



SOUTH DAKOTA BOARD OF REGENTS
ACADEMIC AFFAIRS FORMS
New Certificate

UNIVERSITY:	University of South Dakota
TITLE OF PROPOSED CERTIFICATE:	Artificial Intelligence
INTENDED DATE OF IMPLEMENTATION:	Fall 2021
PROPOSED CIP CODE:	11.0102
UNIVERSITY DEPARTMENT:	Computer Science-UCSC
UNIVERSITY DIVISION:	College of Arts & Sciences-2A

University Approval

To the Board of Regents and the Executive Director: I certify that I have read this proposal, that I believe it to be accurate, and that it has been evaluated and approved as provided by university policy.

<i>Elizabeth M. Freeburg</i>	3/23/2020
Institutional Approval Signature	Date
<i>President or Chief Academic Officer of the University</i>	

1. Is this a graduate-level certificate or undergraduate-level certificate?

Undergraduate Certificate Graduate Certificate

2. What is the nature/purpose of the proposed certificate?

The proposed Artificial Intelligence (AI) certificate in the CS department focuses on the development of AI tools for different purposes, including machine vision (e.g., robotics), machine learning for big data, data analytics, the internet of things, and information retrieval, in which data may include web-based medical text, cultural heritage documents, etc. These courses will also take advantage of USD’s high-performance computing capacity.

The current options for completing the certificate represent the regular two-year rotation of courses, and will permit students to complete the certificate in a timely fashion, and with an emphasis in specific subfields of Artificial Intelligence, based on their interests and career objectives.

3. If you do not have a major in this field, explain how the proposed certificate relates to your university mission and strategic plan, and to the current Board of Regents Strategic Plan 2014-2020.

Links to the applicable State statute, Board Policy, and the Board of Regents Strategic Plan are listed below for each campus.

- BHSU: [SDCL § 13-59](#) [BOR Policy 1:10:4](#)
 - DSU: [SDCL § 13-59](#) [BOR Policy 1:10:5](#)
 - NSU: [SDCL § 13-59](#) [BOR Policy 1:10:6](#)
 - SDSMT: [SDCL § 13-60](#) [BOR Policy 1:10:3](#)
 - SDSU: [SDCL § 13-58](#) [BOR Policy 1:10:2](#)
 - USD: [SDCL § 13-57](#) [BOR Policy 1:10:1](#)
- [Board of Regents Strategic Plan 2014-2020](#)

According to both its statutory mission and its mission as provided in BOR policy, USD is charged with offering both liberal arts and professional education. As programs supported across the existing liberal arts curriculum and engaged in current technological developments,

the proposed specialization will also provide students with skills that are urgently needed within South Dakota. At present, no SDBOR programs in Artificial Intelligence exist.

4. Provide a justification for the certificate program, including the potential benefits to students and potential workforce demand for those who graduate with the credential.¹

At present, no SDBOR programs in Artificial Intelligence exist. The closest match to this proposed AI program is the undergraduate Data Science major and minor at SDSU. The primary difference is that the USD programs will offer hands-on projects involving several different applications, unlike SDSU's program that primarily relies on statistics coursework.

According to the Bureau of Labor Statistics (BLS), employment of computer and information technology occupations is projected to grow 12% from 2018 to 2028, much faster than the average for all occupations. These occupations are projected to add about 546,200 new jobs. Demand for these workers will stem from greater emphasis on cloud computing, the collection and storage of big data, and information security. Considering all computer science jobs, the median annual wage for computer and information technology occupations was \$86,320 in May 2018, which was higher than the median annual wage for all occupations of \$38,640.

Based on BLS data, graduates with an AI specialization are and will be in great demand. Conventionally, graduates with this background would be candidates for the position of information research scientist². Such a job is projected to grow by 16% by 2028, and the average salary for this position at present is \$106,500 (2018 median pay). Another application domain is information security, and the BLS is projected that the number of jobs will be increased by 37% across the states, where AI and machine-learning tools are now expected. Another important application domain is the finance industry, where artificial intelligence tools are considered as complementary tools for risk management³. The employment of financial managers is projected to grow 18.7% (2016 – 2026)⁴.

AI is not just limited to one domain; it includes data analytics, statistics computational chemistry, physics, biology, and health sciences (just to name a few). Regardless of source of data (big data), there is a strong need for AI/Data analysts to interpret data, make decisions, and visualize output.

In South Dakota alone (using the BLS data)⁵, we observe similar trends in computing jobs. Computing jobs, such as computer and information analyst, programmer, game developer, and data analyst will increase by minimum 3% (and maximum on average 16%) by 2028.

On the whole, the primary purpose for proposing this program is workforce development, as the United States anticipates dramatic workforce demand in computer science professionals. If we just address computer and information research scientist jobs, we observe that these professionals have a median pay of \$111,840 per year across the United States (2018).

¹ For workforce related information, please provide data and examples; data sources may include but are not limited to the South Dakota Department of Labor, the US Bureau of Labor Statistics, Regental system dashboards, etc.

²<https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm>

³<https://www.bls.gov/opub/btn/volume-7/in-the-money-occupational-projections-for-the-financial-industry.htm>

⁴ Percentage in North American Industry Classification System (NAICS) 520000 (Source: U.S. Bureau of Labor Statistics)

⁵ https://www.bls.gov/oes/2018/may/oes_sd.htm#15-0000

The proposed program can also be considered as bridge for several different programs, departments, and divisions across the USD campus. Our human intelligence with artificial intelligence has the potential to help develop research in academic and industrial communities as we live in the world of big data. At present time there is a high demand for students with a basic knowledge of AI.

5. Who is the intended audience for the certificate program (including but not limited to the majors/degree programs from which students are expected)?

The Artificial Intelligence certificate includes prerequisite courses that are required for all majors and minors in Computer Science, and the certificate requirements will fit into the major and minor requirements, allowing any Computer Science major and minor to complete the certificate with no additional credits.

6. Certificate Design

A. Is the certificate designed as a stand-alone education credential option for students not seeking additional credentials (i.e., a bachelor's or master's degree)? If so, what areas of high workforce demand or specialized body of knowledge will be addressed through this certificate?

Persons in the workforce with an existing Bachelors or Masters degree in Computer Science.

B. Is the certificate a value added credential that supplements a student's major field of study? If so, list the majors/programs from which students would most benefit from adding the certificate.

Computer Science, BA/BS 12 credit hours

C. Is the certificate a stackable credential with credits that apply to a higher level credential (i.e., associate, bachelor's, or master's degree)? If so, indicate the program(s) to which the certificate stacks and the number of credits from the certificate that can be applied to the program.

Computer Science, BA/BS 12 credit hours

7. List the courses required for completion of the certificate in the table below (if any new courses are proposed for the certificate, please attach the new course requests to this form):⁶

Prefix	Number	Course Title	Prerequisites for Course <i>Include credits for prerequisites in subtotal below.</i>	Credit Hours	New (yes, no)
Select 9 credit hours from the following courses:					
CSC	425	High Performance Computing	CSC 225 min grade D	3	No
CSC	447	Artificial Intelligence	None	3	No
CSC	457	Data Analysis, Decision Making & Visualization	CSC 155/155L	3	Yes
CSC	486	Data Mining Methods	CSC 300 FOR LEVEL UG WITH MIN. GRADE OF D OR MATH 281 FOR LEVEL UG WITH MIN. GRADE OF D OR STAT 281 FOR LEVEL UG WITH MIN. GRADE OF D OR MATH 381 FOR LEVEL UG WITH MIN. GRADE OF D OR MATH 481 FOR LEVEL UG WITH MIN. GRADE OF D OR STAT 481 FOR LEVEL UG WITH MIN. GRADE OF D	3	No
CSC	488	Pattern Recognition and Machine Learning	CSC 155/155L	3	Yes
Select 3 credit hours from the following elective courses:					
STAT	480	Applied Statistics	STAT 281 or MATH/STAT 481	3	No
STAT	481	Probability and Statistics	MATH 225	3	No
Subtotal				12	

8. Student Outcome and Demonstration of Individual Achievement.⁷

A. What specific knowledge and competencies, including technology competencies, will all students demonstrate before graduation? The knowledge and competencies should be specific to the program and not routinely expected of all university graduates.

- Students will explain the fundamental theories underlying AI tools and/or technologies.
- Students will acquire and analyze data as appropriate to application domains, such as AI in robotics and natural language processing in healthcare.
- Students will apply machine-learning tools/techniques on big data that are built on statistical models.
- Students will explore data mining tools: data analysis, decision-making, visualization in high performance computing setup.
- Students will explore pattern recognition (anomaly detection, for instance) on big data, especially for large time-series data.

B. Complete Appendix A – Outcomes using the system form.

⁶ Regental system certificate programs typically are a subset of the curriculum offered in degree programs, include existing courses, and involve 9-12 credits for completion. Deviations from these guidelines require justification and approval.

⁷ Board Policy 2:23 requires certificate programs to “have specifically defined student learning outcomes.”

Individual Student Outcome	Program Courses that Address the Outcomes						
	CSC 425	CSC 447	CSC 457	CSC 486	CSC 488	STAT 480	STAT 481
Fundamental theories underlying AI tools and/or technologies		X				X	X
Acquire and analyze data as appropriate to application domains, such as AI in robotics and natural language processing healthcare.		X					
Machine-learning tools/techniques on big data that are built on statistical models		X	X	X	X	X	X
Data mining tools: data analysis, decision-making, visualization in high performance computing setup	X		X	X			
Pattern recognition on big data (anomaly detection), especially for large time-series data	X				X	X	X

Expand the table as necessary to include all student outcomes. Outcomes in this table are to be the same ones identified in the text.

9. Delivery Location.⁸

- A. Complete the following charts to indicate if the university seeks authorization to deliver the entire program on campus, at any off campus location (e.g., UC Sioux Falls, Capital University Center, Black Hills State University-Rapid City, etc.) or deliver the entire program through distance technology (e.g., as an on-line program)?

	Yes/No	Intended Start Date
On campus	Yes	Fall 2021

	Yes/No	If Yes, list location(s)	Intended Start Date
Off campus	No		

	Yes/No	If Yes, identify delivery methods ⁹	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		

- B. Complete the following chart to indicate if the university seeks authorization to deliver more than 50% but less than 100% of the certificate through distance learning (e.g., as an on-line program)?¹⁰

	Yes/No	If Yes, identify delivery methods	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		

⁸ The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.

⁹ Delivery methods are defined in [AAC Guideline 5.5](#).

¹⁰ This question responds to HLC definitions for distance delivery.

Appendix A

Individual Student Outcomes and Program Courses

List specific individual student outcomes—knowledge and competencies—in each row. Label each column with a course prefix and number. Indicate required courses with an asterisk (*). Indicate with an X the courses that will provide the student with an opportunity to acquire the knowledge or competency listed in the row. All students should acquire the program knowledge and competencies regardless of the electives selected. Modify the table as necessary to provide the requested information for the proposed program.

Individual Student Outcome	Program Courses that Address the Outcomes						
	CSC 425	CSC 447	CSC 457	CSC 486	CSC 488	STAT 480	STAT 481
Fundamental theories underlying AI tools and/or technologies		X				X	X
Acquire and analyze data as appropriate to application domains, such as AI in robotics and natural language processing healthcare.		X					
Machine-learning tools/techniques on big data that are built on statistical models		X	X	X	X	X	X
Data mining tools: data analysis, decision-making, visualization in high performance computing setup	X		X	X			
Pattern recognition on big data (anomaly detection), especially for large time-series data	X				X	X	X

Expand the table as necessary to include all student outcomes. Outcomes in this table are to be the same ones identified in the text.



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New Course Request

USD	Arts & Sciences/Computer Science	
Institution	Division/Department	
<i>Elizabeth M. Freeburg</i>		3/23/2020
Institutional Approval Signature		Date

Section 1. Course Title and Description

Prefix & No.	Course Title	Credits
CSC 457/557	Data Analysis, Decision Making, and Visualization	3

Course Description
The course aims to deliver fundamental ideas on analyzing data with the help of statistics, implementing scientific decisions using machine learning tools/techniques, and visualizing them for production at the output in accordance with the user’s need. The course employs current programming languages appropriate to the discipline.

Pre-requisites or Co-requisites

Prefix & No.	Course Title	Pre-Req/Co-Req?
CSC 155/155L	Introduction to Computer Science & Programming	Pre-Req.

Registration Restrictions

N/A

Section 2. Review of Course

2.1. Was the course first offered as an experimental course (place an “X” in the appropriate box)?
 Yes (if yes, provide the course information below) No

2.2. Will this be a unique or common course (place an “X” in the appropriate box)?
If the request is for a unique course, verify that you have reviewed the common course catalog via Colleague and the system [Course Inventory Report](#) to determine if a comparable common course already exists. List the two closest course matches in the common course catalog and provide a brief narrative explaining why the proposed course differs from those listed. If a search of the common course catalog determines an existing common course exists, complete the Authority to Offer an Existing Course Form.

Unique Course

Prefix & No.	Course Title	Credits
CSC 486/586	Data Mining	3
CSC 460	Scientific Visualization	3

Provide explanation of differences between proposed course and existing system catalog courses below:
 CSC 486/586 is a course that explores data, especially large data; however, CSC 486/586 does not incorporate the decision making and visualization component that CSC 457/557 offers. The proposed course has a capability to deliver fundamental ideas on analyzing data, implementing scientific decisions using machine learning tools/techniques that are built upon statistical modeling, and visualizing them for production at the output in

Section 3. Other Course Information

3.1. Are there instructional staffing impacts?

- No.** Schedule Management, explain: This course will be taught with current faculty. CSC 457/557 will be part of the regular faculty teaching load on the course rotation. No new hiring will be necessary.

3.2. Existing program(s) in which course will be offered: B.A./B.S./M.S. in Computer Science.

3.3. Proposed instructional method by university: D Discussion/Recitation

3.4. Proposed delivery method by university: U01: Face-to-face Term Based Instruction and U15/U18 Online if offered during summer term.

3.5. Term change will be effective (enter catalog year): 2020-21

3.6. Can students repeat the course for additional credit?

- Yes, total credit limit: _____ No

3.7. Will grade for this course be limited to S/U (pass/fail)?

- Yes No

3.8. Will section enrollment be capped?

- Yes, max per section: 30 No

3.9. Will this course equate (i.e., be considered the same course for degree completion) with any other unique or common courses in the common course system database in Colleague and the [Course Inventory Report](#)?

- Yes No

3.10. Is this prefix approved for your university?

- Yes No

Section 4. Department and Course Codes (Completed by University Academic Affairs)

4.1. University Department Code: UCSC

4.2. Proposed [CIP Code](#): 11.0701

Is this a new CIP code for the university? Yes No



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<i>Elizabeth M. Freeburg</i>	3/23/2020
Institutional Approval Signature	Date

Section 1. Course Title and Description

Prefix & No.	Course Title	Credits
CSC 488/588	Pattern Recognition & Machine Learning	3

Course Description
This course covers fundamental concepts, theories, and algorithms for pattern recognition and machine learning. It includes basic ideas on probability and statistics, parametric and non-parametric learning, data clustering, support vector machine, and neural networks. It covers multiple applications, such as pattern recognition in bioinformatics and pattern analysis & machine intelligence in healthcare.

Pre-requisites or Co-requisites

Prefix & No.	Course Title	Pre-Req/Co-Req?
CSC 155/155L	Introduction to Computer Science & Programming	Pre-Req.

Registration Restrictions N/A

Section 2. Review of Course

2.3. Was the course first offered as an experimental course (place an "X" in the appropriate box)?
 Yes (if yes, provide the course information below) No

2.4. Will this be a unique or common course (place an "X" in the appropriate box)?

Unique Course

Prefix & No.	Course Title	Credits
CSC 448/548	Machine Learning	3
CSC 449/549	Advanced Topics Artificial Intelligence	3

Provide explanation of differences between proposed course and existing system catalog courses below:

The scope of the proposed in this new course goes beyond the material covered in the CSC 548/448 Machine learning and CSC 449/549 topics Artificial Intelligence courses. The proposed course covers pattern recognition applications using machine learning tools/techniques. Pattern recognition applications can be varied from healthcare and/or bioinformatics to computational physics and chemistry, where anomaly detection, for example, in large data is crucial.

Section 3. Other Course Information

3.11. Are there instructional staffing impacts?

- No.** Schedule Management, explain: This course will be taught with current faculty. CSC-488/588 will be part of the regular faculty teaching load on the course rotation. No new hiring will be necessary.

- 3.12. Existing program(s) in which course will be offered: B.A./B.S./M.S. in Computer Science.
- 3.13. Proposed instructional method by university: D Discussion/Recitation
- 3.14. Proposed delivery method by university: U01: Face-to-face Term Based Instruction and U18 Online Synchronous/U15 Asynchronous
- 3.15. Term change will be effective (enter catalog year): 2020-21
- 3.16. Can students repeat the course for additional credit?
 Yes, total credit limit: _____ No
- 3.17. Will grade for this course be limited to S/U (pass/fail)?
 Yes No
- 3.18. Will section enrollment be capped?
 Yes, max per section: 30 No
- 3.19. Will this course equate (i.e., be considered the same course for degree completion) with any other unique or common courses in the common course system database in Colleague and the [Course Inventory Report](#)?
 Yes No
- 3.20. Is this prefix approved for your university?
 Yes No

Section 4. Department and Course Codes (Completed by University Academic Affairs)

- 4.3. University Department Code: UCSC
- 4.4. Proposed [CIP Code](#): 11.0701

Is this a new CIP code for the university? Yes No