Agendum
Oakland University
Board of Trustees Formal Session
February 2, 2024

Bachelor of Science in Data Science
A Recommendation

1. **Division and Department:** Academic Affairs, School of Engineering and Computer Science, Department of Computer Science and Engineering.

2. **Introduction:** Oakland University proposes a new Bachelor of Science degree in Data Science. The new major expands upon the strength of the existing major in computer science in the Department of Computer Science and Engineering. Its distinguishing features include: (1) the curriculum of the program satisfies the latest accreditation criteria of ABET for data science; (2) the program is consistent with the 2021 recommendation of the ACM Data Science Task Force on competencies for undergraduate data science curricula; (3) the program shares many courses with the computer science program, enabling data science students to complete a second major in computer science by adding just one extra semester to their four-year course plan; and (4) the program allows students to complete the degree in data science with a specialization in artificial intelligence in four years, the first such a program in Michigan.

The demand for education in the area of data science has intensified in recent years due to the exponential increase of structured and unstructured data generated by global society and our aspirations to take advantage of such data to improve numerous aspects of our lives. The U.S. Bureau of Labor Statistics anticipates a nationwide surge of 35.8 percent in data science job opportunities over the next decade, the sixth-highest rate of expansion among all professions, accompanied by a median annual wage of $101,000 for data scientists in 2021. The proposed program has been developed to meet this rising demand and is expected to provide opportunities for growth, particularly in the context of declining enrollment.

3. **Previous Board Action:** None.

4. **Budget Implications:** The primary source of funding for the program will be undergraduate tuition. The program is expected to generate a net income for the university from its first year of operation. Tuition revenue is expected to reach a steady state with 65 students in the fifth year of the program's operation. Salary expenses include a full-time faculty member and a graduate assistant. Operating expenses include library and marketing. The proforma budget is included as Attachment B.

5. **Educational Implications:** The proposed program aims to introduce five new courses in data science within the Computer Science and Engineering Department. These newly developed courses will enhance the department's programs in computer science, information technology, cybersecurity, and artificial intelligence by providing students with additional elective choices.

6. **Personnel Implications:** To manage the anticipated teaching load arising from the introduction of the new courses, the program will necessitate the hiring of a full-time faculty member at the assistant professor level starting from the second year of its operation. Additionally, annual hiring of a graduate assistant will be essential to supervise the labs for two of the new courses.

7. **University Reviews/Approvals:** The proposed program has been reviewed by the School of Engineering and Computer Science Faculty Assembly, the University Committee on Undergraduate Education, the Oakland University Senate, and the Executive Vice President for Academic Affairs and Provost.

8. **Recommendation:**

WHEREAS, the Bachelor of Science in Data Science degree program is consistent with the objectives contained in Oakland University's Institutional Priorities; and

WHEREAS, the Bachelor of Science in Data Science degree program will build on the academic and research strengths in the Department of Computer Science and Engineering and provide new educational and community engagement opportunities in the field of data science; now, therefore, be it

RESOLVED, that the Board of Trustees authorizes the School of Engineering and Computer Science to offer the Bachelor of Science in Data Science; and, be it further

RESOLVED, that the Executive Vice President for Academic Affairs and Provost will complete annual reviews of the Bachelor of Science in Data Science degree program to evaluate academic quality and fiscal viability to determine whether the program should continue.

9. **Attachments:**

A. Proposal for the Bachelor of Science in Data Science degree program.
B. Proforma budget for the Bachelor of Science in Data Science degree program.

Submitted to the President
on 1/29, 2024 by

Britt Rios-Ellis, M.S., Ph.D.
Executive Vice President for
Academic Affairs and Provost

Recommended on 1/29, 2024
to the Board for Approval by

Ora Hirsch Pescovitz, M.D.
President

Reviewed by

Joshua D. Merchant, Ph.D.
Chief of Staff and
Secretary to the Board of Trustees

Attachment A

Proposal
for a Bachelor of Science Degree in
Data Science

Department of Computer Science and Engineering
School of Engineering and Computer Science
Oakland University

Approvals

Department of Computer Science and Engineering Data Science Program Committee
Approved: November 11, 2022

Department of Computer Science and Engineering Undergraduate Affairs Committee
Approved: December 2, 2022

Department of Computer Science and Engineering Faculty
Approved: January 6, 2023

School of Engineering and Computer Science Undergraduate Curriculum Committee
Approved: January 9, 2023

School of Engineering and Computer Science Faculty Assembly
Approved: January 20, 2023

University Committee on Undergraduate Instruction
Submitted: January 20, 2023; Approved: April 4, 2023

University Senate
Approved: November 16, 2023

TABLE OF CONTENTS

Proposal for a Bachelor of Science Degree in Data Science

Department of Computer Science and Engineering
School of Engineering and Computer Science
Oakland University

ABSTRACT

The Department of Computer Science and Engineering in the School of Engineering and Computer Science proposes a new major: Bachelor of Science in Data Science. The new major expands upon the strength of the existing major in computer science in the department and has the following distinguishing features: (1) the curriculum of the program satisfies the latest accreditation criteria of ABET for data science; (2) the program is consistent with the 2021 recommendation of the ACM Data Science Task Force on competencies for undergraduate data science curricula; (3) the program shares many courses with the computer science program which facilitates data science students to complete the computer science as a second major by adding one extra semester to their four-year course plan; and (4) the program allows students to complete the degree in data science with a specialization in artificial intelligence—the first such a program in Michigan—which requires no more than 128 credit hours of coursework.

The demand for education in the area of data science has increased many times in recent years, driven by the exponential increase of structured and unstructured data generated by the global society and our aspirations to take advantage of such data to improve numerous aspects of our lives. To this end, we are required to capture, curate, and analyze such data and prescribe actions based on the insights gained. In accomplishing these tasks, data scientists utilize a unique combination of expertise in quantitative analysis and computing techniques including programming, algorithms and applications development, database integration, data modeling, data mining, data visualization, and big data processing using large-scale computer systems. The U.S. Bureau of Labor Statistics projects a nationwide growth of 35.8 percent in data science jobs over the next decade—the sixth highest growth rate over all professions—and reports a median 2021 annual wage of $101,000 for data scientists. The proposed program has been developed to meet this growing demand for data scientists. The major is also expected to offer potential for growth in the context of declining enrollment.

1 RATIONALE

The winner of the 1998 Turing Award and pioneering computer scientist James Gray introduced his vision for data-intensive science as a fourth paradigm of discovery as an addition to the well-established empirical, theoretical, and computational sciences.[1] For the discovery to happen in this new frontier of science, we require appropriate tools and techniques as well as trained professionals to work with data. Data science is considered as a new field of study even though some of the specialized knowledge and technical expertise possessed by data scientists have been in use for a long time. Because of the increasing role that data scientists are playing in enterprises, the U.S. Bureau of Labor Statistics (BLS) has taken the lead to define the profession as follows:

> "Develop and implement a set of techniques or analytics applications to transform raw data into meaningful information using data-oriented programming languages and visualization software. Apply data mining, data modeling, natural language processing, and machine learning to extract and analyze information from large structured and unstructured datasets. Visualize, interpret, and report data findings. May create dynamic data reports."*
>
> *Data Scientists: Occupational Employment and Wage Statistics, BLS, May 2021, https://www.bls.gov/oes/current/oes152051.htm. Accessed on January 10, 2023.

It is believed that Thomas Redman, the author of *Getting in Front on Data: Who Does What* once said "where there is data smoke, there is business fire." Netflix is one of the prime examples of modern enterprises that managed to harness the power of data for its business advantages. In fact, Netflix generates $1 billion a year in value using big data.[2] As the auto capital of the world, Michigan has the potential to lead all kinds of innovations in monetizing vehicle data which is projected to generate $450 to $750 billion in revenue worldwide by 2030.[3] The global data science software applications market is expected to grow from about $5 billion in 2020 to $80 billion by 2030 which represents over 30 percent compound annual growth.[4] Similarly, the global big data analytics market size is projected to grow from $271 billion in 2022 to $655 billion in 2029.[5] All these indicate that the demand for professionals with the right kind of expertise to work with data will also continue to grow for the foreseeable future.

---

[1]The ACM Turing Award given annually by the Association for Computing Machinery is often referred to as the "Nobel Prize of Computer Science." More on Dr. Gray's fourth paradigm in science can be found in: T. Hey, S. Tansley, and K. Tolle, eds., *The Fourth Paradigm: Data-Intensive Scientific Discovery*, Microsoft Research, October 2009.

[2]How Netflix Uses Big Data to Drive Success, Dataconomy, https://tinyurl.com/netflix-big-data. Accessed on January 7, 2023.

[3]Monetizing Car Data, McKinsey & Company, https://tinyurl.com/monetizing-auto-data. Accessed on January 7, 2023.

[4]Global Data Science Platform Market Forecast 2020-2030, Allied Market Research, https://tinyurl.com/platform-market. Accessed on January 7, 2023.

[5]Big Data Analytics Market Forecast 2022-2029, Fortune Business Insights, https://tinyurl.com/big-data-forecast. Accessed on January 7, 2023.

1.1 Program Need

The surge of interest in data science is attributed to the exponential increase of structured and unstructured data generated by the global society. In 2023, the world is expected to produce 1.2×10^{11} terabytes of data or 15 terabytes per person on average.[6] This data generation is projected to grow at a compound annual rate of 21 percent in subsequent years. The role of a data scientist is to apply quantitative and computational techniques to this raw data in order to extract actionable information. Deciding which data is important, analyzing even a tiny fraction of the new and existing data, and recommending solutions based on insights gained from it, to meet various evolving business requirements and societal needs are going to be an enormous challenge in the next decade. As society becomes more technologically advanced and enterprises gather more data, the immediate benefits of applying data science grow as well. Data science is already indispensable in finance, healthcare, and logistics, just to name a few, and its prevalence is expected to only increase.

Data science has proven to be one of the most desirable career paths in recent years. The job aggregator Glassdoor has ranked data scientists among the top three *Best Jobs in America* each year since 2016.[7] Glassdoor lists over 10,000 data science job openings in USA with a median annual base salary of $120,000. This includes over 400 data science jobs in the metro Detroit area.[8] Indeed.com has listed 23,500 and Dice.com has listed 31,000 data science jobs nationally.[9,10] The Occupational Outlook Handbook published by the BLS reports a median 2021 annual wage of $101,000 for data scientists and projects a nationwide growth of 35.8 percent in data science jobs over the next decade, the sixth highest growth rate over all professions and an increase of 40,500 positions.[11] As per the BLS, about 13,500 openings for data scientists are projected each year, on average, over the next decade, and the typical entry-level requirement for data science jobs is a bachelor's degree with no relevant work experience.[12]

Although a relatively new area of study, data scientists are often better compensated than those working in other computing fields. The compensation solution vendor Payscale reports an entry-level base median salary of $86,000 for data scientists compared to $70,000 for computer

[6] High Data Growth and Modern Applications Drive New Storage Requirements in Digitally Transformed Enterprises, IDC White Paper, https://tinyurl.com/data-growth. Accessed on January 7, 2023.

[7] Best Jobs in America for 2022, Glassdoor, https://tinyurl.com/best-jobs. Accessed on September 8, 2022.

[8] Data Science Jobs: Metro Detroit Area, Glassdoor, https://tinyurl.com/detroit-ds-jobs. Accessed on September 8, 2022.

[9] Data Science Jobs, Indeed.com, https://www.indeed.com/q-data-science-jobs.html. Accessed on January 8, 2023.

[10] Data Scientist Jobs, Dice.com, https://www.dice.com/jobs/q-Data+Scientist-jobs. Accessed on January 18, 2023.

[11] Fastest Growing Occupations, BLS, https://tinyurl.com/fastest-growing-occupations. Accessed on September 8, 2022.

[12] Data Scientists, BLS, https://tinyurl.com/bls-data-scientists. Accessed on September 8, 2022.

scientists.[13,14] After one to four years of experience, Payscale reports that salaries for data scientists rise to $97,000 compared to $77,000 for the computer scientists, and this trend continues to favor data scientists across all experience ranges. Over 30 percent of the recent data science job postings are listed as "remote" which offers numerous advantages including higher pay than non-remote positions.[15,16]

Students select Oakland University (OU) because of its outstanding academic programs, dedicated faculty, and excellent facilities, just to name a few. In addition, the university is located at the heart of a major population center which makes college education easily accessible to many. In particular, Oakland and Macomb counties account for 21.4 percent of Michigan population and OU receives over 75 percent of its students from these two counties. Presently, eight Michigan public universities are offering undergraduate-level programs in data science but none of them are in this geographic area. In other words, over 21 percent Michigan residents have to send their students out of this population center to get an undergraduate education in data science from a public university. Research shows that 25 and 57 percent students enroll in colleges within 23 and 50 miles, respectively, from their permanent home.[17,18] This implies that many students from Oakland and Macomb counties will not study data science as undergraduates simply because of lack of access to such opportunities. Among the public universities, the University of Michigan-Dearborn (UM-D) is the closest to Oakland and Macomb counties that offers a data science undergraduate program. However, Table 1 shows that the primary service area of UM-D is outside Oakland and Macomb counties. This has created an opportunity for OU to offer an undergraduate program in data science as well as serve our community as a public university.

Because of the importance of data science as an area of study and the significant impact it can have on our economy and society in general, the Computing Accreditation Commission of ABET has recently developed criteria for accreditation of data science programs. Data science is one of the five baccalaureate-level programs that are accredited by the commission at present, and two of such accredited programs are currently offered by the Computer Science and Engineering (CSE) Department at OU. Similarly, Association for Computing Machinery (ACM) has also published

---

[13]Data Scientist Salary, Payscale, https://tinyurl.com/ds-salary. Accessed on October 22, 2022.

[14]Computer Scientists Salary, Payscale, https://tinyurl.com/salary-for-cs. Accessed on October 22, 2022.

[15]Best Remote Tech Jobs for 2023, *Computerworld*, https://tinyurl.com/remote-techjobs. Accessed on January 12, 2023.

[16]Remote Hiring Brings Jobs and Higher Pay to Small and Medium Cities Across the US, Gusto, https://tinyurl.com/higher-pay. Accessed on January 12, 2023.

[17]Student Choice of College: How Far Do Students Go for an Education? *Journal of College Admission*, 2009, https://eric.ed.gov/?id=EJ838811. Accessed on January 17, 2023.

[18]N. Hillman and T. Weichman, Education Deserts: The Continued Significance of "Place" in the Twenty-First Century, American Council on Education, 2016, https://tinyurl.com/within-50-miles. Accessed on January 17, 2023.

Table 1: Source of students (Fall 2022).*,†

	Oakland County	Macomb County	Wayne County	Other
Oakland University (All)	42.4%	35.8%	7.6%	14.2%
Oakland University (SECS)	44.3%	42.0%	4.8%	8.9%
University of Michigan-Dearborn (All)	11.6%	4.3%	56.6%	27.5%

*All Enrolled Student Profile: Enrollment Map, https://tinyurl.com/ou-student-profile. Accessed on January 18, 2023.
†A Look at Fall 2022 Enrollment, https://tinyurl.com/umd-fall2022. Accessed on January 18, 2023.

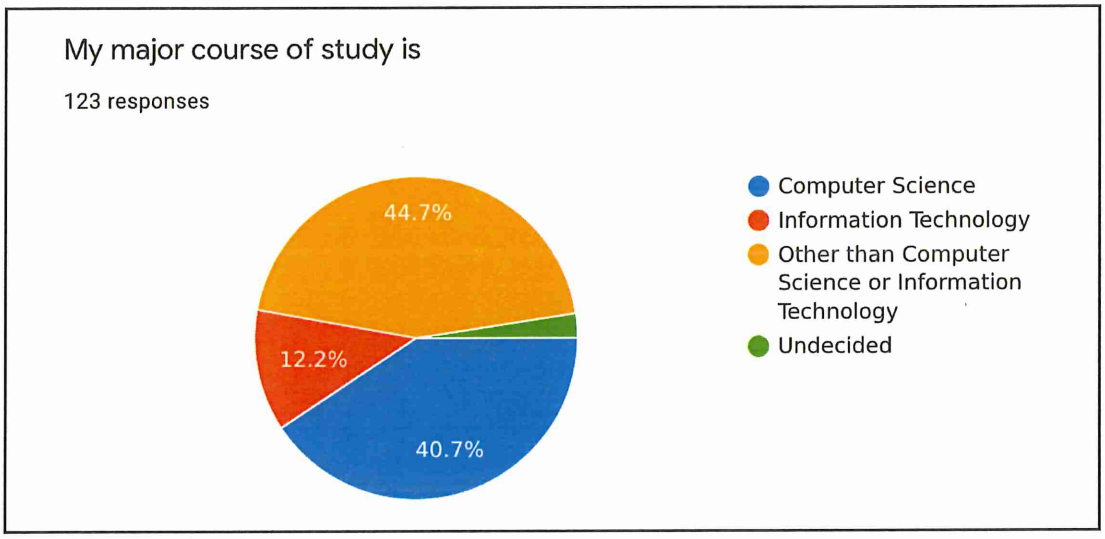


Figure 1: Distribution of responding students by major.

its Data Science Task Force report in 2021 on the recommended competencies for undergraduate data science curricula. It should be noted that there is a perfect harmony between the definition of data science proposed by the BLS—as quoted on Page 5—and the curricula recommended by the ABET and ACM.

To gather information on interests of students on a data science major, we invited students who have taken at least one course offered by the CSE Department to take an online survey in Fall 2021. It was completed by 123 students. The survey results (Figures 1–6) strongly support the creation of: (1) a major in data science in the School of Engineering and Computer Science (SECS), (2) a major in data science with a specialization in artificial intelligence (AI), and (3) opportunities that allow students to add data science as a second major.

A careful look to the data gathered from the survey shows that 51 out of 123 or 41.5 percent

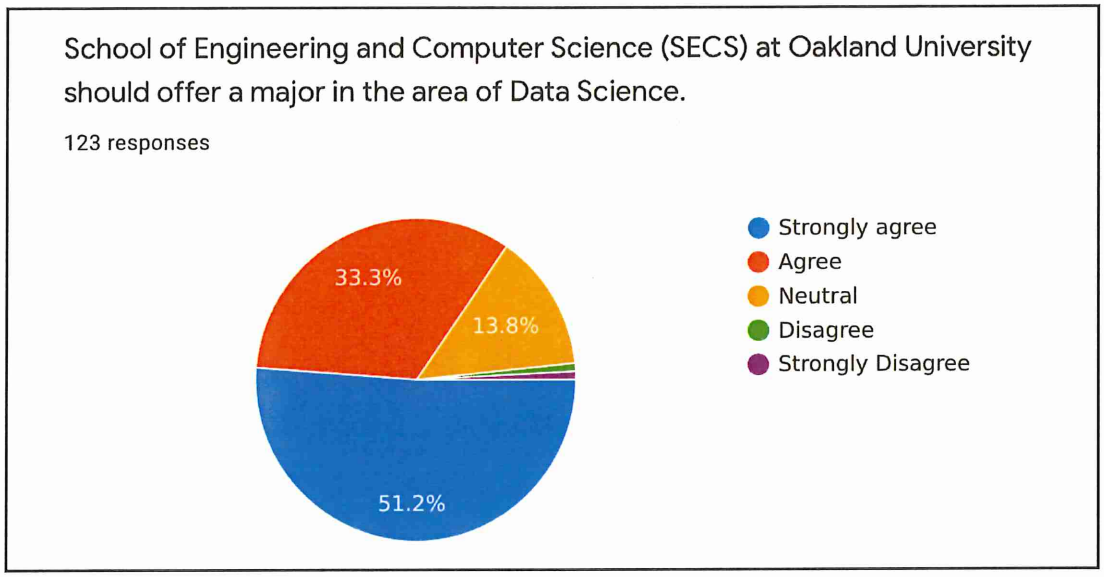


Figure 2: Favorability of data science as a major in SECS.

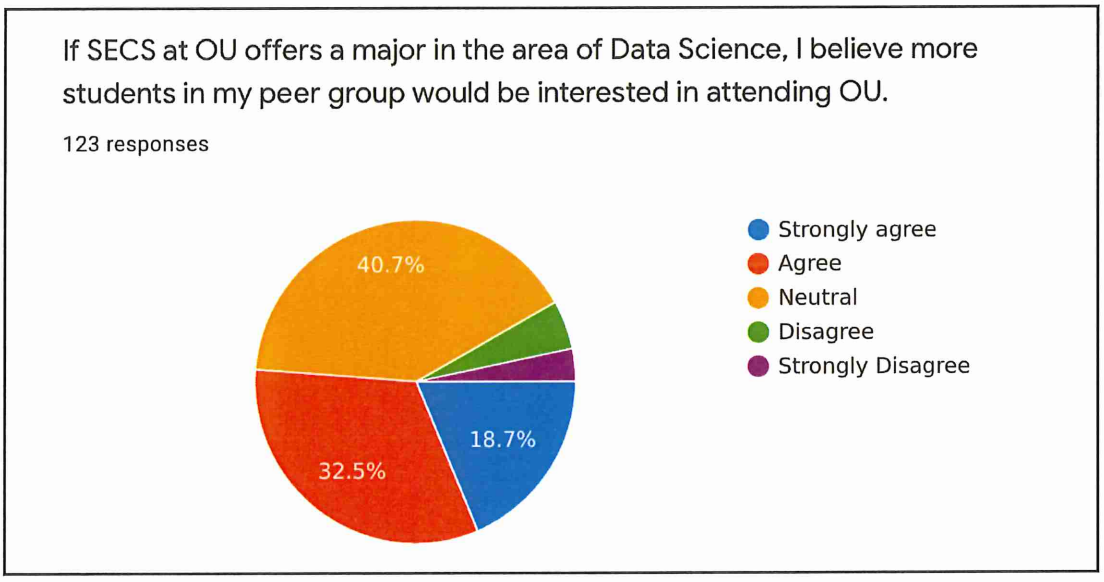


Figure 3: Anticipated potential of a data science major in attracting students to Oakland University.

of responders to the survey were computer science students. Thirty out of 51 or 58.8 percent of computer science students have expressed interest in adding data science as a second major. Sixteen out of 51 or 31.4 percent of computer science students have expressed interest in changing their major to data science. Thirty-three out of 51 or 64.7 percent of computer science students have expressed interest in changing their major to data science with a specialization in AI. These results reveal that computer science students are highly interested in a program in data science.

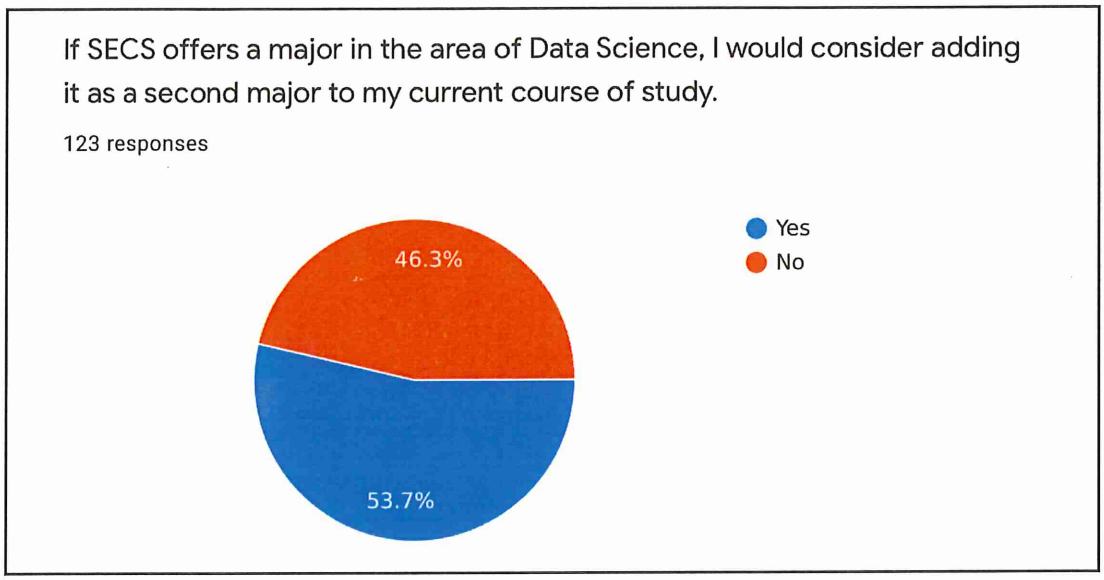


Figure 4: Interest in adding data science as a second major.

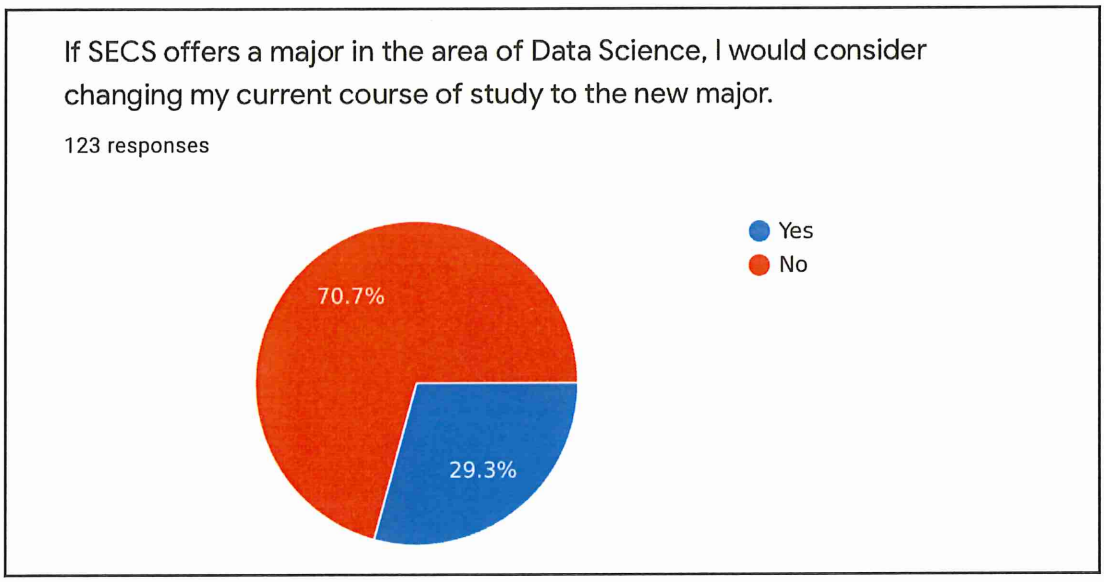


Figure 5: Interest in changing to data science major.

The huge interest in data science, particularly with a specialization in AI, is also supported by a 2019 Gartner survey of more than 3,000 Chief Information Officers which found that 37 percent of enterprises were applying AI in some form, up from the 25 percent found in the previous

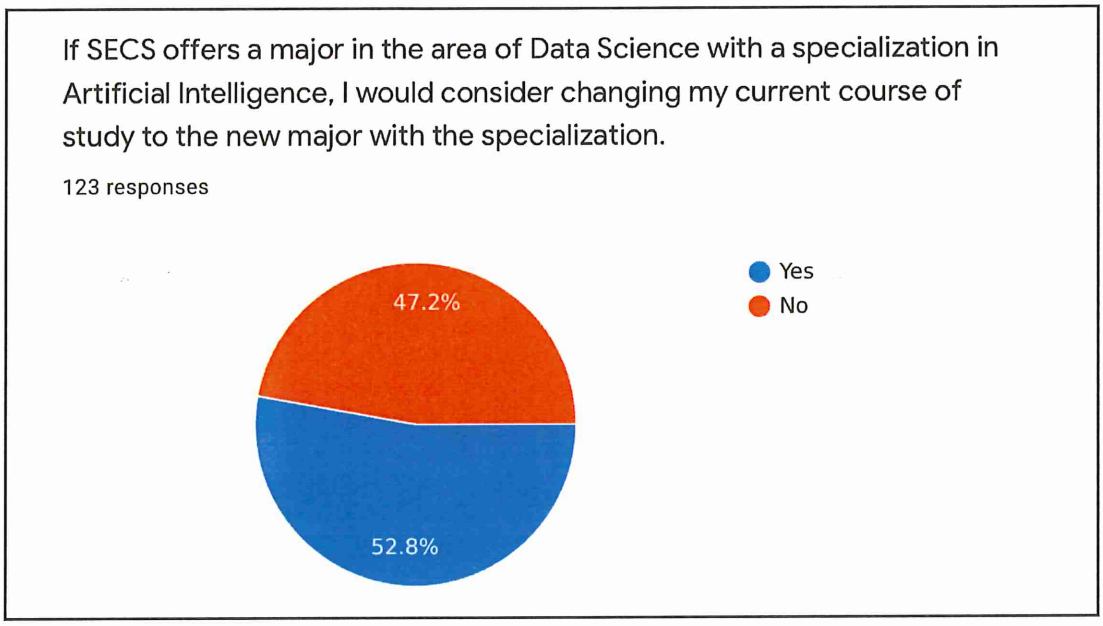


Figure 6: Interest in changing to data science major with a specialization in AI.

year's survey.[19] A data science program with an AI specialization—the first such a program in Michigan—will be a powerful draw for prospective data scientists.

During the discussions with the industry leaders and advisory board members, we have found a strong support for the proposed program. The support letters (Appendix H) from the key industries also demonstrate the importance of programs in data science. Some of the excerpts from these letters are provided here. Sanjay Khunger, Head of Smart Connected Mobility at Cognizant has indicated that they "faced major challenges to hire" qualified "data scientists in the last few years." Ali Husain, Director of Software Research and AI at Ford Motor Company has stated that the proposed program "is really addressing critical needs for the automotive industry especially in data analysis, cloud data science, and data ethics." William Lambertson, Vice President of Cloud, 5G and Edge at IBM is "impressed by the quality of the program as it is structured" to meet the "industry needs in this critical area." Sami Ben Romdhane, Vice President and Fellow of Platform Architecture and Data Infrastructure at eBay has expressed delight at the proposed program's "great matching with the needs of the industry." Li Yong, Data Science Manager at DTE Energy is "glad that the department is proposing this new program to help" the industry to find "talents in this very important areas." Karim Beguir, CEO at InstaDeep™ would like to be an active partner

[19]Gartner survey shows 37 percent of organizations have implemented AI in some form, https://tinyurl.com/ai-growth. Accessed on September 19, 2022.

"with the department to grow this critical program for the industry as there is a huge shortage" of talents in this area.

1.2 How the Program will Help Promote the Role and Mission of the University

The proposed Bachelor of Science degree with a major in data science will help Oakland University (OU) fulfill its overall mission and vision. In just the past several years, data science has already become well-established as a field of study. Data science is currently transforming many industries, including the automotive sector[20] which contributes over $225 billion annually to our state's economy. An undergraduate data science program will greatly increase the university's educational impact both in Michigan and beyond.

Creating a data science major is also consistent with the stated mission of the SECS which seeks to "prepare graduates for careers in the coming decades," that can be fulfilled by a program in data science. It is expected that the economy will only become further driven by data at every level—local, national, and global—and the proposed program will educate undergraduates to be capable of fulfilling the needs of the broad spectrum of industries where data science is applicable.

1.3 Program Goals

The primary objective of the proposed program is to prepare its graduates for a successful career as a data scientist. The program curriculum requires a unique combination of quantitative analysis and computer science topics that are generally not found in any other single field of study. It will prepare graduates with sufficient technical strength and a comprehensive understanding of data science landscape. This will be accomplished by using multiple distinct components of the program.

The program will reflect the OU philosophy of education, and students will receive a broad general education appropriate for a data science program. To begin with, it requires an extensive mathematical and statistical foundations. The students will then master the theoretical foundations and computing tools and techniques necessary for the profession of data science. Students will be required to choose an application area to which knowledge of data science can be applied. Each student will take courses relevant to their chosen application area, culminating in a senior capstone project where they apply their technical knowledge to solve a real-world problem while working with highly qualified faculty. The program also aims to develop skills in teamwork, ethics, and professional communication.

[20]Big Data and Analytics in the Automotive Industry, Deloitte, https://tinyurl.com/big-data-in-auto. Accessed on January 7, 2023.

Table 2: Comparison universities (Michigan institutions).

Michigan Institution	First Program Year	Credit Hours	Degree Offered	Minor Offered	MS Offered	Specialization	Capstone	Application Area (AA) or Specialization
University of Michigan	2015-2016	128	BS, Data Science	No	Yes	No	Yes	Requires 3 credit AA
Western Michigan University	2015-2016	122	BS, Data Science	Yes	Yes	No	Yes	Requires no AA
University of Michigan-Dearborn	2017-2018	120	BS, Data Science	No	Yes	No	Yes	Requires 18 credit AA
Eastern Michigan University	2017-2018	124	BS, Data Science and Analytics	No	No	Yes	Yes	Requires 12-15 credit AA
Michigan State University	2019-2020	120	BS, Data Science	Yes	Yes	Yes	Yes	Requires no AA
Andrews University	2019-2020	124	BS, Data Science	Yes	No	No	No	Requires 12-18 credit AA
Calvin University	2019-2020	124	BS, Data Science	Yes	No	No	Yes	Requires no AA
Lawrence Technological University	2021-2022	125	BS, Data Science	No	No	No	Yes	Requires no AA
Lake Superior State University	2022-2023	124	BS, Data Science	No	No	Yes	Yes	Requires 30-36 credit specialization
Central Michigan University	2022-2023	120	BS, Data Science	No	No	No	Yes	Requires 24-28 credit minor
Northern Michigan University	2022-2023	120	BS, Data Science	Yes	No	No	No	Requires no AA
Oakland University (Proposed)	2024-2025	128	BS, Data Science	No	No	Yes	Yes	Requires 8 credit AA

In addition, the data science program is expected to help increase enrollment, create more visibility for the department and the university, increase the participation of undergraduate students in research and hands-on projects, and stimulate additional interactions with the local industry. It is also expected that the program will further enhance the department's successful programs in computer science and information technology, particularly by making additional elective courses available for all students.

1.4 Comparison to Similar Programs

Table 2 summarizes a set of undergraduate data science or similar programs offered by the Michigan institutions. In addition, University of Michigan offers a B.S.E. in Data Science and Michigan State University offers a B.S. in Computational Data Science. More than half of the programs in Michigan have started on or after the 2019-2020 academic year, highlighting the significant recent growth in demand for undergraduate education in data science. Table 3 summarizes a selection of data science programs offered by the out-of-state institutions where a similar trend is also evident.

In general, the courses in a data science program can be categorized into five groups: general education, mathematics and science, computer science background, application area, and data science professional subjects. While many programs have similar mathematics and computer

Table 3: Comparison universities (out-of-state institutions).

Out-of-State Institution	First Program Year	Credit Hours	Degree Offered	Minor Offered	MS Offered	Specialization	Capstone	Application Area (AA) or Specialization
Purdue University	2017-2018	120	BS, Data Science	No	Yes	No	Yes	Requires no AA
Penn State University	2017-2018	124	BS, Data Sciences	No	No	Yes	Yes	Requires 12 credit AA
Colorado State University	2018-2019	120	BS, Data Science	Yes	Yes	Yes	Yes	Requires 20-29 credit specialization
Iowa State University	2018-2019	120	BS, Data Science	Yes	No	No	Yes	Requires 9 credit AA
University of North Dakota	2018-2019	124	BS, Data Science	No	Yes	No	Yes	Requires 6 credit AA
University of Utah	2019-2020	122	BS, Data Science	No	Yes	No	Yes	Requires 9 credit AA
The University of Texas at Dallas	2019-2020	120	BS, Data Science	No	No	No	Yes	Requires no AA
University of Wisconsin-Madison	2020-2021	120	BS, Data Science	No	Yes	No	No	Requires no AA
University of Minnesota-Twin Cities	2020-2021	120	BS, Data Science	No	Yes	No	Yes	Requires no AA
University of Arkansas	2020-2021	120	BS, Data Science	Yes	No	No	Yes	Requires 20-21 credit AA

science background, there are significant variations in the number of required data science and application area credits, reflecting differing amounts of emphasis placed upon different areas. Within the data science core curriculum, most programs require courses which specifically apply the popular Python and R programming languages. This is also true for the proposed program at OU.

The proposed program is distinguished from other Michigan programs in a few ways. First, it requires a sophomore project and no other program in Michigan offers such an experience. Second, the proposed program offers a specialization in AI—a highly sought-after specialization within data science as indicated by the student survey (Figure 6). Only three Michigan data science programs offer a specialization or concentration of any kind, and none of them offers one in AI. In addition, the proposed program has been developed to meet the accreditation requirements of ABET. However, the same cannot be said for almost half of the Michigan programs. For example, the programs that do not require any application area courses cannot meet ABET accreditation requirements.

Because many computer science students have expressed interest in double majoring in data science, we have created a nine-semester 149-credit hours course plan to satisfy the requirements of both majors.

Table 4: Credit comparison of data science programs.

Institution	First Program Year	Gen. Ed.	Req. Math/Sci	DS Found.	Req. DS Prof.	DS Prof. Elec.	Appl. Area	Capstone	Free Elec.	Req. credits for degree
University of Michigan (CoE)*†	2015-2016	16	35	12	28	15	3	4	15	128
University of Michigan-Dearborn*	2017-2018	20	36	12	27	4	18	3	0	120
Penn State University*	2017-2018	21	28	16	22	6	12	3	15	123
Colorado State University*#	2018-2019	19	26	16	10	18	27	4	0	120
Iowa State University	2018-2019	21	38	16	16	0	9	3	17	120
University of North Dakota*	2018-2019	24	23	26	24	15	6	6	0	124
University of Utah*	2019-2020	24	20	17	27	9	9	3	13	122
Michigan State University (CoE)*†	2019-2020	20	38	16	18	12	0	4	12	120
The University of Texas at Dallas	2019-2020	27	35	10	24	14	0	4	6	120
University of Minnesota-Twin Cities	2020-2021	23	42	12	21	18	0	4	0	120
University of Arkansas*	2020-2021	27	20	26	18	0	20	5	4	120
Lawrence Technological University	2021-2022	21	32	26	28	12	0	6	0	125
Oakland University* (Proposed)	2024-2025	28	28	18	30	12	8	4	0	128

*Covers ethics in data science. †CoE: College of Engineering. #Economics concentration.

Comparison of Program Requirements

Table 4 compares the degree requirements of a selection of data science (DS) programs examined earlier in this section. Courses are placed under different categories.[21] Only programs that require

[21] *General Education:* The minimum number of credits needed to satisfy general education requirements. However, if a course is required by a DS program also counts towards a general education requirement, its credits are not counted as part of the general education category.

Required Mathematics and Science: All required courses both at lower- and upper-division under mathematics, statistics, and science rubrics are included in this category. The only exceptions are courses within these rubrics which primarily apply the R programming language; such courses are counted as DS foundations or DS professional courses depending on their course level.

DS Foundations: Required courses at the 1000- and 2000-level which teach programming and other foundational computer science skills required for data scientists are included in this category. These courses are often under a computer science rubric, but a course under another rubric is also counted under this category if its primary focus is programming or computer science. For example, a 2000-level statistics course on R programming would be counted under this category.

Required DS Professional: Upper-division required courses that are not counted under mathematics and science category are counted under this category. If a DS program requires a technical writing course, it is counted under this category. Senior capstone project courses are not counted under this category because they are counted in their own category.

at least 80 credits to satisfy all the requirements except general education and free electives are included in the table.

2 Academic Unit

The Computer Science and Engineering (CSE) Department within the School of Engineering and Computer Science (SECS) currently offers four bachelor's and four master's programs, as well as a Ph.D. program. Our well-established B.S. programs in Computer Science and Information Technology are accredited by ABET. Recently, we have launched B.S. programs in Artificial Intelligence and Cybersecurity in Fall 2023. Our master's offerings comprise M.S. programs in Computer Science, Software Engineering and Information Technology, Cybersecurity, and Artificial Intelligence. Additionally, the Ph.D. program is in Computer Science and Informatics. The department actively participates in the school-wide Ph.D. program in Systems Engineering.

Currently, the department has proposed a B.S. program in Software Engineering, which is under review at the school faculty assembly as part of our shared governance process. The department is currently composed of 24 full-time faculty members and is supported by a full-time administrative assistant.

The department has long maintained a healthy enrollment in its two undergraduate programs. Figure 7 shows Fall semester enrollment headcounts for the computer science (CS) and information technology (IT) majors from 2015 to 2022. Figure 8 shows analogous data for Winter semesters.[22] Figure 9 shows the number of degrees awarded in the CS and IT majors over the past 10 academic years.

DS Professional Electives: Upper-division elective courses relevant to the major which may include mathematics, statistics, or computer science courses are counted under this category. The listed credit number reflects a DS program's explicit minimum requirement for such upper-division electives.

Application Area: If a program requires a student to take courses from an area so that the student gains a better understanding of how data science could be applied to that area, those courses are counted under this category. The listed credit number reflects the number of credits most students will require to satisfy a DS program's application area requirement.

Capstone: If a program requires one or more senior project courses, the credits for those courses are counted under this category.

Free Electives: Once all program requirements have been met, both for the major and general education, a student may not have reached the university's undergraduate degree credit requirement. In that case, further required coursework is classified as free electives.

[22]Starting with the Fall 2020 semester, headcount for the CS program shown in Figures 7 and 8 includes students with both CS and pre-CS designations. Similarly, IT headcount includes students with both IT and pre-IT designations.

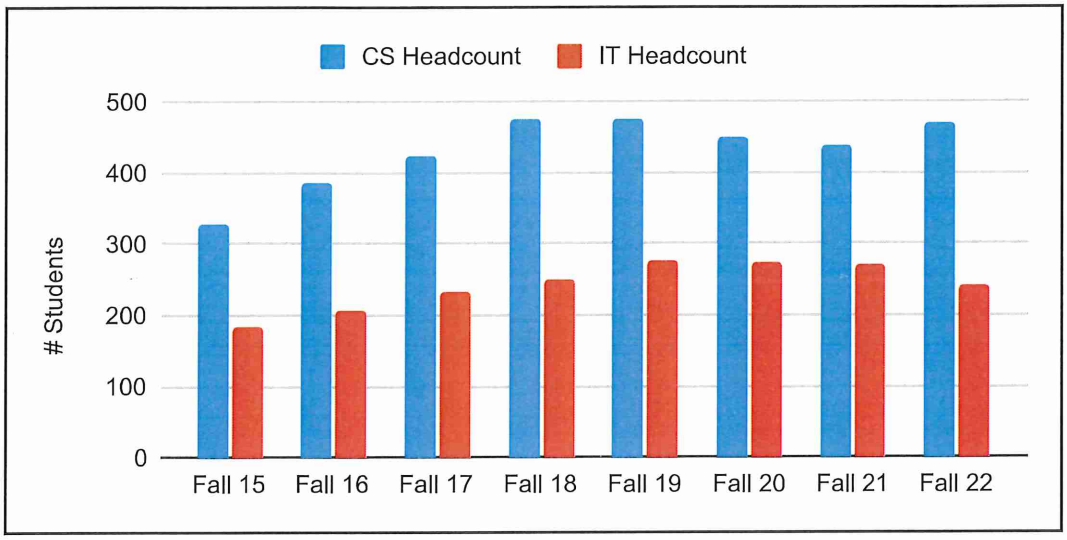


Figure 7: Fall enrollment in CS and IT majors in recent years.

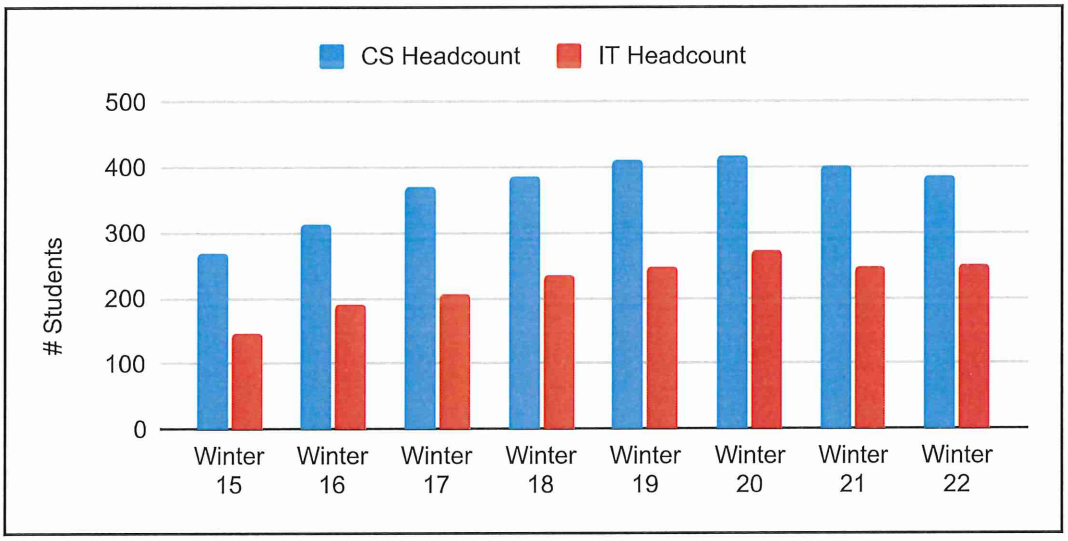


Figure 8: Winter enrollment in CS and IT majors in recent years.

2.1 How the Goals of the Unit are Served by the Program

The program is consistent with the goals of the department and school to prepare graduates for careers in the coming years as well as to serve the needs of Michigan industry. The program will make OU an attractive choice for prospective data scientists. It is expected that the program will help strengthen the department's collaborations and interactions with local industry and faculty on campus from other units. The projected growth in data science jobs is expected to ensure that the program will increase enrollment of the department.

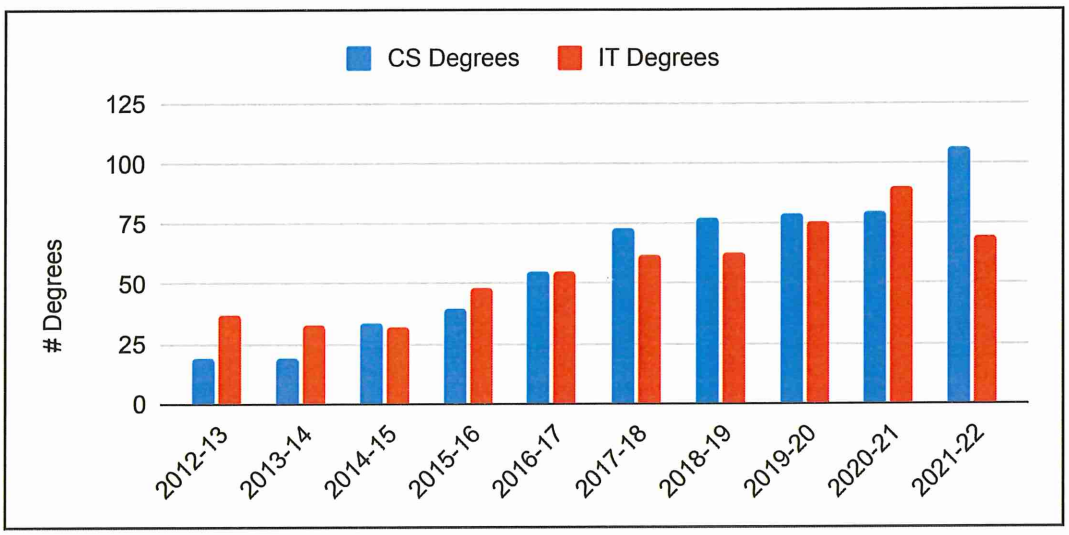


Figure 9: B.S. degrees awarded in CS and IT in recent academic years.

2.2 Staffing Needs

CSE Department will be required to create five new courses to support the curriculum of the proposed new program as outlined later in Section 3.2. To meet the expected teaching load resulting from the introduction of the new courses, the program will require support of a full-time faculty at the assistant professor level from the second year of its operation. To determine the staffing needs, an analysis of the teaching load for the first five years of the program's operation is provided later in Section 4.1. Support for a graduate teaching assistant will also be required every year to supervise the labs for two of the new courses.

2.3 Faculty Qualifications

The current faculty members of the department have the required expertise to teach all courses for the new program. The department currently has 24 full-time faculty members, and each of them is holding a Ph.D. degree. Please visit the department's homepage at https://cse.secs.oakland.edu/ for teaching and research interests of the faculty.

2.4 Impact on Current Programs

We anticipate a significant number of CS students to add DS as a second major, and vice versa. A nine-semester 149-credit hours course plan for such a double major is presented in Appendix C. Data from the University of Wisconsin-Madison (UW-M) and University of Michigan-Dearborn (UM-D) show that such a double major is a popular choice. Forty percent data science students at

UW-M also selected computer science major or certificate as an additional field of study.[23] Also, UM-D has as many students in the DS program as it has in the dual degree program in DS and Computer and Information Science.[24]

A slight decline in enrollment in the CS program is probable at the beginning because many CS students have expressed interests in the new major. Since DS programs are often small—usually 5 to 15 percent of the CS programs when two programs at the same campus are compared—we expect that the decrease in enrollment in the CS program to be minimal. We, however, anticipate any decrease in enrollment in the CS program to be offset by the additional course credits that will be generated from the CS students selecting DS as a second major. We believe that the proposed program will have no impact on the enrollment of the IT program because the two programs cater to slightly different student populations.

In the long run, we expect the new major to help grow all the programs in the department by the increased synergy created by the new program and new elective courses available to the students. Such was the case after the introduction of the IT program. Figure 10 shows Fall semester enrollment in the CS and IT majors after the IT program was introduced. The data shows that the IT program did not have a long-term adverse effect on CS enrollment. In fact, the combined enrollment of the two programs almost doubled from 169 in 2005 to 329 in 2012 and followed a consistent upward trajectory.

3 Program Plan

3.1 Admissions Requirements

To be admitted to the proposed new program, applicants will have to meet both OU and SECS admissions requirements.

OU Admissions Requirements

Freshman admission to OU is based on a combination of criteria. In short, a cumulative high school grade point averages (GPA) of 3.2 or above is required. Applicants with cumulative GPA below 3.2, but above 2.5, may be admitted after consideration of the quality of academic preparation. Admission criteria for transfer students depends on how many credits they have already earned from another institution at the time of application: (a) for 24 or more college

[23]New Data Science Degree Emerges as the Fastest Growing Major at UW-Madison, University of Wisconsin-Madison, July 2021, https://tinyurl.com/uw-madison-growth. Accessed on January 7, 2023.

[24]Enrollment Data and Degrees Awarded, University of Michigan-Dearborn, https://tinyurl.com/umd-enrollment. Accessed on January 7, 2023.

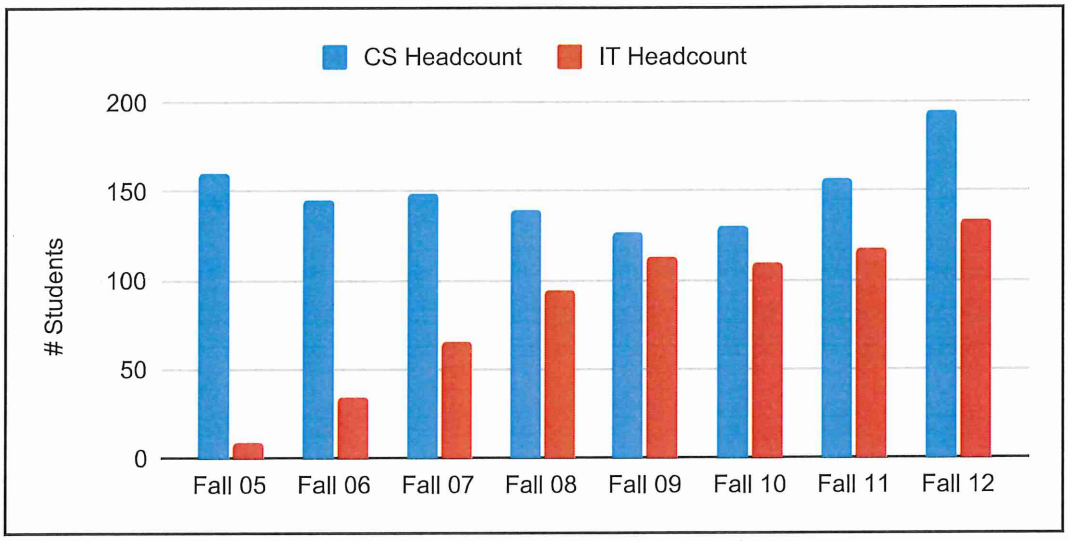


Figure 10: Fall enrollment in CS and IT majors immediately after introduction of the IT program.

credits, GPA of at least 2.5 and positive grade trends will be considered for admission; and (b) for fewer than 24 college credits, admission will be based on both college and high school records. A detailed guidelines of the requirements for admission is provided at the Undergraduate Admissions website (https://oakland.edu/futurestudents). Figure 11 shows a simplified view of academic paths students will take to become a data science major.

SECS Admissions Requirements

A high school GPA of minimum 3.0 is required for admission into the SECS programs. High school students admitted to OU who wish to join the data science program but whose GPA is below 3.0 will be designated as an EGR/CS Candidate Major and will be required to follow the internal transfer policy. Similarly, non-SECS majors and students with undecided status will also be able to change their status to EGR/CS Candidate Major and follow the internal transfer policy to become a data science major.

Internal Transfer Policy

EGR/CS Candidate Majors must complete MTH 1554 with a C or better to join the data science program.

Transfer Policy

The programs offered by the SECS are designed to meet accreditation criteria, as well as to reflect the OU philosophy of education. To ensure the integrity of its programs, the SECS has adopted the

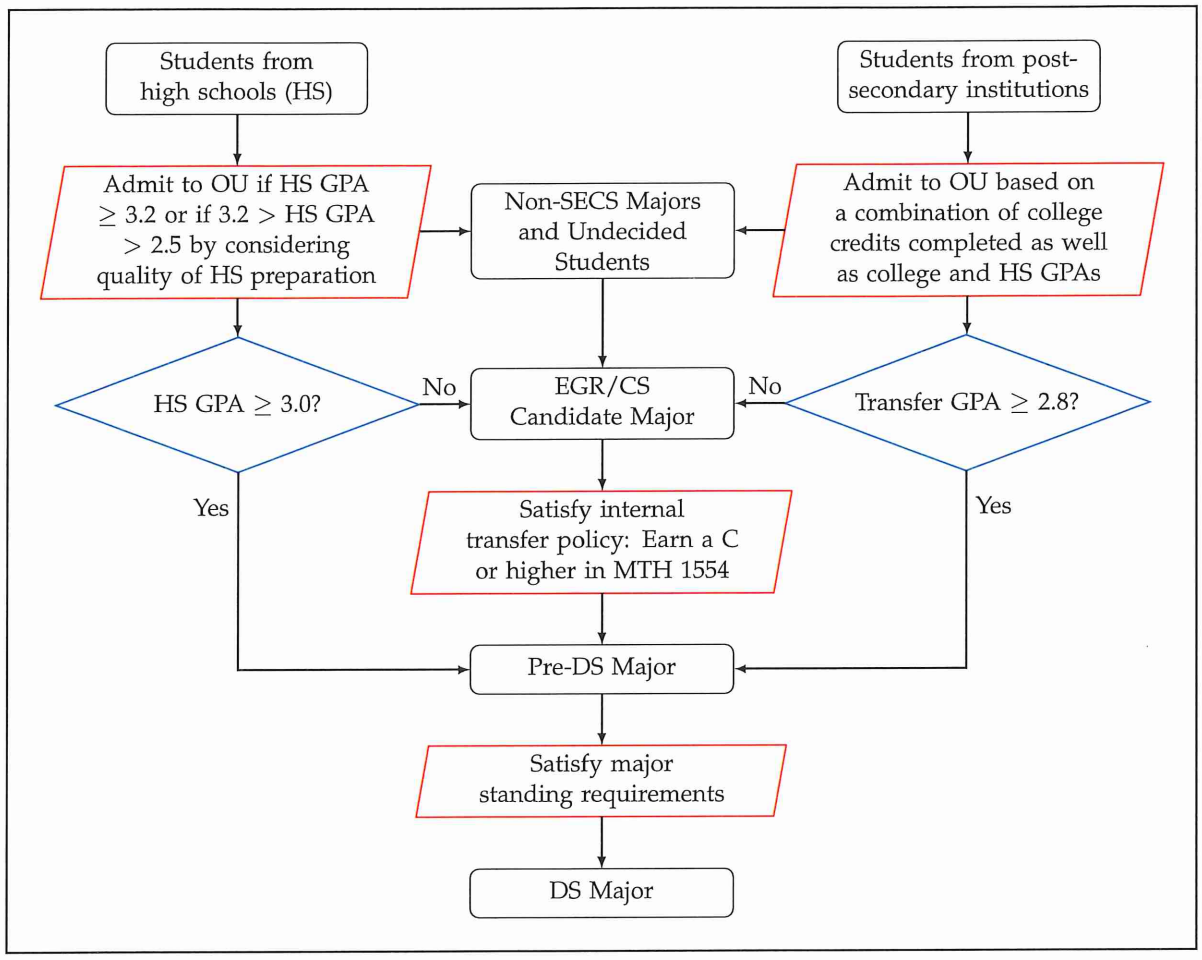


Figure 11: A simplified view of academic paths for data science majors.

following transfer policy. Records of students transferring to OU from other academic institutions are evaluated and transfer credit is granted as appropriate. Staff members from the Office of the Registrar regularly work with the SECS faculty to make sure that the students can easily transfer equivalent SECS courses to OU from other institutions. Students must have a transfer GPA of 2.8 or greater in order to transfer into the SECS programs. Transfer students admitted to OU who wish to join the data science program but whose transfer GPA is below 2.8 will be designated as an EGR/CS Candidate Major and will be required to follow the internal transfer policy outlined above to change to the data science major. To make the transfer experience as smooth and rewarding as possible, OU does not limit the amount of transfer credits from other institutions. All data science students will be required to complete CSI 4990 (Data Science Capstone) at OU, and an analysis of the proposed curriculum shows that over two-thirds of the credit hours for the program can be transferred from other institutions (Page 29).

3.2 Overview of Curriculum

To earn the Bachelor of Science degree with a major in data science, students must complete a minimum of 128 credits and meet the following requirements.[25]

General Education

The General Education Requirements are comprised of three parts: Foundations, Explorations, and Integration. In addition, U.S. Diversity and Writing Intensive requirements must also be met. For details, refer to the General Education section of the catalog. In order to satisfy both general education and other program requirements, in some of the general education areas students should select from the courses listed below.

Foundations

- Writing Foundations
- Formal Reasoning **(satisfied by MTH 1554; see Mathematics and Statistics)**

Explorations: One course from each of the following seven areas

- Arts
- Foreign Language and Culture
- Global Perspective
  ECN 2020 will satisfy the Global Perspective General Education requirement and act as a prerequisite for students pursuing the Economics Application Area.
- Literature
- Natural Science and Technology **(satisfied by Approved Science Elective)**
  BIO 1200 will satisfy the Natural Science and Technology General Education requirement and act as a prerequisite for students pursuing the Genomics Application Area.
- Social Science
  PS 1100 will satisfy the Social Science General Education requirement and act as a prerequisite for students pursuing the Politics Application Area.
  ECN 2010 will satisfy the Social Science General Education requirement and act as a prerequisite for students pursuing the Economics or Risk Management Application Areas.
- Western Civilization **(satisfied by PHL 1310; see Additional Major Requirements)**

[25] It is expected that most students will complete 28 credits of general education, 24 credits of mathematics and statistics, 4 credits of approved science elective, 18 credits of data science core, 34 credits of professional courses, 12 credits of professional elective courses, and 8 credits of application area courses.

Integration

- Knowledge Applications **(satisfied by MTH 1555; see Mathematics and Statistics)**

U.S. Diversity

- May be met by an approved course in the Explorations area.

Capstone and Writing Intensive

- Capstone **(satisfied by CSI 4990; see Professional Courses)**
- Writing Intensive in the Major **(satisfied by CSI 4990; see Professional Courses)**
- Writing Intensive in General Education **(satisfied by an approved course in the Explorations area)**

Additional Major Requirements

All data science students must complete the following requirement. The course also satisfies the Western Civilization General Education requirement.

- Professional Ethics: PHL 1310 - Introduction to Ethics in Science and Engineering (4)

MATHEMATICS AND STATISTICS

- MTH 1554 - Calculus I (4) **(satisfies Formal Reasoning)**
- MTH 1555 - Calculus II (4) **(satisfies Knowledge Applications)**
- MTH 2775 - Linear Algebra (4)
- APM 2663 - Discrete Mathematics (4)
- STA 2226 - Applied Probability and Statistics (4)
- STA 4002 - Applied Linear Models I (4) or STA 4111 - Statistical Methods in Data Science (4)

APPROVED SCIENCE ELECTIVE

Take one of the following: BIO 1200, BIO 1300, BIO 3000, (CHM 1440 and CHM 1470), CHM 3000, ENV 3080, HS 2000, LIN 1182, PHY 1060, PHY 1200, or (PHY 1510 and PHY 1100). **(satisfies Natural Science and Technology)**

Data Science Core

- CSI 1320 - Introduction to Python Programming and Unix (4)
- CSI 2300 - Object Oriented Computing (4)
- CSI 2310 - Data Structures (4)
- CSI 2810 - Introduction to Data Science in Python (4) **[New CSE Course]**
- CSI 2999 - Sophomore Project (2)

Professional Courses

- CSI 3450 - Database Design and Implementation (4)
- CSI 3480 - Security and Privacy in Computing (4)
- CSI 3610 - Design and Analysis of Algorithms (4)
- CSI 3820 - Data Visualization (3) **[New CSE Course]**
- CSI 3860 - Contemporary Issues in Data Science (3) **[New CSE Course]**
- CSI 4810 - Information Retrieval and Knowledge Discovery (4)
- CSI 4820 - Big Data Analysis with Cloud Computing (4) **[New CSE Course]**
- STA 4840 - Introduction to R for Data Science (4)
- CSI 4990 - Data Science Capstone (4) **[New CSE Course] (satisfies General Education Capstone and Writing Intensive in the Major)**

Professional Elective Courses

Students must complete three professional elective courses. At least two of them must be from Group A. Any remaining course can be from Group A or Group B.

Group A

- CSI 3370 - Software Engineering and Practice (4)
- CSI 4130 - Artificial Intelligence (4)
- CSI 4140 - Deep Learning and Applications (4)
- CSI 4170 - Machine Learning (4)
- CSI 4180 - Natural Language Processing (4)
- CSI 4240 - Cloud Computing (4)
- CSI 4450 - Database System I (4)
- CSI 4780 - Bioinformatics (4)
- ISE 4435 - Data Analytics (4)

Table 5: Sample four-year data science schedule.

Semester 1 (16 credits)	**Semester 2 (16 credits)**
CSI 1320 - Introduction to Python Programming and Unix (4)	CSI 2300 - Object Oriented Programming (4)
MTH 1554 - Calculus I (4)	MTH 1555 - Calculus II (4)
General education (4)	General education (4)
General education (4)	General education (4)
Semester 3 (16 credits)	**Semester 4 (18 credits)**
APM 2663 - Discrete Mathematics (4)	CSI 2310 - Data Structures (4)
CSI 2810 - Introduction to Data Science in Python (4)	CSI 2999 - Sophomore Project (2)
Approved science elective (4)	MTH 2775 - Linear Algebra (4)
General education (4)	STA 2226 - Applied Probability and Statistics (4)
	General education (4)
Semester 5 (15 credits)	**Semester 6 (15 credits)**
CSI 3450 - Database Design and Implementation (4)	CSI 3820 - Data Visualization (3)
CSI 3610 - Design and Analysis of Algorithms (4)	CSI 3480 - Security and Privacy in Computing (4)
CSI 3860 - Contemporary Issues in Data Science (3)	STA 4111 - Statistical Methods in Data Science (4)
General education (4)	Application area course (4)
Semester 7 (16 credits)	**Semester 8 (16 credits)**
STA 4840 - Introduction to R for Data Science (4)	CSI 4810 - Information Retrieval and Knowledge Discovery (4)
Application area course (4)	CSI 4820 - Big Data Analysis with Cloud Computing (4)
Professional elective course (4)	CSI 4990 - Data Science Capstone (4)
Professional elective course (4)	Professional elective course (4)

Group B

- Any CSI or STA designated course numbered 3000 or higher.

Application Area Courses

Students are required to take two courses from an area in which knowledge of data science can be applied, and the application area courses should be completed before taking CSI 4990 (Data Science Capstone). At most one of the courses used to satisfy the application area requirement may also be used to meet the general education requirement. The application area courses need not to be from a single rubric or department but together they should provide a context for data science activities. A list of application area courses is provided in Appendix B. If students are interested in selecting the application area courses from outside the provided list, they are advised to work with a faculty adviser from the Department of Computer Science and Engineering to get the application area courses approved before taking such courses. General Elective credits may be needed to meet the 128 credits required depending on chosen Application Area.

Table 5 shows a sample four-year schedule meeting the requirements of the proposed data science program. The descriptions of the new courses which would be introduced as part of

Table 6: Data science skills and course category that provides such skills.

Data Science Skills	Required Courses	Electives Courses
Agile Software Development		✓
Algorithm Development	✓	
Artificial Intelligence		✓
Big Data Analytics	✓	
Bioinformatics		✓
Cloud Computing		✓
Data Analysis	✓	
Data Ethics and Governance	✓	
Data Mining	✓	
Data Modeling	✓	
Data Visualization	✓	
Deep Learning		✓
Java	✓	
Machine Learning		✓
Natural Language Processing		✓
NoSQL Database		✓
Privacy and Security	✓	
Python	✓	
R	✓	
SQL	✓	
Statistical Analysis	✓	

the proposed program are included in Appendix A. The descriptions of the existing courses are available in the current undergraduate catalog.

Data Science Skill Set

Table 6 lists a set of skills for data scientists and how such skills are provided by the proposed curriculum using the required and electives courses. In addition to the skill set provided by the required courses, a student can gain expertise in up to four different areas by using the elective courses to align their training at OU with their professional goals and market demands.[26] The students also have the flexibility to select an upper division or graduate-level course from statistics or computer science to augment their expertise in a particular area.

[26]The salary information for the data scientists with the skill set provided by the proposed program is available online: Data Scientist Salaries by Skill, Payscale, https://tinyurl.com/ds-skills. Accessed on October 27, 2022.

Data Science and Computer Science Double Major

Double major in DS and CS is a popular combination and an excellent educational opportunity for ambitious students. As presented in Section 1.1, 58.8 percent CS students have expressed an interest in adding DS as a second major in the survey that we have conducted in Fall 2021. With this in mind, we have explored ways to complete the double major in an effective manner. Appendix C presents a detail analysis, and Table 11 shows a sample nine-semester 149-credit hours course schedule satisfying the requirements of both majors.

Data Science with a Specialization in Artificial Intelligence

More than half of the students in the survey have also expressed an interest in a data science program with a specialization in artificial intelligence (Figure 6). We have developed such a specialization which requires no more than 128 credit hours of coursework. The catalog wordings for the AI specialization in data science program is provided in Appendix D. It should be noted that the AI specialization in data science program aligns with the recently approved AI specialization in computer science program which has already appeared in the 2023-2024 undergraduate catalog.

Similarities and Differences Between Data Science and Computer Science Majors

The following discussion is based on the computer science curriculum from the 2023-2024 catalog and the data science curriculum presented at the beginning of this section.

The following courses are required by the DS program but not by the CS program.

- CSI 2810 - Introduction to Data Science in Python (4)
- CSI 3820 - Data Visualization (3)
- CSI 3860 - Contemporary Issues in Data Science (3)
- CSI 4810 - Information Retrieval and Knowledge Discovery (4)
- CSI 4820 - Big Data Analysis with Cloud Computing (4)
- STA 4840 - Introduction to R for Data Science (4)
- STA 4002 - Applied Linear Models I (4) or STA 4111 - Statistical Methods in Data Science (4)
- Two courses from an application area (8)

The following courses are required by the CS program but not by the DS program.

- CSI 2470 - Introduction to Computer Networks (4)

- CSI 3370 - Software Engineering and Practice (4)
- CSI 3430 - Theory of Computation (4)
- CSI 3640 - Computer Organization (4)
- CSI 4350 - Programming Languages (4)
- CSI 4500 - Fundamentals of Operating Systems (4)
- CSI 4650 - Parallel and Distributed Computing (4)

The following are some other similarities and differences between the two programs.

- DS program requires CSI 1320 (Introduction to Python Programming and Unix) while CS program requires CSI 1420 (Introduction to C Programming and Unix).
- DS program requires CSI 4990 (Data Science Capstone) while CS program requires CSI 4999 (Senior Capstone Project).
- CS program requires 9 credits of science coursework with at least 1 credit of science lab while while DS program requires 4 credits of science coursework and no science lab.

The students of both programs are required to take the following common courses.

- MTH 1554 - Calculus I (4)
- MTH 1555 - Calculus II (4)
- MTH 2775 - Linear Algebra (4)
- APM 2663 - Discrete Mathematics (4)
- STA 2226 - Applied Probability and Statistics (4)
- CSI 2300 - Object-Oriented Computing (4)
- CSI 2310 - Data Structures (4)
- CSI 2999 - Sophomore Project (2)
- CSI 3450 - Database Design and Implementation (4)
- CSI 3480 - Security and Privacy in Computing (4)
- CSI 3610 - Design and Analysis of Algorithm (4)

Both programs require 28 credits of general education in addition to the general education courses that are part of the major requirements. Most of the required professional courses of the CS program can be used as professional electives of the DS program, and vice versa.

Use of Transfer Courses to Meet the Program Requirements

Following a longstanding tradition of OU, transfer students—particularly from community colleges—often bring a significant number of credits to satisfy the requirements of the CS and IT programs. The curriculum of the proposed program also have the same flexibility. We have a well-established process in place to facilitate transfer credits from numerous institutions including local community colleges to satisfy the requirements of a set of courses offered by the CSE Department. We expect students to transfer some of the following six courses to meet the proposed program requirements.[27]

- CSI 1320 - Introduction to Python Programming and Unix (4)
- CSI 2300 - Object-Oriented Computing (4)
- CSI 2310 - Data Structures (4)
- CSI 3370 - Software Engineering and Practice (4)
- CSI 3450 - Database Design and Implementation (4)
- CSI 3610 - Design and Analysis of Algorithm (4)

All but one mathematics and science course and all the general education courses for the proposed program can also be satisfied by using transfer courses from the community colleges. The procedures for such transfer of courses have also been in place at OU for a long time. In addition, the application area requirement can be satisfied by many different courses listed in Appendix B. Students also have an option to propose new application areas for approval. Therefore, the application area offers an increased flexibility in using transfer courses.

In summary, it would be possible to transfer up to 28 credits of general education, 24 credits of mathematics and science, 12 credits of data science core, 8 credits of professional courses, 8 credits of professional elective courses, and 8 credits of application area courses from community colleges to satisfy the proposed program requirement. Even though students often transfer these courses to OU, it is highly unlikely that many students will bring so many transfer credits applicable for the proposed major. Because of the specialized nature of the upper division courses, there are at least 40 credit hours of coursework which almost all students will complete at OU unless they

[27]Data shows that the courses equivalent to CSI 2300, CSI 2310, CSI 3370, CSI 3450, and CSI 3610 have been accepted by OU on 558, 155, 49, 193, and 17 occasions, respectively, in the most recent four and a half years. CSI 1320 is a new course and has been satisfied by transfer courses 49 times in the most recent eight months. Source: Reuben Ternes, Assistant Director and Lead Data Scientist, Office of Institutional Research, Assessment, and Data Analytics at OU. Personal communications, January 2023.

Table 7: General curriculum requirements of Computing Accreditation Commission of ABET.

Requirements	Satisfied by
1. Techniques, skills, and tools necessary for computing practice	Data science core and professional courses
2. Principles and practices of privacy and security in computing	CSI 3480
3. Local and global impacts of computing solutions on individuals, organizations, and society	CSI 4990
4. Computing solutions that consider the needs of diverse populations	CSI 4990
5. Computing topics to prepare students for a career, further study, and lifelong professional development	Data science core, professional courses, and professional elective courses
6. General education components	University general education courses

transfer from a data science program in another university. As part of the residency requirement, students are required to complete a minimum of 45 credit hours of coursework at OU. Therefore, the proposed program can be considered as one of the most transfer-friendly undergraduate programs.

Accreditation Requirement

In developing the curriculum of the proposed program, we have kept three primary objectives in mind: (1) make the program accreditable; (2) create the least number of new courses; and (3) keep our existing undergraduate-level courses unchanged.

We have followed the accreditation criteria for data science programs published by the Computing Accreditation Commission (CAC) of ABET. ABET is considered as the global gold standard in accreditation of professional technical education and is the most prominent accreditor of programs in computing, engineering, and technology. SECS has seven ABET-accredited undergraduate programs. The computer science and information technology programs are accredited by CAC and the other five programs are accredited by the Engineering Accreditation Commission of ABET. It should be noted that we have followed the data science criteria for the 2022-2023 accreditation cycle which is the latest criteria available during the preparation of this curriculum plan. A mapping of the ABET curriculum requirements to the proposed data science curriculum is presented in Tables 7 and 8. In addition, we have followed the 2021 recommendation of the ACM Data Science Task Force on competencies for undergraduate data science curricula in developing the proposed program.

Experience in working in team settings is part of the ABET student outcomes for any computing and engineering programs. Traditionally, this requirement has been satisfied by the

Table 8: Data science-specific curriculum requirements of ABET.

Requirements	Satisfied by
1. Fundamental data science lifecycle topics	
a) Data acquisition and representativeness	CSI 2810, CSI 4810, and STA 4840
b) Data management	CSI 3450
c) Data preparation and integration	CSI 2810, CSI 4810, and CSI 4820
d) Data analysis	CSI 2810, CSI 3820, CSI 4810, CSI 4820, CSI 4990, and STA 4840
e) Model development and deployment	CSI 4810 and STA 4840
f) Visualization and communication of the knowledge obtained from the data	CSI 3820 and CSI 3860
2. Concepts that span and are applied to the data science lifecycle	
a) Data ethics including legitimate use and algorithmic fairness	CSI 3860
b) Governance including privacy, security, and stewardship	CSI 3480 and CSI 3860
c) Statistics and mathematics including inference, modeling, linear algebra, probability and optimization	MTH 1554, MTH 1555, MTH 2775, APM 2663, STA 2226, STA 4002/4111, STA 4840, and CSI 4810
d) Computing including data structures and algorithms	CSI 1320, CSI 2300, CSI 2310, CSI 3610
3. Advanced data science coursework that provides depth	Professional elective courses
4. Coverage of at least one application domain area to provide a context for data science activities	Application area courses
5. A major project that incorporates an application domain area and that requires integration and application of knowledge and skills acquired in earlier coursework	CSI 4990

SECS programs using capstone courses where students work in a semester-long team project. The proposed program will have to use a different approach for teamwork. The data science capstone projects will build on the application area courses. In a class for capstone course, we might not have more than one student with a background in the same application area. As a result, the data science capstone projects will be mostly done individually instead of in groups. The data science students will gain teamwork experience from CSI 3820 (Data Visualization) and CSI 4820 (Big Data Analysis with Cloud Computing), each of which will have a comprehensive semester-long team project.

3.3 Degree Requirements

To earn the Bachelor of Science degree with a major in Data Science, students must complete a minimum of 128 credits and meet the requirements of general education, mathematics and science, data science core, professional courses, professional elective courses, and application area courses as listed in Section 3.2.

Major Standing

To enroll in 3000- or higher level courses and to become candidates for the degree of Bachelor of Science with a major in Data Science, students must gain major standing. An application for major standing should be submitted prior to intended enrollment in 3000- or higher level courses. Students can obtain the major standing form from the SECS Undergraduate Advising Website. When the application for major standing is approved, students with majors of Pre-Data Science will have their major changed to Data Science. Approval of both a major standing application and change of major to Data Science is required prior to enrolling in any 3000- or higher-level courses.

To gain major standing in Data Science, students must:

A) have an average GPA of 2.0 in the following mathematics and statistics courses: MTH 1554, MTH 1555, and STA 2226.

B) have an average GPA of 2.0 in the following data science core courses: CSI 1320, CSI 2300, CSI 2310, CSI 2810, and CSI 2999.

C) have no more than two grades below C in the courses listed in A and B above.

D) have not attempted any course listed in A and B above more than three times.

E) have not repeated more than three different courses listed in A and B. Courses in which a W (withdrawal) grade is recorded will not be counted.

Conditional major standing may be granted in the semester in which the student will complete requirements A and B above.

Performance Requirements

Satisfactory completion of the program requires an average grade of at least 2.0 within each group: mathematics and statistics, and approved science elective; data science core; professional courses which includes required professional courses, professional elective courses, and application area courses. Within the professional courses at most two different courses may be repeated, a total of three attempts per course is permitted, and at most two grades below C are permitted. A grade of C or better in CSI 4990 (Data Science Capstone) must be received.

3.4 Support of Other Departments and Academic Units

CSE Department has reached an understanding with the Department of Mathematics and Statistics (DMS) regarding the development of two undergraduate programs. To align with the faculty strengths of the respective departments, it has been agreed that the CSE Department will develop a Data Science (DS) program and DMS will develop a program in Quantitative Data Science (QDS). The programs will share a set of existing and new courses offered by the two departments. To support the QDS program, the DMS will develop STA 4111 (Statistical Methods in Data Science) and STA 4840 (Introduction to R for Data Science) and make them available to the DS program. Similarly, to support the DS program, CSE Department will develop CSI 2810 (Introduction to Data Science in Python), CSI 3820 (Data Visualization), and CSI 4820 (Big Data Analysis with Cloud Computing) and make them available to the QDS program. The description of these new courses are provided in Appendix A. PHL 1310 (Introduction to Ethics in Science and Engineering) and ISE 4435 (Data Analytics) are presently offered by the Department of Philosophy and Industrial and Systems Engineering Department, respectively. Pertinent letters of support have been enclosed in Appendix H.

DS students will also take a wide variety of courses as part of their application area requirements. A list of 10 such areas is provided in Appendix B. Based on the projected enrollment in the proposed new program, it is expected that one to three students will take courses from an application area each year on average.

3.5 Source of Students

Due to the high demand for data scientists across many industries in Michigan and throughout the country and prospect for highly compensated jobs, a data science program is expected to attract a significant number of new students who would otherwise not consider attending OU. We anticipate that Oakland and Macomb counties will continue to be the main source of students for the proposed program as is the case for other programs in SECS (Table 1). It is expected that the proposed program will encourage students from leaving our local community for a distant institution to get a data science degree. The new program represents a combination of theory and practice that we expect to appeal many prospective OU students. In addition, many of the SECS students who drop out because they find the current majors not to their liking—for example due to heavy emphasis on theory—are expected to find the new program attractive. The data science program would also be suitable for working professionals from local industries who wish to broaden their careers with expertise in data science.

3.6 Recruiting

One of the important goals of the program is to attract new and highly motivated students to OU. Therefore, we will devote valuable resources for the recruitment. The program will be publicized through open house, summer camps for high school students, mailing brochures to high schools and local industries, and SECS and CSE websites. The department will use multiple social media tools as well as engage with the SECS Outreach Office in an effort to reach high school students. Special efforts will be made to recruit underrepresented minorities by publicizing the program through existing channels of the university such as OU Community Connections, OU-Pontiac Initiative, Detroit Regional Talent Compact, Oakland80 Initiative, and Project Upward Bound College Prep Academy. University Communications and Marketing will be engaged to launch a paid media campaign after approval of the program.

3.7 Expected Enrollment

Although it is challenging to predict the future enrollment in any program, we cite recent enrollment statistics of 17 programs for which we could find data from the publicly available sources to provide some context (Table 9). If we look to the data for some individual institutions, Eastern Michigan University continues to show a slow but steady upward trend in DS enrollment. Western Michigan University appears to have reached a plateau with about 25 DS students. One of the programs at the University of Michigan has doubled its enrollment in the last five years while the enrollment in the other program remains almost the same during the same period. On the other hand, the combined enrollment in the two programs at Michigan State University has grown by 1.65 times during the last two years. As noted in Section 1.1, the BLS projects a nationwide growth of 35.8 percent in DS jobs over the next decade. Therefore, it is conceivable that these institutions will also see a somewhat similar increase in enrollment in the DS programs during the same period.

Programs at the University of Michigan-Dearborn (UM-D) are still growing; in particular, the enrollment in the dual degree program in Computer and Information Science (CIS) and Data Science is showing a significant upward trend. It is noteworthy that the UM-D has an equal number of students in its DS program and dual degree program with DS. Some DS programs have showed a significant growth in recent years. For example, University of Wisconsin-Madison saw its DS program to grow to 2.6 percent of the undergraduate population in just three years. While the statistics presented above might not be repeated by any other programs, we can still try to find some basis for a reasonable prediction of enrollment in the proposed program. In the following we provide four separate analyses as the basis for our expected enrollment.

Table 9: Fall semester undergraduate enrollment.

Institution	First Program Year	Total (2022)	Data Science					
			2017	2018	2019	2020	2021	2022
University of Michigan (CoE)	2015-2016	32,448	55	70	85	102	114	80
University of Michigan (LSA)			76	95	123	130	156	182
Western Michigan University	2015-2016	14,397	16	16	22	24	25	26
University of California, Irvine	2015-2016	28,661	111	106	113	157	178	121
Eastern Michigan University	2017-2018	11,617	3	11	16	20	26	29
University of Michigan-Dearborn (DS)	2017-2018	6,117		19	24	19	28	31
University of Michigan-Dearborn (Dual Degree in DS and CIS)					1	10	19	31
University of North Dakota	2018-2019	9,928		2	8	12	23	33
Iowa State University	2018-2019	25,241			37	49	63	70
Colorado State University	2018-2019	23,794		18	43	76	101	101
Michigan State University (DS)	2019-2020	39,021			19	82	109	161
Michigan State University (CDS)					12	35	29	34
The University of Texas at Dallas	2019-2020	21,467			90	154	187	206
The University of Utah	2020-2021	26,355				21	56	76
University of Arkansas	2020-2021	26,269				9	84	143
University of Wisconsin-Madison	2020-2021	35,184				145	546	915
Georgia College & State University	2022-2023	5,265						15

For the University of Michigan, enrollment data for the DS programs in the College of Engineering (CoE) and College of Literature, Science, and the Arts (LSA) are shown separately. The same is also done for the DS and Computational DS (CDS) programs at the Michigan State University (MSU). For the University of Michigan-Dearborn, enrollment data for the dual degree program in DS and Computer and Information Science (CIS) are presented separately from the DS enrollment. For 2021 and 2022, data for MSU are obtained on February 6, 2023, from the institution's Office of the Registrar.

Analysis A: Out of all the institutions listed in Table 9, UM-D is somewhat comparable to OU. Both are public institutions and located in the suburban Detroit area even though the majority of students come to these institutions are from slightly different geographic regions (Table 1). In Fall 2022, UM-D and OU had 6,117 and 12,841 undergraduate students enrolled, respectively. At the same time, UM-D had 31 students in the DS major and another 31 in the dual degree program in DS and CIS. Because UM-D enrollment data shows an upward trend and the BLS projects a 35.8 percent growth in DS jobs over the next decade, we estimate that DS majors at UM-D will have a 14 percent growth in the next four years resulting in a combined enrollment of 71 students in the two programs. In fact, if UM-D programs continue to grow at the same rate as in the last few years, the combined enrollment will reach over 71 students in just one year. We are cautiously optimistic that the proposed program at OU will also see at least a similar enrollment once it is fully established. It is relevant to note that OU graduates do fairly well in the job market

compared to the graduates of similar institutions. For example, data from the U.S. Department of Education shows that CIS graduates from OU earn more than the graduates of the similar programs at UM-D.[28] We anticipate that similar will also be true for the data science graduates.

Analysis B: As of Fall 2022, UM-D had a total 427 students in the CIS and dual degree with CIS programs. At the same time, it had a total 62 students in its two DS programs as noted earlier. This implies that the ratio of CIS and DS majors at UM-D is 6.89. Using the same ratio for the CS and DS programs at OU, it can be anticipated that the DS major will have 68 students based on 470 students enrolled in the CS program at OU in Fall 2022.

Analysis C: Data for the University of Wisconsin-Madison in Table 9 appear not following the norm. Therefore, we have excluded this data from consideration and conducted an analysis of the remaining data to make another projection.[29] From this analysis, it can be projected that the proposed program will have 73 students at the end of fourth year of its operation.

Analysis D: In Table 9, there are eight DS programs in five Michigan institutions in 2022. Using the same reasoning as used in Analysis C above, it can be projected that the program will have 81 students at the end of fourth year of its operation.[30]

The above four analyses indicate that the proposed program would have 71, 68, 73, and 81 students at the end of fourth year of its operation. Based on this information, we would like to make a projection that it will have about 70 students once it is in full operation in four years' time. If we assume that 15 students will move from other OU programs to the DS program during this period, we can expect 55 new students in the program at the end of its fourth year of operation. This is the enrollment number we have used as the most likely scenario in the *pro forma* budget presented in Appendix F. We anticipate that the program will have 70 and 40 new students after four years of operation in the best-case and worst-case scenarios, respectively.

We are cautiously optimistic that our projection will become true. Our optimism is rooted in facts such as: (1) the quality of the proposed curriculum; (2) the prospect of highly compensated

---

[28]U.S. Department of Education College Scorecard, Salary Comparison of CIS Programs, https://tinyurl.com/ou-umd-cis-salary. Accessed on January 25, 2023.

[29]After exclusion of data for the University of Wisconsin-Madison from Table 9, we have enrollment data for 16 programs from 13 institutions in 2022. These 13 institutions had a total 1,339 students in the DS programs for a total 265,315 undergraduate enrollment. Therefore, 0.50 ($= {}^{1,339}/_{265,315} \times 100$) percent of students of these 16 institutions were pursuing a DS major, on average, in Fall 2022. Based on the BLS projection, we estimate that the institutions will see a 14 ($\approx 35.8 \times {}^{4}/_{10}$) percent growth in the DS enrollment in the next four years. Therefore, we expect 0.57 ($= 0.50 \times 1.14$) percent of the undergraduate students to pursue a DS education in four years in these institutions. We assume that the same will also be true for OU. In Fall 2022, undergraduate enrollment at OU was 12,841, and we assume that OU will have the same enrollment in four years from now. Therefore, it can be projected that the proposed program will have 73 ($\approx$ 0.57 percent of 12,841) students in four years.

[30]Five Michigan institutions in 2022 had a total 574 students in the DS programs for a total 103,600 undergraduate enrollment.

jobs in Metro Detroit area and beyond in the field; (3) over 85 percent of SECS students come from Oakland and Macomb counties that is inhibited by 21.4 percent of Michigan population; and (4) Oakland and Macomb counties are not served by a public university offering an undergraduate program in data science. A reasonable concern in adding any new program is whether it will attract new students or simply divert prospective or existing students from old majors to the new one. As discussed in Section 2.4, we expect the proposed program to help grow all the programs in the department as was the case after the introduction of the IT program in 2005.[31]

3.8 Academic Advising

Professional academic advising at OU plays a crucial role in guiding students towards their academic, career, and personal objectives. Through a constant process of exploration and assessment, advisers help students recognize opportunities, evaluate choices, and understand the impacts of their decisions. They provide continuous support throughout a student's academic journey, leading them towards successful graduation. At the SECS advising office, six full-time advisers work within a caseload model, ensuring that every student is assigned a dedicated academic adviser.

The academic advisers offer crucial educational, procedural, and informational support to both current and prospective students. They possess in-depth knowledge about the university's policies and enrollment requirements, as well as the most effective strategies for students to achieve their educational goals. Students with inquiries regarding degree requirements, transfer credits, academic or major standing, or petitions are encouraged to consult an academic adviser. SECS academic advisors are committed to assist students in reaching their full potential as they pursue their educational and career aspirations.

The OU First-Year Advising staff advises SECS students who enter OU as freshmen. These students can meet with SECS advisers in addition to their First-Year Advisers. By the end of the first year at OU, most SECS students are assigned to their designated SECS Adviser. All transfer students meet with an SECS adviser for a personalized orientation and are advised by their assigned SECS Adviser through graduation. Students are highly recommended to meet with an academic adviser regularly, preferably each semester, to review progress towards their degree.

[31] A review of historical data from Figures 7 and 10 might provide some context to the discussion in this section. First, it is often challenging to predict the enrollment in a new program. When the IT proposal was undergoing review in early 2005, CSE Department projected the program to have 70 students after four years of operation. However, after four years the major had 113 students—a 61 percent higher enrollment than the original estimate. The IT is now a vibrant program with 243 students as of Fall 2022. Second, the CS program has grown from 160 students in Fall 2005 to 470 students in Fall 2022. The department believes the IT program helped grow the CS program, and vice versa.

All SECS students are required to meet with an adviser before approval of their major standing. Advising appointments are available virtually and in person.

SECS Academic Advisers participate in numerous outreach and communication initiatives, including faculty feedback, dropped course reports, non- and under-enrollment related activities, major standing, registration, and graduation audits. The SECS advising staff refers students to faculty mentors for advice on career choices, professional elective courses, research opportunities, graduate program exploration, and other professional issues as needed. The data science program will have an increased level of required faculty advising as students have more flexibility regarding the application area courses. The CSE Program Coordinator and faculty teaching in the data science program will participate in advising the students. The CSE Department will also organize an open discussion forum for data science students and faculty every semester to answer questions, gather feedback, and enhance the communication between the two groups.

4 Needs and Costs of the Program

4.1 New Resources Needed for the Program

We anticipate about 35 percent students of the program to transfer in from other institutions.[32] Most of such students are expected to join the program at the sophomore or junior level. When transfer students are considered with the sample four-year course plan (Table 5), it becomes evident that we will be required to offer the new DS courses a little earlier than how they are laid out in the four-year course plan. This is essential to support transfer students' smooth progression through the program.

The CSE Department will be required to create five new courses to support the curriculum of the new program (Section 3.2), and each of them will be offered once every year. The new courses are as follows:

- CSI 2810 - Introduction to Data Science in Python (4)
- CSI 3820 - Data Visualization (3)
- CSI 3860 - Contemporary Issues in Data Science (3)
- CSI 4820 - Big Data Analysis with Cloud Computing (4)
- CSI 4990 - Data Science Capstone (4)

[32]This estimation is consistent with the profile of recent SECS undergraduate students. Source: OU Office of Institutional Research, Assessment, and Data Analytics, (https://tinyurl.com/ou-new-students). Accessed on January 2, 2023.

Table 10: Plan for offering the new DS courses for the first five years.

Year of Operation	1	2	3	4	5
New DS courses to be offered	CSI 2810	CSI 2810, CSI 3820, CSI 3860	CSI 2810, CSI 3820, CSI 3860, CSI 4820, CSI 4990		
Number of new courses to be taught by the faculty hired for the DS program	--	2	2	4	4
Number of new courses CSE Department will offer using its existing resources	1	1	3	1	1
In addition to lectures, CSI 2810 and CSI 3820 will have weekly lab sessions.					

CSI 4820 will be cross-listed with CSI 5820 which will be incorporated in our graduate programs.

Table 10 summarizes a plan to offer the new courses for the first five years of the program's operation. The program will require support of a new full-time faculty from the second year. In general, newly hired assistant professors in SECS teach two courses per year for the first two years, after which their teaching load becomes four courses per year. The department will utilize its existing faculty resources to offer at least one new course every year. Specifically, the department plans to offer three new courses during the third year of program operation using the existing faculty resources. Support of a graduate teaching assistant will also be required every year to supervise the labs for CSI 2810 and CSI 3820.

Considering the projected small size of the proposed program with 10 to 20 new students joining it every year (Section 3.7) compared to our two other undergraduate programs with the Fall 2022 total enrollment of 713 students (Figure 7), the department will be able to continue supporting our existing courses that DS students will also take. Thus, we expect no additional faculty support to be necessary to manage the extra teaching loads generated by the DS program on our existing courses in the near future.

4.2 Source of New Resources

The program is expected to generate sufficient revenues for self-sufficiency from the beginning.

4.3 Budget and Revenue from the Program

A *pro forma* budget for the program is presented in Appendix F. The program is expected to generate a net income for the university from its first year of operation even in the worst-case scenario.

4.4 Library Holdings

A report on library collection evaluation for the proposed program and its associated budget from Professors Helen Levenson and James E. Van Loon from the University Libraries is presented in Appendix G.

4.5 Classroom, Laboratory, and Space Needs

The program will require classrooms with 30 to 40 seats to run five new courses which will be offered once every year. Existing SECS computer laboratories will be sufficient to run the program. No additional space requirement is anticipated.

4.6 Equipment Needs

Students will use the existing SECS Linux servers and desktop computers that are used by the computer science and information technology students. No other equipment would be necessary for the new program.

5 Implementation Plan and Timeline

The department would like to start the program from Fall 2024. There should not be any logistical problem in this regard because the department currently offers many courses for the proposed program. In addition, the department already has the faculty expertise to develop and teach the new courses required for the program. A timeline for introducing the new courses and faculty hiring is provided in Section 4.1.

6 Program Delivery Method

The program will use the in-person delivery method. Therefore, a meeting with the e-LIS prior to completion of the proposal is not required as per the guidelines for new proposal preparation.

7 Assessment of Student Learning

The SECS has a rigorous assessment process in place that serves the school for its current accreditation requirements by ABET. We plan to use the same process to assess the data science program and seek ABET accreditation. To fulfill the OU assessment requirements, a mapping of the Higher Learning Commission requirements to the ABET requirements is presented in Appendix I.

8 Expected Career Options for Graduates

The data science jobs are found in industry, government, business, and service sectors. Typical job titles for DS graduates include data scientist, data engineer, data architect, big data engineer, data visualization developer, data manager, data analyst, and data administrator. Sectors of the economy that will employ DS graduates include financial services, insurance, automotive, media and entertainment, healthcare, retail, telecommunications, marketing, and cybersecurity.

The graduate study options for DS graduates include pursuing a master's or doctoral level education in data science, computer science, data engineering, artificial intelligence, machine learning, information systems, software engineering, and applied statistics. For example, the DS majors would be able to enroll in our current MS programs in Computer Science, Software Engineering and Information Technology, Cybersecurity, or Artificial Intelligence.

APPENDIX A DESCRIPTION OF NEW COURSES

New Computer Science and Engineering Courses

The CSE Department requires to create the following five new courses including a capstone course as part of the proposed data science program. Three of these courses will also be used by the Quantitative Data Science program in the Department of Mathematics and Statistics as discussed in Section 3.4.

CSI 2810 - Introduction to Data Science in Python (4)
An introductory level overview of data science lifecycle topics including data acquisition, management, preparation, analysis, model development and deployment, and data visualization. Students will gain practical experience by learning and applying libraries and packages that comprise Python data analysis ecosystem. It emphasizes concepts and strategies for writing Python code. With Laboratory. Prerequisite(s): CSI 1320 or CSI 2330.

CSI 3820 - Data Visualization (3)
The course introduces interactive data visualization. Students learn best practices in data visualization and how to design and implement dashboards for use by stakeholders. It provides hands-on experiences using popular visualization software such as Tableau. Students practice data visualization skills in multiple assignments and a comprehensive semester-long team project. With Laboratory. Prerequisite(s): (CSI 1320 or CSI 1420) and major standing.

CSI 3860 - Contemporary Issues in Data Science (3)
The course provides an introduction to the relationship between data, ethics, governance, policy, and society to help students think explicitly about their social responsibilities as data scientists using case studies and examples. The course emphasizes writing, communication, and critical thinking. Prerequisite(s): WRT 1060 with a grade of C or higher and major standing.

CSI 4820 - Big Data Analysis with Cloud Computing (4)
Topics related to storage, management, and analysis of Big Data on cloud platform by introducing technologies like Hadoop with MapReduce, Spark, Pig, and Hive. It also covers modeling and implementation of Big Data using various NoSQL databases such as Key-value, Columnar, Document, and graph-based. It includes a semester-long team project. Prerequisite(s): CSI 2300, CSI 3450, and major standing.

CSI 4990 - Data Science Capstone (4)
The primary objective of this senior project is to apply the technical knowledge gained in the data science curricula to the domain of an application area. In addition to a working demo, written reports and oral presentations are required. It should only be taken after completion of the application area courses. Prerequisite(s): CSI 3450, (CSI 3820 or CSI 4810 or CSI 4820), two courses from an application area,[33] and major standing.

[33] A list of application area courses is provided in Appendix B.

Cross-Listed Computer Science and Engineering Course

CSE Department will create the following course by cross-listing the existing CSI 5450.

CSI 4450 - Database System I (4)

This course introduces the fundamental concepts of NoSQL databases required to effectively manage the data storage and query requirements of modern-day applications in a scalable manner. The course covers the architecture, implementation, and use cases of four major NoSQL database categories: document, key-value stores, column-oriented, and graph. Cross-listed with CSI 5450. Prerequisite(s): major standing.

New Mathematics and Statistics Courses

Department of Mathematics and Statistics will create the following two new courses as part of the Quantitative Data Science program and make the courses available for the Data Science program as discussed in Section 3.4.

STA 4111 - Statistical Methods in Data Science (4)[34]

Linear regression, supervised and unsupervised learning, decision trees, support vector machines, factor-models and principal component analyses, feature screening, resampling methods, time series models, machine learning methods. Prerequisite(s): STA 2226 and MTH 2775.

STA 4840 - Introduction to R for Data Science (4)[35]

The course introduces R and how to use it for data science applications. The goal is to transform data into a format that is amenable to analysis, learn essential R packages for solving data problems, generate hypotheses and test them, use techniques in statistical modeling and analysis, and make predictions. Prerequisite(s): STA 2226.

[34]DS students are required to select either STA 4002 or STA 4111 (Section 3.2). Therefore, only one of them will be sufficient to start the new program. STA 4002 is an existing course which is offered regularly. In case, STA 4111 is not ready in Curriculog™ by the time the proposed program will be required to build in the same system, only STA 4002 will be kept as part of the curriculum and STA 4111 will be removed from the program for the time being. In that case, STA 4111 will be added back to the curriculum once it becomes a regular course.

[35]DS students are required to take STA 4840 (Section 3.2). In case, STA 4840 is not ready in Curriculog™ by the time the proposed program will be required to build in the same system, CSI 4840 (Introduction to R for Data Science - 4 credits) will be created with the same description and prerequisite presented above. In that case, CSI 4840 will replace STA 4840 in the curriculum for the time being, and CSI 4840 will be phased out once STA 4840 becomes a regular course.

APPENDIX B APPLICATION AREAS

The program requires students to take two courses from an application area (Section 3.2). A list of such areas and the courses that will satisfy each of them is provided in the following. If students are interested in selecting the application area courses from outside the provided list, they are advised to work with a faculty adviser from the Department of Computer Science and Engineering to get the application area courses approved before taking such courses.

Advertising

1. PR 2400 - Introduction to Advertising (4)
2. One of:
    - PR 3410 - Advertising Account Planning and Research (4)
    - PR 3420 - Advertising Creative Strategy (4)

Cybercrime

1. CRJ 1100 - Introduction to Criminal Justice (4)
2. CRJ 3341 - Cybercrime (4)

Economics

1. ECN 3020 - Intermediate Macroeconomics (3)
2. One of:
    - ECN 3100 - Economics of the Environment (3)
    - ECN 3260 - International Economic Development (3)
    - ECN 3670 - Economics of Health Care (3)

Prerequisites for the Economics Application Area: ECN 2010 and ECN 2020.

Environment

1. One of:
    - ENV 3120 - Energy and the Environment (3)
    - ENV 3550 - Public and Environmental Health (3)
    - ENV 3540 - Global Environmental Governance (4)
2. ENV 4520 - Geographic Information System Analysis for Sustainability (4)

Genomics

1. BIO 3400 - Genetics (4)
2. One of:
    - BE 4200 - Genetic and Genomic Engineering (4)
    - BIO 4400 - Advanced Genetics (4)
    - BIO 4412 - Functional Genomics and Bioinformatics (4)

Prerequisite for the Genomics Application Area: BIO 1200.

Health

1. HS 2000 - Introduction to Health and Health Behaviors (3)
2. One of:
    - HS 3430 - Sociology of Health and Medicine (4)
    - PH 3000 - Introduction to Public Health (3)
    - WHP 3500 - Health Program Implementation (4)
    - WHP 4850 - Population Health, Health Policy, and Healthcare Delivery (4)

Malware Detection

1. CSI 2470 - Introduction to Computer Networks (4)
2. One of:
    - CSI 4460 - Information Security (4)
    - CSI 4480 - Information Security Practices (4)

Politics

1. Two of:
    - PS 3160 - Media and Politics (4)
    - PS 3165 - Elections and Voting Behavior (4)
    - PS 3230 - Public Opinion (4)
    - PS 3235 - Politics and the Internet (4)

Prerequisite for the Politics Application Area: PS 1100.

Risk Management

1. ECN 3500 - Insurance and Risk Management (3)
2. One of:
    - ACC 2000 - Financial Accounting (4)
    - ISE 4455 - Foundations of Safety Engineering (4)
    - ISE 4456 - Engineering Risk Analysis (4)

Prerequisite for the Risk Management Application Area: ECN 2010.

Supply Chain Management

Two of:

1. ISE 4410 - Supply Chain Modeling and Analysis (4)
2. POM 3430 - Operations Management (3)
3. POM 4420 - Supply Chain Management (3)

APPENDIX C DATA SCIENCE AND COMPUTER SCIENCE DOUBLE MAJOR

The following course plan meets both the DS and CS program requirements with 149 $(= 28 + 33 + 22 + 54 + 12)$ total credits. The DS program requirements are listed in Section 3.2 and the CS program requirements are listed in the current undergraduate catalog. It should be noted that a 0 for the credit hours in the following indicates that the credit hours for that particular course requirement is counted somewhere else in the two programs.

General Education Requirements (28 credits)

- Writing Foundations (4)
- Formal Reasoning (0) **(satisfied by MTH 1554)**
- Arts (4)
- Foreign Language and Culture (4)
- Global Perspective (4)
- Literature (4)
- Natural Science and Technology (0) **(satisfied by Approved Science Elective)**
- Social Science (4)
- Western Civilization (4)
- Knowledge Applications (0) **(satisfied by MTH 1555)**
- Capstone (0) **(satisfied by CSI 4990)**
- Writing Intensive in General Education (0) **(satisfied by double-counting a general education course)**
- Writing Intensive in the Major (0) **(satisfied by CSI 4990)**
- U.S. Diversity (0) **(satisfied by double-counting a general education course)**

Mathematics, Statistics, and Sciences (33 credits)

Data Science

- MTH 1554 (4)
- MTH 1555 (4)
- MTH 2775 (4)
- APM 2663 (4)
- STA 2226 (4)
- STA 4111 (4)
- Approved science elective (4)[36]

Computer Science

- MTH 1554 (0) **[DS course]**
- MTH 1555 (0) **[DS course]**
- MTH 2775 (0) **[DS course]**
- APM 2663 (0) **[DS course]**
- STA 2226 (0) **[DS course]**
- Approved science elective with lab (5)
- Approved science elective (0) **[DS course]**

[36]The chosen science elective should be valid for both programs.

Core Requirements (22 credits)

Data Science

- CSI 1320 (4)
- CSI 2300 (4)
- CSI 2310 (4)
- CSI 2810 (4)
- CSI 2999 (2)

Computer Science

- CSI 1420 (0) **[CSI 1320 petition]**
- CSI 2300 (0) **[DS course]**
- CSI 2310 (0) **[DS course]**
- CSI 2470 (4)
- CSI 2999 (0) **[DS course]**

Required Professional Subjects (54 credits)

Data Science

- CSI 3450 (4)
- CSI 3480 (4)
- CSI 3610 (4)
- CSI 3820 (3)
- CSI 3860 (3)
- CSI 4810 (4)
- CSI 4820 (4)
- STA 4840 (4)
- CSI 4990 (4)

Computer Science

- CSI 3370 (0) **[DS course]**
- CSI 3430 (4)
- CSI 3450 (0) **[DS course]**
- CSI 3480 (0) **[DS course]**
- CSI 3610 (0) **[DS course]**
- CSI 3640 (4)
- CSI 4350 (4)
- CSI 4500 (4)
- CSI 4650 (4)
- CSI 4999 (0) **[CSI 4990 petition]**

Professional Electives of DS and Professional Track of CS (12 credits)

Data Science

- CSI 3370 (4)
- CSI 4130 (4)
- CSI 4140 (4)

Computer Science (Computational Intelligence Track)

- CSI 4130 (0) **[DS course]**
- CSI 4810 (0) **[DS course]**

Professional Electives of CS (0 credits)

Professional electives of the CS program can be satisfied by 5 credits of 3000- or 4000-level CSI courses, including any two DS professional subjects not already counted towards the CS program, for example CSI 3820 and CSI 3860.

Application Area of DS (0 credits)

The application area courses should be chosen to satisfy the general education requirements, computer science core, or computer science required professional subjects. For example, ECN 2010 satisfies Social Science and ECN 2020 satisfies Global Perspective. A petition of exception with the SECS Undergraduate Advising Office will be required to count one of the general education

Table 11: Sample nine-semester schedule of DS and CS double major.

Semester 1 (17 credits)	**Semester 2 (16 credits)**
CSI 1320 - Introduction to Python Programming and Unix (4)	CSI 2300 - Object Oriented Programming (4)
MTH 1554 - Calculus I (4)	CSI 2810 - Introduction to Data Science in Python (4)
General education (4)	MTH 1555 - Calculus II (4)
Approved science elective with lab (5)	General education (4)
Semester 3 (16 credits)	**Semester 4 (18 credits)**
APM 2663 - Discrete Mathematics (4)	CSI 2310 - Data Structures (4)
CSI 2470 - Introduction to Computer Networks (4)	CSI 2999 - Sophomore Project (2)
General education (4)	MTH 2775 - Linear Algebra (4)
General education (4)	STA 2226 - Applied Probability and Statistics (4)
	Approved science elective (4)
Semester 5 (18 credits)	**Semester 6 (16 credits)**
CSI 3450 - Database Design and Implementation (4)	CSI 3430 - Theory of Computation (4)
CSI 3610 - Design and Analysis of Algorithms (4)	CSI 3480 - Security and Privacy in Computing (4)
CSI 3820 - Data Visualization (3)	STA 4111 - Statistical Methods in Data Science (4)
CSI 3860 - Contemporary Issues in Data Science (3)	STA 4840 - Introduction to R for Data Science (4)
General education (4)	
Semester 7 (16 credits)	**Semester 8 (16 credits)**
CSI 4820 - Big Data Analysis with Cloud Computing (4)	CSI 4140 - Deep Learning and Applications (4)
CSI 3640 - Computer Organization (4)	CSI 4500 - Fundamentals of Operating Systems (4)
CSI 4130 - Artificial Intelligence (4)	CSI 4810 - Information Retrieval and Knowledge Discovery (4)
Application area/General education course (4)	Application area/General education course (4)
Semester 9 (16 credits)	
CSI 3370 - Software Engineering and Practice (4)	CSI 4650 - Parallel and Distributed Computing (4)
CSI 4350 - Programming Languages (4)	CSI 4990 - Data Science Capstone (4)

courses also as an application area course. The student will also have to work with a faculty adviser in the Department of Computer Science and Engineering to create a new application area.

Table 11 shows a sample nine-semester course schedule satisfying the requirements of data science and computer science double major.

ABET is in the process to revise the computer science accreditation criteria and has released a revised curriculum on October 29, 2022 for a 180-day review and public comments. If the revised curriculum is adopted by ABET, the DS and CS double major will require 145 credits instead of 149 credits.

APPENDIX D DATA SCIENCE WITH A SPECIALIZATION IN ARTIFICIAL INTELLIGENCE

As discussed in Section 3.2, the following is a catalog description of the data science program with a specialization in artificial intelligence.

Catalog Language

Data Science, B.S., Specialization in Artificial Intelligence

The Department of Computer Science and Engineering offers an optional specialization in Artificial Intelligence to students interested in broadening their knowledge in this specific area of data science and wishing the area of specialization in their degree. The specialization is available to, but not required of, any student enrolled in the Bachelor of Science degree in Data Science. The specialization will be noted on the transcript and diploma of the students. Students may earn only one specialization and the specialization must be completed as part of their degree.

To earn a Bachelor of Science degree in Data Science with a specialization in Artificial Intelligence, students must complete the following sequence of courses to satisfy their professional elective area requirements of the Bachelor of Science degree in Data Science. To complete the specialization with 128 credits, students should strategically select an application area course also to count as a general education course. See Data Science degree requirements for detail. Students who are interested in the specialization are advised to consult an academic adviser for guidance on course selection.

Required subjects

Take the following four courses

- CSI 4130 - Artificial Intelligence (4)
- CSI 4140 - Deep Learning and Applications (4)
- CSI 4170 - Machine Learning (4)
- CSI 4180 - Natural Language Processing (4)

Students can substitute one of the required subjects with CSI 4900 (Special Topics), CSI 4995 (Undergraduate Research), or CSI 4996 (Independent Study) provided that the coursework is in the area of artificial intelligence. Approvals of both the instructor and the chair of the Department of Computer Science and Engineering are required for such a substitution.

APPENDIX E FACULTY

The Computer Science and Engineering Department currently has the following 24 full-time faculty members. This includes six professors, six associate professors, seven assistant professors, two visiting assistant professors, and three special instructors.

- Mehdi Bagherzadeh, Ph.D.
- Katherine Bowers, Ph.D.
- Angel Bravo-Salgado, Ph.D.
- Jingshu Chen, Ph.D.
- Debatosh Debnath, Ph.D.
- Huirong Fu, Ph.D.
- Hadeel Jawad, Ph.D.
- Dae-Kyoo Kim, Ph.D.
- Anyi Liu, Ph.D.
- Lunjin Lu, Ph.D.
- Tianle Ma, Ph.D.
- Hua Ming, Ph.D.
- Guangzhi Qu, Ph.D.
- Sunny Raj, Ph.D.
- Julian Rrushi, Ph.D.
- Soulmaz Salehian, Ph.D.
- Amartya Sen, Ph.D.
- Ishwar K. Sethi, Ph.D.
- Mohammad-Reza Siadat, Ph.D.
- Gautam B. Singh, Ph.D.
- Makram Soui, Ph.D.
- Mohammad Wardat, Ph.D.
- Steven Wilson, Ph.D.
- Lanyu Xu, Ph.D.

Please visit the department's homepage at https://oakland.edu/secs/departments/cse/ for teaching and research interests of the faculty.

APPENDIX F *PRO FORMA* BUDGET

The *pro forma* budget in the following pages is based on FY2024 template from the OU Budget Review Committee. As the template indicates, three possible scenarios have been explored in the *pro forma* budget: most likely scenario, best-case scenario, and worst-case scenario. The budget has the following components.

- *Tuition rate:* The tuition for the first two years, constituting the SECS lower division, and the subsequent two years, comprising the SECS upper division, are used based on the in-state tuition rate for simplicity.
- *Estimated new students to the program:* Based on the analysis provided in Section 3.7, we expect about 55 new students in the program by the end of the fourth year of its operation. We have used this number as the most likely scenario in the *pro forma* budget. We anticipate the program to bring 10 new students to OU during the first year and expect the number to increase in the subsequent years.
- *Faculty salaries:* The program will require support of a new full-time faculty at the assistant professor level from the second year of its operation. To demonstrate the need of the new faculty, an analysis of the teaching load resulting from the new courses is provided in Section 4.1. Given the absence of any projected tuition growth in the budget template, we have maintained flat salaries as well.
- *Graduate assistant:* A graduate teaching assistant will be required every year to supervise the labs for two new courses. During the first year of the program's operation, 50 percent support of a teaching assistant will be sufficient because only one of the courses with lab will be offered during this time. Section 4.1 discusses workload of the teaching assistant.
- *Library:* The library budget item has been incorporated based on a report from the library.
- *Recruitment and advertising:* The fund in this category will be used for recruitment and advertising efforts as outlined in Section 3.6. University Communications and Marketing will be engaged to launch a paid media campaign. Their estimated costs is $25,000 during the first year and $5,000 in the subsequent years.

The program is expected to generate a net income for the university from its first year of operation even in the worst-case scenario.

SBRC Proforma Template — Data Science, B.S. — FY2024

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		10	13	15	17	20
1st Year Cohort Revenue		$ 172,880	$ 224,744	$ 259,320	$ 293,896	$ 345,760
2nd Year Cohort Revenue		$ -	$ 172,880	$ 224,744	$ 259,320	$ 293,896
3rd Year Cohort Revenue		$ -	$ -	$ 203,440	$ 264,472	$ 305,160
4th Year Cohort Revenue		$ -	$ -	$ -	$ 203,440	$ 264,472
Gross Tuition Revenue		$ 172,880	$ 397,624	$ 687,504	$ 1,021,128	$ 1,209,288
Less: Avg Financial Aid (30%)		$ (51,864)	$ (119,287)	$ (206,251)	$ (306,338)	$ (362,786)
Net Tuition Revenue		**$ 121,016**	**$ 278,337**	**$ 481,253**	**$ 714,790**	**$ 846,502**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 74,540**	**$ 92,544**	**$ 294,986**	**$ 528,012**	**$ 659,175**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template — Data Science, B.S. — FY2024

Best-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		12	16	20	22	24
1st Year Cohort Revenue		$ 207,456	$ 276,608	$ 345,760	$ 380,336	$ 414,912
2nd Year Cohort Revenue		$ -	$ 207,456	$ 276,608	$ 345,760	$ 380,336
3rd Year Cohort Revenue		$ -	$ -	$ 244,128	$ 325,504	$ 406,880
4th Year Cohort Revenue		$ -	$ -	$ -	$ 244,128	$ 325,504
Gross Tuition Revenue		$ 207,456	$ 484,064	$ 866,496	$ 1,295,728	$ 1,527,632
Less: Avg Financial Aid (30%)		$ (62,237)	$ (145,219)	$ (259,949)	$ (388,718)	$ (458,290)
Net Tuition Revenue		**$ 145,219**	**$ 338,845**	**$ 606,547**	**$ 907,010**	**$ 1,069,342**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 98,743**	**$ 153,052**	**$ 420,280**	**$ 720,232**	**$ 882,015**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template

Data Science, B.S.

FY2024

Worst-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		7	9	11	13	15
1st Year Cohort Revenue		$ 121,016	$ 155,592	$ 190,168	$ 224,744	$ 259,320
2nd Year Cohort Revenue		$ -	$ 121,016	$ 155,592	$ 190,168	$ 224,744
3rd Year Cohort Revenue		$ -	$ -	$ 142,408	$ 183,096	$ 223,784
4th Year Cohort Revenue		$ -	$ -	$ -	$ 142,408	$ 183,096
Gross Tuition Revenue		$ 121,016	$ 276,608	$ 488,168	$ 740,416	$ 890,944
Less: Avg Financial Aid (30%)		$ (36,305)	$ (82,982)	$ (146,450)	$ (222,125)	$ (267,283)
Net Tuition Revenue		**$ 84,711**	**$ 193,626**	**$ 341,718**	**$ 518,291**	**$ 623,661**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 38,235**	**$ 7,833**	**$ 155,451**	**$ 331,513**	**$ 436,334**

[1]The tuition calculations do not account for any attrition of students.

APPENDIX G LIBRARY HOLDINGS

As discussed in Section 4.4, a report on library collection evaluation for the proposed data science program and its associated budget from Professors Helen Levenson and James E. Van Loon from the University Libraries is presented in the following pages.

OAKLAND UNIVERSITY
Libraries

January 30, 2022

To: Debatosh Debnath, Associate Professor, Department of Computer Science and Engineering, School of Engineering and Computer Science (SECS)

From: Helen Levenson, Associate Professor and Collection Development Librarian, University Libraries

James E. Van Loon, Assistant Professor and Liaison Librarian to SECS, University Libraries

Re: Library collection evaluation for proposed B.S. program in Data Science

In developing this collection evaluation, we reviewed the draft proposal for the bachelor's program in data science, as well as title lists of core journals and resources in the field. Overall, the library is well-positioned to support the proposed bachelor's program; only a few resources appropriate for undergraduate use should be added to strengthen the collection in subject areas related to new course offerings. Below is a brief description of the resources currently available, those that should be acquired, and a five-year cost estimate in support of this proposed program.

Journals and Conference Proceedings

Currently, the library subscribes to the IEEE Library, which includes all journals, proceedings and standards produced by the IEEE. The library also maintains online access to all Association of Computing Machinery (ACM) journals, magazines, transactions and conference proceedings through the ACM Digital Library. The ACM and IEEE digital libraries, along with the library's current subscriptions to the Springer publisher package and to Elsevier's Science Direct associated resources, provide full-text access to most of the journal and proceedings literature. Our review of the major journals (Appendix A) and major proceedings and series (Appendix B) lead us to conclude that the library's current holdings of journals and proceedings would provide strong support for the new BS program.

Indexes

To access the journal and conference literature in computer science, the University Libraries maintain subscriptions to a number of online indexes. The most important of these are Scopus (an Elsevier product), which indexes journals and conferences across all subjects; Compendex (accessed through Engineering Village), a bibliographic index to journals and conference proceedings in engineering and computing from 1969 to the present; and Science Citation Index

(available online through the Web of Science platform), which indexes journals from 1980 to present in the sciences. The library also provides access to Applied Science and Technology Source, which covers both academic and trade journal literature in science and technology. Other important resources include the ACM Digital Library and IEEE Xplor, both of which index journals and conferences published by their respective societies. No additional indexes are needed to support the program adequately.

Monographs and Reference Sources

The library purchases the complete collection of Springer eBooks each year, which includes the essential book series Lecture Notes in Computer Science (and all its subseries) and other book and book series, totaling more than 29,000 volumes related to computer science. Beyond the Springer eBook collection, the library purchases only a minimal number of books related to data science, data analysis, data processing, and data visualization. Table 1 shows the library's holdings (total, and recently acquired) in the Library of Congress subject classifications most relevant to data science.

To ensure that the Libraries' monographic collection adequately supports the new proposed bachelors' degree program, we recommend the purchase of approximately five ebooks each year in the subject areas treated by the new courses in the BS program; these materials would be selected at a level appropriate for undergraduate use.

Table 1: Monographic titles in subjects relevant to the proposed B.S. in Data Science

LC call number	Subject	Number of books owned (all publication years)	Number of books owned (publication 2015-present)
P98 - P98.5	Natural language processing	105	32
Q183.9	Science - Data processing	44	17
Q325.5 - Q325.787	Cybernetics - Machine learning	385	252
Q335 - Q336	Cybernetics - Artificial intelligence	521	254
QA76.585	Computer science - Cloud computing	238	159
QA76.73.J38	Programming languages - Java	346	105
QA76.73.P98	Programming languages - Python	111	80
QA76.73.R3	Programming languages - R	0	0
QA76.87	Computer science - Neural networks	285	105
QA76.9.B45	Computer science - Big data	206	184
QA76.9.D343	Computer science - Data mining	580	260
QA76.9.I52	Computer science - Information visualization	42	22
QA76.9.M65	Computer science - Moral and ethical aspects	7	2
QA76.9.Q36	Computer science - Quantitative data analysis	5	5
QA276.4	Statistics - Data processing	54	13
QA276.45.R3	Statistics - Data processing - R (Computer program language)	31	12
QA278.55	Multivariate analysis - Cluster analysis	2	2
QH324.2 - QH324.7	Bioinformatics	353	141
QH441 - QH441.2	Genetics - techniques, data processing	7	2
TA347.A78	Artificial intelligence	18	16
R858 - R859.7	Computer applications to medicine. Medical informatics	354	161

Library Budget Request

Appendix C provides cost estimates for new resources needed to support the proposed bachelor's level program: funding to purchase approximately five ebooks on topics related to new course content each year (average current cost for these monographs is $160). Because this program will rely largely on existing library resources, we have also included funding to cover anticipated annual inflationary cost increases for the library's current journals and research databases (estimated at ten percent per year) in computer science. Without additional funding, the library cannot guarantee that we will be able to continue to subscribe to our current resources. Therefore, we ask that the library be given funds each year to assist us in continuing to subscribe to these necessary resources for computer science faculty and students.

Appendix A

Major Journals - Data Science

Title	Publisher	OU Access
ACM Transactions on Knowledge Discovery from Data	ACM	yes
Applied Intelligence	Springer Nature	yes
Artificial Intelligence In Medicine	Elsevier	yes
Artificial Intelligence Review	Springer Nature	no
Big Data	Mary Ann Liebert	yes
Big Data And Society	SAGE	yes (open access)
Big Data Research	Elsevier	yes
Bioethics	Wiley-Blackwell	yes
Bioinformatics	Oxford University Press	yes
BMC Bioinformatics	Springer Nature	yes (open access)
BMC Medical Informatics And Decision Making	Springer Nature	yes (open access)
Computational Intelligence And Neuroscience	Hindawi	yes (open access)
Computers In Biology And Medicine	Elsevier	yes
Ecological Informatics	Elsevier	yes
Engineering Applications Of Artificial Intelligence	Elsevier	yes
Expert Systems With Applications	Elsevier	yes
Future Generation Computer Systems	Elsevier	yes
Gigascience	Oxford University Press	yes (open access)
IEEE Internet Of Things Journal	IEEE	yes
IEEE Transactions On Big Data	IEEE	yes
IEEE Transactions On Cloud Computing	IEEE	yes
IEEE Transactions On Cybernetics	IEEE	yes
IEEE Transactions On Industrial Informatics	IEEE	yes
IEEE Transactions On Knowledge And Data Engineering	IEEE	yes
IEEE Transactions On Neural Networks And Learning Systems	IEEE	yes
IEEE Transactions On Parallel And Distributed Systems	IEEE	yes
IEEE Transactions On Pattern Analysis And Machine Intelligence	IEEE	yes
IEEE Transactions On Visualization And Computer Graphics	IEEE	yes
IEEE/ACM Transactions On Computational Biology And Bioinformatics	IEEE	yes
Information Sciences	Elsevier	yes
Information Visualization	SAGE	no
International Journal Of Machine Learning And Cybernetics	Springer Nature	yes
Journal Of Big Data	Springer Nature	yes (open access)
Journal Of Biomedical Informatics	Elsevier	yes
Journal Of Cloud Computing	Springer Nature	yes (open access)
Journal Of Machine Learning Research	MIT Press	yes
Journal Of Medical Ethics	BMJ Publishing Group	yes
Journal Of Visual Communication And Image Representation	Elsevier	no
Journal Of Visualization	Springer Nature	yes
Knowledge-Based Systems	Elsevier	yes
Machine Learning	Springer Nature	yes
Multimedia Tools And Applications	Springer Nature	yes
Neural Computing And Applications	Springer Nature	yes
Neural Networks	Elsevier	yes
Neurocomputing	Elsevier	yes
Nucleic Acids Research	Oxford University Press	yes (open access)
Plos Computational Biology	Public Library of Science	yes (open access)
Science And Engineering Ethics	Springer Nature	yes
Visual Informatics	Elsevier	yes (open access)

Appendix B

Major Conference Proceedings and Series - Data Science

Title	Publisher	OU Access
ACM Conference Proceedings	ACM	yes
Advances In Intelligent Systems And Computing	Springer	yes
Aip Conference Proceedings	AIP	yes
Ceur Workshop Proceedings	RWTH Aachen University	yes (open access)
Communications In Computer And Information Science	Springer	yes
E3s Web Of Conferences	EDP Sciences	yes (open access)
Frontiers In Artificial Intelligence And Applications	IOS Press	no
IEEE Conference Proceedings	IEEE	yes
IFAC Papersonline	Elsevier	yes
IFIP Advances In Information And Communication Technology	Springer	yes
International Archives Of The Photogrammetry Remote Sensing And Sp	ISPRS	yes (open access)
Iop Conference Series: Earth And Environmental Science	IOP Science	yes (open access)
Iop Conference Series: Journal Of Physics	IOP Science	yes (open access)
Iop Conference Series: Materials Science And Engineering	IOP Science	yes (open access)
Lecture Notes In Artificial Intelligence	Springer	yes
Lecture Notes In Bioinformatics	Springer	yes
Lecture Notes In Business Information Processing	Springer	yes
Lecture Notes In Computer Science	Springer	yes
Lecture Notes In Electrical Engineering	Springer	yes
Lecture Notes In Networks And Systems	Springer	yes
Lecture Notes Of The Institute For Computer Sciences Social Informati	Springer	yes
Procedia Computer Science	Elsevier	yes
Proceedings Of SPIE: Progress In Biomedical Optics And Imaging	SPIE	no
Proceedings Of SPIE: The International Society For Optical Engineering	SPIE	no
Smart Innovation Systems And Technologies	Springer	yes
Studies In Health Technology And Informatics	IOS Press	no

Appendix C

Library Budget for Proposed B.S. in Data Science

	Year 1	Year 2	Year 3	Year 4	Year 5
Monographs[1]	$ 800	$ 840	$ 882	$ 926	$ 972
Support for current resources[2]	$ 5,000	$ 5,400	$ 5,832	$ 6,299	$ 6,802
Total	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774

[1]Purchase of 5 ebooks per year, reflects a 5% annual inflation rate

[2]Reflects an 8% annual inflation rate

cc: Polly Boruff-Jones, Dean of University Libraries
Amanda Nichols Hess, University Libraries Representative to University Senate

APPENDIX H LETTERS OF SUPPORT

A set of external and internal letters of support is enclosed in the following.

November 29, 2022

To: CSE department, Oakland University

I am pleased to advise you that Cognizant is strongly supportive of the new BS in Data Science that will be offered by your department.

Cognizant is interested to support the program by hiring some of your future students for internships, full-time positions, etc. Indeed, we faced major challenges to hire qualified data engineers and data scientists in the last few years. We believe that the program is very much aligned with our needs in data visualization, data governance, data storage, and beyond.

Our intention is to continue to be active partner with your department via your advisory board and other channels such as the career fair and help to continuously update the program based on the needs of the market.

We look forward to continuing and extending our relationship with your department via this new exciting program in Data Science.

Sincerely,

Sanjay Khunger

Head, Smart Connected Mobility

Cognizant

s.khunger@cognizant.com

November 30, 2022

Dear Dr. Kessentini,

I reviewed the proposal of the BS in Data Science at Oakland University and I engaged in the advisory board meetings to review this exciting program. I have also attended the presentation given by Dr. Debatosh and the discussions about the program.

I strongly support the program since it is really addressing critical needs for the automotive industry especially in data analysis, cloud data science, data ethics, etc. We are really finding a lot of challenges to find qualified data engineers in those areas within the state of Michigan. I am looking forward to see this program approved so we can start hiring your graduates as soon as possible based on the huge demand in that area. I will be also happy to continuously provide feedback to the program.

All the very best,

Ali Husain

Director – Software Research & AI, Ford Motor Co.

alhusain4@ford.com

November 19, 2022

Dear Dr. Kessentini,

I participated in your recent advisory board and reviewed the new BS in Data Science that will be offered by your department. I am impressed by the quality of the program as it is structured in a way that is meeting industry needs in this critical area. I found the program balancing both the theoretical and applied aspects of Data Science.

IBM is already collaborating with the CSE department on different hands-on workshops and we will be happy to support some of your lectures in different courses of the program. We will be also happy to support the program via internships via the recent agreement between IBM and OU as part the IBM academic initiative.

We look forward to working with you making the BS in DS program a great success.

All the best,

William Lambertson,

Vice President Cloud, 5G and

Edge, IBM

November 17, 2022

To: Dr. Marouane Kessentini, Professor and CSE department chair

Subject: New Bachelor of Science in Data Science at Oakland University

Based on my involvement with the he CSE department via its advisory board, I strongly support the new program of the BS in Data Science. I was really very impressed by the quality of the proposal and the great matching with the needs of industry in Data Science including data sampling, could data analytics, data ethics and governance, etc.

eBay is interested in supporting the program should the proposal is approved Oakland University.

Our intention is to be active partners for this new program. We will probably hire from the graduates of this program and I am committed to provide continuous feedback on the program including several application areas which are very important for us such as data governance.

We welcome the opportunity to work with you in this exciting new program on the BS in DS and look forward to continuing and extending our relationship with Oakland University.

Sincerely,

Sami

Sami Ben Romdhane eBay

VP & Fellow of Platform Architecture and Data Infrastructure 408-759-2081

2065 Hamilton Ave. | San Jose, CA | 95125 (408) 376-7800

December 6, 2022

Dear Dr. Kessentini,

I am pleased to advise you that DTE Energy is strongly supporting the new BS in Data Science of Oakland University.

DTE is interested in supporting the program based on current and future partnerships especially that we have a strong need to hire data scientists and data engineers.

Our intention is to be active partners with this new program at OU. We will also contribute in providing continuous feedback to the program and offering opportunities to our team members to join it.

As you know, I reached out to you several times to recommend data scientists and engineers for DTE. Thus, I am glad that the department is proposing this new program to help us finding talents in this very important areas. Last summer, we were not able to fill out all our interns positions in data science so I am looking forward to support your program as much as we can.

Sincerely,

Li Yong

Data Science Manager, DTE Energy

yong.li@dteenergy.com

InstaDeep™

December 11, 2022

To : Dr. Marouane Kessentini, Chair of the CSE department at Oakland University

Instadeep has been in discussion with the CSE department about the new BS in Data Science at Oakland University. We attended and contributed to align the program with industry needs via the meetings of the advisory board.

Our intention is to be active partners with the department to grow this critical program for industry as there is a huge shortage in talents around DS and AI.

We look forward to support the program as much as possible.

Sincerely,

Karim Beguir CEO, Instadeep

kb@instadeep.com

OAKLAND UNIVERSITY
College of Arts and Sciences

DEPARTMENT OF MATHEMATICS AND STATISTICS
Rochester, Michigan 48309-4479

August 2, 2022

Professor Lunjin Lu, Chair
Computer Science and Engineering Department
School of Computer Science and Engineering
Oakland University

Dear Lunjin:

I am enthusiastically providing this letter to give my strongest support for the proposed Bachelor of Science Degree in Data Science in the Computer Science and Engineering Department (CSE) within the School of Computer Science and Engineering (SECS) at Oakland. I have reviewed the program outline for the degree program, and I strongly believe it will be a successful program given the strong expertise of faculty in the CSE.

The Department of Mathematics and Statistics (DMS) has a long-standing collaborative relationship with CSE. This is a great benefit to students and is a basis for the success of our collaborative programs. We look forward to continuing our positive collaboration, and we strongly support the Data Science Degree Program in the CSE. To this end, as we have discussed during our meetings regarding both of our data science programs, we are delighted that students in the Data Science Program in the CSE will take several classes offered by the DMS as well as newly proposed courses offered by the DMS, including the two required courses STA 4111, "Statistical Methods in Data Science," and STA 4840, "Introduction to R for Data Science." (The course numbers are still tentative.) Similarly, DMS students in our Quantitative Data Science Degree Program will take several required and elective CSE courses, as described in the attached draft.

The DMS Committee on Undergraduate Programs is looking forward to continuing our positive collaborations. To this end, we are happy to meet regularly with the CSE committee on undergraduate curriculum to continuously strengthen and improve our programs. As part of this initiative, we will plan to coordinate in our efforts to recruit students and advertise.

I strongly believe the new Data Science Degree Program in the CSE and the new Quantitative Data Science Degree in the DMS will increase enrollment at Oakland, and ultimately benefit the local industrial community by providing them highly qualified job candidates. I also strongly believe the programs are complementary and will help keep Oakland competitive.

In summary, the DMS wholeheartedly supports the Bachelor of Science in Data Science Degree Program in the CSE. We look forward to continuing our strong and successful collaborations with the CSE.

Sincerely,

Anna Maria Spagnuolo

Anna Maria Spagnuolo, Ph.D.
Professor and Chair

OAKLAND UNIVERSITY

Mark C. Navin, Ph.D., HEC-C
Professor and Chair of Philosophy
Lecturer in Foundational Medical Studies
Clinical Ethicist

Department of Philosophy
746 Mathematics and Science Center
146 Library Drive
Rochester, MI, 48309-4479
(248) 370-3390
navin@oakland.edu

OAKLAND UNIVERSITY

Lunjin Lu, PhD
Professor and Chair
Department of Computer Science & Engineering
Oakland University

July 20, 2022

Dear Professor Lu:

I write in my capacity as chair of the Department of Philosophy to express my support for the Bachelor of Science in Data Science you are developing.

Your proposed program will provide students with mathematics and statistics knowledge, in addition to programming skills, so they can extract meaningful insights from datasets. In the age of Big Data these skills are especially important, and they also help to address important issues in machine learning and AI.

I appreciate that the Data Science BS includes PHL 1310 (Introduction to Ethics in Science and Engineering) as a required course. It is important for Data Science students to learn about the social, policy, ethical and legal aspects of their field of study.

Please let me know if I can provide any additional support for your important new program.

Sincerely,

Mark C. Navin, PhD

OAKLAND UNIVERSITY

Department of Industrial and Systems Engineering

10/23/2022

MEMO

To: Prof. Debatosh Debnath, CSE Dept.

From: Prof. Vijitashwa Pandey, ISE Dept. Chair

Subject: Support letter for BS in Data Science

Dear Professor Debnath,

I am delighted to write this letter of support for the new BS program proposal in Data Science. The program includes the Data Analytics course from the ISE department and encompasses several other topics relevant to ISE. It will prepare students in the school for the critical current and future needs of industry located in Michigan, and elsewhere in the United States. I strongly support this program.

Please let me know if I can be of assistance in any way.

School of Engineering and Computer Science

Engineering Center, Room 502 | 115 Library Drive, Rochester, Michigan 48309-4479
(248) 370-2989 | Fax: (248) 370-4625 | oakland.edu/ise

APPENDIX I HLC TO ABET REQUIREMENTS MAPPING FOR ASSESSMENT

The proposed data science curriculum has been developed to satisfy the accreditation criteria of ABET. The SECS has seven ABET-accredited programs and plans to seek accreditation of the proposed program by Computing Accreditation Commission (CAC) of ABET. Based on a guideline published by the OU Assessment Committee, all the ABET-accredited programs in SECS opt to use a special assessment process which requires creation of a mapping of the Higher Learning Commission (HLC) requirements to the ABET requirements. Accordingly, we have created a mapping of the HLC requirements to the CAC requirements for the data science program and enclosed it in the following. A copy of the Criteria for Accrediting Computing Programs for the 2022-2023 accreditation cycle can be downloaded from ABET website.[37]

[37] https://www.abet.org/wp-content/uploads/2022/03/2022-23-CAC-Criteria.pdf

Oakland University Assessment Committee
Assessment Process for Programs with External Accreditation

Overview

The Higher Learning Commission (HLC) of the North Central Association (NCA), the university's accrediting body, requires the university to *'demonstrate a commitment to educational achievement and improvement through ongoing assessment of student learning'*. However, the NCA allows the university to decide how best to meet this requirement.

Typically, programs meet this requirement by participating in the university's assessment cycle, as detailed by the university assessment committee (UAC). Programs normally participate in this cycle by first submitting an assessment plan to the UAC, and upon approval, implementing that plan and reporting the results of the implementation back to the UAC in two-year repeating cycles.

Programs with external accreditation sometimes operate with a slightly different process than other programs. Typically, external accreditors have assessment requirements that are more stringent then the requirements of the HLC. As such, fulfilling the assessment requirements of the external accreditor is usually sufficient to satisfy the requirements of both the UAC and the HLC. Programs with external accreditation are eligible to apply for a special waiver to have their accreditation process substitute for the normal university process, reducing the burden on programs with external accreditation and on the UAC.

This is how it works. First, the program must show how their external accrediting body's requirements meet or exceed the requirements of the Higher Learning Commission. This is done through a simple 'mapping' process that is submitted to the UAC. Once the mapping process is reviewed and approved, the UAC then only requires your accrediting body's formal letter of accreditation as evidence that the program is fulfilling the assessment requirements of the HLC. Each time a program is re-accredited, it will need to submit another formal letter, which serves as a substitute for the normal assessment process until its next round of accreditation. This saves the program and the UAC time, because the program does not have to submit formal plans or reports to the UAC.

Instructions: Summary

Step 1: Basic Information
Step 2: Mapping of Standards
Step 3: Final Steps

Please fill this form out electronically. If you are **NOT** accredited by an external body, use this form instead.

For questions, comments, or help with this form, contact Reuben Ternes (ternes@oakland.edu).
Completed forms should be sent electronically to Reuben Ternes (ternes@oakland.edu).

Step 1: Basic Information
Please fill out the following basic information about your program.

Program Name: ***B.S. in Data Science***

School or College your program resides in: ***School of Engineering and Computer Science***

Program Level (check all that apply):

Undergrad	***X***
Master's	__
Doctoral	__

External Accrediting Agency: ***Computing Accreditation Commission of ABET***

Today's Date: ***January 2, 2023***

Current Assessment Contact Representative (& E-mail): ***Debatosh Debnath, debnath@oakland.edu***
Current Department or Program Chair (& E-mail): ***Marouane Kessentini, kessentini@oakland.edu***
Current Dean (& E-mail): ***Louay Chamra, chamra@oakland.edu***

Step 2: Program Mapping

Programs with external accreditation must still meet the accrediting standards of the Higher Learning Commission, or submit an assessment report using the long form. Programs with external accreditation must meet the following requirements as stipulated by the Higher Learning Commission of the North Central Association:

1) The program has clearly stated goals for student learning and effective processes for assessment of student learning and achievement of learning goals.
2) The program assesses achievement of the learning outcomes that it claims for its curricular and co-curricular programs.
3) The program uses the information gained from assessment to improve student learning.
4) The program's processes and methodologies to assess student learning reflect good practice, including the substantial participation of faculty and other instructional staff members.

In order for your mapping to be approved, your external accrediting agency must require the above criterions to be met, in some fashion or another. Below, please provide the exact language that your accrediting body uses to show that each of the requirements listed above is also required by your accrediting body. Understand that this mapping is to the HLC's requirements and the requirements of your accrediting body, and has nothing to do with your program or how your program does assessment. Use the exact language of your accrediting body. In addition, you must provide the location of where members of the UAC can find this language – either a page number in a document or a hyperlink to the appropriate location on the website of your accrediting agency.

Higher Learning Commission Requirements	Your Accrediting Body's Associated Requirements	Location
The program has clearly stated goals for student learning and	***Criterion 2. Program Educational Objectives*** The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There	*CRITERIA FOR ACCREDITING COMPUTING PROGRAMS,*

Higher Learning Commission Requirements	Your Accrediting Body's Associated Requirements	Location
effective processes for assessment of student learning and achievement of learning goals.	must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria. ***Criterion 3. Student Outcomes*** The program must have documented and publicly stated student outcomes that include (1) through (6) below. Graduates of the program will have an ability to: (1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. (2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. (3) Communicate effectively in a variety of professional contexts. (4) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. (5) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. (6) Apply theory, techniques, and tools throughout the data analysis science lifecycle and employ the resulting knowledge to satisfy stakeholders' needs. ***Criterion 4. Continuous Improvement*** The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.	*2022-2023, Pages 5, 6, and 20.*
The program assesses achievement of the learning outcomes that it claims for its curricular and co-curricular programs.	***Criterion 4. Continuous Improvement*** The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.	*CRITERIA FOR ACCREDITING COMPUTING PROGRAMS, 2022-2023, Pages 5 and 6.*

Higher Learning Commission Requirements	Your Accrediting Body's Associated Requirements	Location
The program uses the information gained from assessment to improve student learning.	***Criterion 4. Continuous Improvement*** The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.	*CRITERIA FOR ACCREDITING COMPUTING PROGRAMS, 2022-2023, Pages 5 and 6.*
The program's processes and methodologies to assess student learning reflect good practice, including the substantial participation of faculty and other instructional staff members.	***Criterion 4. Continuous Improvement*** The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program. ***Criterion 6. Faculty*** Each faculty member teaching in the program must have expertise and educational background consistent with the contributions to the program expected from the faculty member. The competence of faculty members must be demonstrated by such factors as education, professional credentials and certifications, professional experience, ongoing professional development, contributions to the discipline, teaching effectiveness, and communication skills. Collectively, the faculty must have the breadth and depth to cover all curricular areas of the program. The faculty serving in the program must be of sufficient number to maintain continuity, stability, oversight, student interaction, and advising. The faculty must have sufficient responsibility and authority to improve the program through definition and revision of program educational objectives and student outcomes as well as through the implementation of a program of study that fosters the attainment of student outcomes.	*CRITERIA FOR ACCREDITING COMPUTING PROGRAMS, 2022-2023, Pages 5 and 6.*

Step 3: Final Steps

Please e-mail your completed form to the UAC/OIRA liaison, Reuben Ternes (ternes@oakland.edu). The UAC will review the program mapping to make sure it meets the HLC standards. After the review is complete, you will receive a response from the UAC indicating the final result of the review.

Attachment B

SBRC Proforma Template

Data Science, B.S.

FY2024

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		10	13	15	17	20
1st Year Cohort Revenue		$ 172,880	$ 224,744	$ 259,320	$ 293,896	$ 345,760
2nd Year Cohort Revenue		$ -	$ 172,880	$ 224,744	$ 259,320	$ 293,896
3rd Year Cohort Revenue		$ -	$ -	$ 203,440	$ 264,472	$ 305,160
4th Year Cohort Revenue		$ -	$ -	$ -	$ 203,440	$ 264,472
Gross Tuition Revenue		$ 172,880	$ 397,624	$ 687,504	$ 1,021,128	$ 1,209,288
Less: Avg Financial Aid (30%)		$ (51,864)	$ (119,287)	$ (206,251)	$ (306,338)	$ (362,786)
Net Tuition Revenue		**$ 121,016**	**$ 278,337**	**$ 481,253**	**$ 714,790**	**$ 846,502**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 74,540**	**$ 92,544**	**$ 294,986**	**$ 528,012**	**$ 659,175**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template — Data Science, B.S. — FY2024

Best-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		12	16	20	22	24
1st Year Cohort Revenue		$ 207,456	$ 276,608	$ 345,760	$ 380,336	$ 414,912
2nd Year Cohort Revenue		$ -	$ 207,456	$ 276,608	$ 345,760	$ 380,336
3rd Year Cohort Revenue		$ -	$ -	$ 244,128	$ 325,504	$ 406,880
4th Year Cohort Revenue		$ -	$ -	$ -	$ 244,128	$ 325,504
Gross Tuition Revenue		$ 207,456	$ 484,064	$ 866,496	$ 1,295,728	$ 1,527,632
Less: Avg Financial Aid (30%)		$ (62,237)	$ (145,219)	$ (259,949)	$ (388,718)	$ (458,290)
Net Tuition Revenue		**$ 145,219**	**$ 338,845**	**$ 606,547**	**$ 907,010**	**$ 1,069,342**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 98,743**	**$ 153,052**	**$ 420,280**	**$ 720,232**	**$ 882,015**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template — Data Science, B.S. — FY2024

Worst-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		7	9	11	13	15
1st Year Cohort Revenue		$ 121,016	$ 155,592	$ 190,168	$ 224,744	$ 259,320
2nd Year Cohort Revenue		$ -	$ 121,016	$ 155,592	$ 190,168	$ 224,744
3rd Year Cohort Revenue		$ -	$ -	$ 142,408	$ 183,096	$ 223,784
4th Year Cohort Revenue		$ -	$ -	$ -	$ 142,408	$ 183,096
Gross Tuition Revenue		$ 121,016	$ 276,608	$ 488,168	$ 740,416	$ 890,944
Less: Avg Financial Aid (30%)		$ (36,305)	$ (82,982)	$ (146,450)	$ (222,125)	$ (267,283)
Net Tuition Revenue		**$ 84,711**	**$ 193,626**	**$ 341,718**	**$ 518,291**	**$ 623,661**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 38,235**	**$ 7,833**	**$ 155,451**	**$ 331,513**	**$ 436,334**

[1]The tuition calculations do not account for any attrition of students.

Attachment B

SBRC Proforma Template

Data Science, B.S.

FY2024

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		10	13	15	17	20
1st Year Cohort Revenue		$ 172,880	$ 224,744	$ 259,320	$ 293,896	$ 345,760
2nd Year Cohort Revenue		$ -	$ 172,880	$ 224,744	$ 259,320	$ 293,896
3rd Year Cohort Revenue		$ -	$ -	$ 203,440	$ 264,472	$ 305,160
4th Year Cohort Revenue		$ -	$ -	$ -	$ 203,440	$ 264,472
Gross Tuition Revenue		$ 172,880	$ 397,624	$ 687,504	$ 1,021,128	$ 1,209,288
Less: Avg Financial Aid (30%)		$ (51,864)	$ (119,287)	$ (206,251)	$ (306,338)	$ (362,786)
Net Tuition Revenue		**$ 121,016**	**$ 278,337**	**$ 481,253**	**$ 714,790**	**$ 846,502**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 74,540**	**$ 92,544**	**$ 294,986**	**$ 528,012**	**$ 659,175**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template — Data Science, B.S. — FY2024

Best-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		12	16	20	22	24
1st Year Cohort Revenue		$ 207,456	$ 276,608	$ 345,760	$ 380,336	$ 414,912
2nd Year Cohort Revenue		$ -	$ 207,456	$ 276,608	$ 345,760	$ 380,336
3rd Year Cohort Revenue		$ -	$ -	$ 244,128	$ 325,504	$ 406,880
4th Year Cohort Revenue		$ -	$ -	$ -	$ 244,128	$ 325,504
Gross Tuition Revenue		$ 207,456	$ 484,064	$ 866,496	$ 1,295,728	$ 1,527,632
Less: Avg Financial Aid (30%)		$ (62,237)	$ (145,219)	$ (259,949)	$ (388,718)	$ (458,290)
Net Tuition Revenue		**$ 145,219**	**$ 338,845**	**$ 606,547**	**$ 907,010**	**$ 1,069,342**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 98,743**	**$ 153,052**	**$ 420,280**	**$ 720,232**	**$ 882,015**

[1]The tuition calculations do not account for any attrition of students.

SBRC Proforma Template — Data Science, B.S. — FY2024

Worst-Case Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		7	9	11	13	15
1st Year Cohort Revenue		$ 121,016	$ 155,592	$ 190,168	$ 224,744	$ 259,320
2nd Year Cohort Revenue		$ -	$ 121,016	$ 155,592	$ 190,168	$ 224,744
3rd Year Cohort Revenue		$ -	$ -	$ 142,408	$ 183,096	$ 223,784
4th Year Cohort Revenue		$ -	$ -	$ -	$ 142,408	$ 183,096
Gross Tuition Revenue		$ 121,016	$ 276,608	$ 488,168	$ 740,416	$ 890,944
Less: Avg Financial Aid (30%)		$ (36,305)	$ (82,982)	$ (146,450)	$ (222,125)	$ (267,283)
Net Tuition Revenue		**$ 84,711**	**$ 193,626**	**$ 341,718**	**$ 518,291**	**$ 623,661**
Expenses						
Salaries						
Faculty Salaries	6101		$ 100,000	$ 100,000	$ 100,000	$ 100,000
Visiting Faculty	6101					
Administrative Professionals	6201					
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301					
Graduate Assistant	6311	$ 8,663	$ 17,325	$ 17,325	$ 17,325	$ 17,325
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 8,663**	**$ 117,325**	**$ 117,325**	**$ 117,325**	**$ 117,325**
Fringe Benefits	6701	$ -	$ 43,200	$ 43,200	$ 43,200	$ 43,200
Total Compensation		**$ 8,663**	**$ 160,525**	**$ 160,525**	**$ 160,525**	**$ 160,525**
Operating Expenses						
Supplies and Services	7101					
Graduate Tuition	7101	$ 7,014	$ 14,028	$ 14,028	$ 14,028	$ 14,028
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 5,800	$ 6,240	$ 6,714	$ 7,225	$ 7,774
Total Operating Expenses		$ 37,814	$ 25,268	$ 25,742	$ 26,253	$ 26,802
Total Expenses		**$ 46,477**	**$ 185,793**	**$ 186,267**	**$ 186,778**	**$ 187,327**
Net Income (Loss)		**$ 38,235**	**$ 7,833**	**$ 155,451**	**$ 331,513**	**$ 436,334**

[1]The tuition calculations do not account for any attrition of students.

Data Science, B.S.

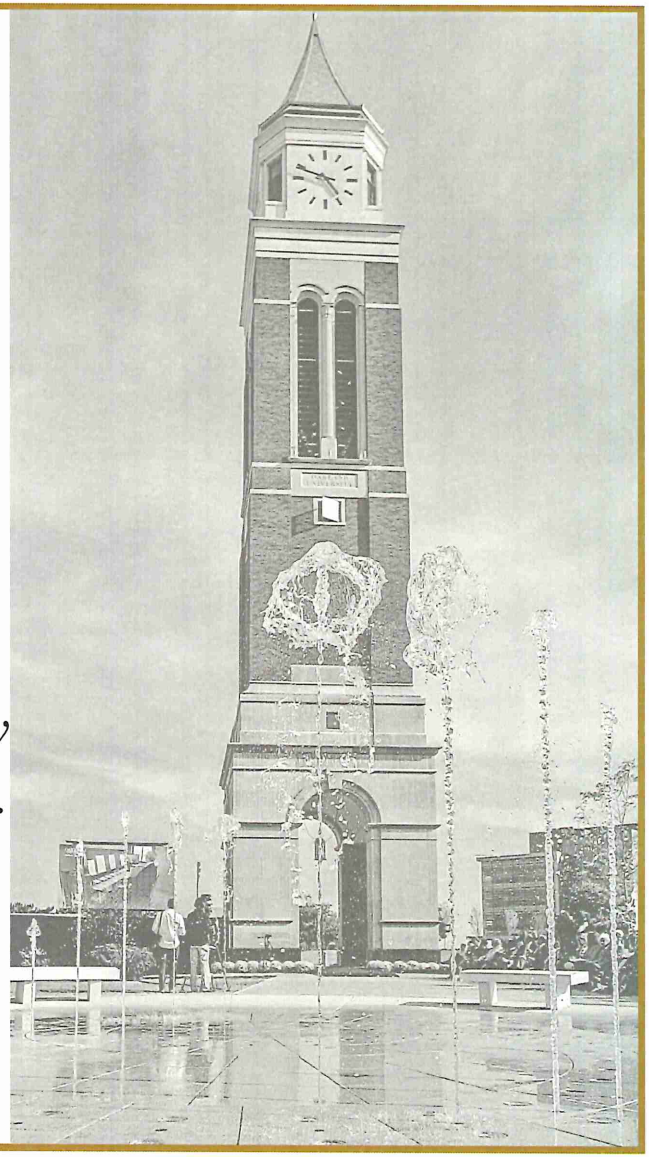
Board of Trustees

Data Science, B.S.

Department of Computer Science and Engineering
School of Engineering and Computer Science

Presented by
Debatosh Debnath, Ph.D.

OAKLAND UNIVERSITY



Summary of Need

- Bureau of Labor Statistics [BLS] projects a nationwide growth of 36.0% in data science (DS) jobs over the next decade.
- The sixth highest growth rate over all professions. [BLS]
- Median 2021 annual wage of $101,000. [BLS]
- Requires an UG degree with no work experience. [BLS]
- Job posting nationally: 23,000 at Indeed.com and 31,000 at Dice.com.

DS Offerings and Regional Insights

- Eight public institutions in Michigan offer UG degrees in DS.
  - Six of them have been launched within the last six years.
- Over 86.0% of students in SECS come from Oakland and Macomb counties.
  - Currently, there are no public institutions in this geographic area offering UG degrees in DS.
  - The counties represent over 21.0% of Michigan residents.

Key Features of the Curriculum

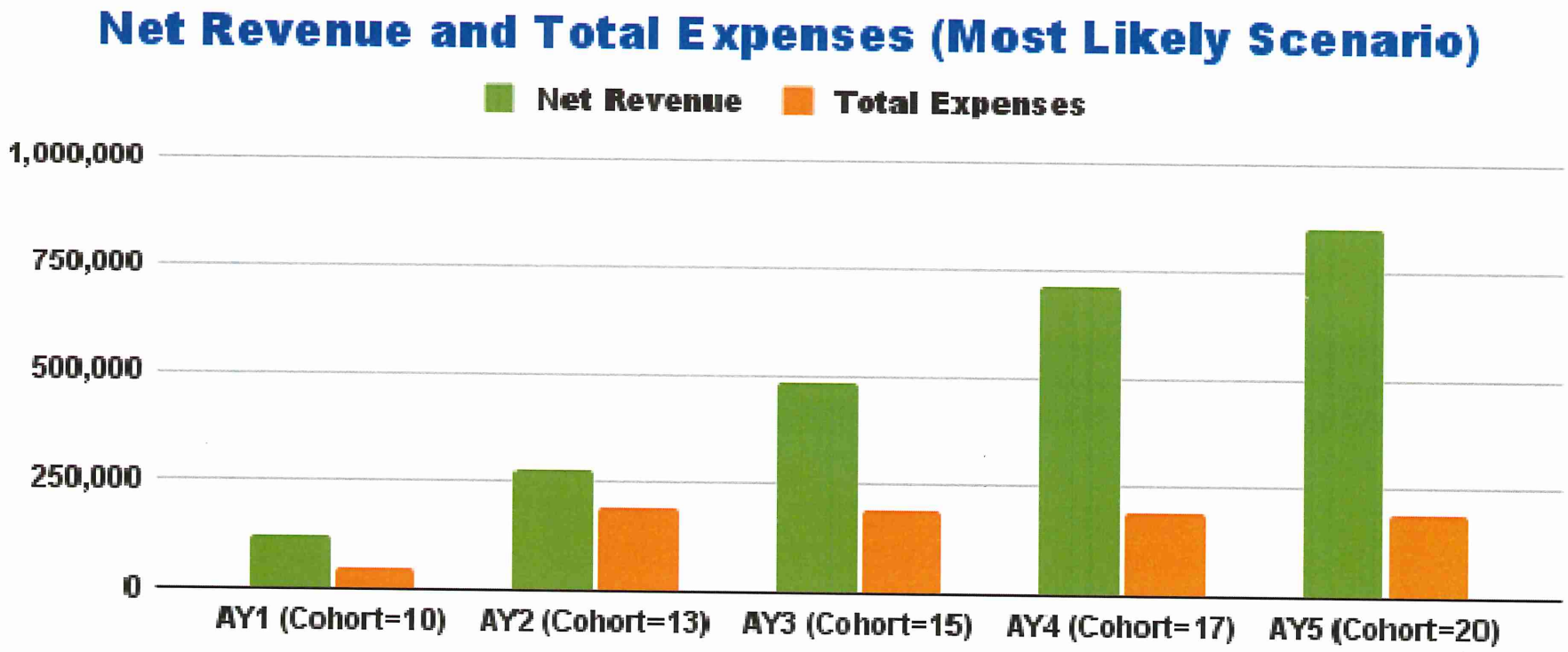
- Satisfies the latest accreditation criteria of ABET.
- Consistent with the 2021 recommendation of the ACM DS Task Force.
- Flexible to add specializations in four-year course plan.
- Double major in DS and CS requires nine semesters.

Curriculum Overview

Requires 128 credits

- General education - 28 credits
- Mathematics and science - 28 credits
- Data science core - 18 credits
- Professional courses - 34 credits
- Professional elective courses - 12 credits
- Application area courses - 8 credits

Proforma


Net Revenue and Total Expenses (Most Likely Scenario)
Net Revenue
Total Expenses
1,000,000
750,000
500,000
250,000
0
AY1 (Cohort=10)
AY2 (Cohort=13)
AY3 (Cohort=15)
AY4 (Cohort=17)
AY5 (Cohort=20)