10-16 5:47 p.m., Engineering Consult wrote:

Dear Dr. Mercer, We support your request and find that it has no impact on Engineering. Best regards, Bruce

Dr. Bruce Quinton, Chair Committee on Undergraduate Studies Faculty of Engineering and Applied Science Memorial University of Newfoundland St. John's NL A1B 3X5

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- $\Box$  Amended or deleted course(s):
- $\Box$  New program(s):
- X Amended or deleted program(s): 11.11.9 Suggested Course Sequences
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

## ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council:

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Programs

# **PROGRAM TITLE**

11.11.9 Suggested Course Sequences

## RATIONALE

These changes make the following clarifications for student information purposes to Table 3- Suggested Course Sequence for B.A. (Honours) in Psychology (Co-operative), Table 4- Suggested Course Sequence for B.Sc. (Honours) in Psychology (Cooperative), and Table 6 - Suggested Course Sequence for B.Sc. (Honours) in Behavioural Neuroscience (Co-operative) to indicate:

1) PSYC 499B can be taken in the Spring (Optional) semester for students who took PSYC 499A (Tables 3, 4, and 6); and

2) PSYC 4910 may be offered in Fall or Winter semesters (change to wording in Winter Semester 6, Tables 3 and 4).

# **CALENDAR CHANGES**

#### Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Cooperative)

Term	Suggested Courses
Fall Semester 1	<ul> <li>Critical Reading and Writing requirement</li> <li>Elective or Humanities and Social Sciences requirement <u>BA Language Study</u> requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Mathematics 1000 or one of Mathematics 1090, 1050, 1051</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li>Critical Reading and Writing requirement</li> <li>Elective or Humanities and Social Sciences requirement <u>BA Language Study</u> requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>One of Mathematics 1000, 1090, 1050 or 1051 (Psychology Majors are required to successfully complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.)</li> <li>Psychology 1001</li> </ul>
Fall Semester 3	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 2520 or 2930</li> <li>Psychology 2910</li> </ul>

Winter Semester 4	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 2911</li> <li>Psychology 2930 or 2520</li> </ul>
Spring Work Term 1	Psychology 199W
Fall Semester 5	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3900</li> </ul>
Winter Semester 6	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology Research Experience course</li> <li>Psychology 4910 (may be offered in Fall or Winter semester)</li> </ul>
Spring Work Term 2	Psychology 299W
Fall Semester 7	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 4000-Level Core</li> <li>Psychology Selected Topics course</li> <li>Psychology 499A</li> </ul>
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A, or 499B
Fall Semester 8	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 4000-Level Core</li> <li>Psychology 499B</li> </ul>

# Table 4 Suggested Course Sequence for B.Sc. (Honours) in Psychology (Cooperative)

Term	Suggested Courses
Fall Semester 1	<ul> <li>Biology 1001</li> <li>Chemistry 1010 (or 1050) or Physics 1020 (or 1050) (Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090)).</li> </ul>

	<ul> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1090 or Mathematics 1000</li> </ul>
	Psychology 1000
Winter Semester 2	<ul> <li>Biology 1002</li> <li>the former Chemistry 1011 (or 1051) or Physics 1021 (or 1051)</li> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1000 or Elective or Science requirement</li> <li>Psychology 1001</li> </ul>
Fall Semester 3	<ul> <li>Biology, Chemistry, or Physics Lab Course</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology 2520 or 2930</li> <li>Psychology 2910</li> </ul>
Winter Semester 4	<ul> <li>Biology, Chemistry, or Physics Lab Course</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology 2911</li> <li>Psychology 2930 or 2520</li> </ul>
Spring Work Term 1	Psychology 199W
Fall Semester 5	<ul> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3900</li> </ul>
Winter Semester 6	<ul> <li>Elective or Science requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology Research Experience</li> <li>Psychology 4910 (may be offered in Fall or Winter semester)</li> </ul>
Spring Work Term 2	Psychology 299W
Fall Semester 7	<ul> <li>Elective or Science requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 4000-Level</li> <li>Psychology Selected Topics</li> <li>Psychology 499A</li> </ul>
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A, or 499B
Fall Semester 8	<ul> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology 3000-Level Core</li> </ul>

Psychology 4000-Level Core
Psychology 499B

# Table 6 Suggested Course Sequence for B.Sc. (Honours) in BehaviouralNeuroscience (Co-operative)

Term	Suggested Courses
Fall Semester 1	<ul> <li>Biology 1001 or Physics 1020 (or 1050) (Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090)).</li> <li>Chemistry 1050 (or 1200)</li> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1090 or 1000</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li>Biology 1002 or Physics 1021 (or 1051)</li> <li>Chemistry 1051 (or 1001)</li> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1000 or 1001</li> <li>Psychology 1001</li> </ul>
Fall Semester 3	<ul> <li>BHNR Requirement 1 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Physics 1020 (or 1050) or Biology 1001(Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090)).</li> <li>Psychology 2521 or 2930</li> <li>Psychology 2910</li> </ul>
Winter Semester 4	<ul> <li>BHNR Requirement 2 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Mathematics 1001 or Elective or Science requirement</li> <li>Physics 1021 (or 1051) or Biology 1002</li> <li>Psychology 2911</li> <li>Psychology 2930 or 2521</li> </ul>
Spring Work Term 1	Psychology 199W
Fall Semester 5	<ul> <li>BHNR Requirement 3 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Psychology 3810, 3830, 3840, or 3860</li> <li>Psychology 3800</li> <li>Psychology 3900</li> </ul>
Winter Semester 6	<ul> <li>BHNR Requirement 4 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology 3000-level core</li> </ul>

	Psychology 3820
Spring Work Term 2	Psychology 299W
Fall Semester 7	<ul> <li>BHNR Requirement 5 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology Research Experience course</li> <li>Psychology 499A</li> </ul>
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A <u>, or 499B</u>
Fall Semester 8	<ul> <li>BHNR Requirement 6 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology Selected Topics course</li> <li>Psychology 499B</li> </ul>

# CALENDAR ENTRY AFTER CHANGES

#### Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Cooperative)

Term	Suggested Courses
Fall Semester 1	<ul> <li>Critical Reading and Writing requirement</li> <li>BA Language Study requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Mathematics 1000 or one of Mathematics 1090, 1050, 1051</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li>Critical Reading and Writing requirement</li> <li>BA Language Study requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>One of Mathematics 1000, 1090, 1050 or 1051 (Psychology Majors are required to successfully complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.)</li> <li>Psychology 1001</li> </ul>
Fall Semester 3	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 2520 or 2930</li> </ul>

	Psychology 2910
Winter Semester 4	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 2911</li> <li>Psychology 2930 or 2520</li> </ul>
Spring Work Term 1	Psychology 199W
Fall Semester 5	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3000-Level Core</li> <li>Psychology 3900</li> </ul>
Winter Semester 6	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology Research Experience course</li> <li>Psychology 4910 (may be offered in Fall or Winter semester)</li> </ul>
Spring Work Term 2	Psychology 299W
Fall Semester 7	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 4000-Level Core</li> <li>Psychology Selected Topics course</li> <li>Psychology 499A</li> </ul>
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A, or 499B
Fall Semester 8	<ul> <li>Elective or Humanities and Social Sciences requirement</li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Psychology 3000-Level Core</li> <li>Psychology 4000-Level Core</li> <li>Psychology 499B</li> </ul>

# Table 4 Suggested Course Sequence for B.Sc. (Honours) in Psychology (Cooperative)

Term	Suggested Courses
Fall Semester 1	• Biology 1001

	• Chemistry 1010 (or 1050) or Physics 1020 (or 1050) (Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090))
	<ul> <li>Critical Reading and Writing requirement</li> </ul>
	Mathematics 1090 or Mathematics 1000
	Psychology 1000
	Biology 1002
Winter	• the former Chemistry 1011 (or 1051) or Physics 1021 (or 1051)
Semester 2	Critical Reading and Writing requirement
	Mathematics 1000 or Elective or Science requirement     Beychology 1001
	Psychology 1001     Biology Chamistan on Dhusica Lab Courses
	Biology, Chemistry, or Physics Lab Course     Elective or Science requirement
Fall	Elective of Science requirement
Semester 3	<ul> <li>Psychology 2520 or 2930</li> </ul>
	Psychology 2910
	Biology, Chemistry, or Physics Lab Course
Winter	Elective or Science requirement
Semester 4	Elective or Science requirement
	Psychology 2911
	Psychology 2930 or 2520
Spring Work Term 1	Psychology 199W
	Elective or Science requirement
Fall	Elective or Science requirement
Semester 5	Psychology 3000-Level Core
	Psychology 3000-Level Core     Bsychology 3900
	Elective or Science requirement
	Psychology 3000-Level Core
Winter	<ul> <li>Psychology 3000-Level Core</li> </ul>
Semester 6	<ul> <li>Psychology Research Experience</li> </ul>
	<ul> <li>Psychology 4910 (may be offered in Fall or Winter semester)</li> </ul>
Spring Work Term 2	Psychology 299W
	Elective or Science requirement
Fall	Psychology 3000-Level Core
Semester 7	Psychology 4000-Level
	Psychology Selected Topics     Device the second seco
	• Psychology 499A
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A, or 499B
Fall	Elective or Science requirement

Semester 8	Elective or Science requirement
	Psychology 3000-Level Core
	Psychology 4000-Level Core
	Psychology 499B

# Table 6 Suggested Course Sequence for B.Sc. (Honours) in BehaviouralNeuroscience (Co-operative)

Term	Suggested Courses
Fall Semester 1	<ul> <li>Biology 1001 or Physics 1020 (or 1050) (Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090)).</li> <li>Chemistry 1050 (or 1200)</li> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1090 or 1000</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li>Biology 1002 or Physics 1021 (or 1051)</li> <li>Chemistry 1051 (or 1001)</li> <li>Critical Reading and Writing requirement</li> <li>Mathematics 1000 or 1001</li> <li>Psychology 1001</li> </ul>
Fall Semester 3	<ul> <li>BHNR Requirement 1 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Physics 1020 (or 1050) or Biology 1001(Students registered in Physics 1050 must also be registered in Mathematics 1000 (not 1090)).</li> <li>Psychology 2521 or 2930</li> <li>Psychology 2910</li> </ul>
Winter Semester 4	<ul> <li>BHNR Requirement 2 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Mathematics 1001 or Elective or Science requirement</li> <li>Physics 1021 (or 1051) or Biology 1002</li> <li>Psychology 2911</li> <li>Psychology 2930 or 2521</li> </ul>
Spring Work Term 1	Psychology 199W
Fall Semester 5	<ul> <li>BHNR Requirement 3 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Psychology 3810, 3830, 3840, or 3860</li> <li>Psychology 3800</li> <li>Psychology 3900</li> </ul>
Winter Semester 6	<ul> <li>BHNR Requirement 4 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> </ul>

	<ul> <li>Elective or Science requirement</li> <li>Psychology 3000-level core</li> <li>Psychology 3820</li> </ul>
Spring Work Term 2	Psychology 299W
Fall Semester 7	<ul> <li>BHNR Requirement 5 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology Research Experience course</li> <li>Psychology 499A</li> </ul>
Winter Work Term 3	Psychology 399W
Spring (Optional)	Psychology 499A, or 499B
Fall Semester 8	<ul> <li>BHNR Requirement 6 (BHNR Requirement 1-6 specified in clause 3, Requirements for a Major in Behavioural Neuroscience (B.Sc. Only).</li> <li>Elective or Science requirement</li> <li>Elective or Science requirement</li> <li>Psychology Selected Topics course</li> <li>Psychology 499B</li> </ul>

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page

CONSULTATIONS SOUGHT	0
Consultations Sought From	<b>Comments Received</b>
Grenfell Campus	
Arts and Social Science	
Fine Arts	Yes
Science and the Environment	Yes
St. John's Campus	
Business	
Education	
Engineering	Yes
Human Kinetics and Recreation	
Humanities and Social Sciences	Yes
Medicine	Yes
Music	
Nursing	
Pharmacy	Yes
Science	
Social Work	
University Library	
Labrador Institute	
Arctic and Subarctic Studies	

Marine Institute

#### Subject FW: Proposed Calendar Changes, Psychology Department- Consulation Request



From Davis, Erin <emdavis@mun.ca>

To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>

Date 2021-10-05 15:17

- 1. Program Change\_Tables 11.11.9\_Tables 4, 5, 6.docx (~34 KB)
- 2. Calendar\_Program\_Change\_11.11.5. Reqs BHNR.docx (~21 KB)
- 3. Calendar Course Change- Psyc Co-op Courses (12.11.3).docx (~23 KB)
- 4. Calendar Course Change- OR Additions(12.11.2).docx (~21 KB)

Hi Carolyn,

Thank you for the opportunity to comment on the proposed changes. We don't believe they will affect our pharmacy programs or students and have no concerns.

Erin

--Erin Davis, PharmD Associate Dean Undergraduate Studies Associate Professor Memorial University School of Pharmacy T 709 864 8815 E <u>emdavis@mun.ca</u>

----Original Message----From: Deputy Head, Department of Psychology [mailto:psychdeputyhead@mun.ca]
Sent: Tuesday, October 5, 2021 12:22 PM
To: Faculty of Humanities and Social Sciences <<u>hss@mun.ca</u>>; Shannahan, Rachelle
<<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; kjacobse@grenfell.mun.ca;
ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; HKR Dean <<u>hkrdean@mun.ca</u>>; Ashlee Cunsolo
<<u>ashlee.cunsolo@mun.ca</u>>; miugconsultations@mi.mun.ca; deanofmedicine@med.mun.ca; Karen Bulmer
<<u>kbulmer@mun.ca</u>>; DeanNurse <<u>DeanNurse@mun.ca</u>>; pharminfo@mun.ca; Dean of Science
<<u>deansci@mun.ca</u>>; adeanugradswk <<u>adeanugradswk@mun.ca</u>>; Library Correspondence <<u>univlib@mun.ca</u>>
Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks,

**RE: Proposed Calendar Changes, Psychology Department- Consulation** Subject roundcube Request Hennessey, Todd <THENNESSEY@grenfell.mun.ca> open source webmail software From То Deputy Head, Department of Psychology <psychdeputyhead@mun.ca> 2021-10-05 15:54 Date Hi Carolyn Thanks for the chance to review; Fine Arts has no feedback at this time. All the best, Todd TODD HENNESSEY, PhD (Birmingham) DEAN School of Fine Arts Grenfell Campus, Memorial University Corner Brook, Newfoundland 0: 709.637.6277 C: 709.640.5695 www.grenfell.mun.ca Chat with me on Teams! ----Original Message-----From: Deputy Head, Department of Psychology <psychodeputyhead@mun.ca> Sent: October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; Shannahan, Rachelle <<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; Jacobsen, Ken <<u>kjacobse@grenfell.mun.ca</u>>; Dean - School of Science and the Environment <<u>ssedean@grenfell.mun.ca</u>>; Hennessey, Todd <<u>THENNESSEY@grenfell.mun.ca</u>>; hkrdean@mun.ca; Ashlee Cunsolo <ashlee.cunsolo@mun.ca>; MIUG Consultations <<u>MIUGconsultations@mi.mun.ca</u>; <u>deanofmedicine@med.mun.ca</u>; Karen Bulmer <<u>kbulmer@mun.ca</u>>; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca Cc: psychundergradadvisor@mun.ca Subject: Proposed Calendar Changes, Psychology Department- Consulation Request Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to: 1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error; 2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors; 3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty; 4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses. These changes will not require a Library Report and have no resource implications. Please send any comments on these proposals to me at: psychdeputyhead@mun.ca Feedback by October 26th would be appreciated. Thanks, Carolyn Carolyn Walsh, PhD (she/her) Associate Professor

5.A.b. (Page 31 of 239)

Subject	RE: Proposed Calendar Changes, Psychology Department- Consulation Request
From	Shute,Renee S. <rshute@mun.ca></rshute@mun.ca>
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>
Date	2021-10-07 09:32



Hi Carolyn,

If it is not too late, might I make a suggestion for Proposal 1 Program Change 11.11.9 Tables 4, 5, 6 (the tables in the proposal are actually 3, 4, 6).

In table 3 might I suggest?

#### Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Co-operative)

Term	Suggested Courses
Fall Semester 1	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Mathematics 1000 or one of Mathematics 1090, 1050, 1051</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u> <u>BA Language Study Requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>One of Mathematics 1000, 1090, 1050 or 1051 (Psychology Majors are required to successfully complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.)</li> <li>Psychology 1001</li> </ul>

Thanks for listening

Renee

Renée Shute

Manager of Academic Programs, Faculty of Humanities and Social Sciences

Memorial University of Newfoundland

St. John's, NL, Canada A1C 5S7

Office: AA4077

Tel (709) 864-7454

Subject RE: Proposed Calendar Changes, Psychology Department- Consulation Request



From Bailey, Robert F. <rbailey@grenfell.mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc Piercey-Normore, Michele D <mpiercey-normore@grenfell.mun.ca>, Scott, Robert J. <rscott@grenfell.mun.ca>, Bennett, Sylvia S. <sylviab@grenfell.mun.ca>
- Date 2021-10-07 16:09

Dear Carolyn,

The four sets of proposed Calendar changes in the Department of Psychology have been forwarded to me. None of the changes have any impact on programs in the School of Science and the Environment at Grenfell Campus. I do have a couple of comments on item 3 (changes to the Behavioural Neuroscience program), particularly the listings of mathematics and physics courses, given that these listings are being reviewed. (I also noticed that "Neuroscience": is misspelled in a couple of places in the proposal document!)

It seems odd to me (as a mathematics faculty member) that the listing of mathematics courses specifically includes MATH 3000 and 3001: these are typically taken only by students completing a major or minor in mathematics, as the content is quite abstract and non-mathematics students would find it challenging. Also, in the past few years, MATH 2320 has been added as an additional prerequisite for MATH 3000. In fact, the majority of 3000- or 4000-level mathematics courses have either MATH 2320 (for pure mathematics) or MATH 2260 (for applied mathematics) as a prerequisite. Consequently, it may be wise to list these two courses as options at the 2000-level, and have a general statement about 3000/4000-level courses (as is done for the other disciplines).

For Physics, I can understand why PHYS 2151 is excluded, given that it is a general-interest astronomy course rather than one with significant physics content. PHYS 2150, another general-interest astronomy course with complementary subject matter, has recently been added to the Grenfell Campus section of the Calendar; this is typically offered as an online course, with many St. John's students enrolling in it, so you may also want to add this to the list of exceptions.

Thank you for the opportunity to comment on these proposals.

Regards,

**Robert Bailey** 

Chair, Committee on Academic Programming

School of Science and the Environment

\_\_\_\_\_

Dr. Robert Bailey

Associate Professor, Mathematics

Chair, General Science program

School of Science and the Environment

Grenfell Campus

Memorial University of Newfoundland Corner Brook, NL A2H 6P9, Canada

Subject	Re: Proposed Calendar Changes, Psychology Department- Consulation Request	٢
From	Engineering Consult <engrconsult@mun.ca></engrconsult@mun.ca>	0
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>	
Date	2021-10-20 14:06	

5.A.b. (Page 34 of 239)

Dear Carolyn,

Thank you for the opportunity to respond to your below consultation request.

Engineering reports no impact on our program, and is happy to support this request.

Best regards, Bruce

---Dr. Bruce Quinton, Chair Committee on Undergraduate Studies Faculty of Engineering and Applied Science Memorial University of Newfoundland St. John's NL A1B 3X5

On 2021-10-05 12:22, Deputy Head, Department of Psychology wrote: Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the in-person Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn



Request From McKeen, Dolores Madeline <dmckeen@mun.ca>

- **To** psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc DeanofMedicine@med.mun.ca <DeanofMedicine@med.mun.ca>

Re: Proposed Calendar Changes, Psychology Department- Consulation

Date 2021-10-07 12:17

Dr. Walsh,

Subject

I have reviewed the above noted Proposed Calendar Changes, Psychology Department on behalf of Dean Steele for the Faculty of Medicine and have no concerns. Thanks Dolores

Dolores M McKeen MD FRCPC MSc CCPE Vice Dean | Education & Faculty Affairs Professor | Memorial University of Newfoundland President | Canadian Anesthesiologists' Society @dolores\_mckeen

Faculty of Medicine <<u>http://www.med.mun.ca/</u>> Memorial University of Newfoundland Faculty of Medicine Building | Rm 2M315 300 Prince Philip Drive St. John's NL CA A1B 3V6 T: 709 864 6417 | F: 709 864 6336

----Original Message----From: Deputy Head, Department of Psychology <<u>psychdeputyhead@mun.ca</u>> Sent: Tuesday, October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; <u>rshannahan@mun.ca</u>; <u>efurey@mun.ca</u>; <u>engrconsult@mun.ca</u>;

kjacobse@grenfell.mun.ca; ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; hkrdean@mun.ca; Cunsolo, Ashlee <ashlee.cunsolo@mun.ca>; miugconsultations@mi.mun.ca; Steele, Dr. Margaret: Dean of Medicine <<u>DeanofMedicine@med.mun.ca</u>>; kbulmer@mun.ca; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca

Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn

# LIBRARY REPORT

None required

# **RESOURCE IMPLICATIONS**

None
# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- $\Box$  Amended or deleted course(s):
- $\Box$  New program(s):
- Amended or deleted program(s): 11.11.5 REQUIREMENTS FOR A MAJOR IN BEHAVIORAL NEUROSCIENCE
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

## ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council:

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Programs

## **PROGRAM TITLE** 11.11.5 REQUIREMENTS FOR A MAJOR IN BEHAVIORAL NEUROSCIENCE

## RATIONALE

Remove Math 1001 from 11.11.5. 2 (a), as the content is not required for Behavioural Neuroscience majors.

Add two additional courses, CHEMISTRY 2302 and 2610 to the clause of acceptable Chemistry laboratory courses that majors may complete to fulfill 11.11.5. 3 (c).

## **CALENDAR CHANGES**

## 11.11.5 Requirements for a Major in Behavioural Neuroscience (B.Sc. Only)

Students completing this program cannot receive credit for Psychology 2920.

A program is offered in the Psychology Department to provide an education in Behavioural Neuroscience. Students planning to enroll in the program are advised to consult with the Head of the Department at the earliest opportunity because certain course choices may restrict later options. Students who intend to pursue graduate studies should take courses leading to the Honours degree.

As a component of the <u>Degree Regulations</u> for the General Degree of Bachelor of Science, the program for a Major in Behavioural Neuroscience shall include:

- 1.
- a. Psychology 1000, 1001, 2521, 2910, 2911, 2930, 3800, 3820, and one of 3810, 3830, 3840, or 3860.
- b. Three credit hours in Psychology chosen from the following: 3050, 3100, the former 3250, 3251, 3350, 3450, 3620, 3650, 3750.
- c. Any research experience course and one of Psychology 4250, 4251, 4850, 4851, 4852, 4853, or 4854; or, any selected topics course and Psychology 4870.
- 2.
- a. Mathematics 1000 (or equivalent) and 1001.
- b. Chemistry 1050 and 1051 (or 1200 and 1001).
- c. Physics 1020 (or 1050) and 1021 (or 1051).
- d. Biology 1001 and 1002.
- e. Six credit hours in <u>Critical Reading and Writing (CRW)</u> courses, including at least 3 credit hours in English courses.

- 3. Eighteen credit hours from the following courses chosen from at least two different sciences:
  - a. Biochemistry: Any 2000-, 3000-, or 4000-level course except the former 2000, 2005, the former 2010, the former 2011, 3202, 3402, or 4502.
  - b. Biology: Any 2000-, 3000-, or 4000-level course except 2040, 2041, 2120, 3053, or 3820.
  - c. Chemistry: 2100, 2210, 2301 (or the former Chemistry 2300), <u>2302,</u> 2400, 2401, <u>2610</u>, or any 3000 or 4000 level course.
  - d. Computer Science: Any 2000, 3000, or 4000 level course except the former 2650 and the former 2801.
  - e. Ocean Sciences: any 2000-, 3000-, or 4000-level course.
  - f. Mathematics: 2000, 2050, 2051, 3000, 3001 or any 3000 or 4000 level pure or applied mathematics course.
  - g. Medicine 310A/B.
  - h. Physics: Any 2000, 3000, or 4000 level course except 2151, 3150, 3151.

1. Credit may not be obtained for both Biology 3750 and Psychology 3750 or for both Biology 4701 and Psychology 4701.

2. The courses listed under Clause 3 may have prerequisites. It is the student's responsibility to ensure that all prerequisites have been met, or that waivers have been obtained, before registering for these courses.

## CALENDAR ENTRY AFTER CHANGES

## 11.11.5 Requirements for a Major in Behavioural Neuroscience (B.Sc. Only)

Students completing this program cannot receive credit for Psychology 2920.

A program is offered in the Psychology Department to provide an education in Behavioural Neuroscience. Students planning to enroll in the program are advised to consult with the Head of the Department at the earliest opportunity because certain course choices may restrict later options. Students who intend to pursue graduate studies should take courses leading to the Honours degree.

As a component of the <u>Degree Regulations</u> for the General Degree of Bachelor of Science, the program for a Major in Behavioural Neuroscience shall include:

1

Notes:

- a. Psychology 1000, 1001, 2521, 2910, 2911, 2930, 3800, 3820, and one of 3810, 3830, 3840, or 3860.
- b. Three credit hours in Psychology chosen from the following: 3050, 3100, the former 3250, 3251, 3350, 3450, 3620, 3650, 3750.
- c. Any research experience course and one of Psychology 4250, 4251, 4850, 4851, 4852, 4853, or 4854; or, any selected topics course and Psychology 4870.
- 2
- a. Mathematics 1000 (or equivalent).

- b. Chemistry 1050 and 1051 (or 1200 and 1001).
- c. Physics 1020 (or 1050) and 1021 (or 1051).
- d. Biology 1001 and 1002.
- e. Six credit hours in <u>Critical Reading and Writing (CRW)</u> courses, including at least 3 credit hours in English courses.
- 3 Eighteen credit hours from the following courses chosen from at least two different sciences:
  - a. Biochemistry: Any 2000-, 3000-, or 4000-level course except the former 2000, 2005, the former 2010, the former 2011, 3202, 3402, or 4502.
  - b. Biology: Any 2000-, 3000-, or 4000-level course except 2040, 2041, 2120, 3053, or 3820.
  - c. Chemistry: 2100, 2210, 2301 (or the former Chemistry 2300), 2302, 2400, 2401, 2610, or any 3000 or 4000 level course.
  - d. Computer Science: Any 2000, 3000, or 4000 level course except the former 2650 and the former 2801.
  - e. Ocean Sciences: any 2000-, 3000-, or 4000-level course.
  - f. Mathematics: 2000, 2050, 2051, 3000, 3001 or any 3000 or 4000 level pure or applied mathematics course.
  - g. Medicine 310A/B.
  - h. Physics: Any 2000, 3000, or 4000 level course except 2151, 3150, 3151.

Notes:

1. Credit may not be obtained for both Biology 3750 and Psychology 3750 or for both Biology 4701 and Psychology 4701.

2. The courses listed under Clause 3 may have prerequisites. It is the student's responsibility to ensure that all prerequisites have been met, or that waivers have been obtained, before registering for these courses.

## Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page Comments Received

CONSULTATIONS SOUGHT	No
	NO
Consultations Sought From	Yes
	Yes
Grentell Campus	
Arts and Social Science	
Fine Arts	No
Science and the Environment	No
	Yes
St. John's Campus	No
Business	Yes
Education	Yes
Engineering	No
Human Kinetics and Recreation	No
Humanities and Social Sciences	Yes
Medicine	No
Music	No
Nursing	No
Pharmacy	
Science	
Social Work	No
University Library	
	No
Labrador Institute	
Arctic and Subarctic Studies	

Marine Institute

#### Subject FW: Proposed Calendar Changes, Psychology Department- Consulation Request



From Davis, Erin <emdavis@mun.ca>

To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>

Date 2021-10-05 15:17

- 1. Program Change\_Tables 11.11.9\_Tables 4, 5, 6.docx (~34 KB)
- 2. Calendar\_Program\_Change\_11.11.5. Reqs BHNR.docx (~21 KB)
- 3. Calendar Course Change- Psyc Co-op Courses (12.11.3).docx (~23 KB)
- 4. Calendar Course Change- OR Additions(12.11.2).docx (~21 KB)

Hi Carolyn,

Thank you for the opportunity to comment on the proposed changes. We don't believe they will affect our pharmacy programs or students and have no concerns.

Erin

--Erin Davis, PharmD Associate Dean Undergraduate Studies Associate Professor Memorial University School of Pharmacy T 709 864 8815 E <u>emdavis@mun.ca</u>

----Original Message----From: Deputy Head, Department of Psychology [mailto:psychdeputyhead@mun.ca]
Sent: Tuesday, October 5, 2021 12:22 PM
To: Faculty of Humanities and Social Sciences <<u>hss@mun.ca</u>>; Shannahan, Rachelle
<<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; kjacobse@grenfell.mun.ca;
ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; HKR Dean <<u>hkrdean@mun.ca</u>>; Ashlee Cunsolo
<<u>ashlee.cunsolo@mun.ca</u>>; miugconsultations@mi.mun.ca; deanofmedicine@med.mun.ca; Karen Bulmer
<<u>kbulmer@mun.ca</u>>; DeanNurse <<u>DeanNurse@mun.ca</u>>; pharminfo@mun.ca; Dean of Science
<<u>deansci@mun.ca</u>>; adeanugradswk <<u>adeanugradswk@mun.ca</u>>; Library Correspondence <<u>univlib@mun.ca</u>>
Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks,

5.A.c. (Page 43 of 239) Re: Proposed Calendar Changes, Psychology Department- Consulation

From McKeen, Dolores Madeline <dmckeen@mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc DeanofMedicine@med.mun.ca <DeanofMedicine@med.mun.ca>

Date 2021-10-07 12:17

Request

Dr. Walsh,

Subject

I have reviewed the above noted Proposed Calendar Changes, Psychology Department on behalf of Dean Steele for the Faculty of Medicine and have no concerns. Thanks Dolores

Dolores M McKeen MD FRCPC MSc CCPE Vice Dean | Education & Faculty Affairs Professor | Memorial University of Newfoundland President | Canadian Anesthesiologists' Society @dolores\_mckeen

Faculty of Medicine <<u>http://www.med.mun.ca/</u>> Memorial University of Newfoundland Faculty of Medicine Building | Rm 2M315 300 Prince Philip Drive St. John's NL CA A1B 3V6 T: 709 864 6417 | F: 709 864 6336

----Original Message----From: Deputy Head, Department of Psychology <<u>psychdeputyhead@mun.ca</u>> Sent: Tuesday, October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; <u>rshannahan@mun.ca</u>; <u>efurey@mun.ca</u>; <u>engrconsult@mun.ca</u>;

kjacobse@grenfell.mun.ca; ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; hkrdean@mun.ca; Cunsolo, Ashlee <ashlee.cunsolo@mun.ca>; miugconsultations@mi.mun.ca; Steele, Dr. Margaret: Dean of Medicine <<u>DeanofMedicine@med.mun.ca</u>>; kbulmer@mun.ca; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca

Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn Subject RE: Proposed Calendar Changes, Psychology Department- Consulation Request



From Bailey, Robert F. <rbailey@grenfell.mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc Piercey-Normore, Michele D <mpiercey-normore@grenfell.mun.ca>, Scott, Robert J. <rscott@grenfell.mun.ca>, Bennett, Sylvia S. <sylviab@grenfell.mun.ca>
- Date 2021-10-07 16:09

Dear Carolyn,

The four sets of proposed Calendar changes in the Department of Psychology have been forwarded to me. None of the changes have any impact on programs in the School of Science and the Environment at Grenfell Campus. I do have a couple of comments on item 3 (changes to the Behavioural Neuroscience program), particularly the listings of mathematics and physics courses, given that these listings are being reviewed. (I also noticed that "Neuroscience": is misspelled in a couple of places in the proposal document!)

It seems odd to me (as a mathematics faculty member) that the listing of mathematics courses specifically includes MATH 3000 and 3001: these are typically taken only by students completing a major or minor in mathematics, as the content is quite abstract and non-mathematics students would find it challenging. Also, in the past few years, MATH 2320 has been added as an additional prerequisite for MATH 3000. In fact, the majority of 3000- or 4000-level mathematics courses have either MATH 2320 (for pure mathematics) or MATH 2260 (for applied mathematics) as a prerequisite. Consequently, it may be wise to list these two courses as options at the 2000-level, and have a general statement about 3000/4000-level courses (as is done for the other disciplines).

For Physics, I can understand why PHYS 2151 is excluded, given that it is a general-interest astronomy course rather than one with significant physics content. PHYS 2150, another general-interest astronomy course with complementary subject matter, has recently been added to the Grenfell Campus section of the Calendar; this is typically offered as an online course, with many St. John's students enrolling in it, so you may also want to add this to the list of exceptions.

Thank you for the opportunity to comment on these proposals.

Regards,

**Robert Bailey** 

Chair, Committee on Academic Programming

School of Science and the Environment

\_\_\_\_\_

Dr. Robert Bailey

Associate Professor, Mathematics

Chair, General Science program

School of Science and the Environment

Grenfell Campus

Memorial University of Newfoundland Corner Brook, NL A2H 6P9, Canada

Subject	Re: Proposed Calendar Changes, Psychology Department- Consulation Request	٢
From	Engineering Consult <engrconsult@mun.ca></engrconsult@mun.ca>	0
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>	
Date	2021-10-20 14:06	

5.A.c. (Page 45 of 239)

Dear Carolyn,

Thank you for the opportunity to respond to your below consultation request.

Engineering reports no impact on our program, and is happy to support this request.

Best regards, Bruce

---Dr. Bruce Quinton, Chair Committee on Undergraduate Studies Faculty of Engineering and Applied Science Memorial University of Newfoundland St. John's NL A1B 3X5

On 2021-10-05 12:22, Deputy Head, Department of Psychology wrote: Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the in-person Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn

**RE: Proposed Calendar Changes, Psychology Department- Consulation** Subject roundcube Request Hennessey, Todd <THENNESSEY@grenfell.mun.ca> open source webmail software From То Deputy Head, Department of Psychology <psychdeputyhead@mun.ca> 2021-10-05 15:54 Date Hi Carolyn Thanks for the chance to review; Fine Arts has no feedback at this time. All the best, Todd TODD HENNESSEY, PhD (Birmingham) DEAN School of Fine Arts Grenfell Campus, Memorial University Corner Brook, Newfoundland 0: 709.637.6277 C: 709.640.5695 www.grenfell.mun.ca Chat with me on Teams! ----Original Message-----From: Deputy Head, Department of Psychology <psychodeputyhead@mun.ca> Sent: October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; Shannahan, Rachelle <<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; Jacobsen, Ken <<u>kjacobse@grenfell.mun.ca</u>>; Dean - School of Science and the Environment <<u>ssedean@grenfell.mun.ca</u>>; Hennessey, Todd <<u>THENNESSEY@grenfell.mun.ca</u>>; hkrdean@mun.ca; Ashlee Cunsolo <ashlee.cunsolo@mun.ca>; MIUG Consultations <<u>MIUGconsultations@mi.mun.ca</u>; <u>deanofmedicine@med.mun.ca</u>; Karen Bulmer <<u>kbulmer@mun.ca</u>>; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca Cc: psychundergradadvisor@mun.ca Subject: Proposed Calendar Changes, Psychology Department- Consulation Request Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to: 1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error; 2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors; 3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty; 4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses. These changes will not require a Library Report and have no resource implications. Please send any comments on these proposals to me at: psychdeputyhead@mun.ca Feedback by October 26th would be appreciated. Thanks, Carolyn Carolyn Walsh, PhD (she/her) Associate Professor

5.A.c. (Page 46 of 239)

## LIBRARY REPORT

None required

## **RESOURCE IMPLICATIONS**

None

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- Amended or deleted course(s): 12.11.3. Psychology Work Term Descriptions Psychology 199W, Psychology 299W, Psychology 399W
- □ New program(s):
- □ Amended or deleted program(s):
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

## ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council:

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses

COURSE NUMBER AND TITLE 12.11.3. Psychology Work Term Descriptions Psychology 199W, Psychology 299W, Psychology 399W

## RATIONALE

The proposed changes have been requested by the Co-operative Education office for the following reasons: 1) the changes streamline the text, removing information that is better placed in the course syllabus; 2) the changes also align the course descriptions with changes made to the main calendar entry in 2018 with respect to assignments, as several years ago the Co-op programs switched from a single end-of term report to several short reflective essays; 3) these changes make the entries for Psychology Co-op courses consistent with those in other programs, in which much of the course detail was removed in the Calendar entries, so as to better facilitate changes based on evolving best practices in the field.

## CALENDAR CHANGES

1. <u>In Work Terms I, II, and III, students must register for Psychology 199W, 299W, and 399W respectively.</u>

The Following Work Terms courses are a requirement of the Psychology Co-op Program only. available only to students admitted to the Psychology Co-operative Education Program and who meet continuance requirements as outlined in 11.11.8.2.2.

## 199W

## Work Term I

<u>normally</u> follows the successful completion of Semester 4. Students are expected to <u>learn</u>, <u>build on classroom learning and</u> develop and practice the high standards of behaviour and performance normally expected in the <u>a</u> work environment. (A detailed description of each job is normally posted during the job competition.) As one component of the Work Term, the student is required to complete a work report. The work report, as a minimum requirement should:

- 1. analyse an issue/problem related to the student's work environment.
- 2. demonstrate an understanding of the structure of a professional report, and show reasonable competence in written communication and presentation skills.

(Students should consult the evaluation form provided in the placement package.)

Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.

Seminars on professional development, conducted by Co-operative Education, are presented during Semester 4 to introduce and prepare the student for participation in the subsequent work terms. Topics may include among others, work term evaluation, work report writing, career planning, employment seeking skills, resume preparation, self employment, ethics and professional concepts, behavioural requirements in the work place, assertiveness in the work place and industrial safety.

<u>CH: 0</u> <u>LC: 0</u> <u>OR: co-op professional development sessions</u> PR: Full-time status in previous term; admitted to PCOP

### 299W

#### Work Term II

<u>normally</u> follows the successful completion of Semester 6. Students are expected to further develop and expand their knowledge and work-related skills and should be able to accept increased responsibility and challenge. In addition, students are expected to demonstrate an ability to deal with increasingly complex work-related concepts and problems. The work report, as a minimum requirement, should:

- 1. analyse an issue/problem related to the student's work environment and demonstrate an understanding of practical application of concepts relative to the student's academic background
- 2. demonstrate competence in creating a professional report, and

3. show competence in written communication and presentation skills Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.

<u>CH: 0</u> <u>LC: 0</u> PR: Psychology 199W

#### 399W

### Work Term III

<u>normally</u> follows the successful completion of Semester 7. Students should have sufficient academic grounding and work experience to contribute in a positive manner to the problem-solving and management processes needed and practiced in the work environment. Students should become better acquainted with their discipline of study, should observe and appreciate the attitudes, responsibilities, and ethics normally expected of professionals and should exercise greater independence and responsibility in their assigned work functions. The work report should reflect the growing professional development of the student and, as a minimum requirement, will:

- 1. demonstrate an increased ability to analyse a significant issue/problem related to the student's experience in the work environment
- 2. demonstrate a high level of competence in producing a professional report, and

3. show a high level of competence in written communication and presentation skills Late reports will be graded as FAL unless prior permission for a late report has been given by Co-operative Education.

<u>CH: 0</u> <u>LC: 0</u> PR: Psychology 299W

### **CALENDAR ENTRY AFTER CHANGES**

#### 12.11.3 Psychology Work Term Descriptions

1. In Work Terms I, II, and III, students must register for Psychology 199W, 299W, and 399W respectively.

The following Work Term courses are available only to students admitted to the Psychology Co-operative Education Program and who meet continuance requirements as outlined in 11.11.8.2.2.

199W

Work Term I

normally follows the successful completion of Semester 4. Students are expected to build on classroom learning and develop and practice high standards of behaviour and performance in a work environment.

CH: 0

LC: 0

OR: co-op professional development sessions

PR: Full-time status in previous term; admitted to PCOP

299W Work Term II

normally follows the successful completion of Semester 6. Students are expected to further develop and expand their knowledge and work-related skills and demonstrate an ability to deal with increasingly complex work-related concepts and problems. CH: 0 LC: 0

PR: Psychology 199W

399W

Work Term III

normally follows the successful completion of Semester 7. Students should have sufficient academic grounding and work experience to contribute in a positive manner to

the problem-solving and management processes needed and practiced in the work environment. CH: 0 LC: 0 PR: Psychology 299W

## SECONDARY CALENDAR CHANGES

none

## Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page Comments Received

CONSULTATIONS SOUGHT	
	No
Consultations Sought From	Yes
	Yes
Grenfell Campus	
Arts and Social Science	
Fine Arts	No
Science and the Environment	No
	Yes
St. John's Campus	No
Business	Yes
Education	Yes
Engineering	No
Human Kinetics and Recreation	No
Humanities and Social Sciences	Yes
Medicine	No
Music	No
Nursing	No
Pharmacy	
Science	
Social Work	No
University Library	
	No
Labrador Institute	
Arctic and Subarctic Studies	

Marine Institute

#### Subject FW: Proposed Calendar Changes, Psychology Department- Consulation Request



From Davis, Erin <emdavis@mun.ca>

To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>

Date 2021-10-05 15:17

- 1. Program Change\_Tables 11.11.9\_Tables 4, 5, 6.docx (~34 KB)
- 2. Calendar\_Program\_Change\_11.11.5. Reqs BHNR.docx (~21 KB)
- 3. Calendar Course Change- Psyc Co-op Courses (12.11.3).docx (~23 KB)
- 4. Calendar Course Change- OR Additions(12.11.2).docx (~21 KB)

Hi Carolyn,

Thank you for the opportunity to comment on the proposed changes. We don't believe they will affect our pharmacy programs or students and have no concerns.

Erin

--Erin Davis, PharmD Associate Dean Undergraduate Studies Associate Professor Memorial University School of Pharmacy T 709 864 8815 E <u>emdavis@mun.ca</u>

----Original Message----From: Deputy Head, Department of Psychology [mailto:psychdeputyhead@mun.ca]
Sent: Tuesday, October 5, 2021 12:22 PM
To: Faculty of Humanities and Social Sciences <<u>hss@mun.ca</u>>; Shannahan, Rachelle
<<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; kjacobse@grenfell.mun.ca;
ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; HKR Dean <<u>hkrdean@mun.ca</u>>; Ashlee Cunsolo
<<u>ashlee.cunsolo@mun.ca</u>>; miugconsultations@mi.mun.ca; deanofmedicine@med.mun.ca; Karen Bulmer
<<u>kbulmer@mun.ca</u>>; DeanNurse <<u>DeanNurse@mun.ca</u>>; pharminfo@mun.ca; Dean of Science
<<u>deansci@mun.ca</u>>; adeanugradswk <<u>adeanugradswk@mun.ca</u>>; Library Correspondence <<u>univlib@mun.ca</u>>
Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks,

Subject	RE: Proposed Calendar Changes, Psychology Department- Consulation Request
From	Shute,Renee S. <rshute@mun.ca></rshute@mun.ca>
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>
Date	2021-10-07 09:32



Hi Carolyn,

If it is not too late, might I make a suggestion for Proposal 1 Program Change 11.11.9 Tables 4, 5, 6 (the tables in the proposal are actually 3, 4, 6).

In table 3 might I suggest?

#### Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Co-operative)

Term	Suggested Courses
Fall Semester 1	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Mathematics 1000 or one of Mathematics 1090, 1050, 1051</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u> <u>BA Language Study Requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>One of Mathematics 1000, 1090, 1050 or 1051 (Psychology Majors are required to successfully complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.)</li> <li>Psychology 1001</li> </ul>

Thanks for listening

Renee

Renée Shute

Manager of Academic Programs, Faculty of Humanities and Social Sciences

Memorial University of Newfoundland

St. John's, NL, Canada A1C 5S7

Office: AA4077

Tel (709) 864-7454



From McKeen, Dolores Madeline <dmckeen@mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc DeanofMedicine@med.mun.ca <DeanofMedicine@med.mun.ca>

Re: Proposed Calendar Changes, Psychology Department- Consulation

Date 2021-10-07 12:17

Request

Dr. Walsh,

Subject

I have reviewed the above noted Proposed Calendar Changes, Psychology Department on behalf of Dean Steele for the Faculty of Medicine and have no concerns. Thanks Dolores

Dolores M McKeen MD FRCPC MSc CCPE Vice Dean | Education & Faculty Affairs Professor | Memorial University of Newfoundland President | Canadian Anesthesiologists' Society @dolores\_mckeen

Faculty of Medicine <<u>http://www.med.mun.ca/</u>> Memorial University of Newfoundland Faculty of Medicine Building | Rm 2M315 300 Prince Philip Drive St. John's NL CA A1B 3V6 T: 709 864 6417 | F: 709 864 6336

----Original Message----From: Deputy Head, Department of Psychology <<u>psychdeputyhead@mun.ca</u>> Sent: Tuesday, October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; <u>rshannahan@mun.ca</u>; <u>efurey@mun.ca</u>; <u>engrconsult@mun.ca</u>;

kjacobse@grenfell.mun.ca; ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; hkrdean@mun.ca; Cunsolo, Ashlee <ashlee.cunsolo@mun.ca>; miugconsultations@mi.mun.ca; Steele, Dr. Margaret: Dean of Medicine <<u>DeanofMedicine@med.mun.ca</u>>; kbulmer@mun.ca; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca

Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn Subject RE: Proposed Calendar Changes, Psychology Department- Consulation Request



From Bailey, Robert F. <rbailey@grenfell.mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc Piercey-Normore, Michele D <mpiercey-normore@grenfell.mun.ca>, Scott, Robert J. <rscott@grenfell.mun.ca>, Bennett, Sylvia S. <sylviab@grenfell.mun.ca>
- Date 2021-10-07 16:09

Dear Carolyn,

The four sets of proposed Calendar changes in the Department of Psychology have been forwarded to me. None of the changes have any impact on programs in the School of Science and the Environment at Grenfell Campus. I do have a couple of comments on item 3 (changes to the Behavioural Neuroscience program), particularly the listings of mathematics and physics courses, given that these listings are being reviewed. (I also noticed that "Neuroscience": is misspelled in a couple of places in the proposal document!)

It seems odd to me (as a mathematics faculty member) that the listing of mathematics courses specifically includes MATH 3000 and 3001: these are typically taken only by students completing a major or minor in mathematics, as the content is quite abstract and non-mathematics students would find it challenging. Also, in the past few years, MATH 2320 has been added as an additional prerequisite for MATH 3000. In fact, the majority of 3000- or 4000-level mathematics courses have either MATH 2320 (for pure mathematics) or MATH 2260 (for applied mathematics) as a prerequisite. Consequently, it may be wise to list these two courses as options at the 2000-level, and have a general statement about 3000/4000-level courses (as is done for the other disciplines).

For Physics, I can understand why PHYS 2151 is excluded, given that it is a general-interest astronomy course rather than one with significant physics content. PHYS 2150, another general-interest astronomy course with complementary subject matter, has recently been added to the Grenfell Campus section of the Calendar; this is typically offered as an online course, with many St. John's students enrolling in it, so you may also want to add this to the list of exceptions.

Thank you for the opportunity to comment on these proposals.

Regards,

**Robert Bailey** 

Chair, Committee on Academic Programming

School of Science and the Environment

\_\_\_\_\_

Dr. Robert Bailey

Associate Professor, Mathematics

Chair, General Science program

School of Science and the Environment

Grenfell Campus

Memorial University of Newfoundland Corner Brook, NL A2H 6P9, Canada

Subject	Re: Proposed Calendar Changes, Psychology Department- Consulation Request	1
From	Engineering Consult <engrconsult@mun.ca></engrconsult@mun.ca>	c
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>	
Date	2021-10-20 14:06	



Dear Carolyn,

Thank you for the opportunity to respond to your below consultation request.

Engineering reports no impact on our program, and is happy to support this request.

Best regards, Bruce

\_\_\_\_ Dr. Bruce Quinton, Chair Committee on Undergraduate Studies Faculty of Engineering and Applied Science Memorial University of Newfoundland St. John's NL A1B 3X5 

On 2021-10-05 12:22, Deputy Head, Department of Psychology wrote: Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the in-person Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn

**RE: Proposed Calendar Changes, Psychology Department- Consulation** Subject roundcube Request Hennessey, Todd <THENNESSEY@grenfell.mun.ca> open source webmail software From То Deputy Head, Department of Psychology <psychdeputyhead@mun.ca> 2021-10-05 15:54 Date Hi Carolyn Thanks for the chance to review; Fine Arts has no feedback at this time. All the best, Todd TODD HENNESSEY, PhD (Birmingham) DEAN School of Fine Arts Grenfell Campus, Memorial University Corner Brook, Newfoundland 0: 709.637.6277 C: 709.640.5695 www.grenfell.mun.ca Chat with me on Teams! ----Original Message-----From: Deputy Head, Department of Psychology <psychodeputyhead@mun.ca> Sent: October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; Shannahan, Rachelle <<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; Jacobsen, Ken <<u>kjacobse@grenfell.mun.ca</u>>; Dean - School of Science and the Environment <<u>ssedean@grenfell.mun.ca</u>>; Hennessey, Todd <<u>THENNESSEY@grenfell.mun.ca</u>>; hkrdean@mun.ca; Ashlee Cunsolo <ashlee.cunsolo@mun.ca>; MIUG Consultations <<u>MIUGconsultations@mi.mun.ca</u>; <u>deanofmedicine@med.mun.ca</u>; Karen Bulmer <<u>kbulmer@mun.ca</u>>; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca Cc: psychundergradadvisor@mun.ca Subject: Proposed Calendar Changes, Psychology Department- Consulation Request Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to: 1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error; 2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors; 3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty; 4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses. These changes will not require a Library Report and have no resource implications. Please send any comments on these proposals to me at: psychdeputyhead@mun.ca Feedback by October 26th would be appreciated. Thanks, Carolyn Carolyn Walsh, PhD (she/her) Associate Professor

5.A.d. (Page 59 of 239)

## LIBRARY REPORT

None required

## **RESOURCE IMPLICATIONS**

None

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- ✗ Amended or deleted course(s): 12.11.2. Majors Courses- PSYCHOLOGY 3800, PSYCHOLOGY 3820, PSYCHOLOGY 4870
- □ New program(s):
- □ Amended or deleted program(s):
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

### ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council: \_\_\_\_\_

## Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses

## COURSE NUMBER AND TITLE

12.11.2. Majors Courses

PSYCHOLOGY 3800 PSYCHOLOGY 3820 PSYCHOLOGY 4870

#### RATIONALE

These three courses in Behavioural Neuroscience may require students to have completed the Canadian Council for Animal Care's online Animal Care Training, and inperson Animal Handling course, should live animals be used in the laboratories. The online training is offered via Brightspace and students self-register. Once the online portion is completed, students may register for the handling course through Animal Care Services. Neither course appears on student transcripts, therefore cannot be considered a "pre-requisite" per se. We propose to present them as an OR (= Other requirements of the course such as tutorials, practical sessions, or seminars).

### **CALENDAR CHANGES**

#### 3800

#### **Cellular and Molecular Neuroscience**

addresses the structure and function of neurons and neural circuits and examines principles of electrochemical neural communication at the macroscopic, microscopic and molecular level. The relevance of this knowledge to understanding brain mechanisms of normal and diseased brain functions will be touched upon. The molecular basis of the formation of some types of memories will be explored.

LH: one laboratory period weekly PR: PSYC 2520 or 2521, 2911, and 2930 or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience; and Science 1807 and 1808 <u>OR: Animal Care Online Training and Animal Handling Training should be</u> completed prior to start of this course

### **Research Techniques in Behavioural Neuroscience**

allows students to increase their understanding of how knowledge is generated in the study of neuroscience and behavior. Students will visit various on-campus laboratories that are engaged in research relevant to these fields. In addition to observations and hands-on tutorials, readings, discussions, and writing assignments will strengthen students' understanding of the techniques used to answer specific research questions in neuroscience and behaviour.

PR: Science 1807; PSYC 2520 or 2521, 2911, and 2930, or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience

OR: Animal Care Online Training and Animal Handling Training should be completed prior to start of this course

## 4870

#### **Research Experience in Behavioural Neuroscience**

allows students to gain research experience in selected areas of neuroscience. PR: Science 1807 and Science 1808; PSYC 3820 or the former 3801, and admission to a Major in Psychology or Behavioural Neuroscience <u>OR: Animal Care Online Training and Animal Handling Training should be</u> completed prior to start of this course

### **CALENDAR ENTRY AFTER CHANGES**

#### 3800

#### **Cellular and Molecular Neuroscience**

addresses the structure and function of neurons and neural circuits and examines principles of electrochemical neural communication at the macroscopic, microscopic and molecular level. The relevance of this knowledge to understanding brain mechanisms of normal and diseased brain functions will be touched upon. The molecular basis of the formation of some types of memories will be explored.

LH: one laboratory period weekly

PR: PSYC 2520 or 2521, 2911, and 2930 or the former 2570,

Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience; and Science 1807 and 1808

OR: Animal Care Online Training and Animal Handling Training should be completed prior to start of this course

### **Research Techniques in Behavioural Neuroscience**

allows students to increase their understanding of how knowledge is generated in the study of neuroscience and behavior. Students will visit various on-campus laboratories that are engaged in research relevant to these fields. In addition to observations and hands-on tutorials, readings, discussions, and writing assignments will strengthen students' understanding of the techniques used to answer specific research questions in neuroscience and behaviour.

PR: Science 1807; PSYC 2520 or 2521, 2911, and 2930, or the former 2570, Biology 1001 and 1002, and admission to a Major in Psychology or Behavioural Neuroscience

OR: Animal Care Online Training and Animal Handling Training should be completed prior to start of this course

### 4870

#### **Research Experience in Behavioural Neuroscience**

allows students to gain research experience in selected areas of neuroscience. PR: Science 1807 and Science 1808; PSYC 3820 or the former 3801, and admission to a Major in Psychology or Behavioural Neuroscience OR: Animal Care Online Training and Animal Handling Training should be completed prior to start of this course

### SECONDARY CALENDAR CHANGES

none

## Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page Comments Received

CONSULTATIONS SOUGHT	No
Consultations Sought From	Yes
Sonsultations Cought From	Yes
Grenfell Campus	
Arts and Social Science	
Fine Arts	No
Science and the Environment	No
	Yes
St. John's Campus	No
Business	Yes
Education	Yes
Engineering	No
Human Kinetics and Recreation	No
Humanities and Social Sciences	Yes
Medicine	No
Music	No
Nursing	No
Pharmacy	
Science	
Social Work	No
University Library	
	No
Labrador Institute	
Arctic and Subarctic Studies	

Marine Institute

#### Subject FW: Proposed Calendar Changes, Psychology Department- Consulation Request



From Davis, Erin <emdavis@mun.ca>

To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>

Date 2021-10-05 15:17

- 1. Program Change\_Tables 11.11.9\_Tables 4, 5, 6.docx (~34 KB)
- 2. Calendar\_Program\_Change\_11.11.5. Reqs BHNR.docx (~21 KB)
- 3. Calendar Course Change- Psyc Co-op Courses (12.11.3).docx (~23 KB)
- 4. Calendar Course Change- OR Additions(12.11.2).docx (~21 KB)

Hi Carolyn,

Thank you for the opportunity to comment on the proposed changes. We don't believe they will affect our pharmacy programs or students and have no concerns.

Erin

--Erin Davis, PharmD Associate Dean Undergraduate Studies Associate Professor Memorial University School of Pharmacy T 709 864 8815 E <u>emdavis@mun.ca</u>

----Original Message----From: Deputy Head, Department of Psychology [mailto:psychdeputyhead@mun.ca]
Sent: Tuesday, October 5, 2021 12:22 PM
To: Faculty of Humanities and Social Sciences <<u>hss@mun.ca</u>>; Shannahan, Rachelle
<<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; kjacobse@grenfell.mun.ca;
ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; HKR Dean <<u>hkrdean@mun.ca</u>>; Ashlee Cunsolo
<<u>ashlee.cunsolo@mun.ca</u>>; miugconsultations@mi.mun.ca; deanofmedicine@med.mun.ca; Karen Bulmer
<<u>kbulmer@mun.ca</u>>; DeanNurse <<u>DeanNurse@mun.ca</u>>; pharminfo@mun.ca; Dean of Science
<<u>deansci@mun.ca</u>>; adeanugradswk <<u>adeanugradswk@mun.ca</u>>; Library Correspondence <<u>univlib@mun.ca</u>>
Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks,

**RE: Proposed Calendar Changes, Psychology Department- Consulation** Subject roundc Request Hennessey, Todd <THENNESSEY@grenfell.mun.ca> open source webmail software From То Deputy Head, Department of Psychology <psychdeputyhead@mun.ca> 2021-10-05 15:54 Date Hi Carolyn Thanks for the chance to review; Fine Arts has no feedback at this time. All the best, Todd TODD HENNESSEY, PhD (Birmingham) DEAN School of Fine Arts Grenfell Campus, Memorial University Corner Brook, Newfoundland 0: 709.637.6277 C: 709.640.5695 www.grenfell.mun.ca Chat with me on Teams! ----Original Message-----From: Deputy Head, Department of Psychology <psychodeputyhead@mun.ca> Sent: October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; Shannahan, Rachelle <<u>rshannahan@mun.ca</u>>; Furey, Edith <<u>efurey@mun.ca</u>>; engrconsult@mun.ca; Jacobsen, Ken <<u>kjacobse@grenfell.mun.ca</u>>; Dean - School of Science and the Environment <<u>ssedean@grenfell.mun.ca</u>>; Hennessey, Todd <<u>THENNESSEY@grenfell.mun.ca</u>>; hkrdean@mun.ca; Ashlee Cunsolo <ashlee.cunsolo@mun.ca>; MIUG Consultations <<u>MIUGconsultations@mi.mun.ca</u>; <u>deanofmedicine@med.mun.ca</u>; Karen Bulmer <<u>kbulmer@mun.ca</u>>; deanNurse@mun.ca; pharminfo@mun.ca; deansci@mun.ca; adeanugradswk@mun.ca; univlib@mun.ca Cc: psychundergradadvisor@mun.ca Subject: Proposed Calendar Changes, Psychology Department- Consulation Request Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to: 1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error; 2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors; 3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty; 4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses. These changes will not require a Library Report and have no resource implications. Please send any comments on these proposals to me at: psychdeputyhead@mun.ca Feedback by October 26th would be appreciated. Thanks, Carolyn Carolyn Walsh, PhD (she/her) Associate Professor

5.A.e. (Page 67 of 239)

Subject	RE: Proposed Calendar Changes, Psychology Department- Consulation Request
From	Shute,Renee S. <rshute@mun.ca></rshute@mun.ca>
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>
Date	2021-10-07 09:32



Hi Carolyn,

If it is not too late, might I make a suggestion for Proposal 1 Program Change 11.11.9 Tables 4, 5, 6 (the tables in the proposal are actually 3, 4, 6).

In table 3 might I suggest?

#### Table 3 Suggested Course Sequence for B.A. (Honours) in Psychology (Co-operative)

Term	Suggested Courses
Fall Semester 1	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>Mathematics 1000 or one of Mathematics 1090, 1050, 1051</li> <li>Psychology 1000</li> </ul>
Winter Semester 2	<ul> <li><u>Critical Reading and Writing requirement</u></li> <li><u>Elective or Humanities and Social Sciences requirement</u> <u>BA Language Study Requirement</u></li> <li>Elective or Humanities and Social Sciences requirement</li> <li>One of Mathematics 1000, 1090, 1050 or 1051 (Psychology Majors are required to successfully complete Mathematics 1000 or two of 1090, 1050, 1051 (or equivalent). An Elective or Humanities and Social Sciences requirement can be taken if Mathematics 1000 was taken in Semester 1.)</li> <li>Psychology 1001</li> </ul>

Thanks for listening

Renee

Renée Shute

Manager of Academic Programs, Faculty of Humanities and Social Sciences

Memorial University of Newfoundland

St. John's, NL, Canada A1C 5S7

Office: AA4077

Tel (709) 864-7454

Subject RE: Proposed Calendar Changes, Psychology Department- Consulation Request



From Bailey, Robert F. <rbailey@grenfell.mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc Piercey-Normore, Michele D <mpiercey-normore@grenfell.mun.ca>, Scott, Robert J. <rscott@grenfell.mun.ca>, Bennett, Sylvia S. <sylviab@grenfell.mun.ca>
- Date 2021-10-07 16:09

Dear Carolyn,

The four sets of proposed Calendar changes in the Department of Psychology have been forwarded to me. None of the changes have any impact on programs in the School of Science and the Environment at Grenfell Campus. I do have a couple of comments on item 3 (changes to the Behavioural Neuroscience program), particularly the listings of mathematics and physics courses, given that these listings are being reviewed. (I also noticed that "Neuroscience": is misspelled in a couple of places in the proposal document!)

It seems odd to me (as a mathematics faculty member) that the listing of mathematics courses specifically includes MATH 3000 and 3001: these are typically taken only by students completing a major or minor in mathematics, as the content is quite abstract and non-mathematics students would find it challenging. Also, in the past few years, MATH 2320 has been added as an additional prerequisite for MATH 3000. In fact, the majority of 3000- or 4000-level mathematics courses have either MATH 2320 (for pure mathematics) or MATH 2260 (for applied mathematics) as a prerequisite. Consequently, it may be wise to list these two courses as options at the 2000-level, and have a general statement about 3000/4000-level courses (as is done for the other disciplines).

For Physics, I can understand why PHYS 2151 is excluded, given that it is a general-interest astronomy course rather than one with significant physics content. PHYS 2150, another general-interest astronomy course with complementary subject matter, has recently been added to the Grenfell Campus section of the Calendar; this is typically offered as an online course, with many St. John's students enrolling in it, so you may also want to add this to the list of exceptions.

Thank you for the opportunity to comment on these proposals.

Regards,

**Robert Bailey** 

Chair, Committee on Academic Programming

School of Science and the Environment

\_\_\_\_\_

Dr. Robert Bailey

Associate Professor, Mathematics

Chair, General Science program

School of Science and the Environment

Grenfell Campus

Memorial University of Newfoundland Corner Brook, NL A2H 6P9, Canada 5.A.e. (Page 70 of 239) Re: Proposed Calendar Changes, Psychology Department- Consulation



Request From McKeen, Dolores Madeline <dmckeen@mun.ca>

- To psychdeputyhead@mun.ca <psychdeputyhead@mun.ca>
- Cc DeanofMedicine@med.mun.ca <DeanofMedicine@med.mun.ca>

Date 2021-10-07 12:17

Dr. Walsh,

Subject

I have reviewed the above noted Proposed Calendar Changes, Psychology Department on behalf of Dean Steele for the Faculty of Medicine and have no concerns. Thanks Dolores

Dolores M McKeen MD FRCPC MSc CCPE Vice Dean | Education & Faculty Affairs Professor | Memorial University of Newfoundland President | Canadian Anesthesiologists' Society @dolores\_mckeen

Faculty of Medicine <<u>http://www.med.mun.ca/</u>> Memorial University of Newfoundland Faculty of Medicine Building | Rm 2M315 300 Prince Philip Drive St. John's NL CA A1B 3V6 T: 709 864 6417 | F: 709 864 6336

----Original Message----From: Deputy Head, Department of Psychology <<u>psychdeputyhead@mun.ca</u>> Sent: Tuesday, October 5, 2021 12:22 PM To: <u>HSS@mun.ca</u>; <u>rshannahan@mun.ca</u>; <u>efurey@mun.ca</u>; <u>engrconsult@mun.ca</u>;

kjacobse@grenfell.mun.ca; ssedean@grenfell.mun.ca; thennessey@grenfell.mun.ca; hkrdean@mun.ca; Cunsolo, Ashlee <<u>ashlee.cunsolo@mun.ca</u>; <u>miugconsultations@mi.mun.ca</u>; Steele, Dr. Margaret: Dean of Medicine <<u>DeanofMedicine@med.mun.ca</u>; <u>kbulmer@mun.ca</u>; <u>deanNurse@mun.ca</u>; <u>pharminfo@mun.ca</u>; <u>deansci@mun.ca</u>; <u>adeanugradswk@mun.ca</u>; <u>univlib@mun.ca</u>

Cc: psychundergradadvisor@mun.ca

Subject: Proposed Calendar Changes, Psychology Department- Consulation Request

Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the inperson Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn

Subject	Re: Proposed Calendar Changes, Psychology Department- Consulation Request	ſ
From	Engineering Consult <engrconsult@mun.ca></engrconsult@mun.ca>	op
То	Deputy Head, Department of Psychology <psychdeputyhead@mun.ca></psychdeputyhead@mun.ca>	
Date	2021-10-20 14:06	

5.A.e. (Page 71 of 239)

Dear Carolyn,

Thank you for the opportunity to respond to your below consultation request.

Engineering reports no impact on our program, and is happy to support this request.

Best regards, Bruce

---Dr. Bruce Quinton, Chair Committee on Undergraduate Studies Faculty of Engineering and Applied Science Memorial University of Newfoundland St. John's NL A1B 3X5

On 2021-10-05 12:22, Deputy Head, Department of Psychology wrote: Please find attached 4 proposed Calendar changes for the Department of Psychology. The items are, in brief, changes to:

1) 11.11.9 Suggested Course Sequences: Additions to Tables 4, 5, and 6 to clarify course progression options for students. This item was for information purposes only as it was approved last year, but was omitted from the Calendar changes in error;

2) 11.11.5, Requirements for a major in Behavioural Neuroscience: Removal of a required course (Math 1001) and addition of two Chemistry courses as options for Behavioural Neuroscience majors;

3) 12.11.3. Psychology Work Term Descriptions: As per a request from the Co-operative Education office, the course descriptions for Work Terms were simplified and brought in line with those of other programs in the Faculty;

4) 12.11.2. Majors Courses Psychology 3800, 3820 4870. Add an "Other Requirement" note to the course description to indicate that students should take the online Animal Care course and the in-person Animal Handling training course before taking these courses.

These changes will not require a Library Report and have no resource implications.

Please send any comments on these proposals to me at: psychdeputyhead@mun.ca

Feedback by October 26th would be appreciated.

Thanks, Carolyn

## LIBRARY REPORT

None required

## **RESOURCE IMPLICATIONS**

None
# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

### LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- $\Box$  New course(s):
- ✓ Amended or deleted course(s):
- □ New program(s):
- $\Box$  Amended or deleted program(s):
- □ New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- □ New, amended or deleted General Academic Regulations (Undergraduate)
- □ New, amended or deleted Faculty, School or Departmental regulations
- □ Other:

#### ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President:

Date:

Date of approval by Faculty/Academic Council: \_\_\_\_\_

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses

### COURSE NUMBER AND TITLE

EASC 3170 Seismic and Potential Fields Methods in Geophysics

### **REVISED COURSE NUMBER AND TITLE**

EASC 3170 Geophysics for Natural Resource Exploration

### ABBREVIATED COURSE TITLE

Geophys for Natural Resources

### RATIONALE

These changes to the title and description mean they would highlight the societal needs and issues that the geophysical methods covered in this course provide solutions to. The existing title and description, which emphasize the particular geophysical techniques covered, while not incorrect, do nothing to indicate the applications of the techniques. The new title and description will more accurately reflect the full range of content provided in this course, which includes applications as well as methodology. This, along with a similar change to EASC 3172, will also make clear to students in the other Earth Sciences streams (economic geology, petroleum geology, environmental geoscience) which 3000-level applied geophysics course(s) best suits their interests and program. It is expected that the content of the course will remain substantially the same (at most a 20% change in content, with some material coming across from the current version of EASC 3172), with the main change being a re-ordering of the content that will result in applications being described and illustrated first followed by descriptions and explanations of the relevant geophysical techniques.

### **CALENDAR CHANGES**

**3170 Seismic and Potential Fields Methods in Geophysics** examines fundamentals of seismic energy transmission in the Earth; basic methods in seismic exploration - data acquisition, processing and interpretation for refraction and reflection surveys; fundamentals of gravity and magnetic data acquisition, processing and interpretation; introduction to gravity and magnetic modelling.

3170 Geophysics for Natural Resource Exploration is an introduction to geophysical methods used to investigate the subsurface of the Earth, with particular application to finding and developing natural resources, for example, critical minerals, oil and gas, and geothermal energy, and to burial of waste products, for example carbon sequestration and nuclear waste. The laboratory component involves hands-on exercises collecting data (generally indoors), as well as analysis and interpretation of geophysical data using modern software. Pertinent seismic, gravity, magnetic, electric and electromagnetic techniques will be covered.

LH: 3

PR: Physics 1051 (or 1021 or the former 1054); Mathematics 1001; Mathematics 2000 or Statistics 2550. or the former Statistics 2510; EASC 2905 or permission of the Head of the Department for students following a Minor in Earth Sciences or a Major in Environmental Physics.

#### **CALENDAR ENTRY AFTER CHANGES**

**3170 Geophysics for Natural Resource Exploration** is an introduction to geophysical methods used to investigate the subsurface of the Earth, with particular application to finding and developing natural resources, for example, critical minerals, oil and gas, and geothermal energy, and to burial of waste products, for example carbon sequestration and nuclear waste. The laboratory component involves hands-on exercises collecting data (generally indoors), as well as analysis and interpretation of geophysical data using modern software. Pertinent seismic, gravity, magnetic, electric and electromagnetic techniques will be covered.

LH: 3

PR: Physics 1051 (or 1021); Mathematics 1001; Mathematics 2000 or Statistics 2550.

## Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses

#### COURSE NUMBER AND TITLE

EASC 3172 Electric and Electromagnetic Methods in Geophysics

#### **REVISED COURSE NUMBER AND TITLE**

EASC 3172 Environmental and Geotechnical Geophysics

#### ABBREVIATED COURSE TITLE

**Environ & Geotech Geophysics** 

#### RATIONALE

These changes to the title and description mean they would highlight the societal needs and issues that the geophysical methods covered in this course provide solutions to. The existing title and description, which emphasize the particular geophysical techniques covered, while not incorrect, do nothing to indicate the applications of the techniques. The new title and description will more accurately reflect the full range of content provided in this course, which includes applications as well as methodology. This, along with a similar change to EASC 3170, will also make clear to students in the other Earth Sciences streams (economic geology, petroleum geology, environmental geoscience) which 3000-level applied geophysics course(s) best suits their interests and program. It is expected that the content of the course will remain substantially the same (at most a 20% change in content, with some material coming across from the current version of EASC 3170), with the main change being a re-ordering of the content that will result in applications being described and illustrated first followed by descriptions and explanations of the relevant geophysical techniques. Former prerequisites have been removed as these are very old. The prerequisite for EASC 2905, which is a field school, limited this course to Earth Science Majors. However, our intention is not to limit EASC 3172 to Earth Science Majors alone. The appropriate background geologic knowledge will be provided within the course material. This is represented in the modified course description

#### **CALENDAR CHANGES**

**3172 Electric and Electromagnetic Methods in Geophysics** is an introduction to electrical and electromagnetic methods in geophysics applied in mineral exploration, petroleum well logging and environmental studies, and examples of application of various techniques; use of data processing and modelling techniques in interpretation; introduction to radiometric methods used in mineral and petroleum exploration. The laboratory component involves outdoor surveys using geophysical equipment, and computer-based presentation and analysis of collected data using modern geophysical software.

3172 Environmental and Geotechnical Geophysics is an introduction to geophysical methods used to investigate the shallow Earth, with particular application to studies of environmental issues, such as ground water distribution and contaminant tracking, and infrastructure, such as dams, and buried pipes and artifacts. The laboratory component involves outdoor surveys, where students work in small teams using a wide range of geophysical equipment, followed by analysis of collected data using modern software. Pertinent seismic, gravity, magnetic, electric and electromagnetic techniques will be covered, as well as the appropriate background geologic knowledge.

AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.

CO: EASC 2905 or permission of the Head of the Department

<u>CO: EASC 2905 or permission of the instructor for students not following a Major in</u> Earth Sciences.

LH: 3

PR: Physics 1051 (or 1021 or the former 1054); Mathematics 1001;

Mathematics 2000 or Statistics 2550 or the former Statistics 2510; EASC 2905 or permission of the Head of the Department for students following a Minor in Earth Sciences or a Major in Environmental Physics; Earth Sciences 2905 or permission of the instructor for students not following a Major in Earth Sciences; Science 1807 and Science 1808.

#### **CALENDAR ENTRY AFTER CHANGES**

**3172 Environmental and Geotechnical Geophysics** is an introduction to geophysical methods used to investigate the shallow Earth, with particular application to studies of environmental issues, such as ground water distribution and contaminant tracking, and infrastructure, such as dams, and buried pipes and artifacts. The laboratory component involves outdoor surveys, where students work in small teams using a wide range of geophysical equipment, followed by analysis of collected data using modern software. Pertinent seismic, gravity, magnetic, electric and electromagnetic techniques will be covered, as well as the appropriate background geologic knowledge.

AR: attendance is required in the laboratory component of this course. Failure to attend may result in a failing grade or deregistration from the course.

CO: EASC 2905 or permission of the instructor for students not following a Major in Earth Sciences.

LH: 3

PR: Physics 1051 (or 1021); Mathematics 1001; Mathematics 2000 or Statistics 2550; Earth Sciences 2905 or permission of the instructor for students not following a Major in Earth Sciences; Science 1807 and Science 1808.

# **Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Appendix Page**

#### **CONSULTATIONS SOUGHT From**

Response

Humanities and Social Sciences **Business Administration - YES** Education **Engineering and Applied Science** Human Kinetics and Recreation - YES Medicine Music Nursing Pharmacy - YES Science Social Work Library **Grenfell Campus** Arts and Social Science Science and the Environment Fine Arts Marine Institute Labrador Institute Arctic and Subarctic Studies

#### LIBRARY REPORT

Not applicable

#### **RESOURCE IMPLICATIONS**

Not applicable

# ADDITIONAL INFORMATION REQUIRED FOR NEW COURSE PROPOSALS

Not applicable

#### Consults EASC 3170 and EASC 3172

#### Subject Proposed Calendar Changes From Earth Sciences

From Penny L Morrill cpmorrill@mun.ca> L

hss@mun.ca\_, eoldford@mun.ca\_, efurey@mun.ca\_, engrconsult@mun.ca\_, hkrdean@mun.ca\_, deanofmedicine@med.mu To, deansci@mun.ca\_, adeanugradswk@mun.ca\_, univlib@mun.ca\_, kjacobse@grenfell.mun.ca\_, ssedean@grenfell.mun.ca\_

, <u>ashlee.cunsolo@mun.ca</u> 🕹

Date Today 12:36

#### <u>UCCPF\_EASC3170\_3172\_Oct282021.pdf</u> (~186 KB)

Oct. 28, 2021

Hello,

Please circulate the attached for consultations from the Department of Earth Sciences.

In summary, these consultations are for changes in course names, course descriptions, and prerequisites for EASC 3170 and EASC 3172. The intent of these changes are to make these courses more attractive to students by highlighting the applications taught the course instead of the methods taught. The content of the courses will remain substantially the same (no more than 20% change in content). We are proposing to remove old, outdated prerequisites, and a change the EASC2905 prerequisite, because this perquisite limited these courses to Earth Science Majors only.

Please send your comments to pmorrill@mun.ca.

Thank you,

Penny

Subject Re: Proposed Calendar Changes From Earth Sciences

```
From <u>HKR Dean <hkrdean@mun.ca></u>
```

To Penny L Morrill <pmorrill@mun.ca>

Date Today 13:19

Hello,

HKR has no concerns with the proposed changes. Good luck.

Anne-Marie

Anne-Marie Sullivan (she/her), PhD, CTRS Interim Dean, School of Human Kinetics & Recreation Memorial University, St. John's, NL, A1S 5S7 (p) 709-864-8129; (e) hkrdean@mun.ca

We acknowledge that the lands on which Memorial University's campuses are situated are in the traditional territories of diverse Indigenous groups, and we acknowledge with respect the diverse histories and cultures of the Beothuk, Mi'kmaq, Innu, and Inuit of this province.

#### Subject FW: Proposed Calendar Changes From Earth Sciences

From Davis, Erin < emdavis@mun.ca>

To pmorrill@mun.ca <pmorrill@mun.ca>

Date Today 09:16

#### • UCCPF EASC3170 3172 Oct282021.pdf (~186 KB)

```
Hello Dr. Morrill,
```

Pharmacy has no concerns with the proposed changes and we do not believe they will affect our students or programs. Thank you for the opportunity to comment on this proposal.

Erin

Erin Davis, BSc(Pharm), PharmD Associate Professor | School of Pharmacy Associate Dean, Undergraduate | School of Pharmacy Chair, Committee on Undergraduate Studies | School of Pharmacy Clinical Assistant Professor | Faculty of Medicine, Discipline of Family Medicine

Memorial University of Newfoundland and Labrador School of Pharmacy Health Sciences Centre 300 Prince Phillip Dr.| Rm H3443 St. John's NL | AlB 3V6

T 709 864 8815 | F 709 864 6941

Subject RE: Proposed Calendar Changes From Earth Sciences

From Oldford, Erin <eoldford@mun.ca>

To Penny L Morrill cpmorrill@mun.ca> I

Cc Hooper, Denise <deniseh@mun.ca>

Date Sat 14:06

Hi Penny,

No comments from us. Thanks for sharing and best wishes.

Erin

Dr. Erin Oldford Interim Associate Dean, Undergraduate Programs Faculty of Business Administration Memorial University of Newfoundland



## Proposal for a new graduate program

## Master of Applied Science in Software Engineering

# Memorial University, St. John's, NL, Canada

Name of the program	Master of Applied Science in Software Engineering			
Degree name in short form	M.A.Sc.SE			
Academic units offering the program	Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science and Department of Computer Science, Faculty of Science			
Administrative home of the program	Faculty of Engineering and Applied Science			
Proponents	Dr. Cheng Li (licheng@mun.ca) Dr. Sharene Bungay (cs-chair@mun.ca) Dr. Stephen Czarnuch (sczarnuch@mun.ca) and Dr. Lourdes Pena-Castillo (lourdes@mun.ca)			
Date	October 19, 2021			
Tentative start of the program	Fall 2022			

## Contents

1	Ex	ecutive summary	4
2	De	scription of the program	5
	2.1	Name of the program	5
	2.2	Graduate student profile	5
	2.3	Learning outcomes	5
	2.4	Key learning outcomes	5
	2.5	Requirements for admission	6
	2.6	Program overview	6
	2.6	.1 Core courses	6
	2.6	.2 Elective courses	6
	2.6	.3 Program schedule	7
3	Sta	tement of Justification	7
	3.1	Introduction	7
	3.2	Contribution to strategic goals of the University	7
4	Ma	rket analysis	8
	4.1	International and national comparison of related programs and unique attributes	8
5	Pro	vjected enrollment	0
6	Re	source implications	0
	6.1	Existing faculty resources1	0
	6.2	New faculty resources	2
	6.3	Additional non-faculty resources1	2
	6.4	Administration of the program1	2
7	Bu	dget1	2
	7.1	Program expenses	3
	7.2	Revenue1	4
	7.3	Payment schedule	4
А	ppend	ix A: Library holdings evaluation1	5
А	ppend	ix B: Calendar regulations1	6
А	ppend	ix C: Course listings	7

Core courses	. 17
Elective courses	. 17
Appendix D: Consultation	. 18
Appendix E: Faculty CVs	. 19
Appendix F: Canadian university survey of undergraduate and graduate programs in software	
engineering	. 26

#### **1** Executive summary

This proposal calls for the creation of the Master of Applied Science in Software Engineering program housed in the Faculty of Engineering and Applied Science at Memorial University, but jointly offered by the Department of Electrical and Computer Engineering (Faculty of Applied Science and Engineering) and the Department of Computer Science (Faculty of Science). Software is critical to most modern technologies. Given the expected and accelerated growth for professions related to software over the next decades, the development of software programs has become a priority for almost all major universities. The proposed program is in direct alignment with the strategic goals of the University regarding information and communication technologies. Further the proposed software engineering program has been designed with an internationally recognisable curriculum. The curriculum focuses on the fundamental aspects of the field, and is intended to attract local, national and international students who want to break into this emerging area. The establishment of the proposed software engineering program is not only timely but will also put Memorial University at the lead among the Atlantic Canadian universities. Specifically, the program is intended to yield advanced software engineers and architects to lead and facilitate information innovation and commercialization.

### 2 Description of the program

The Master of Applied Science in Software Engineering (MAScSE) is a course-based Master's program intended for students with a computer science or computer engineering background who wish to upgrade their background to specialize in software engineering. The MAScSE is a four-term, course-based Master's program to be offered jointly by the Faculty of Science and the Faculty of Engineering and Applied Science. Graduates of the program will have knowledge and understanding of the core areas and methods of Software Engineering and will be ready to work in positions of software development, computer systems architecture and design, and distributed services. We foresee graduates working in both the private and public sectors locally in Newfoundland and Labrador and across Canada. We expect the program to attract students with a background in computer science, computer engineering and cognate areas.

The selection of core courses is intended to cover much of the required part of the Engineers Canada examination syllabus for Software Engineering<sup>1</sup> and the selection of electives is intended to cover some of the optional parts of the syllabus. It is not intended for the program to be accredited by Engineers Canada (note that Engineers Canada does not accredit graduate programs.) Students who complete the program may go on to register with a provincial regulator as a Professional Engineer; however completing the program is neither necessary nor sufficient to qualify for registration. The program distinguishes itself from the existing course option MSc in Computer Science and MASc in Computer Engineering by an increased focus on software engineering and adjunct topics and a decreased emphasis on other areas of computer science, digital design, and communications.

#### 2.1 Name of the program

The proposed name for the new program is Master of Applied Science in Software Engineering (MAScSE).

### 2.2 Graduate student profile

Applicants should have a four-year undergraduate degree (or equivalent) in computer science, computer engineering or a cognate area. Applicants must meet the English Proficiency requirements described under Section 4 (General Regulations), Subsection 4.1.5 (English Proficiency Requirements) of the School of Graduate Studies Calendar. Admission will be competitive, selective, and based on overall academic performance.

#### 2.3 Learning outcomes

Students will graduate with a broad understanding of the main areas of Software Engineering as well as in-depth knowledge in some of these areas. Students will acquire practical experience through course projects, and by completing a substantial team capstone project.

#### 2.4 Key learning outcomes

By completing the proposed MAScSE program, it is expected that a graduate shall be able to:

<sup>&</sup>lt;sup>1</sup> https://engineerscanada.ca/sites/default/files/2021-04/Software-engineering-syllabus.pdf

Faculty of Engineering and Applied Science 5.B.a. (Page 87 of 239)

- Develop an in-depth understanding of software engineering methods and techniques in areas such as software quality assurance, software security, human-machine interfaces, software development and maintenance, project planning and management
- Build the skills to design and develop, implement, integrate, and maintain software and software related products.
- Refine and apply the skills necessary to develop and manage small-, medium-, and largescale software systems with a primary focus on theory and foundational knowledge

### 2.5 Requirements for admission

Admission will be competitive, selective, and based on overall academic performance. The Chair of the Program in concurrence with Graduate Studies committees of the departments will oversee the admission process to ensure that the proper policies and regulations are followed and the best candidates are offered admission. The minimum requirements are:

- Applicants should have a four-year undergraduate degree (or the equivalent) in computer science or computer engineering (or cognate area).
- Applicants must meet the English Proficiency requirements described under Section 4 (General Regulations), Subsection 4.1.5 (English Proficiency Requirements) of the School of Graduate Studies Calendar.

#### 2.6 Program overview

The program consists of 21 credit hours of core courses and 9 credit hours of elective courses (subject to the Chair of the Program's approval), either from the list below or an approved replacement.

	ENGI 9818	Software Fundamentals	
	COMP 6901	Applied Algorithms	
	COMP 6905	Software Engineering	
	ENGI 9867	Advanced Computing Concepts for Engineering	
	ENGI 9874	Software Design and Specification	
	SE xxx2	Software Verification and Validation	
	SE xxx1 <sup>†</sup>	Software Engineering Capstone	
<sup>†</sup> Normally SE xxx1 will be taken in the final term			

### 2.6.1 Core courses

#### 2.6.2 Elective courses

COMP 6904 <sup>1</sup>	Advanced Computer Architecture
ENGI 9861 <sup>1</sup>	High-Performance Computer Architecture
COMP 6908	Database Technology and Applications
COMP 6910	Services Computing, Semantic Web and Cloud Computing
COMP 6916	Security and Privacy or ENGI 9807 Computer Security
COMP 6921	Syntax and Semantics of Programming Languages

COMP 6922	Compiling Methods			
COMP 6925 <sup>2</sup>	Advanced Operating Systems			
ENGI 9875 <sup>2</sup>	Embedded and Real-Time Systems Design			
COMP 6934	Introduction to Data Visualization			
ENGI 9872	Digital Communications			
ENGI 9877	Cryptography			
ENGI 9876	Advanced Data Networks			
ENGI 9869 <sup>3</sup>	Advanced Concurrent Programming			
COMP 6903 <sup>3</sup>	Concurrent Computing			
SE xxx3	Software Engineering Practice			
AI xxx	Topics in Artificial Intelligence			
<sup>1</sup> Students can take one of COMP 6904 or COMP 9861				
<sup>2</sup> Students can take one of COMP 6925 or ENGI9875				
<sup>3</sup> Students can take one of ENGI 9869 or COMP 6903				

2.6.3 Program schedule

Term	Core courses	Elective courses
Fall	ENGI 9818 (Software Fundamentals)	
	COMP 6901 (Applied Algorithms)	
Winter	COMP 6905 (Software Engineering)	Elective (1)
	ENGI 9867 (Advanced Computing Concepts for Engineering)	
Spring	ENGI 9874 (Software Design and Specification)	Elective (1)
	SE xxx2 (Software Verification and Validation)	
Fall	SE xxx1 (Software Engineering Capstone)	Elective (1)

### **3** Statement of Justification

### 3.1 Introduction

With our lives lived increasingly utilizing varied technologies, software lies at the heart of technological function. With an increased reliance on modern, advanced technologies, there is an ever-increasing demand for specialists being able to develop software, understand and support computer systems architecture and design, and distributed services, tasks which are done by software engineers. Given the continuing demand for software engineers, and the expected accelerated growth of this profession over the next few decades, the development of a software engineering graduate degree has become a top priority for many major universities global. The development of a Master of Applied Science in Software Engineering program at Memorial University is therefore especially timely, poising Memorial as a national leader in this exciting field.

### 3.2 Contribution to strategic goals of the University

Memorial University's Strategic Plan notes that we must strive to be "A University for Our Province". With the increasing growth of technology companies in Newfoundland and Labrador (e.g., Verafin), producing highly skilled and highly trained software engineers allows the University to directly fulfill an industrial need. Further, Memorial's Strategic Research Plan, and

specifically the "Information and Communication Technology" theme, specifically lists "software engineering" as a priority area. The formation of a software engineering master's program thus directly responds to the strategic research goals of the university.

#### 4 Market analysis

Recent years have seen accelerated growth in demand for software developers. The United States Bureau of Labour Statistics estimates a growth of 22% in the fields of Software Developers, Quality Assurance Analysts, and Testers from 2020-2030, "much faster than average"<sup>2</sup>. In Canada, there is expected to be a labour shortage for software engineers over the next 10 years, with an expected 27,500 new job openings and only 24,000 new job seekers available to fill these positions<sup>3</sup>. By province, job prospects for software engineers are fair to good (on a scale of limited, fair, and good), and while projections for Newfoundland and Labrador are not known, projections in the rest of Atlantic Canada are all good (the highest rating). Wages for software engineers are high, averaging around \$95,000 per year (\$45.67 per hour) in Canada<sup>3</sup> and \$110,140 per year  $($52.95 \text{ per hour})^2$  in the United States. Overall, there is a pressing demand for graduates to enter this domain. The proposal of a course-based Master of Applied Science in Software Engineering at Memorial University is in direct response to the rapid developments of this field. As an exceptionally interdisciplinary field, it is worth mentioning that Memorial University already has considerable research expertise in software engineering, distributed among the departments of Electrical and Computer Engineering, Computer Science, and beyond. The consolidation of this expertise in a master program in software engineering will allow Memorial to fill this lacuna in skilled software engineers quickly. Additionally, by producing highly educated and skilled graduate students in software engineering with master's degrees, we will help ensure that our graduates are prepared to enter the field at the top of the profession. The creation of a dedicated master's program in software engineering can, therefore, be seen as a timely approach for structuring the training of the next generation of software professionals. Since the proposed coursebased MAScSE program is intended to attract strong undergraduate students, we most notably expect to be able to offer a promising set of graduates to fulfill local industry demand in addition to growing local, national and international markets.

### 4.1 International and national comparison of related programs and unique attributes

Most major Canadian universities offer software engineering programs, including the University of Toronto<sup>4</sup>, the University of Waterloo<sup>5</sup>, the University of Alberta<sup>6</sup>, and McGill University<sup>7</sup>. Notably, these programs are housed in both the department electrical and computer engineering (e.g., University of Toronto), the department of computer science (e.g., University of Alberta) and

<sup>&</sup>lt;sup>2</sup> U.S. Bureau of Labour Statistics (2021), https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm

<sup>&</sup>lt;sup>3</sup> Government of Canada (2019), https://www.jobbank.gc.ca/marketreport/outlook-occupation/5485/ca

<sup>&</sup>lt;sup>4</sup> University of Toronto (2021), https://www.ece.utoronto.ca/prospective-students/curriculum-streams/software-hardware/

<sup>&</sup>lt;sup>5</sup> University of Waterloo (2021), https://uwaterloo.ca/future-students/programs/software-engineering

<sup>&</sup>lt;sup>6</sup> University of Alberta (2021), https://www.ualberta.ca/computing-science/research/research-areas/software-engineering.html

<sup>&</sup>lt;sup>7</sup> McGill University (2021), https://www.mcgill.ca/undergraduate-admissions/program/software-engineering-faculty-engineering

jointly between the two (e.g., McGill University). In Canada, fewer universities offer graduate programs in computer engineering with an optional specialization in software engineering, including Carleton University<sup>8</sup> and the University of Waterloo<sup>9</sup>. Globally, universities around the world<sup>10</sup> have started graduate programs in software engineering with a broad interpretation of the definition of the term "software engineer" and a wide variety of curricula, some focusing more on software and information systems, some centred on hardware and computer architectures related to software engineering, and others seeking a balance between the two, or allowing students the option to choose a specialization. Generally, depending on the focus of the program, software engineering graduate degrees are offered through either the Faculty of Engineering and applied Science (e.g., department of Electrical and Computer Engineering), the Faculty of Science (e.g., the department of Computer Science), or jointly between the two. Many such programs are offered as a specialization of existing programs in either faculty.

Given the rapid development in the field of software engineering, which is only expected to accelerate over the coming decade, and to leverage the current expertise at Memorial, we propose a Master of Applied Science in Software Engineering graduate program that is balanced between software and hardware, with a slightly stronger focus on software principals and theoretical fundamentals of software engineering. In proposing a program that is focused on the fundamental theoretical aspects of this field rather than specific areas of application, our prospective students will be appropriately prepared for the ever-evolving job market.

Out of 96 Canadian universities surveyed, there are presently 27 universities offering undergraduate degrees specifically in software engineering (or equivalent). Of those same 96 Canadian universities surveyed, ten are offering masters degrees in software engineering or related areas. A detailed survey of software engineering-related programs offered in Canadian universities are given in Appendix F: Canadian university survey of undergraduate and graduate programs in software engineering. In Alberta, the Universities of Alberta and Lethbridge offer options or specializations within existing Master of Science degrees, while the University of Calgary offers a one-year course-based Master of Software Engineering. In British Columbia, Simon Fraser University offers a related program resulting in a Master of Science in Professional Computer Science which is similar to the proposed MAScSE. In Nova Scotia, St. Mary's University offers a one-year course-based Master of Science in Software Engineering. In Ontario, McMaster, Western and Wilfred Laurier Universities offer course-based Master of Software Engineering degrees, while Queen's University offers a software engineering specialization with the Master of Science program. Finally, in Quebec, Concordia University and École de technologie supérieure offer course-based Master of Software Engineering degrees. Notably, among the Atlantic universities only St. Mary's University offers a specific Masters degree in software engineering, "with a primary focus on quality, reliability, and maintainability<sup>11</sup>". Memorial University, being a leader of Atlantic universities, is in the unique position of offering a Master of Applied Science in

<sup>&</sup>lt;sup>8</sup> Carleton University (2021), https://carleton.ca/sce/graduate-studies/

<sup>&</sup>lt;sup>9</sup> University of Waterloo (2021), https://uwaterloo.ca/graduate-studies-academic-calendar/engineering/departmentelectrical-and-computer-engineering/master-engineering-meng-electrical-and-computer-engineering

<sup>&</sup>lt;sup>10</sup> Texas State University, San Marco, Texas; University of Europe for Applied Sciences, Berlin, Germany; Innopolis University, Kazan, Russia; Torrens University, Australia; Ben-Gurion University of the Negev, Beersheba, Israel

<sup>&</sup>lt;sup>11</sup> St. Mary's University (2021), https://www.stmarytx.edu/academics/programs/master-software-engineering/

Software Engineering in which students can learn and apply the fundamental techniques from a theoretical foundation, jointly delivered by both the department of Electrical and Computer Engineering, and the department of Computer Science.

Type/year	Year 1	Year 2	Year 3	Year 4	Year 5
FT enrolment	15	20	25	30	30
PT enrolment	-	-	-	-	-
Canadian enrolment	2	2	2	2	2
International enrolment	13	18	23	28	28
On-campus	15	20	25	30	30
Online	-	-	-	-	-
Thesis	-	-	-	-	-
Non-thesis	15	20	25	30	30
Total	15	20	25	30	30

#### 5 Projected enrollment Table 1 Projected 5 year enrolment\*

\*Enrolment as of Fall semester of each year.

#### 6 **Resource implications**

The Faculty of Engineering and Applied Science and the Faculty of Science, and in particular the departments of Electrical and Computer Engineering and Computer Science, have both the teaching and research expertise relevant to the core components of software engineering. Significant research involving software engineering is conducted in both faculties, and many faculty members have existing expertise that can contribute to the success of the program. In fact, the interest in software across the university can be used to enrich the program through, for example, the capstone project as well as enlarging the pool of elective courses.

The program requirements of proprietary software will be minimal because the program will leverage existing software (e.g., Matlab) and other open-source resources. However, students still need access to high performance computing facilities and, depending upon enrolment, the department's computer lab facilities may be overwhelmed. Should such an eventuality arise, a portion of the generated revenue would need to be directed to address this. Meanwhile, some alternatives have been sought. For example, the Centre for Health Informatics and Analytics of the Faculty of Medicine hosts a cluster with big data analysis capabilities, and students whose adviser holds an affiliation with the Faculty of Medicine may be granted access to the computing resources.

#### 6.1 Existing faculty resources

Below a list of faculty members with teaching and research expertise relevant to the core components of software engineering is provided.

Name	Faculty	Description		
Andrew Vardy	FEAS/Science	Swarm robotics and navigation		
Octavia Dobre	FEAS	Wireless, optical and underwater communication		
Cheng Li FEAS		wireless communications and networking, communications		
		signal processing, underwater communication and		
		networking, and mobile ad hoc and wireless sensor		
		networks		

Dennis Peters	FEAS	Software, ranging from introductory programming courses to advanced topics such as software engineering and
		concurrent programming
Thumeera	FEAS	Autonomous robotics systems, multi-sensor data fusions,
Wanasinghe		applied AI and machine learning, and digitalization and its
_		socioeconomic impact.
Howard Heys	FEAS	Cryptography, digital hardware design, and communication networks.
Mohsin Jamil	FEAS	Advanced control systems, digital signal processing and machine learning, as well as advanced control systems, mechatronics, power electronics, power systems and instrumentation.
Ramachandran	FEAS	Parallel processing architectures and applications, error
Venkatesan		control coding, underwater communications, wireless
		communications and ontical communications
Weimin Huang	FFAS	Mapping of oceanic surface parameters via high-frequency
wemmin muang	TLAS	ground wave roder. V hand marine roder, and global
		ground wave radar, A-band marme radar, and grobar
D C1 1 ' 1'		navigation satellite systems.
Reza Shahidi	FEAS	Software engineering, theory of computation, digital signal
		processing and digital systems, incorporating machine
		learning, both from theoretical and practical standpoints
Sarah Power	FEAS	Brain-computer interfaces involving the
		classification/detection of mental states using non-
		invasively measured neural signals, signal processing and
		biomedical engineering
Cecilia Moloney	FEAS	Nonlinear signal and image processing methods, signal
		representations, and radar signal processing, ethics in
		engineering, problem solving in engineering, and methods
		for engineering discovery, signals and systems, probability
		and random processes, and communications
Siu O'Young	FEAS	Sense-and-avoid technology for remotely piloted aircraft
Stu o Toung		systems ("drones")
Theodore	FEAS	Formal programming methods, semantics of programming
Norvell		languages, implementation of programming languages.
		automated verification of concurrent programs, design of
		programming languages program animation and visual
		programming languages
Stenhen	FFAS	
Czarnuch	I LAS	Intelligent, pervasive technologies based on autonomously
Czamuch		tracking human motion using computer vision and machine
		learning.
Dave Churchill	Science	His research revolves around artificial intelligence, video
		games, and robotics.
Karteek Popuri	Science	
	~ • • • • • • • •	iviedical image analysis, machine learning, artificial
		intelligence and computer vision.
Alex Bihlo	Science	Numerical analysis and machine learning (deep learning)
		with applications to geophysical fluid dynamics

Matthew Hamilton	Science	Digital twin and virtual reality systems, including aspects such as vision/sensing, simulation/modelling, graphics/visualization and user interfaces.
---------------------	---------	---

#### 6.2 New faculty resources

The Department of Electrical and Computer Engineering is seeking two tenure-track faculty to support the delivery of the program.

#### 6.3 Additional non-faculty resources

The proposed program will use some of the existing courses offered in the departments of Electrical and Computer Engineering and Computer Science. However, it will require of 3 new on-campus courses, additional sections to existing courses, and a capstone project as well as the teaching time to offer a comprehensive selection of elective courses.

#### 6.4 Administration of the program

The proposed Master of Applied Science in Software Engineering program will be administered by the Dean of the Faculty of Engineering and Applied Science, who will appoint a Program Chair. The Chair will struck the joint committee with members from the Department of Electrical and Computer Engineering and the Department of Computer Science. The chair must work in conjunction with the department heads of Electrical and Computer Engineering and Computer Science or their representatives in all relevant matters concerning the program. The committee will meet regularly to deal with admissions, student progress reviews, changes to the curriculum and content, and review the regulations governing the program.

#### 7 Budget

The proposed budget for the Master of Applied Science in Software Engineering (MAScSE) program is provided in Table 2 with different enrolment scenario. The budget of the enrollment is based on one local student from Newfoundland and Labrador (NL), one Canadian student (non-NL) and one international student each year, where the program fees and special fees of Canadian students will be lower than the international students, and the rest will be international students. As per the budget, program will have a break-even with about 25 - 30 students. With the strong demand in this subject area, it is expected that the program will reach its intended capacity within four years. Surplus of revenues will be used to support students through upgrades in technology as well as entrance scholarship, in-program scholarship, and bursaries for students.

As detailed in the market analysis, there is a high demand for the MAScSE program. However, in case of low enrolments, efforts will be taken to improve the intake by different recruitment strategies with available Memorial resources. The highly related but still complementary sister program (Master of Artificial Intelligence; MAI) as well as other existing course-based programs in the Faculty of Engineering and Applied Science and the Faculty of Science will provide a large pool to attract students from outside, and will serve as a large buffering zone in case one program experiences short term enrolment challenges.

Type/year		Year 1	Year 2	Year 3	Year 4	Year 5
	International student	13	18	23	28	28
Enrolments	Canadian student	1	1	1	1	1
(students)	NL student	1	1	1	1	1
	Total student	15	20	25	30	30
	Program fees	138,810	187,140	235,470	283,800	283,800
	Special fees	294,270	395,680	497,090	598,500	598,500
	Other revenue					
Revenue	Total Revenue	433,080	582,820	732,560	882,300	882,300
	Revenue to MUN central	138,810	187,140	235,470	283,800	283,800
	account					
	VP office fee (20% of	58,854	66,967	99,418	119,700	119,700
	gross)					
	Revenue to FEAS and FS	235,416	316,544	397,672	478,800	478,800
	Tenure-track professor	240,000	240,000	240,000	240,000	240,000
	(incl. benefits, 2 positions)					
Expenditures	Per-course instructor	17,284	17,284	17,284	17,284	17,284
(Instructional	(3 positions)					
&	Teaching assistantships	6,719	6,719	6,719	6,719	6,719
Administrative	(5 positions)					
costs)	Administration support	34,287	34,287	34,287	34,287	34,287
	Course related materials,				60.000	60.000
Expenditures	int'l scholarships and	30,000	50,000	50,000	60,000	60,000
(Materials,	equipment (@\$2,000 per					
Supplies, and	student)	10.000	10.000	10.000	10.000	10.000
Recruitment	Recruitment expenses and	10,000	10,000	10,000	10,000	10,000
costsj	Pageuitment ageney	22.280	50.058	50.058	71.806	71.806
	commission	33,380	39,038	39,038	/1,090	/1,890
	(@2.568  per student)					
	Entrance scholarship to	5.000	5.000	5.000	5.000	5.000
	Canadian student	5,000	5,000	5,000	5,000	5,000
Total Expenditures		574 335	665 786	757 236	848 687	848 687
100	an Expenditures	5/1,005	000,700	101,200	010,007	010,007
	Net Balance	\$(141,255)	\$(82,966)	\$(24,676)	\$33,613	\$33,613

Table 2: Proposed budget for Master of Applied Science in Software Engineering

### 7.1 Program expenses

The major part of the expenses is the salary portion of two tenure track faculty positions. It is highly necessary as software engineering is a fast growing area globally. It is hard to attract highly qualified candidates without such positions. Those faculty members are also expected to be actively engaged in research and graduate student supervision. Three per-course instructors are considered to complement additional teaching tasks. As per the Memorial regulations, 20% of the gross income will contribute to the Provost Office expenses. Other expenses include teaching

assistantship, faculty administration support, program related materials, equipment and scholarships, recruitment expense and travel expense, and recruitment agency commissions.

#### 7.2 Revenue

The revenue for the program is generated based on the student's regular program fee plus the special fee. The regular fees of the program are \$9,666, \$7,434, and \$5,718 for international students, Canadian students, and Newfoundland students, respectively. The special fees of the program are \$20,282 for international students, and \$15,302 for Canadian and Newfoundland students.

#### 7.3 Payment schedule

Based on the proposed budget, a payment schedule (Table 3) is proposed where students need to pay a non- refundable deposit fee.

Туре	Fee type	Deposit	<b>S1</b>	S2	<b>S3</b>	<b>S4</b>	<b>S5</b>	<b>S6</b>	Total
Local Student	Program	\$2,000	\$953	\$953	\$953	\$953	\$953	\$953	\$5,718
	fee								
	Special		\$8,981	\$4,321	-	-	-	-	\$15,302
	fee								
Canadian Student	Program	\$2,000	\$1,239	\$1,239	\$1,239	\$1,239	\$1,239	\$1,239	\$7,434
	fee								
	Special		\$8,981	\$4,321	-	-	-	-	\$15,302
	fee								
Intl Student	Program	\$2,000	\$1,611	\$1,611	\$1,611	\$1,611	\$1,611	\$1,611	\$9,666
	fee								
	Special		\$11,969	\$6,313	-	-	-	-	\$20.282
	fee								

Table 3: F	ayment	schedule
------------	--------	----------

\_

## Appendix A: Library holdings evaluation



2 November, 2021

#### TO: Dr. Cheng Li and Dr. Sharene Bungay

FROM: Meghan McKibbon, Public Services Librarian, Engineering

#### SUBJECT: Master of Applied Science in Software Engineering

The QEII Library received a proposal for a new graduate program, housed in the Faculty of Engineering and Applied Science but jointly offered by Department of Electrical and Computer Engineering (Faculty of Applied Science and Engineering) and the Department of Computer Science. I have determined that Memorial University Libraries has sufficient resources to support the objectives of this program.

Students in computer science are often not exposed to research literature within the discipline at any great depth. I would recommend reaching out to the library and incorporating information literacy into the curriculum.

As is shown below, the library can meet the research requirements of students in this program. Additional resources may be purchased as needed.

#### Library Holdings Summary

The library carries many periodicals specifically on the subject of software engineering. We have subscriptions to all the periodical titles from IEEE and the Association for Computing Machinery (ACM), the two major associations in computer science and engineering. Of the top 25 journals in the Software subject area of periodicals indexed in Scopus, we have access to twenty-two.

The library also has access to many literature databases covering the discipline, including IEEE Xplore, ACM Guide to Computing Literature, Scopus, Web of Science, and many others. Another useful product is Knovel, a full-text searchable and interactive collection of reference material, including handbooks and conference proceedings.

Articles which are not held by the library can be readily obtained through Document Delivery services, usually within a few days.

We have a strong ebook collection in software engineering, made up of permanent purchases for many titles from the major publishers, and subscription packages to ensure that we have access to current content.

The resources listed here are only a portion of the library holdings available through the Memorial University Libraries. I feel confident that this degree would be well supported by existing and future resources in the library, within existing budget allocations.

### **Appendix B: Calendar regulations**

xxx. Regulations Governing the Degree of Master of Applied Science in Software Engineering

The Degree of Master of Applied Science in Software Engineering (MAScSE) is a four-term, course-based Master's program jointly offered by the Department of Computer Science and the Department of Electrical and Computer Engineering.

xxx.1 Qualifications for Admission

- 1. Admission is limited and competitive, and based on overall academic performance.
- 2. To be considered for admission, applicants shall normally hold a minimum secondclass 4-year Bachelor's Degree in computer science, computer engineering or in a related discipline from a university of recognized standing.
- 3. To be eligible for consideration for admission applicants will meet the English Proficiency Requirements described under General Regulations, English Proficiency Requirements.
- 4. Admission to the program shall be upon acceptance by the Dean of Graduate Studies after recommendation by the Chair of the Program or either Head of the Departments of Computer Science or Electrical and Computer Engineering, along with a tentative program of study.

xxx.2 Degree Requirements

- 1. The degree program requires the completion of 30 credit hours.
  - a. 3 credit hours of a Capstone project course SE XXX1.
  - b. 18 credit hours by completing ENGI 9818, COMP 6901, COMP 6905, ENGI 9867, ENGI 9874, and SE xxx2.
  - c. 9 credit hours (three courses) to be selected from COMP 6904, 6908, 6910, 6916, 6921, 6922, 6925, 6934, ENGI 9807, 9869, 9876, 9877, SE xxx3, and AI xxx.

#### xxx.3 Evaluation

Students must obtain a grade of at least 65% in all program courses to receive credit for the course towards their program requirements. Any student who fails to receive 65% or more in a course must repeat the course in the case of core courses, or must either repeat or replace the course with another program course in the case of elective courses. Any student who receives a grade of less than 65% in two courses or in a repeated course will be required to withdraw from the program.

## Appendix C: Course listings

Core courses

ENGI 9818	Software Fundamentals		
COMP 6901	Applied Algorithms		
COMP 6905	Software Engineering		
ENGI 9867	Advanced Computing Concepts for Engineering		
ENGI 9874	Software Design and Specification		
SE xxx2	Software Verification and Validation		
SE xxx1 <sup>†</sup>	Software Engineering Capstone		
<sup>†</sup> Normally SE xxx1 will be taken in the final term			

#### Elective courses

COMP 6904 <sup>1</sup>	Advanced Computer Architecture			
ENGI 9861 <sup>1</sup>	High-Performance Computer Architecture			
COMP 6908	Database Technology and Applications			
COMP 6910	Services Computing, Semantic Web and Cloud Computing			
COMP 6916	Security and Privacy or ENGI 9807 Computer Security			
COMP 6921	Syntax and Semantics of Programming Languages			
COMP 6922	Compiling Methods			
COMP 6925 <sup>2</sup>	Advanced Operating Systems			
ENGI 9875 <sup>2</sup>	Embedded and Real-Time Systems Design			
COMP 6934	Introduction to Data Visualization			
ENGI 9872	Digital Communications			
ENGI 9877	Cryptography			
ENGI 9876	Advanced Data Networks			
ENGI 9869 <sup>3</sup>	Advanced Concurrent Programming			
$COMP 6903^3$	Concurrent Computing			
SE xxx3	Software Engineering Practice			
AI xxx	Topics in Artificial Intelligence			
<sup>1</sup> Students can take one of COMP 6904 or COMP 9861				
<sup>2</sup> Students can take one of COMP 6925 or ENGI9875				
<sup>3</sup> Students can take one of ENGI 9869 or COMP 6903				

## Appendix D: Consultation

#### **Appendix E: Faculty CVs**

Andrew Vardy is a Professor jointly appointed to the Department of Computer Science and the Department of Electrical and Computer Engineering at Memorial University in St. John's, Canada. He completed degrees in electrical engineering (B.Eng., Memorial University, 1999), evolutionary and adaptive systems (M.Sc., University of Sussex, 2000), and computer science (Ph.D., Carleton University, 2005). His main research area is swarm robotics but he has also developed new techniques in visual robot navigation. He leads the Bio-Inspired Robotics (BOTS) lab which is focused on developing swarms of robots that can actively organize their environments, for example by sorting objects or cleaning a space.

**Octavia A. Dobre** received the Dipl. Ing. and Ph.D. degrees from the Polytechnic Institute of Bucharest, Romania, in 1991 and 2000, respectively. Between 2002 and 2005, she was with New Jersey Institute of Technology, USA. In 2005, she joined Memorial University, Canada, where she is currently a Professor and Research Chair. She was a Visiting Professor with Massachusetts Institute of Technology, USA and Université de Bretagne Occidentale, France. Her research interests encompass wireless, optical and underwater communication technologies. She has (co)authored over 400 refereed papers in these areas.

Dr. Dobre serves as the Editor-in-Chief (EiC) of the IEEE Open Journal of the Communications Society. She was the EiC of the IEEE Communications Letters, Senior Editor, Editor, and Guest Editor for various prestigious journals and magazines. She also served as General Chair, Technical Program Co-Chair, Tutorial Co-Chair, and Technical Co-Chair of symposia at numerous conferences.

Dr. Dobre was a Fulbright Scholar, Royal Society Scholar, and Distinguished Lecturer of the IEEE Communications Society. She obtained Best Paper Awards at various conferences, including IEEE ICC, IEEE Globecom, IEEE WCNC, and IEEE PIMRC. Dr. Dobre is a Fellow of the Engineering Institute of Canada, a Fellow of the Canadian Academy of Engineering, and a Fellow of the IEEE.

**Cheng Li** received his B. Eng. and M. Eng. degrees from Harbin Institute of Technology, Harbin, P. R. China, in 1992 and 1995, respectively, and his Ph.D. degree in Electrical and Computer Engineering from Memorial University, St. John's, Canada, in 2004. He is currently a Full Professor and Head of the Department of Electrical and Computer Engineering of Memorial University, St. John's, Canada. His research interests include wireless communications and networking, communications signal processing, underwater communication and networking, and mobile ad hoc and wireless sensor networks. He has (co)authored over 350 technical papers in his research areas.

Dr. Li is an IEEE Communications Society Distinguished Lecturer for the 2021-22 term. He is an associate editor of the IEEE Transactions on Communications, IEEE Internet-of-Things Journal, IEEE Network Magazine, and IEEE Systems Journal. He has served as the General Co-Chair of the ICNC'22, WINCOM'19, and AICON'19, and the TPC Co-chair for the ICNC'20, MSWiM'14, WiMob'11 and QBSC'10. He has served as a co-chair for various technical symposia/tracks of many international conferences, including IEEE GLOBECOM, ICC, and WCNC. He is the recipient of the best paper awards in various international conferences, including the IEEE Globecom'2017 and ICC'2010. Dr. Li is a registered Professional Engineer (P. Eng.) in Canada and is a Senior Member

of the IEEE and a member of the IEEE Communication Society, Computer Society, Vehicular Technology Society, and Ocean Engineering Society.

**Dennis K. Peters** is Professor and Associate Dean (Undergraduate Studies) for the Faculty of Engineering and Applied Science at Memorial University in St. John's, NL, Canada where he has been a member of Faculty since 1998. He earned the B.Eng. (Electrical) degree at Memorial University in 1990, before going to work in the high-tech industry at Newbridge Networks (now Alcatel) in Ottawa, Ontario. After two years in industry he returned to school, this time at McMaster University in Hamilton, Ontario where he completed the M.Eng. (Electrical & Computer) in 1995 and Ph.D. (Electrical & Computer Engineering) in 2000. His research involves applications of machine learning techniques to a variety of problems ranging from marine operations to oilfield characterization. He also studies techniques for design and verification of software and computer systems, with particular focus on high performance computing, simulation, real-time applications and parallel or distributed processing.

Dr. Peters is an active volunteer in the professional engineering community in Canada. He is a former Chair (2014-15) of the Board of Directors of the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL), and served (2008-2020) on the Canadian Engineering Qualifications Board (CEQB), including a term as Chair (2016-18). He was a member (2002-13) of the Registration Committee for PEGNL, including the last 7 years as Chair. He is a member (1999-present) of the executive committee for the Newfoundland and Labrador Section of the IEEE, including a term as Chair and several years as Student Branch Counselor. He has participated in accreditation visits for the Canadian Engineering Accreditation Board (CEAB) and has served on the organizational committees for local, national and international conferences.

His teaching activity is primarily in the area of software, ranging from introductory programming courses to advanced topics such as software engineering and concurrent programming.

Thumeera Wanasinghe received his B.Sc. (Hons.) and M.Sc. degree in Electronic and Telecommunication Engineering from the University of Moratuwa, Sri Lanka, in 2009 and 2011, respectively. He obtained his doctoral degree in Electrical Engineering from Memorial University of Newfoundland, Canada, in 2017. His masters' thesis focussed on electrical parametric modelling of human skin impedance spectroscopy in response to variations in blood glucose level, and his doctoral thesis focussed on autonomous multi-robot collaboration. After completing his doctoral degree, he joined the Memorial University of Newfoundland as a postdoctoral researcher. He led three industrial funded research projects exploring underwater image processing, 3D point-cloud processing, and opportunities and challenges of digitalization of extractive industries. He has completed several online certifications in data science, machine learning, deep learning, and selfdriving cars during his postdoctoral study. Currently, he is an Assistant Professor (Teaching term) attached to the Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science, Memorial University of Newfoundland. His main research areas are autonomous robotics systems, multi-sensor data fusions, applied AI and machine learning, and digitalization and its socioeconomic impact. His teaching interests embrace but are not limited to the following areas: communications systems, electrical/ electronic/ digital circuits, signal processing, electromagnetic principles, autonomous robotic systems, control systems, machine learning, artificial intelligence, and data science.

**Howard M. Heys** obtained a B.E.Sc degree in electrical engineering in 1984 from the University of Western Ontario in London, Ontario, Canada, and a Ph.D. degree in computer engineering in 1994 from Queen's University, Kingston, Ontario, Canada. He worked for several years as a software designer in Ottawa and Toronto and is now a professor of Electrical and Computer Engineering at Memorial University. His current research interests include cryptography, digital hardware design, and communication networks. He has supervised or co-supervised 25 graduate student research theses and served on numerous conference program committees, as well as hosting and chairing the Conference on Selected Areas in Cryptography (SAC) twice at Memorial. His recent teaching activities have included introductory courses in digital logic, computer hardware foundations, and circuits and advanced courses in communication networks and cryptography.

**Mohsin Jamil** received a Bachelor of industrial electronics Engineering degree from NED University of Engineering and Technology, Karachi, Pakistan, in 2005. He received two master's degrees in electrical engineering from Dalarna University Sweden and the National University of Singapore in 2006 and 2008, respectively, with major in Automation and Control Engineering. He received his PhD degree in electrical engineering from the University of Southampton in 2012.

He is currently an assistant professor (teaching) and adjunct professor within the Department of Electrical and Computer Engineering at Memorial University of Newfoundland, Canada, since August 2019. Between 2016 and 2019, he worked in the Department of Electrical Engineering at the Islamic University of Madinah, Saudi Arabia. Between 2012 and 2016, He was working at the Robotics Department of the National University of Sciences and Technology (NUST), Islamabad, Pakistan. His teaching interest includes advanced control systems, digital signal processing and machine learning, as well as advanced control systems, mechatronics, power electronics, power systems and instrumentation. He also works in other multidisciplinary areas as well, such as process control, system identification, artificial intelligence, and machine learning.

He is the author and co-author of several IEEE publications in different journals and peer-reviewed conferences. He is the recipient of different awards and funding grants. He is a registered Professional Engineer in the Province of Newfoundland and Labrador, Canada. He is an associate editor of IEEE Access and a senior member of IEEE.

**Ramachandran Venkatesan** received the B.E. degree (Hons.) from Madurai University, Madurai, India, and the M.Sc.E. and Ph.D. degrees from the University of New Brunswick, Fredericton, NB, Canada, all in electrical engineering. He is a professor (emeritus) of computer engineering with Memorial University of Newfoundland, St. John's, NL, Canada, where he has been working since 1987. He worked in Industry as a welding research engineer for several years. He has held several academic administrative positions including the Chair of Electrical and Computer Engineering, the Associate Dean for Graduate Studies and Research, the Associate Dean for Undergraduate Studies, the Acting Dean, and the Dean Pro Tempore of Engineering. His research interests include parallel processing architectures and applications, error control coding, underwater communications, wireless communications, and optical communications. He is a Registered Professional Engineer.

**Weimin Huang** received the B.S., M.S., and Ph.D. degrees in radio physics from Wuhan University, Wuhan, China, in 1995, 1997, and 2001, respectively, and the M.Eng. degree in electrical engineering from the Memorial University of Newfoundland, St. John's, NL, Canada, in 2004. From 2008 to 2010, he was a Design Engineer with Rutter Technologies, St. John's. Since 2010, he has

been with the Faculty of Engineering and Applied Science, Memorial University of Newfoundland, where he is a Professor. He has authored more than 250 research articles.

His research interests include the mapping of oceanic surface parameters via high-frequency ground wave radar, X-band marine radar, and global navigation satellite systems. Dr. Huang has been a Technical Program Committee Member. He serves as a regular Reviewer for more than 60 international journals and a Reviewer for many IEEE international conferences, such as RadarCon, the International Conference on Communications, IEEE Global Communications Conference, IEEE Geoscience and Remote Sensing Society, and Oceans. He was a recipient of the Postdoctoral Fellowship from the Memorial University of Newfoundland. In 2017, he was a recipient of the Discovery Accelerator Supplements Award from the Natural Sciences and Engineering Research Council of Canada. He was a recipient of the IEEE Geoscience and Remote Sensing Society 2019 Letters Prize Paper Award. He has served as the Technical Program Co-Chair for the IEEE Newfoundland Electrical and Computer Engineering Conference in 2012 and 2013. He is an Area Editor of the IEEE Canadian Journal of Electrical and Computer Engineering, an Associate Editor of IEEE Access, an Editorial Board Member of Remote Sensing, and a Guest Editor of IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

**Reza Shahidi** received the Bachelor of Mathematics degree (Joint Honours Computer Science and Pure Mathematics) from the University of Waterloo, Waterloo, ON, Canada, in 1998, and the M. Eng. and Ph.D. degrees in computer engineering from the Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, NL, Canada, in 2003 and 2008, respectively.

He was a Postdoctoral Fellow from 2008 to 2009 with the University of British Columbia, Vancouver, BC, Canada, where he conducted research on seismic imaging, after which he spent several years working in industry in radar signal and image processing. In 2019, he was appointed as an Adjunct Professor with the Electrical and Computer Engineering Department, Faculty of Engineering and Applied Science, Memorial University, where he holds a multi-year NSERC Discovery Grant to conduct research into ocean parameter spectrum extraction from HF radar data. His research interests include signal and image processing, machine learning, algorithm design, HF and X-band radar, and vehicular networks. Before being appointed Teaching Assistant Professor with the ECE Department at MUN in December 2020, he was Product Development Lead with Seamatica Aerospace, St. John's, NL, Canada, and has roughly a decade of industrial research and development experience. As Teaching Assistant Professor, and prior to that, Dr. Shahidi has taught courses in Software Engineering, Theory of Computation, Digital Signal Processing and Digital Systems. He has introduced and incorporated machine learning, both from theoretical and practical standpoints, when teaching graduate courses in Advanced Computing Concepts and Concurrent Programming over the past year. He is the author or co-author of approximately 50 peerreviewed journal and conference publications in prestigious venues and has supervised/cosupervised several graduate students both at the University of British Columbia and Memorial University.

**Sarah Power** received the B.Eng. degree from Memorial University and the M.A.Sc. and Ph.D. degrees from the University of Toronto. She is an assistant professor, joint-appointed to the Department of Electrical and Computer Engineering and the Division of Community Health and

Humanities. Broadly, her research interests lie in biomedical signal processing and the application of machine learning to medical, rehabilitation, and human factors problems. Her main research focus is in the area of brain-computer interfaces, which involves the classification/detection of mental states (e.g., mental workload, fatigue, attention, affective state, task proficiency) using non-invasively measured neural signals (e.g., EEG). Her current teaching activities are primarily in the areas of signal processing and biomedical engineering.

**Cecilia Moloney** is a faculty member at Memorial University where she is a Professor of Electrical and Computer Engineering. She is a member of the Radar Remote Sensing Laboratory (RRSL), with research interests that include nonlinear signal and image processing methods, signal representations, and radar signal processing. In addition, she is a founder of the MetaKettle Project, a legacy project of the NSERC/Petro-Canada Chair for Women in Science and Engineering, Atlantic Region that she held at Memorial University in 2004-2009. The MetaKettle Project promotes and conducts research in transformative pedagogy for science and engineering; her recent contributions have addressed aspects of ethics in engineering, problem solving in engineering, and methods for engineering discovery. Dr. Moloney has taught courses at undergraduate and graduate levels in the Signals and Systems stream of courses (e.g. Engi 9821, Digital Signal Processing), in probability and random processes (e.g. Engi 9825, Random Signals), and in communications (e.g. Engi 9871, Information Theory and Coding). To the courses she teaches she brings the technical knowledge and pedagogical insights she has honed over her academic career, from the classroom and from her research and outreach initiatives.

**Siu O'Young** is a Professor in Electrical and Computer Engineering at Memorial University. He has a Ph.D. in Electrical Engineering from the University of Waterloo. His current research focus is on sense-and-avoid technology for remotely piloted aircraft systems ("drones"). He is active in the RTCA SC228 committee for US detect-and-avoid standards and is a member of the TSO Mirror Committee on Unmanned Aircraft Systems for the Standards Council of Canada. He also has more than 20 years of business experience in mentoring high-tech start-ups and in accessing capital.

**Theodore S. Norvell** is a Professor of Computer Engineering at Memorial University, where he has been a faculty member for 26 years. His research has included formal programming methods, semantics of programming languages, implementation of programming languages, automated verification of concurrent programs, design of programming languages, program animation, and visual programming languages. He has taught courses in computing theory, software design, software development, concurrent programming, algorithms, data structures, discrete math, formal methods, digital logic, operating systems, and more, and he has developed software including "The Teaching Machine" (with Michael Bruce-Lockhart). He has supervised numerouse undergraduate capstone projects including, most recently, aspects of the Killick-1 satellite, has supervised numerous capstone projects for course-based masters students, and has supervised or co-supervised 16 thesis-based students.

**Stephen Czarnuch** is an Associate Professor in Biomedical Engineering at Memorial University. He received his B.Eng. and Mgmt. and M.A.Sc. degrees in Electrical and Computer Engineering from McMaster University, and his Ph.D. in Biomedical Engineering from the Institute of Biomaterials and Biomedical Engineering at the University of Toronto in 2002, 2005, and 2014, respectively. Following a short post-doctoral appointment at Memorial University, he was appointed

to the Faculty of Engineering and Applied Science at Memorial in 2015. He currently holds or has held 12 grants as PI (including grants from CIHR and NSERC) and 8 grants as CI (including CIHR and SSHRC). He is currently supervising or has supervised 4 doctoral and 6 masters students, 15 research assistants, mentored 4 medical residents and over 40 undergraduate senior engineering students. He has extensive experience developing intelligent technologies for vulnerable populations by implementing a holistic, user-centered design philosophy centered on identifying user needs and evaluating health outcomes. His research is inherently interdisciplinary, lying at the intersection of engineering, computer science, medicine, gerontology, rehabilitation, psychology, and sociology. Specifically, he seeks to develop relevant, accessible, acceptable and adoptable patient-oriented technological interventions based on autonomously tracking human motion using computer vision. Further, he emphasizes the evaluation of their efficacy by connecting academic research with providers and patients in a real-world context. His technical focus is on machine learning, deep learning, and computer vision.

**Dave Churchill** – David Churchill is an Associate Professor of Computer Science at Memorial university, and runs the MUN AI and games lab. His research revolves around artificial intelligence, video games, and robotics.

**Karteek Popuri** is currently an Assistant Professor at the Department of Computer Science at Memorial University of Newfoundland. He got his Bachelor of Technology degree in Chemical Engineering at the Indian Institute of Technology (IIT) Madras, and his Master's degree in chemical engineering from the University of Alberta. He received his PhD degree in Computing Science from the University of Alberta. Dr. Popuri's research interests are broadly in the areas of medical image analysis, machine learning/artificial intelligence and computer vision.

**Alex Bihlo** is an Associate Professor and Canada Research Chair in Numerical Analysis and Scientific Computing in the math department, and cross-appointed with the computer science department. His research is on numerical analysis and machine learning (deep learning) with applications to geophysical fluid dynamics. I am teaching courses on numerical analysis, deep learning and reinforcement learning. I am also supervising several students in this research direction.

**Matthew Hamilton** holds a PhD in Computing Science from the University of Alberta in Canada, as well as an undergraduate degree in Pure Mathematics/Computer Science from Memorial University. He is author and co-author of multiple scientific and engineering articles and patents. Dr. Hamilton is currently and an Assistant Professor of Computer Science at Memorial University and President of Birch Scientific. Previously, he has worked in industrial research as a Holographic Rendering and CODEC R&D Engineer at Avalon Holographics and Senior Research Scientist, NSERC/Research and Development Corporation-NL Postdoctoral Industrial R&D Fellow at GRI Simulations, specializing in oil and gas virtual reality environments (simulation development, computer graphics, and data visualization) as well as computational aspects of developing a 3D display (rendering, codec development and display perception).

His research centers around developing digital twin and virtual reality systems, including aspects such as vision/sensing, simulation/modelling, graphics/visualization and user interfaces. He has particular interest in application of vision and computer graphics towards holographic 3D displays. He is interested in capture of real-world holographic imagery for live cinematic capture, visual modelling for games and digital twins and robotic vision in terms of processing and compression.

He also works on applying machine learning to digital twin systems for automating decision-making (e.g. in radiology), recognition of novel patterns and data-driven simulation of physical aspects of digital twin systems.

**Ed Brown** is an associate professor at Memorial's department of Computer Science with principal research interests in human-computer interaction, privacy issues related to technology, intellectual property, and technology law. His teaching responsibilities are primarily software design courses. He has an undergraduate degree from Memorial University, M.Sc. and Ph.D. from the University of Toronto, and J.D. from the University of Victoria, Canada. Dr. Brown was called to the Newfoundland Bar in June of 2004. Dr. Brown has worked in the area of toolkit implementation and user interface design in North American and Europe, and with intellectual property specialty firms in Canada and the U.S.

Adrian Fiech joined Memorial University in September 1994. He obtained his Master's degree from the Technical University Dortmund in Germany. His PhD is from Kansas State University in US. Dr. Fiech's research interests are in the area of Programming Languages, Cloud Computing, Concurrency and Software Testing. Currently he is teaching Software Engineering, Object-Oriented Programming, Web Development and Logic courses at Memorial University.
# Appendix F: Canadian university survey of undergraduate and graduate programs in software engineering

Alberta	City	Undergrad.	Grad.
Athabasca University	Athabasca	No	No
Concordia University of Edmonton	Edmonton	No	No
MacEwan University	Edmonton	No	No
Mount Poyal University	Calgary	No	No
	Springbank	INO	INO
The King's University	Edmonton	Yes	No
University of Alberta	Edmonton	Yes	Yes
University of Calgary	Calgary	Yes	Yes
University of Lethbridge	Lethbridge	No	Yes
British Columbia			
Capilano University	North Vancouver	No	No
Emily Carr University of Art + Design	Vancouver	No	No
	Surrey	-	
Kwantlen Polytechnic University	Langley	- No	No
<i>y</i>	Richmond	_	
	Cloverdale		
Royal Roads University	Victoria	No	No
	Burnaby		
Simon Fraser University	Surrey	Yes	Yes
	Vancouver		
The University of British Columbia	Vancouver	- No	No
	Kelowna	110	110
Thompson Rivers University	Kamloops	Yes	No
Trinity Western University	Langley	No	No
	Prince George	_	
	Terrace	_	
University of Northern British Columbia	Fort St John	No	No
	Quesnel	_	
	Gitwinksihlkw		
University of the Fraser Valley	Abbotsford	No	No
University of Victoria	Victoria	Yes	No
Vancouver Island University	Nanaimo	No	No
Manitoba			
Brandon University	Brandon	No	No
Canadian Mennonite University	Winnipeg	No	No
St Paul's College	Winnipeg	No	No
The University of Winnipeg	Winnipeg	No	No
Université de Saint-Boniface	Winnipeg	No	No
University of Manitoba	Winnipeg	No	No
N D 1			
New Brunswick	0 1 11	<b>N</b> T	
Mount Allison University	Sackville	No	No
St Thomas University	Fredericton	No	No
Université de Moncton	Moncton	Yes	No

Faculty of Engineering and Applied Science 5.B.a. (Page 110 of 239)

Master of Applied Science in Software Engineering

	Edmundston		
	Shippagan	**	
University of New Brunswick	Fredericton	Yes	No
	Saint John		
Newfoundland & Labrador			
Memorial University of Newfoundland	Corner Brook St John's	No	No
Nova Scotia	XX7 10 '11	<b>N</b> T	NT
Acadia University	Wolfville	No	No
Cape Breton University	Sydney	No	No
Dalhousie University	Halifax	Ye	No
Mount Saint Vincent University	Halifax	NO	NO
NSCAD University	Halifax	NO	NO
Saint Mary's University	Halifax	NO	Yes
St Francis Xavier University	Antigonish	NO	NO
Universite Sainte-Anne	Pointe-de-l'Eglise	NO	NO
University of King's College	Halifax	No	No
Ontario			
	Sault Ste Marie		
Algoma University	Brampton	No	No
	South Porcupine		
Brescia University College	London	No	No
Brock University	St Catharines	No	No
Carleton University	Ottawa	Yes	No
Huron University College	London	No	No
King's University College	London	No	No
Lakehead University	Thunder Bay	Vas	No
	Orillia	105	INU
Lourontion University	Sudbury	Vac	No
	Barrie	105	
McMaster University	Hamilton	Yes	Yes
Nipissing University	North Bay	No	No
OCAD University	Toronto	No	No
Ontario Tech University	Oshawa	Yes	No
Queen's University	Kingston	Yes	Yes
Redeemer University	Ancaster	No	No
Royal Military College of Canada	Kingston	No	No
Ryerson University	Toronto	No	No
St. Jerome's University	Waterloo	No	No
Trent University	Peterborough	Yes	No
University of Guelph	Guelph	No	No
University of Ottawa	Ottawa	Yes	No
University of St Michael's College	Toronto	No	No
University of Sudbury	Sudbury	No	No
	Toronto	INU	INU
University of Toronto	Mississanda	Ves	No
	Scarborough	1 03	110
	Starborough		

Faculty of Engineering and Applied Science 5.B.a. (Page 111 of 239)

Master of Applied Science in Software Engineering

University of Trinity College	Toronto	No	No
University of Waterloo	Waterloo	Yes	No
University of Windsor	Windsor	No	No
Victoria University	Toronto	No	No
Western University	London	Yes	Yes
	Waterloo	NT	NT
Wilfrid Laurier University	Brantford	No	No
York University	Toronto	Yes	No
Prince Edward Island			
University of Prince Edward Island	Charlottetown	No	No
Québec			
Bishop's University	Sherbrooke	No	No
Concordia University	Montreal	Yes	Yes
École de technologie supérieure	Montreal	Yes	Yes
École nationale d'administration publique	Québec	No	No
HEC Montréal	Montréal	No	No
Institut national de la recherche scientifique	Québec	No	No
McGill University	Montreal	Yes	No
Polytechnique Montréal	Montreal	No	No
Université de Montréal	Montréal	No	No
	Sherbrooke	NT	NT
Universite de Sherbrooke	Longueuil	No	No
Université du Québec	Québec	No	No
Université du Québec à Chicoutimi (UQAC)	Chicoutimi	No	No
Université du Québec à Montréal (UQAM)	Montréal	Yes	No
Université du Québec à Rimouski (UQAR)	Rimouski	No	No
Université du Québec à Trois-Rivières (UQTR)	Trois-Rivières	No	No
Université du Québec en Abitibi-Témiscamingue (UQAT)	Rouyn-Noranda	No	No
Université du Québec en Outaouais	Gatineau	No	No
Université Laval	Québec	Yes	No
Université TÉLUQ	Québec	No	No
Saskatchewan			
Campion College	Regina	No	No
	Regina		
First Nations University of Canada	Saskatoon	No	No
	Prince Albert		
Luther College	Regina	No	No
St Thomas More College	Saskatoon	No	No
University of Regina	Regina	Yes	No
University of Saskatchewan	Saskatoon	No	No

# ENGI 9818 Software Foundations

## Course Information Sheet

## Memorial University of Newfoundland

#### 2021 Fall

Instructor Theodore Norvell, EN-3064 until Sept. 22 CSF-4117 after Sept. 22, 864-8962.

**Times** MWF 11:00–12:00. Lab: Monday 13:00–15:00 or possibly Thursday 11:00 to 13:00

- Location CSF-2112 when it is ready. Until then, Wednesday and Friday are in EN 4034. I don't know where we will be on Monday. If the lab is on Thursdays it will be in EN-3000/3029 until CSF-2112 is ready. First lab will be on Thusday Sept 9 at 11:00 in EN-3000/3029.
- **Office hours** Wednesday and Friday at 2:00 subject to change. In my office (see above). Appointments can be made for other times. You are welcome to knock on my office door anytime and if it's not a bad time, I'll be happy to talk.
- Mail For anything concerning the course, please use the Brightspace "Course Mail"; I am user "theo". For all other matters use regular email "theo@mun.ca" please send from your MUN email address.
- **TA** Ahmadi Mehrnaz (as far as I know)
- Web page http://www.engr.mun.ca/~theo/Courses/swf/ and for some things the Brightspace page.

# Description

Computer Software Foundations covers fundamental topics in computer software design and construction such as: design by contract, procedures, procedural abstraction and recursion; error handling; data structures, invariants, representation relations, and data abstraction; interfaces, inheritance of interface, inheritance of behaviour, inheritance of implementation, overriding, dynamic dispatch, and polymorphic code; simple patterns such as iterators; genericity; event-driven code; higher-order programming.

# Textbook

Barbara Liskov and John Guttag, Program Development in Java: Abstraction, Specification, and Object-Oriented Design Addison-Wesley Professional, 2000.

• This book is available only as an e-book or used.

# References

Cay Horstmann, Core Java(TM) 2, Volume I–Fundamentals, 11th ed., Prentice Hall PTR, 2020, or 9th ed., 2009. (9th edition available electronically from the library. See course web page.) What we really need is the 12 edition, but it is not yet published. The Java Language Specification, Java SE 16 Edition, online at https://docs.oracle.com/javase/specs/Bertrand Meyer, Object-Oriented Software Construction, 2nd ed., Prentice Hall, 1997.

# 1 Software

Java 16 or 17 JDK (or later)

Eclipse for Java Developers 2021-06 version. Or your favourite IDE. But it must support the Java 16 JDK.

 $\operatorname{Git}$ 

Optionally, SourceTree from Atlassian.

# Evaluation Scheme with *Tentative* Dates

Midterms	25%	Oct. 13 and Nov. 15
Assignments	25%	
Labs	10%	
Final	30%	TBA
Float	10%	(Better of midterms (combined) & final)

# **Other Information**

- If you are forced to isolate during the term, let me know. I will do my best to ensure that you can continue to participate.
- All the above is subject to change in case of a lock-down or other expected or unexpected crap.

- Late assignments and projects will not be accepted without prior arrangement or documented justification.
- Any complaints about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) <u>must</u> be brought to my attention <u>before</u> the exam.
- Academic dishonesty will, as a minimum, result in a mark of zero for the offending work. Academic dishonesty will be reported to the Associate Dean. Academic dishonesty includes copying from another student's work or allowing another student to copy from one's own work, consulting with any unauthorized person during an examination or test, using unauthorized aids, and presenting the ideas or works of another as one's own. If you have any doubt about whether something constitutes academic honesty, consult with the instructor. I am getting really freaking pissed off about cheating, so don't do it.
- Asking questions is strongly encouraged.
- Comments, suggestions and constructive criticisms are always welcome.

# **COMP 6901 -- Applied Algorithms Fall 2020**

Announcements | Course information | Assignments and tests | Lecture notes

# Course information

The course information below is very tentative! The way the lectures/tests are done and the marking scheme, inparticular, are likely to change depending on everybody's availability, enrolment, software licenses and other factors.

Instructor: Antonina Kolokolova Instructor office hours: TBA. Also on Zoom. Additionally, we will be using discussion boards on Brightsgace.

We will be using <u>Brightsnace (formerly: known as D2L)</u> for assignment submissions, tests, grades, announcements, etc. The assignments, slides and videos of lectures will also be posted here. The Brightspace shell for our course should be available shortly to all registered students; ifyou cannot register/access Brightspace after the first week of classes, please let me know.

Textbook: There will be no official textbook for this course. We will mostly follow *J. Kleinbe-rg*, *E. Tardos*. *Algorithm Design*, but you do not need to buy it.

Reference books:

- J. Kleinberg, E. Tardos.Algorithm Design.
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms

We will also use other materials such as research papers.

See the lecture notes from the previous run of this course for more information.

**Marking scheme:** (tentative!): 4 assignments 15% each, and two tests 20% each. The last test is likely to be scheduled during the last week of classes.

**Description:** The goal of this course is to study both classical and advanced algorithm design techniques with emphasis on real-world applications. We will cover greedy algorithms, dynamic programming, backtracking, network flows as well more advanced algorithms and techniques (time permitting). Time permitting, we will consider randomized, parallel and distributed algorithms, and/or streaming algorithms.

**Prerequisites:** This course assumes proficiency in the core subjects of computer science: <u>programming</u>, discrete math, and basic data structures/algorithms. In particular, I will assume that you can read and write proofs, know basic probability theory and combinatorics, know basic data structures and algorithm complexity analysis, can read and write pseudocode, and can program fluently in some programming language. Check our undergraduate courses COMP 1001, COMP 1002 and COMP 2002, and make sure you are comfortable with the material covered there; this should take care of most of the skills you need to succeed in COMP 6901.

**Policy on collaboration:** The work you submit must be your own. You may discuss problems from assignments with each other; however, you should prepare written solutions alone, and do not interact with anybody except the instructor while doing tests and online exercises. Plagiarism is a serious academic offense and will be dealt with accordingly. When in doubt, check How to avoid P-lagiarism

5.B.a. (Page 116 of 239)

**Computer Science 6905** Software Engineering Fall 2020



**Department of Computer Science** 

Instructor: Dr. Adrian Fiech

Virtual Office Hours:During the scheduled class time (Monday, Wednesday and Friday 2:00 p.m. – 3:00 p.m.)e-mail:Brightspace (D2L) email: afiech@online.mun.ca

Please note that you **cannot** email to a Brightspace "online.mun.ca" email address from an outside address (such as "mun.ca" or "gmail.com"), nor can you email from a Brightspace "online.mun.ca" email address to an outside address. Thus, Brightspace "online.mun.ca" email addresses can only be used within the Brightspace environment. The course number **must** be included in the subject line of any emails to the instructor or the instructional staff.

Course information (e.g., assignments, labs, quizzes, lecture notes, announcements, grades, etc.) can be found on Brightspace (D2L).

## **Course Prerequisite:**

Undergraduate Software Engineering course.

## **Course Summary:**

This course starts with review of the basic skills necessary for a developer to function in a software engineering context (chapters 1-3). Next, we focus on methods and technologies that enable developers to specify, design and implement complex systems (chapters 4-8). Finally (student presentations, chapters 12-16), we learn methods and technologies that support the control, assessment and implementation of changes throughout the development of a system.

## Textbook:

*Object-Oriented Software Engineering: Using UML, Patterns, and Java*<sup>™</sup> (3<sup>rd</sup> Edition) by Bernd Bruegge, Allen H. Dutoit, Prentice Hall; ISBN-10: 0136061257; ISBN-13: 978-0136061250.

## **Evaluation:**

The final grade in this course will be determined as follows:	
Assignment (28. September – 16. October)	20%
Presentations (due 19. October)	15%
Oral Midterm Exam (21./22./23. October)	35%
Project (26. October – 4. December)	30%

Your final mark can be no more than your midterm exam mark plus 15%! The passing mark for a graduate course is 65%. **To pass this course you must obtain at least 50% on the midterm exam!**  Lecture Time: No live lectures; asynchronous delivery via notes and presentation slides.

#### **Tentative Course Schedule:**

Dates	Chapter(s)	Topics(s)
09. September – 11. September	1	Introduction to Software Engineering
14. September – 18. September	2	Modeling with UML
	3	Project Organization and
		Communication
21. September – 25. September	4	Requirements Elicitation
	5	Analysis
28. September – 02. October	5	Analysis
	6	System Design: Decomposing the
		System
	7	System Design: Addressing Design
		Goals
05. October – 09. October	7	System Design: Addressing Design
		Goals
	8	Object Design: Reusing Pattern
		Solutions
12. October – 16. October		Review
(MIDTERM BREAK - 12-13. October)		
19. October – 23. October		Presentations and Midterm Exam
26. October – 04. December		Project

## Notes on Assignment/Project/Presentation:

- Assignment and Project will require programming using the Eclipse IDE. We will be using a GIT repository for group collaboration.
- Your submissions should be uploaded in the correct format, and in the correct folder, using Brightspace's Assessment/Assignments tool (instructions will be given on the first assignment). Be aware that the files you submit for evaluation should be uploaded on or before the due date and much before the cut off time. Even if you are late by a few seconds you will not be allowed to submit your work; hence you should try to upload the files 15 minutes before the cut off time since your system clock is not synchronized with CITL's system clock and the cutoff time is based on CITL's system clock. Please note that if your file has been correctly uploaded, you will get a confirmation receipt from the Assessment/Assignments tool. If you do not receive this receipt, please contact the CITL Support team (https://www.citl.mun.ca/support/). Your instructor will not be able to help you in this regard. It is very important to remember that what is not uploaded, so please do check for the confirmation that your files have been uploaded.
- Material submitted for grading must be your group's original work. Copying someone else's work or allowing your work to be copied is a serious breach of university regulations and ethics. Any and <u>all</u> copied material will receive the mark of 0%. If your assignments are quite similar then it can be construed as copying. Please see the University Calendar University Regulations General Academic Regulations (Undergraduate)
  - 6.12 Academic Misconduct.

## **Oral Midterm Exams:**

• The exams will be scheduled on the 21., 22. and 23. October. Your (30 minutes) time slot will be decided at the beginning of October.

## Student support:

- Memorial University of Newfoundland is committed to supporting inclusive education based on the
  principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the
  University Policies for the Accommodations for Students with Disabilities
  (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are
  asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity
  (www.mun.ca/blundon).
- Help with a variety of Online Learning issues, such technical support, etc., is available by contacting the CITL Support Centre via phone (1-866-435-1396, or locally at 709-864-8700), online chat (when available) or via their ticketing system. This contact information is available at: <u>https://www.citl.mun.ca/support/</u>
- Please note that Memorial University offers a broad range of supports. For a more comprehensive list of student supports and resources, please check out the following links:
  - o https://www.mun.ca/munup/support/
  - o <u>https://www.mun.ca/main/students.php</u>
  - o <u>https://www.munsu35.ca/resource-centres/</u>

## Other:

- If, for special circumstances (such as medical or bereavement) you miss a deadline for a grade item, notify your instructor as soon as possible, providing any related documentation (if documentation is required). Failure to do this can result in a mark of 0% for that work. Please refer to the current University policy regarding medical notes and the information to be in them. For more information, please see the University Calendar University Regulations General Academic Regulations (Undergraduate) 6.7.5 Exemptions from Parts of the Evaluation and 6.15 Appeal of Decisions, or consult the Registrar's Office. If your reasons for the missed work are acceptable, then your instructor may suggest an alternative evaluation scheme.
- Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.
- Note that your instructor prefers to use Brightspace (D2L) email for course correspondence. Please send any
  emails to afiech@online.mun.ca address within Brightspace. Also, please include [COMP6905] in the
  subject line. Official email correspondence within the university must be via a valid Memorial University
  email account.
- The lectures and displays (and all material) delivered or provided in COMP 6905 Software Engineering by Professor Fiech, including any visual or audio recording thereof, are subject to copyright owned by Professor Fiech. It is prohibited to record or copy by any means, in any format, openly or surreptitiously, in whole or in part, in the absence of express written permission from Professor Fiech any of the lectures or materials provided or published in any form during or from the course.

# ENGI. 9867 - Advanced Computing Concepts for Engineering

Memorial University of Newfoundland

#### Winter 2021

Instructor Reza Shahidi, EN-3060, Phone TBD.

**Email** For course-related email, please use online.mun.ca; user name "rshahidi", or advancedcoco@reza.courses. For all other email, please use rshahidi@mun.ca.

TAs Zhao Zhenxin

Lectures (Virtual)

Mondays, Wednesdays, Fridays 11:00–11:50 WebEx (through BrightSpace)

Tutorials (to be held as needed)

Thursdays 12:00–12:50 EN-1000

Office Hours By appointment or Tuesday 11:00am to 12:00noon.

- **Suitable for** Graduate students in Computer Engineering or Computer Science or undergraduates in Computer Engineering interested in a somewhat theoretical course.
- Web page http://online.mun.ca and possibly http://advancedcoco. reza.courses

**Textbook** Parts of: Theodore S. Norvell, *Theories of Computation*. Current draft. Available at the course web-site.

 References • Thomas Sudkamp, Languages and Machines, 3rd Ed., Addison-Wesley, 2005.

- Feldman and Harel, *Algorithmics: The Spirit of Computing*, 3rd Ed., Addison Wesley, 2004.
- Eric Hehner, a Practical Theory of Programming, current edition, 2019. http://www.cs.toronto.edu/~hehner/aPToP/
- Shalev-Shwartz and Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
- Burkov, *The Hundred-Page Machine Learning Book*, Publisher: Andriy Burkov, 2019.
- **Outline** The course looks at a number of important questions from four general areas of computing theory: Theory of programming, formal language theory, computational complexity theory and machine learning.
  - Theory of Programming. How do I describe a computational problem? How do I derive a program (or system) to solve a given problem. Does my program (or system) actually solve the problem it is meant to solve?
    - Specification
    - Design synthesis
    - Verification
    - Documentation
  - Formal Language Theory. What kinds of computers are there? Which kinds of computers can solve which problems? Are there problems that no computer can solve? How can we finitely describe complex infinite sets such as the inputs to a computer program or the sentences in a human language?
    - Finite machines
    - Regular expressions
    - Transducers and statecharts
    - Context free grammars
    - Computability and uncomputability
  - Computational Complexity Theory. How efficient is my algorithm? Is it maximally efficient for the problem? How hard are problems?

- $-O, \Omega$ , and  $\Theta$
- Complexity of algorithms
- Complexity of problems upper and lower bounds, average and worst-case complexity
- The class **NP**
- The class NP-complete and polynomial time reductions
- Machine Learning. What is learning? When do we need machine learning? What are the different types of machine learning?
  - Formal Learning Model
  - Computational Complexity of Learning
  - Support Vector Machines, Kernel Methods, Nearest Neighbour Algorithms
  - Artificial Neural Networks (Shallow vs. Deep Learning)

It turns out that the answers to these questions have considerable engineering utility. The course deals with both the theory and the application of the theory.

#### Evaluation and approximate schedule

Assignments	15%	About 5. Times TBA.
Term paper / presentation	20%	Paper April 9. Presentations start March 29.
Midterm	10%	Feb 26
Midterm	10%	Mar 19
Final	30%	TBA
Better of midterms & final	10%	
Better of Term paper & assignments	5%	

# **Other Information**

- Late assignments will **not** be accepted without prior arrangement or documented justification. Missed tests will require a note from a medical doctor or a nurse practitioner.
- Any questions about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) <u>must</u> be brought to my attention <u>before</u> the exam.

- Unless otherwise specified, assignments are to be done individually.
- Academic dishonesty will, as a minimum result, in a grade of zero for the offending work, and will be reported to the Associate Dean. Academic dishonesty includes copying, allowing your work to be copied, unauthorized working in groups, and failing to correctly cite sources. If you have any doubt about whether something constitutes academic honesty, consult with me. See section 4.12 of the School of Graduate Studies regulations for more information. http://www.mun.ca/ regoff/calendar/sectionNo=GRAD-0029
- Asking questions is strongly encouraged. If you have a question, it is likely that others have the same question. Please ask questions during class, not after.
- Comments, suggestions and constructive criticisms are always welcome.

## The Memorial University of Newfoundland Code

All members of the Memorial University of Newfoundland Community, which includes students, faculty, and staff, shall treat others with respect and fairness, be responsible and honest, and uphold the highest standards of academic integrity.

## **Expectations of Student Conduct**

Engineering students are expected to behave in a professional manner at all times. Memorial has two sets of rules which deal with inappropriate behaviour by students. The first set deals with academic offences such as cheating (http://www.mun.ca/regoff/calendar/sectionNo=GRAD-0029), while the other set deals with non-academic offences such as disruptive behaviour in class (see https://www.mun.ca/student/supports-and-resources/respectful-campus/ student-code-of-conduct.php). The penalties can be severe, the severest being expulsion from the University. It is strongly recommended that students read and follow these rules.

1

MEMORIAL	CourseOutline ENGI-9874
UNIVERSITY Faculty of Engineering and Applied Science	Spring 2021

#### ENGI-9874: Software Specification and Design

Instructor	Ebrahim Karami	ТА	Mehrnaz Ahmadi
E-mail	ekarami@mun.ca	E-mail	mehrnaza@mun.ca
Phone	709-219-1633	Phone	

Preferred method of communication: MUN email.

SCHEDULE: Lecture: MWF 10:00-10:50 am, online room in D2L.

#### **RESOURCES:**

#### **Required Textbooks:**

- 1. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, 3<sup>rd</sup> ed., Prentice Hall, 2010.
- 2. Robert C. Martin, Agile Software Development, Prentice Hall, 2003.

#### **Optional Resources:**

- Martin Fowler, UML Distilled, 3rd ed, Addison Wesley, 2004, ISBN 0-321-19368-7.
- Cay Horstmann, Core Java(TM) 2, Volume I—Fundamentals, 11th ed., Prentice Hall PTR, 2020, or 9th ed., 2009. (9th edition available electronically from the library. See course web page.)
- Craig Larman, Applyling UML and Patterns, 2nd ed., Prentice Hall PTR, 2002.
- Erich Gamma et al, Design Pattern
- Booch et al., The UML User Guide
- Rumbaugh et al, The UML Reference Manual Freeman and Freeman, Head First Design Patterns

#### **MAJOR TOPICS:**

- Introduction, Methodologies
- The UML notation
- Requirements Elicitation, Analysis/Design
- Analysis
- System Design
- Case Study

MEMORIAL UNIVERSITY	CourseOutline ENGI-9874	2
Faculty of Engineering and Applied Science	Spring 2021	
ASSESSMENT:		

	Weight	Approximate date
Assignments	15%	-
Assignment 1	5%	June 14
Assignment 2	5%	July 5
Assignment 3	5%	July 26
Midterms	20%	
Midterm 1	10%	June 18
Midterm 2	10%	July 16
Project	35%	TBA
Final Exam	30%	TBA

**Course Materials on D2L:** This course will use D2L for online rooms, exams, the distribution of course materials, such as class presentations, assignments, solutions, and other information as pertinent, as well as for occasional email notices to the whole class. Materials will be posted as we progress through the course.

#### Exams:

There will be two midterm exams during the class time. Deferred tests can be permitted only if the student proves his/her inability to take the test for very serious reasons, such as sickness. Evaluations outside regular class periods require approval of the Associate Dean of Undergraduate Studies.

**Calculator Policy:** In order to ensure fair assessment of students' understanding of course materials, there is a restriction on the calculators which can be used during the tests and exam. Basic scientific calculators can be used in the tests and exam which have none of the following capabilities: graphing, text memory, programmability. Similarly, the use of notebook computers, tablets, or other communicating devices such as cell phones or smartphones will be prohibited during the tests and exam. If you are uncertain, please check ahead of time with the instructor or TA prior to the tests or exam to be sure that the calculator you plan to use complies with the calculator policy.

## **The Required Fine Print** – *Please read and observe*

#### Academic Integrity and Professional Conduct:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at <a href="https://www.engr.mun.ca/undergrad/academicintegrity">www.engr.mun.ca/undergrad/academicintegrity</a>.

**The Memorial University of Newfoundland Code:** "All members of the Memorial University of Newfoundland Community, which includes students, faculty, and staff, shall treat others with respect and fairness, be responsible and honest, and uphold the highest standards of academic integrity." (<u>http://www.mun.ca/regoff/calendar/sectionNo=GENINFO-1502</u>)



CourseOutline ENGI-9874 Spring 2021

**Faculty of Engineering Student Code of Conduct:** "Like Professional Engineers, engineering students are expected to behave in a professional manner at all times. Students are encouraged to conduct themselves in a manner consistent with the PEG-NL Code of Ethics." Read more at <u>http://www.engr.mun.ca/policies/codeofconduct.php</u>

**Safety:** Students are expected to demonstrate awareness of, and personal accountability for, safe conduct within the classroom and building. Take note of emergency exits. Students will immediately report any concerns regarding safety to the teaching assistant and/or professor.

**Inclusion and Equity:** Students who require physical or academic accommodations are encouraged to speak privately to the instructor so that appropriate arrangements can be made to ensure your full participation in the course. All conversations will remain confidential.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

**Student Assistance:** Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.

#### **ADDITIONAL INFORMATION:**

**Team Project:** A major part of this course is the term project. Carefully read the following points with respect to the project:

- Projects will be undertaken by teams of no more than two students.
- Teams must define their own projects.

#### **MISCELLANEOUS NOTES:**

- Submitted materials are due by 11:59pm on the due date. Late materials will not be accepted without prior arrangement or documented justification.
- Any complaints about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) must be brought to my attention before the final report deadline.
- Academic dishonesty will, as a minimum result in a grade of zero for the offending work and may be reported to the Dean for treatment through the prescribed formal process. Academic dishonesty includes copying, allowing your work to be copied, and failing to cite sources. Refer to the relevant information available through Memorial University.
- Questions related to the course are strongly encouraged.
- Constructive comments, suggestions and criticisms are always welcome.

5.B.a. (Page 126 of 239)



Science and Engineering

Course Outline SE xxx2

Spring 2023

# SE xxx2 Software Verification and Validation

Instructor	Prof. X x@mun.ca (709) 864-TBD EN-TBD	TA(s)	TBD
Office Hours	TBD		
Website Communication	https://TBD TBD		
Calendar Entry	SE xxx2 Software Verification quirements, verification of soft ing) and static analysis. Verifi- tion, system, and acceptance I Development, peer review, ma- ered. Traceability from require	and Validation ware via both ication is cover evels. Techniqu nual and auton ements to imple	covers validation of re- dynamic analysis (test- ed at the unit, integra- ues such as Test Driven nated proof will be cov- ementation is covered.
Schedule	Lecture MTuWThF TBDtim	ne-TBDTime	TBDplace
Credit Value	3 credits		
Textbook	TBD, AUTHOR, ED, PUB (Y	TEAR).	

# 1 Learning goals

The goal of the course is to introduce the student to concepts and techniques of requirements validation and design verification for software systems and systems that include software. This will include techniques for validation of systems requirements in including prototyping, review, writing of acceptance tests, modelling and checks for completeness, consistency, and determinism. Students should learn concepts of defects, errors, faults, hazards, and failures. And they should learn techniques for verifying that software has a low or zero defect rate. These techniques include software and system testing from unit testing to acceptance testing. They also include static analysis techniques that can prove the absence of classes of defects and program proofs that ensure that the software meets its formal requirements.

Students should learn how to integrate validation and verification into software development processes including agile processes. Concepts covered will include peer review, test driven and behaviour driven development, defensive programming, regression testing, fault injection, code coverage, trace-ability, developer testing, and separate quality assurance teams.

# 2 Major Topics

- Requirements Validation
- Unit, integration, systems, and acceptance testing.
- Static analysis.

- Proofs of correctness.
- BDD, TDD, Peer review, regression testing.
- Coverage, trace-ability.

DRAFT typeset October 21, 2021. Please do not distribute further.

## **3** Assessment

Assignments (5)		10%	
Quizzes (4)		40%	
Project and presentation	15% Final Exam		35%

## 4 Lab Safety

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

# 5 Inclusion and Equity

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

## 6 Student Assistance

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at http://www.mun.ca/student.



Science and Engineering

Course Outline SE xxx1

Fall 2021

# SE xxx1 Software Engineering Capstone

Instructor	Prof. X x@mun.ca (709) 864-TBD EN-TBD	TA(s)	TBD
Office Hours	TBD		
Website Communication	https:TBD TBD		
Calendar Entry	Software Engineering Capsto two semesters of the program. The project involves the design of software. Students will be we supervised by one of the course have a client who may be the s consist of 3 to 5 students workin Effective collaboration and organ an important aspect of the course The course is only available to s Engineering	ne will ne and ana ork in tea instruct ame as t g togethe ization c e. students	ormally be taken in the final alysis of a significant piece ams and each team will be ors. The project will also the supervisor. Teams will er in a coordinated fashion. of the team and the work is in the Masters of Software
Schedule	Lecture MWF TBDtime-TBD'	Time	TBDplace
Credit Value	3 credits		
Textbook	TBD, AUTHOR, ED, PUB (YEA	AR).	

## 1 Assessment

Each team is assessed according to the following scheme

Component	Mark
Progress Report 1	15%
Progress Report 2	15%
Presentation	20%
Final Report	50%

Each student's mark will be determined not only by their team mark, but also according to their individual effort and contribution as assessed by the instructors and by their peers.

# 2 Lab Safety

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the

teaching assistant, staff technologist, and professor.

## **3** Inclusion and Equity

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

## 4 Student Assistance

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at http://www.mun.ca/student.

#### Computer Science 6908 Fall 2020

**Course Name:** Database Technology and Applications **Class Time:** 3:30pm – 4:45pm, T, Th **Instructor:** Jian Tang **Office Hours:** 2:15pm – 3:15pm, T, Th, or by appointment

- **Textbook:** "Database Management Systems", 3<sup>rd</sup> Ed., Raghu Ramkrishnan, Johannes Gehrke, McGraw – Hill Education, ISBN: 0-07-246563-8 (E-copy available from the web)
- **Reference:** "Fundaments of Database Systems", 7<sup>th</sup> ED, Ramez Elmasri, Shamkant B. Navathe, Pearson Education Ltd, ISBN 13: 978-1-292-09761-9 (E-copy available from the web)
- **Objectives:** To introduce students to database processing, database management systems and database design considerations. Additional topics covered include the theory and methodologies essential for the relational database design, implementation and management under the corporation as well as web application environment.

Prerequisites: COMP 3725 or COMP 2004, and COMP 3754 or COMP 2007

#### **Representative topics:**

A review of relational data model Concepts and notations SQL Nested SQL Embedded SOL Database applications on web Client-server architecture of web applications HTML Python Queries using relational algebra Storage organizations Hardware aspects Storing files on a disk **Operations of files** Index structures Hashing B+-tree A review of FD and normal forms Relational decomposition and dependency preservation Lossless joins Query processing Implementation of select, project and join Cost analysis of implementation schemes Overview of transaction management The ACID property

Transactions and schedules Problems caused by concurrent executions Problems caused by aborted transactions Serializability and recoverability Concurrency control Lock-based concurrency control 2PL Timestamp-based concurrency control Crash recovery The log Checkpointing Redo phase Undo phase

Course Deficulte (for reference only, subject to change)
--

week	date	Content
1	Sept. 10	Introduction, review of relational model
2	Sept. 15, 17	SQL and nested SQL
3	Sept. 22	Database in web applications, HTML, Python
3	Sept. 24	Relational algebra
4	Sept. 29, Oct. 1	Relational algebra
5	Oct. 6, 8	Storage organization, B+ tree
6	Oct. 12 – 13	Mid-term break, no class
6	Oct. 15	Hash
7	Oct. 20	Query processing and implementation:25 mins
7	Oct. 22	Review, query processing and implementation
8	Oct. 27	Review, query processing and implementation
8	Oct. 29	FD and normal forms
9	Nov. 3, 5	FD and normal forms, LJ and DP
10	Nov. 10	LJ and DP
10	Nov. 12	Transaction, concurrency control
11	Nov. 17	Concurrency control
11	Nov. 19	Crash recovery
12	Nov. 24, 26	Crash recovery
13	Dec. 1	Crash recovery
13	Dec. 3	Crash recovery, review

title	coverage	weight	due date
Assignment 1	RD, SQL, relational algebra	4%	Oct. 1
Assignment 2	Relational algebra, storage organization, B+ tree	4%	Oct. 15
Assignment 3	Hash, query processing	4%	Nov. 3
Assignment 4	FD and normal forms	4%	Nov. 17
Assignment 5	Tran. magt, con. control and crash recovery	4%	Dec. 3
Project1	Database application on the web	12%	Oct. 9
Project2	Implementation of relational algebra with B+tree	23%	Nov. 23
Final	full coverage	45%	To be determined

Evaluations and schedules\*

\*The due dates may change depending on the progress of the classes.

\*Project1 is an individual project. Project2 is a group project with at most two members.

\*Assignments and projects are designed to be the independent work of each student (and each group for the group project). Word-to-word copying (including superficial modification) is an academic offence. Identical copies will receive zero for both copies.

**Method of Lecture Delivery:** The entire course will be taught online throughout the semester. A combination of synchronous and asynchronous delivery will be used for the lectures. In most cases, I will give live lectures at the assigned time-slots. Depending on the circumstances, however, I may post the pre-recorded lectures on or before the assigned class time. When this happens, I will inform you in advance.

• A statement of Memorial University's commitment to accommodation of students with disabilities:

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities(www.mun.ca/policy/site/policy.php?id=239).Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

• A statement regarding academic integrity:

Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

## COMP 6910

# Fall 2016

# Services Computing, Semantic Web and Cloud Computing

## Course objectives / description

This course will cover the fundamental concepts and technologies behind services computing, semantic Web and cloud computing. Services Computing deals with all aspects relating to services, including creation, registration, discovery, composition and delivery. The core concept behind Semantic Web is the representation of data in a machine-interpretable way. Ontologies facilitate the means to realize such representation. Cloud Computing advocates the concept that any computation can be done anywhere and at anytime. Scalability, elasticity, security and confidentiality are important requirements

Course outline (Topics include the following):

- The Principles of Services and Services Computing;
- Service-Oriented Architecture (SOA);
- Web Ontology Language;
- Web Services Publishing and Discovery;
- Semantic Service Selection;
- Co-ordination Frameworks for Web Services;
- Transaction Concepts;
- Service Management;
- Overview of Cloud Computing;
- Security, Privacy and Trust Management Issues for Cloud Computing;

#### Prerequisites / background required

Introductory courses in Databases, Computer Architecture and Operating Systems (equivalent to COMP 3754 and COMP 3725) are required.

#### Evaluation

Assignments	40 %
Midterm	20 %
Project	40%
-	

## **References / reading list**

- Services Computing, Liang-Jie Zhang, Jia Zhang and Hong Cai, Springer, 2007, ISBN 978-3-540-38281-2.
- Service Computing Concepts, Methods and Technology, Zhaohui Wu, Shuiguang Deng and Jian Wu, Morgan Kaufmann, ISBN 978-0-12-802330-3, 2015.
- Service-Oriented Computing Semantics, Processes, Agents, Munindar Singh and Michael N. Huhns, Wiley, 2004, ISBN 978-0-470-09148-7.
- Cloud Computing Principles and Paradigms, (ed) Raj Kumar Buyya, James Broberg and Andrej Goscinski, John Wiley & Sons, 2011, ISBN 978-0-470-88799-8.
- Cloud Computing Methodology, Systems and Applications, (ed) Lizhe Wang, Rajiv Ranjan, Jinjun Chen and Boulem Benetallah, CRC Press, 2012, ISBN 978-1-4398-5641-3.
- Web Services -- Concepts, Architectures and Applications, G. Alonso, F. Casati, H. Kuno, and V. Machiraju, Springer, 2004, ISBN 978-3-642-07888-0.

#### COMP 6922 : Compiling Methods Winter 2018

**Objectives:** This course provides theoretical foundations for compiler design. Emphasis is on practical mechanisms of lexical and syntax analyses. Classical compiler writing tools (LEX and YACC) are included as example implementations of some compiling methods.

**Required background:** Practical knowledge of programming in a high-level language is assumed. Some background in formal languages, automata theory and computer organization (machine-level programming) is needed.

Evaluation:

Assignments	25 %	Note: All assignments are expected to be worked out indi-
Project	25 %	vidually; no credit is given for assignments which are consid-
Final examination	50 %	ered identical.

#### **Outline:**

- Overview of formal grammars and formal languages (and in particular, context-free grammars and languages) with basic properties and some grammar transformations
- Definition of programming languages, lexical, syntax and semantics analyses of programming languages
- Recursive-descent parsing, code generation, error-recovery
- Finite automata and scanning; LEX
- General top-down and bottom-up parsing
- Bottom-up parsing, LR(k), SLR(k) and LALR(k) parsers, YACC
- Top-down parsing, LL(k) parsers
- Attribute grammars, inherited and synthesized attributes, attribute evaluation, examples

#### References:

- A.V. Aho, M.S. Lam, R. Sethi, J.D. Ullman, "Compilers principles, techniques, and tools" (3-rd ed.); Addison-Wesley Longman 2006 (ISBN 0-321-48681-1)
- K. Cooper, L. Torzon, "Engineering a compiler"; Elsevier Science 2007 (ISBN 1-55860-698-X, 1-55860-699-8).
- A. Meduna, "Elements of compiler design"; Auerbach Publ. 2008 (ISBN 1-4200-63233-5).
- T.A. Mogensen, "Introduction to compiler design"; Springer-Verlag London 2011 (ISBN 978-0-85729-828-7).
- S. Muchnick, "Advanced compiler design and implementation"; Academic Press 1997 (ISBN 1-55860-320-4).
- A.T. Schreiner, H.G. Friedman, "Introduction to compiler construction with UNIX"; Prentice-Hall 1985 (ISBN 0-13-474396-2)

Directory: www.cs.mun.ca/courses/cs6922 or /local/pub/cs/cs6922 Instructor: Dr. W.M. Zuberek, office: EN-2028, tel. 864-4701, email: wlodek@mun.ca Please review carefully and retain this document for future reference.

## First important thing you must do, and do it immediately:

Send me an email, with subject header. COMP 6925 my mun email address.

Then I will be able to include your email address in my address book.

All future correspondence, including your assignments etc., will be done via email.

CS6725 Advanced Operating Systems Fall 2018 Instructor: Ashoke Deb email: ashoke@mun.ca Office: EN2026

#### Recommended Reading:

- Operating System Design, The XINU Approach, Comer
- Operating System Concepts, Silberscatz et. al.
- Operating Systems Internals and Design Principles, Stalling
- Principles of Concurrent Programming, Ben-Ari
- Modern Operating Systems, Tanenbaum et al.

#### Grading Scheme:

- There are no exams
- The evaluation will be based on the following:

One semester-long group project: worth 60% (More about group project later.)

- Two assignments (to be done independently): worth 40%

### NOTE:

- When sending email, please prefix subject with CS6725:
- For making appointments, send me an email, but give enough lead time.

Students are required to attend lectures, and maintain a complete and accurate copy of the class notes.

The process of writing the class notes is half the study! Also, please refer to the University Calendar articles 6.8.3 and 6.11.

The assignments are due on the due date, approximately a week to 10 days from the date assigned.

Due dates are strictly final, and assignments are due in class.

Assignments submitted outside the class will not be accepted.

#### **Class Policy:**

Please turn off and put away all communication devices while in class.

No hw will be given on the last two weeks of classes; but a previously assigned hw may be due during that time. The span of more than one hw may overlap in time, ie. a new hw may be assigned before the previous one is due.

Programming projects can be done in any language of your choice. No programming language will be covered in this course.

5.B.a. (Page 139 of 239)

Please (a) submit your work, in a brown envelop, properly labeled; (b) submit your work in class, before the lecture begins; (c) work submitted outside the class, and not on due date, will not be accepted; (d) due dates are final, and are not extended.

OFFICE HOURS: Office hours are by appointment. Please send me an email with subject header: COMP 6925 Can i make an appointment to see you.

I do not have a cell phone, and do not check my email after hours, or weekends, or holidays.

So, please give a lead time, say a couple of days, for a response.

3

# Course Syllabus - Fall 2021

# Computer Science 4304: Data Visualization Computer Science 6934: Intro to Data Visualization

Instructor:	Terrence Tricco (he/him)
Email:	tstricco@mun.ca
Office:	ER-6031
Lectures:	11:00 - 11:50am M-W-F (Three 50 minute lectures per week.)
Lecture Room:	EN-2006
Office Hours:	1:00 - 3:00pm on Mondays (or by email appointment)
4304 Pre-requisites:	COMP 2001, COMP 2002, Statistics 2500 or Statistics 2500

# **Instructional Continuity**

Welcome back to campus. All lectures in this course will be taught both in-person and through recorded video posted online to Brightspace. The recorded lectures will be a duplicate of the in-person lecture. You can choose which mode of learning you prefer.

Masks are currently required on campus. If this policy changes during the term, it is still recommended to wear a mask even if not required. There will be different levels of comfort and anxiety for mask use. Please be respectful of everyone in the class.

Should there be disruption to in-person lectures over the course of the term by other health directives or the overall situation connected to Covid-19, then instruction will continue through the online videos according to the course schedule.

# **Course Objectives**

Data visualization is the art of creating images based on data. Visualizations enable users to explore, understand, and extract insights from data in an efficient way. This course will be centred on data visualization for data science, and will cover three broad topics. One will be the tools of data visualization, specifically Jupyter notebooks and Python visualization libraries. A second topic will be standard types of visualizations for different types of data. The third topic will be on the theoretical aspects of data visualization, such as viewer perception and rules of thumb for good visualizations.

# **Course Outline**

- Data Visualization Tools
  - Jupyter Notebooks and Python
  - Pandas data library

- Matplotlib, Seaborn and Plotly visualization libraries
- Vector graphics (svg), Rasterization
- Interactivity
- Standard Visualisation Types
  - Relational: Line plots, Scatter plots, Bubble plots, Heat maps
  - Categorical: Bar plots, Histograms, Box plots, Radar charts
  - Hierarchical: Pie charts, Venn diagrams
  - Multi: Scatterplot matrix
  - Spatial: Chloropleth, Contour plots, Kernel density estimation
  - Data reduction: t-SNE, Principal component analysis
- Data Visualisaton Theory
  - Planning and design process
  - Human perception
  - Colour theory
  - Elements of style
  - Rules of thumb, pitfalls to avoid

## Evaluation

There will not be any in-person evaluation. The final grade in the course will be determined as follows:

Assignments (8)	50%
Course Project	50%
<ul> <li>Project Proposal</li> </ul>	(10%)
<ul> <li>Project Submission and Code</li> </ul>	(25%)
• Video Presentation	(15%)

# **Recommended Reading (Optional)**

There is no required textbook for this course. The following textbooks are only recommended for further reading on course topics.

- A. Kirk, Data Visualisation: A Handbook for Data Driven Design, 2nd Edition, Sage, 2019.
- T. Munzner, Visualization Analysis & Design, CRC Press, 2014.
- R. Spence, Information Visualization: An Introduction, 3rd Edition, Springer, 2014.

# **Memorial University Policies**

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www. mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.



Course Outline ECE7400 / ENGI 9869

Spring 2021

Faculty of Engineering and Applied Science

# ECE 7400 / ENGI 9869 (Advanced) Concurrent Programming

Instructor	Dr. Reza Shahidi rshahidi@mun.ca Phone number: 864-2617 EN-3060	TA(s)	Sidra Anwar and Dharar Samir sidraa and sdharar @mun.ca
Office Hours	By appointment		
Website Communication	https://online.mun.ca/ E-mail is the preferred form of confidential, please use the ma	of commu il system	nication. If you need to discuss something in D2L or email me at rshahidi@mun.ca.
Calendar Entry Other Requirements Prerequisites	ECE 7400 Concurrent Programming (same as the former ENGI 7894) surveys parallel and distributed architectures and examines patterns of concurrent program design; correctness of concurrent programs: safety and liveness properties, proof of properties; synchronization using locks, semaphores, and monitors; communication using message passing and remote procedures; parallelization for high-performance computation and advanced topics such as scientific applications, distributed systems, model checking, and transaction processing. Counter-Requisites: the former ENGI 7894 or the former ENGI 8893 ECE 5400 or the former ENGI 5892 or the former ENGI 6892, ECE 6500 or the former ENGI 6861		
Schedule	<b>Lecture</b> Tue/Thu 10:30–11:4	$5 \mathrm{am}$	Virtual (WebEx via D2L)
Textbook	The Art of Multiprocessor Programming (Second Edition) by Maurice Herlihy, Nir Shavit, Victor Luchangco, Michael Spear. (Morgan Kaufmann, Sept 2020). Paperback: ISBN: 978-0-124-15950-1, Ebook: 978-0-123-91406-4.		
References			
	• Java Concurrency in Pr fessional, 2006). Paperba 132-70225-6.	<i>actice</i> , by ack. ISBN	v Brian Goetz et al. (Addison-Wesley Pro- N: 978-0-321-34960-6, E-Book. ISBN: 978-0-
	• The Little Book (Green Tea Press http://www.greenteapres	<i>of</i> , 200 ss.com/set	Semaphores, by A. Downey, 8). E-book available from maphores/downey08semaphores.pdf
	• Concurrent Programming tion, by Doug Lea, (Add 978-0-201-31009-2.	g in Java: lison-Wes	Design Principles and Patterns, second edi- sley Professional, 1999). Paperback. ISBN:

#### 5.B.a. (Page 144 of 239) ECE 7400 / ENGI 9869 (Advanced) Concurrent Programming Spring 2021

# 1 Major Topics

- Overview of Concurrent/Distributed/Parallel Programming
- Processes and Synchronization
- Concurrency Semantics
- Locks and Mutexes
- Deadlock and Starvation
- Semaphores
- Monitors
- Barriers and Futures
- Advanced Java concurrency features
- RPC/Rendezvous
- Concurrent Data Structures
- Introduction to GPU Programming
- Introduction to Cuda and OpenCL
- Examples of GPU algorithms/implementations
- Concurrency Issues in Real-time O/S programming/Internet of Things
- Parallel Algorithms
- Parallel Programming and Scientific Programming (MPI)
- OpenMP/vectorization (SSE/MMX)
- Designing Concurrent Programs with UML
- Other concurrent/parallel languages (e.g., Haskell, Go, Scala)

## 2 Course Description

The course content will be delivered through lectures (virtual) and assigned readings. Assessment will be in the form of five assignments, two midterm exams, a project (including report and presentation, only for ENGI 9869) and a final exam.

#### 2.1 Lectures

Questions during lectures are welcome. Student participation in active learning exercises during class time is required.

#### 2.2 Website

I will be using Desire2Learn (D2L) as the course websites for ECE 7400/ENGI 9869. Apart from responding to e-mails I have received, **D2L will be my sole means of contact with you.** As such, I recommend that you log in to check for messages or announcements at least once a day. Should you have any problems using D2L, please contact their technical support—I have no ability to access or fix your account or solve your problems.

Naturally, any personal questions pertaining to your grades, absences, lateness, etc., should be sent directly to me via the website's e-mail functionality rather than posting on the discussion board.
### 2.3 Absences and Lateness

Absences during any of the scheduled assessment (tests and exams) may be excused for valid medical reasons or bereavement in accordance with university policy. You are responsible for providing appropriate documentation.

# **3** Learning Outcomes

Upon successful completion of this course, the student will be able to:

	Learning Outcomes	Methods of Assessment
1	Recognize and explain various common parallel and distributed	Assignments, Midterms,
	architectures	Final Exam
2	Recognize and explain various common patterns of concurrent	Assignments, Midterms,
	program design	Final Exam
3	Analyse concurrent programs to determine if they satisfy appro-	Assignments, Midterms,
	priate safety and liveness properties	Final Exam
4	Design solutions to problems using shared memory concurrent	Assignments, Midterms,
	techniques including locks, barriers, semaphores, and monitors.	Final Exam
5	Design solutions to problems using distributed memory concurrent	Assignments, Midterms,
	techniques such as message passing and remote procedure calls.	Final Exam
6	Design and analyse solutions to computational problems using	Assignments, Midterms,
	both data and task parallelization and modern programming	Final Exam
	tools.	
7	Appreciate the impact of choice of programming language on con-	Assignments, Midterms,
	currency.	Final Exam

# 4 Assessment

### 4.1 ECE 7400

Assignments (5 in total, due May 25, June 8, June 29, July 13, July 27)	30%
Midterm 1 (June 10)	15%
Midterm 2 (July 22)	15%
Final Exam	40%

# 4.2 ENGI 9869

Assignments (5 in total, due May 25, June 8, June 29, July 13, July 27)	20%
Midterm 1 (June 10)	10%
Midterm 2 (July 22)	10%
Course Project	20%
Final Exam	40%

No calculators may be used on the exams or tests.

Any questions about marks (addition, recording, etc.) or special circumstances (illness, bereavement, etc.) must be brought to my attention before the final exam. No reconsideration of marks other than the final exam will be made after the day before the exam date.

# 4.3 Midterms

There will be two in-class midterm examinations. They are worth 15% each for ECE 7400 students and 10% each for ENGI 9869 students.

Needless to say, the midterms are individual tests.

# 4.4 Course Project (only grad section)

There will be a course project only for ENGI 9869, worth 20% of the term mark for that course on a topic chosen by the student and agreed to by the instructor. A presentation will be given by each ENGI 9869 student as well as a report prepared on the agreed-upon topic. These will be due during the last week of lectures.

# 4.5 Final Exam

The final examination will be worth 40% of the term mark for both ECE 7400 and ENGI 9869. The 'safelabs' option was passed to the class, elide the Lab Safety statement.

# 5 Academic Integrity and Professional Conduct

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php.

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at http://www.mun.ca/engineering/undergrad/academicintegrity.php and Memorial University's Code of Student Conduct at http://www.mun.ca/student/conduct/.

# 6 Inclusion and Equity

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

# 7 Student Assistance

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at http://www.mun.ca/student.



Faculty of Engineering and Applied Science

Course Outline ENGI 9875

Winter 2020-21

# Engineering 9875: Real-time and embedded systems design

Instructor	Jonathan Anderson		TA(s)	Mahya Soleimani Jadidi	
	jonathan.anderson@mun.ca			msoleimanija@mun.ca	
	(709) 864-2715				
	EN-3028				
Office Hours	Tuesdays 1600–1700				
Website	http://memorialu.gitlab.io/Engineering/ECE/Teaching/operating-systems/website				
Communication	All communication should be via email, Webex or in person: D2L mail may not be checked.				
Calendar entry	9875 Embedded and real-time sys	tem design e	kamines real-t	ime process scheduling; memory and device	
	management; I/O communications; real-time systems; operating system and hardware concurrency issues;				
	kernel architectures; device drivers	s; and a surve	ey of available	e real-time operating systems and embedded	
	platforms.				
Schedule	Lecture MWF	0900–0950	online		
	Lab Mon	1400–1650	EN-1038B	(remote)	
Credit value	3 credit-hours		Lab hours	(at least) four 3-hour sessions per semester	
Textbook	_				
References	Operating Systems: Three Easy Pieces, Remzi and Andrea Arpaci–Dusseau, http://www.ostep.org, v1.00.				
	The Design and Implementation of the FreeBSD Operating System (2nd Edition), K McKusick, G V Neville-				
	Neil and R N M Watson, 2014.				

# 1 Learning Outcomes

Upon successful completion of this course, the student will be able to:

- 1. explain how operating systems mediate between applications and hardware,
- 2. synthesize correct low-level software in C,
- 3. synthesize simple OS primitives with concurrency,
- 4. explain the unique constraints of real-time and embedded systems and implications for their design and
- 5. design software to take advantage of efficient OS primitives.

# 2 Assessment

Assignments (5 of 6)	20%	The final assignment will be <b>due in the last two weeks of classes</b> , so it will be assigned <b>before the last two weeks of classes</b> persuant to §6.7.3 of the Calendar.
Labs (5)	15%	You must complete all labs to complete Engineering 9875.
Quizzes	20%	
Tentative dates:		
Jan 19, Feb 9, Mar 9, Mar 22		
Project	15%	The project will include a proposal, presentation and report.
Midterm exam	10%	
Tentative date: Feb 19		
Final Exam	20%	Exams will be closed-book; online proctoring will be used.

#### Real-time and embedded systems design Winter 2020-21

# 3 Topic details

### 3.1 Processes, privilege and system calls

- Recall: microprocessors, virtual memory
- OS and computing history
- Processes
- Privilege: modes and rings
- Filesystem abstractions
- System calls
- Memory allocation
- Traps, interrupts and interrupt handling

# 3.2 Process co-ordination and shells

- Review: Unix files and system calls
- Process control
- Shells
  - Environment variables
  - Pipes and pipelines
  - Shell scripting
- Inter-process communication
- init(8)

### 3.3 Kernels, scheduling and threading

- Review: concurrency
- Kernel architectures and data structures
- Scheduling
  - Process models
  - Scheduling policies
  - Multiprocessing
- Threading
  - Multithreading
  - User- and kernel-level threads
  - Thread scheduling

### 3.4 Memory management

- Review: virtual memory
- Memory managment hardware
  - segmentation
  - paging
- Paging policies

### 3.5 Files, filesystems and protection

- Review: filesystem abstractions
- Unix permissions, MAC policies and capabilities
- Filesystem implementation
- FAT filesystems
- Copy-on-write filesystems

### 3.6 Networking essentials

- Berkeley sockets
- Internet Protocol
- TCP/IP
- DHCP and PXE
- NFS

### 3.7 Busses, I/O and device drivers

- Review: memory and I/O interfacing
- Data busses and modern chipsets
- Polling, programmed I/O and DMA
- I/O buffer strategies
- Device drivers
- Asynchronous I/O

### 3.8 Real-time and embedded systems

- Review: assembly programming and interrupts
- Embedded systems
- System-on-chip designs
- Early OS boot
- Bootloaders
- Real-time scheduling
  - Periodic scheduling and RMS
  - Aperiodic scheduling
  - Priorities and priority inversion

# 4 Academic Integrity and Professional Conduct

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php.

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at http://www.mun.ca/engineering/undergrad/academicintegrity.php and Memorial University's Code of Student Conduct at http://www.mun.ca/student/conduct.

# 5 Inclusion and Equity

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/ about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

# 6 Student Assistance

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at http://www.mun.ca/student.

# **ENGINEERING 9876: Advanced Data Networks**

Instructor	Dr. Cheng Li	Teaching Assistants	Xiaohang Zhao
E-mail	licheng@mun.ca	E-mail	xiaohangz@mun.ca
Phone	864-8972	Phone	
Office Location	EN-4012	Office Location	EN-4031
Office Hours	Wed. 2:00-4:00	Office Hours	Thur. 2:00-4:00

Website D2L course page

**Communication** *Email, course website, and bulletin board on the website.* 

### **COURSE DESCRIPTION:**

This course includes the fundamental concepts, protocols, analysis and modelling techniques, architectures, and applications pertaining to data communications networks.

PREREQUISITES:	It is expected that students have had an introductory course in computer networks. If a student does not have this background, the onus is on the student to fill in the necessary background for the various areas of the course. The introductory reference texts listed below are a good foundation for developing this background.
SCHEDULE:	LECTURE: Tuesday and Thursday 10:30-11:45 am, Room: online

TUTORIAL: There will be 2-3 tutorial sessions, which will be mostly used to review mid-term exam papers and cover additional lecture materials. Time and venue will be determined during the term.

CREDIT VALUE: 3 credits

### **RESOURCES:**

### TEXT BOOK

• S. Keshav, *An Engineering Approach to Computer Networking*, Addison-Wesley, 1997. (Note: second edition will be available soon).

### **COURSE NOTES**

• Lecture notes will be available through online or will be handed out in class for most lectures.

### REFERENCES

Introductory

- 1. A. Leon-Garcia and I. Widjaja, *Communication Networks: Fundamental Concepts* and Key Architectures, 2nd ed., McGraw Hill, 2004.
- 2. W. Stallings, Data and Computer Communications, 8th ed., Prentice-Hall, 2007.
- 3. A. Tanenbaum, Computer Networks, 4th ed., Prentice-Hall, 2003.

### Intermediate

4. W. Stallings, *High-Speed Network and Internets: Performance and Quality of Service*, 2nd ed., Prentice-Hall, 2002.

<u>Advanced</u>

5. D. Bertsekas and R. Gallager, *Data Networks*, 2nd ed., Prentice-Hall, 1992. + many, many others (eg. books focussed on networks, the Internet, network security, etc.).

# **MAJOR TOPICS:**

The topics will include, but not be limited to:

- Introductory Concepts
- network topologies, communication architectures
- Elements of Communication Protocols
  - packet formats, flow control, error control, protocol analysis
- Packet Switching
  - datagram vs. virtual circuit
- Queuing Theory
  - M/M/1, M/D/1, and other queues
- Scheduling
  - scheduling strategies for best-effort and guaranteed-service
  - connections
- Routing
  - distance-vector and link-state routing strategies for packet switching
- High Speed Switching Architectures
  - sampling of switch fabric architectures such as broadcast bus, Batcher-Banyan, and Balanced Gamma networks
- Security (time permitting)
  - symmetric key and public key encryption, authentication, digital signatures
- 5G Networks (time permitting)
  - properties, applications and enabling technologies
- Wireless Sensor Networks (time permitting)
  - an introduction to wireless sensor networking technologies, challenges, and applications

### **LEARNING OUTCOMES:**

Upon successful completion of this course, the student will be able to:

- Understand the basic concepts of data communication architectures and protocols.
- Able to analyze the performance of a network using probability tools and queuing theory
- Understand networking techniques including scheduling, routing, and switching
- Understand data network applications

### ASSESSMENT:

### Approximate Due Dates

Project:	30 %	
Midterm 1:	15 %	(Oct. 19, 2021, tentative)
Midterm 2:	15 %	(Nov. 16, 2021, tentative)
Final exam:	40 %	

Please note that the two midterm examinations will be in-class tests, tentatively scheduled for Tuesday, October 19 (10:30 am-12:00 pm) and Tuesday, November 16 (10:30 am-12:00 pm).

### PROJECT:

There will be one major project in the course. The nature of the project will be a survey of a topic in an area applicable to the course. The project deliverables are:

(1) project title, due Friday, Sept. 24

(2) project proposal (1 page), due Friday, Oct. 1

- (3) seminar (15~20 minutes), presentation schedule starting from the week of Nov. 22
- (4) paper (~25-30 pages 1.5 line spaced), due Friday Dec. 3

The project must be new work produced by the student and must not be the repetition of a project from a previous course or other context. Also, although the project will represent a survey of work by other researchers, the organization and wording of your final report must be entirely original. Work that contains any amount of copied material will be given a mark of zero.

### **PROBLEM SETS:**

The course will have several problem sets designed to reinforce the topics covered in the lectures. No marks will be given for the problem sets.

### ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at www.engr.mun.ca/undergrad/academicintegrity.

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at <u>http://www.engr.mun.ca/policies/codeofconduct.php</u> and Memorial University's Code of Student Conduct at <u>http://www.mun.ca/student/conduct</u>.

### LAB SAFETY:

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

### INCLUSION AND EQUITY:

Students who require physical or academic accommodations are encouraged to speak privately to the instructor so that appropriate arrangements can be made to ensure your full participation in the course. All conversations will remain confidential.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

### **STUDENT ASSISTANCE:**

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.

5.B.a. (Page 154 of 239)



Science and Engineering

Course Outline SE xxx3

Fall 2023

# SE xxx3 Software Engineering Practice

Instructor	Prof. X x@mun.ca (709) 864-TBD EN-TBD	TA(s)	TBD
Office Hours	TBD		
Website Communication	https://TBD TBD		
Calendar Entry	SE xxx2 Software Engineering ware development processes, y ware project management usi and practices; deployment, ope	Practice introd practices, and ng agile proces erations, and de	uces the student to soft- tools. It includes soft- sses; development tools ev-ops.
Schedule	Lecture MTuWThF TBDtin	ne–TBDTime	TBDplace
Credit Value	3 credits		
Textbook	TBD, AUTHOR, ED, PUB (Y	YEAR).	

# 1 Learning goals

# 2 Major Topics

- Requirements engineering
- Software project management
- Practices and tools
- Operations and development-perations

# **3** Assessment

Assignments (5)	10%
Quizzes (4)	40%
Project and Presentation	20%
Final Exam	30%

# 4 Lab Safety

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

# 5 Inclusion and Equity

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

# 6 Student Assistance

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at http://www.mun.ca/student.

# Proposal for a new graduate program: Master of Artificial Intelligence Memorial University, St. John's, NL, Canada

Name of the program	Master of Artificial Intelligence
Degree name in short form	MAI
Academic units	Department of Computer Science,
	Faculty of Science, and
	Department of Electrical and Computer Engineering,
	Faculty of Engineering and Applied Science
Administrative home of the program	Faculty of Science
Proponents	Dr. Sharene Bungay (cs-chair@mun.ca)
	Dr. Cheng Li (licheng@mun.ca)
	Dr. Lourdes Peña-Castillo (lourdes@mun.ca) and
	Dr. Stephen Czarnuch (sczarnuch@mun.ca)
Date	November 1, 2021
Tentative start of the program	Fall 2022

# Contents

1	Executive summary	4			
2	Description of the program2.1Name of the program	<b>5</b> 5 6 6 7 7 7 7			
3	Statement of Justification         3.1       Introduction	<b>8</b> 8 8			
4	Market analysis	9			
	4.1 International and national comparison of related programs and unique attributes	10			
5	Projected enrolment	13			
6	Resource implications         6.1       Existing faculty resources         6.2       New faculty resources         6.3       Additional non-faculty resources         6.3.1       Teaching and Learning Space         6.4       Administration of the program	<b>14</b> 14 15 15 16			
7	Budget         7.1       Program expenses         7.2       Revenue         7.3       Payment schedule	<b>16</b> 17 18 18			
$\mathbf{A}_{\mathbf{j}}$	ppendix A: Library holdings evaluation	19			
$\mathbf{A}_{]}$	Appendix B: Calendar regulations				
$\mathbf{A}$	Appendix C: Course listings 2				

Appendix D: Consultation	25
Appendix E: Faculty Bios	26
Appendix F: Canadian university survey of undergraduate and grad- uate programs in software engineering	34

# 1 Executive summary

This proposal calls for the creation of the Master of Artificial Intelligence program housed in the Faculty of Science at Memorial University, but jointly offered by the Department of Computer Science (Faculty of Science) and the Department of Electrical and Computer Engineering (Faculty of Applied Science and Engineering). Artificial intelligence (AI) is increasingly being integrated and deployed in computer programs used in a wide variety of sectors such as finance, health care, social media, smart appliances, transportation, entertainment (including video games) and security. With the massive amount of data that is generated in diverse areas such as life sciences, medicine, and humanities, AI systems will be critical for analyzing, extracting useful patterns and interpreting these data. The demand for graduates skilled on AI research and development is increasing, and offering AI programs has become a priority for almost all major universities. The proposed program is in direct alignment with the strategic goals of the University regarding information and communication technologies. Further, the proposed AI program has been designed with an internationally recognizable curriculum. The curriculum focuses on the fundamental aspects of the field with opportunities for specialization in a specific area of AI, and is intended to primarily attract international students, and some local and national students who want to enter this vital area. The establishment of the proposed AI program is not only timely but will also put Memorial University at the lead among the Atlantic Canadian universities. Specifically, the program is intended to yield advanced AI professionals to lead and facilitate innovation and commercialization in a wide variety of sectors.

# 2 Description of the program

The Master of Artificial Intelligence is a course-based Master's program intended for students who wish to gain the skills to integrate and deploy Artificial Intelligence in a variety of sectors. The Master of Artificial Intelligence (MAI) is a four-term, course-based Master's program to be offered jointly by the Faculty of Science and the Faculty of Engineering and Applied Science intended for students with a computer science, computer engineering or scientific computing background who wish to upgrade their background to specialize in artificial intelligence. Graduates of the program will have knowledge and understanding of the core areas and methods of Artificial Intelligence and will be ready to work in applied positions in a variety of areas including but not limited to autonomous vehicles, automated decision making, intelligent sensing, precision agriculture, personalized medicine. financial security, smart appliances, and other emerging areas that will be vital to future economic growth. We foresee graduates working in both the private and public sectors locally in Newfoundland and Labrador and across Canada. We expect the program to attract students with a background in computer science. computer engineering, or related areas such as data science, scientific computing, bioinformatics, or computational chemistry.

The selection of core courses is intended to provide the foundations for AI and an overview of the areas in AI. The electives courses offer students the opportunity to dive deeper into specific areas of AI such as robotics, machine learning or image processing. The program distinguishes itself from the existing course-based option MSc in Computer Science and MASc in Computer Engineering by an increased focus on artificial intelligence and related topics, and a decreased emphasis on other areas of computer science and computer engineering.

# 2.1 Name of the program

The proposed name for the new program is Master of Artificial Intelligence (MAI).

# 2.2 Graduate student profile

Applicants must have a four-year undergraduate degree (or the equivalent) in computer science, computer engineering, or a related area such as data science, scientific computing, bioinformatics, or computational chemistry. Applicants must meet the English proficiency requirements for graduate programs with higher English proficiency requirements described at the web site of the School of Graduate Studies https://www.mun.ca/become/graduate/apply-to-memorial/. Admission will be competitive, selective, and based on overall academic performance.

# 2.3 Learning outcomes

Students will graduate with a broad understanding of the main areas of Artificial Intelligence as well as in-depth knowledge in some of these areas. Students will acquire practical experience through course projects, and by completing a capstone project focusing on the application of artificial intelligence.

# 2.4 Key learning outcomes

By completing the proposed MAI program, it is expected that a graduate shall be able to:

- Develop an in-depth understanding of artificial intelligence methods and techniques in areas such as machine learning, data mining, robotics, and image processing.
- Build the skills to design and develop, implement, integrate, and maintain artificial intelligence components into software related products.
- Refine and apply problem solving and analytical skills to identify which AI technique is best suited to address a problem and how to optimize its outcomes.
- Recognize ethical issues that arise with the application of AI.

# 2.5 Requirements for admission

Admission will be competitive, selective and based on overall academic performance. The Chair of the Program together with Graduate Studies committees of the departments will oversee the admission process to ensure that the proper policies and regulations are followed and the best candidates are offered admission. The minimum requirements are:

- Applicants must have a four-year undergraduate degree (or the equivalent) in computer science, computer engineering, or a related area such as data science, scientific computing, bioinformatics, or computational chemistry.
- Applicants must have taken at least one course in each of the following areas: linear algebra, vector calculus, statistics, and computer programming.
- Applicants must meet the English proficiency requirements for graduate programs with higher English proficiency requirements described in the web site of the School of Graduate Studies https://www.mun.ca/become/graduate/ apply-to-memorial/.

# 2.6 Program overview

The program consists of 21 credit hours of core courses and 9 credit hours of elective courses, either from the list below or an approved replacement.

#### 2.6.1 Core courses

 AI xxx0 AI Foundations

 AI xxx1 Topics in AI

 AI xxx2 Artificial Intelligence Capstone<sup>1</sup>

 COMP 6901 Applied Algorithms

 COMP 6915 Introduction to Machine Learning

 COMP 6980 Algorithmic Techniques for Artificial Intelligence

ENGI 9818 Software Fundamentals

#### 2.6.2 Elective courses

COMP 6907 Data Mining Techniques and Methodologies

COMP 6912 Autonomous Robotics

COMP 6934 Introduction to Data Visualization

COMP 6981 Data preparation techniques

COMP xxxx Advanced Machine Learning

DSCI 6601 Practical Machine Learning

**DSCI 6602** Deep Learning and Artificial Intelligence or **MATH 6205** Deep Learning **ENGI 9804** Image Processing and Applications

**ENGI 9805** Computer Vision or **COMP 6982** Computer Vision

**ENGI 9821** Digital Signal Processing

ENGI 9826 Advanced Control Systems

ENGI 9940 Advanced Robotics

### 2.6.3 Program schedule

The first term is preparatory in nature, covering key aspects from mathematics and computing that will be required for subsequent courses. The second term provides a broad introduction to Artificial Intelligence. The third and fourth terms focus on electives and a capstone course, allowing students to begin to specialize in their topics of greatest interest.

<sup>&</sup>lt;sup>1</sup>Normally AI xxx2 will be taken in the final term.

Term	Core	Elective
	courses	courses
Fall	AI xxx0 (AI Foundations)	
	COMP 6901 (Applied Algorithms)	
	ENGI 9818 (Software Fundamentals)	
Winter	COMP 6915 (Introduction to Machine Learning)	
	COMP 6980 (Algorithmic Techniques for Artificial Intelligence)	
	AI xxx1 (Topics in AI)	
Spring		Elective $(2)$
Fall	AI xxx2 (Capstone for AI)	Elective $(1)$

# **3** Statement of Justification

# 3.1 Introduction

We are increasingly utilizing varied *smart* or *autonomous* technologies, that have artificial intelligence at the heart of their technological function. With an increased reliance on these technologies, there is an ever-increasing demand for specialists being able to envision how to solve problems with AI technologies, and develop, understand and maintain AI-based systems. Given the continuing demand for AI specialists, and the expected accelerated growth of this profession over the next few decades, the development of an artificial intelligence graduate degree has become a top priority for many major universities. The development of a master of artificial intelligence program at Memorial University is therefore especially timely, poising Memorial as a national leader in this transforming field.

# 3.2 Contribution to strategic goals of the University

Memorial's Strategic Research Plan, and specifically the "Information and Communication Technology" theme, specifically lists "intelligent computing", "autonomous ocean systems", and "managing ... the vast amounts of data collected by businesses and other organizations" as priority areas. All these areas are related to and impacted by artificial intelligence. Thus, the formation of an artificial intelligence master's program directly responds to the strategic research goals of the university. Additionally, Memorial University's Strategic Plan notes that we must strive to be "A University for Our Province". With the increasing growth of companies in Newfoundland and Labrador using artificial intelligence (for example, Mysa, Nucliq, Verafin, among others), producing highly skilled and highly trained AI specialists allows the University to directly support the provincial demand for expertise in this area.

# 4 Market analysis

Recent years have seen the use of artificial intelligence in a variety of sectors increased, and as a consequence of this, an accelerated growth in demand for artificial intelligence specialists in Canada and abroad. The United States Bureau of Labour Statistics identifies AI-relying industries such as Security as having an estimate growth faster than the average growth for all workers in all industries.<sup>2</sup> It also estimates a growth of 22% in employment for Computer and Information Research Scientists from 2020-2030 with a 2020 median pay of  $$126.830.^3$  This is much higher than the median annual wage of \$41,950 for all occupations in the USA. By renewing the CIFAR Pan-Canadian Artificial Intelligence Strategy with a \$443.8 million commitment over 10 years starting in 2021-22,<sup>4</sup> the Canadian Government has recognized that artificial intelligence will play a key part in the Canadian economy. According to a recent report by Accenture, "54% of Canadian companies surveyed indicated that they have adopted AI at some level within their companies".<sup>5</sup> Thus, there is and will be a pressing demand for graduates to enter this domain. The proposal of a course-based master in artificial intelligence at Memorial University is in direct response to the rapid expansion of this field. As an exceptionally interdisciplinary field, it is worth mentioning that Memorial University already has considerable research expertise in artificial intelligence distributed among the departments of Computer Science, Electrical and Computer Engineering, Mathematics and Statistics, and beyond. The consolidation of this expertise in a master program in artificial intelligence will allow Memorial to fill this demand in skilled AI specialists quickly. Additionally, by producing highly educated and skilled master's graduate students in AI, we will help ensure that our graduates are prepared to enter the field at the top of the profession. The creation of a dedicated master's program in artificial intelligence can, therefore, be seen as a timely approach for structuring the training of the next generation

<sup>&</sup>lt;sup>2</sup>Stanislava Ilic-Godfrey. "Artificial intelligence: taking on a bigger role in our future security". In: *Beyond the Numbers: Employment & Unemployment* 10.9 (2021). URL: https://www.bls.gov/opub/btn/volume-10/investigation-and-securityservices.htm.

<sup>&</sup>lt;sup>3</sup>U.S. Department of Labor Bureau of Labor Statistics. *Occupational Outlook Handbook, Computer and Information Research Scientists.* 2021. URL: https://www.bls. gov/ooh/computer-and-information-technology/computer-and-informationresearch-scientists.htm.

<sup>&</sup>lt;sup>4</sup>Government of Canada. *Helping Canadian Businesses Grow and Succeed*. URL: https://www.budget.gc.ca/2021/report-rapport/p2-en.html#chap4.

<sup>&</sup>lt;sup>5</sup>accenture. *Pan-Canadian AI strategy: Shaping the AI ecosystem*. URL: https://www.accenture.com/ca-en/insights/artificial-intelligence/pan-canadian-ai-strategy.

of AI professionals. Since the proposed course-based MAI program is intended to attract strong undergraduate students, we most notably expect to be able to offer a promising set of graduates to fulfill provincial demand in addition to growing national and international demand.

# 4.1 International and national comparison of related programs and unique attributes

Globally, universities around the world have started graduate programs in artificial intelligence with a wide variety of curricula, including top universities such as Carnegie Mellon University, King's College London, and Imperial College London. Out of 96 Canadian universities surveyed (Appendix F), there are presently six universities, including Memorial, offering undergraduate options to specialize in artificial intelligence. These programs are the following.

- 1. Simon Fraser University, B.Sc. in Computing Science Artificial Intelligence Concentration  $^6$
- 2. University of the Fraser Valley, B.Sc. in Computing Science Artificial Intelligence and Data Mining Concentration <sup>7</sup>
- 3. University of Victoria, BSE<br/>ng Specialization Data mining and analysis, artificial intelligence, and machine learning<br/>  $^8$
- 4. Memorial University of Newfoundland, B.Sc. in Computer Science (Smart Systems) <sup>9</sup>
- 5. University of Toronto, Artificial Intelligence Engineering <sup>10</sup>
- 6. McGill University, BEng Minor Applied Artificial Intelligence <sup>11</sup>

<sup>6</sup>https://www.sfu.ca/computing/prospective-students/ undergraduate-students/programs/degree-programs/areas-of-concentration. html <sup>7</sup>https://www.ufv.ca/calendar/current/ProgramsC-E/COMP\_MAJOR.htm <sup>8</sup>https://www.uvic.ca/ecs/software/current-students/specializations/ index.php <sup>9</sup>https://www.mun.ca/computerscience/undergraduates/programs/ major-in-computer-science/smart-systems-stream <sup>10</sup>https://future.utoronto.ca/undergraduate-programs/ artificial-intelligence-engineering <sup>11</sup>https://www.mcgill.ca/study/2021-2022/faculties/engineering/ undergraduate/programs/bachelor-engineering-beng-minor-applied-artificial-intelligence Of those same 96 Canadian universities surveyed, eleven are offering masters programs in artificial intelligence. These degrees are listed below.

- 1. University of Alberta, M.Sc. in Computing Science with specialization in Statistical Machine Learning  $^{\rm 12}$
- 2. Lakehead University, M.Sc. in Computer Science with specialization in Artificial Intelligence  $^{13}$
- 3. Queen's University
  - Master of Management in Artificial Intelligence <sup>14</sup>
  - MASc with a field of study in Artificial Intelligence <sup>15</sup>
- 4. Ryerson University, MEng with AI concentration <sup>16</sup>
- University of Guelph, Collaborative Specialization in Artificial Intelligence (CSAI) <sup>17</sup>
- 6. University of Ottawa, Master of Computer Science Concentration in Applied Artificial Intelligence <sup>18</sup>
- 7. University of Waterloo, Master of Data Science and Artificial Intelligence (MDSAI) <sup>19</sup>
- 8. University of Windsor, M.Sc. in Computer Science Artificial Intelligence Stream  $^{20}$

```
<sup>12</sup>https://calendar.ualberta.ca/preview_program.php?catoid=34&poid=38981
<sup>13</sup>https://www.lakeheadu.ca/programs/graduate/programs/masters/
computer-science
<sup>14</sup>https://smith.queensu.ca/grad_studies/mmai/
<sup>15</sup>https://www.ece.queensu.ca/graduate/masc/field-of-study-in-ai.html
<sup>16</sup>https://www.ryerson.ca/electrical-computer-biomedical/
electrical-computer-graduate/meng-ai
<sup>17</sup>https://calendar.uoguelph.ca/graduate-calendar/
collaborative-specializations/artificial-intelligence/
<sup>18</sup>https://catalogue.uottawa.ca/en/graduate/master-computer-science-specialization-artificialin
<sup>19</sup>https://uwaterloo.ca/graduate-studies-academic-calendar/
mathematics/data-science-and-artificial-intelligence/
master-data-science-and-artificial-intelligence/
master-data-science/
master-data-science-and-artificial-intelligence/
master-data-science-and-artificial-intelligence/
master-data-science-and-artificial-intelligence/
master-
```

- 9. Western University, Vector Institute Accredited Graduate Collaborative Specialization in Artificial Intelligence (CSAI)<sup>21</sup>
- 10. York University
  - M.Sc. in Computer Science with Specialization in Artificial Intelligence<sup>22</sup>
  - Master of Management in Artificial Intelligence (MMAI) <sup>23</sup>
- Université Laval, Professional Master's in Computer Science Artificial Intelligence <sup>24</sup>

Additionally there are eight other Canadian Universities (namely University of Toronto, University of Alberta, University of Calgary, University of Winnipeg, Dalhousie University, St Francis Xavier University, McGill University, and Université de Montreal) that offer certificates or diplomas in Artificial Intelligence. This year the Université de Moncton announced that a new Centre for Artificial Intelligence will be created to, among other goals, deliver new programs <sup>25</sup>. Thus, the proposed MAI program will place Memorial University at the forefront of Atlantic Universities. Memorial University is in the unique position of offering a Master of Artificial Intelligence in which students can learn and apply the fundamental AI techniques, jointly delivered by both the department of Computer Science, and the department of Electrical and Computer Engineering.

The proposed Master of Artificial Intelligence (MAI) is complementary to the Master of Data Science (MDSc), which is offered jointly by the Departments of Computer Science and Mathematics and Statistics in the Faculty of Science at Memorial University. Out of 12 elective courses in the proposed MAI program, there are three elective courses shared with the MDSc program (DSCI 6601, DSCI 6602 and COMP 6915). Other differences between the programs are that 1) the MDSc program provides a strong training in mathematical and statistical skills for data science; and 2) in the MAI program we require a strong background in computer science or computer engineering, whereas the MDSc program is open to students with a strong mathematical background in areas relevant to data science which might be other than computer science or computer engineering.

The proposed Master of Artificial Intelligence (MAI) is also complementary to the Scientific Computing interdisciplinary Master's program offered by the Faculty

<sup>&</sup>lt;sup>21</sup>https://www.csd.uwo.ca/graduate/future/vector-institute-program.html

<sup>&</sup>lt;sup>22</sup>https://eecs.gradstudies.yorku.ca/ai/

<sup>&</sup>lt;sup>23</sup>https://schulich.yorku.ca/programs/mmai/

<sup>&</sup>lt;sup>24</sup>https://iid.ulaval.ca/en/training/professional-masters-computer-science-artificial-intellige <sup>25</sup>https://www.nbpower.com/en/about-us/news-media-centre/news/2021/

universite-de-moncton-creates-centre-for-artificial-intelligence-in-partnership-with-nb-power

of Science. Out of 12 elective courses in the proposed MAI program, there are three elective courses shared with the Scientific Computing program (COMP 6918, ENG 9821 and ENG 9826). The Scientific Computing program lists about 90 elective courses from a wide variety of disciplines in Science and Engineering. Students in the Scientific Computing program are able to complete their program requirements without taking any AI-related course. As per Calendar entry 28.21.4<sup>26</sup>, the Scientific Computing program is "designed to educate students to apply computational, numerical and programming concepts and tools to solve and model complex problems in science and engineering". In sum, the Scientific Computing program has a much wider scope than the proposed MAI program.

Given the rapid development in the field of artificial intelligence, which is only expected to accelerate over the coming decade, and to leverage the current expertise at Memorial, we propose a Master of Artificial Intelligence graduate program that covers several areas of artificial intelligence, with a slightly stronger focus on machine learning. In proposing a program that is focused on the fundamental aspects of this field rather than specific areas of application, our prospective students will be appropriately prepared for applying AI in a wide variety of sectors and the ever-evolving job market.

# 5 Projected enrolment

Projected five year enrolment is provided in Table 1. This projected enrolment is based on typical composition of our current graduate student population.

Type/year	Year 1	Year 2	Year 3	Year 4	Year 5
FT enrolment	15	20	25	30	30
PT enrolment	-	-	-	-	-
Canadian enrolment	2	2	2	2	2
International enrolment	13	18	23	28	28
On-campus	15	20	25	30	30
Online	-	-	-	-	-
Thesis	-	-	-	-	-
Non-thesis	15	20	25	30	30
Total	15	20	25	30	30

Table 1: Projected 5-year enrolment. Enrolment as of Fall semester of each year.

<sup>26</sup>https://www.mun.ca/regoff/calendar/sectionNo=GRAD-0254#GRAD-1932

# 6 Resource implications

The Faculty of Science and the Faculty of Engineering and Applied Science, and in particular the departments of Computer Science and Electrical and Computer Engineering, have both the teaching and research expertise relevant to the core components of artificial intelligence. Significant research involving artificial intelligence is conducted in both faculties, and many faculty members have existing expertise that can contribute to the success of the program. In fact, the interest in AI across the university can be used to enrich the program through, for example, the capstone project as well as enlarging the pool of elective courses.

The program requirements of proprietary software will be minimal because most AI applications are developed in open access languages such as Python and R using open access packages such as Python's TensorFlow and scikit-learn, and R's caret. However, students still need access to high performance computing facilities and, depending upon enrolment, the department's computer lab facilities may be overwhelmed. Should such an eventuality arise, a portion of the generated revenue would need to be directed to address this. Meanwhile, some alternatives have been sought. For example, the Centre for Health Informatics and Analytics of the Faculty of Medicine hosts a cluster with big data analysis capabilities, and students whose adviser holds an affiliation with the Faculty of Medicine may be granted access to the computing resources. Additionally, students whose adviser has a Compute Canada account may be granted access to Compute Canada resources.

## 6.1 Existing faculty resources

Below a list of faculty members with teaching and research expertise relevant to the core components of artificial intelligence is provided. Their bios are provided in Appendix D.

- Alex Bihlo, Faculty of Science
- Dave Churchill, Faculty of Science
- Stephen Czarnuch, FEAS
- Octavia A. Dobre, FEAS
- Matthew Hamilton, Faculty of Science
- Mohsin Jamil, FEAS
- Xianta Jiang, Faculty of Science

- Cecilia Moloney, FEAS
- Theodore Norvell, FEAS
- Siu O'Young, FEAS
- Lourdes Peña Castillo, Faculty of Science
- Dennis K. Peters, FEAS
- Karteek Popuri, Faculty of Science
- Sarah Power, FEAS
- Vinicius Prado da Fonseca, Faculty of Science
- Reza Shahidi, FEAS
- Amilcar Soares, Faculty of Science
- Hamid Usefi, Faculty of Science
- Andrew Vardy, Faculty of Science/FEAS
- Thumeera Wanasinghe, FEAS

# 6.2 New faculty resources

The Department of Computer Science is seeking two tenure-track faculty to support the delivery of the program.

# 6.3 Additional non-faculty resources

The proposed program will use some of the existing courses offered in the departments of Computer Science and Electrical and Computer Engineering. However, it will require of four new on-campus courses, including a capstone project course; additional sections to existing courses; and the teaching time to offer a comprehensive selection of elective courses. The Department of Computer Science is seeking a 0.5 administrative staff (graduate secretary) to support the management of the program and student advising.

#### 6.3.1 Teaching and Learning Space

A computer laboratory to support the students in this proposed program will be needed, and one time funding is being sought to build and equip this space. The new computer laboratory would be shared between the MAI and MAScSE programs, and would also be available to graduate students in related programs, including the Master of Data Science and the interdisciplinary program in Scientific Computing. Additionally, it could potentially have other uses such as outreach and undergraduate program support.

## 6.4 Administration of the program

The proposed Master of Artificial Intelligence program will be administered by the Dean of the Faculty of Science, who will appoint a Program Chair. The Chair will form the joint committee with members from the Department of Computer Science and the Department of Electrical and Computer Engineering. The chair must work in conjunction with the department heads of Computer Science and Electrical and Computer Engineering, or their representatives, in all relevant matters concerning the program. The committee will meet regularly to deal with admissions, student progress reviews, changes to the curriculum and content, and review the regulations governing the program.

# 7 Budget

The proposed budget for the Master of Artificial Intelligence (MAI) program is provided in Table 2 with different enrolment scenario. The budget of the enrolment is based on one local student from Newfoundland and Labrador (NL), one Canadian student (non-NL) and one international student each year, where the program fees and special fees of Canadian students will be lower than the international students, and the rest will be international students. As per the budget, program will have a break-even with about 25 - 30 students. With the strong demand in this subject area, it is expected that the program will reach its intended capacity within four years. Surplus of revenues will be used to support students through upgrades in technology as well as competitive bursaries and academic awards for students.

As detailed in the market analysis, there is a high demand for the MAI program. However, in case of low enrolments, efforts will be taken to improve the intake by different recruitment strategies with available Memorial resources. The complementary sister program (Master of Applied Science in Software Engineering, MAScSE) as well as other existing course based programs in the Faculty of Science and the Faculty of Engineering and Applied Science will provide a large pool to attract students from outside, and will serve as a large buffering zone in case one program experiences short term enrolment challenges.

		Year 1	Year 2	Year 3	Year 4	Year 5
Enrolments	International student	13	18	23	28	28
(students)	Canadian student	1	1	1	1	1
	NL student	1	1	1	1	1
	Total student	15	20	25	30	30
Revenue	Program fees	138,810	187,140	235,470	283,800	283,800
	Special fees	294,270	$395,\!680$	497,090	598,500	598,500
	Other revenue	-	-	-	-	-
	Total Revenue	433,080	582,820	732,560	882,300	882,300
	Revenue to MUN	138,810	187,140	235,470	283,800	283,800
	central account					
	VP office fee $(20\% \text{ of gross})$	58,854	66,967	99,418	119,700	119,700
	Revenue to FEAS and FS	235,416	$316,\!544$	397,672	478,800	478,800
Expenditures	Tenure-track professor	240,000	240,000	240,000	240,000	240,000
(Instructional	(incl. benefits, 2 positions)					
& Adminis-	Per-course instructor	17,284	17,284	17,284	17,284	17,284
trative costs)	(3 positions)					
	Teaching assistantships	6,719	6,719	6,719	6,719	6,719
	(5 positions)					
	Administration support	34,287	34,287	34,287	34,287	34,287
Expenditures	Course related materials,					
(Materials,	int'l scholarships and	30,000	50,000	50,000	60,000	60,000
Supplies, and	equipment (@2,000 per student)					
Recruitment	Recruitment expenses and	10,000	10,000	10,000	10,000	10,000
costs)	travel expenses					
,	Recruitment agency					
	commission $(@2,568 \text{ per student})$	33,380	59,058	59,058	71,896	71,896
	Competitive bursaries and	5,000	5,000	5,000	5,000	5,000
	academic awards					
	Total Expenditures	574,335	665,786	757,236	848,687	848,687
	Net Balance	\$(141,255)	\$(82,966)	\$(24,676)	\$33,613	\$33,613

Table 2: Proposed budget for Masters of Artificial Intelligence

# 7.1 Program expenses

The major part of the expenses is the salary portion of two tenure track faculty positions. It is highly necessary as AI is a fast growing area globally. It is hard to attract highly qualified candidates without such positions. Those faculty members are also expected to be actively engaged in research and graduate student supervision. Three per-course instructors are considered to complement additional teaching tasks. As per the Memorial regulations, 20% of the gross income will contribute to the Provost Office expenses. Other expenses include teaching assistantship, faculty administration support, program related materials, equipment

and scholarships, recruitment expense and travel expense, and recruitment agency commissions.

# 7.2 Revenue

The revenue for the program is generated based on the student's regular program fee plus the special fee. The regular fees of the program are \$9,666, \$7,434, and \$5,718 for international students, Canadian students, and Newfoundland students, respectively. The special fees of the program are \$20,282 for international students, and \$15,302 for Canadian and Newfoundland students.

# 7.3 Payment schedule

Based on the proposed budget, a payment schedule (Table 3) is proposed where students need to pay a non-refundable deposit fee. This schedule follows plan A of Memorial School of Graduate Studies (SGS) available at https://www.mun.ca/finance/fees/tuition\_fees/grad.php.

Student type	Fee type	Deposit	S1	S2	S3	S4	$\mathbf{S5}$	$\mathbf{S6}$	Total
Local Student	Program fee	\$2,000	\$953	\$953	\$953	\$953	\$953	\$953	\$5,718
	Special fee		\$8,981	\$4,321	-	-	-	-	\$15,302
Canadian Student	Program fee	\$2,000	\$1,239	\$1,239	\$1,239	\$1,239	\$1,239	\$1,239	\$7,434
	Special fee		\$8,981	\$4,321	-	-	-	_	\$15,302
Intl Student	Program fee	\$2,000	\$1,611	\$1,611	\$1,611	\$1,611	\$1,611	\$1,611	\$9,666
	Special fee		\$11,969	\$6,313	-	-	-	-	\$20,282

Table 3: Payment schedule.

Appendix A: Library holdings evaluation



2 November, 2021

# TO: Dr. Sharene Bungay and Dr. Cheng Li

FROM: Meghan McKibbon, Public Services Librarian, Engineering

### SUBJECT: Master of Artificial Intelligence

The QEII Library received a proposal for a new graduate program, housed in the Faculty of Science, but jointly offered by the Department of Electrical and Computer Engineering (Faculty of Applied Science and Engineering) and the Department of Computer Science (Faculty of Science). I have determined that Memorial University Libraries has sufficient resources to support the objectives of this program.

Students in computer science are often not exposed to research literature within the discipline at any great depth. I would recommend reaching out to the library and incorporating information literacy into the curriculum.

As is shown below, the library can meet the research requirements of students in this program. Additional resources may be purchased as needed.

### Library Holdings Summary

The library carries many periodicals specifically on the subject of artificial intelligence. We have subscriptions to all the periodical titles from IEEE and the Association for Computing Machinery (ACM), the two major associations in computer science and engineering. Of the top 25 journals in the Artificial Intelligence subject area of periodicals indexed in Scopus, we have access to twenty-one.

The library also has access to many literature databases covering the discipline, including IEEE Xplore, ACM Guide to Computing Literature, Scopus, Web of Science, and many others. Another useful product is Knovel, a full-text searchable and interactive collection of reference material, including handbooks and conference proceedings.

Articles which are not held by the library can be readily obtained through Document Delivery services, usually within a few days.

We have a strong ebook collection in artificial intelligence, made up of permanent purchases for many titles from the major publishers, and subscription packages to ensure that we have access to current content.

The resources listed here are only a portion of the library holdings available through the Memorial University Libraries. I feel confident that this degree would be well supported by existing and future resources in the library, within existing budget allocations.

# **Appendix B: Calendar regulations**

xxx. Regulations Governing the Degree of Master of Artificial Intelligence

The Degree of Master of Artificial Intelligence (MAI) is a four-term, coursebased Master's program jointly offered by the Department of Computer Science and the Department of Electrical and Computer Engineering.

xxx.1 Qualifications for Admission

- 1. Admission is limited and competitive, and based on overall academic performance.
- 2. To be considered for admission, applicants shall normally hold a minimum second class upper (or with at least a 75% average) 4-year Bachelor's Degree in computer science, computer engineering, or a related area such as data science, scientific computing, bioinformatics, or computational chemistry from a university of recognized standing.
- 3. To be eligible for consideration for admission applicants shall meet the English Proficiency Requirements for graduate programs with higher English proficiency described at https://www.mun.ca/become/graduate/apply-to-memorial.
- 4. Admission to the program shall be upon acceptance by the Dean of Graduate Studies after recommendation by the Chair of the Programme or either Head of the Departments of Computer Science or Electrical and Computer Engineering, along with a tentative program of study.

xxx.2 Degree Requirements

- 1. The degree program requires the completion of 30 credit hours.
  - (a) 3 credit hours of a Capstone project course AI XXX2.
  - (b) 18 credit hours (six courses) by completing AI XXX0, AI XXX1, COMP 6901, 6915, 6980 and ENGI 9818.
  - (c) 9 credit hours (three courses) to be selected from COMP 6907, 6912, 6934, 6981, 6982, 6XXX, DSCI 6601, 6602, ENGI 9804, 9805, 9821, 9826, 9940 and MATH 6205.

xxx.3 Evaluation

Students must obtain a grade of at least 65% in all program courses to receive credit for the course towards their program requirements. Any student who fails to receive 65% or more in a course must repeat the course in the case of core courses,

or must either repeat or replace the course with another program course in the case of elective courses. Any student who receives a grade of less than 65% in two courses or in a repeated course will be required to withdraw from the program.

# Appendix C: Course listings

### Core courses

AI xxx0 AI Foundations

AI xxx1 Topics in AI

AI xxx2 Artificial Intelligence Capstone<sup>27</sup>

COMP 6901 Applied Algorithms

COMP 6915 Introduction to Machine Learning

COMP 6980 Algorithmic Techniques for Artificial Intelligence

**ENGI 9818** Software Fundamentals

# Elective courses

COMP 6907 Data Mining Techniques and Methodologies

COMP 6912 Autonomous Robotics

COMP 6934 Introduction to Data Visualization

COMP 6981 Data preparation techniques

COMP 69xxx Advanced Machine Learning

DSCI 6601 Practical Machine Learning

DSCI 6602 Deep Learning and Artificial Intelligence or MATH 6205 Deep Learning

ENGI 9804 Image Processing and Applications

ENGI 9805 Computer Vision or COMP 6982 Computer Vision

**ENGI 9821** Digital Signal Processing

ENGI 9826 Advanced Control Systems

ENGI 9940 Advanced Robotics

 $<sup>^{27}</sup>$ Normally AI xxx2 will be taken in the final term.

# **Appendix D: Consultation**

Feedback received was considered to improve earlier versions of this proposal specifically with respect to the following academic items:

- Clarifying similarity and differences with the Master of Data Science and the Scientific Computing interdisciplinary graduate programs. Paragraphs addressing this are included under section 4.1
- Missing textbook for the new course AI xxx1. Textbook included in updated course outline.
- Listing faculty resources from other departments. Original proposal listed faculty members from Computer Science, Engineering and Math.
- Standardization of new course outlines. New-proposed course outlines are all presented in a uniform format.
- Ethics not sufficiently included in the curriculum. Recognizing ethical issues in AI has been added as a key learning objective of the program. Discussion of ethical issues is listed in the topics of the courses AI xxx1 and COMP 6915.
# **Appendix E: Faculty Bios**

- Alex Bihlo is an Associate Professor and Canada Research Chair in Numerical Analysis and Scientific Computing in the math department, and crossappointed with the computer science department. His research is on numerical analysis and machine learning (deep learning) with applications to geophysical fluid dynamics. He is teaching courses on numerical analysis, deep learning and reinforcement learning. He is also supervising several students in this research direction.
- **Dave Churchill** is an Associate Professor of Computer Science at Memorial university, and runs the MUN AI and games lab. His research revolves around artificial intelligence, video games, and robotics.
- Stephen Czarnuch is an Associate Professor in Biomedical Engineering at Memorial University. He received his B.Eng. and Mgmt. and M.A.Sc. degrees in Electrical and Computer Engineering from McMaster University, and his Ph.D. in Biomedical Engineering from the Institute of Biomaterials and Biomedical Engineering at the University of Toronto in 2002, 2005, and 2014, respectively. Following a short post-doctoral appointment at Memorial University, he was appointed to the Faculty of Engineering and Applied Science at Memorial in 2015. He currently holds or has held 12 grants as PI (including grants from CIHR and NSERC) and 8 grants as CI (including CIHR and SSHRC). He is currently supervising or has supervised 4 doctoral and 6 masters students, 15 research assistants, mentored 4 medical residents and over 40 undergraduate senior engineering students. He has extensive experience developing intelligent technologies for vulnerable populations by implementing a holistic, user-centered design philosophy centered on identifying user needs and evaluating health outcomes. His research is inherently interdisciplinary, lying at the intersection of engineering, computer science, medicine, gerontology, rehabilitation, psychology, and sociology. Specifically, he seeks to develop relevant, accessible, acceptable and adoptable patientoriented technological interventions based on autonomously tracking human motion using computer vision. Further, he emphasizes the evaluation of their efficacy by connecting academic research with providers and patients in a real-world context. His technical focus is on machine learning, deep learning, and computer vision.
- Octavia A. Dobre received the Dipl. Ing. and Ph.D. degrees from the Polytechnic Institute of Bucharest, Romania, in 1991 and 2000, respectively. Between 2002 and 2005, she was with New Jersey Institute of Technology,

USA. In 2005, she joined Memorial University, Canada, where she is currently a Professor and Research Chair. She was a Visiting Professor with Massachusetts Institute of Technology, USA and Université de Bretagne Occidentale, France. Her research interests encompass wireless, optical and underwater communication technologies. She has (co)authored over 400 refereed papers in these areas.

Dr. Dobre serves as the Editor-in-Chief (EiC) of the IEEE Open Journal of the Communications Society. She was the EiC of the IEEE Communications Letters, Senior Editor, Editor, and Guest Editor for various prestigious journals and magazines. She also served as General Chair, Technical Program Co-Chair, Tutorial Co-Chair, and Technical Co-Chair of symposia at numerous conferences.

Dr. Dobre was a Fulbright Scholar, Royal Society Scholar, and Distinguished Lecturer of the IEEE Communications Society. She obtained Best Paper Awards at various conferences, including IEEE ICC, IEEE Globecom, IEEE WCNC, and IEEE PIMRC. Dr. Dobre is a Fellow of the Engineering Institute of Canada, a Fellow of the Canadian Academy of Engineering, and a Fellow of the IEEE.

Matthew Hamilton holds a PhD in Computing Science from the University of Alberta in Canada, as well as an undergraduate degree in Pure Mathematics/Computer Science from Memorial University. He is author and co-author of multiple scientific and engineering articles and patents. Dr. Hamilton is currently and an Assistant Professor of Computer Science at Memorial University and President of Birch Scientific. Previously, he has worked in industrial research as a Holographic Rendering and CODEC R&D Engineer at Avalon Holographics and Senior Research Scientist, NSERC/Research and Development Corporation-NL Postdoctoral Industrial R&D Fellow at GRI Simulations, specializing in oil and gas virtual reality environments (simulation development, computer graphics, and data visualization) as well as computational aspects of developing a 3D display (rendering, codec development and display perception).

His research centers around developing digital twin and virtual reality systems, including aspects such as vision/sensing, simulation/modelling, graphics/visualization and user interfaces. He has particular interest in application of vision and computer graphics towards holographic 3D displays. He is interested in capture of real-world holographic imagery for live cinematic capture, visual modelling for games and digital twins and robotic vision in terms of processing and compression. He also works on applying machine learning to digital twin systems for automating decision-making (e.g. in radiology), recognition of novel patterns and data-driven simulation of physical aspects of digital twin systems.

- Mohsin Jamil received a Bachelor of industrial electronics Engineering degree from NED University of Engineering and Technology, Karachi, Pakistan, in 2005. He received two master's degrees in electrical engineering from Dalarna University Sweden and the National University of Singapore in 2006 and 2008, respectively, with major in Automation and Control Engineering. He received his PhD degree in electrical engineering from the University of Southampton in 2012. He is currently an assistant professor (teaching) and adjunct professor within the Department of Electrical and Computer Engineering at Memorial University of Newfoundland, Canada, since August 2019. Between 2016 and 2019, he worked in the Department of Electrical Engineering at the Islamic University of Madinah, Saudi Arabia. Between 2012 and 2016, He was working at the Robotics Department of the National University of Sciences and Technology (NUST), Islamabad, Pakistan. His teaching interest includes advanced control systems, digital signal processing and machine learning, as well as advanced control systems, mechatronics, power electronics, power systems and instrumentation. He also works in other multidisciplinary areas as well, such as process control, system identification, artificial intelligence, and machine learning. He is the author and co-author of several IEEE publications in different journals and peer-reviewed conferences. He is the recipient of different awards and funding grants. He is a registered Professional Engineer in the Province of Newfoundland and Labrador, Canada. He is an associate editor of IEEE Access and a senior member of IEEE.
- Xianta Jiang received his Ph.D. in computer science from Simon Fraser University (2015) and Zhejiang University (Dual degree), studied mental workload measurement using eye-tracking technology. He then took a post-doc fellowship at Engineering Science, Simon Fraser University, worked in the area of human activity detection using machine learning and wearable sensors. He also worked as a senior research associate in the Department of Surgery at University of Alberta, studied team cognition using Augmented Reality (AR) and eye-tracking technologies. Dr. Jiang is currently an assistant professor in the Department of Computer Science in Memorial University of Newfoundland, Canada.
- **Cecilia Moloney** is a faculty member at Memorial University where she is a Professor of Electrical and Computer Engineering. She is a member of the Radar Remote Sensing Laboratory (RRSL), with research interests that in-

clude nonlinear signal and image processing methods, signal representations, and radar signal processing. In addition, she is a founder of the MetaKettle Project, a legacy project of the NSERC/Petro-Canada Chair for Women in Science and Engineering, Atlantic Region that she held at Memorial University in 2004-2009. The MetaKettle Project promotes and conducts research in transformative pedagogy for science and engineering; her recent contributions have addressed aspects of ethics in engineering, problem solving in engineering, and methods for engineering discovery. Dr. Moloney has taught courses at undergraduate and graduate levels in the Signals and Systems stream of courses (e.g. Engi 9821, Digital Signal Processing), in probability and random processes (e.g. Engi 9825, Random Signals), and in communications (e.g. Engi 9871, Information Theory and Coding). To the courses she teaches she brings the technical knowledge and pedagogical insights she has honed over her academic career, from the classroom and from her research and outreach initiatives.

- Theodore Norvell went to Dalhousie University for his undergrad studies, worked in industry, and went to the University of Toronto for his graduate studies. He did postdocs at Oxford and McMaster. He has been a professor of Computer Engineering at MUN for 26 years. His teaching includes computing theory, software design, software development, concurrent programming, algorithms, data structures, discrete math, formal methods, digital logic, operating systems, and more. His research areas include formal programming methods, semantics of programming languages, implementation of programming languages, automated verification of concurrent programs, design of programming languages, program animation, visual programming languages. He has developed software including "The Teaching Machine". He has supervised many undergraduate projects including, most recently, aspects of the Killick-1 satellite. He has supervised or co-supervised 16 thesis based students to completion. He has also supervised numerous capstone projects for course-based graduate students.
- Siu O'Young is a Professor in Electrical and Computer Engineering at Memorial University. He has a Ph.D. in Electrical Engineering from the University of Waterloo. His current research focus is on sense-and-avoid technology for remotely piloted aircraft systems ("drones"). He is active in the RTCA SC228 committee for US detect-and-avoid standards and is a member of the TSO Mirror Committee on Unmanned Aircraft Systems for the Standards Council of Canada. He also has more than 20 years of business experience in mentoring high-tech start-ups and in accessing capital.

- Lourdes Peña Castillo is an Associate Professor jointly appointed to the Department of Computer Science and the Department of Biology at Memorial University in St. John's, Canada. She completed her PhD at the Ottovon-Guericke University Magdeburg in Germany. Her doctoral dissertation focused on multirelational learning. She continued with a postdoc in bioinformatics in the Banting and Best Department of Medical Research at the University of Toronto. She has published 28 peer-reviewed journal articles, in high quality journals (with impact factors between 2.7 and 19) such as Genome Biology, Scientific Reports, BMC Genomics, RNA Biology, and PeerJ. Her research has been continuously funded by NSERC, and has supervised/co-supervised six PhD students, 14 thesis-based Master's students, and 15 course-based Master's students. Throughout her academic career, she has developed and/or applied artificial intelligence (mostly machine learning) in various areas such as bioinformatics, games and augmented virtuality. She leads the Bioinformatics lab at MUN which is focused on the application of machine learning-based methods to solve biological problems.
- **Dennis K. Peters** is Professor and Associate Dean (Undergraduate Studies) for the Faculty of Engineering and Applied Science at Memorial University in St. John's, NL, Canada where he has been a member of Faculty since 1998. He earned the B.Eng. (Electrical) degree at Memorial University in 1990, before going to work in the high-tech industry at Newbridge Networks (now Alcatel) in Ottawa, Ontario. After two years in industry he returned to school, this time at McMaster University in Hamilton, Ontario where he completed the M.Eng. (Electrical & Computer) in 1995 and Ph.D. (Electrical & Computer Engineering) in 2000. His research involves applications of machine learning techniques to a variety of problems ranging from marine operations to oilfield characterization. He also studies techniques for design and verification of software and computer systems, with particular focus on high performance computing, simulation, real-time applications and parallel or distributed processing. Dr. Peters is an active volunteer in the professional engineering community in Canada. He is a former Chair (2014-15) of the Board of Directors of the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL), and served (2008-2020) on the Canadian Engineering Qualifications Board (CEQB), including a term as Chair (2016-18). He was a member (2002-13) of the Registration Committee for PEGNL, including the last 7 years as Chair. He is a member (1999-present) of the executive committee for the Newfoundland and Labrador Section of the IEEE, including a term as Chair and several years as Student Branch Counselor. He has participated in accreditation visits for the Canadian Engineering Ac-

creditation Board (CEAB) and has served on the organizational committees for local, national and international conferences. His teaching activity is primarily in the area of software, ranging from introductory programming courses to advanced topics such as software engineering and concurrent programming.

- Karteek Popuri is currently an Assistant Professor at the Department of Computer Science at Memorial University of Newfoundland. He got his Bachelor of Technology degree in Chemical Engineering at the Indian Institute of Technology (IIT) Madras, and his Master's degree in chemical engineering from the University of Alberta. He received his PhD degree in Computing Science from the University of Alberta. Dr. Popuri's research interests are broadly in the areas of medical image analysis, machine learning/artificial intelligence and computer vision.
- Sarah Power received the B.Eng. degree from Memorial University and the M.A.Sc. and Ph.D. degrees from the University of Toronto. She is an assistant professor, joint-appointed to the Department of Electrical and Computer Engineering and the Division of Community Health and Humanities. Broadly, her research interests lie in biomedical signal processing and the application of machine learning to medical, rehabilitation, and human factors problems. Her main research focus is in the area of brain-computer interfaces, which involves the classification/detection of mental states (e.g., mental workload, fatigue, attention, affective state, task proficiency) using non-invasively measured neural signals (e.g., EEG). Her current teaching activities are primarily in the areas of signal processing and biomedical engineering.
- Vinicius Prado da Fonseca obtained his Ph.D. degree in Electrical and Computer Engineering from the School of Electrical Engineering and Computer Science, University of Ottawa, Canada, and his M.Sc. degree from the Military Institute of Engineering, Rio de Janeiro, Brazil. He is currently an assistant professor in the Department of Computer Science at Memorial University of Newfoundland. His research interests include robotic manipulation, visuotactile feedback, fuzzy-logic controllers, artificial intelligence, and applied machine learning.
- **Reza Shahidi** received the Bachelor of Mathematics degree (Joint Honours Computer Science and Pure Mathematics) from the University of Waterloo, Waterloo, ON, Canada, in 1998, and the M. Eng. and Ph.D. degrees in computer engineering from the Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, NL, Canada, in 2003

and 2008, respectively. He was a Postdoctoral Fellow from 2008 to 2009 with the University of British Columbia, Vancouver, BC, Canada, where he conducted research on seismic imaging, after which he spent several years working in industry in radar signal and image processing. In 2019, he was appointed as an Adjunct Professor with the Electrical and Computer Engineering Department, Faculty of Engineering and Applied Science, Memorial University, where he holds a multi-year NSERC Discovery Grant to conduct research into ocean parameter spectrum extraction from HF radar data. His research interests include signal and image processing, machine learning, algorithm design, HF and X-band radar, and vehicular networks. Before being appointed Teaching Assistant Professor with the ECE Department at MUN in December 2020, he was Product Development Lead with Seamatica Aerospace, St. John's, NL, Canada, and has roughly a decade of industrial research and development experience. As Teaching Assistant Professor, and prior to that, Dr. Shahidi has taught courses in Software Engineering, Theory of Computation, Digital Signal Processing and Digital Systems. He has introduced and incorporated machine learning, both from theoretical and practical standpoints, when teaching graduate courses in Advanced Computing Concepts and Concurrent Programming over the past year. He is the author or co-author of approximately 50 peer-reviewed journal and conference publications in prestigious venues and has supervised/co-supervised several graduate students both at the University of British Columbia and Memorial University.

- **Amilcar Soares** is an Assistant professor in the Department of Computer Science at Memorial University of Newfoundland. His research interests include spatiotemporal data segmentation, classification, enrichment, and visualization. He holds a Ph.D. in computer science from the Federal University of Pernambuco. He has been involved in several research projects funded by the Natural Sciences and Engineering Research Council of Canada (NSERC), Department of Fisheries and Oceans (DFO), Transport Canada (TC), and Defence Research and Development Canada (DRDC).
- Hamid Usefi is an Associate Professor at the Departments of Mathematics and Computer Science. Dr Usefi's research spans Algebra, Machine Learning, and Cryptography. His research involves developing novel machine learning algorithms and explore applications in bioinformatics, genetics, finance, and industry.
- **Andrew Vardy** is a Professor jointly appointed to the Department of Computer Science and the Department of Electrical and Computer Engineer-

ing at Memorial University in St. John's, Canada. He completed degrees in electrical engineering (B.Eng., Memorial University, 1999), evolutionary and adaptive systems (M.Sc., University of Sussex, 2000), and computer science (Ph.D., Carleton University, 2005). His main research area is swarm robotics but he has also developed new techniques in visual robot navigation. He leads the Bio-Inspired Robotics (BOTS) lab which is focused on developing swarms of robots that can actively organize their environments, for example by sorting objects or cleaning a space.

**Thumeera Wanasinghe** received his B.Sc. (Hons.) and M.Sc. degree in Electronic and Telecommunication Engineering from the University of Moratuwa. Sri Lanka, in 2009 and 2011, respectively. He obtained his doctoral degree in Electrical Engineering from Memorial University of Newfoundland, Canada, in 2017. His masters' thesis focussed on electrical parametric modelling of human skin impedance spectroscopy in response to variations in blood glucose level, and his doctoral thesis focussed on autonomous multi-robot collaboration. After completing his doctoral degree, he joined the Memorial University of Newfoundland as a postdoctoral researcher. He led three industrial funded research projects exploring underwater image processing, 3D point-cloud processing, and opportunities and challenges of digitalization of extractive industries. He has completed several online certifications in data science, machine learning, deep learning, and self-driving cars during his postdoctoral study. Currently, he is an Assistant Professor (Teaching term) attached to the Department of Electrical and Computer Engineering, Faculty of Engineering and Applied Science, Memorial University of Newfoundland. His main research areas are autonomous robotics systems, multi-sensor data fusions, applied AI and machine learning, and digitalization and its socioeconomic impact. His teaching interests embrace but are not limited to the following areas: communications systems, electrical/electronic/digital circuits, signal processing, electromagnetic principles, autonomous robotic systems, control systems, machine learning, artificial intelligence, and data science.

# Appendix F: Canadian university survey of undergraduate and graduate programs in artificial intelligence

Jniversity City		Undergrad.	Grad.	
Alberta				
Athabasca University	Athabasca	No	No	
Concordia University of Edmonton	Edmonton	No	No	
MacEwan University	Edmonton	No	No	
Mount Royal University	Calgary	No	No	
	Springbank			
The King's University	Edmonton	No	No	
University of Alberta	Edmonton	No	Yes	
University of Calgary	Calgary	No	No	
University of Lethbridge	Lethbridge	No	No	
British Columbia				
Capilano University	North Vancouver	No	No	
Emily Carr University of Art + Design	Vancouver	No	No	
Kwantlen Polytechnic University	Surrey	No	No	
	Langley	110	110	
	Bichmond			
	Cloverdale			
Royal Roads University	Victoria	No	No	
Simon Fraser University	Burnaby	Yes	No	
	Surrev			
	Vancouver			
The University of British Columbia	Vancouver	No	No	
	Kelowna			
Thompson Rivers University	Kamloops	No	No	
Trinity Western University	Langley	No	No	
University of Northern British Columbia	Prince George	No	No	
·	Terrace			
	Fort St John			
	Quesnel			
	Gitwinksihlkw			
University of the Fraser Valley	Abbotsford	Yes	No	
University of Victoria	Victoria	Yes	No	

Vancouver Island University	Nanaimo	No	No
Manitoba			
Brandon University	Brandon	No	No
Canadian Mennonite University	Winnipeg	No	No
St Paul's College	Winnipeg	No	No
The University of Winnipeg	Winnipeg	No	No
Université de Saint-Boniface	Winnipeg	No	No
University of Manitoba	Winnipeg	No	No
New Brunswick			
Mount Allison University	Sackville	No	No
St Thomas University	Fredericton	No	No
Université de Moncton	Moncton	No	No
	Edmundston		
	Shippagan		
University of New Brunswick	Fredericton	No	No
	Saint John		
Newfoundland and Labrador			
Memorial University of Newfoundland	Corner Brook St John's	Yes	No
Nova Scotia			
Acadia University	Wolfville	No	No
Cape Breton University	Sydney	No	No
Dalhousie University	Halifax	No	No
Mount Saint Vincent University	Halifax	No	No
NSCAD University	Halifax	No	No
Saint Mary's University	Halifax	No	No
St Francis Xavier University	Antigonish	No	No
Université Sainte-Anne	Pointe-de-l'Église	No	No
University of King's College	Halifax	No	No
Ontario			
Algoma University	Sault Ste Marie Brampton South Porcupine	No	No
Brescia University College	London	No	No
Brock University	St Catharines	No	No

Carleton University	ton University Ottawa		No
Huron University College	London	No	No
King's University College	London	No	No
Lakehead University	Thunder Bay	No	Yes
	Orillia		
Laurentian University	Sudbury	No	No
	Barrie		
McMaster University	Hamilton	No	No
Nipissing University	North Bay	No	No
OCAD University	Toronto	No	No
Ontario Tech University	Oshawa	No	No
Queen's University	Kingston	No	Yes
Redeemer University	Ancaster	No	No
Royal Military College of Canada	Kingston	No	No
Ryerson University	Toronto	No	Yes
St. Jerome's University	Waterloo	No	No
Trent University	Peterborough No		No
	Oshawa		
University of Guelph	Guelph	No	Yes
University of Ottawa	Ottawa	No	Yes
University of St Michael's College	Toronto	No	No
University of Sudbury	Sudbury	No	No
University of Toronto	Toronto	Yes	No
	Mississauga		
	Scarborough		
University of Trinity College	Toronto	No	No
University of Waterloo	Waterloo	No	Yes
University of Windsor	Windsor	No	Yes
Victoria University	Toronto	No	No
Western University	London	No	Yes
Wilfrid Laurier University	Waterloo	No	No
	Brantford		
York University	Toronto	No	Yes
Prince Edward Island			
University of Prince Edward Island	Charlottetown	No	No
Québec			
Bishop's University	Sherbrooke	No	No
Concordia University	Montreal	No	No

École de technologie supérieure	Montreal	No	No
École nationale d'administration publique	Québec	No	No
HEC Montréal	Montréal	No	No
Institut national de la recherche scientifique	e Québec	No	No
McGill University	Montreal	Yes	No
Polytechnique Montréal	Montreal	No	No
Université de Montréal	Montréal	No	No
Université de Sherbrooke	Sherbrooke Longueuil	No	No
Université du Québec	Québec	No	No
Université du Québec à	•		
Chicoutimi (UQAC)	Chicoutimi	No	No
Université du Québec à			
Montréal (UQAM)	Montréal	No	No
Université du Québec à			
Rimouski (UQAR)	Rimouski	No	No
Université du Québec à			
Trois-Rivières (UQTR)	Trois-Rivières	No	No
Université du Québec en			
Abitibi-Témiscamingue (UQAT)	Rouyn-Noranda	No	No
Université du Québec en			
Outaouais	Gatineau	No	No
Université Laval	Québec	No	Yes
Université TÉLUQ	Québec	No	No
Saskatchewan			
Campion College	Regina	No	No
First Nations University of Canada	Regina	No	No
	Saskatoon		
	Prince Albert		
Luther College	Regina	No	No
St Thomas More College	Saskatoon	No	No
University of Regina	Regina	No	No
University of Saskatchewan	Saskatoon	No	No
Total number of "Yes"		6	11

# AI xxx0: AI Foundations

# **Calendar Description**

AI xxx0 AI foundations provides background required for students taking graduate courses in Artificial Intelligence.

# Learning goals

The goal of this course is to provide the essential mathematical foundations needed to understand the concepts and algorithms used in artificial intelligence. This background is usually taught in several math courses that will go deeper into each of the areas covered. This course will refresh and advance basic knowledge in areas such as vector calculus, linear algebra and statistics to the point where it can be applied in the understanding of core AI techniques. These AI techniques will serve as the primary motivating examples around which the material will be structured.

For an example of this approach, the mathematical underpinnings for the backpropagation algorithm used to train neural networks will be established. Backpropagation requires the concepts of partial derivatives, function composition, and matrix multiplication. Once these concepts have been covered, the algorithm will be presented as an example of their application. Another motivating example would be Principal Components Analysis (PCA) which is an important method for dimensionality reduction. PCA requires the concepts of linear transformations, eigenvalues, eigenvectors, and covariance matrices. The set of motivating examples chosen could be different year-by-year but would consistently support the same fundamental topics listed in the next section.

# **Topics:**

- 1. Linear algebra
- 2. Analytic geometry
- 3. Matrix decompositions
- 4. Vector calculus
- 5. Probability distributions
- 6. Continuous optimization

# **Textbook and Resources:**

- Mathematics for Machine Learning. M. Deisenroth, A. Faisal, and C. Ong. Cambridge University Press, (2020). <u>https://www.cambridge.org/highereducation/books/mathematics-for-machine-learning/5EE57FD1CFB23E6EB11E130309C7EF98#overview</u>
- Chapters 2 to 5 of Deep Learning. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. The MIT Press. 2016.

# Evaluation

Assignments	20%
Quizzes	40%
Final Exam	40%

# AI xxx1: Topics in Artificial Intelligence

#### **Calendar Description**

This course provides an overview of the history of AI and its main areas, emphasizes the relevance of ethics considerations in AI research and application, and introduces a selection of the disciplines that constitute modern AI.

### Learning goals

Upon succesful completion of this course, students should:

- Be able to narrate AI history
- Be aware of ethical issues in AI
- Have a broad perspective on AI
- Be familiar with selected AI areas
- Be able to describe current AI applications

#### Topics

- 1. History of AI
- 2. Current AI applications
- 3. Ethics of AI
- 4. Introduction to selected AI areas among others:
  - Knowledge representation
  - Probabilistic reasoning (Bayesian inference, Bayesian networks, Markov chains)
  - Agent-based and multi-agent systems
  - Planning and scheduling
  - Data mining
  - Constraint satisfaction
  - Natural language processing
  - Computer vision
  - Robotics
  - Machine learning
  - Heuristic search
  - Game playing
  - Human/AI collaboration
  - Neuroscience and Cognitive Science
  - AI and philosophy of Mind

#### **Textbook and Resources:**

- Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig. Fourth edition, 2020.
- Review articles corresponding to selected AI areas

#### **Evaluation**

Topic activities	90%
Participation	10%
Final Exam	40%

# AI xxx2: Capstone for Artificial Intelligence

# **Calendar Description**

AI xxx2 provides an opportunity for students to integrate the knowledge that they have acquired in modern AI techniques through application to a relevant challenge or problem. Students work independently or in small teams to propose and implement an AI solution to a specific problem. Challenge/problem might be in a variety of areas.

# Learning goals

- Refine and apply problem solving and analytical skills to identify which AI technique is best suited to address a given problem
- Follow best practices of AI application to optimize outcomes
- Design, develop and implement an AI-based solution for a given problem
- Critically evaluate AI-based solution implemented

# **Textbook and Resources:**

Vary depending on the challenge/problem.

# Evaluation

Progress reports	30%
Presentation	20%
Final Report	50%

# **COMP 6901 -- Applied Algorithms Fall 2020**



The course information below is very tentative! The way the lectures/tests are done and the marking scheme, inparticular, are likely to change depending on everybody's availability, enrolment, software licenses and other factors.

Instructor: Antonina Kolokolova Instructor office hours: TBA. Also on Zoom. Additionally, we will be using discussion boards on Brightsgace.

We will be using <u>Brightsnace (formerly: known as D2L)</u> for assignment submissions, tests, grades, announcements, etc. The assignments, slides and videos of lectures will also be posted here. The Brightspace shell for our course should be available shortly to all registered students; ifyou cannot register/access Brightspace after the first week of classes, please let me know.

Textbook: There will be no official textbook for this course. We will mostly follow *J. Kleinbe-rg*, *E. Tardos*. *Algorithm Design*, but you do not need to buy it.

Reference books:

- J. Kleinberg, E. Tardos. Algorithm Design.
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms

We will also use other materials such as research papers.

See the lecture notes from the previous run of this course for more information.

**Marking scheme:** (tentative!): 4 assignments 15% each, and two tests 20% each. The last test is likely to be scheduled during the last week of classes.

**Description:** The goal of this course is to study both classical and advanced algorithm design techniques with emphasis on real-world applications. We will cover greedy algorithms, dynamic programming, backtracking, network flows as well more advanced algorithms and techniques (time permitting). Time permitting, we will consider randomized, parallel and distributed algorithms, and/or streaming algorithms.

**Prerequisites:** This course assumes proficiency in the core subjects of computer science: <u>programming</u>, discrete math, and basic data structures/algorithms. In particular, I will assume that you can read and write proofs, know basic probability theory and combinatorics, know basic data structures and algorithm complexity analysis, can read and write pseudocode, and can program fluently in some programming language. Check our undergraduate courses COMP 1001, COMP 1002 and COMP 2002, and make sure you are comfortable with the material covered there; this should take care of most of the skills you need to succeed in COMP 6901.

**Policy on collaboration:** The work you submit must be your own. You may discuss problems from assignments with each other; however, you should prepare written solutions alone, and do not interact with anybody except the instructor while doing tests and online exercises. Plagiarism is a serious academic offense and will be dealt with accordingly. When in doubt, check How to avoid P-lagiarism

# COMP 6907 Data Mining Techniques and Methodologies

#### **Objectives of the Course**

This course introduces the basic concepts and techniques for data mining. Upon the completion of the course, students are expected to understand the essential data mining technologies and be able to design and evaluate methods for data mining applications.

## **Representative Course Outline**

- Data mining basic concepts
- Pattern/knowledge discovery introduction
- Mining frequent patterns
- Sequential pattern mining
- Constraint-based mining
- Graph pattern mining
- Mining large data sets
- Clustering
  - o Basic concepts
  - Partitioning-based clustering
  - o Hierarchical method
  - Density based methods
  - o Grid based methods
  - o Cluster evaluation/validation

## **Method of Evaluation**

Assignments	30%
Final exam	30%
Project	40%

## Suggested texts/references

"Data Mining, concepts and techniques" by Jiawei Han, Micheline Kamber and Jian Pei, 3rd ED, Morgan Kaufmann Publishers. 2011

# Computer Science 6912 Graduate Course: Autonomous Robotics

Memorial University of Newfoundland

Winter, 2019-20

Instructor: Dr. Andrew Vardy

**Office:** EN-2018

E-mail: av followed by the 'at' symbol, then mun.ca

Web page: Brightspace

Lectures: Mon, Wed, Fri from 10:00 - 10:50 in EN-1051

Labs: Tuesdays from 2:00 - 4:50 in EN-1049. Three labs are planned, which will take up at least three 3-hour sessions. However, it is possible that more than three sessions will be required. There will be no option to make-up for missed labs.

For students in 6912, the lab slot will also be used for presentations and demos.

Instructor Office Hours: Mondays and Wednesdays 1:00 – 2:00. E-mail to arrange an appointment outside of office hours. You can also stop by my office and if my door is ajar, I will be happy to help you. If my door is closed I am either out of the office or very busy. Note: The Wednesday office hour will have to be cancelled a few times throughout the semester to accommodate Departmental/Faculty meetings.

## Calendar Description:

<u>Introduction to Autonomous Robotics</u> examines the fundamental constraints, technologies, and algorithms of autonomous robotics. The focus of this course will be on computational aspects of autonomous wheeled mobile robots. The following topics will be covered: major paradigms in robotics, methods of locomotion, kinematics, simple control systems, sensor technologies, stereo vision, feature extraction, modelling uncertainty of sensors and positional information, localization, SLAM, obstacle avoidance, and 2-D path planning.

## **Course Outline:**

- Major Paradigms in Robotics
- Representing Position and Orientation (Ch. 2 of Corke)
- Robot Vehicles and Control (Ch. 4 of Corke)
- Perception and Sensors (Ch. 4 of Siegwart, Nourbakhsh, and Scaramuzza)
- Probabilistic Robotics (Selected Chapters from Thrun, Burgard, and Fox)
- Navigation and Reinforcement Learning (Various Sources)
- Swarm Robotics (Selected Material from Hamann)

## Textbook: There is no required textbook for this course.

For much of the course we will utilize material from [Corke, 2017]. Fortunately, it is available for free in electronic form from the MUN library. We will also use some material from [Siegwart, Nourbakhsh, and Scaramuzza, 2011], [Thrun, Burgard, and Fox, 2005] and [Hamann, 2018] as indicated above. [Hamann, 2018] is available in electronic form from the MUN library.

## **References:**

Corke, Peter. Robotics, Vision and Control: Fundamental Algorithms In MATLAB®, Second Edition Springer, 2017.

Hamann, Heiko. Swarm Robotics: A Formal Approach. Springer, 2018.

- Siegwart, Roland, Illah Reza Nourbakhsh, and Davide Scaramuzza. Introduction to autonomous mobil MIT press, 2011.
- Thrun, Sebastian, Wolfram Burgard, and Dieter Fox. <u>Probabilistic robotics</u>. MIT press, 2005.

# **Prerequisites:**

Students should have a solid background in computer programming, algorithms, calculus, linear algebra, and statistics. Such a background may have been obtained through completion of the following courses at Memorial: COMP 2711, MATH 2000, MATH 2050, and STAT 2510. Assignments will require the use of Python, although some work from the final section of the course (swarm robotics) will require the use of Javascript (in-depth Javascript knowledge is not required).

# **Evaluation scheme:**

Assignments (5 @ 5% each)	25%
Labs $(3 @ 3.333\% each)$	10%
Tests $(2 @ 15\% \text{ each})$	30%
Presentation	5%
Project Demo	15%
Project Report	15%

# **Presentation:**

Each student will prepare a presentation on a modern research paper in robotics. The paper should be chosen from the proceedings of one of the main conferences in robotics:

- IEEE/RSJ International Conference on Intelligent Robots and Systems
- IEEE International Conference on Robotics and Automation

The proceedings for both of these conferences are available through IEEE Xplore, which is accessible through the university library's web site. Papers published in other respectable conference proceedings and journals may also be accepatable. The paper chosen should be reasonably self-contained so that it can be explained without having to go through all of its references. It should also present additional material beyond what is discussed in class.

Students should select two different topics of interest and for each topic submit a recent paper (2016+), plus an older paper which the recent paper builds upon. Thus, a total of four papers should be provided as PDF files to the instructor by the paper selection deadline. The instructor will consult with the student to discuss which paper is most suitable for presentation.

# **Project:**

The project will involve implementation of one or more of the concepts developed in the presented paper. The student should discuss the scope of the implementation with the instructor. It is crucial that some experimental results be demonstrated either in simulation or using physical robots.

The project can be completed either individually or in groups of two. Projects completed by groups will be held to a significantly higher standard of accomplishment.

Further information on the requirements for the project demo and report will be posted on Brightspace.

## Schedule:

Assignment 1	24 Jan.
Lab 1	28 Jan.
Assignment 2	7 Feb.
Lab 2	11 Feb.
Test 1	14 Feb.
Assignment 3	28 Feb.
Assignment 4	13 Mar.
Lab 3	17 Mar.
Test 2	20 Mar.
Assignment 5	27 Mar.
Project Interim Demo	31 Mar.
Project Final Demo	7 April
Project Report Due	10 April

Presentations will be scheduled during the Tuesday afternoon lab slot in March once enrollment stabilizes.

Note: The schedule for course events (assignments, labs, and tests) will be posted on Brightspace. This schedule is subject to change which will be announced in class.

#### Assignments:

Each assignment will consist of two parts. Part A will involve pen-and-paper calculations, problem solving exercises and potentially small programming exercises. Part B will be a more substantial programming exercise. The weighting of marks between Parts A and B may differ from one assignment to the next.

Programming tasks (in parts A and B) will require the use of Python. Part of the last assignment will require the use of Javascript, but in-depth knowledge of the language is not required.

Both parts of assignment 1 must be completed individually. For assignments 2-5 part B may be completed individually or in groups of two. If completed in a group of two, the expectation is that the group will go beyond bare-bones functionality and include some level of experimentation and analysis (e.g. studying the impact of varying parameters). Part A for all assignments must be completed individually.

For all assignments, part A is to be completed on paper and submitted at the beginning of class (at 10:00). Part B will be due on the same day but will be submitted through Brightspace.

## Labs:

Three lab sessions are planned. Students will work in pairs to implement problems studied in class on real-world robots. It is anticipated that the first lab session will involve some manual assembly and setup tasks. Labs 2 and 3 will involve programming the robots to execute various tasks.

# Other Info.

- Note that there **will** be an assignment due during the last two weeks of term. For students in 6912, the project final demo will also occur during the last two weeks of term.
- Late assignments, labs, and missed tests will only be accepted in case of illness, childbirth, or bereavement, <u>or by prior arrangement with the Instructor</u>. In case of illness, you should obtain a doctor's certificate prior to the test time or due time.
- If you feel any mark was unfair or incorrectly recorded, ensure the instructor is aware of the problem as soon as possible, and within at most 2 weeks of receiving the mark. No reconsideration of term marks will be made after the final exam.
- Cases of academic offences will be dealt with in accordance with university regulations. Academic offences includes: copying, allowing work to be copied, failing to cite sources, and presenting work done in collaboration as one's own. Please read Section 6.12.4 of the university calendar if you need clarification as to what constitutes an academic offence.



COMP 3202/COMP 6915 – Intro to Machine Learning Course Outline - Winter 2021

Instructor: Dr. Lourdes Peña-CastilloOffice: ER-6037Phone: 864-6769Webpage: www.cs.mun.ca/~lourdesEmail: Use Brightspace (online.mun.ca) shell's email. Email will be replied within two working days.

**Lectures:** TR 12:00 - 12:50 pm and F 1:00 - 1:50 pm (Brightspace online rooms. Synchronous lectures. Lectures will be recorded)

**Office Hours:** Monday 9:00 – 11:00 am, or by appointment (conducted through Webex).

Questions: Students are encouraged to post course-related questions in Brightspace discussion forum.

## **Course Description:**

This course introduces concepts and algorithms in machine learning for regression and classification tasks. The course gives the student the basic ideas and intuition behind model selection and evaluation, and selected machine learning methods such as random forests, support vector machines, and hidden Markov models.

# **Pre-requisites:**

## COMP-3202

COMP 3200; or COMP 2001 or the former COMP 2710, COMP 2002 or the former COMP 2711, and Statistics 2550 ; and Mathematics 2050

## COMP-6915

Python programming, a statistics course at the undergraduate level (similar to STAT 2550), and a linear algebra course at the undergraduate level (similar to MATH 2050).

#### Learning Goals:

- 1. Understand the basis underlying supervised machine learning methods
- 2. Understand the algorithms behind certain machine-learning methods
- 3. Acquire hands-on experience applying supervised machine-learning methods
- 4. Be able to appropriately evaluate and select a machine-learning model for a specific task

#### **Course Activities:**

- 1. Six assignments
- 2. Twelve quizzes
- 3. A final exam
- 4. COMP-6915: A 15-min video tutorial

#### **Textbooks:**

- The Elements of Statistical Learning: Data Mining, Inference and Prediction. T. Hastie, R. Tibshirani, J. Friedman. Springer. 2nd Edition. 2009 (<u>http://statweb.stanford.edu/~tibs/ElemStatLearn/</u>)
- An Introduction to Statistical Learning. G. James, D. Witten, T. Hastie and R. Tibshirani. Springer. 2013 (<u>https://statlearning.com/</u>)

• Deep Learning. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. The MIT Press. 2016 (https://www.deeplearningbook.org/)

#### **Evaluation Scheme:**

	<b>COMP-3202</b>	COMP-6915
Assignments (6)	36%	30%
Quizzes (12)	40%	40%
Final exam	24%	10%
Video tutorial	N/A	20%

#### Notes:

- 1. In the event of university closure on the day of a test, the test will be given in the next class meeting.
- 2. Assignments will be submitted in electronic format using the Dropbox application in Brightspace. No late assignments will be accepted.
- 3. Course materials, news and communications will be available from the Brightspace system.
- 4. All grades will be assigned according to the University Calendar (Section 6.9.2 under University Regulations).
- 5. All written materials delivered must comply with the expectations of Good Writing set out in the University Calendar (Section 6.9.3 under University Regulations).
- 6. If, for special circumstances (such as medical or bereavement), you miss a deadline for a grade item, notify your professor as soon as possible and no later than 48 hours after the original deadline, providing any necessary related documentation (if documentation is required). Failure to do this might result in a mark of 0% for that grade item. For more information, please see Section 6.7.5 and Section 6.15.6 under University Regulations in the University Calendar or consult the Registrar's Office.
- 7. From section 6.12 of the University Calendar: "A student is expected to adhere to those principles which constitute proper academic conduct. Academic misconduct cannot be condoned or even appear to be condoned. A student has the responsibility to know which actions, as described under <u>Academic Offences</u>, could be construed as dishonest or improper.". Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. In addition, see "<u>Avoiding plagiarism a guide</u>".
- 8. Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities. Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).
- 9. The lectures and displays (and all material) delivered or provided in this course, including any visual or audio recording thereof, are subject to copyright owned by the instructor of the course. It is prohibited to record/copy and distribute by any means, in any format, openly or surreptitiously, in whole or in part, in the absence of express written permission from the instructor any of the lectures or materials provided or published in any form during or from the course.
- 10. It is the responsibility of the instructor to determine, maintain and enforce the standards of behavior acceptable to preserving an atmosphere appropriate for teaching and learning. Students will be warned if their behavior is evaluated by the instructor as disruptive.
- 11. Although changes to this document are not intended at this time, any part of this course outline can be subject to change, particularly during the first two weeks of classes. Students should be aware that the latest version of the course outline will be available through the Brightspace shell for the course.

# Assignments:

- Assignments will be done in groups of two students.
- Assignment programs have to be implemented in Python 3.
- Assignment programs are required to run in linux command-line.
- For each assignment, data and interface specifications will be provided. If the assignment program does not run according with the specifications, points will be deducted.
- Check Brightspace calendar for due dates

### **Tentative Course Schedule**

Week	Monday	Tuesday	Wed.	Thursday	Friday
1	Jan 11	Intro to 6915		Intro to ML (ESLII	Intro to ML
	Lectures			Ch2, DL Ch5)	
	begin				
2	Jan 18	KNN		KNN	Model assessment and
					selection (ESLII Ch7)
3	Jan 25	Model assessment		Model assessment and	Linear methods for
	Last day to	and selection		selection	regression (ESLII
	add				Ch3)
4	Feb 1	Linear methods for		Linear methods for	Linear methods for
		classification		classification	classification
		(ESLII Ch4)			
5	Feb 8	Tree-based methods		Tree-based methods	Tree-based methods
	<b>D</b> 1 15	(ESLII Ch9)			
6	Feb 15	Bagging & Boosting		Bagging & Boosting	Random Forest
	E.1. 00	(ESLII Chiu)			E.1. 2(
/	Feb 22				Feb 26
	winter break				winter break enas
0	Degins Marah 1	Dandom Forest		Support vootor	SVMs
0		(FSLUC) (FSLUC)		support vector machines (FSI II	5 V IVIS
		(ESLII CIIIS)		Ch12 IFI Ch0)	
9	March 8	SVMs		Feedforward networks	Feedforward
	Last day to	5 1 115		(DL Ch6)	networks
	dron				networks
10	March 15	Feedforward		Feedforward networks	Regularization (DL
		networks			Ch7)
					,
11	March 22	Regularization		Convolutional	March 26
		0		networks (DL Ch9)	CNNs
					Saturday March 27
					Follow Friday schedule
					CNNs
12	March 29	Recurrent and		RNNs	April 2
		recursive nets (DL			Good Friday, no
		Ch10)			classes
13	April 5	Practical		Ethical issues	April 9
		Methodology			Lectures end
14	A 11.10		A		Q&A
14	April 12		April 14		
			Final		
			exams horiz		
15	Annil 10		Degin		A mril 22
15	April 19				Final arams and
					T indi exams end

Course Syllabus - Fall 2021

# Computer Science 4304: Data Visualization Computer Science 6934: Intro to Data Visualization

Instructor:	Terrence Tricco (he/him)
Email:	tstricco@mun.ca
Office:	ER-6031
Lectures:	11:00 - 11:50am M-W-F (Three 50 minute lectures per week.)
Lecture Room:	EN-2006
Office Hours:	1:00 - 3:00pm on Mondays (or by email appointment)
4304 Pre-requisites:	COMP 2001, COMP 2002, Statistics 2500 or Statistics 2500

# **Instructional Continuity**

Welcome back to campus. All lectures in this course will be taught both in-person and through recorded video posted online to Brightspace. The recorded lectures will be a duplicate of the in-person lecture. You can choose which mode of learning you prefer.

Masks are currently required on campus. If this policy changes during the term, it is still recommended to wear a mask even if not required. There will be different levels of comfort and anxiety for mask use. Please be respectful of everyone in the class.

Should there be disruption to in-person lectures over the course of the term by other health directives or the overall situation connected to Covid-19, then instruction will continue through the online videos according to the course schedule.

# **Course Objectives**

Data visualization is the art of creating images based on data. Visualizations enable users to explore, understand, and extract insights from data in an efficient way. This course will be centred on data visualization for data science, and will cover three broad topics. One will be the tools of data visualization, specifically Jupyter notebooks and Python visualization libraries. A second topic will be standard types of visualizations for different types of data. The third topic will be on the theoretical aspects of data visualization, such as viewer perception and rules of thumb for good visualizations.

# **Course Outline**

- Data Visualization Tools
  - Jupyter Notebooks and Python
  - Pandas data library

- Matplotlib, Seaborn and Plotly visualization libraries
- Vector graphics (svg), Rasterization
- Interactivity
- Standard Visualisation Types
  - Relational: Line plots, Scatter plots, Bubble plots, Heat maps
  - Categorical: Bar plots, Histograms, Box plots, Radar charts
  - Hierarchical: Pie charts, Venn diagrams
  - Multi: Scatterplot matrix
  - Spatial: Chloropleth, Contour plots, Kernel density estimation
  - Data reduction: t-SNE, Principal component analysis
- Data Visualisaton Theory
  - Planning and design process
  - Human perception
  - Colour theory
  - Elements of style
  - Rules of thumb, pitfalls to avoid

# Evaluation

There will not be any in-person evaluation. The final grade in the course will be determined as follows:

Assignments (8)	50%
Course Project	50%
<ul> <li>Project Proposal</li> </ul>	(10%)
<ul> <li>Project Submission and Code</li> </ul>	(25%)
• Video Presentation	(15%)

# **Recommended Reading (Optional)**

There is no required textbook for this course. The following textbooks are only recommended for further reading on course topics.

- A. Kirk, Data Visualisation: A Handbook for Data Driven Design, 2nd Edition, Sage, 2019.
- T. Munzner, Visualization Analysis & Design, CRC Press, 2014.
- R. Spence, Information Visualization: An Introduction, 3rd Edition, Springer, 2014.

# **Memorial University Policies**

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www. mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

# MEMORIAL UNIVERSITY OF NEWFOUNDLAND Department of Computer Science

# Computer Science 6980 Special Topics in Artificial Intelligence

Instructor:	David Churchill	Phone:	864-6140
Office:	ER-6030	Email:	dchurchill@mun.ca
Office Hours:	TBA	Website:	www.cs.mun.ca/~dchurchill/

#### **Course Website:**

<u>https://www.cs.mun.ca/~dchurchill/courses/3200</u> (most course activity will take place on D2L)

#### **Course Objectives:**

This course is an introduction to Artificial Intelligence (AI), covering algorithmic techniques and data structures used in modern problem-solving environments. Each topic will have a related assignment where the learned techniques are applied to simple games.

#### **Course Outline:**

- Introduction to Artificial Intelligence
  - o What is AI? What can Modern AI do?
  - o Games as a Testing Environment for AI
  - Agents, Environments, and Problems
- Search Algorithms
  - Exhaustive Search (BFS / DFS)
  - Heuristic Functions / Incorporating Knowledge
  - Heuristic Search (Best-First Search / A\*)
  - o Introduction to Game Theory / Nash Equilibrium
  - o Adversarial Search (Minimax / Alpha-Beta)
  - o Data Structures / Optimizations for Search
- Genetic Algorithms (GA)
  - o Introduction to Evolutionary Algorithms
  - o GA Representations: (Genotype, Phenotype)
  - o GA Implementation: Mutation, Crossover, Selection, Reproduction
- Reinforcement Learning (RL)
  - o Introduction to RL: Agent, Environment, Actions, Policies, Rewards
  - o Bandit Problems (Exploration vs. Exploitation)
  - o Markov Decision Processes
  - o Generalized Policy Iteration
  - o Monte-Carlo Methods
  - o Temporal Difference Learning (SARSA / Q-Learning)
- Neural Networks (NN)
  - o Artificial Neurons / NN Structure / Training
  - o Brief Introduction to Deep Learning

**Textbook:** Artificial Intelligence: A Modern Approach (Optional) Russel & Norvig

> Reinforcement Learning: An Introduction (Free Online) Sutton & Barto http://incompleteideas.net/book/the-book.html

Format: 2 lectures per week on Tuesday / Thursday (80 minutes each)

## **Evaluation:**

The evaluation structure of the course is as follows:

•	Assig	nments		50% (≤ 2 Per Group)
	0	Intro to JS + BFS/ DFS	(Programming)	
	0	A* Search Pathfinding	(Programming)	
	0	Minimax + Alpha-Beta	(Programming)	
	0	Genetic Algorithm	(Programming)	
	0	Reinforcement Learning	(Programming)	
•	Midte	rm Exam	(Written)	10% (Solo)
•	Final	Exam	(Written)	20% (Solo)
•	Final	Project	(Programming)	20% (Solo)

**Note**: Due the group work nature of this course, to effectively show that you have individually learned the material, <u>you must pass the final exam to pass the course</u>. If your grade on the final exam is less than 50%, then your overall course grade will be equal to the mark that you received on the final exam. If your final exam grade is greater than or equal to 50%, your course grade is determined by the scheme above.

#### **Memorial University Policies:**

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

## Differences from COMP 3200 (undergrad):

This course will be taught along with the undergraduate course COMP 3200, and therefore will cover many of the same topics as that course. In order to differentiate it from COMP 3200, there will be several differences which assign extra reading / work to graduate students, in order to further their learning beyond that of the undergraduate course.

- Graduate students will be assigned extra reading for advanced topics
- This course will have a project requirement, unlike 3200
- This course will have a more difficult final exam from 3200
- Assignments will have bonus material for graduate students

# Appendix

#### **Computer Science 6981**

**Data Preparation Techniques** 



## **Department of Computer Science**

#### Instructor: Dr. Amilcar Soares

#### Email: <u>amilcarsj@mun.ca</u> (please use this email to contact your instructor, not D2L)

Course information (e.g., lecture notes, announcements, grades, etc) can be found on Brightspace (D2L). However, please note that your instructor **DOES NOT check email in Brightspace (D2L)**. The course number must be included in the subject line of any emails to the instructor or the instructional staff.

#### **Current Course Prerequisites/Credit Restrictions:**

Basic knowledge of Statistics and programming in Python 3 are required skills.

#### **Course Description:**

Students will learn several data preparation techniques for preprocessing your data set for data analytics tasks such as data mining, machine learning and data visualization. The course includes data cleaning, scaling, normalizing, discretizing, and imputing data and feature engineering, feature selection, and dimensionality reduction. The course will also include how to scale up the processing with distributed frameworks such as Apache Spark to handle large datasets. Finally, the students will see a high-level overview of some traditional data mining algorithms, such as linear regression and classification, decision trees, k-means and DBSCAN that will be eventually introduced to evaluate the impact of the techniques being taught.

#### List of topics

- iPython, Jupyter notebooks, and NumPy basics.
- Pandas (mapping, sorting and ranking, and descriptive statistics), Matplotlib
- Data cleaning
  - Why to clean your data?
  - o Identify values for cleaning, formatting, finding outliers and duplicates.
- Data scaling, normalization, and discretization
  - Min-max scaler, standard scaler, max abs scaler, robust scaler, quantile transformer scaler, power transformer scaler, unit vector scaler.
  - Range, clipping, log and z-score normalization.
  - Equal width discretization and equal-frequency discretization.
  - Binning histogram and correlation analysis for data discretization.
- Scikit-learn basics, Supervised Learning (Bayesian, k-Nearest neighbors, Decision trees, Linear models)
  - Basics of the scikit-learn package, how to prepare your data, load and execute models.
  - Using basic models such as Bayesian, kNearest neighbors, Decision trees, Linear models.
  - How cleaning, scaling, normalization and discretization affects supervised learning?

- Scikit-learn, Unsupervised Learning (Kmeans and DB-SCAN)
  - How cleaning, scaling, normalization and discretization affects unsupervised learning.
- Scikit-learn, Dimensionality reduction (PCA and TSNe)
  - How cleaning, scaling, normalization and discretization affects dimensionality reduction.
- Scikit-learn, Feature selection
  - Statistics for filter feature selection method, correlation statistics, selection method, and transform variables.
- Data integration and encodings
  - A data integration primer. How to combine data sets with join, merge and concatenation.
  - One-hot encoding.
- Map Reduce
  - Scaling up the data analysis with the Map Reduce framework. Apache spark basics and examples

#### **Course Objectives:**

To give students basic knowledge on how preprocess raw data. We will cover both processing techniques for small and big data. While advancing in the content, some simple models would be introduced in the course for evaluating the impact of the addition of the preprocessing techniques.

At the end of this course the students will be able to:

- Perform data pre-processing in small and large data sets
- Evaluate the effect of pre-processing techniques using data mining/machine learning methods
- Scale the up pre-processing of large datasets using distributed frameworks

#### **Recommended Readings**

- 1. Zheng, A., & Casari, A. (2018). *Feature engineering for machine learning: principles and techniques for data scientists.* " O'Reilly Media, Inc.".
- 2. Osborne, J. W. (2013). Best practices in data cleaning: A complete guide to everything you need to do before and after collecting your data. Sage.

#### Evaluation:

The final grade in this course will be determined by three project iterations as follows:

Quizzes (6)	30%
Assignments (3)	40%
Final Exam	30%

Assignments and Quizzes are individual. You must pass the final exam to pass the course.

# **Computer Science 6982** Computer Vision Winter 2022



# **Department of Computer Science**

Instructor:	Matthew Hamilton
E-mail:	mhamilton@mun.ca

Course Content: <u>https://online.mun.ca/</u>

# **Course Objectives:**

CS 6982 Computer Vision studies how to develop methods that enable a machine to "understand" or analyze images. The course introduces the fundamental problems in computer vision and the state-of-the-art approaches that address them. Topics include feature detection and matching, geometric and multi-view vision, structure from X, segmentation, object tracking and visual recognition.

# **Topics:**

- 1. Feature detection and matching
- 2. Geometric and multi-view vision
- 3. Structure from X
- 4. Segmentation
- 5. Object tracking
- 6. Visual recognition

# **Textbook and Resources:**

Computer Vision: Algorithms and Applications by Richard Szeliski (available for free on author's page)

Computer Vision: A Modern Approach by David Forsyth and Jean Ponce

Additional materials assigned throughout the course.

# **Evaluation:**

	Grade Weight
Assignments	20%
Class Tests	20%
Project	30%
Final	30%
	100%

# Difference between the graduate and the undergraduate version of this course:

Where this course is offered in conjunction with undergraduate Computer Visions course (CS 4301/ENGI 8410), graduate students projects should reflect a higher level of sophistication and should be based on the implementation of techniques or algorithms presented in a journal publication.
### **COMP 69xx: Advanced machine learning**

### **Course Description**

This course explores advanced machine learning topics and its applications. Students will have to read and present manuscripts published within the last five years in top machine learning conferences (e.g., ICML, IJCAI, NIPS) or journals. Students taking this course should be comfortable with the material covered in COMP-6915 and MATH 6205.

### Learning goals

- Be aware of forefront research in machine learning
- Acquire deeper knowledge in certain areas of machine learning
- Apply machine learning methods

### **Topics covered may include:**

- 1. Alternative learning paradigms such as:
  - a) Active learning
  - b) Incremental learning
  - c) Semi-supervised leaning
  - d) Transfer learning
  - e) Adversarial learning
  - f) Dual learning
  - g) Meta learning
- 2. Learning methods for alternative models such as:
  - a) Time-series machine learning
  - b) Generative models
  - c) Graph-based learning
- 3. Approaches for better machine learning such as:
  - a) Trustworthy machine learning
  - b) Explainable machine learning
- 4. Alternative network architectures such as
  - a) Capsule networks
  - b) Autoencoders
  - c) Compensatory neural networks
  - d) Compact neural controllers

### Suggested textbook/readings

Related conference proceedings and journal articles.

### Evaluation

Project	40%
Presentation (2)	40%
Discussion	20%

# **DSCI-6601** Practical machine learning

**Course description:** This course provides a practical introduction to machine learning. The course will mostly focus on applying supervised learning methods to a variety of data-sets using R and Python. Model selection and assessment will be discussed and applied.

Prerequisites: None.

### Tentative syllabus:

- 1. Introduction to Machine Learning (ML)
  - (a) Definition
  - (b) Types of ML
  - (c) Supervised ML
    - i. Classification and regression
    - ii. Generalization, underfitting, overfitting, bias and variance
- 2. Introduction to scikit-learn
- 3. Introduction to caret package
- 4. Exploring, understanding and representing data
  - (a) Data exploration (recap)
  - (b) Data transformations
  - (c) Data encoding
  - (d) Feature selection
- 5. Model performance assessment
  - (a) Performance metrics
  - (b) Cross-validation
- 6. Supervised ML algorithms
  - (a) Nearest Neighbours
  - (b) Linear Models
  - (c) Naive Bayes Classifiers
  - (d) Ensembles of Decision Trees
  - (e) Support Vector Machines
  - (f) Feed forward neural networks

### Textbooks:

- An Introduction to Statistical Learning: with Application in R. G. James, D. Witten, T. Hastie and R. Tibshirani. Springer, 2013. (https://www-bcf.usc.edu/ gareth/ISL/).
- Introduction to Machine Learning with Python: A Guide for Data Scientists. Sarah Guido, Andreas Muler. O'Reilly Media, 2016.
- Machine Learning with R: Expert techniques for predictive modeling, 3rd Edition. Brett Lantz. Packt, 2019.

Evaluation Scheme: Assignments (6) Project In-class participation

60% 30% 10%

# DSCI-6602 Deep learning and artificial intelligence

**Course description:** This course will provide a short overview of classical methods of machine learning before delving into the recent developments in the areas of deep learning, reinforcement learning, deep reinforcement learning and artificial intelligence.

**Prerequisites:** Undergraduate linear algebra at the level of Math-2050, multivariate calculus at the level of Math-2000 as well as elementary probability. Elementary experience with Python.

### Tentative syllabus:

- 1. Review: Classical machine learning
  - (a) Least squares regression
  - (b) Logistic regression
  - (c) Autoencoders and matrix factorization methods
- 2. Deep neural networks and deep learning
  - (a) Multilayer perceptron's
  - (b) Gradient descent, optimization, backpropagation algorithms
  - (c) Convolutional neural networks
  - (d) Recurrent neural networks
  - (e) Stability of neural networks
  - (f) Applications to computer vision, natural language processing, time series analysis
  - (g) Computational considerations for training neural networks
- 3. Advanced topics in deep learning
  - (a) Variational autoencoders
  - (b) Generative adversarial networks and generative methods
  - (c) Adversarial examples
  - (d) Neural ordinary differential equations
- 4. (Deep) reinforcement learning and artificial intelligence
  - (a) *ɛ*-greedy algorithms
  - (b) Finite Markov decision processes
  - (c) Temporal-difference learning
  - (d) Function approximations for reinforcement learning
  - (e) Policy gradient methods
  - (f) Case studies (ATARI games, AlphaGo, autonomous vehicles)
  - (g) Ethical questions and AI safety

**Textbooks:** The following books are either publicly available or available through our library.

- C.C. Aggarwal. *Neural Networks and Deep Learning*, Springer, 2018. (available as ebook in our library)
- I. Goodfellow, Y. Bengio and A. Courville. Deep learning, MIT press, 2016. (available online)
- R.S. Sutton and A.G. Barto. Reinforcement learning, MIT press, 2018 (available online)

Evaluation scheme: The suggested grading scheme for this course will consist of:

- Assignments 15% One assignment every 2–3 weeks, which includes both analytical and numerical components.
- Final project 15% Each student will prepare an individual final project consisting of a written report and an oral presentation, to be given on the last day of class, on a topic relevant to the course.
- Midterm 30% The midterm exam will be a one hour written exam.
- Final exam 40% The final exam will be a three-hour exam, two hours of which will be a written exam and one hour will be a numerical lab component.

# ENGI 9818 Software Foundations

### Course Information Sheet

### Memorial University of Newfoundland

### 2021 Fall

Instructor Theodore Norvell, EN-3064 until Sept. 22 CSF-4117 after Sept. 22, 864-8962.

**Times** MWF 11:00–12:00. Lab: Monday 13:00–15:00 or possibly Thursday 11:00 to 13:00

- Location CSF-2112 when it is ready. Until then, Wednesday and Friday are in EN 4034. I don't know where we will be on Monday. If the lab is on Thursdays it will be in EN-3000/3029 until CSF-2112 is ready. First lab will be on Thusday Sept 9 at 11:00 in EN-3000/3029.
- **Office hours** Wednesday and Friday at 2:00 subject to change. In my office (see above). Appointments can be made for other times. You are welcome to knock on my office door anytime and if it's not a bad time, I'll be happy to talk.
- Mail For anything concerning the course, please use the Brightspace "Course Mail"; I am user "theo". For all other matters use regular email "theo@mun.ca" please send from your MUN email address.
- **TA** Ahmadi Mehrnaz (as far as I know)
- Web page http://www.engr.mun.ca/~theo/Courses/swf/ and for some things the Brightspace page.

# Description

Computer Software Foundations covers fundamental topics in computer software design and construction such as: design by contract, procedures, procedural abstraction and recursion; error handling; data structures, invariants, representation relations, and data abstraction; interfaces, inheritance of interface, inheritance of behaviour, inheritance of implementation, overriding, dynamic dispatch, and polymorphic code; simple patterns such as iterators; genericity; event-driven code; higher-order programming.

# Textbook

Barbara Liskov and John Guttag, Program Development in Java: Abstraction, Specification, and Object-Oriented Design Addison-Wesley Professional, 2000.

• This book is available only as an e-book or used.

# References

Cay Horstmann, Core Java(TM) 2, Volume I–Fundamentals, 11th ed., Prentice Hall PTR, 2020, or 9th ed., 2009. (9th edition available electronically from the library. See course web page.) What we really need is the 12 edition, but it is not yet published. The Java Language Specification, Java SE 16 Edition, online at https://docs.oracle.com/javase/specs/Bertrand Meyer, Object-Oriented Software Construction, 2nd ed., Prentice Hall, 1997.

# 1 Software

Java 16 or 17 JDK (or later)

Eclipse for Java Developers 2021-06 version. Or your favourite IDE. But it must support the Java 16 JDK.

 $\operatorname{Git}$ 

Optionally, SourceTree from Atlassian.

# Evaluation Scheme with *Tentative* Dates

Midterms	25%	Oct. 13 and Nov. 15
Assignments	25%	
Labs	10%	
Final	30%	TBA
Float	10%	(Better of midterms (combined) & final)

# **Other Information**

- If you are forced to isolate during the term, let me know. I will do my best to ensure that you can continue to participate.
- All the above is subject to change in case of a lock-down or other expected or unexpected crap.

- Late assignments and projects will not be accepted without prior arrangement or documented justification.
- Any complaints about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) <u>must</u> be brought to my attention <u>before</u> the exam.
- Academic dishonesty will, as a minimum, result in a mark of zero for the offending work. Academic dishonesty will be reported to the Associate Dean. Academic dishonesty includes copying from another student's work or allowing another student to copy from one's own work, consulting with any unauthorized person during an examination or test, using unauthorized aids, and presenting the ideas or works of another as one's own. If you have any doubt about whether something constitutes academic honesty, consult with the instructor. I am getting really freaking pissed off about cheating, so don't do it.
- Asking questions is strongly encouraged.
- Comments, suggestions and constructive criticisms are always welcome.



Course Outline ECE7410/ENGI9804

Faculty of Engineering and Applied Science Spring 2021

# **ECE7410/ENGI9804:** Image Processing and Applications

Instructor:	Stephen Czarnuch	<b>Teaching Assistants:</b>	Ali Ebrahimi
E-mail:	<u>sczarnuch@mun.ca</u>		
Phone:	864-7850	E-mail:	aebrahimi@mun.ca
Office Location:	IIC-3030		
Office Hours:	TBD		

### Website

The course content such as lecture notes and assignments are posted onD2L, which should appear in your course list at <u>http://online.mun.ca/</u>.

### Communication

Through lectures on Tuesday and Thursday from 9:00-10:15 and via MUN email (not D2L email). Changes to course information (e.g., cancelled classes) will be communicated via D2L and/or the MUN cancellation web page. I am also available outside office hours, but to guarantee my availability simply confirm an appointment by email first.

### CALENDAR ENTRY:

**Image Processing and Applications** presents fundamental theoretical and practical concepts of image processing and analysis. These concepts include image enhancement and filtering, frequency domain analysis, morphological image operations, image segmentation, and feature extraction. The course enables the use of these concepts to automatically process and analyze images and videos from various real-world applications such as biomedical imaging, visual surveillance, and robotics.

### CR: CS4756

LH: at least four 3-hour sessions per semester

### LAB EXPERIENCE: None.

CREDIT VALUE: 3 credit hours

**COURSE TYPE:** Compulsory

### **ACCREDITATION UNITS:**

Contact hours/week on average over 12 weeks (Lecture/Lab/Tutorial): 2.5/1/0

### **CONTENT CATEGORIES:** (expressed as %, no category can be 0 < c < 25)

		· • • •	1	
Math	Natural science	<b>Complementary Studies</b>	<b>Engineering Science</b>	Engineering Design
	50		50	

1

MEMORIAL UNIVERSITY	Course Outline ECE7410/ENGI9804	2
Faculty of Engineering and Applied Science	Spring 2021	

### **COURSE DESCRIPTION:**

SCHEDULE: LECTURE: Tue/Thur 9:00-10:15 Room: EN-1051

### **RESOURCES:**

Core Text Book

1. Gonzalez, R.C. and Woods, R.E., Digital Image Processing, 4th Edition, Pearson, 2017.

Recommended Text books:

- 1. Szeliski, R., Computer Vision: Algorithms and Applications, Springer-Verlag, 2011.
- 2. Forsyth, D. and Ponce, J., Computer Vision: A Modern Approach, Second Edition, Pearson, 2011.
- 3. Marques, O., Practical Image and Video Processing Using MATLAB, Wiley-IEEE Press, 2011.

Other sources:

1. Scholarly publications related to your selected project topic

### **MAJOR TOPICS:**

- Preliminaries
- Image formation
- Projective geometry and pinhole camera model
- Image enhancement and filtering
- Frequency domain analysis
- Morphological Image Operations
- Image Segmentation
- Recognition

### LEARNING OUTCOMES:

### Course Level Graduate Attribute Focus: KB.A, Inv.A, Des.A

### Upon successful completion of this course, the student will be able to:

	LEARNING OUTCOMES	GRADUATE ATTRIBUTES. LEVEL*	Methods of Assessment
1	Identify and distinguish the various techniques in the fields of	KB.A, Inv.D	Assignments, Labs, Quiz
	image processing and machine vision.		



### Course Outline ECE7410/ENGI9804

3

Faculty of Engineering and Applied Science

Spring 2021

2	Design, implement, and systematically test fundamental image processing methods/algorithms.	KB.A, Tools.D	Assignments, Labs, Quiz, Project
3	Choose appropriate image processing methods for image filtering, image reconstruction, and segmentation.	KB.A, Inv.A	Assignments, Project, Final Exam
4	Perform a critical assessment of different machine vision research approaches in terms of their merits and shortcomings in different applications.	KB.A, Inv.A, PA.D	Assignments, Project
5	Implement and test a machine vision system for an application.	Des.A	Project

\*Each Graduate Attribute for each learning outcome is rated at a Content Instructional Level of I=Introduced, D=Developed, or A=Applied.

See <u>www.mun.ca/engineering/undergrad/graduateattributes.pdf</u> for definitions on the 12 Graduate Attributes and the Content Instructional Levels.

### ASSESSMENT:

	Weight		Approximate date
	(Undergrad)	(Graduate)	
Assignments	10%	10%	-
Assignment 1	5%	5%	June 25
Assignment 2	5%	5%	July 10
Midterm	15%	15%	June 17
Labs	10%	10%	
Lab 1	-	-	June 11
Lab 2	-	-	July 2
Lab 3	-	-	July 16
Lab 4	-	-	July 30
Project	25%	40%	-
Project proposal	10%	0%	May 28
Technical content and working demo	60%	70%	August 3
Final report	30%	30%	August 6
Final exam	40%	25%	TBD

### ADDITIONAL INFORMATION:

**Assignments:** You will work individually on the course assignments and submit your completed assignments (via BrightSpace).

**Labs:** The labs are intended to serve as methodological procedures, so that you can independently work your way through an image processing problem, implement a solution, and discuss and interpret the results. You are expected to complete these labs and submit (via

MEMORIAL	Course Outline
UNIVERSITY	ECE7410/ENGI9804
Faculty of Engineering and Applied Science	Spring 2021

BrightSpace) a step-by-step output, including your code, input and output images, to show that you understand the impact of each image processing step.

**Project:** A major part of this course is the term project.

Undergraduate student project: Undergraduate students will work <u>in pairs</u>, and both members will receive the same mark. You will define an image processing project of your choice. The project MUST:

- Address a realistic application of image processing
- Utilize <u>at least</u> four fundamental image processing approaches covered in this course
- Include a clear justification for, and explanation of, the parameters and approaches chosen
- Not include an implementation of more advanced computer vision techniques

*Graduate student project:* Undergraduate students will work <u>individually</u>. You will define an image processing project of your choice. The project MUST:

- Be an implementation of a recent (2015+) image processing publication that processed a public image dataset, ideally related to your program of study
- Utilize <u>at least</u> *two* fundamental image processing approaches covered in this course as significant steps in the methodology
- Include a clear explanation of the parameters and approaches chosen
- Include an evaluation of the approach on the public dataset, showing you have replicated the implementation and achieve the same results
- <u>Not</u> include a significant implementation of more advanced computer vision techniques

*Project proposal:* Proposals must include the following:

- 1. A one-line problem statement
- 2. A description of the proposed image processing application, including the major image processing techniques and a summary of the methodology
- 3. A concise summary of relevant work you may use for your project

### LAB SAFETY:

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steeltoed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

### ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level

MEMORIAL	Course Outline ECE7410/ENGI9804
Faculty of Engineering and Applied Science	Spring 2021

of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at <u>http://www.mun.ca/engineering/undergrad/academicintegrity.php</u> and Memorial University's Code of Student Conduct at <u>http://www.mun.ca/student/conduct/</u>.

### **INCLUSION AND EQUITY:**

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, <u>http://www.mun.ca/blundon/about/index.php</u>. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

**STUDENT ASSISTANCE:** Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.

### **MISCELLANEOUS NOTES:**

- Submitted materials are due by 11:59pm on the due date. Late materials will not be accepted without prior arrangement or documented justification.
- Any complaints about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) must be brought to my attention before the final report deadline.
- Academic dishonesty will, as a minimum result in a grade of zero for the offending work, and may be reported to the Dean for treatment through the prescribed formal process. Academic dishonesty includes copying, allowing your work to be copied, and failing to cite sources. Refer to the relevant information available through Memorial University.
- Questions related to the course are strongly encouraged.
- Constructive comments, suggestions and criticisms are always welcome.

TBA TBA



Course Outline ENGI 8814/9805

Faculty of Engineering and Applied Science

Winter 2020

# **ENGINEERING 8814/9805: Computer Vision**

Instructor	Ebrahim Karami	Teaching Assistant
E-mail	<u>ekarami@mun.ca</u>	E-mail
Phone	864-6412	
Office Location	EN3052	
Office Hours	Mon. & Fri. 11:00-12:00	

### Website

The course content such as lecture notes and assignments are posted on D2L, which should appear in your course list at <u>http://online.mun.ca/</u>.

#### Communication

Through lectures on Monday, Wednesday, and Friday from 10:00:10:50 and via MUN email (not D2L email). Changes to course information (e.g., cancelled classes) will be communicated via D2L and/or the MUN cancellation web page. I am also available outside office hours, but to guarantee my availability, simply confirm an appointment by email first.

#### CALENDAR ENTRY:

This course will discuss special topics in computer vision and introduce some fundamental approaches in theory as well as discuss current state of the art research. Topics include feature detection and matching; camera model and calibration; pose estimation; structure from motion; stereovision; target detection and tracking; and advanced topics in deep neural networks. **LAB EXPERIENCE:** None.

**CREDIT VALUE:** 3 credit hours

**COURSE TYPE:** Compulsory

#### **ACCREDITATION UNITS:**

Contact hours/week on average over 12 weeks (Lecture/Lab/Tutorial): 2.5/1/0

#### **CONTENT CATEGORIES:** (expressed as %, no category can be 0 < c < 25)

Math	Natural science	<b>Complementary Studies</b>	Engineering Science	Engineering Design
	50		50	

COURSE DESCRIPTION:		
SCHEDULE:	LECTURE:	MWF 10:00-10:50 Room: EN-2040
	LAB:	M 17:00-19:00 Room: EN-3000

**RESOURCES:** 



Course Outline ENGI 8814/9805

Faculty of Engineering and Applied Science

Winter 2020

### Text Book

There are no required text books. All material are available from the course slides. However, the suggested text books for the course are:

- 1. <u>Computer Vision: Algorithms and Applications</u> by Richard Szeliski (available for free on author's page)
- 2. <u>Computer Vision: A Modern Approach</u> by David Forsyth and Jean Ponce
- 3. <u>Deep Learning</u> by Ian Goodfellow, Yoshua Bengio and Aaron Courville (available for free online)

Other sources:

1. Scholarly publications related to your selected project topic

### **MAJOR TOPICS:**

- Preliminaries
- Feature detection and matching
- Geometric and multi-vision
- Feature based alignment
- Structure from motion
- Segmentation and tracking
- Deep Learning
- SLAM

### LEARNING OUTCOMES:

Course Level Graduate Attribute Focus: KB.A, Inv.A, Des.A

### Upon successful completion of this course, the student will be able to:

	LEARNING OUTCOMES	GRADUATE ATTRIBUTES. LEVEL*	Methods of Assessment
1	Identify and distinguish the various techniques in the fields of image processing and machine vision.	KB.A, Inv.D	Assignments, Labs, Quiz
2	Design, implement, and systematically test fundamental image processing methods/algorithms.	KB.A, Tools.D	Assignments, Labs, Quiz, Project
3	Choose appropriate image processing methods for image filtering, image reconstruction, and segmentation.	KB.A, Inv.A	Assignments, Project, Final Exam
4	Perform a critical assessment of different machine vision research approaches in terms of their merits and shortcomings in different applications.	KB.A, Inv.A, PA.D	Assignments, Project
5	Implement and test a machine vision system for an application.	Des.A	Project

\*Each Graduate Attribute for each learning outcome is rated at a Content Instructional Level of I=Introduced, D=Developed, or A=Applied.

A manager income a data



**Faculty of Engineering and Applied Science** 

# Course Outline ENGI 8814/9805

14/0:064

Winter 2020

See <u>www.mun.ca/engineering/undergrad/graduateattributes.pdf</u> for definitions on the 12 Graduate Attributes and the Content Instructional Levels.

### ASSESSMENT:

	weight		Approximate date
	(Undergrad)	(Graduate)	
Assignments	10%	5%	-
Assignment 1	2.5%	1.25%	February 4
Assignment 2	2.5%	1.25%	February 14
Assignment 3	2.5%	1.25%	March 6
Assignment 4	2.5%	1.25%	March 20
Midterm	15%	15%	February 28
Labs	10%	5%	
Lab 1	2.5%	1.25%	February 3
Lab 2	2.5%	1.25%	February 24
Lab 3	2.5%	1.25%	March 9
Lab 4	2.5%	1.25%	March 23
Project	25%	35%	-
Project proposal	5% (1.25%)	5% (1.75%)	February 3
Technical content and working demo	60% (15%)	60% (21%)	March 20
Oral presentation	10% (2.5%)	10% (3.5%)	March 23
Final report	25% (5%)	25% (7%)	March 23
Final exam	40%	40%	-

### Lecture Capture:

All classes for this course, unless otherwise notified, will be recorded.

Comments and questions by those present in the class may be captured in the audio of the recording.

Additionally, student presentations/participation may be captured on video.

Questions or concerns about the use of lecture capture in this course should be directed to your instructor.

### ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at <a href="http://www.mun.ca/engineering/undergrad/academicintegrity.php">http://www.mun.ca/engineering/undergrad/academicintegrity.php</a>

Students are encouraged to consult the Faculty of Engineering and Applied Science Student

	Cot
MEMORIAL	EN
UNIVERSITY	****
Faculty of Engineering and Applied Science	W11

Code of Conduct at <u>http://www.mun.ca/engineering/undergrad/academicintegrity.php</u> and Memorial University's Code of Student Conduct at <u>http://www.mun.ca/student/conduct/</u>.

### INCLUSION AND EQUITY:

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, <u>http://www.mun.ca/blundon/about/index.php</u>. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

**STUDENT ASSISTANCE:** Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.

### ADDITIONAL INFORMATION:

**Team Project:** A major part of this course is the term project. Carefully read the following points with respect to the project:

- Projects will be undertaken by teams of no more than two students.
- Teams can define their own projects.
- Teams must have an operational machine vision system that can be demonstrated to the class during the demonstrations.
- Undergraduate students should target a realistic application of machine vision.
- Graduate students projects should reflect a higher level of sophistication and should be based on the implementation of techniques or algorithms presented in a journal publication.
- All team members receive the same mark for all components of project.
- Project proposal are due on February 3rd and must include the following:
  - 1. A problem statement.
  - 2. A description of the proposed machine vision system. What useful purpose or function will your system serve?
  - 3. A description of the software tools and hardware (if applicable) that will be used.
  - 4. The deliverables what will your team demonstrate to the class at the end of the term.
  - 5. Pertinent references and/or a brief state-of-the-art survey of comparable systems



• Project progress meeting is scheduled on March 2<sup>nd</sup> and during that meeting groups will present a two-page report.

### MISCELLANEOUS NOTES:

- Submitted materials are due by 11:59pm on the due date. Late materials will not be accepted without prior arrangement or documented justification.
- Any complaints about marks, addition, recording etc., or special circumstances (e.g., illness, bereavement) must be brought to my attention before the final report deadline.
- Academic dishonesty will, as a minimum result in a grade of zero for the offending work, and may be reported to the Dean for treatment through the prescribed formal process. Academic dishonesty includes copying, allowing your work to be copied, and failing to cite sources. Refer to the relevant information available through Memorial University.
- Questions related to the course are strongly encouraged.
- Constructive comments, suggestions and criticisms are always welcome.



# Course Outline ENGI 9821

Dept. Electrical & Computer Engineering

Semester

### Engi 9821: Digital Signal Processing

Instructor:TBAE-mailTBA@mun.caOffice HoursTBAWebsiteBrightspace course shellPreferred methods of communication: TBA

### Teaching Assistant: TBA

**Course Objectives:** To build upon foundational knowledge of basic discrete-time signals and systems and digital signal processing (DSP); to extend this foundational knowledge to the study of DSP methods and applications; to investigate the application of DSP across fields in engineering and science, with a more in-depth investigation of one topic or application via a design project.

**Level of course:** Students are expected to be self-motivated and responsible for their learning, as is usual in a graduate course. Students are expected to keep up with class work and deliverables, to participate in discussions with the class and with the instructor, and to select and investigate a topic in digital signal processing through an individual research project to be conducted at a graduate level of inquiry and performance. Also see Assumed Background next.

**Prerequisites:** ENGI 7600 (formerly ENGI 7824) at MUN.

**Alternatively, Assumed Background:** Students are expected to have taken undergraduate course(s) on continuous-time and discrete-time systems and signals and the sampling theorem at the level of a text such as B.P. Lathi, *Linear Systems and Signals*, 2<sup>nd</sup> edition, Oxford University Press, 2005, or A.V. Oppenheim, A.S. Willsky and B.H. Nawab, *Signals and Systems*, 2<sup>nd</sup> edition, Prentice-Hall, 1997.

Schedule: Specific to semester

Credit Value: 3 credits

[Required Resources] Text: A.V. Oppenheim and R.W. Schafer, *Discrete-time Signal Processing*, Third edition, Prentice-Hall, 2010, ISBN 0-13-198842-5

[Required Resources] Software: MATLAB to analyze and design DSP systems.

### **Major Topics:**

Engi 9821 is layered lecture-wise with ECE 8600 (Design of DSP Systems). Its course material will address the following topics:

- 1. Introduction to Digital Signal Processing (DSP). Review of background (as in ECE 7600) including discrete-time (DT) systems and signals in the time (n), Fourier ( $\omega$ ) and z-transform domains, and their key properties for use in DSP analysis and design
- 2. DSP as the discrete-time (DT) processing of continuous-time (CT) signals via sampling

 MEMORIAL
 Course Outline

 UNIVERSITY
 ENGI 9821

 Dept. Electrical & Computer Engineering
 Semester

- 3. Computable transforms, i.e. the Discrete Fourier Transform (DFT) and the Fast Fourier Transform (FFT)
- 4. Fourier analysis of DT signals (and of CT signals via sampling)
- 5. Transform analysis of linear, time-invariant (LTI) systems, for use in filter design
- 6. Finite impulse response (FIR) filter design
- 7. Infinite impulse response (IIR) filter Design
- 8. Practical issues in the design and implementation of DSP systems
- 9. Examples of the above topics in selected applications of DSP throughout the course.

Assessment:			
Deliverable	Val	ue (Due) I	Date
Review Assign	4%	TBD	
Design Assignment	8%	TBD	
Design project (see break-down below)		6	
Proposal	4%	TBD	
Final report	14%	TBD	
Presentation	3%	TBD	
Presentation Oral	3%	TBD	
Problem Sets (see note below)			
Mid-term Test 1	149	6 TBD	
Mid-term Test 2	149	6 TBD	
Final Exam	36%	6 TBD	
Total	100	%	

### Notes for specific offering of this course, e.g.:

Note on Format: Note on Course Materials on Brightspace: Note about Problem Sets: Note about Review Assignment: Note about 9821 Design Assignment: Note about the 9821 Design Project:

### Engi 9821 Policy on Extensions and Deferrals: Specific to offering

### Some Reference Texts:

### **On Discrete-time Systems and Signals**

- 1. B.P. Lathi, *Linear Systems and Signals*, 2<sup>nd</sup> edition, Oxford University Press, 2005.
- A.V. Oppenheim, A.S. Willsky & B.H. Nawab, *Signals and Systems*, 2<sup>nd</sup> ed., Prentice-Hall, 1997.

### On DSP

- 3. Richard Lyons, *Understanding Digital Signal Processing*, 3<sup>rd</sup> ed., Prentice-Hall, 2011.
- 4. D.G. Manolakis and V.K. Ingle, *Applied Digital Signal Processing: Theory and Practice*, Cambridge University Press, 2011.
- 5. S.K. Mitra, *Digital Signal Processing: A Computer-based Approach*, 4<sup>th</sup> ed., McGraw-Hill, 2011 (or 3<sup>rd</sup> ed. 2006, or 2<sup>nd</sup> ed. 2001).

MEMORIAL UNIVERSITY

Course Outline ENGI 9821

Dept. Electrical & Computer Engineering

- Semester
- 6. J.G. Proakis and D.G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 4th ed., Macmillan, 2007 (or 3<sup>rd</sup> ed. 1996).
- 7. M.H. Hayes, *Digital Signal Processing*, 2<sup>nd</sup> ed. McGraw-Hill (Schaum's Outlines), 2012. *On Matlab for DSP:*
- 8. J.H. McClellan, R.W. Schafer and M.A. Yoder, DSP First, 2<sup>nd</sup> ed., Pearson, 2016.
- 9. V.K. Ingle and J.G. Proakis, *Digital Signal Processing using Matlab: A Problem Solving Companion*, 4<sup>th</sup> ed., Cengage Learning, 2017.

### Rules and Regulations (to be updated for each offering based on MUN policies):

Academic Integrity and Professional Conduct: Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at <a href="https://www.engr.mun.ca/undergrad/academicintegrity">www.engr.mun.ca/undergrad/academicintegrity</a>.

**The Memorial University of Newfoundland Code:** "All members of the Memorial University of Newfoundland Community, which includes students, faculty, and staff, shall treat others with respect and fairness, be responsible and honest, and uphold the highest standards of academic integrity." (http://www.mun.ca/regoff/calendar/sectionNo=GENINFO-1502)

**Faculty of Engineering Student Code of Conduct:** "Like Professional Engineers, engineering students are expected to behave in a professional manner at all times. Students are encouraged to conduct themselves in a manner consistent with the <u>PEG-NL Code of Ethics</u>." Read more at <u>http://www.engr.mun.ca/policies/codeofconduct.php</u>

**Safety:** Students are expected to demonstrate awareness of, and personal accountability for, safe conduct within the classroom and building. Take note of emergency exits. Students will immediately report any concerns regarding safety to the teaching assistant and/or professor.

**Inclusion and Equity:** Students who require physical or academic accommodations are encouraged to speak privately to the instructor so that appropriate arrangements can be made to ensure your full participation in the course. All conversations will remain confidential.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

**Student Assistance:** Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.



Course Outline

Faculty of Engineering and AppliedScience

ENGI 9826 Winter 2020-2021

# **ENGINEERING 9826: Advanced Control Systems**

InstructorDr. Siu O'YoungE-mailoyoung@mun.caPhone864-8345Office LocationEN-3074Office Hours10:00 - 2:00pm Wednesday

PREFERRED METHOD OF CONTACT: email

### SCHEDULE: MWF 12:00 – 12:50 noon (concurrent with 7200) and W: 4:00-5:40pm (9826 specific)

### **RATIONALE:**

This is an introductory graduate level course aimed at exposing a novice to different theoretical areas in systems and controls. It will review both classical controls and modern controls and introduce optimal control for continuous-time dynamical systems, and discrete-event systems built upon automata theory. The course will also give a unified view of continuous-time dynamical systems and discrete-event systems as hybrid systems.

### **REFERENCES:**

- Luenberger, D.C., Introduction to Dynamical Systems, Wiley, 1979
- Nise, N. S., Control Systems Engineering, 7th Ed., Wiley, 2015
- Ogata, K., *Modern Control Engineering*, 5<sup>th</sup> Ed., Prentice Hall, 2009
- Williams, R. L. and D. A. Lawrence, Linear State-Space Control Systems, Wiley, 2007
- Belegundu, A.D. and T.R. Chandrupatla, *Optimization Concepts and Applications in Engineering*, Prentice-Hall, 1999
- Hopcroft, J.E. and J.D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3<sup>rd</sup> Ed., Pearson, 2006
- Cassandras, C.G. and S. Lafortune, *Introduction to Discrete-Event Systems*, 2<sup>nd</sup> Ed., Springer, 2009
- Polderman, J.C. and J.C. Willems, *Introduction to Mathematical Systems Theory: A Behavioral Approach*, Springer, 1998

### **MAJOR TOPICS:**

- Dynamical Systems and Representations
- Classical Control Systems in Frequency Domain
- Modern Control Systems in Time Domain
- Optimal Control
- Behavioral Systems
- Discrete-Event Systems
- Hybrid Systems



ENGI 9826 Winter 2020-2021

Faculty of Engineering and AppliedScience

### ASSESSMENTS:

- Assignments (20%)
- Midterm (20%)
- Project Presentation (15%)
- Final Project (45%)

### LAB SAFETY:

Students are expected to demonstrate awareness of, and personal accountability for, safe laboratory conduct. Appropriate personal protective equipment (PPE) must be worn (e.g. steel-toed shoes, safety glasses, etc.) and safe work practices must be followed as indicated for individual laboratories, materials and equipment. Students will immediately report any concerns regarding safety to the teaching assistant, staff technologist, and professor.

### ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at <a href="http://www.mun.ca/engineering/undergrad/academicintegrity.php">http://www.mun.ca/engineering/undergrad/academicintegrity.php</a>

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at <u>http://www.engr.mun.ca/policies/codeofconduct.php</u> and Memorial University's Code of Student Conduct At <u>http://www.mun.ca/student/home/conduct.php</u>.

### **INCLUSION AND EQUITY:**

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, <u>http://www.mun.ca/blundon/about/index.php</u>. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

### STUDENT ASSISTANCE:

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at <u>www.mun.ca/student</u>.