Michigan Tech

Office Memo

TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacquelin E Huntoon

DATE: April 24, 2020

SUBJECT: Senate Proposal 46-20

Attached is Senate proposal 46-20, "Establishment of a New Graduate Certificate in Data Science Foundations," and a memo stating the Senate passed this proposal at their April 22, 2020 meeting. I have reviewed this memo and recommend approving this proposal.

I concur ✓ do not concur _____ with this recommendation.

_____   04/27/2020
Richard Koubek, President   Date

DATE:	April 23, 2020
TO:	Richard Koubek, President
FROM:	Michael Mullins University Senate President
SUBJECT:	Proposal 46-20
COPIES:	Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on April 22, 2020, the University Senate approved Proposal 46-20, "Establishment of a New Graduate Certificate in Data Science Foundations". Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University

Proposal 46-20

Establishment of a New Graduate Certificate in Data Science Foundations

Submitted by:
Master of Science in Data Science Program
Data Science Executive Committee

1. **Proposal Date:**   March 20, 2020

2. **Proposing Contacts and Departments:**   Laura E. Brown, Data Science Program Director
<u>lebrown@mtu.edu</u>

3. **Sponsor Department Approvals:** Not Applicable, Interdisciplinary Certificate

4. **General Description and Characteristics of Certificate**

   4.1. **General Description:**

   The Data Science program at Michigan Technological University proposes a nine credit
   Certificate in Data Science Foundations. The graduate certificate in Data Science
   Foundations has the following three 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 student basic skills in communication and visualization; and,
   iii) to provide students the opportunity to gain fundamental skills to analyze large data
   sets.

   4.2. **Catalog Description:**

   The Certificate in Data Science Foundations is designed to develop skills and competencies
   in fundamental data science techniques, including predictive modeling, data mining,
   information management, data analytics, and data visualization. In addition, the curriculum
   integrates building skills in communication and teamwork while working on data from
   real-world problems.

5. **Rationale for the Certificate:**

The Data Science Foundation graduate certificate will serve two student populations. First, the certificate may serve students, not currently enrolled in another graduate program at Michigan Tech, with a path to upskilling and gaining new knowledge in the field of data science. This pathway would likely consist of students enrolled online.

Additionally, current Michigan Tech graduate students from a wide range of disciplines are seeking to equip themselves for our data-driven world. The proposed Graduate Certificate will provide academic training in data analysis to students from backgrounds including physical sciences, geosciences, bio/chem-informatics, social sciences, business, computational sciences, and engineering. This nine-credit certificate will provide a strong foundation in Data Science skills that most students can fit into their curriculum.

Students from both groups could elect to continue their education to enter the Data Science MS program.

As an interdisciplinary certificate, tuition rates would follow that of Data Science.

6. **Related Programs:**

There has been a proliferation of Data Science programs in the last five years. Here is a sampling of graduate certificate programs:
- American University, Washington, DC. The program requires 12-credit hours of instruction and focuses on the R programming language for visualizing, analyzing, and building models for prediction. https://www.american.edu/cas/mathstat/ms/data-science-certificate.cfm

- Columbia University, New York, NY. The Certification of Professional Achievement in Data Sciences requires four courses in preparing students in developing foundational data science skills. https://datascience.columbia.edu/certification

- George Mason University, Fairfax, VA. The certificate program focuses on mastering a variety of basic computational skills to manage and analyze data and is designed primarily for professionals in technical fields who seek to upgrade their expertise in data science. The coursework consists of 15 total credits. https://cos.gmu.edu/cds/graduate-certificate-in-data-science/

- George Washington University, Washington, DC. The 12-credit graduate certificate in data science program allows students to study fundamental ideas that underlie large data systems and document a knowledge base for work in data intensive jobs. http://bulletin.gwu.edu/arts-

sciences/data-science/certificate/

- Indiana University, Bloomington, Indiana. The 12-credit graduate certificate in Data Science allows students to acquire new skills in topics such as data analysis, cloud computing, health and medicine, statistics, and data mining.
https://datascience.indiana.edu/programs/graduate-certificate-online/index.html

- Marquette University, Milwaukee, WI. The 15-credit data science certificate program and its curriculum are designed to connect data analytics and data science skills and knowledge with the needs evident in a host of fields. https://www.marquette.edu/grad/programs-data-science-certificate.php

- University of Michigan, Ann Arbor, MI. The 9-credit certificate is designed to train data scientists with significant multidisciplinary knowledge, broad analytical skills and agile technological abilities. https://midas.umich.edu/certificate/

- University of Minnesota, Minneapolis, MN. The 12-credit certificate is designed for students seeking expertise in methods of managing and analyzing Big Data.
https://datascience.umn.edu/admissions/certificate

7. **Projected Enrollments:**

Initially, the program will have most of the enrollment from currently enrolled Michigan Tech graduate students. An online offering will expand the number of students enrolled. Given the current level of interests, we expect the program to grow before stabilizing enrollment. If interest exceeds this projected enrollment, in particular through online enrollment, additional resources will be required (see section 15 below).

Semester	On-campus Enrollment	Online Enrollment
Fall 2020	4-5 students	---
Fall 2021	5 students	2-5 students
Fall 2022	5-7 students	5-10 students
Fall 2023	5-7 students	5-10 students
Fall 2024	5-7 students	5-10 students

8. **Scheduling Plans:**

The on-campus coursework will be offered during regular instructional time periods and will not require changes to scheduling of classes. Online offerings will need to be coordinated with the participating departments.

9. **Curriculum Design:**

Required Course - 3 credits
UN 5550 - Introduction to Data Science

Elective Courses - 6 credits (select 2 of the 3 courses)
BA 5200 - Information Systems Management & Data Analytics
*MA 5790 - Predictive Modeling
CS 5831 - Advanced Data Mining

The course marked with an asterisk is already available online through the Applied Statistics MS program. The other courses are in preparation or will begin the online course process this summer and next year.

10. **Course Descriptions:**

Course Descriptions for each respective course are as follows:

UN 5550 - Introduction to Data Science
Introduces concepts and skills fundamental to Data Science including: getting data, data wrangling, exploratory data analysis, basic statistics, data visualization, data modeling, and learning. The course introduces data science from different perspectives: computer science, mathematics, business, engineering, and more.

BA 5200 - Information Systems Management and Data Analytics
Focuses on management of IS/IT within the business environment. Topics include IT infrastructure and architecture, organizational impact of innovation, change management, human-machine interaction, and contemporary management issues involving data analytics. Class format includes lecture, group discussion, and integrative case studies.

MA 5790 - Predictive Modeling
Application, construction, and evaluation of statistical models used for prediction and classification. Topics include data pre-processing, over-fitting and model tuning, linear and nonlinear regression models and linear and nonlinear classification models.

CS 5831 - Advanced Data Mining
Data mining focuses on extracting knowledge from large data sources. The course covers data mining concepts, methodology (measurement, evaluation, visualization), algorithms (classification/regression, clustering, association rules) and applications (web mining, recommender systems, bioinformatics).

Students interested in the Data Science Foundations certificate will work with the program advisor to select courses that fit their interest and ensure they have the proper foundational prerequisite skills.

11. **Model Schedule Demonstrating Completion Time:**

The Certificate can be completed in a two-semester sequence or spread over three semesters (depending on student preference and scheduling requirements). The courses are offered in the semester listed below.

Fall Semester	Spring Semester
UN 5550 - Intro to Data Science	CS 5831 - Advanced Data Mining
BA 5200 - Info Sys Mgmt.	
MA 5790 - Predictive Modeling	

12. **Library and Other Learning Resources:**

No library or other learning resources are required at this time.

13. **Faculty Resumes:**

The following faculty are assigned to teach the curriculum:
    - UN5550 & CS5831 - Laura E. Brown
    Associate Professor, Computer Science
    Data Science Program Director
    https://pages.mtu.edu/~lebrown/

    - BA 5200 - Jeffrey Wall
    Assistant Professor of Management Information Systems, College of Business
    Richard and Joyce Ten Haken Faculty Fellow in Business
    https://www.mtu.edu/business/people-groups/faculty/jeffrey-wall/

- MA 5790 - Qiuying Sha
Professor, Mathematical Sciences
Portage Health Foundation Endowed Professor of Population Health
https://www.mtu.edu/math/department/faculty-staff/faculty/sha/

Additional faculty associated with the Data Science program may also be the instructors for these courses: https://www.mtu.edu/data-science/people-groups/faculty/

14. **Equipment:**

No additional equipment will be required.

15. **Program Costs:**

Initial costs for offering the certificate to on-campus students will not incur additional costs, but will require continued funding for Data Science graduate teaching support and positions.

The online offering of the certificate will also require continued backing of the graduate teaching support as well as agreement and support between the respective departments and Graduate school for faculty teaching loads for the online sections.

We anticipate that the initial enrollment load can be covered with our current faculty. However, many courses in the Data Science certificate are impacted by increased enrollments in cognate programs such as MBA and MS in Computer Science, Math, and Applied Statistics (for example, MA 5790 – Predictive Modeling and CS 5831 – Advanced Data Mining). Therefore, teaching support to fulfill increased needs will need to be evaluated regularly.

16. **Space:**

No additional space will be required.

17. **Policies, Regulations, and Rules:**

Not applicable

18. **Accreditation Requirements:**

The program will not seek accreditation as there is no formal accreditation body for data science programs.

19.   Planned Implementation Date:

Fall 2020
Online - Fall 2021

20.   Assessment:

The learning objectives of the Certificate are:
1. Demonstrate core proficiency in data science foundations

2. Demonstrate understanding of the application data science foundations to specific problems

3. Demonstrate professional skills of a data scientists (data, written, and oral communication)

Assessment Points	Graduate Learning Objectives (GLO)
Grades in certificate courses (UN5550, BA5200, MA5790, CS5831)	GLO1, GLO2
Class Communication Evaluation - Evaluation form instructor must complete	GLO3