SOUTH DAKOTA BOARD OF REGENTS
ACADEMIC AFFAIRS FORMS

Intent to Plan for a New Program

UNIVERSITY:	DSU and SDSU
DEGREE(S) AND TITLE OF PROGRAM:	B.S. in Software Engineering
INTENDED DATE OF IMPLEMENTATION:	Fall 2019

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.

President of the University, Dakota State University	8/20/2018
	Date

President of the University, South Dakota State University	1/10/2019
	Date

1. What is the general nature/purpose of the proposed program?

Software engineering is the systematic development and application of techniques leading to the creation of correct and reliable software.[1] It has also been defined as "The application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software."[2] The purpose of the proposed program is to provide skilled and knowledgeable graduates who will meet the needs of businesses and organizations in writing, editing and testing software. Software engineering is a rapidly changing field; most software engineers continue to learn on the job, as languages and development environments evolve. To be sure, there are many layers of computer software, and each requires a specialist in languages specific to that layer.

Most software engineers specialize in a few areas of development, such as networks, operating systems, databases or applications, and each area requires fluency in its own set of computer languages and development environments. Also, most software engineers collaborate with other specialists in development groups all working together to create complex projects.

Educational requirements for software engineers include broad experience with computer systems and applications. Larger companies, or organizations with unique or proprietary development platforms, typically provide training for new employees. Commonly required

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[1] Software engineering description at University of Strathclyde, Glasgow, Scotland.
[2] IEEE Standard Gloassary of Software Engineering terminology

skills include strong analytical skills and the ability to pay careful attention to detail, as well as the capacity to work well in groups and a willingness to understand the various roles played by fellow team members. Knowledge about the subject area in which they are working, or the intended audience, is valuable.[3]

DSU and SDSU are proposing to create an academic degree in software engineering at the Bachelor of Science (B.S.) level. Responding to the national need for professionals in computer science, cyber security, computer network development and web development for public and private organizations, the proposed major will produce individuals responsible for the entire software development process. From theoretical design to programming, these graduates will provide project leadership and technical guidance along every stage of the software development life cycle.

2. **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.)?**

The workforce need for software engineers is very robust. Currently, DSU and SDSU have nearly 550 computer science majors combined with approximately 350 majors at DSU and 200 at SDSU.

The U.S. Bureau of Labor Statistics (BLS) projects that jobs for software developers will grow by 17% from 2014 to 2024, making software engineering one of the faster growing sectors in the job market.

From the Occupational Outlook Handbook, there is evidence of a growing need for software development professionals.[4]

Quick Facts: Software Developers	
2017 Median Pay ?	$103,560 per year $49.79 per hour
Typical Entry-Level Education ?	Bachelor's degree
Work Experience in a Related Occupation ?	None
On-the-job Training ?	None
Number of Jobs, 2016 ?	1,256,200
Job Outlook, 2016-26 ?	24% (Much faster than average)
Employment Change, 2016-26 ?	302,500

In addition to national demand, strong growth is expected for positions as software engineers within South Dakota. For example, the SD Department of Labor and Regulation notes that employment of software developers is expected to grow between 14-24% in Rapid City and Sioux Falls with a total of about 24 annual job openings in those two cities through 2024.[5]

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[4] https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm
[5] Labor Market Information Center, South Dakota Department of Labor and Regulation, July 2017. Available from https://dlr.sd.gov/lmic/documents/substate_occupational_projections_2014_2024.xlsx

Statewide during the 2016 period there were 42 openings and it is expected that close to 800 openings will need to be filled during the 2016-2026 time period[6].

Federal and state governments, large and medium size corporations, the military, including the National Guard and Reserve, all need graduates educated with this type of skill set and knowledge base.

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

The proposed bachelor's degree in software engineering will be of benefit to students by preparing them to be highly competitive in a field where those equipped with knowledge and skills in software engineering are very employable in relatively high paying positions. The program will offer educational experiences that assist students in becoming program solvers for society with the tools, knowledge and vision to build systems and applications and the ability to manage the development, maintenance and evolution of software.

Because this is a collaborative proposed program, students will benefit from the resources offered by both institution and will complete shared core courses and then specialize in specific niches at their home institution. This model has operated successfully making both institutions stronger, benefitting graduate and regional workforce development and effectively utilizing faculty resources.

DSU is developing a stackable progression in this area. Starting with the current A.S. in software development at DSU or other schools, a student will be able to stack those credits into the B.S. in Software Enginering degree or at least the specialization. This provides the student the opportunity to scaffold of their software engineering skill set while the college can use the courses most efficiently.

4. **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?[7]**

The Legislature established Dakota State University as an institution specializing in programs in computer management, computer information systems, and other related undergraduate and graduate programs as outlined in SDCL 13-59-2.2. The Beacom College of Computer and Cyber Sciences provides complete realization of this mission in its programs related to computer science, network administration, computer game design and cybersecurity. The Board implemented SDCL 13-59-2.2 by authorizing undergraduate and graduate programs that are technology-infused and promote excellence in teaching and learning. These programs support research, scholarly and creative activities and provide service to the State of South Dakota and the region.

The Legislature established South Dakota State University as the Comprehensive Land Grant University to meet the needs of the State and region by providing undergraduate and graduate programs of instruction in the liberal arts and sciences and professional education in

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[6] South Dakota Dept. of Labor, Dec. 2018, Available from
https://www.southdakotaworks.org/vosnet/analyzer/results.aspx?session=occproj
[7] South Dakota statutes regarding university mission are located in SDCL 13-57 through 13-60; Board of Regents policies regarding university mission are located in Board Policies 1:10:1 through 1:10:6. The Strategic Plan 2014-2020 is available from https://www.sdbor.edu/the-board/agendaitems/Documents/2014/October/16_BOR1014.pdf.

agriculture, education, engineering, human sciences, nursing, pharmacy, and other courses or programs as the Board of Regents may determine (SDCL 13-58-1). SDSU's Jerome J. Lohr College of Engineering supports a variety of engineering programs as well as undergraduate and graduate computer science programs.

In addition, the SDBOR Strategic Plan 2014-2020 includes the following vision:
- South Dakotans will have increased access to continuing education opportunities needed to upgrade their credentials while remaining in the workforce;
- South Dakota will have a working-age population with advanced levels of education needed to support our democracy and the modern, knowledge-based economy; and
- South Dakota will be a recognized national leader in the use of information technology to enhance its educational, economic, social, scientific, and political development.

Adding a collaborative software engineering B.S. degree at DSU and SDSU is consistent with the board-designated missions of the universities, supports system goals, and will contribute to the state's workforce and economic development as this program aligns with existing and future state workforce needs.

5. **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?**[8] *If there are no related programs within the Regental system, enter "None."*

The University of South Dakota (USD) and the South Dakota School of Mines and Technology (SDSM&T) currently both offer the bachelors' level program in Computer Science. Dakota State offers the Software Development (A.S.) and a specialization in software and web development within its Computer Information Systems major, and South Dakota State offers a minor in software engineering and the B.S. in Computer Science.

The bachelor's level degree in software engineering provides students with the needed content and skill development in order to design, build, and maintain software systems throughout the life of the system. This differs from computer science, as it is the theory and practice of processing and using information. The software engineer works to satisfy the customer requirements for the overall project, while the computer scientist is concerned with developing the specific algorithms for solving individual problems. A software engineer will work with the team and the customers while the computer scientist will work with coding the solution.

6. **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.*[9]

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[8] Lists of existing system programs are available through university websites and the RIS Reporting: Academic Reports database available from http://apps.sdbor.edu/ris-reporting/AcademicProgramReports.htm.

[9] 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	Software Engineering (B.S.)
North Dakota	North Dakota State University	Computer Engineering (B.S.)
Montana	Montana Tech of the University of Montana	Software Enginnering (B.S.)
Iowa	Iowa State University	Software Engineering (B.S.)

SDSU formerly offered a B.S. in Software Engineering from 2003 through 2011. The B.S. in Software Engineering was terminated due to its status as a relatively new program when the Regental system endured statewide budget cuts. SDSU noted at the time a desire to eventually reauthorize the program.

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

   The majority of students in the program are expected to be new to DSU and SDSU. When the program was created at SDSU, several Computer Science majors switched to Software Engineering as they were interested in the new opportunity. However, once the program was established SDSU was able to attract students due to the program and we anticipate this will be true when the program is restarted. There may also be interest from students who are currently in data science wishing to change their major to software engineering. The stackability of programs offered will also encourage students to continue in the software enginnering major as they move from the associates to bachelors to master's levels.

8. **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.**

   DSU and SDSU anticipate that in the first year of the program, five students will be enrolled at both institutions. Over time, an average of 15 or more students are expected to be enrolled each year.

   Typically DSU strives for about a 1:1 mix by modality. DSU's A.S. in Software Development is in it's second year and already has 12 enrolled students (Fall 2018) who are potential students for the B.S. degree. An affordable software engineering degree should be in high demand.

9. **Complete the following charts to indicate if the university intends to seek authorization to deliver the entire program at any off-campus location (e.g., UC Sioux Falls, Capital University Center, Black Hills State University-Rapid City, etc.) or intends to seek authorization to deliver the entire program through distance technology (e.g., as an on-line program)?**[10]

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[10] 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	DSU	Yes	Fall 2019
	SDSU	Yes	Fall 2019

	Yes/No	*If Yes, list location(s)*	*Intended Start Date*
Off-campus	No		Fall 2019

		Yes/No	*If Yes, identify delivery methods*	*Intended Start Date*
Distance Delivery	DSU	Yes	Online	Fall 2019
	SDSU	Yes	Online	Fall 2019

10. **What are the university's plans for obtaining the resources needed to implement the program?** *Indicate "yes" or "no" in the columns below.* Need to provide brief explanation and examples of likely external resources (if Yes is indicated)

	Development/ Start-up	Long-term Operation
Reallocate existing resources	Yes	Yes
Apply for external resources	Yes	Yes
Ask Board to seek new State resources[11]	No	No
Ask Board to approve a new or increased student fee	No	No

DSU has hired several faculty as part of the Sanford/Beacom gift and some of those faculty have the requisite expertise in software engineering to augment the expertise of existing faculty at DSU and SDSU.

11. **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 curriculum example included in Appendix A is from Iowa State University. The information may be found online at http://catalog.iastate.edu/collegeofengineering/softwareengineering/.

The specific design of the undergraduate curriculum has been heavily debated and still is. Institutions will often offer slightly differing course structures, many may have a stronger focus on mathematical foundations for example. It is true, however, that students of a four-year software engineering course will typically have a similar first year of study as students of Computer Science, including classes such as computer programming, program design, computer systems analysis, fundamentals of hardware, networking and computer architecture. In addition to these computer science courses, software engiuneering programs typically offer course work like introduction to software engineering, software requirements & modeling,

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[11] 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.

software design & construction, software testing, verification, and validation, software quality assurance, software project management, and software configuration management.

DSU and SDSU plan to pursue a similar model to the M.S. in Data Science/Analytics cooperative programs. Both DSU and SDSU recognize that they have a successful, collaborative process and team that allows them to develop premier programs in specialized areas related to computing and data. They look forward to continuing and strengthening their joint commitments in these important specialties for South Dakota.

DSU and SDSU will be adding 4-5 new courses, most of which can be covered by existing faculty offering the programs. An emphasis often serves a fundamentally different purpose than a major. A speciliazation within a computer science program may provide some software engineering skills/tools which may be all that is needed or appropriate for some positons, however, it may not serve as well when a stand alone degree or specific credentials are required. It will also include some ancillary changes, for example, additional math courses may be added to the curriculum.

DSU will augment their capacity to offer the appropriate coursework by securing external funding for operation and support, the use of the DSU Rising! gift, the strategic use of adjuncts, and potentially, the use of remote faculty to provide richness and depth to the curriculum. This will include additional software engineering faculty. They currently have several faculty with expertise in this area that teach several courses to support an A.S. in Software Development and several graduate level courses software engineering.

APPENDIX A
Example B.S. in Software Engineering - Iowa State University

The Software Engineering program is an interdisciplinary program delivered jointly by the College of Engineering and the College of Liberal Arts & Sciences.

Leading to the degree bachelor of science.

Total credits required: 125 cr. Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs. Note: Pass/Not Pass credits cannot be used to meet graduation requirements.

International Perspectives: 3 cr.[1]

U.S. Diversity: 3 cr.[1]

Communication Proficiency/Library requirement:

ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
LIB 160	Information Literacy	1
Choose one of the following:		3
ENGL 309	Proposal and Report Writing (C or better in this course)	
ENGL 314	Technical Communication (C or better in this course)	
Total Credits		10

General Education Electives: 15 cr.[2]

Choose 1 course from the following:		3
ECON 101	Principles of Microeconomics	
ECON 102	Principles of Macroeconomics	
I E 305	Engineering Economic Analysis	
Arts and Humanities		6
Social Sciences		3
Additional Arts and Humanities or Social Sciences course		3
Total Credits		15

Basic Program: 27 cr.
A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Basic Program GPA). See Requirement for Entry into Professional Program in College of Engineering Overview section.

CHEM 167	General Chemistry for Engineering Students	4
or CHEM 177	General Chemistry I	
ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3

ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
S E 101	Software Engineering Orientation [3]	R
S E 185	Problem Solving in Software Engineering [3]	3
LIB 160	Information Literacy	1
MATH 165	Calculus I	4
MATH 166	Calculus II	4
PHYS 221	Introduction to Classical Physics I	5
Total Credits		27

Math and Physical Science: 11 cr.

COM S 227	Introduction to Object-oriented Programming	4
COM S 228	Introduction to Data Structures	3
MATH 267	Elementary Differential Equations and Laplace Transforms	4
Total Credits		11

Software Engineering Core: 37 cr.

A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Core GPA):

CPR E 281	Digital Logic	4
Choose one of the following:		3
COM S 327	Advanced Programming Techniques	
CPR E 288	Embedded Systems I: Introduction	
Choose one of the following:		3
COM S 321	Introduction to Computer Architecture and Machine-Level Programming	
CPR E 381	Computer Organization and Assembly Level Programming	
Choose one of the following:		3
COM S 352	Introduction to Operating Systems	
CPR E 308	Operating Systems: Principles and Practice	
Choose one of the following:		3
COM S 230	Discrete Computational Structures	
CPR E 310	Theoretical Foundations of Computer Engineering	
COM S 311	Design and Analysis of Algorithms	3
COM S 363	Introduction to Database Management Systems	3
COM S 309	Software Development Practices	3
S E 319	Software Construction and User Interfaces	3
S E 329	Software Project Management	3
S E 339	Software Architecture and Design	3
S E 421	Software Analysis and Verification for Safety and Security	3

Note: CPR E 288, CPR E 381 and CPR E 308 are 4-credit courses. The core credit requirement (37 credits) is given in terms of 3-credit courses. If the 4-credit courses are taken instead, then the extra credits will be used as credits for Supplementary Electives.

Total Credits		37

Other Remaining Courses: 35 cr.

S E 491	Senior Design Project I and Professionalism	3
S E 492	Senior Design Project II	2
SP CM 212	Fundamentals of Public Speaking	3
STAT 330	Probability and Statistics for Computer Science	3
One of the following ENGL courses (with a C or better in this course)		3
ENGL 309	Proposal and Report Writing	
ENGL 314	Technical Communication	
Math Elective: Choose one from the following list		3
MATH 207	Matrices and Linear Algebra	
MATH 265	Calculus III	
MATH 304	Combinatorics	
MATH 314	Graph Theory	
MATH 317	Theory of Linear Algebra	
Software Engineering Elective [2]		6
Supplementary Elective [2]		9
Open Elective [2]		3
Total Credits		35

Seminar/Co-op/Internships

S E 166	Careers in Software Engineering	R
S E 494	Software Engineering Portfolio Development	R
Co-op or internship (S E 396, S E 397, S E 398) is optional		

Transfer Credit Requirements

The degree program must include a minimum of 30 credits at the 300-level or above in professional and technical courses earned at ISU in order to receive a B.S. in software engineering. These 30 credits must include S E 491 Senior Design Project I and Professionalism and S E 492 Senior Design Project II and credits in the core professional curriculum and/or in technical electives. The software engineering degree program requires a grade of C or better for any transfer credit course that is applied to the degree program.

1. These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program. U.S Diversity and International Perspectives courses may not be taken Pass/Not Pass.
2. Choose from department approved lists.
3. See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

See also: A 4-year plan of study grid showing course template by semester.

Note: International perspectives and U.S. diversity courses are used to meet the general education electives.