DATA SCIENCE

With increasing availability of data, companies, governments, and nonprofits alike are striving to convert information into actionable information and insight. In the past, students trained in singular disciplines such as computer science, operations research, or statistics had the skill set needed to analyze the required data. But the "volume", "velocity" and "variety" of today's data and future data streams pose unique challenges and also creates unique opportunities. Present data sets requires more programming, mathematics/statistics, modeling skills, and domain knowledge than a traditional undergraduate curriculum offers. In fact, one of the obstacles that must be removed before government, business and social sectors are prepared to use large datasets to enhance their decision-making, is the acquisition of a trained workforce that can leverage it.

Decision makers require data and evidence before resources are committed. In the current environment, commitments are not made unless evidence supports that the opportunities are both cost effective and yield positive net benefits. Healthcare practitioners seek evidence-based medicine; social scientists engage in impact assessments; business analysts practice decision science and engineers and computer scientists desire facility with big data sets using a variety of statistical techniques.

The University of Michigan-Dearborn, with its strong Engineering, Mathematics, Social and Behavioral Sciences, and Business Management programs is in a strategic position to enhance both undergraduate and graduate education with data science course offerings and a Bachelor of Science in Data Science. UM-Dearborn's recent addition of the Department of Health and Human Services is also uniquely positioned in time, developmental stage, and location, to benefit from data science offerings. In other words, a case could be made for data science programming that enhances student education and marketability in all four of UM-Dearborn's Colleges--the College of Engineering; the College of Arts, Sciences and Letters; the College of Business and the newly formed College of Education, Health and Human Services.

The Bachelor of Science in Data Science degree is housed within the College of Engineering and Computer Science. The interdisciplinary nature of this degree program will require resources from all academic units, namely the College of Business, the College of Engineering and Computer Science, the College of Arts, Sciences, and Letters and the College of Education, Health, and Human Services. Students in this program will take courses and be involved with scholarly activity from a number of departments and disciplines across campus including Management Studies, Computer and Information Science, and Health and Human Services, Behavioral Science, Social Science as well as the Mathematics and Engineering disciplines.

This program requires technical courses from each college on our campus and is highly multidisciplinary. Taking a multidisciplinary approach, the curriculum is designed to leverage existing courses on campus and combine these with foundational courses in data science. This creates synergy among academic units on campus, provides flexibility in scheduling, and allows for timely completion of the program. Students with varied backgrounds can take different courses to suit their needs, based on interest and guided by faculty advisors.

Program Educational Objectives:

1. Our graduates will be successfully employed in Data Science related fields or other career paths, including industrial, academic, governmental, and non-governmental organizations, or will be successful graduate students in a program preparing them for such employment.
2. Our graduates will lead and participate in culturally diverse and inclusive teams, becoming global and ethical collaborators.
3. Our graduates will continue their professional development through, for example, obtaining continuing education credits, professional registration or certifications, or post-graduate study credits or degrees.

Student Outcomes:

To achieve the educational objectives of the program, graduates of the BS in Data Science 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 lifecycle and employ the resulting knowledge to satisfy stakeholders' needs.

Dearborn Discovery Core (General Education)

All students must satisfy the University's Dearborn Discovery Core requirements (http://catalog.umd.umich.edu/undergraduate/gen_ed_ddc/), in addition to the requirements for the major

A candidate for the degree Bachelor of Science in Data Science is required to pursue scholastic quality and to complete satisfactorily the following program of study:

In addition to completion of the Dearborn Discovery Core, the following courses are required to earn a B.S. degree in Data Science from UM-Dearborn.

Major Requirements

Code	Title	Credit Hours
Prerequisite Courses		
COMP 105	Writing & Rhetoric I	3
COMP 270	Tech Writing for Engineers (Also fulfills 3 credits of DDC Written and Oral Communication)	3
MATH 115	Calculus I	4
MATH 116	Calculus II	4
MATH 215	Calculus III	4
MATH 227	Introduction to Linear Algebra	3
CIS 1501	CS I for Data Scientists	4

CIS 2001	CS II for Data Scientists	4
One course from the following:		
CIS 275	Discrete Structures I	4
MATH 276	Discrete Math Meth Comptr Engr	4
MATH 315	Applied Combinatorics	3
Select one laboratory science sequence from the following:		8
BIOL 130 & BIOL 320	Intro Org and Environ Biology and Field Biology	
CHEM 134 & CHEM 136	General Chemistry IA and General Chemistry IIA	
GEOL 118 & GEOL 218	Physical Geology and Historical Geology	
PHYS 125 & 125L & PHYS 126 & PHYS 126L	Introductory Physics I and Introductory Physics I Lab/Dis and Introductory Physics II and Intro Physics II Lab/Dis	
PHYS 150 & 150L & PHYS 151 & PHYS 151L	General Physics I and General Physics I Lab/Dis and General Physics II and General Physics II Lab/Dis	
Data Science Major Core		
CIS 350	Data Struc and Algorithm Anlys	4
CIS 375	Software Engineering I	4
ECE 3100	Data Science I	4
CIS 3200	Data Science II	4
CIS 422	Massive Data Management	4
ENGR 400 or ENT 400	Appl Business Tech for Engr Entrepreneurial Thinking&Behav	3
HHS 470	Information Science and Ethics	3
STAT 305	Introduction to Data Science for All	3
STAT 325 or IMSE 317	Applied Statistics I Eng Probability and Statistics	4
STAT 430	Applied Regression Analysis	3
CIS 4971	Cap Sem for Data Sci I	2
CIS 4972	Cap Proj for Data Sci II	2
Data Science Applications		**18**

Students should complete 18 credit hours in one of the following analytics areas listed below. Application area courses must be approved in advance by Department Chair.

Applied Social and Behavioral Science Analytics

Take 18 credits from any of the following: Anthropology, Criminology and Criminal Justice, Economics, History, Political Science, Psychology, Sociology. Students must meet the prerequisites for each course. These 18 credits must be from the same subject area.

Business Analytics

Take DS 310 (3) Data Mining for Business Intelligence, plus 15 credit hours in one of the following: Accounting, Finance, Information System Management, Marketing, Operation Management. Students must meet the prerequisites for each course. These 15 credits must be from the same subject area.

Computational Analytics

Take an additional 18 credit hours from courses focusing on Applied Statistics, Mathematics or from CECS. The proposed coursework must be approved by a faculty advisor in the Department of Mathematics or CECS, respectively, prior to enrollment in the course.

Health and Medicine Analytics

Take an additional 18 credit hours from courses focusing on health and medicine. The proposed coursework must be approved by a faculty advisor in the Department of Health and Human Services prior to enrollment in the course.

Data Science Electives		**3-4**
Choose 3-4 credits from list below		
CIS 306	Discrete Structures II	
CIS 411	Introduction to Natural Language Processing	
CIS 412	Introduction to Quantum Computing	
CIS 425	Information Systems	
CIS 439	Text Mining and Information Retrieval	
CIS 446	Wireless & Mobi Comp Security	
CIS 449	Intro to Software Security	
CIS 479	Intro to Artificial Intel	
CIS 481	Computational Learning	
CIS 482	Trustworthy Artificial Intelligence	
CIS 483	Deep Learning	
CIS 489	Edge Computing	
CIS 4851	Data Security and Privacy	
DS 426	Introduction to Simulation	
ECE 427	Digi Content Protec	
ECE 428	Cloud Computing	
ECE 434	Introduction to Machine Learning	
ENGR 399	Experiential Honors Prof. Prac	
ENGR 492	Exper Honors Directed Research	
ENGR 493	Exper Hnrs Dir Dsgn	
IMSE 3005	Intro to Operations Research	
IMSE 421	Eng Economy and Dec Anlys	
IMSE 440	Applied stat models in engin	
IMSE 4585	Simulation in Systems Design	
IMSE 4795	Prod, Inven Control & Lean Mfg	
MATH 325	Probability	
MATH 420	Stochastic Processes	
MATH 425	Statistical Inference	
MATH 435	Mathematics of Finance	
MATH 462	Mathematical Modeling	
MATH 472	Introduction to Computational Mathematics	
MATH 473	Matrix Computation	
STAT 327	Statistical Computing	
STAT 431	Machine Learning and Computational Statistics	
STAT 440	Design and Analysis of Experiments	
STAT 450	Multivariate Stat Analysis	
STAT 460	Time Series Analysis	

General Electives

Any 100 to 400 level course, (that is, courses not on the No Credit list, which is found at the end of the CECS Student Handbook), as needed to get a minimum of 120 credits for graduation.

Learning Goals

1. Students will be able to manage large-scale, complex data.
2. Students will be able to recognize and evaluate the opportunities, needs, and limitations of data.
3. Students will be able to formulate and design data analytic solutions.
4. Students will be able to interpret data analytics and communicate the implications to stakeholders.