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| S:\Communications\Logos and photos\SDBORLogos\final_sdbor_webreadyBW_trans.gif | **SOUTH DAKOTA BOARD OF REGENTS**  ACADEMIC AFFAIRS FORMS |
| Intent to Plan for a New Program |
|  |  |

Use this form to request authorization to plan a new baccalaureate major, associate degree program, or graduate program; formal approval or waiver of an Intent to Plan is required before a university may submit a related request for a new program. The Board of Regents, Executive Director, and/or their designees may request additional information. After the university President approves the Intent to Plan, submit a signed copy to the Executive Director through the system Chief Academic Officer. Only post the Intent to Plan to the university website for review by other universities after approval by the Executive Director and Chief Academic Officer.

|  |  |
| --- | --- |
| **UNIVERSITY:** | DSU |
| **DEGREE(S) AND TITLE OF PROGRAM:** | **BS in Artificial Intelligence** |
| **INTENDED DATE OF IMPLEMENTATION:** | **Fall 2021** |

**Please check this box to confirm that:**

* The individual preparing this request has read [AAC Guideline 2.4](https://www.sdbor.edu/administrative-offices/academics/academic-affairs-guidelines/Documents/2_Guidelines/2_4_Guideline.pdf), which pertains to new intent to plan requests for new programs, and that this request meets the requirements outlined in the guidelines.
* This request will not be posted to the university website for review of the Academic Affairs Committee until it is approved by the Executive Director and Chief Academic Officer.

**University Approval**

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

|  |  |  |
| --- | --- | --- |
|  |  | 8/10/2020 |
| President of the University |  | Date |

|  |
| --- |
|  |

Note: In the responses below, references to external sources, including data sources, should be documented with a footnote (including web addresses where applicable).

1. **What is the general nature/purpose of the proposed program? Please include a brief (1-2 sentence) description of the academic field in this program.**

The purpose of this program is to provide students with the education and training needed to be successful in the many existing and emerging technical fields involving artificial intelligence. (AI) uses data and computational models to make decisions and predictions. These decisions/predictions range from determining the best route for delivery trucks, predicting the probability of lung cancer from looking at chest x-rays, classifying weeds in video as tractors drive through fields, giving inventory predictions for businesses, creating autonomous agents in games and movies that act realistically, or telling a self-driving car to slow down as it approaches a crosswalk. The proposed program will prepare undergraduate students to apply well researched and documented AI algorithms and methodologies to various fields and applications like those just mentioned.

The field of artificial intelligence is a relatively broad field that includes elements of computer science, data science, and cognitive reasoning. In recent years, applying AI in multiple fields; including agriculture, medical research, operations management, and countless others has become attainable to software engineers and data scientists through the use of programming libraries and other tools. As such, applicable AI has reached undergraduate studies, and is no longer restricted purely to theoretical graduate research.

As the public’s exposure to applied AI grows, concern with the control and tasks AI is applied to also grows. Also, the concern of automated machines and software taking human jobs is also an important topic of discussion. A report from the World Economic Forum (WEF) predicts that AI will displace 75 million jobs by 2022. Fortunately, it also predicts that AI will create 133 million new roles by 2022 [1]. It is vital that as the skill sets required by graduates in the modern economy change, we must train students to not only keep up, but to stay ahead and take the lead of that change.

As such, in order for this proposed program to aid in that goal, we are including elements of ethics, societal impacts, cognitive logic, data management & analysis, and computer science. This will prepare students to successfully utilize AI in an ethical manner to all kinds of applications.

[1]http://reports.weforum.org/future-of-jobs-2018/?doing\_wp\_cron=1596291222.6228919029235839843750

1. **What is the need for the proposed program (e.g., Regental system need, institutional need, workforce need, etc.)? What is the expected demand for graduates nationally and in South Dakota (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.)?** *Please cite any sources in a footnote.*

In February of 2019, the White House released Executive Order 13859 announcing the American Artificial Intelligence Initiative [1]. Entailed in this document is a national strategy for promoting U.S. leadership in AI, where one of the key policies and practices included training an AI-ready workforce.

Regarding specific careers, job titles include (but aren’t limited to): Machine Learning Engineer, Data Analyst, Data Scientist, AI/ML Researcher, and Software Engineer. These jobs provide different roles to help firms make scientific or data-driven decisions or automate tasks to reduce costs or scale products, create physical automated bots for a myriad of purposes, or provide research into new applications. These services pertain to nearly all industries. Consolidating all artificial intelligence related jobs, there has been a steady increase in job-posting, while responses have slightly shrunk; indicating an increased demand while the current workforce is decreasing, leaving a gap to fill. AI job postings on the job posting website Indeed saw its largest increase spike from 2016 to 2017 by 136.3%. In the following years, the spike leveled off, but the percentage of job postings continued to rise by 49.1% and 32% from the previous year in 2018 and 2019 respectively; making machine learning and deep learning engineers the most popular jobs posted that year. An incredible overall increase in the last few years. In contrast, the number of job searches only increased by 14% in the last year mentioned; leaving a large gap to fill.

According to Udemy, a global marketplace for learning and instruction, the deep learning tool Tensorflow was the most popular tech skill of the last three years [3].

Pay for these jobs is also fairly high, with averages ranging from $97,850 for AI software engineers to $134,449 for machine learning engineers. [2]

In regard to South Dakota, the biggest player in the economy is agriculture. Research and deployment of AI software and robotics will be a key component to increasing crop and livestock production, as well as operational throughput. Also, AI is used in many areas of medical research, which ties into Sanford and Avera hospitals in the region.

It’s important to note that many new jobs created for degrees such as this are new enough such that they are not listed on the South Dakota Department of Labor’s (SDoL) website or the U.S. Bureau of Labor Statistics (BLS). These types of positions include Machine Learning Engineers, Data Scientists, and Applied AI Specialists mentioned earlier from the Indeed resource

The following tables include positions that could potentially be filled by graduates with this degree. The first table represents the short-term growth projections from 2019 to 2021 by the SDoL [4].

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Average Annual Openings | | | |
| SOC Code | SOC Title | 2019 Employment | 2021 Employment | Numeric Change | Percent Change | Due to Exits | Due to Transfer | Annual Change | Total Opening |
| 15-11-21 | Computer Systems Analyst | 817 | 849 | 32 | 3.9% | 16 | 44 | 16 | 76 |
| 15-1132 | Software Developers, Applications | 1,072 | 1,145 | 73 | 6.8% | 16 | 62 | 36 | 114 |
| 15-1134 | Web Developer | 478 | 500 | 22 | 4.6% | 8 | 29 | 11 | 48 |
| 13-1081 | Logisticians | 141 | 143 | 2 | 1.4% | 4 | 10 | 1 | 15 |
| 13-1111 | Management Analysts | 3,503 | 3,650 | 147 | 4.2% | 111 | 226 | 74 | 411 |
| 13-1161 | Market Research Analyst | 1,013 | 1,074 | 61 | 6.0% | 24 | 82 | 30 | 136 |
| 13-2031 | Budget Analysts | 131 | 132 | 1 | 0.8% | 3 | 7 | 0 | 10 |
| 13-2041 | Credit Analysts | 368 | 374 | 6 | 1.6% | 8 | 25 | 3 | 36 |
| 13-2051 | Financial Analysts | 478 | 492 | 14 | 2.9% | 10 | 32 | 7 | 49 |

The numbers in this second table represent the statewide occupational projections from 2018 to 2028 [5].

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Average Annual Openings | | | |
| SOC Code | SOC Title | 2018 Employment | 2028 Employment | Numeric Change | Percent Change | Due to Exits | Due to Transfer | Annual Change | Total Opening |
| 15-1121 | Computer Systems Analysts | 803 | 897 | 94 | 11.7% | 16 | 45 | 9 | 70 |
| 15-1132 | Software Developers, Applications | 1,041 | 1,300 | 259 | 24.9% | 16 | 66 | 26 | 108 |
| 15-1134 | Web Developer | 460 | 523 | 63 | 13.7% | 8 | 29 | 6 | 43 |
| 13-1081 | Logisticians | 136 | 150 | 14 | 10.3% | 3 | 10 | 1 | 14 |
| 13-1111 | Management Analysts | 3,334 | 3,762 | 428 | 12.8% | 110 | 224 | 43 | 377 |
| 13-1161 | Market Research Analyst | 993 | 1,200 | 207 | 20.9% | 26 | 86 | 21 | 133 |
| 13-2031 | Budget Analysts | 131 | 138 | 7 | 5.3% | 3 | 7 | 1 | 11 |
| 13-2041 | Credit Analysts | 374 | 415 | 41 | 11.0% | 9 | 27 | 4 | 40 |
| 13-2051 | Financial Analysts | 469 | 522 | 53 | 11.3% | 10 | 32 | 5 | 47 |

On a national level, the long-term job increases include [6]:

\*Employment in thousands.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SOC Code | SOC Title | 2018 Employment | 2028 Employment | Numeric Change | Percent Change | Occupational Openings, Annual Average |
| 15-1121 | Computer Systems Analysts | 633.9 | 689.9 | 56.0 | 8.8% | 53.4 |
| 15-1132 | Software Developers, Applications | 944.2 | 1,185.7 | 241.5 | 26.6% | 99.2 |
| 15-1134 | Web Developer | 160.5 | 181.4 | 20.9 | 13.0% | 15.1 |
| 13-1081 | Logisticians | 174.9 | 183.3 | 8.4 | 4.8% | 17.9 |
| 13-1111 | Management Analysts | 876.3 | 994.6 | 118.3 | 13.5% | 99.9 |
| 13-1161 | Market Research Analyst | 681.9 | 821.1 | 139.2 | 20.4% | 90.7 |
| 13-2031 | Budget Analysts | 56.9 | 59.4 | 2.4 | 4.2% | 4.8 |
| 13-2041 | Credit Analysts | 75.8 | 79.5 | 3.7 | 4.9% | 7.4 |
| 13-2051 | Financial Analysts | 329.5 | 349.8 | 20.3 | 6.2% | 30.9 |
| 43-9111 | Statistical Assistants | 13.1 | 14.1 | 1.1 | 8.0% | 1.8 |

Footnotes:

[1] https://www.whitehouse.gov/ai/.

[2] https://www.indeed.com/lead/top-10-ai-jobs-salaries-cities

[3] https://business.udemy.com/resources/5-workplace-learning-trends-2020/

[4]https://dlr.sd.gov/lmic/documents/short\_term\_occupational\_projections\_statewide\_2019\_2021.pdf

[5]https://dlr.sd.gov/lmic/documents/occupational\_projections\_2018\_2028\_statewide\_south\_dakota.pdf

[6] https://data.bls.gov/projections/occupationProj

1. **How would the proposed program benefit students?**

As stated in part (2), AI is an integral part of society and the economy at any scale. This program will help prepare students for the new wave of jobs that require formal training in AI. The objectives aim to provide students with both technical skills and design expertise. Students will 1) understand the technical depth and breadth of artificial intelligence, 2) explore opportunities to apply AI enabled technologies in real-world applications currently in use, 3) master design and deployment of AI in information and communications technology, 4) lead teams in designing and developing new AI technologies and products, and 5) become equipped with clear and persuasive communication skills necessary in a variety of AI careers.

The program will help students meet their career goals by providing comprehensive hands-on tasks to develop the skill set needed by industry professionals. As the possible applications of AI continue to increase, so too does the positive career potential for those with these skills needed to thrive in this industry. The program aims to provide a curriculum to enable graduating students to become data scientists, machine learning engineers, software engineers, computer scientists and AI researchers; along with other top careers that define today’s AI industry.

That isn’t to say that the program can’t help non-major students as well. Literacy and comprehension of technology and AI will be required by a multitude of fields and careers not directly associated with AI development. Beyond career goals, the societal impacts of AI literacy are integral to the well-being of the overall population. It will enable people to express and understand different ideas and opinions, make decisions and solve problems, achieve goals, and participate fully in their community. AI literacy will also help eradicate the misconceptions around AI to create an all-inclusive ecosystem where all members of the community are equipped with the basic skills needed to pursue further learning and better adapt to a changing world where AI will be prevalent.

1. **How does the proposed program relate to the university’s mission as provided in South Dakota Statute and Board of Regents Policy, 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.*

*DSU:* [*SDCL § 13-59*](https://sdlegislature.gov/Statutes/Codified_Laws/DisplayStatute.aspx?Type=Statute&Statute=13-59)[*BOR Policy 1:10:5*](https://www.sdbor.edu/policy/documents/1-10-5.pdf)

[*Board of Regents Strategic Plan 2014-2020*](https://www.sdbor.edu/the-board/agendaitems/Documents/2014/October/16_BOR1014.pdf.)

Under SDCL 13-59, the primary purpose of Dakota State University at Madison in Lake County is to provide instruction in computer management, computer information systems, electronic data processing, and other related undergraduate and graduate programs. The field of artificial intelligence falls directly into this description.

Dakota State University’s mission statement goes on to empower people with STEM-based education, preparing them for compelling, creative, and lasting careers. As listed in item (2) above, the field of artificial intelligence is one of the fastest growing fields, not only related to technology, but in relation to all known fields. The proposed program would not only train students directly in the application of known technologies, but also set them up for advanced research in the advanced degree programs. Students who do not necessarily wish to join the degree directly can also benefit by taking courses to increase their literacy in artificial intelligence and STEM as AI continues to affirm its place in the daily life of average citizens.

1. **Do any related programs exist at other public universities in South Dakota? If a related program already exists, explain the key differences between the existing programs and the proposed program, as well as the perceived need for adding the proposed new program. Would approval of the proposed new program create opportunities to collaborate with other South Dakota public universities?** *A list of existing system programs are available through the university websites and the* [*RIS Reporting: Academic Reports Database*](http://apps.sdbor.edu/ris-reporting/AcademicProgramReports.htm)*. If there are no related programs within the Regental system, enter “None.”*

Currently, there are no artificial intelligence undergraduate majors in any public university in South Dakota. At the August 4, 2020 meeting, the Board approved an undergraduate minor in Artificial Intelligence and Machine Learning at DSU.  In addition, the Board approved an undergraduate certificate at USD and a specialization within USD’s undergraduate computer science program in Artificial Intelligence. Regarding collaboration, AI can help enhance application in many fields: medical, agricultural, and social, just to name a few. This allows for the potential collaboration between many different programs from different colleges across all of South Dakota’s universities, colleges, and schools; leading to cross-discipline courses, grant writing and research, and entrepreneurship.

The proposed degree leans heavily on a Computer Science foundation.  In that regard, it is similar to the Cyber Operations program that also utilizes a number or tradition Computer Science courses in the core. But that degree moves in a focused direction to break away from Computer Science.  The proposed Artificial Intelligence degree takes a similar approach following a natural evolution and maturation of degree programs.   The separation from Computer Science will include depth of courses in artificial intelligence as well as breadth of supporting course work. The B.S. in AI program will require advanced mathematics in areas outside those a typical Computer Science student would take. Also, following the model presented by Carnegie Mellon University, students will be expected to take courses broadly in areas of ethics and cognitive logic that a specialization would not be able to require.

The focused degree program allows student in a B.S. in Artificial Intelligence to pursue electives in application areas such as security, biology, data management, visualization, etc.  Students can also take on specific aspects of AI that build in the program core that would be out of reach for a non-major.

1. **Do related programs exist at public colleges and universities in Minnesota, North Dakota, Montana, and/or Wyoming?** *If a related program exists, enter the name of the institution and the title of the program; if no related program exists, enter “None” for that state. Add additional lines if there are more than two such programs in a state listed.*

*This question addresses opportunities available through Minnesota Reciprocity and WICHE programs such as the Western Undergraduate Exchange and Western Regional Graduate Program in adjacent states. List only programs at the same degree level as the proposed program. For example, if the proposed program is a baccalaureate major, then list only related baccalaureate majors in the other states and do not include associate or graduate programs.*

|  |  |  |
| --- | --- | --- |
|  | **Institution** | **Program Title** |
| ***Minnesota*** | University of Minnesota | B.S. in Computer Science: Track in AI/Robotics |
| ***North Dakota*** | None |  |
| ***Montana*** | None |  |
| ***Wyoming*** | None |  |

1. **Are students enrolling in this program expected to be new to the university or redirected from other existing programs at the university?**

In the first two years, we expect that most students will likely be transitioning students from Computer Science or Data Science who wish to pursue this avenue more directly. Note that just over the past two years 112 undergraduate students have graduated from the DSU computer science program. By the third and fourth years, we expect the number of newly incoming freshman students to surpass the number existing transitioning students.

1. **What are the university’s expectations/estimates for enrollment in the program through the first five years? What are the university’s expectations/estimates for the annual number of graduates from the program after the first five years? Provide an explanation of the methodology the university used in developing these estimates.**

Several undergraduate AI and machine learning topic courses have been implemented within the last few years. These courses routinely enroll 20-30 students for face-to-face instruction, with an additional 15-20 students online. From student interest, perhaps a third of these students may be interested in changing majors to this new AI program.

That said, we predict 15 new students in the first year of the program’s offering, and 20 new students each year after that. As a guiding metric, we can analyze the undergraduate cyber operations program. Their program started with 65 students in the Fall of 2013 and rose to 489 as of Fall 2019. By advertising the program, and the fact that it will be the only such program in the region, then enrollment would likely follow a similar trajectory, which has seen continual growth since its inception.

1. **Complete the following charts to indicate if the university intends to seek 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)?**

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

|  |  |  |
| --- | --- | --- |
|  | **Yes/No** | ***Intended Start Date*** |
| **On campus** | Yes | **Fall 2021** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Yes/No** | ***If Yes, list location(s)*** | ***Intended Start Date*** |
| **Off campus** | No |  | Choose an item.Choose an item. |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Yes/No** | ***If Yes, identify delivery methods***  *Delivery methods are defined in* [*AAC Guideline 5.5*](https://www.sdbor.edu/administrative-offices/academics/academic-affairs-guidelines/Documents/5_Guidelines/5_5_Guideline.pdf)*.* | ***Intended Start Date*** |
| **Distance Delivery (online/other distance delivery methods)** | Yes | 015 Internet Asynchronous – Term Based Instruction | **Fall 2021** |
| **Does another BOR institution already have authorization to offer the program online?** | No | **If yes, identify institutions:** | |

1. **What are the university’s plans for obtaining the resources needed to implement the program?** *Indicate “yes” or “no” in the columns below*.

|  |  |  |
| --- | --- | --- |
|  | Development/Start-up | Long-term Operation |
| Reallocate existing resources | No | Yes |
| Apply for external resources  *If checking this box, please provide examples of the external funding identified below.* | No | Yes |
| Ask Board to seek new State resources  *Note that requesting the Board to seek new State resources may require additional planning and is dependent upon the Board taking action to make the funding request part of their budget priorities. Universities intending to ask the Board for new State resources for a program should contact the Board office prior to submitting the intent to plan.* | No | No |
| Ask Board to approve a new or increased student fee | No | No |

1. **Curriculum Example: Provide (as Appendix A) the curriculum of a similar program at another college or university.** *The Appendix should include required and elective courses in the program. Catalog pages or web materials are acceptable for inclusion*. **Identify the college or university and explain why the selected program is a model for the program under development**.

The closest example to what we would like to offer is Carnegie Mellon’s B.S. in Artificial Intelligence. The program is designed around 5 areas of study: Computer Science, Math and Statistics, Artificial Intelligence, Ethics & Cognitive Reasoning, and General Education. Our program would follow a similar structure to provide students with a background encompassing the field of AI to develop a wide range of employable skills. Also, the majority of the anticipated curriculum is already in place at Dakota State University, minimizing the cost of introducing the program.

Please see Appendix A for Carnegie Mellon’s curriculum.

**Appendix A: Carnegie Mellon Example Curriculum.**

* Math and Statistics Core (6 Courses)
  + Math Foundations of Computer Science. If not available, Concepts of Mathematics can be substituted.
  + Integration and Approximation
  + Matrices and Linear Transformations
  + Calculus in Three Dimensions
  + Probability Theory for Computer Scientists
  + Modern Regression
* Computer Science Core (5 Courses Plus Freshman Immigration Course)
  + Freshman Immigration Course
  + Principles of Imperative Computation
  + Principles of Functional Programming
  + Parallel and Sequential Data Structures and Algorithms
  + Introduction to Computer Systems
  + Great Theoretical Ideas in Computer Science
* Artificial Intelligence Core (3 Courses Plus Concepts in Artificial Intelligence)
  + Concepts in Artificial Intelligence
  + Introduction to AI: Representation and Problem Solving
  + Introduction to Machine Learning
  + Take one of the following courses:
    - Introduction to Natural Language Processing
    - Introduction to Computer Vision
* Ethics Elective (1 Course from the following)
  + Freshman Seminar: Artificial Intelligence and Humanity
  + Ethics and Policy Issues in Computing
  + AI, Society and Humanity
* Humanities and Arts

BSAI students take seven courses in the humanities and arts as part of the SCS General Education requirements. Of the seven Humanities and Arts courses in the curriculum, one must be in cognitive science or cognitive psychology. Examples include:

* + Cognitive Psychology
  + Human Information Processing and Artificial Intelligence
  + Perception
  + Human Memory
  + Visual Cognition
  + Language and Thought
* AI Cluster Electives (4 Courses)

Take one course from each of the following areas:

* + Decision Making and Robotics Cluster
    - Neural Computation
    - Autonomous Agents
    - Truth, Justice and Algorithms
    - Cognitive Robotics
    - Strategic Reasoning for AI
    - Planning Techniques for Robotics
    - Mobile Robot Programming Laboratory
    - Robot Kinematics and Dynamics
  + Machine Learning Cluster
    - Deep Reinforcement Learning and Control
    - Intermediate Deep Learning
    - Machine Learning for Structured Data
    - Machine Learning for Text Mining
    - Introduction to Deep Learning
    - Advanced Data Analysis
  + Perception and Language Cluster
    - Search Engines
    - Speech Processing
    - Computational Perception
    - Computational Photography
    - Vision Sensors
  + Human-AI Interaction Cluster
    - Design of Artificial Intelligence Products
    - Human-AI Interaction
    - Designing Human-Centered Systems
    - Human-Robot Interaction
* SCS Electives

BSAI students take two electives within the School of Computer Science.

* Science and Engineering

BSAI students take four courses in science and engineering as part of the SCS General Education requirements.