BOARD OF HIGHER EDUCATION

REQUEST FOR BOARD ACTION

NO.: BHE 22-56

BOARD DATE: June 21, 2022

APPROVAL OF LETTER OF INTENT OF WESTFIELD STATE UNIVERSITY TO AWARD THE BACHELOR OF SCIENCE IN DATA SCIENCE AND AUTHORIZATION FOR FAST TRACK REVIEW

MOVED: The Board of Higher Education (BHE) has evaluated the Letter of Intent of Westfield State University to award the **Bachelor of Science in Data Science** and has determined that the proposal aligns with BHE criteria. Accordingly, the BHE authorizes the Commissioner to review the program and to make a final determination on degree-granting authority pursuant to the Fast Track Review protocol.

VOTED: Motion approved and advanced to the full BHE by the Executive Committee on 6/13/2022; and adopted by the BHE on 6/21/2022.

Authority: Massachusetts General Laws Chapter 15A, Section 9(b), AAC 18-40

Contact: Winifred M. Hagan, Ed.D., Senior Associate Commissioner for Strategic Planning and Public Program Approval

BOARD OF HIGHER EDUCATION
March, 2022
Westfield State University
Letter of Intent
Bachelor of Science in Data Science

DEGREE TITLE ABSTRACT ON INTENT AND MISSION OF PROGRAM

The Westfield State University's (WSU) proposed Bachelor of Science in Data Science (BS/DS) program is planned to emphasize core competencies related to data analytics, machine learning, and computational fluency through applied problem solving and learning experience in authentic situations. An interdisciplinary curriculum is designed to be integrated into the mathematics and computer science departments. This program is expected to enable students to understand modern notions in data analysis-oriented computing; develop the ability to build and assess data-based models; design and manage a variety of databases and structures; process data in distributed environments; develop Python/R coding skills to work with TensorFlow, PyTorch, Keras and other machine learning libraries; design computer information systems by applying analysis and design techniques; confidently apply common algorithms to tackle data-driven problems; and communicate appropriate solutions effectively.

The proposed Bachelor of Science in Data Science was approved by the Westfield State University Board of Trustees on June 29, 2021. The LOI was circulated on January 27, 2022. No comments were received.

A. ALIGNMENT WITH MASSACHUSETT'S GOALS FOR HIGHER EDUCATION

Address Gaps in Opportunity and Achievement in Alignment with Campus-Wide Goals

WSU reports that the proposed BS/DS program is aligned to the University's Strategic Plan 2019-2024, which specifically identified priorities to develop robust programs that are aligned to Massachusetts' work force needs. As well, the programs' alignment to BHE's Equity Agenda is expected to help Westfield broaden under-represented student participation in STEM, while meeting the need for data professionals with a significant capacity to problem-solve. The BS/DS at WSU presents an affordable, accessible

degree program to traditionally underserved students in STEM fields. Since 2020, WSU has been a proud charter member of the American Association for the Advancement of Science' Stem Equity Achievement Change program (AAAS SEA Change[1]), which serves to underscore both WSU's commitment to equity, and its' alignment with BHE's Equity Agenda. WSU was nationally recognized as one of seven charter institutions (the six other charter members are all R1[2] classified). SEA Change work aligns with WSU's mission. SEA Change principles will guide the recruitment and retention initiatives within the proposed BS/DS program. WSU established a SEA Change institutional team to work and develop an action plan that aligned with the goals of both SEA Change and WSU. SEA Change supports a movement for institutional and department level change to remove barriers to education and research for traditionally underserved students in STEM fields. It is a voluntary commitment by the institution as well as individual academic departments, to a set of principles that advance diversity, equity, and inclusion. STEM programs, including the proposed BS/DS will participate in periodic self-assessment and review to monitor progress and action. This commitment is expected to progress-monitor, to inform recruitment, retention, and persistence efforts as well as guide the supports planned and provided to traditionally underserved students in the proposed program.

It is well-documented there are structural and social barriers in attracting a diverse population in Computer Science (Google, Inc. & Gallup, Inc., 2016). This is largely an issue of recruitment and retention in the discipline (Levitan, 2018). Despite these challenges, we recognize that a novel program with clear applications and well-planned student support services will improve the recruitment and retention of diverse populations (Colby et al., 2016).   In partnership with the University's Career Center, the program will launch career interest and development events on campus for current students and prospective students to connect with industry partners. We will expand

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[1] *SEA Change is a program of the American Association for the Advancement of Science. SEA Change aims to advance institutional transformation in support of diversity, equity, and inclusion, especially in colleges and universities. (Seachange.aaas.org. Retrieved 2/4/22)*

[2] *Carnegie Classification 'research 1' denotes very high research activity. Carnegie Classification is a framework that is widely used in the study of higher education , to represent and control for institutional differences, and also in the design of research studies to ensure adequate representation of sampled institutions, students or faculty. (carnegieclassification.iu.org. Retrieved 2/4/22)*

our connections with alumni who are working in the field of data science who will mentor and support our undergraduates. In addition to career support, students will receive academic support through the Mathematics Tutoring Center and through tutoring in the Computer Sciences.

Program or Department Supports to Ensure Student Retention and Completion

WSU expects that students will be able to complete the proposed program in four years and attribute this projection to an advisory application that is used to demonstrate a clear pathway to completion. WSU plans to support student persistence by creating a culture of belonging to the major, ensuring students have a clear understanding of career opportunities, and academic support for challenging coursework. It is planned that Data Science majors will have a dedicated faculty advisor and will receive clear advising coaching and materials to monitor progress through the program.

An Introduction to Data Science course addresses the needs of beginners and newcomers to the field. With no prerequisites, this course is designed to provide students with knowledge and skills in inferential thinking, computational thinking, and career-relevance. The course introduces students to computer programming and statistical inference, in conjunction with hands-on analysis of datasets. WSU has established a STEM tutoring program that serves students every semester and includes Mathematics and Computer Science. In addition, a dedicated Mathematics Tutoring Center provides an inquiry-based approach to supporting teaching and learning. The new Office of Course Achievement, Retention and Engagement (CARE) is part of a more comprehensive approach to tutoring services and will support students in the proposed program.

Alliances and Partnerships

WSU's College of Mathematics and Sciences serves as the lead for the Pioneer Valley STEM Network one of nine regional networks in the Commonwealth[3]. Multiple faculty

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[3] *The Pioneer Valley Science, Technology, Engineering and Mathematics Network (PVSTEM NET) is based in the Pioneer Valley, which includes the three Western Massachusetts counties along the Connecticut River and I-91. Regional networks were established in 2004 by the Massachusetts STEM*

members from WSU are members of the Advisory Committee and the Dean of the College of Mathematics and Sciences serves as the Regional Manager. WSU plans to connect the proposed program with the employer community, higher education, and PK-12. We will utilize this relationship to establish an advisory group for the proposed program.

WSU plans to stay current in industry trends and opportunities for students through a Data Science Advisory Committee and will consist of faculty, students, alumni, and industry professionals.   A diverse list of advisors and their affiliations was submitted with the LOI materials and once the program is approved, will help inform course and curricular changes and internship opportunities.

Relationship to MassHire Regional Blueprints

WSU had a market analysis for the proposed program conducted by the Education Advisory Board[4] (EAB), which found that regional employers, advertised 4,413 job openings for bachelor's level data sciences professionals and increased the demand for bachelor's-level data sciences professionals by 72 percent in the last 4.5 years; statewide demand increased 63 percent over the same time period; local and statewide financial industry employers demonstrated high demand for bachelor's-level data sciences professionals; local employers sought baccalaureate-level data science professionals with data analysis skills in 43 percent of postings and structured query language (SQL) skills in 38 percent of postings; and sought baccalaureate-level data sciences professionals with business analysis, business intelligence, or business process skills in 36 percent of job postings over the last 12 months. WSU expects the proposed program will prepares student for careers as data scientists, statisticians,

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computer program analysts, data analysts allowing students to immediately enter the workforce or pursue a graduate degree.

Duplication

WSU reports that there are only a few BS in Data Science programs in western Massachusetts including Smith College, both of which are less interdisciplinary than what WSU proposes and more expensive. In comparing itself to area programs WSU finds that the proposed major would be the only BS Data Science program offered at a state institution, though Worcester State offers a minor in Data Science and, Bridgewater, Framingham and Salem State offer a BS in Computer Science, all outside of the Pioneer Valley. WSU plans that the program will include a dual emphasis on the principles of both mathematics and computer science, with foundational training in technical skills for data science, making it an interdisciplinary program.

Innovative Approaches to Teaching and Learning

It is planned that students will be encouraged to access Amazon's AWS Free Digital Training in Artificial Intelligence. WSU also anticipates that within specific courses, students will experience machine learning, connecting theory to practice. For example, students will develop data science applications using TensorFlow, PyTorch, Keras and other popular libraries. In addition, competency-based learning is planned to include writing data analysis code using modern statistical software. WSU expects that a dual emphasis on the principles of mathematics, including calculus, linear algebra, discrete mathematics, mathematical statistics, and experimental design) and computer science (including algorithms, data structures, computer systems and architectures, databases, software engineering, data mining, artificial intelligence, and machine learning) will provide students with integrated foundational knowledge of mathematics and computer sciences, and a competitive edge in the job market.

B. ALIGNMENT WITH CAMPUS STRATEGIC PLAN AND MISSION

Priority Rationale and Support of Strategic Plan and Overall Mission of Institution
WSU's Strategic Plan (2019-2024) has guided the development of the proposed program. A focus on the student experience included plans for the development of innovative programs that serve workforce needs. The specific development of a Data Science program was a significant priority within the student experience goal. The proposed LOI is a direct result of the WSU strategic plan.

Program Goals and Learning Objectives (Form B)

The goals of the proposed program are to provide students with solid theoretical knowledge of math, statistics and computer science; train students to develop relevant programming abilities and execute statistical analyses with Python, R, SQL and other popular software; equip students with the ability to build and assess statistical models; train students to design, use and build a relational data base; train students to design and develop computer information systems in real-time; equip students with the ability to solve practical problems with data science and present their solutions effectively.

ALIGNMENT WITH OPERATIONAL AND FINANCIAL OBJECTIVES OF INSTITUTION

Enrollment Projections (Form C, Appendices)

A Spring 2020 course titled "Special Topics: Data Science Topics", was designed to help WSU gauge student interest in the data science major. The enrollment at that time (30), provided a basis for the full-time enrollment projection for every year, including an approximate attrition rate in the first year (10%). An approximate 15% part-time student ratio, and the EAB report's finding of approximately 15% annual increase of regional job postings in data science. WSU projects that within four years 129 students will be enrolled with four-year cohorts in place. The Data Science major represents a substantial intersection of required courses between two existing majors and this is

expected to provide some students with a double-major opportunity. It is expected that the existing administrative assistant, will also support the Data Science program. This position is currently slotted as a 9-month position, spring and fall semesters. WSU plans to compensate for the increased workload by extending the position to cover a full year by the third year of the data science program.

Collaboration with the Biology Department has been developed in order to construct a Center for Data Science and Bioinformatics space. After renovating an old computer lab, the space will be designed for machine learning and analytics. The computing courses of the proposed Data Science program will be offered in this space, which is planned to include computer stations and data science software (e.g., Python, R, Anaconda, Octave), which reportedly can be installed and used at no cost, and are already included in projected library acquisitions costs for the university.

STAFF REVIEW AND VALIDATION

Staff thoroughly reviewed the **LOI** proposing full degree granting authority for the **Bachelor of Science in Data Science** submitted by **Westfield State University.** Staff validate that the **LOI** includes all data required by the Massachusetts Board of Higher Education. Staff recommendation is for BHE authorization for the Commissioner to review the program pursuant to the Fast Track review protocol.

Form A1: LOI Undergraduate Program Curriculum Outline

Required (Core) Courses in the Major (Total # courses required = 18)		
Course Number	Course Title	Credit Hours
MATH 105	Calculus 1	4
MATH 106	Calculus 2	4
MATH 201	Calculus 3	4
MATH 218	Linear Algebra	3
MATH 220	Discrete Structures	3
MATH 340	Mathematical Statistics I	3
MATH 333	Applied Statistics and Experimental Design	3
CAIS 117	Introduction to Computer Programming	3
CAIS 217	Python II	3
CAIS 230	Data Structures/Algorithms Analysis	4
CAIS 236	Computer Organization and Architectures	4
CAIS 310	Database Management	3
CAIS 240	Software Engineering	3
CAIS 311	Data Mining	3
CAIS 350	Artificial Intelligence	3
DATA 3XX	Machine Learning	3
MATH 113 or CAIS 105	Introduction to Data Science	3
DATA 3xx	Data Science Capstone	3
	Sub Total Required Credits	59

Elective Courses (Total # courses required = 10) *(attach list of choices if needed)*		
CAIS XXX	Select CAIS elective	3
MATH XXX	Select MATH Elective	3
XXXX xxx	General Electives	23

	Sub Total Elective Credits	29
Distribution of General Education Requirements (Total # courses required = 10) Attach List of General Education Offerings (Course Numbers, Titles, and Credits). See Common Core of Studies attached below. MATH 105 & 106, which are part of the major requirement, also satisfy the general education requirements of the University, and are not counted here.		32
Mathematics and the Natural and Physical Sciences These subjects are included as part of the major requirements (8 credits with MATH 105 & 106) and the general education requirements (7 credits with two science courses: see Common Core of Studies attached below for course details.), and hence, are not counted here.		0
	Sub Total General Education Credits	32
Curriculum Summary		
Total number of courses required for the degree	38	
Total credit hours required for degree	120	
Prerequisite, Concentration or Other Requirements:		

Form B: LOI Goals and Objectives

Goal	Measurable Objective	Strategy for Achievement	Timetable
Provide students with solid theoretical knowledge of math, statistics and computer science.	• Use mathematics, statistics, data analysis, and computer science to solve and analyze real-world data science problems.	Lectures, interactive labs, problem sets in MATH 105 106 201 218 220	Yrs. 1&2
Train students to develop relevant programming abilities and execute statistical analyses with Python, R, SQL and other popular software.	• Create and use computer programs to solve real-world problems. • Apply common machine learning algorithms in practice and implementing their own. • Execute statistical analyses with professional statistical software like R/Python.	Lectures, interactive labs, problem sets in CAIS 117 217 230 MATH 333	Yrs. 1&2&3
Equip students with the ability to build and assess statistical models.	• Create models using appropriate statistical methods. • Analyze statistical and computational models in applied settings.	Lectures, interactive labs, problem sets in "Introduction to data science", MATH 333 340	Yrs. 1&2&3
Train students to design, use and build a relational database.	• Demonstrate proficiency with statistical analysis of real-world data sets. • Manage data in a relational database.	Lectures, interactive labs, problem sets in CAIS 310 MATH 333	Yrs. 2&3
Train students to design and develop computer information systems in real world environment.	• Use appropriately system design notations. • Apply system design engineering process in order to design, plan, and implement software systems.	Lectures, interactive labs, problem sets in CAIS 250 236	Yrs. 2&3
Equip students with the ability to solve practical problems with data science and present their solutions effectively.	• Apply data science tools in a variety of contexts and communicate these works professionally.	Take all the core courses in the DS program i.e., the capstone project	Yrs. 3&4

Form C: LOI Program Enrollment

	Year 1	Year 2	Year 3	Year 4	Year 5
New Full-Time	25	30	30	30	30
Continuing Full-Time	0	25	55	85	115
New Part-Time	2	2	5	5	5
Continuing Part-Time	0	2	4	9	13
Totals	27	59	94	129	163

Form D: LOI Program Budget

One Time/ Start Up Costs						
		Annual Enrollment				
	Cost Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Full Time Faculty *(Salary & Fringe)*			110,500	110,500	110,500
	Part Time/Adjunct Faculty *(Salary & Fringe)*		6,935		13,869	13,869
	Staff			15,000	15,000	15,000
	General Administrative Costs	500	500	1000	1000	1000
	Instructional Materials, Library Acquisitions	1,000	1,000	1,000	1,000	1,000
	Facilities/Space/Equipment	95,000				
	Field & Clinical Resources					
	Marketing	9,000				
	Other (Specify) software licenses					
One Time/Start-Up Support			***Annual Income***			

	Revenue Sources	Year 1	Year 2	Year 3	Year 4	Year 5
	Grants					
	Tuition	24, 250	53,350	82,450	111,550	116,400
	Fees	254,225	559,295	864,365	1,169,435	1,220,280
	Departmental					
	Reallocated Funds					
	Other (specify) CGCE part-time tuition (assuming 4 c.h/year)	7,920	15,840	35,640	55,440	71,280
	TOTALS	$286,395	$628,485	$982,455	$1,336,425	$1,407,960