Michigan Tech

Office Memo

Office of the Provost and
Senior Vice President for Academic Affairs

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TO: Richard Koubek, President

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

Jacqueline E Huntoon

DATE: April 22, 2021

SUBJECT: Senate Proposal 68-21

Attached is Senate proposal 68-21, “Establishment of a New Graduate Certificate in Geospatial Data Science and Technology,” and a memo stating the Senate passed this proposal at their April 21, 2021 meeting. I have reviewed this memo and recommend approving this proposal.

I concur X do not concur _____ with this recommendation.

Richard Koubek, President

4/26/21
Date

Michigan Tech

University Senate

DATE:	April 22, 2021
TO:	Richard Koubek, President
FROM:	Samuel Sweitz University Senate President
SUBJECT:	Proposal 68-21
COPIES:	Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on April 21, 2021, the University Senate approved Proposal 68-21, "Establishment of a New Graduate Certificate in Geospatial Data Science and Technology". Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University
Proposal 68-21
(Voting Units: Academic)

Establishment of a New Graduate Certificate in Geospatial Data Science and Technology

Submitted by: Department of Civil & Environmental Engineering

1. **Proposal Date:**
   February 1, 2021

2. **Proposing Contacts and Department:**
   Eugene Levin, Ph.D,CP:elevin@mtu.edu
   Jeffery Hollingsworth,PS,GISP: jphollin@mtu.edu
   Dr. Roman Shults, Ph.D: rshults@mtu.edu
   Joseph Foster,PS,PLS: josephfo@mtu.edu

   Department of Civil & Environmental Engineering

3. **Sponsor Department Approvals**
   At the end of the document

4. **General Description and Characteristics of Program:**

4.1 General Description of Certificate

The Civil & Environmental Engineering Department at Michigan Technological University proposes a nine-credit Certificate in Geospatial Data Science and Technology. The graduate certificate in Geospatial Data Science and Technology has the following three objectives.

i) Attract students who want to be prepared for the analysis and applying for multiple real-life application scenarios novel cyber phenomena of Geospatial Big Data. Those scenarios include but not limited to: autonomous navigation, smart-cities (digital twins) and Internet of Things (IoT);
ii) To provide students applied geospatial science and technology knowledge and skills, including geospatial data mining and crowdsourcing, use of computing toolsets and programming environments for operating structured and non-structured geospatial data widely available in the global cyberspace;

iii) To provide students fundamental applied skills in cloud-based geospatial services, specific geospatial data mining techniques such as trajectories, images, natural language mining and obtaining useful geospatial data from open depositories and social media for use in various application scenarios.

4.2 Catalog Description

The Certificate in Geospatial Data Science and Technology is designed to develop skills and competencies in geospatial data mining and crowdsourcing, use of computing toolsets and programming environments for operating Geospatial Big Data. The curriculum builds skills for geospatial big data mining technologies for real-world application scenarios such as autonomous navigation, smart cities and Internet of Things (IoT).

5. Rationale for Certificate:

The Geospatial Data Science and Technology Certificate will serve three potential student populations. First, the certificate will provide students in the bachelor of science in geospatial engineering and integrated geospatial technology master of science program at Michigan Tech with a path to gaining skills and knowledge in data science and technologies. This pathway would be available to current students on-campus or students enrolled online.

Second, current Michigan Tech graduate students from a wide range of disciplines such as civil, environmental, geological, computer engineering, data science and forestry who are seeking to equip themselves for a geospatial big data and technologies driven world. The proposed Graduate Certificate will provide academic and hands-on training in R programming language, mining of the geospatial data and imagery (space, aerial, UAV, terrestrial, social media) to students from various backgrounds civil engineering, forestry, geosciences, computational sciences, and computer engineering. This nine-credit certificate will provide a strong foundation in Geospatial Big Data that most students can fit into their curriculum.

Third, working geospatial professionals in the private sector, aerospace industry and multiple government agencies may require skills and knowledge they did not gain during their undergraduate education but are required for projects and research opportunities that are presented in their current career. Geospatial data science and operational knowledge of geospatial data processing technologies are essential for many industries. For example, the current job market in the US per (https://www.indeed.com/jobs?q=Geospatial+Data+Science&from=sug) has a capacity of 1400 open positions. Per U.S. Bureau of Labor Statistics (https://www.bls.gov/ooh/about/data-for-occupations-not-covered-in-detail.htm#Data-scientists-and-mathematical-science-occupations,-all-other) occupations associated with

Data Science have growth rate of 31% (much faster than average). Proposed Certificate aimed to merge data science with geospatial technology competencies which is important for many industries. Specifically, Surveying Engineering industry constantly is looking for CED credits for the licensed professionals towards NSPS CED programs [https://www.nsps.us.com/page/EducationPolicy#]. Therefore, another intended audience for the certificate consists of geospatial workforce representatives working on their education advancement.

6. Related Programs:

There are several related online geospatial data science and technology programs. Examples include:

- Temple University, Face-to-face only, Philadelphia, Pennsylvania. Temple University offers 12-credits "Geospatial Data Science" Graduate Certificate that focuses on location-based data.https://www.temple.edu/academics/degree-programs/geospatial-data-science-certificate-graduate-la-gsds-grad
- Purdue University, Online, West Lafayette, Indiana. Purdue University offers 12-credits online graduate certificate in "Spatial Data Science": https://online.purdue.edu/programs/agriculture/spatial-data-science-certificate
- Penn State University, Online, College Station, Pennsylvania. Penn State University offers 12-credits undergraduate online certificate in "Geospatial Big Data Analytics": https://bulletins.psu.edu/undergraduate/colleges/earth-mineral-sciences/geospatial-big-data-analytics-certificate/#programrequirementstext
- Cornell University, Online, Ithaca, New York, Cornell University offers 9-credits graduate certificate in Data Analytics: https://info.ecornell.com/data-analytics?creative=431504773632&keyword=%2Bdata%20%2Bscience%20%2Bcertificate&matchtype=b&network=g&device=c&utm_campaign=datascience_US+-+BMM+-+Data+Analytics&utm_source=google&utm_medium=cpc&utm_term=%2Bdata%20%2Bscience%20%2Bcertificate&utm_content=g_431504773632_b&creative=431504773632&keyword=%2Bdata%20%2Bscience%20%2Bcertificate&matchtype=b&network=g&device=c&url=https%3A%2F%2Finfo.ecornell.com%2Fdata-analytics%3Fcreative%3D431504773632%26keyword%3D%252Bdata%2520%252Bscience%2520%252Bcertificate%26matchtype%3Db%26network%3Dg%26device%3Dc&target=&position=&gclid=CjwKCAiAr6-ABhAfEiwADO4sfSxvnzmPY-3aL_F9GK4MSN-C-b0qtXwV12xuEtRJMMpSfT4z7UXtJxoCGmwQAvD_BwE
- YounSei University (Korea) offers an online program in "Spatial Data Science and Applications" towards Courserra. Current enrollment exceeds 15,000 students per: https://www.coursera.org/learn/spatial-data-science

7. Projected Enrollments:

Initially, the majority of enrollment will consist of current Michigan Tech students. integrated Geospatial Technology master's program students will earn that certificate automatically while taking certificate courses as elective in pursuit of their master's degree. Based on the current growing geospatial courses enrollments, we expect the program to grow over the next several academic years. If enrollment exceeds projections, in particular through online enrollment, additional resources will be required (see section 15 below).

Semester	On-campus Enrollment	On-line Enrollment
Fall 2021	2 students	3 students
Fall 2022	2-5 students	2-5 students
Fall 2023	5-10 students	5-10 students
Fall 2024	5-10 students	10-15 students
Fall 2025	10-15 students	15-20 students

8. Scheduling Plans:

No change in the regular scheduling of the existing courses is anticipated. The certificate is available for onground and online students.

9. Curriculum Design:

Coursework: 9 credits, two required courses (6 credits) and choose 1 elective course (3 credits) for certificate completion (only 3 credits may be at the 4000 level):

Required courses:
SU5601 R for Geosciences in Applied and Fundamental Tasks and Research (3 cr., Spring)
SU5012 Geospatial Data Mining and Crowdsourcing (3cr., Spring)

Elective Courses (one of the following):

GE5950 Applied Remote Sensing and Machine Learning (3cr., Spring)
SU5300 Geospatial Monitoring of Engineering Structures and Geodynamic Processes. (3cr., Fall/Spring)
GE 5515 - Advanced Geoinformatics (3 cr., Spring)
SU5011 Cadaster and Land Information Systems (3 cr., Spring)
SS5049 GIS Applications for the graduate Researcher (3 cr., Fall)
SS5050 Advanced GIS Methods and Projects (3cr., alternate years)
FW5550 GIS for Resource Management (4cr, Fall)
FW5553 Python Programming for ArcMap GIS (3cr, Fall)
FW5555 Advanced GIS Concepts and Analysis (3cr, Spring)

10. Course Descriptions

SU5601 R for Geosciences in Applied and Fundamental Tasks and Research (3 cr., Spring) R for Geosciences is intended to build up modern engineers and scientists and to get them acquainted with a powerful tool for the solution of miscellaneous applied statistical tasks in geosciences.

SU5012 Geospatial Data Mining and Crowdsourcing (3cr., Spring) This course comprises theory and applications of geospatial data mining. Typical application scenarios are covered. Attention is given to open-source data and systems crowdsourcing, as well as social media. Special focus on imaging and visual analytics.

GE 5515 - Advanced Geoinformatics (3 cr., Spring) This course covers the concepts and theories in geospatial science, GIS analysis techniques (network analysis, cost distance analysis, multi-layer raster data analysis), and remote sensing theories and applications across different spectra. Basic concepts and techniques associated with geostatistics, and analysis of spatial relationships are also introduced using examples in geophysical and environmental research.

GE5950 Applied Remote Sensing and Machine Learning (3cr., Spring) This course introduces Earth science and engineering applications of remote sensing. The course will also introduce students to an open source collection of machine learning algorithms for data mining tasks using Weka.

SU5011 Cadaster and Land Information Systems (3 cr., Fall, alternate years) Topics include: an introduction to land rights, land ownership, lease, and traditional rights, mortgaging and land as capital, description of land rights, boundary description, land information systems, examples of cadastre types over the globe, and modern technical aspects.

SS5049 GIS Applications for the graduate Researcher (3 cr., Fall)
Applications of Geographic Information Science and Technologies for research problem identification, analysis, and dissemination. Students learn how to use GIS as a tool to collect and analyze qualitative and quantitative data for graduate research. Hands-on experience in data collection, analysis, and problem solving.

SS5050 Advanced GIS Methods and Projects (3cr., alternate years) Advanced application of Geographic Information Systems in social sciences as a tool to collect and analyze qualitative and quantitative data. Students gain hands-on experience in data collection, advanced spatial analysis, and scripting.

FW5550 Use of geographic information systems (GIS) in resource management. (4cr. Fall) Studies various components of GIS in detail, as well as costs and benefits. Laboratory exercises use ArcGIS software package to solve resource management problems.

FW 5553 - Python Programming for ArcMap GIS (3cr, Fall) An introduction to Python scripting and basic Python coding within ArcMap. Labs cover tasks found in typical GIS workflows. Students learn how to write and debug Python scripts, models and mapping programs.

FW5555 Advanced GIS Concepts and Analysis (3cr. Fall) This course moves beyond the fundamentals of GIS to explore the application of GIS technology to environmental monitoring and resource management issues. Students learn graphic modeling techniques, network analysis, 3D visualization, geodatabase construction and management, and multivariate spatial analysis.

All the SU courses listed above are already developed and are delivered in asynchronous online mode.

11. Model Schedule Demonstrating Completion Time

The Certificate can be completed in a 1 or 2 semester sequence or spread over 3 semesters (depending on student preference and scheduling requirements). The courses are offered in the semester listed below. Students can start any semester for increased flexibility. Once courses are all online, faculty may teach the courses other semesters as overload. A 2-semester example schedule is shown below.

Fall Semester

SU5011, Cadaster and Land Information Systems

Spring Semester

SU5601 R for Geosciences in Applied and Fundamental Tasks and Research
SU5012 Geospatial Data Mining and Crowdsourcing

12. Library and other Learning Resources

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

13. Faculty Resumes

The following faculty will be supporting the program.

Eugene Levin Ph.D, CP , Associate Professor
https://www.mtu.edu/epssi/members/levin/

Jeffery Hollingsworth, PS, GISP, Professor of Practice
https://www.mtu.edu/cee/people/faculty-staff/faculty/hollingsworth/

Roman Shults, Ph.D, Adjunct Professor
https://www.researchgate.net/profile/Roman_Shults

14. Equipment

No additional equipment will be required.

15. Program Costs

Initially, the certificate will not incur additional costs, as we anticipate that the initial enrollment load can be covered with our current faculty. As online instruction enrollment grows, the additional costs associated with instruction will be covered from tuition return from the students who are enrolled online.

16. Space

There are no new space requirements.

17. Policies, Regulations, and Rules

Not applicable

18. Accreditation Requirements

Michigan Tech is accredited by the Higher Learning Commission (HLC). The proposed certificate will meet HLC criteria 3 and 4. The proposed certificate will not seek additional accreditation.

19. Planned Implementation Date

Fall 2021

20. Assessment

Students earning this certificate will be able to:

GLO1. Implement efficient strategies for geospatial big data mining as decision support tools for the real-world application scenarios.

GLO2. Apply R technology in the geospatial data domain

21. Approval Process

Departmental Graduate Committee: , 2021
Department: , 2021
College of Engineering: , 2021
Provost's Office and Deans' Council: , 2021
Graduate School: , 2021
Approved by the Senate:
Approved by the President: