### PROPOSAL – 1

### NEW DEGREE PROGRAM

 1. **PROPOSED PROGRAM TITLE:** Bachelor of Science in Data Science

 2. **CIP CODE REQUESTED:** 30.3001 – Computational Science

 3. **PROPOSED STARTING DATE:** Fall 2020

 4. **CONTACT PERSON**

 Name (Provost/Academic Affairs Officer): Dr. Terry Martin

 Title: Senior Vice Provost for Academic Affairs

 Name of Institution: University of Arkansas

 E-mail Address: tmartin@uark.edu

 Phone Number: 479-575-2151

 Name (Program Contact Person): Dr. Karl D. Schubert

 Title: Professor, Director of Research for Innovation and Data Science Initiatives

 for the College of Engineering and the Sam M. Walton College of Business

 E-mail Address: schubert@uark.edu

 Phone Number: 479-575-2264

 5. **PROGRAM SUMMARY**

 Provide a general description of the proposed program. Include overview of any curriculum additions or modifications; program costs; faculty resources, library resources, facilities and equipment; purpose of the program; and any information that will serve as introduction to the program.

List degree programs or emphasis areas currently offered at the institution that support the proposed program.

The goal for the University of Arkansas B.S. Data Science Program is to have a program to leverage the State of Arkansas’ strengths in data science and analytics including integrating real-world industry-based open-ended challenges for workforce development and education by creating a rigorous Data Science curriculum as a partnership of the University of Arkansas Fayetteville College of Engineering (COE), the Walton College of Business (WCOB), and the Fulbright College of Arts and Sciences (ARSC). The objective of the program is to develop graduates who are prepared students for a successful career in data science with an amalgamation of capabilities as described in the Learning Outcomes.

The core curriculum is centered around:

• Computing and Programming Foundation: Object Oriented Programming, Data Science *lingua franca* (R, Python), Programming Algorithms and Paradigms, Data Structures and Databases, Data Processing, and Cloud Computing and Big Data.

• Statistics and Probability Foundation: Probability and Statistics, Linear Algebra, Statistical Methods for Data Science, Decision Making, Machine Learning, and Optimization.

• General Education: Math, Science, Humanities, Fine Arts, and Social Science.

• Multidisciplinary Environment: Technical Composition, Role of Data Science in Today’s World, Micro and Macro Economics, General Business, Data Visualization and Communications, and Social Issues in Data Science.

• Multi-College, Interdisciplinary: Draw on knowledge from different disciplines analyzes, synthesizes and harmonizes links between disciplines into a coordinated and coherent whole through Core courses and the Mandatory Data Science Practicum.

• Domain Concentrations: to provide specific domain expertise to the Data Science core.

The Bachelor of Science in Data Science (BSDASC) will prepare students for a successful career in data science with an amalgamation of capabilities:

1. an ability to use information systems, statistics, and computer science principles and apply state-of-the-art technologies for data representation, data retrieval, data manipulation, data storage, data governance, data security, machine learning, computational analytics, and data analysis and visualization;

2. an ability to develop descriptive, predictive, and prescriptive mathematical and statistical models to provide abstractions of complex systems and organizational problems and to apply computational methods to draw conclusions supported by data;

3. an ability to use foundational knowledge and apply critical thinking skills to problem identification, problem solving, decision making, visualization, and an awareness of societal and ethical impacts;

4. an ability to adapt analytics concepts to interpret and communicate findings and implications to senior decision makers;

5. an ability to work effectively in multidisciplinary teams and transfer findings from one knowledge domain to another; and,

6. an ability to communicate in written, verbal, technical, and non-technical forms.

Integral to the core Data Science curriculum are concentrations to provide specific domain knowledge: Accounting Analytics, Bioinformatics, Biomedical and Healthcare Informatics, Business Data Analytics, Computational Analytics, Data Science Statistics, Geospatial Data Analytics, Operations Analytics, Social Data Analytics, and Supply Chain Analytics. The program includes a two-semester, mandatory, multi-college interdisciplinary Practicum with industry and government partners for real-world immersion in applied data science.

The Data Science Program has been designed as a “hub” (the Core) and “spoke” (the Concentrations) model to allow for additional Concentrations to be added seamlessly.

There are seventeen new courses required to be developed based on the current courses available in the College of Engineering, Sam M. Walton College of Business, and the J. William Fulbright College of Arts and Sciences.

*DASC 1001 Introduction to Data Science*

*DASC 1104 Programming Languages for Data Science (R, Python)*

*DASC 1204 Introduction to Object Oriented Programming for Data Science (Java) DASC 1222 Role of Data Science in Today’s World*

*DASC 2103 Data Structures & Algorithms*

*DASC 2113 Principles and Techniques in Data Science*

*DASC 2203 Data Management & Data Base*

*DASC 2213 Data Visualization and Communication*

*DASC 2594 Multivariable Mathematics for Data Scientists*

*DASC 3103 Cloud Computing & Big Data*

*DASC 3203 Optimization Methods in Data Science*

*DASC 3213 Statistical Learning*

*DASC 4113 Machine Learning*

*DASC 4123 Social Problems (Issues) in Data Science & Analytics*

*DASC 4533 Information Retrieval*

*DASC 4892 Data Science Practicum I*

*DASC 4993 Data Science Practicum II*

Existing courses for the remainder of the required and elective courses are leveraged from the three colleges.

Resources are required to develop the new courses, renovation of existing facilities, course development, and faculty and staff. Renovations to an existing area in Champions Hall will create office, lab, team and student learning spaces. The space will also include office space for a Program Director, Associate Director / Advisor, and Administrative Support. Resources will also be required for software licensing, cloud storage and computing, and general maintenance.

The University Libraries have resources to support this program. Since no accreditation review board currently provides a list of recommended texts and journals needed to support the program coupled with the program being practice-based

rather than research-based, at this point, no new information resources are required. As the Data Science program continues to evolve and the need for information resources

changes and accreditation standards emerge that provide recommended text and journals, the Data Science program and the University Libraries will monitor changes annually and acquire or provide access to the necessary information resources.

No additional facilities beyond the renovation of the existing facility noted above are anticipated. Data used for the courses and the practicums will be housed in secure cloud environments. Equipment required will include student workstations for the lab, team room setups, and a program printer.

The Colleges partnering for the Data Science program have degree programs and emphasis areas that support the program. From the College of Engineering: First-Year Engineering Program, Department of Biomedical Engineering, Computer Science and Computer Engineering, and Industrial Engineering. From the Sam M. Walton College of Business: Department of Accounting, Department of Economics, Department of Finance, Department of Information Systems, Department of Management, and the Department of Supply Chain Management. From the J. William Fulbright College of Arts and Sciences: Department of Biological Sciences, Department of Geosciences, Department of Mathematical Sciences, and the Department of Sociology & Criminal Justice.

 6. **NEED FOR THE PROGRAM**

 (Submit Employer Needs Survey Forms)

 Provide survey data. Submit numbers that show job availability, corporate demands and employment/wage projections, not student interest and anticipated enrollment. Focus mostly on state needs and less on regional and national needs, unless applicable to the program.

 Survey data can be obtained by telephone, letters of interest, student inquiry, etc. Focus mostly on state needs for undergraduate programs; for graduate programs, focus on state, regional and national needs.

 Provide names and types of organizations/businesses surveyed.

Letters of support should address the following when relevant: the number of current/anticipated job vacancies, whether the degree is desired or required for advancement, the increase in wages projected based on additional education, etc.

 Indicate if employer tuition assistance is provided or if there are other enrollment incentives.

 Describe what need the proposed program will address and how the institution became aware of this need.

 Indicate which employers contacted the institution about offering the proposed program.

 Indicate the composition of the program advisory committee, including the number of members, professional background of members, topics to be considered by the members, meeting schedule (annually, bi-annually, quarterly), institutional representative, etc.

Employers active in the Data Science area in the state and region were asked to provide survey data. The survey data summary form is attached as *Appendix A - Employer Needs Survey Summary and Submissions*. Summarizing the responses:

Hiring preference to graduates with B.S. DASC: Yes = 6, Maybe = 5, No = 0

Employees would benefit from selective enrollment: Yes = 6, Maybe = 0, No = 3

Would your organization provide tuition assistance: Yes = 2, Maybe = 5, No = 2

Type of support your organization is willing to provide (number of organizations willing to do so): On-site Internships (7), Part-Time Faculty (3), Tuition Reimbursement (4), Real world data and problems for instructional and practicum use (7), Employee Release Time (5), Program Start-Up Funds (1), Equipment (2).

Number of unique position titles = 35 (including levels within titles)

Average Starting Salary Range = $45k/year (Low), $86k (Avg.), $150K (High)

Salary Increase Range = 3% - 5% - 10% depending on performance

Position titles requiring this skill:

Evaluating the quality of data = 36

Understanding and rigorously analyzing data = 36

Working in a team-based environment = 34

Communicating findings in writing = 32

Communicating findings using visualization = 32

Applying critical thinking skills for novel problems = 31

Data cleansing, processing, and wrangling = 31

Generalizing knowledge across domains = 30

Applying to organizational business and economics = 30

Collecting data via research techniques = 29

Relevant work or internship experience = 29

Applying to understand data and make predictions = 27

Communicating findings via public speaking = 27

Data privacy, security, and ethics = 23

Management of data bases = 21

Project management skills and leading teams = 17

The project management response was related to positions that were higher-level.

Additionally, respondents to the survey provided quotes in support of the program where each quote is from a different respondent:

“Locally, there is a tremendous need for analytical talent in Northwest Arkansas. A local source for this talent would benefit this region greatly. [T]his skillset will help the company optimize productivity and improve [many aspects of our business and resources]. Within our state as well as nationally, data science will help reduce natural resource consumption such as water, fuel and food waste. Data Science helps corporations reduce costs by optimizing business systems, re-allocating/optimizing human capital and discover previously unknown solutions to business problems that drive the enterprise forward.”

“This program will help “[b]y providing more entry-level analytical talent to the region. There is currently a shortage of analytical talent nationwide. By granting this program we will benefit by being able to bring on skilled analytical talent into our recruiting pipeline and grow the talent. This benefits all employers in the local area, region, and State. Also, by investing in growing talent locally, the students are more likely to want to stay local rather than leave. This makes recruiting easier.”

“The data science field is blowing up in the business and technology industry. Arkansas, particularly Northwest Arkansas, has been playing catchup in many areas around developing technology talent. We have a major talent gap in terms of the number of positions open and the number of graduates to fill those positions. Adding a Data Science program at the U of A would help make Northwest Arkansas known as a regional hub for producing IT talent. Additionally, creating a local talent pool will help fill jobs here in NWA vs. in other states or countries. The large employers who need this skillset will hire it where they can find it. Growing and hiring talent here will help further economic development in NWA.”

“This program would benefit us through creating a currently unavailable workforce, opening the door to a new economic stream, and also position us to become the known experts in a rapidly evolving field. In addition to creating new opportunities for employees and employer, this degree would lessen the need to ‘look elsewhere’ for solutions to field related challenges.”

“We have a delivery center in [Central Arkansas]. I could move Data Scientist work there if there were a concentration of people there who are qualified.”

“[We] would prefer the ability to take advantage of a skillset around Python and R as well as a cloud-based background. Regarding modeling preferences, we will leverage the basic models (Linear Regression, Clustering etc.) but we will increasingly make use of Artificial Neural Networks using libraries such as TensorFlow and Keras. [Our] data science skillset will also leverage knowledge around Computer Vision and Edge Computing. We would also benefit from a program grounded in practical application of real-world business problems and solutions. There would also be benefit in collaborating with the University on Data Science Internships. This provides valuable real-world experience for the students as well as partnership between [us] and the University’s Data Science program.”

“A thorough understanding of algorithms and statistical analysis would be something we are looking for. Too many times, we have interviewed perspective employees who understand a software package vs. model validation and the underlying mechanics of the models. Also, of interest to us is getting exposure to some of the … open source platforms such as R & Python. Many programs focus on only large enterprise vendors such as SPSS, SAS, etc. While we do utilize IBM [technology], we are also doing cutting-edge work with Python and exposure to Python would be useful to us.”

“This degree program could supplement preferred degrees in urban and transportation planning.”

“We are very excited about the potential of this program. Please let us know what we could possibly do to help.”

The following organizations provided responses to the *Employer Needs Survey*:

* @OneStoneEconmm
* DXC.technology
* First Orion
* J.B. Hunt Transport, Inc.
* Metova, Inc.
* Movista
* Rock Analytics
* Rock Region (RR) Metro Transit Authority
* Sightline Retail
* Tyson Foods
* Walmart



The Data Science Curriculum Committee is composed of the following faculty from the College of Engineering (CoE), the Sam M. Walton College of Business (WCOB), and the J. William Fulbright College of Arts and Sciences (ARSC) and were appointed by their respective Deans:

* Andrew J. Alverson, PhD, Associate Professor, Biological Sciences, ARSC
* W. Art Chaovalitwongse, PhD, Professor, Industrial Engineering, Co-Director, Institute of Advanced Data Analytics, CoE
* Jackson Cothren, PhD, Professor, Geosciences, Director of CAST, ARSC
* Paul Cronan, PhD, Professor, Information Systems, WCOB
* Norman D. Dennis, PhD, PE, Senior Associate Dean and University Professor, CoE
* Brian Fugate, PhD, Professor and Chair, Supply Chain Management, WCOB
* Casey T. Harris, PhD, Associate Professor, Sociology, Co-Director, Center for Social Research, ARSC
* Fred Limp, PhD, University Professor, Geosciences, ARSC
* Xiaoqing (Frank) Liu, PhD, Professor and Head, Computer Science / Computer Engineering, CoE
* Edward A. Pohl, PhD, Professor and Head, Industrial Engineering, CoE
* Raj R. Rao, PhD, Professor and Head, Biomedical Engineering, CoE
* Karl D. Schubert, PhD, FIET, Research Professor, Director of Research for Innovation and Data Science Initiatives, CoE and WCOB
* John R. Tipton, PhD, Assistant Professor, Mathematical Sciences/Statistics, ARSC
* Xintao Wu, PhD, Professor, Computer Science / Computer Engineering, CoE

The Data Science Advisory Council is composed of representatives from industry, government, and state and regional authorities and meets twice yearly. To date, the Advisory Council has meet twice (September 2018 and May 2019). The Advisory Council members are as follows:

* Shannon Bedore, Managing Director, Sightline Retail
* Meagan Bowman, CIO and Co-Founder, @OneStoneEcomm
* Brian Clark, VP and General Manager for Walmart Global Business, NCR
* Ross DeVol, Walton Fellow, The Walton Family Foundation, Inc.
* Kelly Eichler, Member and Assistant Secretary, University of Arkansas Board of Trustees
* William (Bill) Groves, Chief Data and Analytic Officer, Walmart
* Scott Hambuchen, EVP Technology and Solutions Development, First Orion
* Brandi Joplin, SVP and Chief Audit Executive, Walmart
* Aric LaBarr, Associate Professor of Analytics, Institute for Advanced Analytics, NCSU
* Douglas (Doug) Mettenburg, VP of Engineering and Technology, J.B. Hunt Transport, Inc.
* Nelson Peacock, President and CEO, Northwest Arkansas Council
* Elizabeth Phillips, Owner and Data Visualization Specialist, Rock Analytics
* Bill Ryan, (Former) Director of Category Development, (formerly of) Wrigley
* Scott Spradley, EVP and Chief Technology Officer, Tyson Foods
* Alison Williams, Chief of Staff for Governor Asa Hutchinson
* Emma Xu, VP of Operations, Systems, and Club Applications, Sam’s Club

The inaugural Advisory Council meeting, September 2018, was focused on gaining feedback on the general concept and approach of the Data Science Program and understanding the need. With significantly positive feedback, program proposal development continued. The second Advisory Council meeting, May 2019, was focused on receiving feedback on the proposed core curriculum and the concentrations. Again, with significantly positive feedback, program proposal submission proceeded. Future meetings will focus on continued engagement and feedback and active participation in the program and with the faculty and students.

Indicate the projected number of program enrollments for Years 1 - 3.

|  |  |  |
| --- | --- | --- |
| **Enrollment** | **FY20** | **FY21** |
| Freshmen | 50 | 50 |
| Sophomore | 0 | 55 |
| Junior | 0 | 0 |
| Senior | 0 | 0 |
| Total | 50 | 105 |

It is estimated that the first two years the students enrolled will come from existing degree programs.

Indicate the projected number of program graduates in 3-5 years.

It is estimated that in years 3-5 the students enrolled will come from a mix of existing degree programs and students attracted and recruited specifically to the program.

|  |  |  |  |
| --- | --- | --- | --- |
| **Enrollment** | **FY22** | **FY23** | **FY24** |
| Freshmen | 50 | 50 | 50 |
| Sophomore | 55 | 55 | 55 |
| Junior | 60 | 60 | 60 |
| Senior | 0 | 60 | 60 |
| Total | 165 | 225 | 225 |

7. **CURRICULUM**

#  Provide curriculum outline by semester (include course number and title).

#  (For bachelor’s degree program, submit the 8-semester degree plan.)

* Please see *Appendix B - DASCBS 8-Semester Suggested Plan of Study*

Give total number of semester credit hours required for the program, including prerequisite courses.

* 120 semester credit hours are required to complete the program, including prerequisite courses.

 Identify new courses *(in italics)* and provide course descriptions.

There are seventeen new courses required to be developed based on the current courses available in the College of Engineering, Sam M. Walton College of Business, and the J. William Fulbright College of Arts and Sciences.

*DASC 1001 Introduction to Data Science* is a course providing an overview of Data Science and preparation of Data Science First Year students for the Data Science program and for choosing one of the Data Science program concentrations: Bioinformatics, Biomedical and Healthcare Analytics, Business Data Analytics, Computational Analytics, Data Science Statistics, Geospatial Data Analytics, Operations Analytics, Social Data Analytics, or Supply Chain Analytics.

*DASC 1104 Programming Languages for Data Science* provides a semester-long introduction to basic concepts, tools, and languages for computer programming using Python and R, two powerful programming languages used by data scientists. This class will introduce students to computer programming and provide them with the basic skills and tools necessary to efficiently collect, process, analyze, and visualize datasets. Students will gain hands-on experience with *de novo* programming in R and Python, finding and utilizing packages, and working in both interactive (Jupyter and RStudio) and non-interactive (Unix) environments.

*DASC 1204 Introduction to Object Oriented Programming for Data Science* introduces object-oriented programming in JAVA. It covers object-oriented programming elements and techniques in JAVA, such as primitive types and expressions, basic I/O, basic programming structures, abstract data type, object class and instance, Methods, Java File I/O, object inheritance, collections and composite objects, advanced input /output: streams and files, and exception handling. Students will gain hands-on programming experience using JAVA.

*DASC 1222 Role of Data Science in Today’s World* is a survey course providing an overview of the Data Science Curriculum and an introduction to the essential elements of data science: data collection and management; summarizing and visualizing data; basic ideas of statistical inference; predictive analytics and machine learning. Students will gain hands-on experience using the Python programming language and Jupyter notebooks.

*DASC 2103 Data Structures & Algorithms* focuses on fundamental data structures and associated algorithms for computing and data analytics. Topics include the study of data structures such as linked lists, stacks, queues, hash tables, trees, and graphs, recursion, their applications to algorithms such as searching, sorting, tree and graph traversals, divide-and-conquer, greedy algorithms, and dynamic programming, and the theory of NP-completeness. Students will gain hands-on experience using Python or Java.

*DASC 2113 Principles and Techniques in Data Science* is an intermediate semester-long data science course that follows an overview of data science in today’s world. This class bridges between introduction to data science and upper division data science courses as well as methods courses in other concentrations. This class equips students with essential basic elements of data science, ranging from database systems, data acquisition, storage and query, data cleansing, data wrangling, basic data summarization and visualization, and data estimation and modeling. Students will gain hands-on experience using Python and various packages in Python.

*DASC 2203 Data Management & Data Base* focuses on the investigation and application of data science database concepts including DBMS fundamentals, database technology and administration, data modeling, SQL, data warehousing, and current topics in modern database management.

*DASC 2213 Data Visualization and Communication* is a seminar providing an essential element of data science: the ability to effectively communicate data analytics findings using visual, written, and oral forms. Students will gain hands-on experience using data visualization software (Tableau, Python) and preparing multiple formats of written reports (technical, social media, policy) that build a data literacy and communication toolkit for interdisciplinary work. In essence, this is a course emphasizing finding and telling stories from data, including the fundamental principles of data analysis and visual presentation conjoined with traditional written formats.

*DASC 2594 Multivariable Mathematics for Data Scientists* provides an in depth look at the multivariate calculus and linear algebra necessary for a successful understanding of modeling for data science. Students will gain an understanding of the mathematical and geometric concepts used in optimization and scientific computation using mathematical and computational techniques. At the end of the course, students will be equipped with the calculus and linear algebra skills and knowledge to be successful in courses in optimization and advanced data science methods.

*DASC 3103 Cloud Computing & Big Data* covers: introduction to distributed data computing and management, MapReduce, Hadoop, cloud computing, NoSQL and NewSQL systems, Big data analytics and scalable machine learning, real-time streaming data analysis. Students will gain hands-on experience using Amazon AWS, MongoDB, Hive, and Spark.

*DASC 3203 Optimization Methods in Data Science* is an advanced mathematical course providing the foundations and concepts of optimization that are essential elements of machine learning algorithms in data science, ranging from mathematical optimization to convex optimization to unconstrained and constrained optimization to nonlinear optimization to stochastic optimization. Students will gain hands-on experience using Python and various optimization packages in Python.

*DASC 3213 Statistical Learning* is a course providing an in depth look at the theory and practice of applied linear modeling for data science: including model building, selection, regularization, classification and prediction. Students will gain hands-on experience using statistical software to learn from data using applied linear models.

*DASC 4113 Machine Learning* covers: logistic regression, ensemble methods, support vector machines, kernel methods, neural networks, Bayesian inference, reinforcement learning, learning theory, and their applications in text, image, and web data processing. Students will gain hands-on experience of developing machine learning algorithms using Python and scikit-learn.

*DASC 4123 Social Problems (Issues) in Data Science & Analytics* explores the ways data analytics and data science are impacted by or intersect with issues of social justice, poverty and economic inequality, racial and ethnic relations, gender, crime, education, health and healthcare, and other contemporary social problems.

*DASC 4533 Information Retrieval* is a course providing expertise in processing unstructured data as a key component of data science. It covers text processing, file structures, ranking algorithms, query processing, and web search. Students will gain hands-on experience developing their own search engine from scratch, using Python, C, C++, or Java on a Linux server and making their search engine web accessible. Note: Prior user-level knowledge of Linux for file and directory management and remote login is required for this course.

*DASC 4892 Data Science Practicum I* focus is on the application of data science, analytics, business intelligence, data mining, machine learning, and data visualization to existing problems. Data Science techniques using current and relevant software and problem-solving methods are applied to current problems for presentation to management. This is the first semester of the required full-year multi-college interdisciplinary practicum using real-world data to solve real-world problems.

*DASC 4993 Data Science Practicum II* focus is on the application of data science, analytics, business intelligence, data mining, machine learning, and data visualization to existing problems. Data Science techniques using current and relevant software and problem-solving methods are applied to current problems for presentation to management. This is the second semester of the required full-year multi-college interdisciplinary practicum using real-world data to solve real-world problems.

There are three new courses required to be developed based on the current courses available in the College of Engineering, Sam M. Walton College of Business, and the J. William Fulbright College of Arts and Sciences for proposed Concentration. These courses will not be exclusive to the Data Science program.

*GEOS 4263 Geospatial Data Science – Sources and Characteristics* covers the wide range of geospatial data sources and characteristics with emphasis on data science applications through hands-on experience recognizing the unique requirements of major sources. Techniques for the integration of disparate, heterogeneous data sets will be covered.

*STAT 4013 Statistical Forecasting and Prediction* is a course providing an in depth look at the theory and practice of applied modeling of temporal data for data science: including model building, selection, autocorrelation, autoregression and moving averages, and prediction for correlated data. Students will gain hands-on experience using statistical software to learn from data using applied time series and models.

*STAT 4023 Bayesian Methods* is a course providing an introductory look at the theory and practice of applied Bayesian modeling for data science: including model building, selection, regularization, classification and prediction. Students will gain hands-on experience using statistical software to learn from data using applied Bayesian models.

 Identify required general education courses, core courses and major courses.

* MATH 2554 Calculus I
* ENGL 1013 Composition I
* MATH 2564 Calculus II
* INEG 2313 Applied Probability and Statistics for Engineers I
* INEG 2333 Applied Probability and Statistics for Engineers II
-- or --
* STAT 3013 Introduction to Probability and Statistics
* STAT 3003 Statistical Methods
* MGMT 2053 Business Foundations
* PHIL 3103 Ethics and the Professions
* ECON 2143 Basic Economics: Theory and Practice

For each program major/specialty area course, list the faculty member assigned to teach the course.

* The faculty members teaching the courses will be selected from the list provided in *Appendix D - DASCBS Faculty*

Identify courses currently offered by distance technology (with an asterisk\*) and endnote at the end of the document.

* None of the new proposed DASC courses will initially be offered by distance technology.

 Indicate the number of contact hours for internship/clinical courses.

* There are no internship courses required for this program.

 State the program admission requirements.

Application for admission to the B.S. DASC program is made through the University of Arkansas “Application for Admission” portal (<https://application.uark.edu/>). The requirements for admission are provided in the “New Freshman” portal (<http://catalog.uark.edu/undergraduatecatalog/enrollmentservices/newfreshmen/>).

 Describe specified learning outcomes and course examination procedures.

1. An ability to use information systems, statistics, and computer science principles and apply state-of-the-art technologies for data representation, data retrieval, data manipulation, data storage, data governance, data security, machine learning, computational analytics, and data analysis and visualization;
2. An ability to develop descriptive, predictive, and prescriptive mathematical and statistical models to provide abstractions of complex systems and organizational problems and to apply computational methods to draw conclusions supported by data;
3. An ability to use foundational knowledge and apply critical thinking skills to problem identification, problem solving, decision making, visualization, and an awareness of societal and ethical impacts;
4. An ability to adapt analytics concepts to interpret and communicate findings and implications to senior decision makers;
5. An ability to work effectively in multidisciplinary teams and transfer findings from one knowledge domain to another; and,
6. An ability to communicate in written, verbal, technical, and non-technical forms.

 Include a copy of the course evaluation to be completed by the student.

* Please see *Appendix C - DASCBS Standard Course Evaluation*

 Include information received from potential employers about course content.

Employers confirmed the need for the following knowledge and skills through the *Employer Needs Survey* and affirmed in the May 2019 Data Science Advisory Council meeting that these needs were addressed by the B.S. DASC Program course content:

Evaluating the quality of data

Understanding and rigorously analyzing data

Working in a team-based environment

Communicating findings in writing

Communicating findings using visualization

Applying critical thinking skills for novel problems

Data cleansing, processing, and wrangling

Generalizing knowledge across domains

Applying to organizational business and economics

Collecting data via research techniques

Relevant work or internship experience

Applying to understand data and make predictions

Communicating findings via public speaking

Data privacy, security, and ethics

Management of data bases

Project management skills and leading teams

Provide institutional curriculum committee review/approval date for proposed program.

September 11, 2019

 8. **FACULTY**

 List the names and credentials of all faculty teaching courses for the proposed program. Include college/university awarding degree; degree level; degree field; subject area of courses faculty currently teaching and/or will teach. (For associate degrees and above: A minimum of one full-time faculty member with appropriate academic credentials is required.)

* Please see *Appendix D - DASCBS Faculty*

 Indicate lead faculty member or program coordinator for the proposed program.

Lead faculty member for the proposed program:

Dr. Norman D. Dennis, Jr., P.E., Senior Associate Dean, College of Engineering, and University Professor, Department of Civil Engineering.

Lead program coordinator for the proposed program:

Dr. Karl D. Schubert, FIET, Professor, Office of the Dean, College of Engineering and Director of Research for Innovation and Data Science Initiatives for the College of Engineering and the Sam M. Walton College of Business.

 Total number of faculty required for program implementation, including the number of existing faculty and number of new faculty. **For new faculty, provide the expected credentials/experience and expected hire date.**

The Deans of the College of Engineering, the Sam M. Walton College of Business, and the J. William Fulbright College of Arts and Sciences have each committed two faculty lines over the next four years to support this program in addition to those listed in *Appendix D – DASCBS Faculty*.

For proposed graduate programs: Provide the curriculum vita for faculty teaching in the program, and the expected credentials for new faculty and expected hire date. Also, provide the projected startup costs for faculty research laboratories, and the projected number of and costs for graduate teaching and research assistants.

N/A.

9. **DESCRIPTION OF RESOURCES**

 Current library resources in the field

“Since no accreditation review board currently provides a list of recommended texts and journals needed to support the program coupled with the program being practice-based rather than research-based, at this point, no new information resources are required.  As the Data Science program continues to evolve and the need for information resources changes and accreditation standards emerge that provide recommended text and journals, the College of Engineering and the University Libraries will monitor changes annually and acquire or provide access to the necessary information resources.” [E-mail from Mr. Joel B. Thornton, Head of Research & Instruction and Associate Professor, University Libraries, April 12, 2019.]

 Current instructional facilities including classrooms, instructional equipment and technology, laboratories (if applicable)

Current classroom facilities, team and individual work spaces, and computer laboratories will be used to support the program. All current library resources, facilities, classrooms, equipment and technology may be used for the program. All online resources at the University of Arkansas as well as the on-campus library will be used to support the program.

 New instructional resources required, including costs and acquisition plan

Instructional facilities for data science laboratory assignments, team work spaces, and data science visualization are required and are planned through renovation of an existing space in Champions Hall. Renovation costs, including the instructional facilities, administrative offices, workspaces, and furniture are estimated to be $170,405 and are targeted for the second year of the program. The equipment and technology required for the program are estimated to be $150,000 and are targeted for one half in the first year and one half in the second year of the program.

10. **NEW PROGRAM COSTS – Expenditures for the first 3 years**

 New administrative costs (number and position titles of new administrators)

1 x Program Director – $182,333

1 x Associate Director / Advisor – $130,000

1 x Administrative Support – $32,083

Number of new faculty (full-time and part-time) and costs

Tenure / Tenure Track Faculty, full-time, re-directed from existing lines over 4 years

2 x College of Engineering

2 x Sam M. Walton College of Business

2 x J. William Fulbright College of Arts and Sciences

New library resources and costs

No new library resources and costs.

New/renovated facilities and costs

$170,405

New instructional equipment and costs

$150,000

Distance delivery costs (if applicable)

N/A

Other new costs (graduate assistants, secretarial support, supplies, faculty development, faculty/students research, program accreditation, etc.)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **FY20** | **FY21** | **FY22** |
|  |  |  |  |
| Teaching Assistants Salary |  $ 100,000  |  $ 202,000  |  $ 286,040  |
| Benefits |  $ 5,840  |  $ 11,915  |  $ 17,041  |
| Tuition |  $ 48,732  |  $ 100,166  |  $ 144,112  |
|  |  |  |  |
| Instructional Faculty Salary |  $ -  |  $ 227,500  |  $ 232,050  |
| Benefits |  $ -  |  $ 66,014  |  $ 68,008  |
|  |  |  |  |
| Faculty Buyout Pool |  $ 110,000  |  $ 40,000  |  $ 75,000  |
| Benefits |  $ 31,603  |  $ 11,607  |  $ 21,981  |
|  |  |  |  |
| **Total other new costs** | **$ 296,175** | **$ 659,202** | **$ 844,232** |

 **If no new costs required for program implementation, provide explanation.**

11. **SOURCE OF PROGRAM FUNDING – Income for the first 3 years of program operation**

If there will be a reallocation of funds, indicate from which department, program, etc.

The Deans of the College of Engineering, the Sam M. Walton College of Business, and the J. William Fulbright College of Arts and Sciences have each committed two faculty lines over the next four years to support this program. At this time, the specific source departments, programs, etc., have not been identified.

Provide the projected annual student enrollment, the amount of student tuition per
credit hour, and the total cost of the program that includes tuition and fees.

|  |  |  |  |
| --- | --- | --- | --- |
| **Projected Student Enrollment** | **FY20** | **FY21** | **FY22** |
| Freshmen | 50 | 50 | 50 |
| Sophomore | 0 | 55 | 55 |
| Junior | 0 | 0 | 60 |
| Senior | 0 | 0 | 0 |
| **Total** | **50** | **105** | **165** |

The amount of student tuition per credit hour and the proposed differential tuition rate:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **FY20** | **FY21** | **FY22** |
| Tuition Rate | $ 246.12 | $ 251.04 | $ 256.06 |
|  |  |  |  |
|  | **FY20** | **FY21** | **FY22** |
| Differential Tuition Rate | 32.00% | 33.00% | 34.00% |

The total cost of the program, including tuition and fees:

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Expenses** |  $ 765,867  |  $ 1,676,076  |  $ 1,865,363  |
|  |  |  |  |
| **Net Income** |  $ (7,253) |  $ 20,766  |  $ (115,799) |

 Indicate the projected annual state general revenues for the proposed program (Provide
 the amount of state general revenue per student).

The majority of the students in the program during the first two years are estimated to come from existing programs.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **FY20** | **FY21** | **FY22** |
| New Tuition |  $ -  |  $ 552,293  |  $ 774,591  |
| New Differential Tuition |  $ 34,654  |  $ 50,121  |  $ 62,075  |
| **Total New Revenue** |  **$ 34,654**  |  **$ 602,414**  |  **$ 836,666**  |
| **Total New Revenue per Student** |  **$ 693**  |  **$ 5,737**  |  **$ 5,070**  |

Other (grants [list grant source & amount of grant], employers, special tuition rates,
 mandatory technology fees, program specific fees, etc.).

|  |  |  |  |
| --- | --- | --- | --- |
|  | **FY20** | **FY21** | **FY22** |
| Differential Tuition Rate | 32.00% | 33.00% | 34.00% |
| TELE Fees | $ 45,000 | $ 90,000 | $ 140,000 |

12. **ORGANIZATIONAL CHART REFLECTING NEW PROGRAM**

Proposed program will be housed in the College of Engineering in the Office of the Dean.

13. **SPECIALIZED REQUIREMENTS**

 If specialized accreditation is required for program, list the name of accrediting agency.

There are currently no accreditation bodies for a B.S. Data Science program.

 Indicate the licensure/certification requirements for student entry into the field.

N/A.

#  Provide documentation of Agency/Board review/approvals (education, nursing--initial approval required, health-professions, counseling, etc.)

N/A.

14. **BOARD OF TRUSTEES APPROVAL**

 Provide the date that the Board approved (or will consider) the proposed program.

January 30, 2020

 Provide a copy of the Board meeting agenda that lists the proposed program, and written documentation of program/unit approval by the Board of Trustees prior to the Coordinating Board meeting that the proposal will be considered.

15. **SIMILAR PROGRAMS**

#  List institutions offering program:

##  Proposed undergraduate program – list institutions in Arkansas

None.

 List institution(s) offering a similar program that the institution used as a model to
 develop the proposed program.

1. The Ohio State University (B.S. Data Science)
2. North Carolina State University (M.S. Data Analytics)

 Provide a copy of the e-mail notification to other institutions in the state notifying them of the proposed program. Please inform institutions not to send the response to **“Reply All”**. If you receive an objection/concern(s) from an institution, reply to the institution and copy ADHE on the email. That institution should respond and copy ADHE. If the objection/concern(s) cannot be resolved, ADHE may intervene.

 **Note: A written institutional objection/concern(s) to the proposed program/unit may delay Arkansas Higher Education Coordinating Board (AHECB) consideration of the proposal until the next quarterly AHECB meeting.**

16. **DESEGREGATION**

 State the total number of students, number of black students, and number of other minority students enrolled in related degree programs, if applicable.

N/A.

1. **INSTITUTIONAL AGREEMENTS/MEMORANDUM OF UNDERSTANDING (MOU)**

 If the courses or academic support services will be provided by other institutions or organizations, include a copy of the signed MOU that outlines the responsibilities of each party and the effective dates of the agreement.

N/A.

1. **ACADEMIC PROGRAM REVIEW**

 Provide scheduled program review date (within 10 years of program implementation date).

2025-2026.

1. **PROVIDE ADDITIONAL INFORMATION IF REQUESTED BY ADHE** **STAFF**
2. **INSTRUCTION BY DISTANCE TECHNOLOGY**

 If the proposed program will be offered by distance technology, provide the following information:

 Summarize institutional policies on the establishment, organization, funding and management of distance courses/degrees.

 Describe the internal organizational structure that coordinates (development, technical support, oversight) distances courses/degrees.

 Summarize the policies and procedures to keep the technology infrastructure current.

 Summarize the procedures that assure the security of personal information.

 Provide a list of services that will be outsourced to other organizations (course materials, course management and delivery, technical services, online payment, student privacy, etc.).

 N/A.