February 4, 2014
(Last update: 01/14/14)

Handouts of the Graduate Faculty Council

Michigan Tech
Recommendations to GFC for Report, Thesis, and Dissertation Processing

The sub-committee to address revisions to the submission process has met twice, considered faculty and student feedback, and recommends the following revisions to the process:

- Change and clarify the deadlines for completion of a degree within any given semester. See Table 1 for proposed dates for fall 2014 in comparison to current deadlines. These changes, if this proposal is accepted, would first be implemented in fall 2014.
  o **Reasoning:**
    - Since the majority of students submit on or very near to deadlines, many students do not receive a final review of their document until after the semester deadline for revisions. This leads to the perception that the deadlines are set up to force students to pay a resubmission fee and complete their degrees later.
    - Setting a deadline for scheduling a defense and holding a defense will help students and advisors to plan ahead for completion of the degree.
    - The dates chosen are based on the observation that approximately 40% of students submit a final document within 14 days of their defense. The majority of the remaining students take 90 days (that is, until the deadline for completion in the subsequent semester). See Figure 1.

- Discontinue reviewing draft dissertations, theses, and reports. Instead, provide a simple checklist of the most common items students need to consider as they prepare the final document for submission.
  o **Reasoning:** The documents are revised, sometimes greatly, before final submission. By providing a simple checklist and tools for students to examine their own documents, students and advisors will be able to address concerns during the pre- and post- final oral examination period as they work through the technical changes required by the committee.

- Do not accept documents with any formatting errors.
  o **Reasoning:** Currently, the Graduate School is accepting documents that have one or two minor formatting errors that are changes normally required by the Guide. This is creating confusion among students who believe that some of the requirements are not really required, and gives the impression that the Graduate School is treating students differently.

- Revise web site, Guide, and title/approval page template based on student and faculty input to make content clearer and friendlier.

- Provide more training opportunities to students and advisors to better understand document preparation. Examples could include workshops on copyright and hands-on formatting assistance. These workshops would emphasize why the formatting requirements are needed and how they will help prepare students professionally for future career activities such as paper and proposal submission.
Table 1. Proposed deadlines for completion of dissertations, theses, and reports for fall 2014. Students who meet each of these deadlines will be eligible to graduate during fall 2014. Students who do not complete a milestone before the deadline will graduate in a subsequent semester.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Deadline (proposed)</th>
<th>Deadline (current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last day to <strong>schedule a final oral examination</strong> (submit Pre-defense form and draft document to Graduate School)</td>
<td>Monday, Week 9 October 27, 2014</td>
<td>Two weeks before final oral examination</td>
</tr>
<tr>
<td>Last day to <strong>hold a final oral examination</strong></td>
<td>Monday, Week 11 November 10, 2014</td>
<td>-NA- No deadline</td>
</tr>
<tr>
<td>Last day to <strong>submit advisor and committee approved document and all associated paperwork</strong>¹</td>
<td>Monday, Week 13 December 1, 2014</td>
<td>Monday, Finals week December 15, 2014</td>
</tr>
<tr>
<td>Student receives review of advisor and committee approved document no later than</td>
<td>Monday, Finals week December 15, 2014</td>
<td>Monday, two weeks after finals week December 29, 2014</td>
</tr>
<tr>
<td>Deadline to <strong>turn in final document</strong> (conforms to all formatting requirements)**²</td>
<td>Friday, Finals week December 19, 2014</td>
<td>Friday, Finals week December 19, 2014</td>
</tr>
</tbody>
</table>

1. If students meet this deadline, they do not have to pay tuition in the following semester, even if they are unable to turn in a final document that conforms to all formatting requirements before the end of the current semester.
2. If a document is submitted that does not conform to all formatting requirements or if the final document is not submitted by this date, students will be charged a resubmission fee and will complete their degree in a subsequent semester.

Figure 1. Days between the defense and final submission shown as a histogram (blue bars) and cumulative percentage (line graph). Data from fall 2012-fall 2013 (might not include all fall 2013 graduates).
Objectives
- Review submission process – are there areas where we can make it clearer or easier for students and faculty?
- Review deadlines – how can this be communicated most clearly to students and faculty? Are there adjustments necessary for clarity?
- Review communication – how can we help faculty and students understand their responsibilities and maintain quality of dissertations, theses, and reports?

Submission process
- Guide – table (Table 2.1, page 2) and flowchart (Figure 2.1, page 3) and summarizing process
- Web page – broken down into “Before Oral Defense” and “After Oral Defense” (pages 4-5)
- Seminar – each semester (generally week 2); available online with streaming video and a one-page handout (page 6)
- Blog posts – step by step tutorials for the most common questions
  o Submission process – ProQuest, Canvas, etc.
  o Word – styles, rotated page numbers, etc.
  o Acrobat – embedding fonts, checking page number location, etc.

Deadlines
- Web page (page 7-8)
- Google calendar
- Canvas calendar
- Reminders

Communication
To student
- MyMichiganTech.mtu.edu – status messages based on items received and current date in relation to defense and checklist items showing what is received and due (page 9)
  o Soon – list of all items necessary for degree with “complete” and “incomplete” status
  o Would like to rely more on MMT in the future and less on e-mails based on student feedback
- Email when draft review is available with final submission instructions
- Email when final submission is incomplete or complete (every morning)
- Email when final submission is reviewed with revision or completion instructions
- Reminder several weeks before deadline to remind and provide link to instructions

To advisor
- Email when draft or final (1st) has been reviewed – encourages advisor to review with student. Contains instructions to access review on ImageNow (or to ask graduate program assistant)
- Email when student is off campus asking for approval of publishing options and binding order
Table 2.1. Degree completion requirements and deadlines. Shaded cells apply only to students completing a dissertation, thesis, or report.

<table>
<thead>
<tr>
<th>Form</th>
<th>Purpose</th>
<th>Deadlines for Submission to Graduate School</th>
<th>Penalty for Failure to Meet Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree schedule</td>
<td>Triggers degree audit.</td>
<td>Semester prior to completion.</td>
<td>Possibly not meeting requirements for degree.</td>
</tr>
<tr>
<td>Commencement application (Optional)</td>
<td>Requests inclusion in commencement ceremony.</td>
<td>Ten weeks prior to commencement.</td>
<td>Not allowed to participate in ceremony.</td>
</tr>
<tr>
<td>Pre-defense form</td>
<td>Schedules defense, submits written draft document.</td>
<td>Two weeks before final oral defense.</td>
<td>Defense postponed until at least 2 weeks following submission.</td>
</tr>
<tr>
<td>Report on final oral examination</td>
<td>Indicates approval by the advisor, committee, and department or school of student’s final oral defense.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>Must enroll in regular course or research credits during subsequent semester or summer session.</td>
</tr>
<tr>
<td>TDR-approval</td>
<td>Documents academic approval of written document. Submits revised version of document to Graduate School.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>Must enroll in regular course or research credits during subsequent semester or summer session.</td>
</tr>
<tr>
<td>Degree completion form</td>
<td>Triggers final review to ensure that all requirements for the degree have been met.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>Must enroll in regular course or research credits during subsequent semester or summer session.</td>
</tr>
<tr>
<td>Includes the Publishing agreement for students completing a dissertation, thesis, or report. Used to order bound copies of the dissertation, thesis, or report, and calculate fees related to completion of the degree.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>Must enroll in regular course or research credits during subsequent semester or summer session.</td>
<td></td>
</tr>
<tr>
<td>Survey of Earned Doctorates (PhD only)</td>
<td>Collects data from PhD recipients in the U.S.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>No penalty – optional form.</td>
</tr>
<tr>
<td>Exit Survey</td>
<td>(Optional) Collects data from Michigan Tech graduate alumni.</td>
<td>Prior to 4 pm first day of finals period in last semester.</td>
<td>May enroll for 1 semester in UN5951 if necessary and all prior steps completed by deadlines.</td>
</tr>
<tr>
<td>---</td>
<td>Make additional corrections to written document and resubmit to Graduate School.</td>
<td>Prior to the end of finals period</td>
<td>Degree not awarded.</td>
</tr>
<tr>
<td>Pay all fees.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2.1. Steps required to complete a degree requiring a dissertation, thesis, or report.
GRADUATE SCHOOL

Submitting a Thesis or Dissertation

Graduate students will follow the procedures found in the Guide to submit a thesis or dissertation to the Graduate School. An outline with links is below. Students may also find the most recent "Submitting your Dissertation, Thesis, or Report" seminar helpful.

Do not e-mail your thesis or dissertation to the Graduate School. Documents received via e-mail will not be reviewed or accepted.

Before Oral Defense
At least two weeks before the oral defense, submit to the Graduate School:

1. A PDF draft of the thesis or dissertation via Canvas to the "Graduate Candidates" course.
   - See our blog for help with logging into Canvas and submitting your assignment.
   - Contact Debra Charlesworth if the course does not appear when you log in.
2. The Pre-defense form.

   The Graduate School reviews all documents in the order they are received and completes a review for the student using the form TDR-Review. You will be notified when the review is complete via e-mail. Students may revise their submission any time prior to their review. Note that only one draft of a document will be reviewed.

After Oral Defense
Immediately after the defense, submit the Report on final oral examination form.

Correct the thesis or dissertation using comments from the oral defense and the review from the Graduate School.

Students can save time by carefully checking their PDF file prior to submission. See our "Introduction to Adobe Acrobat" seminar for a walk through.

Once all corrections from your advisor, committee and Graduate School are complete, submit the following four items at the same time:

1. Approval of a dissertation, thesis, or report (hard copy due in Graduate School no more than one week before items 2-4 below)
2. Degree completion form (via Canvas)
   - Fill in the form, save the form, and upload to Canvas. Do not print or sign the form until directed to do so by the Graduate School.
3. Revised PDF of thesis or dissertation (via Canvas)
   - See our blog for help with logging into Canvas and submitting your assignment.
4. Dissertation or thesis to ProQuest/UMI
   - Traditional Publishing or Open Access Publishing (extra fee) may be selected.
   - Any bound copies ordered from ProQuest/UMI are in addition to those ordered on the Degree completion form.
   - Embargo options must match those selected on the Degree completion form.
   - See our blog for help with submitting to ProQuest/UMI.

Incomplete submissions will not be reviewed. Allow two weeks for document processing.
Documents are reviewed in the order they are completely received, and you will be notified via e-mail when the review is completed. If the document is not acceptable for publication, comments will be returned via Canvas and the document must be resubmitted.

After the document has been reviewed and accepted for publication:

1. Bring to the Graduate School:
   - The Degree completion form signed by the Graduate School and the advisor or graduate program director (see note below if you are off campus)
• A signed signature page (not allowed or required for defenses scheduled after November 1, 2012)

2. The Graduate School will create an online invoice for the student if any fees are due from the student.

3. When the invoice has been processed, pay the publication fees on Banweb.
   • Log in using your Michigan Tech ISO ID and password
   • Select the “Payments/Confirm Enrollment” tab and then “Graduate School Fees” to initiate the payment process.

   **If you are off campus:** Select “not in the Houghton area, and will be unable to come to the Graduate School in person” on the Degree completion form. The Graduate School will obtain program approval for your bindery order, and will let you know when your fees may be paid on Banweb.

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**Graduate School**

Administration Building, 4th Floor  
1400 Townsend Drive  
Houghton, Michigan 49931-1295

Ph. 906-487-2327  
Fax: 906-487-2284  
Email: gradadms@mtu.edu
Helpful information

- **http://mymichigantech.mtu.edu** – Check your status at any time.
- **http://www.gradschool.mtu.edu/professional** (Quick Link: Professional Resources)
  - Our online seminar archive has seminars about submitting your document, Word, Copyright, Great Images, LaTeX, and Adobe Acrobat
- **http://www.gradschool.mtu.edu/td** (Quick Link: Theses and Dissertations)
  - Links to formatting, using copyrighted materials, and submitting
  - Blog answers common “how-to” questions with screen shots; send ddc@mtu.edu your questions!
- **http://blogs.mtu.edu/gradschool/2012/02/23/submit-to-canvas/** - Canvas tutorial

Planning and Preparation

1. Formatting guide available online. [http://www.gradschool.mtu.edu/td/formatting](http://www.gradschool.mtu.edu/td/formatting)
   a. Sample review file available online (Quick Link: Forms and Deadlines)
2. Determine if you need permission to reprint copyrighted items. [http://www.gradschool.mtu.edu/td/copyright](http://www.gradschool.mtu.edu/td/copyright)
3. Recommended: Use EndNote or bibliographic management software to generate your references.
4. Recommended: Defend at least four weeks before you want to complete your degree.

Two weeks before your oral defense

1. Schedule a time, day, and room for your defense.
2. Submit the Pre-defense form as a paper copy to the Graduate School
3. Submit a draft of your dissertation, thesis, or report to the Graduate School.
   a. [http://mtu.instructure.com](http://mtu.instructure.com) – Canvas
5. Ask questions about your review from the Graduate School.

After your oral defense

1. Work on corrections from your committee, advisor, and Graduate School.
2. After all corrections are complete, submit all of the following at the same time (incomplete submissions are not reviewed):
   a. Form: Approval of a final dissertation, thesis, or report (no substitutions for any signatures)
   b. A final dissertation, thesis, or report to Canvas
   c. A completed Degree completion form to Canvas (fill in, save, and upload to the same place as your dissertation, thesis, or report; click on “Add files” to upload more than one file)
3. Wait for your review; resubmit a corrected version if necessary.
4. After the document is accepted, bring to the Graduate School:
   a. Approved Degree completion form*
5. Pay any publishing fees that are due.
   a. Follow the link from the checklist item on [http://mymichigantech.mtu.edu](http://mymichigantech.mtu.edu) OR go to banweb.mtu.edu, select the "Payments/Confirm Enrollment" tab and then "Graduate School Fees" to initiate the payment process. Electronic checks and credit cards are accepted.
   b. When the payment process is complete, the Graduate School will receive a receipt.
   c. Check [http://mymichigantech.mtu.edu](http://mymichigantech.mtu.edu) for the final status of your document.

*Off campus? The Graduate School will obtain program approval for the Degree completion form.
GRADUATE SCHOOL

Graduate School > Academics > Forms and Deadlines

Forms and Deadlines

Forms

Prospective Students

Current Students

Programs

Deadlines

Deadlines to graduate in a given semester and participate in its commencement ceremony are shown below. All paperwork must be submitted by 4pm on the date listed.

<table>
<thead>
<tr>
<th>Graduating in</th>
<th>Submit final dissertation, thesis, or report no later than 4pm on</th>
<th>Complete final degree requirements no later than 4pm on</th>
<th>Apply to walk in commencement before</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2013</td>
<td>December 16, 2013</td>
<td>December 20, 2013</td>
<td>October 11, 2013</td>
</tr>
<tr>
<td>Summer 2014</td>
<td>August 11, 2014</td>
<td>August 15, 2014</td>
<td>NA</td>
</tr>
</tbody>
</table>

1. Students who have submitted a final dissertation, thesis, or report, but who are unable to complete the required formatting changes by this deadline will be enrolled in UN5951 for the next semester and charged a resubmission fee equal to 25% of the current cost of one credit of graduate tuition. Enrollment in UN5951 is limited to one semester. Please note that reviews can take up to two weeks, and the majority of students require at least two revisions before their document can be accepted. Submit well ahead of this deadline to avoid the resubmission fee.

Questions about Deadlines?

Have more questions about deadlines, defenses, and dissertations (or theses and reports)? Check out our FAQ, and the two most common questions below.

What is the deadline to defend this semester?

There are no deadlines for defenses. You may defend at any time that your advisor and committee agree you are ready to defend and they are available to conduct the defense.

There are deadlines, however, to submit a final dissertation, thesis, or report and complete any formatting changes if you wish to graduate in a given semester. Current deadlines are available online.

I need to graduate this semester. What is the last day I can defend?

The Graduate School has no deadline for your defense. You may defend at any time your advisor and committee agree that you are ready to defend and they are available to meet.

After your defense, your committee will require technical and formatting changes before they will approve your final dissertation, thesis, or...
report. Every student and committee is different, so the Graduate School cannot predict how much time will be necessary after your defense to make the required corrections. Approximately 40% of students require 1-14 days after their defense to make the required corrections and submit their documents to the Graduate School, but the time ranges from 1 day to 3 years.

The majority of students submit their final documents at the end of the semester. Therefore, the Graduate School recommends defending at least four weeks before the deadline to submit your final document in the semester you wish to complete your degree requirements. These deadlines can be found online. This will allow two weeks for you to complete changes required by your committee, two weeks for the Graduate School to review, and a week for you to complete any final formatting changes required by the Graduate School.

For example, a sample timeline for Fall 2013:

- The deadline to submit a final dissertation, thesis or report is December 16, 2013.
- Schedule your defense on or before November 18, 2013. This is not a requirement. It is only a recommendation.
- Submit your final dissertation, thesis, or report on or before December 2, 2013. This is not a requirement. It is only a recommendation.
- You will receive a review of your work on or before December 16, 2013. You will have until December 20, 2013 to make any formatting changes and will be able to complete your degree in fall without any additional fees.

Please allow two weeks for the Graduate School to review each submission of a final dissertation, thesis, or report. The majority of students require at least two submissions before their document can be accepted by the Graduate School.

Graduate School
Administration Building, 4th Floor
1400 Townsend Drive
Houghton, Michigan 49931-1295
Ph: 906-487-2327
Fax: 906-487-2284
Email: gradadms@mtu.edu
MyMichiganTech – Current Students

MyMichiganTech – Status message examples (center column)


Final report accepted for Master of Science in Mechanical Engineering.

Draft dissertation review complete. See Canvas for review. Submit final dissertation after technical corrections from committee are complete. See deadlines for upcoming semesters.

MyMichiganTech – Checklist examples (left column)

Draft thesis has been submitted.

Pre-defense form submitted, but final oral examination was cancelled. Please reschedule examination by e-mailing new date, time, and location to Graduate School.

Submit Report on Final Oral Examination form.

Submit final dissertation after technical corrections from committee are complete. See deadlines for upcoming semesters.

Final proof of degree(s) and official transcript(s) received.

Before final oral examination

After final oral examination
November 7, 2013

Proposal to Change Degree Titles:

Current Title: PhD in Rhetoric and Technical Communication

Proposed Title Change: PhD in Rhetoric, Theory and Culture

1. General description and characteristics: This is a modification of the title to reflect the program's alignment with emerging trends of the discipline.

2. Related program in Michigan: PhD in Writing and Rhetoric at Michigan State University

3. Rationale: Over the past 40 years, Michigan Tech’s Humanities department has twice developed innovative programs that had broad national impact—we established the first “Writing across the Curriculum” (WAC) program in the late 1970s, and we established the nation’s first PhD degree in Rhetoric and Technical Communication (RTC) in the late 1980s. In each of these instances, we were in a better position to respond to changing conditions than other departments precisely because we are an interdisciplinary Humanities department in a STEM-focused research university. Now we are in a strong position to lead the profession once again, and this name change reflects that strength.

In changing our name we have retained the key word “Rhetoric.” To educators in the Humanities, this term implies “communication,” and signals our commitment to understand communication in relation to its “historicity” and systemic functions.

Our second term—“Theory”—indicates our program’s focus on issues of the relationship between humans and their technologies. For scholars in the Humanities, the term invokes a tradition of scholarship concerned with the modern world’s changing relationships among individuals, our languages and social structures, and our physical environments. Networked environments and social media such as Facebook and Twitter are profoundly changing the ways people communicate in all areas of work, family and social life. These developments call for new ways of communicating that incorporate visual design with conventional text, and deploy various rhetorical strategies across different delivery platforms such as mobile phones and tablets. The fast-paced developments in digital media require the teaching of new skills, and new ways of teaching. The term “Theory” expresses our commitment to explore and develop these methods and to prepare our graduates to take them into their future classrooms and workplaces.

Our third term—“Culture”—reinforces our emphasis on communication and social interaction. The term also refers to our expertise in areas such as diversity and globalization. Globalization is transforming our workplaces and our societies. Students
who can recognize and understand cultural differences will be better equipped for the job market and for their future lives.

In the late 1980s, the name “Rhetoric and Technical Communication” was a shot across the bow of traditional English and Communication graduate programs. It signaled our intention to prepare graduate students for an emerging but under-served sector of the academic marketplace. Now, there are 76 PhD programs that use “Composition” or “Technical Communication” in the titles. Nearly 70 of them are housed in English departments. Something that sets our program apart from these programs is our interdisciplinarity. We are the only department offering this kind of degree from a faculty that includes nationally recognized scholars of Rhetoric and Composition; Technical Communication; Communication; Culture and Media Studies; English; Linguistics; Modern Languages (Chinese, French, German and Spanish); and Philosophy. We have scholars working at the leading edge of technological change and globalization. And we have maintained our traditional strengths in Rhetoric, Composition Studies and Technical Communication. Our new name retains the initials “RTC” with the intention of emphasizing the continuity of the program. Just as the designation “Rhetoric and Technical Communication” was the herald of a significant movement twenty-five years ago, “Rhetoric, Theory and Culture” will mark our program’s leadership in the discipline during the next twenty-five years.

4. Curriculum design: No change.
5. New course descriptions: Not relevant.
6. Additional resources: Requires no additional resources.
7. Accreditation requirements. No additional accreditation requirements.
8. Planned implementation date: The proposed change will be implemented in the 2014-2015 academic year.

Approved by vote of the Humanities faculty April 8, 2013.

Approved by Chair of the Humanities Department April 8, 2013.

Approved by College of Sciences and Arts Dean

Approved by Provost
November 7, 2013

Proposal to Change Degree Titles:

Current Title: MS in Rhetoric and Technical Communication

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Approved by vote of the Humanities faculty April 8, 2013.
Approved by Chair of the Humanities Department April 8, 2013.

Approved by College of Sciences and Arts Dean

Approved by Provost
**Humanities Response to the Graduate Faculty Council Questions**

1. There was support for this proposal by the majority of faculty in the HU department.

On April 8, 2013 the Humanities faculty voted by secret ballot to change the name of our MS and PhD programs from "Rhetoric and Technical Communication" to "Rhetoric, Theory and Culture". The vote was as follows:

**Question: should we change the name?:**

Yes: 21 (77.8%)

No: 5 (18.5%)

Abstain: 1 (3.7%)

2. This proposal will not involve elimination of existing courses. There is discussion underway regarding adding additional required courses as described below. These discussions are ongoing at present and any changes to the required course list will be proposed to the University community through the binder process at some point in the future.

Currently, all students in the PhD program are required to take three "stream-head" courses:

- HU 5002: Rhetoric, Composition and Literacy Studies
- HU 5003: Technical Communication and Technology Studies
- HU 5004: Communication and Cultural Studies

At present, this structure remains in place, but we are discussing a structure in which students would be required to take five or six courses from the following groups:

**Writing, Literacy and Technical Communication:**
- HU 5002: Composition and Literacy Studies
- HU 5003: Technical Communication

**Philosophy and Rhetoric:**
- HU 5070: History and Theory of Rhetoric
- HU 5XXX: Continental Philosophy

**Communication and Culture:**
- HU 5012: Communication Theory
- HU 5113: Cultural Studies

**Technology and Media:**
- HU 5112: Critical Perspectives on Science and Technology
HU 5114: Introduction to Visual Representation

**Literature and Globalization:**
HU 5040: Reading Literature (to be re-named "Critical Perspectives on Literature and Culture")
HU 5XXX: Critical Perspectives on Globalization

As you can see, we are only contemplating adding two new course (Critical Perspectives on Globalization and Continental Philosophy). We are currently voting on this plan, and the secret-ballot vote is scheduled to be concluded this Monday.
Proposal for a New Non-Departmental Master of Science in Data Science

Contacts: Laura Brown (Computer Science), Mari W. Buche (School of Business & Economics), Gowtham S (Information Technology Services), Timothy Havens (Electrical & Computer Engineering/Computer Science), Jacqueline Huntoon (Graduate School), Saeid Nooshabadi (Electrical & Computer Engineering/Computer Science), and Allan Struthers (Mathematics)
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Executive Summary

This proposal describes a plan for a new master’s degree program. The proposed Master of Science (M.S.) in Data Science will be the first non-departmental master’s degree at Michigan Tech. The M.S. Data Science has three main objectives: i) to attract students from various disciplines who wish to learn the basics of data analysis, data science, and computing tools; ii) to teach students basic skills in communication and build their awareness of business contexts; and iii) to provide students the opportunity to gain domain specific skills that give them the ability to analyze large data sets, including Big Data.

The M.S. program will be developed to adhere to national requirements for Professional Science Master’s (PSM) programs, where the emphasis is on advanced training in science and engineering, while simultaneously developing highly-valued business and communications skills. Once the M.S. program is approved at Michigan Tech it will be submitted to the national PSM oversight organization for accreditation as a PSM. A plan to offer the M.S. as an accelerated master’s will also be developed following approval of the program by Michigan Tech.

1 http://www.sciencemasters.com/
1. Background

The Internet has steadily moved from text-based communications to richer content, including interactive maps, images, videos, and most importantly metadata such as geolocation information and time and date stamps. High-speed communication networks such as 3G, 4G, and WiFi have enabled fast transmission of these storage-intensive data. The amount of data captured by e-health networks, telematics and telemetry devices for monitoring the location, movements, status of mobile units, for use in machine-to-machine and people-to-machine systems, social networks, environmental agencies, commercial and business agencies, and security agencies is exploding. In the year 2000, the amount of data stored in the world was about 800,000 petabytes (one petabyte = one million gigabytes). This amount is expected to reach 35 zettabytes (one million-million petabytes) by 2020. Twitter and Facebook, respectively, generate more than 7 terabytes of data each day. Advances in data storage and data-mining technologies make it possible to preserve increasing amounts of data generated directly or indirectly by users.

As we stand at a point where our economy is driven by Big Data, our data collecting abilities have far outpaced techniques to manage and analyze these data. Hence, enhanced capabilities in data analysis are needed to obtain valuable new insights from these captured data. Examples are sensor networks, big social data and social networks analysis, telephone call meta-data, military surveillance, medical records, imaging and video archives, large-scale e-commerce, astronomy, atmospheric science, genomics, biogeochemical, biological, and other complex and often interdisciplinary scientific research.

The field of data science has emerged as a response to increased data abundance in industry, science, and engineering. The National Consortium for Data Science (NCDS), a collaboration of industry and academic institutions, was formed to identify data science challenges, coordinate research priorities, to support the development of technical and ethical data standards policy, and to foster economic growth by launching a national strategic initiative to secure the U.S. as the world leader in data science.

The Big Data explosion needs data scientists and analysts able to interpret massive data sets. The lack of trained data scientists has meant that less than 5% of data are used effectively, according to the Forrester research firm.

Data scientists primarily manage and analyze data, which requires computer science (CS), statistics, business, marketing, and communications skills. Traditional statistics training lacks the emphases on required CS and domain-specific skills, while traditional CS and engineering training lack emphases on the required statistical analyses skills. Furthermore, both lack acumen in business, marketing, and communications. Data analysis also requires expertise in the specific domain of the application (e.g., engineering, imaging and video analytics, social

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2 [http://data2discovery.org](http://data2discovery.org)
3 [BIG DATA WILL HELP SHAPE YOUR MARKET’S NEXT BIG WINNERS](http://blogs.forrester.com/brian_hopkins/11-09-30-big_data_will_help_shape_your_markets_next_big_winners)
sciences, bioinformatics, etc).

2. Justification and Estimated Market

A simple job search for “Data Scientist” today reveals thousands of job openings. The Bureau of Labor Statistics (BLS) forecasts a 19% growth in employment for computer and information research scientists by 2020. Numerous articles, studies, and blog postings warn of the shortage of Data Scientists, e.g., Information Week⁴; Fortune⁵; and EMC Data Science Study⁶. In 2011, McKinsey Global Institute published “Big data⁷: The next frontier for innovation, competition, and productivity,” citing a need for 140,000-190,000 data scientists in the U.S. alone, by 2018.

The program we are proposing will significantly increase the number of data scientists that Michigan Tech can offer to the workforce. Our M.S. program in Data Science will provide students with strong academic training in data analysis in a range of areas (e.g., physical sciences, geosciences, geoinformatics, bioinformatics, cheminformatics, environmental, social sciences, business and commerce) while at the same time introduce essential business acumen, communication and teamwork skills highly valued by industry and government. The minimum requirements listed in recent data scientist job postings include “strong communication and collaboration skills” (Groupon), “ability to communicate complex quantitative analysis in a clear, precise, and actionable manner” (Quicken Loans), and “expected to communicate their conclusions clearly to a lay audience” (CIA). The M.S. degree is not intended to be a stepping-stone towards a Ph.D.; rather, it is a stand-alone degree designed to prepare students for careers in industry and government.

The proposed program emphasizes data analytics from a general perspective, but the skills to be learned are applicable to a diverse range of areas, including business analytics, computer science and engineering, and informatics. To support the interdisciplinary nature of the Data Science program, applications from multiple areas will be included in the coursework.

The proposal Data Science program is in line with Michigan Tech strategic plan⁸ to “be a leader in creating solutions for society's challenges through education and interdisciplinary endeavors that advance sustainable economic prosperity…”

⁴ Data Scientists: Meet Big Data's Top Guns
⁵ Data scientist: The hot new gig in tech
⁶ Data Science Revealed: A Data-Driven Glimpse into the Burgeoning New Field
⁷ Big data: The next frontier for innovation, competition, and productivity
http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation
⁸ STRATEGIC PLAN https://www.banweb.mtu.edu/pls/owa/strategic_plan2.p_display
3. Competitive Analysis

Established computer science, business analytics, and statistics master’s degrees and certificate programs already exist, both in the U.S. and abroad, and provide specializations in data mining and predictive analytics. However, despite interest and recognized need, there are as yet only a few master’s programs dedicated to data science in the U.S. Further, the existing programs have been designed around business data with a less domain-specific scientific focus. These master’s programs include Northwestern’s new M.S. in Analytics (2011), DePaul’s M.S. in Predictive Analytics (2010), University of San Francisco’s M.S. in Analytics (2012), LSU’s M.S. in Analytics (2011), Rutgers’s Professional Science Master’s (PSM) of Business and Science in Analytics (2012), and NCSU’s M.S. in Analytics (also a PSM program)(2007).

Finally, there is increased recognition by federal agencies that supporting Big Data research is important. For example, the National Institutes of Health (NIH) director, Dr. Francis Collins, recently convened a “Data and Informatics Working Group” that made several key recommendations aimed at fostering NIH sponsored research in Big Data. Other federal agencies have also signaled interest in Big Data research, including National Science Foundation, DARPA, Department of Energy, and Department of Defense.

4. Detailed Description of Master of Science in Data Science

i. Title:

Master of Science in Data Science

ii. Catalog description:

The non-departmental Data Science program at Michigan Tech provides a foundation for the emerging field of “Big Data” science, including the use of data mining, predictive analytics, cloud computing, and business skills, with a domain specific specialization in disciplines of science and engineering. The main threads of analytic techniques, programming practice, domain knowledge, business acumen, and communication skills are intertwined in this program.

The M.S. degree is designed to meet the needs of students and to adhere to the requirements for Professional Science Masters⁹ (PSM) programs. Students benefit from a PSM degree because it prepares them for careers in science and engineering that are highly sought after in industry, government, and nonprofit organizations, where workforce needs in data science are increasing. PSM graduates get advanced training in science and engineering without having to obtain a Ph.D., while simultaneously developing highly-valued business skills without having to obtain an MBA. The curricula for PSMs are based on

⁹ http://www.scientemasters.com/
“science-plus,” where rigorous study in engineering, science, or mathematics is combined with skills-based coursework in management, policy, or law. In addition, PSM programs emphasize writing and communication skills and teamwork experience, with most requiring a “real-world” internship in an industry or public sector enterprise.

To comply with the PSM requirements, the M.S. program is grounded in science, technology, engineering, mathematics, computer science, and computing. It is designed to prepare students for a variety of careers that will fill the skill shortage in data science in industry, business, government, and non-profit organizations. This program prepares graduates for high-level careers in data science by combining advanced training in data analytics with an appropriate component of professional skills. In addition to the course work in data analytics and data management, the M.S. program will have a strong emphasis on skill areas such as written and oral communication, ethics, management, policy, entrepreneurship, and leadership. This program will incorporate an internship and/or an employer-sponsored project.

Entry into this program assumes basic knowledge in statistical and mathematical techniques, programming, and communications, obtained through a degree in business, science and engineering disciplines.

iii. Credits:

The degree will be offered as coursework-only M.S. program that will require a minimum of 30 credits. A minimum of 18 credits applied toward the degree must be earned at the 5000-6000 level, and a maximum of 12 credits can be earned at the 3000-4000 level. Students earning the degree must adhere to all Graduate School policies.

iv. Course work:

The M.S. in Data Science requires 12 credits of required core courses and a minimum of six credits of approved Data Science electives. The remaining required credits can include up to maximum of six credits of approved foundational courses at the 3000-4000 level (Appendix I), plus domain specific courses (Appendix II).

It is expected that students seeking enrollment in this program will have sufficient foundational skills and aptitude in computer programming, statistical analysis, information systems and databases. The required foundational skills may have been obtained through formal academic qualifications, work experience, or a combination. Students will receive advice regarding the expected level of foundational skills for incoming students and may be required to take specific foundational courses (Appendix I) as necessary to acquire the required level of foundational skills.

Students will be allowed to apply up to six credits of 3000-4000 level foundational skills courses (Appendix I) toward the M.S. Data Science degree. Additional courses (more than 6 credits) of foundational skills courses cannot be applied to the degree even though additional courses may be required for students to master necessary skills. Courses at the 1000 or

2000 level cannot be applied toward any graduate degree at Michigan Tech but may be necessary for students to take if they are lacking in a key skill.

Each student’s letter of offer of admission will clearly articulate the expectations for incoming students in the area of foundational skills in computer programming, statistical analysis, information systems and databases. Students will be encouraged to develop their foundational skills before coming to Michigan Tech to start the M.S. program in Data Science. They will be also advised of the availability of the low-level courses (1000 and 2000 level) and medium-level courses (3000 level) that they can take at Michigan Tech during the summer semester before they plan to begin the M.S. program in Data Science. After students matriculate in the program, their assigned advisors will continually monitor students’ progress to ensure that students are given all the necessary advice that they need to be successful in the program.

Coursework Summary

Core courses for M.S. Data Science (12 credits):
The four required core 3-credit courses focus on basic skills in data science analytics, data mining, and business analytics. These courses are:

- UN 5550 - Introduction to Data Science (3 credits)\(^{11}\)
- MA 4790 - Predictive Modeling (3 credits)
- CS 4821 / MA 4795 - Data Mining (3 credits)
- BA 5200 - Information Systems Management and Business Analytics (3 credits)\(^{12}\)

Foundational skills courses for M.S. Data Science (maximum of 6 credits at the 3000-4000 level):

A maximum of six credit hours of foundational skills courses (at the 3000-4000 level may be applied to the M.S. These courses will build skills necessary for successful completion of the M.S. Data Science. See Appendix I for a list of approved foundational skills courses.

Approved Data Science elective courses for M.S. Data Science (minimum of 6 credits):

At least 6 credits for the M.S. must be taken from the approved 3-credit Data Science elective courses below:

\(^{11}\) New course is designed for Fall 2014; submitted to curriculum proposal (binder) Fall 2013. This course will be administered by the Office of the Dean of the Graduate School, and executed by Graduate Program Executive Committee. It is listed as a UN course because it will involve faculty from multiple department. It is the responsibility of the Graduate Program Director and the Graduate Program Executive Committee, with assistance provided by the Graduate School office to design the curriculum for this course, organize the weekly seminar lectures to be delivered by the Data Science faculty across the campus. The Graduate Program Director will work with the Chairs of the units involved to negotiate the faculty load and other resources.

\(^{12}\) Revise course BA 5200-Strategic IS Management; submitted to curriculum proposal (binder) Fall 2013
Domain specific Data Science courses for M.S. program (maximum of 12 credits):

To complete the M.S. program in Data Science, the students must complete the remaining of the required 30 credits through completion of approved domain-specific Data Science courses (see Appendix II). Students may choose domain-specific courses from one or more domains. Each student will consult with her/his advisor in order to determine the appropriate mix of elective courses and domain-specific courses, given the student’s background, interests, and career aspirations.

v. Online delivery:

Our goal is to have all the core data science courses and most approved data science courses offered online by 2016. This would allow off-campus students to complete 12-18 credits of the M.S in Data Sciences online\(^{18}\). Note that BA 5200 - Information Systems Management and Business Analytics will be offered as an online course starting in 2014. Additionally, the approved Data Science courses, CS 5841 / EE 5841 - Machine Learning and CS 5491 - Cloud Computing, will be offered as online courses in 2016.

vi. Description of new or revised Data Science courses:

All new (or revised) courses were added (modified) in the curriculum proposal (binder) process of Fall 2013.

UN 5550 - Introduction to Data Science (new) (3 credits)

\(^{13}\) New course designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
\(^{14}\) New course designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
\(^{15}\) New course designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
\(^{16}\) Graduate version of MA 4780, submitted to curriculum proposal (binder) Fall 2013, to be offered as a split-level undergraduate/graduate course. The graduate version of this course contains additional theoretical material and substantial project work.
\(^{17}\) Graduate version of FW 4099, submitted to curriculum proposal (binder) Fall 2013, to be offered as a split-level undergraduate/graduate course. The graduate version of this course contains additional theoretical material and substantial project work.
\(^{18}\) This would also allow off-campus students to fully complete the Graduate Certificate in Data Sciences with online offerings.
This course provides an introduction to Big Data concepts, with focus on data management, data modeling, visualization, security, cloud computing, and data science from different perspectives: computer science, business, social science, bioinformatic, engineering, etc. This course also introduces the tools for data analytics such as SPSS Modeler, R, SAS, Python, and MATLAB. It involves two case study projects, each of which is integrated with communication and business skills.

BA 5200 - Information Systems Management and Business Analytics (revision) (3 credits)

This course is a restructuring of the existing course BA 5200 - Strategic IS Management to achieve a more acute focus on data analytics. The course incorporates experiential application of methods and analysis of business case studies focusing on contemporary issues in data analytics (i.e., Big Data) to include comprehension of business and organizational context, visualization and interpretation of results, reporting of outcomes from data analytics, evaluation of alternative techniques, and other current topics. Multiple online resources will be employed, including Teradata University. Students in this class will utilize open source software (e.g. Hadoop and NoSQL), developing skills applicable to industry. Ethical foundations and managerial constraints will be integrated throughout the course.

CS 5841 / EE 5841 - Machine Learning (new) (3 credits)

This course will explore the foundational techniques of machine learning. Topics are pulled from the areas of unsupervised and supervised learning. Specific methods covered include naive Bayes, decision trees, support vector machines (SVMs), ensemble, and clustering methods.

CS 5471 - Advanced Topics in Computer Security (new) (3 credits)

This course covers various aspects of producing trusted computer information systems. Topics may vary; network perimeter protection, host-level protection, authentication technologies, formal analysis techniques, and intrusion detection will be emphasized. Current systems will be examined and critiqued.

CS 5491 - Cloud Computing (new) (3 credits)

This course provides an overview of the principles, methods, and leading technologies of cloud computing technologies. Topics include cloud computing concepts and architecture: Hadoop, MapReduce; standards; implementation strategies; Software as a Service (SaaS); Platform as a Service (PaaS); Infrastructure as a Service (IaaS); workload patterns and resource management; migrating to the cloud; and case studies and best practices. Students in this class will build their own cloud application using services from providers such as Amazon or IBM.

SS 5005 - Introduction to Computational Social Science (new) (3 credits) (See Appendix II)
This course is an introduction to the use of computer simulation and modeling to understand social science phenomena. The course will provide an introduction to complexity theory as it applies to the methodological framework of Agent-Based Modeling. Students will be taught the fundamentals of model design including an introduction to standard simulation toolkits. Ultimately, students will be asked to apply what they have learned in this course to develop a pilot simulation study from design to implementation to model validation.

SAT 5600 - Web Application Development (new)  (3 credits) (See Appendix II)

This course provides an introduction to the building and administration of web applications. Topics covered include Apache web server, Tomcat application server, HTML, cascading style sheets, JavaScript, JQuery, server side includes, server side application development, web services, SSL/TLS and authentication/ authorization.

SAT 5002 - Application Programming Introduction (new)  (3 credits) (See Appendix II)

This course provides an introduction to application programming. It develops problem solving skills through the application of a commonly used high-level programming language. Topics include the nature of the programming environment, fundamentals of programming languages (e.g., programming constructs, data management, manipulation of simple data structures), structured programming concepts, object oriented programming concepts, desirable programming practices and design, debugging and testing techniques. Students will use the Java programming language to test programming concepts and to develop application programs.

5. Estimated Costs For Financial Evaluation

While hard to predict the exact figures, it is expected the program will have an initial enrollment of five in Fall 2014, with an increase to eight in Fall 2015. After accreditation as a PSM program it is expected that we will have an steady enrollment of 15 to 20 within five years.

To arrive at this estimation a combination of factors were considered; enrollment in other institutions in Data Science and PSM programs, enrollment in other M.S. programs in Michigan Tech, frequent recent requests from the industry for skills analytics (e.g., Kimberly-Clark), feedback from ECE EAC members, etc.

It is envisioned that the enrollment would primarily come from students who would otherwise not have come to MTU. However, feedback from several units across the University indicates to the likely popularity of the courses that are designed for Data Science in other existing programs.

The initial start up cost of this program is modest. The majority of courses in the Data Science program are based on existing courses in Mathematical Sciences, Computer
Science, and the School of Business and Economics. However, the quality of the program is directly dependant on the ability of the core faculty to develop and continually improve the core and approved elective Data Science courses. To ensure long-term viability of the Data Science program at Michigan Tech, therefore, requires sufficient allocation of resources to support the core Data Science curriculum. The program requires additional resources for the following:

- One new faculty line to be used to attract a strong candidate with multi-disciplinary data science expertise who will be dedicated to the Data Science program. The new faculty will be primarily responsible for teaching of the core and Data Science courses in Data Science program. Michigan Tech should consider this faculty line as a strategic investment in an important area for the university. A faculty search procedure will be proposed by the Data Science Executive Committee (Sec. 7), approved by the the Dean of the Graduate School, and recommended to the appropriate Department Chairs, Deans, and Provost. A joint appointment would be anticipated. The anticipated hire will also help Michigan Tech to enhance research expertise in the area of Data Science. We are in a position to start the program with the existing pool of faculty resources in the four units involved in the offering of core and approved elective Data Science courses, through the temporary diversion of resources. However, the program requires the hiring of one new faculty after the first year.

- Development of core course—UN5550 Introduction to Data Science. This course will be non-departmental; select faculty from Mathematical Sciences, Computer Science, and School of Business & Economics will have a leading role in the administration of this new course. Modest cost may be involved in providing faculty adequate preparation time. There is also need for resources to cover the cost associated with the external guest lectures.

- Development of approved Data Science courses, Machine Learning (CS5841/EECS5491) and Cloud Computing (CS5491). These courses have also been planned for inclusion in the Electrical & Computer Engineering and Computer Science M.S. programs. The program also requires revision of BA 5670 into IS Management and Business Analytics, in the School of Business and Economics, to make it suitable to the Data Science program. There will be also a new domain specific course in the Social Sciences—Introduction to Computational Social Science. Modest cost may be involved in faculty preparation time for the development of these new courses.

- Administration of the program by the Graduate School, extension to online delivery by Fall 2016, and PSM affiliation will incur some additional cost. We envision a ¼ to ½ line of administrative support when the program develops into its capacity of steady enrollment.

- Annual PSM membership, affiliation, and reaffiliation review fee of $1,500.

- Three graduate teaching assistant (GTA) lines are needed initially to help with the
laboratory development and maintenance of the hardware and software tools necessary for the program. Specifically these GTAs will be used to assist with the instruction of core and approved elective Data Science courses listed in Section 4. It is envisioned that the students supported by these three GTA lines will be earning Ph.D. degrees in disciplines related to the Data Science program. The purpose of the GTAs is to support the offering of cutting-edge courses in order to allow affiliated faculty to maintain their active research programs. These lines will also help us to build our pool of research expertise in the area across the University. After the first three years of the project, the number of GTA lines allocated in support of the program may be reduced to one if circumstances allows it.

- Student support through the Graduate Tuition Grant (GTG)\textsuperscript{19} which is designed to assist high-performing domestic students with unmet financial need. This program is already in existence and we expect to enhance the size of the pool of funding available to students by seeking external donations. We view fellowship and scholarship support for this program as important resources for getting this program started. There is often a time-lag between the start of a new program and being able to obtain external support for students in the program; hence, this initial investment in student support will fill that gap. We also plan to seek external funding for the following:
  - A fellowship for an outstanding Data Sciences M.S. candidate, to be named in honor of Professor Thomas Drummer who was instrumental in developing the Data Science program.
  - Several smaller scholarships for excellent students pursuing an M.S. in Data Sciences.

- The Office of Information Technology at Michigan Tech is fully supportive of this program. It has already installed all the tools and computing infrastructure that is needed for the Data Science program.

The resources of the Data Science program and the host departments will require continuous evaluation to ensure that the needs of each are being met in the future.

6. Planned Implementation Date

This program has an anticipated start in Fall semester, 2014. This program will be offered as a regular program. The program will be extended into an online program as soon as it is established and practical to do so. We envision a start date of Fall 2016 for the online delivery of core and approved elective courses.

\textsuperscript{19} Graduate Tuition Grant, [http://www.mtu.edu/gradschool/admissions/financial/tuition-grant/](http://www.mtu.edu/gradschool/admissions/financial/tuition-grant/)
7. Program Governance

Like other non-departmental and interdisciplinary programs at Michigan Tech, the Data Science program will be administered through the Graduate School, which will have overall responsibility and final oversight for the program. The program will have the following management structure.

- **Graduate Program Director**: The Director is appointed by the Dean of the Graduate School for a period of three years. The Dean of the Graduate School will seek nominations for the Graduate Program Director position from the Graduate Program Executive Committee. The Graduate Program Director will report to the Dean of the Graduate School and the Graduate Program Executive Committee. The Graduate Program Director will serve as the interim advisor for all incoming students until such time that each student identifies or is assigned a permanent advisor. The Graduate Program Director will meet with the Dean of the Graduate School and the Graduate Program Directors for other non-departmental and interdisciplinary graduate programs on a regular basis.

- **Graduate Program Executive Committee**: This committee is drawn from and elected by the membership of the Graduate Program Faculty (see next item). The committee will consist of three to five members that are representative of the diversity of programs and areas of interest of the Graduate Program Faculty. Members will serve for staggered five year terms. The Program Director serves as an ex-officio member of the Graduate Program Executive Committee. A staff member from the University IT Services will serve in a non-voting advisory capacity on the Graduate Program Executive Committee. This group will work with the Program Director to make day-to-day decisions regarding the program. This group will identify potential members of the Graduate Program Faculty and External Advisory Board (see below) and conduct voting in order to determine the membership of those bodies. The Graduate Program Executive Committee will provide leadership for the program and will organize and contribute to meetings of the External Advisory Board. Members of the Graduate Program Executive Committee will annually review the membership of the Graduate Program Faculty and External Advisory Board and recommendations for additions or removals will be made to the Dean of the Graduate School.

- **Graduate Program Faculty**: The faculty for this body is drawn from a wide range of units across the Michigan Tech campus community are affiliated with the Data Science program. These faculty members will have adjunct faculty status in the Data Science program. These faculty members will have adjunct faculty status in the Data Science program.

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20 We recognize that the term “adjunct” is not applied at Michigan Tech in the same way as it is used at other universities where it is often used to refer to non-permanent, frequently part-time faculty, who are not on the tenure-track. At Michigan Tech, the term “adjunct” is used to identify faculty members who are deemed eligible to be members of the faculty of a particular department or program. Adjunct faculty members are normally allowed to serve as the primary advisor to students in the department or program in which they hold adjunct status. Per Graduate School policy, adjunct faculty members are not allowed to serve as external members of graduate committees for students in the department or program in which
Sciences program and will be eligible to advise students who are seeking degrees in Data Sciences. Appointments to the Graduate Program Faculty will be made for terms of three-years duration, with the possibility of reappointment for multiple successive terms. Members of the Graduate Program Faculty will be expected to participate in Graduate Program meetings and events. Graduate Program Faculty may be elected to serve as a member of the Graduate Program Executive Committee, and upon this election may be nominated to serve as the Graduate Program Director. Graduate Program Faculty are encouraged to advise the Graduate Program Director on the direction of the Data Science program at Michigan Tech, the development of resources, and creation of opportunities for growth. Additionally, the Graduate Program Faculty are encouraged to actively network with industry experts.

- **External Advisory Board**: This board is drawn from a key pool of experts from industry and academia operating in the forefront of Big Data science. This board will help ensure that the Michigan Tech Data Science program is abreast of industry needs. This board will act as an advocate for the program through its wide-reaching network. An External Advisory Board is a required component of all PSM (Professional Science Master’s) programs. Members of the External Advisory Board will serve staggered three year terms. Members will be allowed to serve multiple terms.

- **Tentative membership**: Appendix III list the tentative membership of three functional bodies for the Data Science program.
Appendix I: Foundational Skills Courses

Note that 2000 level courses listed here cannot be counted towards the requirement for M.S. in Data Science degree.

Mathematics Courses (Credits: 3)

- MA 3740 - Statistical Programming and Analysis

School of Business and Economics Courses (Credits: 3)

- MIS 2000 - IS/IT Management\(^\text{21}\)
- MKT 3600 - Marketing Research
- MIS 3100 - Business Database Management
- MIS 2100 - Introduction to Business Programming\(^\text{22}\)

Computer Science Courses (Credits: 3)

- CS 3425 - Database
- CS 2321 - Data Structures\(^\text{23}\)

School of Technology Courses (Credits: 3)

- SAT 3210 - DB Management
- SAT 3002 - Application Programming Introduction\(^\text{24}\)
- SAT 4600 - Web Application Development\(^\text{25}\)

\(^{21}\) 2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\(^{22}\) 2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\(^{23}\) 2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\(^{24}\) New 3-credit course designed for Fall 2014
\(^{25}\) New 3-credit course designed for Spring 2015
Appendix II: Domain Specific Data Science Courses

Mathematics Courses (Credits: 3)

- MA 4710 - Regression Analysis
- MA 4720 - Design and Analysis of Experiments
- MA 4330 - Linear Algebra
- MA 5201 - Combinatorial Algorithms
- MA 5221 - Graph Theory
- MA 5401 - Real Analysis
- MA 5627 - Numerical Linear Algebra
- MA 5630 - Numerical Optimization
- MA 5701 - Statistical Methods
- MA 5741 - Multivariate Statistical Methods
- MA 5750 - Statistical Genetics
- MA 5761 - Computational Statistics
- MA 5791 - Categorical Data Analysis

Computer Science Courses (Credits: 3)

- CS 4425 - Database System
- CS 4471 - Computer Security
- CS 5321 - Advanced Algorithms
- CS 5331 - Parallel Algorithm
- CS 5441 - Distributed System
- CS/EE 5496 - GPU and Multi-core Programming
- CS 5631 - Data Visualizations
- CS 5760 - HCI Usability Testing
- CS 5811 - Advanced Artificial Intelligence
- CS/EE 5821 - Computational Intelligence

Department Computer Science may also consider developing new courses when appropriate or necessary in visual analytics, mobile applications and graduate software engineering service course.
School of Technology Courses (Credits: 3)

- SAT 5001 - Introduction to Medical Informatics
- SAT 5002 - Application Programming Introduction
- SAT 5121 - Introduction to Medical Sciences, Human Pathophysiology, Healthcare
- SAT 5141 - Clinical Decision Support and Improving Healthcare
- SAT 5161 - Data Warehousing and Business Intelligence
- SAT 5241 - Designing Security Systems
- SAT 5600 - Web Application Development
- SU 5010 - Geospatial Concepts, Technologies and Data
- SU 5045 - Geospatial Data Fusion

Electrical and Computer Engineering Courses (Credits: 3)

- CS/EE 5496 - GPU and Multi-core Programming
- EE 5500 - Probability and Stochastic Processes
- EE 5521 - Detection & Estimation Theory
- EE 5726 - Embedded Sensor Networks
- CS/EE 5821 - Computational Intelligence

Civil and Environmental Engineering Courses (Credits: 3)

- SSE 3200 - Web Based Services
- CE/SSE 4750 - Risk Analysis
- CE/SSE 4760 - Optimization and Decision-making
- CE 5740 - System Identification

School of Business and Economics Courses (Credits: 3)

- MIS 3100 - Business Database Management
- MIS 3400 - Business Intelligence
- EC 4200 - Econometrics
- BA 5610 - Business Process Management

26 New 3-credit course designed for Fall 2014; submitted to curriculum proposal (binder) Fall 2013
27 New 3-credit course designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
- BA 5800 - Marketing, Technology, and Globalization

Geological and Mining Engineering and Sciences Courses (Credits: 3)
- GE 5150 - Advanced Natural Hazards
- GE 5195 - Volcano Seismology
- GE 5250 - Advanced Computational Geosciences
- GE 5600 - Advanced Reflection Seismology
- GE 5670 - Aquatic Remote Sensing
- GE 5870 - Geostatistics & Data Analysis

School of Forestry Courses
- FW 4099 - Programming Skills for Bioinformatics (Credits:3)
- FW 5084 - Data Analysis and Graphics Using R (Credits:2)
- FW 5089 - Tools of Bioinformatics (Credits:4)
- FW 5411 - Applied Regression Analysis (Credits:3)
- FW 5412 - Regression with the R Environment for Statistical Computing (Credits:1)
- FW 5540 - Advanced Terrestrial Remote Sensing (Credits:4)
- FW 5550 - Geographic Information Systems for Resource Management (Credits:4)
- FW 5555 - Advanced GIS Concepts and Analysis (Credits:3)
- FW 5556 - GIS Project Management (Credits:3)
- FW 5560 - Digital Image Processing: A Remote Sensing Perspective (Credits:4)

Social Science Courses
- SS 5005 - Introduction to Computational Social Science (Credits: 3)

Department of Social Sciences may also consider developing new courses, when appropriate or necessary in computational social sciences with elements of social science theory, and land use modeling.

Cognitive and Learning Sciences Courses
- PSY 5220 - Advanced Statistical Analysis and Design II (Credits: 4)

Biological Sciences Courses
- BL 4470 - Analysis of Biological Data (Credits:3)

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28 New 3-credit course designed for Fall 2014; submitted to curriculum proposal (binder) Fall 2013
Biomedical Engineering Courses

- BE 5550 - Biostatistics for Health Research (Credits: up to 4)

Department of Biomedical Engineering may also consider developing new courses, when appropriate or necessary in big data applications to human health. This course may be developed as a BE, BL, or KIP course.

Chemical Sciences Courses (Credits: 3)

- CH 4610 - Introduction to Polymer Science
- CH 5410 - Advanced Organic Chemistry: Reaction Mechanisms
- CH 5420 - Advanced Organic Chemistry: Synthesis
- CH 5509 - Transport and Transformation of Organic Pollutants
- CH 5515 - Atmospheric Chemistry
- CH 5516 - Aerosol and cloud chemistry
- CH 5560 - Computational Chemistry

Department of Chemistry may consider developing new courses when appropriate or necessary in bio-spectroscopy and cheminformatics

Physical Sciences Courses

- PH 4390 - Computational Methods in Physics (Credits: 2)
- PH 4395 - Computer Simulation in Physics (Credits: 3)
Appendix III: Tentative Membership of Data Science Bodies

Graduate Program Faculty Membership
- Asim Banskota (Forestry)
- Laura Brown (Computer Science)
- Mari W. Buche (School of Business & Economics)
- Jason Carter (Kinesiology)
- Sarah Green (Chemistry)
- Timothy Havens (Electrical and Computer Engineering/Computer Science)
- Guy Hembroff (School of Technology)
- Chandra Sekhar Joshi (Biological Sciences)
- Robert Nemiroff (Physics)
- Saeid Nooshabadi (Electrical & Computer Engineering/Computer Science)
- Thomas Oommen (Geological & Mining Engineering & Sciences)
- Mark Rouleau (Social Sciences)
- Gowtham S (Information Technology Services)
- Ching-Kuang Shene (Computer Science)
- Allan Struthers (Mathematics)
- Raymond Swartz (Civil and Environmental Engineering)
- Hairong Wei (Forestry & Bioinformatics)

Graduate Program Executive Committee Membership
- Laura Brown (Computer Science)
- Mari W. Buche (School of Business & Economics)
- Timothy Havens (Electrical & Computer Engineering/Computer Science)
- Saeid Nooshabadi (Electrical & Computer Engineering/Computer Science)
- Gowtham S (Information Technology Services)
- Allan Struthers (Mathematics)

External Advisory Board Membership
- David Barnes (Program Director, Strategy and Emerging Internet Technologies, IBM)
- Tom Grebinski (Founder, Yotta Data Sciences)
• Lonne Jaffe (CEO of Syncsort)
• Jill Recla (Bioinformatics Analyst at The Jackson Laboratory)
• John Soyring (Soyring Consulting Services)
• John Wallin (Professor of Physics and Astronomy, and Director of the Computational Sciences Program at Middle Tennessee State University)
Proposal for a New Non-Departmental Graduate Certificate in Data Science

Contacts: Laura Brown (Computer Science), Mari W. Buche (School of Business & Economics), Gowtham S (Information Technology Services), Timothy Havens (Electrical & Computer Engineering/Computer Science), Jacqueline Huntoon (Graduate School), Saeid Nooshabadi (Electrical & Computer Engineering/Computer Science), and Allan Struthers (Mathematics)

e-mail: datascience@mtu.edu

Executive Summary

This proposal describes a plan for a new Graduate Certificate in Data Science. This program will augment the proposal for a Master of Science (M.S.) in Data Science. Like its M.S. counterpart the Graduate Certificate in Data Science has three main objectives: i) to attract students from various disciplines who wish to learn the basics of data analysis, data science, and computing tools; ii) to teach students basic skills in communication and build their awareness of business contexts; and iii) to provide students the opportunity to gain the basic skills that give them the ability to analyze large data sets, including Big Data.

Our goal is to have all the core data science courses and most approved data science courses offered online by 2016, which we note would allow off-campus students to fully complete the Graduate Certificate in Data Sciences with online offerings.
1. Background
The proposed Graduate Certificate is offered as subset of M.S. in Data Science and is offered to science and engineering graduates who wish to upgrade their qualification to be able to work in a profession with a primarily role to manage and analyze data.

2. Justification and Estimated Market
The program we are proposing will significantly increase the number of data scientists that Michigan Tech can offer to the workforce. The Graduate Certificate program in Data Science like its M.S. counterpart will provide students with strong academic training in data analysis in a range of areas (e.g., physical sciences, geosciences, geoinformatics, bioinformatics, cheminformatics, environmental, social sciences, business and commerce) while at the same time introduce essential business acumen, communication and teamwork skills highly valued by industry and government.

The proposed program emphasizes data analytics from a general perspective, but the skills to be learned are applicable to a diverse range of areas, including business analytics, computer science and engineering, and informatics. To support the interdisciplinary nature of the Data Science program, applications from multiple areas will be included in the coursework.

The proposal Data Science program is in line with [Michigan Tech strategic plan](https://www.banweb.mtu.edu/pls/owa/strategic_plan2.p_display) to “be a leader in creating solutions for society's challenges through education and interdisciplinary endeavors that advance sustainable economic prosperity...”

3. Competitive Analysis
Established computer science, business analytics, and statistics master’s degrees and certificate programs already exist, both in the U.S. and abroad, and provide specializations in data mining and predictive analytics. However, despite interest and recognized need, there are as yet only a few programs dedicated to data science in the U.S. Further, the existing programs have been designed around business data with a less domain-specific scientific focus. These master's programs include Northwestern’s new M.S. in Analytics, DePaul’s M.S. in Predictive Analytics, University of San Francisco’s M.S. in Analytics, LSU’s M.S. in Analytics, Rutgers’s Professional Science Master’s (PSM) of Business and Science in Analytics, and NCSU’s M.S. in Analytics (also a PSM program).

Finally, there is increased recognition by federal agencies that supporting Big Data research is important. For example, the National Institutes of Health (NIH) director, Dr. Francis Collins, recently convened a “Data and Informatics Working Group" that made several key recommendations aimed at fostering NIH sponsored research in Big Data. Other federal agencies have also signaled interest in Big Data research, including National Science...
4. Detailed Description of Graduate Certificate in Data Science

i. Title:
Graduate Certificate in Data Science

ii. Catalog description:
The non-departmental Data Science program at Michigan Tech provides a foundation for the emerging field of “Big Data” science, including the use of data mining, predictive analytics, cloud computing, and business skills, with a domain specific specialization. The main threads of analytic techniques, programming practice, domain knowledge, business acumen, and communication skills are intertwined in this program.

The Graduate Certificate in Data Sciences provides the basic skills in data analytics, data management, business and communication skills. Entry into this program assumes basic knowledge in statistical and mathematical techniques, programming, and communications.

iii. Credits:
Graduate Certificate in Data Science 15 credits (minimum)

iv. Course work:
In accordance with Senate policy, the requirements for the interdisciplinary Graduate Certificate in Data Sciences are a minimum 15 credits of coursework, including the required 12 credits of core courses and 3 credits of approved Data Science electives. All other requirements are per Senate proposals 11-10 and 4-11. Because this is an interdisciplinary certificate, a maximum of six credits can be earned at the 3000-4000 level.

Coursework Summary

Core courses for M.S. Data Science (12 credits):
The four required core 3-credit courses focus on basic skills in data science analytics, data mining, and business analytics. These courses are:

- UN 5550 - Introduction to Data Science (3 credits)\(^2\)
- MA 4790 - Predictive Modeling (3 credits)
- CS 4821 / MA 4795 - Data Mining (3 credits)
- BA 5200 - Information Systems Management and Business Analytics (3 credits)\(^3\)

\(^2\) New course to be designed for Fall 2014; submitted to curriculum proposal (binder) Fall 2013. This course will be administered by the Office of Dean of the Graduate School, and executed by Data Science faculty across the campus.

\(^3\) Revise course BA 5200-Strategic IS Management; submitted to curriculum proposal (binder) Fall 2013
Approved Data Science elective courses for M.S. Data Science (minimum of 3 credits):

The remaining 3 credits for the graduate certificate must be taken from the approved 3-credit Data Science elective courses that are as part of the M.S. program in Data Science as below:

- **CS 5841 / EE 5841 - Machine Learning (3 credits)**
- **CS 5491 - Cloud Computing (3 credits)**
- **CS 5471 – Advanced Topics in Computer Security (3 credits)**
- **MA 5781 - Time Series Analysis and Forecasting (3 credits)**
- **BA 5740 - Managing Innovation & Technology (3 credits)**
- **PSY 5210 - Advanced Statistical Analysis and Design I (4 credits)**
- **FW 5083 - Bioinformatics Programming and Skills (3 credits)**
- **PH 4395 - Computer Simulation in Physics (3 credits)**

**Foundational Prerequisite Requirement:**

It is expected that students seeking enrollment in this program will have sufficient foundational skills and aptitude in computer programming, statistical analysis, information systems and databases. The required foundational skills may have been obtained through formal academic qualifications or work experience. Students will receive advice regarding the expected level of foundational skills and students lacking those skills may be required to take specific foundational courses (Appendix I) prior to earning credits toward the certificate.

Each student’s letter of offer of acceptance into the certificate program will clearly articulate the expectations for incoming students in the area of foundational skills in computer programming, statistical analysis, information systems and databases. Foundational skills can be developed through formal academic coursework, work experience, or a combination. Students will be encouraged to develop their foundational skills before coming to Michigan Tech to start the graduate certificate program in Data Science. They will be also advised of the availability of the low-level courses (1000 and 2000 level) and medium-level courses (3000 level) that they can take at Michigan Tech during the summer semester before they plan to begin earning credits toward the certificate. After students matriculate in the program, their assigned advisors will continually monitor students’ progress to ensure that students are given all the necessary advice that they need to be successful in the program. Appendix I

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4 New course to be designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
5 New course to be designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
6 New course to be designed for Spring 2015; submitted to curriculum proposal (binder) Fall 2013
7 Graduate version of MA 4780, submitted to curriculum proposal (binder) Fall 2013, to be offered as a split-level undergraduate/graduate course. The graduate version of this course contains additional theoretical material and substantial project work.
8 Graduate version of FW 4099, submitted to curriculum proposal (binder) Fall 2013, to be offered as a split-level undergraduate/graduate course. The graduate version of this course contains additional theoretical material and substantial project work.
provides a list of foundational courses.

v. Online delivery:
Our goal is to have all the core data science courses and most approved data science courses offered online by 2016, which we note would allow off-campus students to fully complete the Graduate Certificate in Data Sciences with online offerings. Note that BA 5200 - Information Systems Management and Business Analytics will be offered as an online course starting in 2014. Additionally, the approved Data Science courses, CS 5841 / EE 5841 - Machine Learning and CS 5491 - Cloud Computing, will be offered as online courses in 2016.

vi. Description of new or revised Data Science courses (offered as part of M.S. in Data Science program):

All new (or revised) courses were added (modified) in the curriculum proposal (binder) process of Fall 2013.

UN 5550 - Introduction to Data Science (new) (3 credits)
This course provides an introduction to Big Data concepts, with focus on data management, data modeling, visualization, security, cloud computing, and data science from different perspectives: computer science, business, social science, bioinformatic, engineering, etc. This course also introduces the tools for data analytics such as SPSS Modeler, R, SAS, Python, and MATLAB. It involves two case study projects, each of which is integrated with communication and business skills.

BA 5200 - Information Systems Management and Business Analytics (revision) (3 credits)
This course is a restructuring of the existing course BA 5200 - Strategic IS Management to achieve a more acute focus on data analytics. The course incorporates experiential application of methods and analysis of business case studies focusing on contemporary issues in data analytics (i.e., Big Data) to include comprehension of business and organizational context, visualization and interpretation of results, reporting of outcomes from data analytics, evaluation of alternative techniques, and other current topics. Multiple online resources will be employed, including Teradata University. Students in this class will utilize open source software (e.g. Hadoop and NoSQL), developing skills applicable to industry. Ethical foundations and managerial constraints will be integrated throughout the course.

CS 5841 / EE 5841 - Machine Learning (new) (3 credits)
This course will explore the foundational techniques of machine learning. Topics are pulled from the areas of unsupervised and supervised learning. Specific methods covered include naive Bayes, decision trees, support vector machines (SVMs), ensemble, and clustering methods.

CS 5471 - Advanced Topics in Computer Security (new) (3 credits)

5
This course covers various aspects of producing trusted computer information systems. Topics may vary; network perimeter protection, host-level protection, authentication technologies, formal analysis techniques, and intrusion detection will be emphasized. Current systems will be examined and critiqued.

CS 5491 - Cloud Computing (new) (3 credits)
This course provides an overview of the principles, methods, and leading technologies of cloud computing technologies. Topics include cloud computing concepts and architecture: Hadoop, MapReduce; standards; implementation strategies; Software as a Service (SaaS); Platform as a Service (PaaS); Infrastructure as a Service (IaaS); workload patterns and resource management; migrating to the cloud; and case studies and best practices. Students in this class will build their own cloud application using services from providers such as Amazon or IBM.

5. Estimated Costs For Financial Evaluation
The Graduate Certificate in Data Science program is a subset of M.S. in Data Science program, and does not incur any cost in addition and beyond the M.S. program. The approval of Graduate Certificate program must be subject to the approval of the M.S. program.

6. Planned Implementation Date
This program has an anticipated start in Fall semester, 2014. This program will be offered as a regular program. The program will be extended into an online program as soon as it is established and practical to do so. We envision a start date of Fall 2016 for the online delivery of this program.

7. Program Governance
Like other non-departmental and interdisciplinary programs at Michigan Tech, the Data Science program will be administered through the Graduate School, which will have the overall responsibility and final oversight for the program. The program will have the same management structure that governs the M.S. in Data Science program.
Appendix I: Foundational Skills Courses

Note that 2000 level courses listed here cannot be counted towards the requirement for M.S. in Data Science degree.

Mathematics Courses (Credits: 3)
- MA 3740 - Statistical Programming and Analysis

School of Business and Economics Courses (Credits: 3)
- MIS 2000 - IS/IT Management\textsuperscript{9}
- MKT 3600 - Marketing Research
- MIS 3100 - Business Database Management
- MIS 2100 - Introduction to Business Programming\textsuperscript{10}

Computer Science Courses (Credits: 3)
- CS 3425 - Database
- CS 2321 - Data Structures\textsuperscript{11}

School of Technology Courses (Credits: 3)
- SAT 3210 - DB Management
- SAT 3002 - Application Programming Introduction\textsuperscript{12}
- SAT 4600 - Web Application Development\textsuperscript{13}

\textsuperscript{9}2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\textsuperscript{10}2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\textsuperscript{11}2000 level courses cannot be counted towards the M.S. in Data Science degree requirement.
\textsuperscript{12}New 3-credit course to be designed for Fall 2014
\textsuperscript{13}New 3-credit course to be designed for Spring 2015
Comments on the Data Science Proposals

Minor Editing / Clarification Fixes

- What is meant by ‘credit points’ on p6 (and elsewhere). Are these just regular credits?
  - Fixed: replaced references to “credit points” or “credit hours” with just “credits”
- Also on p6 you mention a Dean of Graduate Studies - I am not clear who this refers to (Dean of the Grad School or someone else)
  - Fixed: replace Dean of Graduate Studies with Dean of Graduate School
- There are a lot of new courses proposed and I think that it will be helpful to indicate which ones are already in the binder process. This at least suggests that issues of resources to deliver these courses have been addressed.
  - Fixed: added footnote comment on submission to binder process Fall 2013. All new course in the core and approved data science electives were considered in the binder process this fall.
- For the statistics classes that you list, have the instructors of these classes been informed that they are listed in the proposals?
  - Comment at meeting - all participating chairs have reviewed proposal. Additionally, all courses listed in the program were provided by the respective unit chairs or the relevant Data Science Faculty who teach the course. In any case the courses have an upper limit and the eligible students can enroll in the course as the discretion of the faculty involved.
- The names of the Grad Program Executive Committee and the Grad Program Faculty are not consistent in the appendix and the main text.
  - Fixed
- The certificate proposal was entitled as a master's proposal.
  - Fixed

Other Questions / Comments

- As we talked about in the meeting, the new faculty line and three TA lines will certainly draw some questions. Where do they come from? Is the faculty line new - in the recent past new lines have come, perhaps exclusively, through faculty hiring initiatives. For the TA lines, it would be good to know if these will be new or come from the existing pool.
- The source of funds for the program assistant also should be addressed.
  - Comment: Provost Seel has indicated support for new faculty line. The source of funding for the TA and admin support is under discussion within the administration
- The issue of additional teaching for the team taught class would also benefit from clarification since this is additional teaching load for those involved.
  - Comment: All units involved have signed up to this proposal and are aware of the teaching allocation required for the faculty. The Program Director will work with the Chairs of the unit involved in this program to negotiate the faculty load and other resources"
Program Characteristics:

Inquiries:

- Forwarded to Graduate Program Director and Graduate Program Assistant

Applications:

- Initial processing by Graduate School (as for all programs)
- Forwarded to Graduate Program Director for review
- Graduate Program Assistant assists with processing
- Review conducted based on procedures developed by Graduate Program Director and Graduate Program Steering Committee and approved by relevant Chair(s)/Dean(s) and Graduate Dean
- Funding decisions made based on procedures developed by Graduate Program Director and Graduate Program Steering Committee and approved by relevant Chair(s)/Dean(s) and Graduate Dean

Admissions:

- Graduate Program Director responsible for final decisions
- Graduate Program Assistant assists with processing
- Graduate School issues official letter of admission (as for all programs)

Student Advising:

- Graduate Program Director serves as temporary advisor for incoming students
- Graduate Program Director and Graduate Program Steering Committee primarily responsible for program management with assistance of Graduate Dean and relevant Chair(s)/Dean(s) if necessary
- Graduate Program Steering Committee collaborates with Graduate Program Director to oversee day-to-day program management
- Graduate Program Steering Committee membership is representative of the academic home units of faculty members participating in the program
- Students reassigned to permanent advisor in home unit as soon as possible
- Students “live” (e.g., get mail, have office [if possible]) in same academic unit as advisor
- Students “count” toward enrollment in advisor’s home academic unit (where advisor has office and primary appointment)
- Graduate Program Directors meet as a group on a regular basis with Graduate Dean to promote communication/collaboration/continual improvement.
- Expectations for completion of milestones for degrees developed by Graduate Program Director and Graduate Program Steering Committee and approved by relevant Chair(s)/Dean(s) and Graduate Dean
• Graduate Program Assistant assists with all aspects of student support, ensuring appropriate level of enrollment (e.g., full-time), processing required forms, scheduling events, entering information into Banner (as for all programs)
• In cases of conflict, Graduate Program Director and Graduate Steering Committee address issues (as is done in other programs), with the Graduate School becoming involved when resolution at the program level is not possible

Curriculum:

• Core – goal of core is to develop commonly agreed upon required body of knowledge, facilitate cross-disciplinary communication and collaboration among faculty and students; highlight relevant recent research outcomes in relevant discipline(s).
  o Minimum of 1 regularly scheduled (can be online) course
  o Minimum of 1 seminar/journal course

• Additional courses:
  o Must conform to relevant rules for graduate programs at relevant level
  o Must promote interdisciplinary themes while providing opportunity to build students’ expertise in a particular area.

Changes to Curriculum or Program:

• Addressed through changes to Program policies and procedures (to be reviewed and approved by Graduate Dean in consultation with relevant Department Chair(s)/Dean(s)
• Addressed through Graduate School Binder Process
Grad Prog Director
Rotating 3-year term

Grad Prog Asst
In Prog Dir's unit

Graduate Program Steering Committee
3-5 member voting body; representation of departments/schools of participating faculty

Graduate Program Faculty
Nominated by Graduate Program Steering Committee, approved by relevant Department Chair/Dean, approved by Graduate School for Adjunct Faculty Status in Program
Authority to serve as primary advisor to students

All faculty supervised by relevant Department Chair/Dean

Graduate Program policies and procedures (written document, available on web) reviewed on 5-year basis by Graduate Dean. Review includes requests for input from relevant Department Chair(s)/Dean(s).

Graduate Program Director reports to Graduate Dean for program-related issues.

All non-departmental/interdisciplinary Graduate Program Directors will meet as a group on a regular basis with Graduate Dean to promote communication/collaboration/continual improvement.