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, March 1, 2017, (rescheduled from February 15) at 1 p.m. in C-2045.

AGENDA (Revised)

1. **Regrets**

2. **Adoption of the Minutes of January 18, 2017**

3. **Business Arising from the Minutes:**   None

4. **Correspondence:**   None

5. **Reports of Standing Committees:**
   A. **Undergraduate Studies Committee:**   None
   B. **Graduate Studies Committee:**
      a. Interdisciplinary Programs, new Graduate program proposal, PhD in Scientific Computing, paper 5.B.a (53 pages).
      b. Department of Mathematics and Statistics, special topics course, MATH 6261, Geometric Numerical Integration, already approved by the committee and presented to Faculty Council for information only, paper 5.B.b. (5 pages).
      c. Department of Psychology, Calendar changes, Psy.D. Program, paper 5.B.c. (5 pages).
   C. **Nominating Committee:**   None
   D. **Library Committee:**   None

6. **Reports of Chair in Teaching & Learning and Teaching Consultant**

7. **Reports of Delegates from Other Councils**

8. **Yaffle Presentation - Jennifer Adams, Office of Public Engagement**

9. **Report of the Dean**

10. **Question Period**

11. **Adjournment**

Mary L. Courage, Ph.D.
Interim Dean of Science

FACULTY OF SCIENCE
FACULTY COUNCIL OF SCIENCE
MINUTES OF MEETING OF JANUARY 18, 2017

A meeting of the Faculty Council of the Faculty of Science was held on Wednesday, January 18, 2017, at 1:00 p.m. in room C-2045.

FSC 2488   **Present**
Biochemistry
Berry, M.   Mulligan, M.

Biology
Jones, I.   Purchase, C.   Staveley, B.

Chemistry
Fridgen, T.   Kerton, F.   Kozak, C.

Computer Science
Shieh, J.

Mathematics & Statistics
Loredo-Osti, J.C.   Radford, C.   Sullivan, S.

Ocean Sciences
Fletcher, G.

Physics & Physical Oceanography
Curnoe, S.   Munroe, J.

Psychology
Neath, I.   Thorpe, C.

Dean of Science Office
Courage, M.   Foss, K.   Foster, A.   Harding, S.   Mackenzie, T.
Meruvia-Pastor, O.   Rideout, J.   Todd, A.   Zedel, L.

Geography
Edinger, E.

Library
Ambi, A.

Faculty of Business
Clift, T.

School of Graduate Studies
Farquharson, D.

Graduate Students
Alloway, H.

Undergraduate Students
Lacey, K.

FSC 2489   **Regrets**
Karen Dobbin-Williams   Collins Onodenalore
Rebecca Matthews   Edward Kendall
Kris Poduska   Xili Duan

FSC 2490   **Adoption of Minutes**
Moved: Minutes of the December 7, 2016, meeting be adopted (Sullivan/Loredo-Osti). **Carried.**

FSC 2491   **Business Arising:**   None

FSC 2492   **Correspondence:**   None

FSC 2493   **Reports of Standing Committees:**

A.   **Undergraduate Studies Committee:**
Report presented by Shannon Sullivan, Chair, Undergraduate Studies Committee
Although there were no items for approval there were several updates provided:
a. All items approved at the December meeting of Faculty Council have been approved by the Senate Committee on Undergraduate Studies (SCUGS) and will now move along to be approved by Senate.
b. SCUGS also approved changes in the Faculty of Humanities and Social Sciences for English courses offerings. First year English courses are being replaced with reformatted offerings. Programs within the Faculty of Science that require English courses will automatically be updated in the calendar with the new English course numbers and descriptions.
c. There are two projects underway within the Faculty of Science Undergraduate Studies Committee. One is to identify the critical reading and writing requirements to replace the current English course requirements in the BSc programs. A proposal should be available in the near future. A second project is a revision of the general

regulations for the Faculty of Science. Departments will receive a draft in the near future for their comments and suggestions.
  - **d.** Departments are reminded to begin work on calendar changes for the 2018/19 academic calendar.
- **B.** **Graduate Studies Committee:**
  Report presented by J.C. Loredo-Osti, Chair, Graduate Studies Committee
  - **a.** **Moved:** Department of Chemistry, calendar changes (Loredo-Osti/Fridgen). **Carried.**
- **C.** **Nominating Committee:** None
- **D.** **Library Committee:** None

FSC 2494   **Reports of Chair in Teaching & Learning and Embedded DELTS Teaching Consultant:**
Report presented by Amy Todd, Embedded Teaching Consultant

The awards process and Teaching and Learning Fund cycle will begin soon. The call for President's Award nominations will be out in February. Also, information about the Dean's Awards will be circulated shortly. Departments are urged to nominate deserving people for these awards.

FSC 2495   **Reports of Delegates from Other Councils:**   None

FSC 2496   **Presentation by Gordon Deveau (NSERC) and Paula Clark (RDC):**
Presentation was cancelled due to illness.

FSC 2497   **Report of the Dean**
Presented by Mary Courage, Interim Dean.

Mark Abrahams mentioned at a previous council meeting that Mary Wall was to receive a President's Award for Distinguished Service and offered her our sincere congratulations. The Interim Dean also acknowledged several other recipients of President's Awards and offered them congratulations as well. These are:

Danny Dyer, Mathematics & Statistics – Distinguished Teaching Award
Brent Snook, Psychology – Outstanding Graduate and Postgraduate Supervision
Chris Rowley, Chemistry – President's Award for Outstanding Research

The time has come to submit nominations for the Dean of Science Awards: Distinguished Scholar, Distinguished Service, and Distinguished Teacher. Andy Foster, Associate Dean (Undergraduate and Administration) has emailed out the terms of reference and application procedures. Please identify faculty and staff in your respective departments who would be competitive for these awards. Faculty Awards are helpful when these individuals are nominated for President's awards and other parallel national Awards.

FSC 2498   **Question Period**
Several items were discussed:

An enquiry was made about whether there were any updates about the new science building. The Interim Dean confirmed there was not but that a committee meeting was scheduled for later this week. Mark Abrahams, now Associate Vice-President (Research) *pro tempore*, will continue to sit on the committee and Mary Courage, Interim Dean, will also sit on the committee as an observer.

There was considerable discussion about the options that might be presented by FSCUGS regarding changes in English offerings for the Faculty of Science. One concern is that requiring first year students to take an English course limits their ability to take an extra Science course. An English course formatted specifically for Science students is being considered. Options will be shared with departments before final decisions are made.

There will be a meeting concerning the scheduling of final exams, prompted by the recent exam period in the Fall semester that was disrupted due to bad weather. Several large enrollment courses were scheduled near the end of the exam session resulting in the nearly impossible task of marking a large volume of exams in a very short time period. Many students had to defer exams to the beginning of the Winter semester causing difficulty for both students and faculty. It was stressed that other faculty should attend this meeting to lobby for large enrolment courses to have their final exams scheduled at the beginning of the exam period.

Another issue relating to rescheduled exams occurred in the previous academic year when students had to vacate residence by a particular date and therefore had to write their exam at an alternate location and were required to pay an invigilation fee. This situation was not created by the students and, therefore, they shouldn't have been burdened with this fee.

These scheduling issues will be discussed further at the next Department Heads meeting.

FSC 2499   **Adjournment**
The meeting adjourned at 1:33 p.m.

Kenny, Gail

From:	JC Loredo-Osti <jcloredoosti@mun.ca>
Sent:	January-27-17 3:48 PM
To:	Kenny, Gail
Subject:	Re: Proposal for a PhD in Scientific Computing at MUN

Hi Gail,

the proposal was already approved in principle in our last meeting.
However, some minor editing was requested. Thus it would be nice if the committee members see the final document.
Can you, please, circulate the document amongst the committee members, stating that the proposal has already been
approved? Thank you in advance, -j

On 01/27/2017 02:55 PM, Kenny, Gail wrote:
> Hi JC,
>
> Has this proposal been approved by the committee? I need confirmation for the FCFS agenda. Thank you.
>
> Gail
>
> -----Original Message-----
> From: JC Loredo-Osti [mailto:jcloredoosti@mun.ca]
> Sent: December-21-16 12:10 PM
> To: Brian E. Staveley <bestave@mun.ca>; Christina Bottaro
> <cbottaro@mun.ca>; JC Loredo-Osti <jcloredoosti@mun.ca>; Kenny, Gail
> <gkenny@mun.ca>; Len Zedel <zedel@mun.ca>; Ron Haynes
> <rhaynes@mun.ca>; Rob Bertolo <rbertolo@mun.ca>; Ivan Booth
> <ibooth@mun.ca>; Stephanie H. Curnoe <curnoe@mun.ca>; Cyr Couturier
> <Cyr.Couturier@mi.mun.ca>; Carolyn Walsh <cwalsh@play.psych.mun.ca>;
> Tom Chapman <tomc@mun.ca>; Courage, Mary <mcourage@mun.ca>; Yuanzhu
> Chen <yzchen@mun.ca>; Alison Malcolm <amalcolm@mun.ca>; A. Kurt
> Gamperl <kgamperl@mun.ca>
> Subject: Fwd: Proposal for a PhD in Scientific Computing at MUN
>
> Hello All,
>
> attached is the proposal for a new Ph.D. programme in scientific computing. The approval of this proposal will be an
item in the agenda for an early in January 2017 meeting of this committee.
>
> Happy holidays,
> -j
>
>
>
> -------- Forwarded Message --------
> Subject: Proposal for a PhD in Scientific Computing at MUN
> Date: Wed, 21 Dec 2016 11:52:39 -0330
> From: Ronald Haynes <rhaynes74@gmail.com>

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MEMORIAL UNIVERSITY

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January 24, 2017

Dr. Mary Courage
Interim Dean of Science
Memorial University of Newfoundland

Dear Dr. Courage:

Attached is a proposal to expand the existing interdisciplinary MSc graduate program in Scientific Computing by creating a new interdisciplinary PhD program in Scientific Computing. The proposal has been through the Faculty of Science Faculty Council Graduate Studies Committee for input and approval and we've made some changes based on that exercise. We would now like it to go forward to Faculty Council for approval.

The proposal has been formulated in consultation with the Board of Study of the current MSc program: Drs. Valerie Booth (Biochemistry), Colin Farquharson (Earth Sciences), Ronald Haynes (Mathematics and Statistics), Ting Hu (Computer Science), Faisal Irshad Khan (Engineering), Scott MacLachlan (Mathematics and Statistics), Christopher Rowley (Chemistry), Ivan Saika-Voivod (Physics and Physical Oceanography). There are minimal resource implications associated with this expansion. Nonetheless, as required, the Head of Library Collections was contacted during the fall of 2015 for their evaluation.

During the fall of 2016, the proposal was sent for collegial consultation within the institution and to some experts across the country. A complete record of that consultation and our response is included in Appendix D of the proposal.

Scientific Computing is a truly interdisciplinary field, which complements the more traditional avenues of the scientific process: theory and experiment. It involves the use of computer hardware, software and algorithms to explore and understand complex problems from science and engineering. Mathematical descriptions of physical, social or economic situations are implemented on a computer. The resulting computational tool allows an improved understanding of the problem.
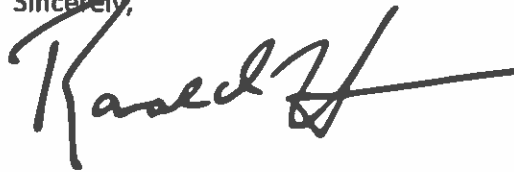
-2-

The program is designed to produce effective researchers in scientific computing and within the application area of interest. The program's courses are designed to ensure advanced understanding of   core scientific computing principles. The flexibility inherent in these course requirements allows students to choose courses from existing offerings in participating departments. A given student's specific program   of study will be tailored by their supervisory committee to meet their needs, ensuring both breadth and an ability to focus on original research culminating in a thesis of publishable quality. The PhD program will   target a four-year completion time. A part-time option will be available.

The program is designed with the understanding that graduates in scientific computing may be employed   in a wide variety of sectors, including private industry, government, and academia.

During the fall of 2016 the Dean of the School of Graduate Studies declared that because this new PhD program is seen as an expansion of the existing MSc program in Scientific Computing, only an internal review will be necessary. The board of study looks forward to this upcoming review process.

Sincerely,

Ronald Haynes, Chair
Scientific Computing Program

New Graduate Program Proposal
Memorial University of Newfoundland

Name of proposed program: PhD in Scientific Computing

Degree name and short form (e.g., Master of Arts (MA)): Doctor of Philosophy (PhD)

Academic unit(s) offering the program: Faculty of Science, Faculty of Engineering, Faculty of Medicine

Administrative home of program (if different from above): Faculty of Science

Proponent name: Dr. Ronald D. Haynes, Chair of Scientific Computing M.Sc. program

Proponent email: rhaynes@mun.ca

Date: December 10, 2016

Anticipated start of new program (semester and year): Fall 2017 or Winter 2018

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1. Executive summary

This is a proposal to expand the existing interdisciplinary MSc graduate program in Scientific Computing by creating a new interdisciplinary PhD program in Scientific Computing. It has been formulated in consultation with the Board of Study of the current MSc program: Drs. Valerie Booth (Biochemistry), Colin Farquharson (Earth Sciences), Ronald Haynes (Mathematics and Statistics), Ting Hu (Computer Science), Faisal Irshad Khan (Engineering), Scott MacLachlan (Mathematics and Statistics), Christopher Rowley (Chemistry), Ivan Saika Voivod (Physics and Physical Oceanography). There are minimal resource implications associated with this expansion nonetheless, as required, the Head of Library Collections was contacted during the fall of 2015 for their evaluation.

Scientific Computing is a truly interdisciplinary field, which complements the more traditional avenues of the scientific process: theory and experiment. It involves the use of computer hardware, software and algorithms to explore and understand complex problems from science and engineering. Mathematical descriptions of physical, social or economic situations are implemented on a computer. The resulting computational tool allows an improved understanding of the problem.

Students enrolled in the PhD program will be assimilated (in terms of space, TAships, etc.) into the department of their primary supervisor – this department will be known as their *home department*.

The program is designed to produce effective researchers in scientific computing and within the application area of interest. The program's courses are designed to ensure advanced understanding of core scientific computing principles. The flexibility inherent in these course requirements allows students to choose courses from existing offerings in participating departments. A given student's specific program of study will be tailored by their supervisory committee to meet their needs, ensuring both breadth and an ability to focus on original research culminating in a thesis of publishable quality. The PhD program will target a four-year completion time. A part-time option will be available.

The program is designed with the understanding that graduates in scientific computing may be employed in a wide variety of sectors, including private industry, government, and academia.

Our forecasted enrolment is modest – it assumes that fewer than half of the faculty who have been actively involved in the existing MSc program over the last 5 years will supervise only 1 student in the program. These numbers allow the program to break even financially from year 0.

2. Program description

Degree name: PhD, Doctor of Philosophy

Academic Units Involved

Biochemistry Department
Chemistry Department
Computer Science Department
Earth Sciences Department
Mathematics and Statistics Department
Ocean Sciences Department
Physics and Physical Oceanography
Department Faculty of Engineering
Faculty of Medicine

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Intended Learning Outcomes

This program will extend our graduate training in scientific computing to the doctoral level, allowing us to offer the highest levels of research and training in the field. Students graduating from this program will be qualified for jobs that integrate computer technology with the physical world. Courses will include scientific programming, numerical analysis, big data analytics, and computer simulations. A PhD level training in scientific computing will prepare students for next-generation careers in academia and industry, with practical skills in the implementation of advanced computer models, analysis of large data sets, and the development of new methods of analysis. This program will include a combination of discipline-specific and general scientific computing training.

Admission Requirements

Normally, students entering the PhD program in Scientific Computing will have an MSc degree from an institution recognized by the Senate. Students in the Master of Science (Scientific Computing) program may request a transfer to the PhD program after a minimum of 12 months in their program of studies. Final decision for transfer from the MSc program to the PhD program rests with the Dean of the School of Graduate Studies. All admission routes are detailed in Section 6.

Program Requirements

Students completing a scientific computing PhD will be required to complete courses, a comprehensive examination, a seminar, and a thesis. The exact number and nature of required courses will be decided at the time of admission (see Section 7 below), and will be based on the student's background and proposed research area. These courses will be specified in the student's program of study form.

The comprehensive examination will typically be completed upon completion of all course work, no later than the seventh semester of the student's program. The candidate is required to prepare a paper on the theoretical background of his or her project. The examination will cover material related to this paper as well as fundamental topics in scientific computing.

Candidates will also be required to prepare and present a public seminar on the subject of his/her thesis as part of the thesis defense. The thesis is expected to be an original and substantial contribution to research in the areas of scientific computing and the sciences.

The duration of the program will typically be 4 years. It will be available on a full-time or part-time basis. The program will primarily be delivered on the St. John's campus of Memorial University. Courses will be offered by faculty in the participating sub-disciplines. Students will generally be hosted in the home department of the thesis advisor. Supervisory committees, examinations, seminars, and other program meetings will be scheduled as needed.

3. Statement of justification

Scientific computing is a rapidly growing multidisciplinary field of research, focused around using modern computer architectures and algorithms to simulate and solve problems across the range of natural sciences and engineering (and, in recent years, expanding to address data challenges in the humanities and social sciences). While scientific computing and the broader research areas of mathematical modelling, applied mathematics, and algorithm design and analysis have long been established as academic sub-disciplines in their own right, the past two decades have seen tremendous growth in industrial use of tools based in scientific computing. The aerospace, automotive, shipbuilding,

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geophysical, and financial industries, to name just a few, are now wholly reliant on these tools for their operations. To both build on existing strengths in the resources sector and diversify its economy, Newfoundland and Labrador would be well-served by having a program of advanced training in scientific computing, as proposed here.

3.1 Academic Rationale

Since the late 1990s, MUN has had a successful interdisciplinary MSc program in scientific computing, which has graduated approximately 40 students with completed theses. Supervisors for these students come from across the engineering and science departments, showing wide faculty interest in research topics in this area. Indeed, over 60 faculty members from the Faculties of Science, Engineering and Applied Science, and Medicine are currently affiliated with this program. A number of these faculty are recent hires, showing growing interest and capability in this area.

Two primary models exist for graduate training programs in scientific computing. When interest in scientific computing comes primarily from a single discipline (often the Mathematical Sciences or Computer Science), disciplinary graduate degrees are typically awarded, with specialization in scientific computing in the individual thesis work. This may be noted by a designation on the degree (as, for example, at the University of Western Ontario) or not (as, for example, at the University of British Columbia). When there is interest from across traditional academic disciplines, in contrast, interdisciplinary degree programs, such as the one proposed here, are commonplace. This avoids potential conflicts between depth and breadth requirements in the disciplinary degree program that have poor relevance to the interdisciplinary nature of scientific computing. As discussed elsewhere in this document, these requirements can naturally be replaced with depth and breadth requirements that fit within the context of the degree.

The primary rationale behind this proposal is one of need. We are currently training a reasonable number of students at the MSc level in scientific computing, but this program feeds poorly into many of the existing disciplinary PhD programs at MUN. This impacts faculty working in this area in several ways.

Firstly, our well-qualified MSc graduates have no natural progression from the existing degree; as such, we often lose them to other universities, even when there is a willing supervisor at MUN. Secondly, we are driven to make difficult choices when recruiting students at the MSc level, placing some of those best-suited for interdisciplinary research into disciplinary MSc programs, to provide a path for an eventual PhD. Finally, we lose out completely on many talented students (particularly those from Canada) who choose to pursue their advanced degrees at universities that better support interdisciplinary research at the PhD level.

Although this program is indeed interdisciplinary in nature, it is much more structured than the existing Interdisciplinary PhD program available at Memorial.

3.2 Need for the program

Numerous studies in North America and Europe have identified the benefits of focused advanced education programs in scientific computing, yet these programs are quite rare in Canada. Indeed, the proposed program would be the first of its kind in Atlantic Canada, as is the existing MSc program. This is surprising particularly because of the role that scientific computing can play in critical industries in the region, such as shipbuilding, natural resources, financial services, and aerospace industries.

These industries, and many others influenced by scientific computing, play a key role nationally, as well, although there are comparatively few programs. At the PhD level, only three comparable programs exist:

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the Graduate Program in Computational Science at the University of Western Ontario, the School of Computational Science and Engineering at McMaster University, and the PhD in Modelling and Computational Science at the University of Ontario Institute of Technology. The latter two programs exist as fundamentally interdisciplinary programs, while the program at the University of Western Ontario is an "add-on" to the disciplinary PhD programs offered there. While not directly granting degrees, the Institute of Applied Mathematics at the University of British Columbia offers a similar administrative structure, in which additional degree requirements are imposed for students participating in relevant interdisciplinary research. A much more restrictive program, in Applied and Computational Mathematics, is offered by Simon Fraser University, as a specialization within the graduate programs offered by the Department of Mathematics there. While a few more schools (University of Waterloo, McGill University, York University) offer programs comparable to our existing MSc degrees, all of these feed only into disciplinary PhD programs. Numerous other schools, including many major research universities, have no graduate education programs in the field of scientific computing, despite having well-respected faculty working in the field.

Internationally, there are many more active programs in scientific computing, applied mathematics, and mathematical modelling, at both the MSc and PhD level. In the United States, well-respected PhD programs include those at the University of Texas, Austin, the University of Minnesota, the University of Illinois, Urbana-Champaign, the University of California, San Diego, and many more. As discussed above, these programs natural divide into those that are "add-ons" to disciplinary PhD programs and those that are truly interdisciplinary in nature. In Europe, education at the PhD level tends to be much more specialized, with diverse groups and concentrations in differing areas of study.

It must be noted that the comparative dearth of programs within Canada serves as a strong justification for the proposed program, simply because the lack of existing training opportunities has many disadvantages. A persistent number of top graduates in the STEM fields in Canada go abroad to pursue advanced education in this area, and many of these do not return, taking academic and industrial jobs in the United States, Europe, and beyond.

3.3 Unique attributes

The proposed program would be unique in its field at Memorial, and join a small number of interdisciplinary graduate degree programs in the Faculty of Science. Such interdisciplinary programs are naturally positioned to support research activities that are unique to Memorial, arising from interaction between faculty researchers from across the science and engineering disciplines. By structuring the qualifying process to be specific to each student's research, we aim to support our ability to train students in new and emerging areas of research that lie at the boundaries between the classical disciplines of academic departments. Additionally, the program would provide a unique opportunity in Atlantic Canada (and be among the first programs of its kind nationally), strengthening the existing MSc program and establishing Memorial as a leader in Scientific Computing nation-wide.

3.4 Contributions to strategic goals

In the Strategic Research Intensity Plan 2014-2020, Graduate Program Creation is identified as one of the recommendations that aims "to initiate a historic generational transformation of Memorial University's ability to achieve" its vision to "be one of the most distinguished public universities in Canada and beyond". As identified in that document, "Masters and Doctoral programs in many Schools and Faculties do not offer a broad enough scope for all faculty members to supervise research students." We believe that the program described in this proposal can be a key piece in addressing this goal by allowing faculty

to supervise students in projects which are interdisciplinary in nature, maybe falling outside the confines of discipline specific programs but providing more structure than offered by the general interdisciplinary PhD program. We clearly see a path for the proposed program to further support the identified aim of doubling the number of research-based graduate degree recipients by 2020.

Within the strategic research themes identified by the Research Strategy Framework, opportunities abound for impact from the proposed program. Within the theme of "Arctic and Northern Regions", key research areas include "technologies for and management of natural resource development", an area to which faculty active in the existing M.Sc. program are already contributing. Significant opportunities exist in the theme of "Environment, Energy and Natural Resources", again with existing faculty working in areas of environmental science, harsh environment engineering, petroleum reservoir characterization and exploration geophysics, and other subfields. Research areas in algorithms and complexity, computational modelling, geographic information systems, and managing large data sets are identified in the theme of "Information and Communication Technology". Opportunities also exist for supporting new programs of research in themes such as "Oceans, Fisheries and Aquaculture", and "Well-being, Health and Biomedical Discovery". We hope this program will be able to leverage opportunities in the recently announced Ocean Frontier Institute.

4. Market analysis

Our confidence in the marketability of the proposed PhD program stems from three primary sources: studies highlighting the importance of this field; our own consultations with business leaders in St. John's; and, most directly, the obvious supply of students graduating from the existing MSc program in Scientific Computing at Memorial University of Newfoundland.

The following is a list of the fifteen students who graduated from the MSc program in Scientific Computing/Computational Science since 2010. The year of completion is given, as is an indication of post-graduation status. The information has been collected from publically available information on the Internet or from MSc supervisors. An asterisk (*) indicates students who completed, are completing or are seeking entry into a PhD program.

Kari Gaalswyk (2016) PhD program at University of Calgary
Lukas Spies (2016) visiting scholar at University of Illinois Urbana-Champaign
*Faysol Ahmed (2015) currently applying for PhD and instructor positions
Bassel Ahmed Alkadour (2015) Research assistant MUN, job hunting
*Mohammad Jalal Ahammad (2014) PhD Theoretical Physics at MUN
*Syed Nasir Danial, (2014) MUN, PhD Electrical and Computer Engineering at
MUN Devin Nippard (2014) Tutors Unlimited (St. John's)
Muyi Xu (2014) private sector in China
Steven C. Dlamini (2013) Research Analyst (Traffic Safety) at Saskatchewan Government Insurance
*Md. Al-Amin Baksh (2013) PhD, Australia Maritime College, University of Tasmania, Australia
Hasan Syed Mahmudul (2012) Software Engineer in Ottawa
*Vahid Hemmati (2012) PhD Engineering, University of North Carolina Charlotte
Adam Royle (2012) Data Query Specialist at AGDATA (Toronto)
Jason Normore (2011) Director of Engineering at Shopify (Ottawa)
*Terrence Tricco (2010) PhD Physics and Astronomy, Monash University, now at the Canadian Institute for Theoretical Astrophysics, Toronto
*Mehdi Fatemi (2011) PhD Computational Science and Engineering, McMaster University, now

Research Scientist at Maluuba (Machine learning software, Montreal)

While it is good to see that those who completed their formal education with an MSc have done well in terms of finding employment, it is particularly noteworthy that 8 out of 15 chose the path of continuing with a PhD. Only three of these eight students are pursuing PhDs at MUN, and they all would or could have benefitted from availability of a Scientific Computing PhD at Memorial. That roughly half of MSc graduates are opting to further their education is supported by what governments are valuing and by realities in industry.

In its Report to the President (of the United States) of June 2005 entitled *Computational Science: Ensuring America's Competitiveness*, the President's Information Technology Advisory Committee described Computational Science, the "Third Column of 21st Century Science" along with theory and experiment, as vital to the US in order to maintain preeminence in science and engineering. The Committee stressed the importance of Computational Science to removing barriers to cross-disciplinary research, as well as to the great variety of areas vastly enriched by it,

"… from investigations of the biochemical processes of the human brain and the fundamental forces of physics shaping the universe, to analysis of the spread of infectious disease or airborne toxic agents in a terrorist attack, to supporting advanced industrial methods with significant economic benefits, such as rapidly designing more efficient airplane wings computationally rather than through expensive and time- consuming wind tunnel experiments."

Fast-forwarding to today, we see President Obama continue to place importance on Computational Science. The Society for Industrial and Applied Mathematics (SIAM) has prepared a *Summary and Analysis of Programs of Interest to the Applied Mathematics and Computational Science Communities in the President's FY 2017 Budget Request* (dated February 2016). Pertinent highlights include a requested increase of 6.8% for Advanced Scientific Computing Research within the Department of Energy's Office of Science and a 6.3% for the Division of Advanced Cyberinfrastructure within the National Science Foundation. Specific initiatives highlighting the need for increasing support for Computational Science include *Rules of Life* (determining genotype to phenotype causal relationships), *Smart and Connected Communities* (connected sensors, data management, analysis and decision making), *Cyber-enabled Materials, Manufacturing, and Smart Systems* (interdisciplinary by its very nature), *Advanced Materials for Energy Innovation* (Dept. of Energy) and Dept. of Defense initiatives to increase warfighting capabilities through *Autonomous Learning Systems, Human-machine Collaborative Decision Making, Advanced Manned-unmanned Systems Operations* and *Autonomous Weapons Hardened for Future Cyber/Electronic Warfare*.

As a very recent and smaller scale example of the support governments are giving to increasing the reach of Scientific Computing, the Trans-Atlantic Platform, an organization backed by eleven countries in the Americas and in Europe, put out the "2016 Digging into Data Challenge Competition". The challenge aims to foster the development of new methods to handle enormous and complex datasets that can include texts, images, music, photographs, audio or audio-visual data inherent in the social sciences. Canada, with funding from NSERC, SSHRC and Quebec equivalents (FRQNT/FRQSC), will support six projects with up to $275,000 for each project.

In terms of employment expectations for PhD graduates in Scientific Computing, the 2012 *SIAM Report on Mathematics in Industry* contains pertinent information. The report highlights the importance of three overlapping technical domains to employability in industry: mathematics, computation and specific application domains. This is exactly what our MSc and proposed PhD programs in Scientific Computing aim to achieve. Job titles held include analyst/modeler, researcher, consultant, engineer,

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software developer/programming in addition to management titles. A survey of 56 PhDs (finishing between 2004 and 2008) revealed a level of 90% in terms of job satisfaction and a median salary of $100,000 (for both men and women).

Closer to home, our motivations for developing the PhD program are guided in part by the 2014 meeting held between the MSc program's Board of Study and the program's Industry Advisors. We wanted to receive feedback from local industry in order to improve our program from the point of view of employability of our graduates. The five advisors represented energy (Nalcor, Husky), weather prediction (AMEC) and remote sensing (Acoustic Zoom, Whitecap Scientific) companies, and their own academic backgrounds spanned naval architecture, biophysics, imaging and physics. They remarked on how the high-tech sector in St. John's and the province has grown in recent years and continues to grow. They saw great value in students graduating with both a core computational skill and knowledge base, and a proven track record of independent problem solving, as demonstrated by completing thesis research. They commented that owing to the advancement of high technology, an MSc is becoming a minimum requirement, while having a PhD is increasingly becoming important. They also stressed the need for homegrown talent, as this helps in retaining highly qualified personnel.

A case in point in favour of PhD training is Dr. Mehdi Fatemi (MSc 2011), who is now a Research Scientist at Maluuba, an artificial intelligence software company in Montreal (www.maluuba.com). To make useful contributions to truly breakthrough technologies requires research abilities developed at the PhD level. The training offered through the MSc program in Scientific Computing offers a good beginning, but the growing sophistication of computing demands doctorate-level training, especially when the techniques are coupled to a deep understanding of the underlying science.

The above analysis shows that having a PhD program in Scientific Computing is overdue. Not having it translates into missed opportunities in terms of attracting and retaining qualified students and providing the correct environment for multidisciplinary computational-based research. Most importantly, PhDs in similar programs are in demand and enjoy a high likelihood of finding meaningful and well paid employment.

5. Projected enrolment

Our forecasted enrollment is modest – it assumes that fewer than half of the faculty who have been actively involved in the existing MSc program over the last 5 years will supervise a student in the program. These numbers allow the program to break even immediately. The split between Canadian and International enrollment reflects the current trends in our MSc program student body.

Table 1. Projected 5-year enrolment*

Type/year	Year 1	Year 2	Year 3	Year 4	Year 5
FT enrolment	2	4	6	8	8
PT enrolment	0	0	0	0	0
Canadian enrolment	1	1	2	2	2
International enrolment	1	3	4	6	6
On-campus	2	4	6	8	8
Online	NA	NA	NA	NA	NA
Thesis	2	4	6	8	8
Non-thesis	NA	NA	NA	NA	NA
Total	2	4	6	8	8

*Enrolment as of Fall semester of each year.

6. Admission requirements

There are four possible ways to enter the Scientific Computing PhD program. The minimum requirements for each of these ways will normally be,

(i) an MSc degree in Scientific Computing, or equivalent, from a university of recognized standing,

(ii) an MSc degree in an appropriate discipline from a university of recognized standing,

(iii) registration and successful performance in the Scientific Computing MSc program at MUN for a minimum of 12 months and demonstration, to the satisfaction of the Board of Study, of an ability to pursue research at the Doctoral level, with the conversion happening no later than the fifth semester of the student's MSc program,

(iv) in exceptional cases, a BSc degree with Honours, or equivalent, in an appropriate discipline that included completion of a thesis or dissertation from a university of recognized standing, and the approval of the Board of Study to enter the PhD program.

Course requirements vary depending on which of the four ways a student enters the PhD program: please see Section 7 for details. All applicants must possess an adequate knowledge of written and spoken English as a prerequisite to admission, as according to the requirements given in Section 4.1.5 "English Proficiency Requirements" of the University Calendar.

Rationale:
Item (ii) above is an extension to the general requirement of "an appropriate area of study" in Section 4.1.3 of the University Calendar that reflects the interdisciplinary nature of Scientific Computing and hence that a discipline degree is an acceptable qualification for entering the PhD program in Scientific Computing, and that an MSc in Scientific Computing is not a widely available degree program.
The addition of the requirement of a thesis or dissertation in item (iv) is to ensure that a student entering via this route has had the opportunity to demonstrate research potential.

7. Program requirements

Each student in the PhD program will be required to successfully complete courses, a comprehensive exam, and a research thesis under the supervision of a faculty member in the Faculty of Science, Faculty of Medicine, or Faculty of Engineering. The program is open to full-time and part-time students. The specific requirements are as follows.

Course requirements

All students MUST complete at least 2 courses, with higher expectations depending on background. The specific course requirements will be decided by the supervisory committee, in consultation with the board of study and will be noted on the program of study form completed upon admission. Given the interdisciplinary nature of the program, the guiding principle is to ensure an adequate background in both the core background in scientific computing and sufficient knowledge of the primary application area. Substitutions for courses in the list of core scientific computing courses below are possible, in keeping with these guiding principles. Normally, the following guidelines would be followed:

- Students who have completed an MSc in Scientific Computing or equivalent will normally be expected to complete two courses either from the list of core courses below or from the application area as appropriate.

- Students who have completed a disciplinary MSc will normally be expected to complete 4 courses. Normally, 3 of these courses would be chosen from the list of core courses below to ensure sufficient training in scientific computing.
- Students who transfer to the PhD program from our MSc in Scientific Computing will normally be expected to complete 6 courses in total, normally 3 to 4 of these courses would be from the list of core courses below.
- In the exceptional case that a student is accepted to the PhD program after completing a BSc (Hons), they will normally be expected to complete 6 courses, normally 3 to 4 of these courses would be from the list of core courses below.

Core courses:

- MATH 6201 Numerical Methods for Time Dependent Partial Differential Equations
- MATH 6202 Nonlinear and Linear Optimization
- MATH 6204 Iterative Methods in Numerical Linear Algebra
- MATH 6210 Numerical Solutions of Differential Equations
- CMSC 6910 Matrix Computations and Applications or COMP 6732 Matrix Computations (credit may be obtained for only one of CMSC 6910 and COMP 6732)
- CMSC 6920 Scientific Programming
- CMSC 6930 Algorithms for Distributed and Shared Memory Computers
- CMSC 6950 Computer Based Tools and Applications
- COMP 6906 Topics in Numerical Methods

Committee Structure

Upon admission a student will be assigned a supervisory committee, which is composed of the student's supervisor(s) and two other faculty members. An examination committee will be formed at least three months before the comprehensive exam. This committee will be composed of the supervisor and two other faculty members who are qualified to examine the student's background and their research progress and proposal. Normally at least one member of the examining committee will be distinct from the members of the supervisory committee. Finally, there will be a thesis examination committee formed according to the regulations of the School of Graduate Studies.

Comprehensive Exam requirement

Students must pass a comprehensive exam to ensure that all graduates have an acceptable knowledge of the field of scientific computing and a mastery of those subdisciplines appropriate to his/her research area. The exam must be completed no later than the end of seventh semester of the student's PhD program.

In the letter initiating the comprehensive exam, the student will be provided with a syllabus and list of texts on which the exam will be based. The candidate will independently prepare a paper of 20 to 25 pages describing the theoretical background, progress to date, and a proposal of their thesis research. This paper must be submitted to the chair of the board of study for dissemination to the comprehensive examination committee at least two weeks before the date of the examination. The student will give a 20 to 30 minute presentation on the contents of the paper. The paper will also serve as the starting point for the oral examination. Examiners may also ask questions related to fundamental aspects of scientific computing or the student's research. The comprehensive examination procedures will follow those described in General Regulations – Comprehensive Examination (PhD and PsyD Comprehensive Examination) section of the School of Graduate Studies calendar.

Seminar Requirement

Each candidate must give at least one public presentation at Memorial on their research. This can take the form of a seminar or by presentation at an approved research colloquium. This requirement is intended to help develop the public speaking skills of students, inform other students enrolled in the program about this area of research, and allow for constructive feedback. Students enrolled in the program are expected to attend all Scientific Computing seminars and seminars in their home departments as identified by their supervisors.

Thesis Requirement

Each candidate must generate original research results and prepare and submit a thesis according to the General Regulations – Theses and Reports of the School of Graduate Studies calendar. Prior to submission for examination, candidates must submit a draft of the thesis to the supervisory committee for feedback and approval. The quality of the thesis would merit publication in a reputable peer-reviewed journal. Scientific computing must be an integral part of the thesis. The thesis is expected to be of a scope and significance that is consistent with the norms of international research universities.

Students will usually complete all requirements and thesis within four years (twelve semesters) of enrolling in the program.

Supervisory Committee Meetings

Students in the PhD program must have an annual meeting of their supervisory committee. The student must prepare a short presentation that describes his/her progress towards completing his/her degree. At this time the supervisory committee will complete an annual progress report, which shall be submitted to the School of Graduate Studies and the board of study.

8. Resource implications
8.1 Faculty complement and workload

The faculty involved with this program have teaching loads decided by their home departments. The proposed PhD program requires no additional teaching above the courses already offered in the Scientific Computing MSc program, or already offered in their home departments. Faculty usually receive remuneration, as extra-teaching, to teach Scientific Computing courses.

Faculty of Science:

Iakov Afanassiev, Professor, Physics and Physical Oceanography, faculty supervisor (PhD, P.P.Shirshov Institute of Oceanology)

Jahrul Alam, Associate Professor, Mathematics and Statistics, faculty supervisor (PhD, McMaster)

Wolfgang Banzhaf, Professor, Computer Science, faculty supervisor (PhD, Karlsruhe)

Alex Bihlo, Assistant Professor, Mathematics and Statistics (PhD, Universität Wien)

Valerie Booth, Associate Professor, Biochemistry (PhD, Toronto)

Edward Brown, Associate Professor, Computer Science (PhD, Toronto)

Sharene Bungay, Associate Professor, Computer Science (PhD, Guelph)

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Steven M. Carr, Professor, Biology (PhD, California, Berkeley)

Stephanie Curnoe, Professor, Physics and Physical Oceanography (PhD, British Columbia)

Brad de Young, Professor, Physics and Physical Oceanography (PhD, British Columbia)

Entcho Demirov, Associate Professor, Physics and Physical Oceanography (PhD, St. Petersburg)

Colin G. Farquharson, Associate Professor, Earth Sciences (PhD, British Columbia)

Chris Flinn, Associate Professor, Chemistry (PhD, Dalhousie)

Travis Fridgen, Professor, Chemistry (PhD, Queen's)

Minglun Gong, Professor, Computer Science (PhD, Alberta)

Ronald Haynes, Professor, Mathematics and Statistics (PhD, Simon Fraser)

Serpil Kocabiyik, Professor, Mathematics and Statistics (PhD, Western Ontario)

Margot Kondratieva, Associate Professor, Mathematics and Statistics and Faculty of Education (PhD, Komsk State)

Jolanta Lagowski, Professor, Physics and Physical Oceanography (PhD, Toronto)

Michael Lau (National Research Council)

Alison Leitch, Associate Professor, Earth Sciences (PhD, Australian National University)

JC Loredo-Osti, Professor, Mathematics and Statistics (PhD, Dalhousie)

Scott MacLachlan, Professor, Mathematics and Statistics (PhD, Colorado at Boulder)

Alison Malcolm, Associate Professor, Earth Sciences (PhD, Colorado School of Mines)

Erika Merschrod, Professor, Chemistry (PhD, Cornell)

Paul Mezey, Professor, Chemistry (PhD, Budapest)

George Miminis, Professor, Computer Science (PhD, McGill)

Alwell Oyet, Associate Professor, Mathematics and Statistics (PhD, Alberta)

David Pike, Professor, Mathematics and Statistics (PhD, Auburn)

Martin Plumer, Professor, Physics and Physical Oceanography (PhD, Toronto)

Ray Poirier, Professor, Chemistry (PhD, Toronto)

Matthew Rise, Associate Professor, Ocean Sciences (PhD,

Victoria) Christopher Rowley, Assistant Professor, Chemistry (PhD,

Ottawa)

Ivan Saika-Voivod, Associate Professor, Physics and Physical Oceanography (PhD, Western Ontario)

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Nabil Shalaby, Professor, Mathematics and Statistics (PhD, McMaster)

Brian E. Staveley, Professor, Biology (PhD, Alberta)

Lev Tarasov, Associate Professor, Physics and Physical Oceanography (PhD, Toronto)

Andrew Vardy, Associate Professor, Joint with Computer Science & Faculty of Engineering and Applied Science (PhD, Carleton)

Asokan Variyath, Associate Professor, Mathematics and Statistics (PhD, Waterloo)

Stefan Wallin, Assistant Professor, Physics and Physical Oceanography (PhD, Lund)

Peter Warburton, Assistant Professor, Chemistry (PhD, Saskatchewan)

H. Todd Wareham, Associate Professor, Computer Science (PhD, Victoria)

Len Zedel, Professor, Physics and Physical Oceanography (PhD, British Columbia)

Wlodek Zuberek, Professor, Department of Computer Science (PhD, Warsaw Tech.)

Faculty of Engineering and Applied Science:

Jonathan Anderson, Assistant Professor, Electrical and Computer Engineering (PhD, Cambridge)

Octavia Dobre, Associate Professor, Electrical and Computer Engineering (PhD, Bucharest)

Raymond Gosine, Professor, Electrical and Computer Engineering (PhD, Cambridge)

Kelly Hawboldt, Professor, Process Engineering (PhD, Calgary)

Howard Heys, Professor, Electrical and Computer Engineering (PhD, Queen's)

Tariq Iqbal, Professor, Electrical and Computer Engineering (PhD, Imperial College)

Thormod Johansen, Professor, Process Engineering (PhD, Oslo)

Shawn Kenny, Adjunct professor, Civil Engineering (PhD, Dalhousie)

Faisal Khan, Professor, Process Engineering (PhD, Pondicherry)

George Mann, Professor, Mechanical Engineering (PhD, Memorial)

Cecilia R. Moloney, Professor, Electrical and Computer Engineering (PhD, Waterloo)

Yuri S. Muzychka, Professor, Mechanical Engineering (PhD, Waterloo)

Theodore Norvell, Associate Professor, Electrical and Computer Engineering (PhD, Toronto)

Siu O'Young, Professor, Electrical and Computer Engineering (PhD, Waterloo)

Heather Peng, Associate Professor, Ocean and Naval Architectural Engineering (PhD, Dalhousie)

Wei Qiu, Professor, Ocean Engineering Research Centre (PhD, Dalhousie)

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Ken Snelgrove, Associate Professor, Civil Engineering (PhD, Waterloo)

Faculty of Medicine:

Bruno Stuyvers, Associate Professor, Cardiovascular, Cellular and Molecular Physiology (PhD, Bordeaux)

Bruce van Vliet, Professor, Cardiovascular/Renal Physiology (PhD, Saskatchewan)

Michael Grant, Professor, Immunology (PhD, McMaster)

Jules Doré, Associate Professor, Cell Biology (PhD, Tennessee)

Saeed Samet, Assistant Professor, Family Medicine (PhD, Ottawa)

8.2 Space, facilities, and student support

Every graduate student will have a desk and workspace assigned to them in their home department. The home department will normally be the home department of their supervisor. Students will complete their work on their own laptops or in existing departmental computer labs as appropriate. Additional computing resources are available through ACEnet and Compute Canada.

The university and participating departments have sufficient software licenses required to complete course work and research requirements. Researchers in this field have considerable experience utilizing open source software where possible. The University has extensive library resources that will be available to students (see the Library audit in Appendix A).

The existing MSc program is managed by a program chair and an appointed board of study. This group will take over management of the proposed PhD program. The student's supervisor and supervisory committee will ultimately be responsible for providing appropriate academic and career advice. Students will be directed towards existing training opportunities in high performance computing through Compute Canada and general professional development programs and resources offered by the Enhanced Development of the Graduate Experience (EDGE) through the School of Graduate Studies at Memorial. Our budget also assumes that students will travel to attend conferences and workshops appropriate to their chosen specialty. This opportunity will provide valuable networking opportunities.

8.3 Financial support

Baseline support will be provided to those eligible students for the first four years of their program, as per School of Graduate Studies regulations. Financial support from the supervisor will also be provided to bring the student to existing norms in their home departments, to a minimum level of $18,000 per annum.

Teaching assistantships will be provided to students (when available) and, in those instances, the amount of the supervisor support can be reduced as appropriate. Teaching assistantships would normally be provided in the home department of the student's supervisor. The contributions above may be reduced for students holding scholarships. Depending on the research area, students and supervisors are encouraged to seek out opportunities for internal and external scholarships and internship opportunities.

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Table 2. Financial support

Type/year	Year 1	Year 2	Year 3	Year 4	Year 5
SGS fellowships	19,570	39,140	58,710	78,280	78,280
*Graduate assistantships	5324	10,648	15,972	21,296	21,296
Grants/contract funds	NA	NA	NA	NA	NA
Dean's Doctoral Awards	5,000	5,000	5,000	5,000	5,000
PDSIF	7,500	15,000	15,000	15,000	15,000
Graduate Officer awards	3,914	3,914	3,914	3,914	3,914
SGS special initiatives funding	5,000	5,000	5,000	5,000	5,000
Total	$46,308	$78,702	$103,596	$128,490	$128,490

SGS Fellowships

New programs are typically given access to five SGS fellowships. Here, we have included the total value of five for the PhD program. Increased funding levels are provided by the usual funding formula for graduate programs.

*Graduate Assistantships

Graduate assistantships will be provided by the home department of the supervisor and funded by the Dean of Science Office. The number of TAs offered to students will be in line with the number offered to students in the home department of the supervisor. The numbers in the table are typical of several of the departments associated with the program. One GA corresponds to 56 work-hours per semester and as of Fall 2016, is paid at a rate of $22.22 per hour. Adding a 7% cost of fringe benefits brings the total cost to the Dean's office to $1331.42 per GA. We assume 2 GAs per student per year.

Grants/Contract Funds

It is difficult to forecast the funds that each researcher associated with the Scientific Computing program   will contribute to graduate students. Faculty members associated with the current MSc program have an impressive record of obtaining external funds. Therefore, we anticipate a substantial amount of student   support will come directly from faculty grants.

Dean's Doctoral Award

The Dean's Doctoral Award is a $5,000 per annum award for outstanding PhD students. We assume one student will hold this award in our program at any given time.

PDSIF

This fund, valued at $7,500 per year, is made available to new faculty in the first three years of their

tenure track appointment at MUN. We are assuming that initially one student and eventually two students will access this fund. This assumes 2 new faculty members over the 5 year period. It is important to note that these are not new faculty members hired for the program (the proposal does not require hiring additional faculty). It simply reflects that many units hire faculty members who we could reasonably expect to be involved with the proposed program.

Graduate Officer Award

The chair of the board of study will have this amount available to support one or more students in the program.

SGS Special Initiatives Funding

The special initiatives funding assumes one student from a Strategic Country Fund (Korea, Turkey, Mexico) or Aboriginal Student Recruitment.

9. Budget

Table 3. Program budget

Type/year	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue					
Program fees	6123	13041	19164	26082	26082
Special fees	0	0	0	0	0
Other revenue	0	0	0	0	0
Expenditures					
Instructional costs					
Regular faculty					
Term appointments					
LUMUN appointments					
Graduate Assistantships	5324	10649	15973	21297	21297
Total instructional costs					
Administrative costs					
Salary costs					
Course remissions					
Stipends					
Administrative support					
Operating costs					
Materials and supplies					
Reference materials					
Computers and software					
Travel	800	800	800	800	800
Other operating costs					
Total expenditures					
Net income/expenditures	-$1	$1,592	$2,391	$3,985	$3,985

Revenue

The program fees are calculated based on the currently forecasted tuition amounts. This gives $888 and $1153 for each Canadian and each International student. The amounts are adjusted assuming 3 International and 1 Canadian in year 2, 4 and 2 in year 3, and 6 and 2 in years 4 and 5.

Expenditures

All courses will be taught by existing faculty. Indeed, the course requirements can be by taking existing courses regularly offered by academic units in the Faculty of Science and Faculty of Engineering. The graduate assistantship amount is calculated according to the TAUMUN collective agreement. Each graduate assistantship costs $22.22 per hour times 56 hours per semester times 7% fringe benefits and assumes two graduate assistantships per student per year.

The current MSC program in Scientific Computing is managed out of the Dean of Science's office. This will continue for the proposed program and will not require any additional staff. The current chair of the program and the board of study will absorb management and guidance of this proposed program.

Since we are able to rely on existing reference materials available through the current library collection, and students will use existing software and computer resources we have no additional operating costs. We have assumed that students in the program will utilize available travel subsidies provided by the School of Graduate Studies.

As forecasted, this program will be essentially revenue-neutral from year 0.

Appendix A. Library holdings evaluation

MEMORIAL
UNIVERSITY

Collection Development
Division Queen Elizabeth II
Library
St. John's, NL A1B 3Y1

20 July 2016

TO: Dr. Ronald D. Haynes

FROM: Alison Ambi, Science Research Liaison Librarian for the departments of Mathematics and Statistics, Computer Science, Physics and Physical Oceanography and Earth Sciences.

Summary Library evaluation for the proposed Ph.D., Scientific Computing

Dr. Ronald Haynes (Mathematics & Statistics) and colleagues from several other departments including Computer Science, Physics and Physical Oceanography and Earth Sciences requested a library evaluation to accompany their proposal to introduce a Ph.D. program in scientific computing. Memorial already offers this specialization at a Master's level (See Appendix 1).

Three analyses of Memorial's library resources were conducted to determine whether the collection at Memorial is adequate to support the proposed Ph.D. program in scientific computing:

1. Database/index subscriptions
2. Journal subscriptions
3. Book holdings, book series subscriptions and eBook package subscriptions

The proposed program is fairly unique in Canada. After consulting various university websites, it appears that the most comparable Canadian institution that offers a computational mathematics/scientific computing specialization at the Ph.D. level is Simon Fraser University. Our library holdings were therefore compared with Simon Fraser's.

Information provided by program proposers from the departments of Mathematics & Statistics, Earth Sciences, and Physics & Physical Oceanography, which included the program description, course outlines and reading lists (Appendix 1), was used to identify the most relevant areas of the library collection to be reviewed.

Memorial's subscriptions include the key databases/indexes relevant to finding periodical literature in scientific computing, and our book collection compares favourably with Simon Fraser University. Memorial Libraries has current subscriptions to just over 50% of the journals expected to be of most significance to the students in the program. Demand for current articles in the journals that were cancelled in 2015 can be adequately met through the library's document delivery service. Although the current fiscal climate prohibits more comprehensive journal subscriptions, the volume of document delivery requests will be monitored closely after the launch of the Ph.D. program and subscriptions will be adjusted as finances permit.

Having reviewed our collections, I conclude that MUN Libraries can adequately support the proposed Ph.D. in scientific computing.

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Collection Analysis

Simon Fraser University was chosen for comparison because the institution also aims to be a comprehensive university, has a similar number of students (approximately 30,000) to MUN, a comparable library budget, and offers a similar Ph.D. program, their Ph.D. in Applied and Computational Mathematics (See Appendix 2 for more information).

1. **Databases and Indexing Tools**

MUN has subscriptions to the three key indexing tools for journal literature in mathematics and the sciences - MathSciNet, Scopus and Web of Science. In addition, students will benefit from well established open access sources for identifying and finding relevant literature including arXiv.org, NetLib and the European Digital Mathematics Library. These tools in conjunction with Google Scholar and the library's OneSearch discovery system should enable students to conduct thorough and comprehensive literature reviews on their chosen topics of enquiry.

2. **Journal Holdings**

2.1 Publisher/Society Journal Packages

Although our journal holdings are not as comprehensive as they were a few years ago, and anticipated ongoing budget constraints over the next few years will result in further cancellations, MUN Libraries is still able to provide to a wide array of journals from mathematical societies and the larger journal publishers.

Society/Publisher Journal Collections Relevant to Mathematics	Subscription status
ACM Digital Library	Subscribed
American Mathematical Society Journals	Subscribed
Cambridge	Selectively subscribed after 2015
Elsevier	Subscribed
Mathematical Association of America	Not Subscribed
Oxford	Selectively subscribed after 2015
Project Euclid	Selectively subscribed
Sage	Subscribed
SIAM (Society for Industrial and Applied Mathematics)	Selectively subscribed
SIAM Online Journal Archive	Subscribed
Springer/Nature	Selectively subscribed after 2015
Taylor & Francis	Fully subscribed until December 2016
Wiley/Blackwell	Selectively subscribed after 2015

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2.2 Scientific Computing Journals

A list of approximately 50 potentially important journals was compiled by using the Scimago journal rankings site, science indexes (MathSciNet, Scopus and Web of Science), by identifying journals in which MUN faculty had recently published papers related to scientific computing, and by obtaining feedback from the members of faculty putting forward the program proposal. MUN Libraries has current subscriptions to just over fifty percent of the journals on the list. Twenty of the journals on the list were affected by the budget-induced 2015 cancellations. The document delivery requests for articles from these journals will be monitored closely and they have been noted as important candidates for future re-subscription when this becomes financially possible for the library.

Title	Publisher/Platform	MUN Subscribed?
ACM Transactions on Mathematical Software	ACM Digital Library	Y
Communication in Pure and Applied Analysis	AIMS	Y
ETNA (Electronic Transactions on Numerical Analysis)	Kent State University	OA
Geophysical Journal International	Oxford	N
Geophysics	SEG	Y
Inverse Problems	IOP	Y
Journal of Chemical Theory and Computation	ACS	Y
Journal of Computational Physics	Elsevier	Y
Journal of Computational Science	Elsevier	Y
Journal of Integral Equations and Applications	Project Euclid	Y
Journal of Scientific Computing	Springer	N
Numerical Linear Algebra with Applications	Wiley	N
SIAM Journal on Numerical Analysis	SIAM	Y
Wiley Interdisciplinary Reviews: Computational Molecular Science	Wiley	N
Bioinformatics	Oxford	N
SIAM Review	SIAM	Y
Proceedings of the Annual IEEE Conference on Computational Complexity	IEEE	Y
Foundations of Computational Mathematics	Springer	N
Journal of Mathematical Fluid Mechanics	Springer	N
Evolutionary Computation	MIT Press (ACM Digital Library)	Y
SIAM Journal on Mathematical Analysis	SIAM	Y
SIAM Journal on Scientific Computing	SIAM	Y
Mathematics of Computation	AMS	Y
Nonlinear Analysis: Real World Applications	Elsevier	Y
Numerische Mathematik	Springer	N
IMA Journal of Numerical Analysis	Oxford	N
Computational Mechanics	Springer	N
ACM Transactions on Computational Logic	ACM Digital Library	Y
Advances in Computational Mathematics	Springer	N
Computational Statistics and Data Analysis	Elsevier	Y
Computational Complexity	Springer	N

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Computational Geosciences	Springer	N
Journal of Computational Chemistry	Wiley	N
ESAIM - Control, Optimisation and Calculus of Variations	Cambridge	N
Applied Numerical Mathematics	Elsevier	Y
Combinatorica	Springer	N
Computational Optimization and Applications	Springer	N
Internet Mathematics	Taylor & Francis	Y
Journal of Numerical Mathematics	DeGruyter	N
Computers and Mathematics with Applications	Elsevier	Y
Journal of Computational Biology	PubMed for some older articles	N
Journal of Computational and Applied Mathematics	Elsevier	Y
Computational Materials Science	Elsevier	Y
Engineering Analysis with Boundary Elements	Elsevier	Y
Numerical Methods for Partial Differential Equations	Wiley	N
BIT Numerical Mathematics	Springer	N
BioData Mining	SpringerOpenFree	OA
Computational Geometry: Theory and Applications	Elsevier	Y
Applied Mathematics and Computation	Elsevier	Y
Journal of Symbolic Computation	Elsevier	Y
International Journal of Applied Cryptography	InderScience	N
Groups, Complexity, Cryptology	DeGruyter	N
Constructive Approximation	Springer	N
Genomics Proteomics Bioinformatics	Elsevier	Y
Numerical Mathematics	Cambridge	N
Computational Intelligence	Wiley	N
Journal of Computational Mathematics	Science Press	Y
Proceedings of the Annual Symposium on Computational Geometry	ACM Digital Library	Y
Annual Reports in Computational Chemistry	Elsevier	Y
Computational Methods in Applied Mathematics	DeGruyter	N
International Journal of Computational Methods	WorldScientific	N
Computational Statistics	Springer	N
Journal of Applied Mathematics and Computing	Springer	N
Computational Biology and Chemistry	Elsevier	Y
Computational Mathematics and Mathematical Physics	Springer	Y

3. eBook Packages and Book Series

MUN Libraries has subscriptions to three eBook packages of particular value to students of scientific computing: SpringerLink, MathNetBase and SIAM eBooks. Current subscriptions are also held for book series like Lecture notes in mathematics, Annual reports in computational chemistry and Memoirs of the American mathematical society, among others. These collections and series provide a firm foundation which can be effectively supplemented with a few additional individual purchases each year.

4. Monograph holdings

Of the 22 books on the reading lists for comprehensive exams and for existing scientific computation courses in Physics, Earth Sciences and Mathematics, the library has the required edition for 18 of them, an earlier edition for 1, and 3 are no longer/not yet available in MUN Libraries.

Date	Authors	Title	On the reading list for	MUN Libraries?
1994	Veseley, Kluwer	Computational physics: an introduction	EASC 6921 - Wave equation modeling, processing and inversion algorithms	QEII: QC6 .V47 1994
2005	Tarantola	Inverse problem theory and methods for model parameter estimation	EASC 6994 - Geophysical inversion and applications	Books24X7 eBook package
1982	Murray, Wright	Practical optimization	EASC 6994 - Geophysical inversion and applications	Not available in MUN Libraries
2012	Menke	Geophysical data analysis: discrete inverse theory	EASC 6994 - Geophysical inversion and applications	QEII: QC802 .A1 M46 2012
1994	Parker	Geophysical inverse theory	EASC 6994 - Geophysical inversion and applications	QEII: QC808.5 .P37 1994
2007	Versteeg, Malalasekera	An introduction to computational fluid dynamics: The finite volume method	Comprehensive Exam - Oceanography	Fisheries and Marine Institute: QA911 .V47 2007
2002	Ferziger, Peric	Computational Methods for Fluid Dynamics	Comprehensive Exam - Oceanography	QEII: QA911 .F434 2002
1980	Patankar	Numerical heat transfer and fluid flow	Comprehensive Exam - Oceanography	QEII: QC320 .P37
2009	Stensrud	Parameterizsation schemes: keys to understanding numerical weather prediction models	Comprehensive Exam - Oceanography	QEII: QC996 .S74 2009
2002	Frenkel, Smit	Understanding molecular simulation - from Algorithms to Applications	Comprehensive Exam - Physics	ebrary Academic

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eBook

				Library has older edition:
2005	Giordano, Naknishi	Computational physics	Comprehensive Exam - Physics	QEII: QC20.7 .E4 G56 1997
2004	Rapaport	The art of molecular dynamics simulation	Comprehensive Exam - Physics	Not available in MUN Libraries
1987	Allen, Tildesley	Computer simulation of liquids	Comprehensive Exam - Physics	QEII: QC145.2 .A43 1987
1994	Ortega	An introduction to Fortran 90 for scientific computing	PHYS 3800 - Computational Physics	Not available in MUN Libraries
1988	Kernighan, Ritchie	The C programming language	PHYS 3800 - Computational Physics	QA76.73 .C15 K47 1988
2007	Press	Numerical recipes	PHYS 3800 - Computational Physics	QEII: QA297 .N885 2007
1999	Nyhoff, Leetstma	An introduction to Fortran 90	PHYS 3800 - Computational Physics	QEII: QA76.73 .F25 N9248 1999
2006	Klein, Godunov	Introductory computational physics	PHYS 3800 - Computational Physics	QEII: QC20.7 .E4 K54 2006
2006	Pang	An introduction to computational physics	PHYS 3800 - Computational Physics	QEII: QC20.7 .E4 P36 2006
2007	Landau, Paez, Bordeianu	Computational physics: problem solving with computers	PHYS 3800 - Computational Physics	QEII: QC20.82 .L36 2007
2007	Boccara	Essentials of Mathematica: with applications to mathematics and physics	PHYS 3800 - Computational Physics	SpringerLink eBook package
2011	Neelin	Climate change and climate modeling	PHYS 6318 - Numerical Modeling	QEII: QC861.3 .N44 2011

Relevant Library of Congress subject headings were identified using information in the course outlines, reading lists and program description. Based on the description of the MSc program in Scientific computing (Appendix 1), key areas of research could include the following computational techniques/tools/processes applied to addressing questions in a range of scientific fields:

- Numerical methods
- High performance computer architectures

- Analysis & processing of large datasets
- Parallel and vector computers
- Graphics and visualizations

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Phone: 709 864-7125   Email: aambi@mun.ca   Fax: 709 864 2153

Using Library of Congress subject headings, the following table shows how MUN's monograph collection compares to that of Simon Fraser University. Allowing for cataloguing variations at the two institutions, it appears that MUN and SFU's collections are very similar. It might be worth strengthening our holdings a little on the subjects of computer architecture, computer graphics, information visualization and the Monte Carlo method.

LC Subject Heading	Number of Catalogue Entries		
	MUN	SFU	Difference
Computational fluid dynamics	86	33	53
Computer architecture	611	691	-80
Computer graphics - mathematics	38	48	-10
Data mining	2546	1422	1124
Data mining – mathematical models	3	8	-5
Differential equations - numerical solutions	256	169	87
Finite volume method	6	9	-3
Fortran 90	8	13	-5
Functional analysis	519	458	61
Image processing	688	314	374
Information visualization	141	281	-140
Intermolecular forces - computer simulation	3	5	-2
Inverse problems - differential Equations	175	145	30
Liquids - data processing	2	1	1
Liquids - mathematical models	2	1	1
Mathematica (Computer file)	86	73	13
Mathematical optimization	1406	1215	191
Mathematical physics	1514	1151	363
Mathematical physics - data processing	20	19	1
Molecules - mathematical models	4	4	0
Monte Carlo method	105	207	-102
Numerical analysis	618	516	102
Numerical weather forecasting	30	9	21
Parallel computers	86	58	28
Parallel processing - electronic computers	749	503	246
Physics - data processing	97	48	49
Science – data processing	606	128	478
Vector processing - computer science	24	10	14

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Appendix 1 – Information provided by program proposers

Program description information provided by Dr. Haynes

The current MSc program (on which the PhD program is based) is described on the program's webpage https://www.mun.ca/become/graduate/programs/computing.php as:

"Memorial University's MSc program in Scientific Computing was one of the first in North America, and remains the only such program in Atlantic Canada. It trains students in advanced computational techniques and in the application of these techniques to at least one scientific area, such as Applied Mathematics, Chemistry, Computer Science, Earth Sciences, Physics, or Physical Oceanography. Students can expect to gain knowledge and experience in: (1) state-of-the-art numerical methods, (2) high performance computer architectures, (3) use of software development tools for parallel and vector computers, (4) graphics, visualization, and multimedia tools, and (5) acquisition, processing, and analysis of large experimental data sets.

The Scientific Computing program is interdisciplinary, enriched by the expertise of faculty members in a range of academic units. Researchers in external organizations contribute by co-supervising students, providing placements for co-op students, providing computing resources, and teaching some courses. The program has close links with ACEnet, the Atlantic Canada Excellence network of high performance computers on which much of our computational work is carried out."

Provided Course Outlines and Reading Lists

Received from/Instructor	Reading list for
Ivan Saika-Voivod	Comprehensive Exam - Oceanography
Ivan Saika-Voivod	Comprehensive Exam - Physics
Alison Malcolm	EASC 6921 - Wave equation modeling, processing and inversion algorithms
Colin Farquharson	EASC 6994 - Geophysical inversion and applications
Martin Plumer	PHYS 3800 - Computational Physics
Entcho Demirov	PHYS 6318 - Numerical Modeling

Appendix 2 – Core course requirements for Simon Fraser University's Ph.D. in Applied and Computational Mathematics

Information excerpted from the SFU website on July 20th, 2016:
http://www.sfu.ca/students/calendar/2016/fall/programs/applied-and-computational-mathematics/doctor-of-philosophy.html

Department of Mathematics   Simon Fraser University Calendar | Fall 2016

Applied and Computational Mathematics

DOCTOR OF PHILOSOPHY

Core Course Requirements

Beyond all the courses the student completed for the bachelor's degree, the candidate will complete 24 units that consist of one of

APMA 900 - Asymptotic Analysis of Differential Equations (4)
APMA 901 - Partial Differential Equations (4)

and one of

APMA 920 - Numerical Linear Algebra (4)
APMA 922 - Numerical Solution of Partial Differential Equations (4)

and one of

APMA 930 - Computational Fluid Dynamics (4)
APMA 935 - Analysis and Computation of Models (4)

and at least one other course from the above course lists that has not already been completed and an additional eight graduate units.

Appendix 3 – Other Sources and Tools Consulted

1. Website: The AARMS Collaborate Research Group in Numerical Analysis and Scientific Computing: http://www.math.mun.ca/anasc/

2. Website: Centre for numerical analysis and scientific computing: https://www.mun.ca/cnasc/

3. Conference Program: Thirteenth Annual Student Research Forum, Computer Science and Scientific Computing, March 31 & April 1, 2016: http://www.mun.ca/computerscience/research/presentationschedule_2016.pdf

4. Online lists of recent publications by:
   - Ronald Haynes: http://www.math.mun.ca/~rhaynes/research.html
   - Herman Brunner: http://www.math.hkbu.edu.hk/~hbrunner/
   - Jahrul Alam: http://www.math.mun.ca/~alamj/publication.htm
   - Colin Farquharson: http://www.esd.mun.ca/~farq/pubs.html
   - Ivan Saika-Voivod: http://www.physics.mun.ca/~saika/pubs.htm
   - Alison Malcolm: http://www.esd.mun.ca/~amalcolm/#pubs
   - Martin Plumer: http://kelvin.physics.mun.ca/~plumer/Pubs/publications.pdf

5. Scimago Journal & Country Rank: http://www.scimagojr.com/journalsearch.php

6. Science Indexes:
   MathSciNet: http://www.ams.org/mathscinet/
   Scopus: https://www.scopus.com/
   Web of Science: http://apps.webofknowledge.com/

7. Simon Fraser University Library:
   - Catalogue: http://troy.lib.sfu.ca/search/X
   - Research guides: http://www.lib.sfu.ca/help/research-assistance/subject

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Phone: 709 864-7125   Email: aambi@mun.ca   Fax: 709 864 2153

Appendix B. Calendar regulations

Scientific Computing
www.mun.ca/science

Board of Study

- Dr. R. Haynes, Department of Mathematics and Statistics - Chair
- Dr. V. Booth, Department of Biochemistry
- Dr. C. Farquharson, Department of Earth Sciences
- Dr. T. Hu, Department of Computer Science
- Dr. F. Khan, Faculty of Engineering and Applied Science
- Dr. S. MacLachlan, Department of Mathematics and Statistics
- Dr. C. Rowley, Department of Chemistry
- Dr. I. Saika-Voivod, Department of Physics and Physical Oceanography

General Information

The Faculty of Science offers a program in Scientific Computing leading to a Doctor of Philosophy (PhD). Full-time and part-time options are available.

Qualifications for Admission

To be considered for admission,

1. applicants shall normally hold an M.Sc. degree in Scientific Computing, or equivalent, from a university of recognized standing, or
2. applicants shall normally hold an M.Sc. degree in an appropriate discipline from a university of recognized standing, or
3. registration and successful performance in the Scientific Computing MSc program for a minimum of 12 months and demonstration, to the satisfaction of the Board of Study, of an ability to pursue research at the Doctoral level, with the transfer happening no later than the fifth semester of the student's MSc program,
4. A BSc degree with an Honours, or equivalent, in an appropriate discipline that included completion of a thesis or dissertation from a university of recognized standing, and the approval of the Board of Study to enter the PhD program.

Program of Study

The supervisory committee, in consultation with the Board of Study, will determine the minimum course requirements for each PhD student in Scientific Computing depend on the admission route of the student. Given the interdisciplinary nature of the program, the guiding principle is to ensure an adequate background in both the core background in scientific computing and sufficient knowledge of the primary application area. Substitution for courses in the list of core scientific computing courses below are possible, in keeping with these guiding principles. Normally, the following guidelines would be followed:

1. Students who have completed an MSc in Scientific Computing or equivalent will be required to complete two courses (6 credit hours) chosen from the list of core courses below or two courses (6 credit hours) from the application area as appropriate.
2. Students who have completed a disciplinary MSc will be required to complete four courses (12 credit hours). Normally, three (9 credit hours) of these courses would be chosen from the list of core courses below to ensure sufficient training in scientific computing.
3. Students who transfer to the PhD program from our MSc in Scientific Computing are required to complete six courses (18 credit hours) in total, normally three to four of these courses would be from the list of core courses below.
4. In the exceptional case that a student is accepted to the PhD program after completing a BSc (Hons), the requirement will be completion of six courses (18 credit hours), normally three to four of these courses would be from the list of core courses below.
5. Students are required to pass a single Comprehensive Examination as prescribed under **Comprehensive Examinations, Ph.D. Comprehensive Examination**. This shall be an oral exam, and may include the presentation of a written research proposal.
6. The submission of an acceptable thesis is required. The thesis is to contain an original scholarly contribution which must be submitted to the School of Graduate Studies for final examination. The thesis must be written in a format according to procedures outlined in Guidelines for Theses and Reports by the School of Graduate Studies at www.mun.ca/sgs/go/guid_policies/theses.php.

Appendix C. Course listing

Core Courses

- MATH 6201 Numerical Methods for Time Dependent Partial Differential Equations
- MATH 6202 Nonlinear and Linear Optimization
- MATH 6204 Iterative Methods in Numerical Linear Algebra
- MATH 6210 Numerical Solutions of Differential Equations
- CMSC 6910 Matrix Computations and Applications or COMP 6732 Matrix Computations (credit may be obtained for only one of CMSC 6910 and COMP 6732)
- CMSC 6920 Scientific Programming
- CMSC 6930 Algorithms for Distributed and Shared Memory Computers
- CMSC 6950 Computer Based Tools and Applications *(credit may be obtained for only one of CMSC 6950 and the former CMSC 6940)*
- COMP 6906 Topics in Numerical Methods

Appendix D. Consultation

.

Feedback Summary and Response - Dec 7, 2016

On October 4, 2016 a request for collegial consultation on the proposal for a PhD program in Scientific Computing was sent to graduate officers, department heads, members of the various Dean's offices. This request and the feedback received is included in (this) Appendix D of the proposal document.

Feedback was received from:

+ Len Zedel (Associate Dean of Science)
+ Travis Fridgen (Head Chemistry)
+ Lev Tarasov (Physics)
+ Kurt Gamperl (Grad Officer Ocean Sciences)
+ Stephanie Curnoe (Deputy Head Grad Studies Physics and Physical Oceanograpy)
+ Leonard Lye (Associate Dean Grad Studies Faculty Engineering)
+ Richard Karsten (Professor, Acadia)
+ Chris Radford (Head Math and Stats)
+ Huaxiong Huang (Professor, York)
+ Paul Muir (Professor, Saint Mary's)
+ Brian Wetton (Professor, University of British Columbia)

On November 22, 2016 the Board of Study for the MSc program in Scientific Computing met to discuss the feedback and determine if any changes were needed. This document summarizes the feedback and highlights any subsequent changes made to the proposal document.

Len Zedel: Dr. Zedel pointed out a typo which has been fixed.
He also suggests that for students entering with MSc in scientific computing, we require 3 (not 2) disciplinary courses.   The board has decided not to make this change.

Travis Fridgen: positive feedback, no revisions.

Lev Tarasov: Dr. Tarasov expressed that he was fine with the general concept.
He asked us to clarify what "MSc in Scientific Computing or equivalent" is meant to mean in one of the admission routes. This is related to his second comment about minimum course requirements versus guidelines. To address these concerns we have reworded the course requirement section and added at the top: "All students MUST complete at least 2 courses, with higher expectations depending on background." Dr. Tarasov asked about the inclusion of a course on data analysis/stats. We have made inquiries to the participating departments (especially Computer Science and Mathematics and Statistics) about existing, related courses which could be included as a core course in the future. Initial responses suggest COMP 6915 Machine Learning or COMP 6907 Data Mining as options. We will look into adding these as possible core courses in both the MSc and Phd programs.   Dr. Tarasov mentions that the level of support is low at $18K. The minimum levels of PhD support varies considerably in the Faculty of Science. We have adjusted the text about student support to: "Financial support from the supervisor will also be provided to bring the student to existing norms in their home departments, to a minimum level of $18,000 per annum." Dr. Tarasov asks us to differentiate a scientific computing PhD from disciplinary degree that uses scientific computing.   We believe this program enforces specific structure (for example ensuring specific courses in scientific computing) that a PhD in Physics that uses scientific computing (for example) does not. Also not all existing disciplinary PhD programs have the flexibility to allow for the scientific computing training ensured here.

Kurt Gamperl: Dr. Gamperl thinks this is a very worthwhile program and asks us to clarify a few things.   Dr. Gamperl has a comment about TAships and the TAUMON agreement. We have clarified this with Carol Sullivan in SGS.   The current TAships for students in the MSc program in scientific computing are provided from a separate TA budget provided by the Dean of Science, and not the home department's TA budget.   If these TAships are indicated on the student's program of study, then Clause 12.03 of the TAUMON agreement does not apply.   Moreover, the Dean of Science office has indicated they have no problem to continue this funding for the MSc program and the new Phd program. TAships are indicated in Table 2 - in the template provided by SGS for new programs they are indicated as Graduate Assistantships.   Dr. Gamperl points out that the Department of Ocean Sciences is not listed as an involved academic unit. We are certainly happy to add them to the list - they have never been involved with the

existing MSc program, hopefully this will change in the future. Dr. Gamperl has reservations about direct admission to the PhD program from a BSc Honours degree. This is normal in Faculty of Science and allowed by SGS. We already say this is an exceptional route, but we can see potential use for it. Dr. Gamperl has concerns about the comprehensive structure. There is huge variability across the University and within the Faculty of Science. We believe this fits within the norms. He has concerns with the minimum support level, we have addressed this concern above. The $9785 per student amount of baseline funding is the amount for students in the Faculty of Science, this has been confirmed with Carol Sullivan. The graduate assistantship amounts provided in Table 2 have been adjusted slightly to fix the arithmetic.

Stephanie Curnoe: Dr. Curnoe thinks this is a logical extension of the existing MSc program and would enhance graduate opportunities. She suggests that we increase the number of required courses from 2 to 3. We have chosen not to do this but we have adjusted the text of the course requirement section as indicated above. Dr. Curnoe also suggest waiting until the ongoing review of the interdisciplinary programs is complete. We have decided not to do this. To best of our knowledge, the current review is a general review of the interdisciplinary programs associated with the Faculty of Science. It will likely not provide a thorough review of the scientific computing program.

Leonard Lye: Dr. Lye indicates that he has circulated the proposal and no one has issues.

Richard Karsten: Dr. Karsten thinks this program meets the obvious requirements with a good list of supporting faculty. We have attempted to tighten the language throughout in the revision of the proposal.

Chris Radford: Dr. Radford lends his strong support for the program, highlighting the demand for the program (the number of MSc students who have went on to more advanced studies elsewhere) and the general societal demand. To address his remark about the comprehensive exams we changed the first sentence to "the student will be provided with a syllabus and list of texts on which the exam will be based".

Huaxiong Huang: Dr. Huang gave a brief response indicating that MUN should support the program.

Paul Muir: Dr. Muir provides a positive letter highlighting the need and utility of the proposed program. He also returned a copy of the proposal highlighting various typos which we have addressed in the revised document.

Brian Wetton: Dr. Wetton provided a positive letter of support with nothing in particular to address.

Subject: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
From: Ronald Haynes <rhaynes74@gmail.com>
Date: Tue, 04 Oct 2016 11 :44:07 -0230
To: Ronald Haynes <rhaynes@mun.ca>, "jcloredoosti@mun.ca" <jcloredoosti@mun.ca>, Chris Radford
<cradford@mun.ca>, physicshead@mun.ca, "curnoe@mun.ca" <curnoe@mun.ca>, chemhead@mun.ca,
bestave@mun.ca, Christina Bottaro <cbottaro@mun.ca>, Yuanzhu Chen <yzchen@mun.ca>, mmiskell@mun.ca,
llye@mun.ca, "Naterer, Greg" <gnaterer@mun.ca>, rgs.associatedean@med.mun.ca, Kurt Gamperl
<kgamperl@mun.ca>, John Hanchar <jhanchar@mun.ca>, biochem@mun.ca, biochead@mun.ca, gong@mun.ca,
Jean-Christophe Nave <jcnave@math.mcgill.ca>, Huaxiong Huang <hhuang@mathstat.yorku.ca>, Richard Karsten
<richard.karsten@acadiau.ca>, "Marino, Paul" <pmarino@mun.ca>, grad-studies@play.psych.mun.ca,
Psychology.Head@mun.ca, "Abrahams, Mark" <mabrahams@mun.ca>, Dean of Graduate Studies
<deanfgs@umanitoba.ca>, mpiercey-normore@grenfell.mun.ca, jahowell@grenfell.mun.ca
CC: "Kenny, Gail" <gkenny@mun.ca>
Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University.
The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific
Computing (please see the attached document). In appendix D of the template for new program proposals, we are
asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and
your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS)
at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our
understanding is that all units will again be contacted by SGS as part of the formal review process during the
remainder of the fall and winter.
Sincerely,
R Haynes
Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/-rhaynes
phone: (709) 864-8825
- Attachments:------------------------------------
PhD_proposal_20160ct4.pdf 944 KB
Subject: RE: Proposal for a PhD program in Scientific Computing
From: "Associate Dean of Science (Research)" <adsr@mun.ca>
Date: Thu, 3 Nov 2016 15:39:25 +0000
To: Ronald Haynes <rhaynes74@gmail.com>, Ronald Haynes <rhaynes@mun.ca>
CC: Cyr Couturier <Cyr.Couturier@mi.mun.ca>, "Fleming, Ian" <ifleming@mun.ca>, Carolyn Walsh
<cwalsh@play.psych.mun.ca>, Tom Chapman <tomc@mun.ca>, "Ivan Booth" <ibooth@mun.ca>
Ron,
My only concern with this program is the balance that needs to be kept between computational skills and
discipline specific skills .... What I don't want to see is us creating a phd degree that looks more like two
MSc's completed in parallel. With that in mind I was looking at the proposed course requirements. I'm
comfortable with the balance achieved for students entering with a discipline specific MSc. For students
entering with an MSc in computational science, I would suggest requiring at least one more course in the
discipline specific area. Without that, if I'm reading that correctly, a student might end up taking only 2
discipline specific courses.
Thanks,
Len

From: Ronald Haynes [mailto:rhaynes74@gmail.com]
Sent: November-03-16 10:44 AM
To: Ronald Haynes <rhaynes@mun.ca>
Cc: Cyr Couturier <Cyr.Couturier@mi.mun.ca>; Fleming, Ian <ifleming@mun.ca>; Carolyn Walsh
<cwalsh@play.psych.mun.ca>; Tom Chapman <tomc@mun.ca>; Ivan Booth <ibooth@mun.ca>;
Associate Dean of Science {Research) <adsr@mun.ca>
Subject: Re: Proposal for a PhD program in Scientific Computing
Hi folks, just a reminder about this request, please send along comments by the end of the day tomorrow. I
will be compiling comments over the weekend.
Sincerely,
RHaynes
Ronald Haynes
October 24, 2016 at 5:40 PM

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday November 2, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.

Subject: Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation

From: Travis Fridgen <chemhead@mun.ca>

Date: Tue, 4 Oct 2016 13:16:37 -0230

To: Ronald Haynes <rhaynes74@gmail.com>

Hi Ron,

I think this proposal for a PhD in Scientific Computing is a fine and worthwhile addition.

Travis

On 04/10/2016 11 :44 AM, Ronald Haynes wrote:

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.

Sincerely,

R Haynes

Dr. Ronald D. Haynes

Professor, Department of Mathematics and Statistics

Chair, Scientific Computing MSc Program

Memorial University of Newfoundland

email: rhaynes@mun.ca

web: www.math.mun.ca/-rhaynes

phone: (709) 864-8825

Travis D. Fridgen BSc, BEd, PhD

Professor and Head

Department of Chemistry

Memorial University

St. John's, NL, A 1 B 3X7

chemhead@mun.ca

709-864-3470

http://www.chem.mun.ca/zfac/tdf.php?

From: Lev Tarasov

Date: October 4, 2016 at 8:29:55 PM Newfoundland Daylight Time

To: S H Curnoe

Cc: Grad Studies 2016-17 , Joy Simmons , Kris Poduska , Qiying Chen , Ronald Haynes [!:] , Lev Tarasov

Subject: Re: FW: New proposal for a PhD In Scientific Computing at Memorial - Appendix D consultation (fwd)

I'm fine with the general concept, but have a few issues:

1) The option 1) route for entrance with limited course requirements (MSc in Scientific computing or equivalent) needs clarification of what equivalent means. Does someone who did a disciplinary MSc that was based on computer modelling qualify? I would hope so, otherwise there is too much weight on program name as opposed to actual background/skills.

2) the 2 course difference in requirements between option 1 and option 2(disciplinary) MScs seems a bit unfair. Both of the above though could be lesser issues if the language were not contradictory: Are they "minimum course requirements" or "guidelines"?

3) With the inclusion of "big data" in the rational, why is there no associated core course on data analysis/stats?

4) $18,000/year recommended support seems a bit low, given that physics is now $21k.

5) A few clearer examples of what differentiates Interdisciplinary scientific computing from disciplinary would help.

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From my quick read, it just seems the program is disciplinary research combined with scientific computing. Then all my grad students would qualify for this. At the MSc level, the program makes sense given the possible applied end-points for the students. At the PhD level, I'd like to see clearer justification given the research end-point for PhDs. But heck, I guess any such programs offer more funding pathways for grad students here ...
1

Lev Tarasov - Dept of Physics and Physical
Oceanography,
Memorial University of Newfoundland.
email: lev@mun.ca
http://www.physics.mun.ca/~lev/
Tel (709)-864-2675
Fax (709)-864-8739
On Tue, 4 Oct 2016, S H Curnoe wrote:
>
>
> Dear committee members,
>
> as an addendum to my previous message, please see email below from Jolanta.
> Please send your comments about this proposal to our committee by October 11,
>and I'll try to formulate a response from us.
>
>
> Stephanie
>
>
> ---------- Forwarded message --------->
Date: Tue, 04 Oct 2016 12:19:30 -0230
> From: Physics Head <physicshead@mun.ca>
>To: S H Curnoe <curnoe@mun.ca>
> Subject: FW: New proposal for a PhD in Scientific
Computing at Memorial -
> Appendix D consultation
>
> Stephanie,
> Please have the Grad Studies Committee look at this and give its input to
>Ron (with a copy to me). I am not sure if at this point I will seek
> consultation from the department as a whole. I might wait till the formal
> review later on.
> Jolanta
>
> On 2016-10-04, 11:44 AM, "Ronald Haynes"
<rhaynes74@gmail.com> wrote:
>
>> Hi folks, I am writing as chair of the MSc interdisciplinary program in
>> Scientific Computing at Memorial University. The board of study for
>> the MSc program has written a proposal for a new interdisciplinary PhD
>> program in Scientific Computing (please see the attached document).
>> In appendix D of the template for new program proposals, we are asked
>> to include evidence of collegial consultation with interested or
>> associated units. Our request for feedback and your responses will be
>> included in the Appendix of the proposal to be sent to the School of
>> Graduate Studies (SGS) at Memorial for formal review. We are asking
>> for your email feedback by Wednesday October 19,
2016. Our
>> understanding contacted by SGS
>> of the formal remainder of the
>>
>> ----
>> Sincerely,
>> R Haynes
>>
is that all units will as part review process during

fall and winter.
>> Dr. Ronald D. Haynes
again be the
>> Professor, Department of Mathematics and
Statistics
>> Chair, Scientific Computing MSc Program
>> Memorial University of Newfoundland
>> email: rhaynes@mun.ca
>> web: www.math.mun.ca/~rhaynes
>> phone: (709) 864-8825
>>
>
From: Kurt Gamperl
Date: October 7, 2016 at 8:40:57 AM Newfoundland Daylight Time
To: Ronald Haynes 0
Cc: Ronald Haynes IIJ , jcloredoosti@mun.ca ILI , Chris Radford IIJ , physicshead@mun.ca , "curnoe@mun.ca" ,
chemhead@mun.ca, bestave@mun.ca,Christina Bottaro, Yuanzhu Chen, mmiskell@mun.ca, llye@mun.ca,
"Naterer, Greg", rgs.associatedean@med.mun.ca,John Hanchar, biochem@mun.ca, biochead@mun.ca,
gong@mun.ca , Jean-Christophe Nave , Huaxiong Huang , Richard Karsten , "Marino, Paul" , gradstudies@
play.psych.mun.ca , Psychology.Head@mun.ca , "Abrahams, Mark" , Dean of Graduate Studies ,
mpiercey-normore@grenfell.mun.ca, jahowell@grenfell.mun.ca,"Kenny, Gail"
Subject: Re: New proposal for a PhD In Scientific Computing at Memorial - Appendix D consultatlon
Ronald:
I think this will be a very worthwhile program, but I have identified a number of points of concern/that require
clarification.
Kurt Gamperl
In the document (Pages 1 and 14) it is indicated that the 'home Dept.' where the supervisor is located will be
providing TA ships ... if my understanding of the TAUMAN agreement is correct ... this can only occur if the Dept.
does not have enough students from its own graduate program(s) to fill all the available TA positions. This is unlikely
to happen in many departments. Also, why are T Aships not included in Table 2 as a source of funding for graduate
students?
The Dept. of Ocean Sciences is not listed as an• Academic Unit Involved'. Have their been any discussions with my
Department?? Is this an oversight that should be corrected in the next reversion?
Admission requirements: I am not comfortable with option (iv) ... entering the Ph.D. direct from an honours B.Sc ..
Further, I don't understand its inclusion as an option, given that students in the Scientific Computing M.Sc. program
cannot transfer until after 12 months in that program ... and only after consideration of the Board of Study of their
performance. Option iv should be removed. Enter the M.Sc. program first.. .if their performance is
exceptional/outstanding ... then they can transfer to a Ph.D.
I have issues with the structure of the comprehensive. The comprehensive exam is to be completed based on the
20-25 page paper, which is specific to the student's thesis, and has various components incl. background, progress
to date, proposal. The student should be well past this point by the 7th semester (given that it is a 4 year program),
and it is the job of the supervisory committee, not the comprehensive
examination committee, to critique the thesis proposal etc. As designed, the comprehensive committee is basically
examining both the supervisory committee members and the candidate on the proposal .... the proposal should
have been devised based on their collective input. I suggest that topic of the •paper' that the student is examined on
be selected by the comprehensive examination committee, and not be
directly on the topic of the thesis to ensure that it will broader the candidates knowledge of their general research
area, and enable the examination committee to truly evaluate the candidates cognitive abilities, and capacity to
synthesize a document that not summarizes a topic, but provides added value with respect to where scientific gaps
are, what the most important work that still needs to be done is. This is the procedure in many other departments,
and I think would serve well here. How long does the student have to prepare the paper? This is not defined.
I feel a recommended level of support of $18,000 is too low, especially given the recent 30% increase in tuition/fees.
I recommend this be set at $19,500 or greater. Is there a commitment from the Dean to provide the number of
Graduate Assistantships/funds as indicated in Tables 2 and 3. In my experience, I would be very surprised is he
would be providing 14.95 GAships (19,908/1331.42) to a program with 8 students. Also, if 8 students each get 2
TAships, would this value not be $21302.72. Please provide commitment in writing/e-mail from the Dean of Science.
Just because the University gets tuition from student fees, there is no obligation to have this returned as GAs to the
Dept., especially the number indicated/requested in this document. Thus, I expect the 'net expenditures' for this
program will be much higher.
Also, comparing Tables 1 and 2, it appears that the program is allocating $9785 per student. I am not clear on
where this value comes from?
Kurt Gamperl

Kurt Gamperl,
Professor and Graduate Officer,
Department of Ocean Sciences,
Memorial University of Newfoundland,
St. John's, NL.
Canada, A1C 5S7
Phone:709-864-2692
FAX: 709-864-3220
Email: kgamperl@mun.ca
https://cloud.creait.mun.ca/osc/research/labs/kgamperl

On 04/10/2016 11 :44 AM, Ronald Haynes wrote:
Hi folks, I am writing as chair of the MSc interdisciplinary program in
Scientific Computing at Memorial University.   The board of study for
the MSc program has written a proposal for a new interdisciplinary PhD
program in Scientific Computing (please see the attached document).
In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or
associated units.   Our request for feedback and your responses will be
included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.

Sincerely,
R Haynes

Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/~rhaynes
phone: (709) 864-8825

From: Ronald Haynes
Date: October 7, 2016 at 10:52:53 AM Newfoundland Daylight Time
To: Kurt Gamperl
Cc: Evernote Upload , Ronald Haynes
Subject: **Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation**
Thanks Kurt for your insight and suggestions. I can respond to a couple of things directly - others will take more thought.
Kurt Gamperl October 7, 2016 at 9:09 AM
Ronald:
I think this will be a very worthwhile program, but I have identified a number of points of concern/that require clarification.
Kurt Gamperl
In the document (Pages 1 and 14) it is indicated that the 'home Dept.' where the supervisor is located will be providing TA ships...if my
understanding of the TAUMAN agreement is correct...this can only occur if the Dept. does not have enough students from its own graduate
program(s) to fill all the available TA positions. This is unlikely to happen in many departments. Also, why are TAships not included in
Table 2 as a source of funding for graduate students?
My personal opinion is that TA positions can always be created - the Dean's office funds the TA positions for interdisciplinary programs. Create a TA position, Dean's office pays. I have had a previous discussion with the Dean's office who indicates that for the number of students we are talking about there should be no problem with the funds.
The Dept. of Ocean Sciences is not listed as an 'Academic Unit Involved'. Have their been any discussions with my Department?? Is this
an oversight that should be corrected in the next reversion?
Sort of an oversight but historically motivated. The list of involved units come from the list historically associated with the current dept. Your dept has not made it on this list and to my knowledge has never been involved with the MSc program. Of course we know you exist otherwise you would not have been contacted at all!

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Admission requirements: I am not comfortable with option (iv)...entering the Ph.D. direct from an honours B.Sc.. Further, I don't
understand its inclusion as an option, given that students in the Scientific Computing M.Sc. program cannot transfer until after 12 months in
that program...and only after consideration of the Board of Study of their performance. Option iv should be removed. Enter the M.Sc.
program first...if their performance is exceptional/outstanding...then they can transfer to a Ph.D.

There was a lot of discussion about this point but the majority of the board decided to go ahead with the proposal this way.

I have issues with the structure of the comprehensive. The comprehensive exam is to be completed based on the 20-25 page paper, which is
specific to the student's thesis, and has various components incl. background, progress to date, proposal. The student should be well past
this point by the 7th semester (given that it is a 4 year program), and it is the job of the supervisory committee, not the comprehensive
examination committee, to critique the thesis proposal etc. As designed, the comprehensive committee is basically examining both the
supervisory committee members and the candidate on the proposal....the proposal should have been devised based on their collective input.
I suggest that topic of the 'paper' that the student is examined on be selected by the comprehensive examination committee, and **not** be
directly on the topic of the thesis to ensure that it will broader the candidates knowledge of their general research area, and enable the
examination committee to truly evaluate the candidates cognitive abilities, and capacity to synthesize a document that not summarizes a
topic, but provides added value with respect to where scientific gaps are, what the most important work that still needs to be done is. This is
the procedure in many other departments, and I think would serve well here. How long does the student have to prepare the paper? This is
not defined.

Not surprisingly this received most of the discussion on the board - I will certainly take your comments back to the board before official submission.

I feel a recommended level of support of $18,000 is too low, especially given the recent 30% increase in tuition/fees. I recommend this be
set at $19,500 or greater.

Sounds great - I will look forward to your contributions! The reality is that a lot of the faculty members traditionally involved with the MSc program work with small grants. This amount is already higher
than the amount that PhD students in Math get now... I agree though that we should strive to get these levels up...

Is there a commitment from the Dean to provide the number of Graduate Assistantships/funds as indicated in Tables 2 and 3. In my
experience, I would be very surprised is he would be providing 14.95 GAships (19,908/1331.42) to a program with 8 students. Also, if 8
students each get 2 TAships, would this value not be $21302.72. Please provide commitment in writing/e-mail from the Dean of Science.
Just because the University gets tuition from student fees, there is no obligation to have this returned as GAs to the Dept., especially the
number indicated/requested in this document. Thus, I expect the 'net expenditures' for this program will be much higher.
Also, comparing Tables 1 and 2, it appears that the program is allocating $9785 per student. I am not clear on where this value comes from?

The numbers were arrived at by Carol Sullivan in SGS - I will certainly check those and attempt to secure commitments in writing from the Dean that match my previous discussions with his office.
Thanks again!
Likely we will address small things before the program is officially submitted for review.
Best,
R Haynes

Kurt Gamperl

Kurt Gamperl,
Professor and Graduate Officer,
Department of Ocean Sciences,
Memorial University of Newfoundland,
St. John's, NL.

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Canada, A1C 5S7
Phone: 709-864-2692
FAX: 709-864-3220
e-mail: kgamperl@mun.ca
https://cloud.creait.mun.ca/osc/research/labs/kgamperl

Ronald Haynes October 4, 2016 at 11:44 AM

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study

for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached

document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with

interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to

the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19,

2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the

fall and winter.

Sincerely,

R Haynes

Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/~rhaynes
phone: (709) 864-8825

--
Dr. Ronald D. Haynes (PhD), Professor
Chair, Scientific Computing MSc Program
Department of Mathematics & Statistics
Memorial University of Newfoundland
St. John's, NL, Canada
A1C 5S7
(P) 709-864-8825
(F) 709-864-3010

Subject: Re: FW: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation (fwd)
From: S H Curnoe <curnoe@mun.ca>
Date: Tue, 18 Oct 2016 13:02:25 -0230 (NOT)
To: Ronald Haynes <rhaynes@mun.ca>

Dear Ron,

The only comments I received were those from Lev, which you can include in the Appendix.

Here are my own comments:

The proposed PhD program in Scientific Computing seems to be a logical extension of the MSc program that would enhance graduate opportunities at MUN.

My only suggestion concerning the proposed calendar regulations is that the normal number of courses for students who have a MSc in Scientific Computing be increased from a minimum of two to three, if three is the norm for PhD programs in the different units that will participate in this program. The course requirement for PhD's in our unit is three.

I understand that there will soon be a review of all of the interdisciplinary programs that operate from the Dean of Science office. My suggestion is to wait until until this review has been completed before proceeding with the proposal.

Sincerely,

Stephanie Curnoe

Stephanie H. Curnoe, Professor and Deputy Head (Graduate Studies)
Department of Physics and Physical Oceanography, Memorial University of Newfoundland, St. John's, NL, A 1 B

3X7, Canada telephone: 1-709-864-8888 facsimile: 1-709-864-8739 curnoe@mun.ca

http://www.physics.mun.ca/-curnoe/

Posting to you live from St. John's

On Tue, 4 Oct 2016, Ronald Haynes wrote:

Date: Tue, 04 Oct 2016 21 :05:28 -0230

From: Ronald Haynes <rhaynes@mun.ca>

To: Lev Tarasov <lev@mun.ca>

Cc: SH Curnoe <curnoe@mun.ca>, Grad Studies 2016-17 <jleblanc@mun.ca>,

Joy Simmons <jsimmons@mun.ca>, Kris Poduska <kris@mun.ca>,

Qiying Chen <qiyinqc@mun.ca>

Subject: Re: FW: New proposal for a PhD in Scientific Computing at Memorial -

Appendix D consultation (fwd)

Thanks Lev for the comments. Dr. Curnoe - I will be happy to include Lev's comments in the Appendix D and/or wait for a general response, whichever you prefer.

Sincerely,

R Haynes

Lev Tarasov wrote:

I'm fine with the general concept, but have a few issues:

1) The option 1) route for entrance with limited course requirements (MSc in Scientific computing or equivalent) needs clarification of what equivalent means. Does someone who did a disciplinary MSc that was based on computer modelling qualify? I would hope so, otherwise there is too much weight on program name as opposed to actual background/skills.

2) the 2 course difference in requirements between option 1 and option 2(disciplinary) MScs seems a bit unfair. Both of the above though could be lesser issues if the language were not contradictory: Are they "minimum course requirements" or "guidelines"?

3) With the inclusion of "big data" in the rational, why is there no associated core course on data analysis/stats?

4) $18,000/year recommended support seems a bit low, given that physics is now $21k.

5) A few clearer examples of what differentiates interdisciplinary scientific computing from disciplinary would help. From my quick read, it just seems the program is disciplinary research combined with scientific computing. Then all my grad students would qualify for this. At the MSc level, the program makes sense given the possible applied end-points for the students. At the PhD level, I'd like to see clearer justification given the research end-point for PhDs. But heck, I guess any such programs offer more funding pathways for grad students here ...

Lev Tarasov - Dept of Physics and Physical Oceanography,

Memorial University of Newfoundland.

email: lev@mun.ca

http://www. physics. mu n.cal-lev/

Tel (709)-864-2675

Fax (709)-864-8739

On Tue, 4 Oct 2016, SH Curnoe wrote:

Dear committee members,

as an addendum to my previous message, please see email below from Jolanta. Please send your comments about this proposal to our committee by October 11 , and I'll try to formulate a response from us.

Stephanie

---------- Forwarded message ---------Date:

Tue. 04 Oct 2016 12:19:30 -0230

From: Physics Head <physicshead@mun.ca>

To: S H Curnoe <curnoe@mun.ca>

Subject: FW: New proposal for a PhD in Scientific Computing at Memorial -

Appendix D consultation

Stephanie,

Please have the Grad Studies Committee look at this and give its input to Ron (with a copy to me). I am not sure if at this point I will seek consultation from the department as a whole. I might wait till the formal review later on.

Jolanta

On 2016-10-04, 11:44 AM, "Ronald Haynes" <rhaynes74@gmail.com> wrote:

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document).

In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or

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associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.

Sincerely,
R Haynes
Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/-rhaynes
phone: (709) 864-8825

Sincerely,
R Haynes
Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/-rhaynes
phone: (709) 864-8825

Subject: RE: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
From: "Lye, Leonard M." <llye@mun.ca>
Date: Wed, 19 Oct 2016 11 :08:00 +0000
To: Ronald Haynes <rhaynes74@gmail.com>
Ron:
I have circulated the proposal and no one has any issues.
Leonard
Dr. Leonard M. Lye, PEng, PhD, FCSCE, FEC, FCAE
Associate Dean (Graduate Studies)
Professor of Civil Engineering
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's, A 1 B 3X5, Canada
Tel: 709-864-8900/8901, Fax: 709-864-3480
Program Director
Shad Valley Memorial
www.shad.ca
Founder and Coordinator
Tetra Society of North America (St. John's Chapter)
tetra.engr.mun.ca
From: Ronald Haynes [mailto:rhaynes74@gmail.com]
Sent: October-19-16 8:20 AM
To: Ronald Haynes; jcloredoosti@mun.ca; Chris Radford; physicshead@mun.ca; curnoe@mun.ca; chemhead@mun.ca; bestave@mun.ca; Christina Bottaro; Yuanzhu Chen; mmiskell@mun.ca; Lye, Leonard M.; Naterer, Greg; rgs.associatedean@med.mun.ca; Kurt Gamperl; John Hanchar; biochem@mun.ca; Biochemistry Head;
gong@mun.ca; Jean-Christophe Nave; Huaxiong Huang; Richard Karsten; Marino, Paul; grad-studies@play.psych.mun.ca; Psychology.Head@mun.ca; Abrahams, Mark; Dean of Graduate Studies; mpierceynormore@
grenfell.mun.ca; jahowell@grenfell.mun.ca
Cc: Kenny, Gail
Subject: Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
Hi folks, just a quick reminder that today is the deadline to submit feedback on the proposal for a PhD program in Scientific Computing. Thanks to those you have submitted already.
Best,
RHaynes
Ronald Haynes
October 4, 2016 at 11:44 AM

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Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.
Sincerely,
RHaynes
Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program
Memorial University of Newfoundland
email: rhavnes@mun.ca
web: www.math.mun.ca/-rhaynes
phone: (709) 864-8825
Dr. Ronald D. Haynes (PhD), Professor
Chair, Scientific Computing MSc Program
Department of Mathematics & Statistics
Memorial University of Newfoundland
St. John's, NL, Canada
AIC 5S7
(P) 709-864-8825
(F) 709-864-3010
Subject: Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
From: Richard Karsten <richard.karsten@acadiau.ca>
Date: Wed, 19 Oct 2016 12:15:46 +0000
To: Ronald Haynes <rhaynes74@gmail.com>
Ron,
Wow, that's a lot of info. I don't have the time to give it a thorough read, but it's looks very good.
I'm not sure I agree with the approach of asking for a new program with little new resources, even if that is necessary to get it approved. There will be considerable extra work involved -- especially in the admin of the program, running all the exams, defences etc.
Also, several times you used a range of numbers, 3 to 4 courses, 20 to 25 pages etc. I'd make these more specific and clear, so that there are easy rules to enforce-- at least 3 courses, between 20 and 25 pages (if you want an upper limit).
I can't imagine this not getting approved, meets all the obvious requirements, with a nice list of supporting faculty.
Cheers,
Richard
Sent from my iPad
On Oct 19, 2016, at 7:47 AM, Ronald Haynes <rhaynes74@gmail.com> wrote:
Hi folks, just a quick reminder that today is the deadline to submit feedback on the proposal for a PhD program in Scientific Computing. Thanks to those you have submitted already.
Best,
R Haynes
Ronald Haynes October 4, 2016 at 11 :44 AM
Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.
Sincerely,
R Haynes
Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, Scientific Computing MSc Program

45

Memorial University of Newfoundland
email: rhaynes@mun.ca
web: www.math.mun.ca/-rhaynes
phone: (709) 864-8825
Dr. Ronald D. Haynes (PhD), Professor
Chair, Scientific Computing MSc Program
Department of Mathematics & Statistics
Memorial University of Newfoundland
St. John's, NL, Canada
A1C 5S7
(P) 709-864-8825
(F) 709-864-3010

Subject: Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
From: Chris Radford <cradford@mun.ca>
Date: Wed, 19 Oct 2016 11:21:30 -0230
To: Ronald Haynes <rhaynes74@gmail.com>

Dear Ron,

I would like to give my strong support to the proposed PhD program in Scientific Computing.

I see the addition of this program to Memorial's suite of graduate degrees as an important acknowledgement of the future direction of much of what is done in science and engineering - the increasing use of computational power and sophisticated mathematical models to test and solve real world scientific problems.

The fact that around half the recent graduates from the Masters program in Scientific Computing have gone on to doctoral studies is a strong indicator that there is a degree of unmet demand, and there is every expectation that the proposed new degree would meet its modest goals.

There is growing recognition worldwide of the need for highly trained personnel in the discipline of Scientific Computing.

People who combine the scientific, mathematical modelling and computing skills necessary to attack diverse, complex problems from a range of scientific disciplines; people who can bring their modelling and computational expertise to teams of scientists working in different scientific disciplines.

The Masters program in Scientific computing has attracted a steady number of students over the years, and has produced graduates who have gone on to good careers in academia and industry. But to some extent the students in the program have been largely project oriented, i.e. the emphasis has very much been on the individual project that the supervisor brings to the program, rather than generalist training in Scientific Computing. The addition of a strong doctoral program in Scientific Computing would bring new life, rigour and students to the discipline of Scientific Computing at Memorial.

One point that it would be good to clarify in the proposal relates to the comments made Kurt Gamperl from the Department of Ocean Sciences on the structure of the proposed Comprehensive Examination. While I think some of the criticism is based on a misunderstanding of the proposed structure - after all, this structure is essentially the one used in Physics and Physical Oceanography - it is probably worth clarifying things in your proposal. In particular I think it would make sense to at least add that "the student will be provided with a syllabus and a list of texts ... " in your description of the comprehensive examination.

Regards,
Chris Radford.

On 2016-10-19 8:16 AM, Ronald Haynes wrote:

Hi folks, just a quick reminder that today is the deadline to submit feedback on the proposal for a PhD program in Scientific Computing. Thanks to those you have submitted already.

Best,
R Haynes

Ronald Haynes October4, 2016at11:44 AM

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are asking for your email feedback by Wednesday October 19, 2016. Our understanding is that all units will again be contacted by SGS as part of the formal review process during the remainder of the fall and winter.

Sincerely,
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Professor, Department of Mathematics and Statistics

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(P) 709-864-8825
(F) 709-864-3010
****

* Dr. Chris Radford *
* Professor and Head, *
* Dept Mathematics and Statistics *
* Memorial University, *
*St John's *
* Canada. * * 1 709 864 8730 *
* cradford@mun.ca *
****

Subject: Re: New proposal for a PhD in Scientific Computing at Memorial - Appendix D consultation
From: hhuang@mathstat.yorku.ca
Date: Wed, 19 Oct 2016 19:29:48 +0800
To: Ronald Haynes <rhaynes74@gmail.com>
Hi Ron,
I'm sorry that I don't have time to evaluate your proposed program.
I think it's a good program and MUN should support it.
Good luck.
Huaxiong
Sent from my iPhone
On Oct 19, 2016, at 6:46 PM, Ronald Haynes <rhaynes74@qmail.com> wrote:
Hi folks, just a quick reminder that today is the deadline to submit feedback on the proposal for a PhD program in Scientific Computing. Thanks to those you have submitted already.
Best,
R Haynes
Ronald Haynes October 4, 2016 at 11 :44 AM
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Dr. Ronald D. Haynes (PhD), Professor
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Department of Mathematics & Statistics
Memorial University of Newfoundland
St. John's, NL, Canada
A1C 5S7

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(P) 709-864-8825
(F) 709-864-3010
"~I~1~ One University. One World. Yours.

To whom it may concern,

FACULTY
OF SCIENCE
MATH & COMPUTING SCIENCE
Department Office
T 902.420.5784
F 902.420-5035
E mcschair@smu.ca

Oct. 21, 2016

I am writing this letter in response to a request (by e-mail dated Oct. 7, 2016) from Dr. Ronald Haynes, chair of the M.Sc. interdisciplinary program in Scientific Computing at Memorial University, to provide comments on the document he sent to me, titled "New Graduate Program Proposal", which is a proposal for a new Ph.D. program in Scientific Computing to be offered by Memorial University. I have carefully reviewed the document; my general comments are as follows:

• As a long-time researcher (30+ years) in the area of Scientific Computing, I can confirm the claims made in Section 3 of the proposal (page 3), that assert that Scientific Computing has become a central pillar in the study of applications in every area of science and engineering. This has been true for many decades and as the complexity of the questions that scientists try to answer increases, the role of Scientific Computing becomes even more critical. In fact, Memorial University already recognized this approximately two decades ago when it introduced its M.Sc. in Scientific Computing. The proposal (on page 7) further indicates that there is interest in Scientific Computing on the local level, involving industries in the St. John's region and across the province.

• I can also confirm, as a long-time researcher in Scientific Computing from the Atlantic provinces, that there is no program in this part of the country that is even remotely similar to the proposed Ph.D. program. (In fact, there is no program even remotely similar to the M.Sc. program in Scientific Computing offered at Memorial.) However, there is certainly value in having such a program available in this region. Page 4 of the proposal documents a number of similar programs that have been offered by other universities across the continent; there is a long history of universities successfully offering such programs.

• The fact that the proposed Ph.D. program will be explicitly interdisciplinary in nature is important. The students in the program will be required to take at least two courses from a specific application department (see page 9). The students who complete the program will not only have a strong base of knowledge in Scientific Computing, they will also have developed strengths in a specific application domain.

• A major advantage of the proposed Ph.D. program is that it is built on the existing M.Sc. program in Scientific Computing, which has had two decades of successful operation. This implies (see page 17) that the new program can make use of the existing resources associated with the M.Sc. program and thus can be offered in an essentially revenue-neutral manner. Memorial University already has the people and organizational infrastructure in place to easily support the new Ph.D.

• Finally, there is a "built-in" population of students who would quite likely be interested in participating in the new Ph.D. program, namely the students who graduate from the M.Sc. in Scientific Computing. And of course I am sure that there would be interest from students from outside Memorial University, including students from other universities in the Atlantic region who graduate with an M.Sc. or B.Sc. in a discipline specific area who have found that they have developed a significant interest in Scientific Computing.

I fully support the proposal for the new Ph.D. program; I think it will provide an important contribution to the program offerings in Atlantic Canada.

Sincerely,

Dr. Paul Muir

923 Robie Street • Halifax • Nova Scotia 83H 3C3 • Canada • www.smu.ca/academic/science/compsci

Subject: Re: Feedback on PhD Proposal in Scientific Computing
From: Brian Wetton <wetton@math.ubc.ca>
Date: Fri, 21Oct2016 11:43:38 -0700
To: Ronald Haynes <rhaynes74@gmail.com>

Ron,

I read through the executive summary of your proposal. I think this will be an excellent programme. Here at UBC we are already behind you: we don't have the interdisciplinary MSc computing programme you are building on. There is a real gap here for graduate students with these interests, noticed most strongly in Computer Science, where there are departmental degree requirements that are not appropriate for this research area.

I thought you made a great case for the programme. They would be foolish to turn this down (but of course, administrators can be foolish). The only thing I saw in the document that you might want to change is there was some formatting issues with the student names at the beginning of section 4.

I had an additional question out of curiosity. In section 8, you mention that faculty teaching scientific computing

courses have that counted as extra teaching. Does that mean they teach these courses above their regular, departmental load?

If so, that shows real dedication, but for the long term health of this important activity, you should push for recognition of this teaching in standard loads. (But... I may have misinterpreted this comment).

Nice pitch. Every time I thought of something to add, you addressed it later in the document.

Best. - Brian.

Dr. Brian R. Wetton, Professor
Mathematics Department, UBC
Director, Institute of Applied Mathematics
wetton@math.ubc.ca
www.math.ubc.ca/-wetton/

On Oct 19, 2016, at 3:47 AM, Ronald Haynes <rhaynes74@gmail.com> wrote:

Hi folks, I hope everyone is surviving the fall so far. A gentle reminder that we would like to have (at least) a few words of feedback on this proposal by Friday.

Best,

R Haynes

Ronald Haynes October 7, 2016 at 12:58 PM

Hi folks, I am writing as chair of the MSc interdisciplinary program in Scientific Computing at Memorial University. The board of study for the MSc program has written a proposal for a new interdisciplinary PhD program in Scientific Computing (please see the attached document). In appendix D of the template for new program proposals, we are asked to include evidence of collegial consultation with interested or associated units. Our request for feedback and your responses will be included in the Appendix of the proposal to be sent to the School of Graduate Studies (SGS) at Memorial for formal review. We are hoping you could provide some email feedback to us by Friday October 21, 2016. If you have some questions about the type of feedback required, please let me know.

Dr. Ronald D. Haynes (PhD), Professor
Chair, Scientific Computing MSc Program
Department of Mathematics & Statistics
Memorial University of Newfoundland
SL John~. NL, Canada
A1C 5S7
(P) 709-864-8825
(F) 709-864-3010
-Attachments:---------------------------------
image002.png O bytes

Appendix E: CVs of those involved in the program

Kenny, Gail

From: MathStat Graduate Officer <mathgrad@mun.ca>
Sent: January-31-17 10:22 PM
To: Kenny, Gail
Subject: Re: SP Topics MATH 6261

Hi Gail,

this course has been approved by the committee with 11 votes in favour (Ron, Alison, Carolyn, Ivan, Cyr, Tom, Kur, Stephanie, Yuanzhu and myself), none against. Thus Faculty Council and Academic Council should be informed of this decision.

-j

On 26/01/17 11:26 AM, Kenny, Gail wrote:
> Hi JC,
>
> Attached are Special Topics form and documents for approval of MATH 6261, Geometric numerical integration.
>
> Items for the agenda for the next Faculty Council meeting (February 15) must be received by February 7.
>
> Gail
>
> Gail Kenny
> Dean of Science Office (C-2001)
> Memorial University of Newfoundland
> St. John's, NL   A1B 3X7
> gkenny@mun.ca
>
>

--
JC Loredo-Osti
Graduate Officer
Department of Mathematics and Statistics
Memorial University
Phone: +(709) 864 8729

1

MEMORIAL
UNIVERSITY

School of Graduate Studies

Request for Approval of a
Graduate Course

Adobe Reader, minimum version 8, is required to complete this form. Download the latest version: http://get.adobe.com/reader. (1) Save the form by clicking on the diskette icon on the upper left side of the screen; (2) Ensure that you are saving the file in PDF format; (3) Specify where you would like to save the file, e.g. Desktop; (4) Fill in the required data and save the file; (5) Submit the completed form to:

School of Graduate Studies; Memorial University of Newfoundland; IIC-2012 (Bruneau Centre for Research and Innovation); St. John's, NL A1C 5S7 Canada   Fax: 709.864.4702   eMail: sgs@mun.ca

To: Dean, School of Graduate Studies
From: Faculty/School/Department/Program
Subject: ☐ Regular Course   ☑ Special/Selected Topics Course

Course No.: MATH 6261

Course Title: Geometric numerical integraion

I.   **To be completed for all requests:**

A. **Course Type:**   ☑ Lecture course   ☐ Lecture course with laboratory
                                   ☐ Laboratory course   ☐ Undergraduate course[1]
                                   ☐ Directed readings   ☐ Other (please specify) term project

B. **Can this course be offered by existing faculty?**   ☑ Yes   ☐ No

C. **Will this course require new funding (including**   ☐ Yes   ☑ No
        Payment of instructor, labs, equipment, etc.)?
        If yes, please specify:

D. **Credit hours for this course:** 3

E. **Estimated number of contact hours per semester:** 36

F. **Course description (reading list required):**
        See attached document

G. **Method of evaluation:**

	Percentage	
	Written	**Oral**
Class tests	30	
Assignments	15	
Other (specify): term project	15	
Final examination:	40	
Total	100	

---
[1] Must specify the additional work at the graduate level

II. **To be completed for special/selected topics course requests only**

For special/selected topics courses, there is no evidence of:

Instructor's Initials

1. duplication of thesis work   AB

2. double credit   AB

3. work that is a faculty research product   AB

4. overlap with existing courses   AB

Recommended for offering in the   ☒ Fall   ☐ Winter   ☐ Spring   20 _17_

Length of session if less than a semester:

III. **This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies**

_____ [Alex Billo]   Jan–19, 2017
Course instructor   Date

_____   23 Jan. 2017
Approval of the head of the academic unit   Date

IV. **This course proposal was approved by the Faculty/School/Council**

_____   _____
Secretary, Faculty/School/Council   Date

Updated October 2011

Math 6261: Geometric numerical integration

Geometric numerical integration is concerned with deriving discretization schemes for ordinary and partial differential equations that preserve certain geometric properties of these equations. Such geometric properties can include a Hamiltonian structure, Lie symmetries, conservation laws and a variational principle. It has been found that preserving geometric properties is of principal importance if one is interested in the long term evolution and in the statistical properties of differential equations. As such, geometric numerical integration has a firm place in fields as diverse as astronomy, fluid mechanics, climate prediction, optimal control, molecular dynamics and mathematical biology.

Objectives: This course will serve as an introduction to the field of geometric numerical integration. The objective is to introduce a variety of geometric properties of differential equations and to derive tools that allow preserving them in the course of numerical discretization. Particular focus will be put on Hamiltonian structures, conservation laws and Lie symmetries.

Prerequisites: Undergraduate linear algebra at the level of MATH 2051, numerical analysis at the level of MATH 3132, multivariate calculus, some background on ordinary differential equations and some elementary experience with programming (Matlab, C or Fortran preferred).

Tentative syllabus:

1. Symplectic integrators

    (a) Introduction to Hamiltonian mechanics (canonical and non-canonical dynamics, symplectic forms and Poisson geometry, Liouville theorem, examples)

    (b) Elementary symplectic integrators (symplectic Euler methods, Störmer–Verlet method, implicit midpoint method, splitting schemes)

    (c) Symplectic Runge–Kutta schemes (Collocation methods, Gaussian quadrature, Gauss–Legendre Runge–Kutta methods)

    (d) Poisson integrators

    (e) Conservation properties

2. Conservative numerical schemes

    (a) Introduction to conservation laws (Definition, characteristic form, multiplier method, Euler operators, examples)

    (b) Conservative schemes for ordinary differential equations (Multiplier method, projection methods)

    (c) Conservative schemes for partial differential equations (Multiplier method, examples)

    (d) Long term stability results

3. Symmetry-preserving numerical methods

    (a) Introduction to Lie symmetries (Lie groups and Lie algebras, invariants, infinitesimal invariance criterion and moving frames)

    (b) Invariant numerical schemes for ordinary differential equations

    (c) Invariant numerical schemes for partial differential equations

4. Mimetic discretization

    (a) Mimetic discretization of div-, grad- and curl-operators on structured and unstructured meshes

    (b) Applications to porous media flow, Maxwell's equations and geophysical fluid mechanics

1

Literature:

The following books are available as hard-copies (unless otherwise specified) through the library.

- V.I. Arnol'd, *Mathematical methods of classical mechanics*, Springer, 1989.
- G.W. Bluman, S.C. Anco and A.F. Cheviakov, *Applications of symmetry methods to partial differential equations*, Springer, 2010. (available as ebook)
- L.B. da Veiga, K. Lipnikov and G. Manzini, *The mimetic finite difference method for elliptic problems*, Springer, 2014. (available as ebook)
- E. Hairer, C. Lubich, and G. Wanner, *Geometric numerical integration. Structure-preserving algorithms for ordinary differential equations*, Second ed., Springer-Verlag, 2006. (available also as ebook)
- A. Iserles, *A first course in the numerical analysis of differential equations*, Cambridge University Press, 2009.
- B. Leimkuhler and S. Reich, *Simulating Hamiltonian dynamics*, Cambridge University Press, 2004.
- P.J. Olver, *Applications of Lie groups to differential equations*, Springer, 2000.
- J.M. Sanz-Serna and M.P. Calvo, *Numerical Hamiltonian problems*, Chapman & Hall, 1994.

The following textbooks are valuable additions to the course, but not available at the library as of now.

- S. Blanes and C. Fernando, *A concise introduction to geometric numerical integration*, CRC Press, 2016.
- J.E. Castillo and G.F. Miranda, *Mimetic discretization methods*, CRC Press, 2013.
- V. Dorodnitsyn, *Applications of Lie groups to difference equations*, CRC Press, 2010.

Evaluation: The suggested grading scheme for this course will consist of:

- Assignments: 15%. One assignment every 2–3 weeks, which includes both analytical an 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 two hour written exam scheduled in the final exam period.

2

Kenny, Gail

From:	JC Loredo-Osti <jcloredoosti@mun.ca>
Sent:	February-07-17 9:01 PM
To:	Kenny, Gail
Subject:	Re: PsyD proposed calendar changes Feb 2017

Hi Gail,

this item has been approved with 7 votes in favour (Cyr, Alison, Carolyn, Yuanzhu, Ron, Stephanie and myself), none against. The proposal can be turned for the approval of the Faculty Council, -j

On 02/02/17 11:16 AM, MathStat Graduate Officer wrote:
> Dear all,
>
> attached is a proposal for calendar changes from the Department of
> Psychology.
>
> The first change concerns with Psy.D. student evaluation, the second
> it is an update to the calendar to reflect the approval of Psy-6670
> (This course was approved last year, however, the calendar was not
> changed to reflect it).
>
> Please, let me know your opinion at your earliest convenience.
>
> -j
>

--
JC Loredo-Osti, Professor
Department of Mathematics and Statistics Memorial University
Phone: +(709) 864 8729

"Alas! all music jars when the soul's out of tune"
           --Miguel de Cervantes

MEMORIAL
UNIVERSITY

Department of Psychology

February 1st 2017

Dr. JC Loredo-Osti
Chair
Graduate Studies Committee of Faculty of Science
Faculty Council (FSFC)

Re: Calendar changes - Psy.D. Program – Department of Psychology

Dear Dr. Loredo-Osti,

The Department of Psychology's Graduate Studies Committee recently sought (and obtained) departmental approval for two calendar changes associated with the Clinical Psychology Graduate (PsyD) Program. Accordingly, I'm forwarding these changes to the Graduate Studies Committee of Faculty of Science for consideration.

The first involves the inclusion of a new course, i.e., Psychology 6670 - Interprofessional Education. This offering represents 3-credit hours, to be offered over six terms: i.e., Fall and Winter terms for Years 1, 2 and 3. Psy.D. faculty members believe that the addition of this course is essential to improve inter professional experiences as part of clinical training.

The second calendar change includes the addition of a completely new calendar section (i.e., 33.5) designed to clarify student performance evaluation, and associated academic consequences. Specifically, it is necessary to provide a clear policy should students not meet standard requirements to continue in the program.

Two Word documents illustrating the changes have been forwarded to the Office of the Dean of Science.

Please contact me if you have any questions or concerns.

Sincerest regards,

Ken Fowler, Ph.D.
Graduate Officer/Professor
Department of Psychology
Memorial University of Newfoundland
Telephone: 1(709) 864-7672
kenfowler@mun.ca

The proposal is to add a new section to the Calendar describing evaluation of students in the Psy.D. program. Currently, the Calendar entry ends with 33.4, so the change is to add the following to *33 Regulations Governing the Degree of Doctor of Psychology* (http://www.mun.ca/regoff/calendar/sectionNo=GRAD-4069):

33.5 Evaluation
1. Failure to attain a final passing grade of A or B in a program course or a PASS in a PASS/FAIL course shall lead to termination of a student's program, unless a re-read has been requested. Failure to obtain the required grades in the re-read shall lead to termination of the student's program.
2. Practica are evaluated on a pass/fail basis. Failure of a practicum shall lead to termination of the program.
3. Failure in the internship, dissertation or comprehensive examination shall lead to termination of the program.
4. To remain in good standing, students are required to maintain professional behaviour consistent with the current professional standards and Code of Ethics of the Canadian Psychological Association. Students who fail to meet this requirement shall be required to withdraw from the program upon the recommendation of the Psy.D. Administrative Committee.

33.3 Program of Study
Students are required to successfully complete at least 6672 credit hours in regulation graduate courses. These include:

a. 9 credit hours in statistics and research design courses (6000, 6001, 6602);

b. 30 36 credit hours in core courses (6611, 6612, 6613, 6620, 6623, 6630, 6631, 6632, 6633, 6650, 6670); and

c. 27 credit hours in practicum courses (7010, 7020, 7021, 7030, 7031, 7032, 7033, 7034, 7035). Students must also complete a year-long internship, pass a comprehensive exam and successfully complete a research thesis.

33.3.1 Comprehensive Examination
The Psy.D. comprehensive exam, consisting of a written and an oral component, shall be taken during the third year of the program. The exam is intended to demonstrate clinical application of the knowledge acquired through course work and practica. The comprehensive exam will be administered according to the guidelines prescribed in the University Calendar for Ph.D. comprehensive examinations.

33.3.2 Thesis
Students will complete a thesis that is applied in nature and relevant to the practice and science of clinical psychology and the communities it serves. The School of Graduate Studies General Regulations, Evaluation of Ph.D. and Psy.D. Theses concerning evaluation of Ph.D. theses will be followed.

33.3.3 Predoctoral Internship
All students will be required to complete a twelve-month, 1750 clock-hour predoctoral internship.

33.4 Courses
6000 Advanced Statistics

6001 Research Design

6602 Research Design in Clinical Psychology

6611 Ethics of Professional Practice

6612 Adult Psychopathology

6613 Child Psychopathology

6614 Selected Topics in Psychopathology

6620 Principles of Adult Assessment and Diagnosis

6621 Principles of Child Assessment and Diagnosis

6622 Selected Topics in Assessment and Diagnosis

6623 Child Psychopathology, Assessment and Diagnosis

6630 Principles of Intervention with Adults

6631 Principles of Intervention with Children

6632 Community Interventions

6633 Clinical Psychopharmacology

6634 Selected Topics in Intervention

6640 Consultation Processes

6650 Supervision

6660-6669 Special Topics in Clinical Psychology

6670- Interprofessional Education (3-credit hours over six terms: Fall and Winter terms for Years 1, 2 and 3)

7010 Practicum in Ethics and Relationship Skills

7020 Practicum in Adult Assessment and Diagnosis

7022 Practicum in Child Assessment and Diagnosis

7030 Practicum in Assessment and Intervention I

7031 Practicum in Assessment and Intervention II

7032 Practicum in Community Intervention and Interprofessional Practice

7033 Practicum in Advanced Assessment and Intervention I

7034 Practicum in Advanced Assessment and Intervention II

7035 Practicum in Rural Intervention and Interprofessional Practice

7050 Practicum in Supervision I

7051 Practicum in Supervision II