DATA SCIENCE AND ANALYTICS, BS

Degree: Bachelor of Science (BS)
Major: Data Science and Analytics

Program Overview

The Data Science and Analytics BS program provides students with a broad foundation in the field and with the instruction, skills, and experience needed to understand and handle large amounts of data to derive actionable information. The degree program has a unique focus on real-world data and real-world applications. This program provides students with a strong background in the fundamentals of mathematics and science. Students can use their technical and open electives to pursue interests in software engineering, algorithms, artificial intelligence, machine learning, databases, data mining, bioinformatics, security, and computer systems. In addition to an excellent technical education, all students in the Case School of Engineering are exposed to societal issues, ethics, professionalism, and have the opportunity to develop leadership skills.

This major is one of the first undergraduate programs nationwide with a curriculum that includes mathematical modeling, computation, data analytics, visual analytics and project-based applications – all elements of the future emerging field of data science.

The Bachelor of Science degree program in Data Science and Analytics is accredited by the Computing Accreditation Commission of ABET, under the commission's General Criteria and Program Criteria for Data Science.

Program Educational Objectives

Graduates from the Data Science and Analytics Bachelor of Science program will be prepared to:

a. Analyze real-world problems and create data-driven solutions based on the fundamentals of data science and computing.
b. Work effectively, professionally, collaboratively, and ethically.
c. Assume positions of leadership in industry, academia, public service, and entrepreneurship.
d. Successfully progress in advanced degree programs in data science, computing, and related fields.

Learning Outcomes

- Students analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- Students design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Students communicate effectively in a variety of professional contexts.
- Students recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- Students function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- Students apply theory, techniques, and tools throughout the data analysis life cycle and employ the resulting knowledge to satisfy stakeholders' needs.

Co-op and Internship Programs

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition but maintain their full-time student status while earning a salary. Alternatively or additionally, students may obtain employment as summer interns.

Undergraduate Policies

For undergraduate policies and procedures, please review the Undergraduate Academics section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Undergraduate Academics section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the Unified General Education Requirements. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the school-specific requirements associated with this major.

Required Mathematics, Science and Engineering Courses:

Code	Title	Credit Hours
Required Mathematics, Science and Engineering Courses:		
CHEM 111	Principles of Chemistry for Engineers [a]	4
CSDS 132	Programming in Java	3
ENGR 399	Impact of Engineering on Society	3
MATH 121	Calculus for Science and Engineering I	4
MATH 122	Calculus for Science and Engineering II	4
or MATH 124	Calculus II	
MATH 223	Calculus for Science and Engineering III	3
or MATH 227	Calculus III	
MATH 224	Elementary Differential Equations	3
or MATH 228	Differential Equations	
PHYS 121	General Physics I - Mechanics	4
or PHYS 123	Physics and Frontiers I - Mechanics	
PHYS 122	General Physics II - Electricity and Magnetism	4
or PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
Total Credit Hours		**32**

a The chemistry sequence CHEM 105-CHEM 106 may be substituted for CHEM 111.

Core Requirement

Code	Title	Credit Hours
Required Courses:		
CSDS 133	Introduction to Data Science and Engineering for Majors	3
CSDS 233	Introduction to Data Structures	4
CSDS 234	Structured and Unstructured Data	3
CSDS 302	Discrete Mathematics	3
CSDS 310	Algorithms	3
CSDS 312	Introduction to Data Science Systems	3
CSDS 313	Introduction to Data Analysis	3
CSDS 341	Introduction to Database Systems	3
CSDS 344	Computer Security	3
or CSDS 356	Data Privacy	
CSDS 398	Senior Project in Data Science	4
MATH 380	Introduction to Probability	3
Choose one of the following:		*3*
STAT 243	Statistical Theory with Application I	
STAT 312	Basic Statistics for Engineering and Science	
Choose one of the following:		*3*
STAT 244	Statistical Theory with Application II	
STAT 325	Data Analysis and Linear Models	
Total Credit Hours		**41**

Core courses provide our students with a strong background in foundations and analytics.

Foundations

Each student must supplement their competence in foundational technical areas by taking at least three additional courses, totaling at least 9 credit hours from the following list. Other courses, beyond those that are listed, may be approved by the student's academic advisor. The following list is organized in topical areas for informational purposes only; foundation courses may come from the same or from different areas.

Foundation Courses:

Code	Title	Credit Hours
Systems Courses:		
CSDS 293	Software Craftsmanship	4
CSDS 338	Intro to Operating Systems and Concurrent Programming	4
CSDS 344	Computer Security	3
CSDS 356	Data Privacy	3
CSDS 393	Software Engineering	3
Statistics Courses:		
STAT 243	Statistical Theory with Application I	3
STAT 244	Statistical Theory with Application II	3
Any STAT 300 level or above course		3-4
Analytics: Artificial Intelligence Courses:		
CSDS 340	Introduction to Machine Learning	3
CSDS 390	Advanced Game Development Project	3
CSDS 391	Introduction to Artificial Intelligence	3
CSDS 442	Causal Learning from Data	3
CSDS 491	Artificial Intelligence: Probabilistic Graphical Models	3
Analytics: Data Mining Courses:		
CSDS 305	Files, Indexes and Access Structures for Big Data	3
CSDS 335	Data Mining for Big Data	3
or CSDS 435	Data Mining	
Theory Courses:		
CSDS 477	Advanced Algorithms	3
MATH 201	Introduction to Linear Algebra for Applications	3
or MATH 307	Linear Algebra	
MATH 327	Convexity and Optimization	3
Engineering: Signals Courses:		
ECSE 246	Signals and Systems	4
ECSE 313	Signal Processing	3
Engineering: Optimization Courses:		
ECSE 346	Engineering Optimization	3
ECSE 416	Convex Optimization for Engineering	3

Applications

Data science graduates are expected to be knowledgeable in a wide range of areas of applications of the data science profession. The breadth requirement is satisfied by choosing at least two courses (totaling at least 6 credit hours) from the following list. Additional courses, beyond those that are listed, may be approved by the student's academic advisor.

Code	Title	Credit Hours
Applications Courses:		
BIOL 319	Applied Probability and Stochastic Processes for Biology	3
BIOL 311A	Survey of Bioinformatics: Technologies in Bioinformatics	1
BIOL 311B	Survey of Bioinformatics: Data Integration in Bioinformatics	1
BIOL 311C	Survey of Bioinformatics: Translational Bioinformatics	1
DSCI 330	Cognition and Computation	3
DSCI 351	Exploratory Data Science	3
ECON 326	Econometrics	4
ECON 327	Advanced Econometrics	3
CSDS 458	Introduction to Bioinformatics	3
CSDS 459	Bioinformatics for Systems Biology	3
MKMR 310	Marketing Analytics	3
MPHP 301	Introduction to Epidemiology	3
MPHP 426	An Introduction to GIS for Health and Social Sciences	3

Technical Electives

Students are required to complete two more technical electives for at least 6 credit hours. The courses can be any CSDS course or a course from the foundations and applications lists. The combination of core,

foundations, and application courses with technical and open electives makes it possible to achieve a minor in fields as different as Economics and Biology. Interested students should contact their advisors.

Sample Plan of Study

The following is a suggested program of study. Current students should always consult their advisors and their individual graduation requirement plans as tracked in SIS.

First Year		
Fall		
CHEM 111	Principles of Chemistry for Engineers	4
CSDS 132	Programming in Java	3
MATH 121	Calculus for Science and Engineering I	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
	Credit Hours	**14**
Spring		
PHYS 121 or PHYS 123	General Physics I - Mechanics or Physics and Frontiers I - Mechanics	4
MATH 122 or MATH 124	Calculus for Science and Engineering II or Calculus II	4
CSDS 133	Introduction to Data Science and Engineering for Majors	3
CSDS 233	Introduction to Data Structures	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
	Credit Hours	**18**
Second Year		
Fall		
CSDS 234	Structured and Unstructured Data	3
CSDS 302	Discrete Mathematics	3
MATH 223 or MATH 227	Calculus for Science and Engineering III or Calculus III	3
PHYS 122 or PHYS 124	General Physics II - Electricity and Magnetism or Physics and Frontiers II - Electricity and Magnetism	4
Breadth, or Elective course [a]		3
	Credit Hours	**16**
Spring		
CSDS 310	Algorithms	3
CSDS 341	Introduction to Database Systems	3
MATH 224 or MATH 228	Elementary Differential Equations or Differential Equations	3
Breadth, or Elective course [a]		3
Probability/Statistics Elective [b]		3
	Credit Hours	**15**
Third Year		
Fall		
CSDS 313	Introduction to Data Analysis	3
CSDS 344	Computer Security (or Foundations) [c]	3
Breadth, or Elective course [a]		3
Probability or Statistics [b]		3
Open Elective		3
	Credit Hours	**15**
Spring		
CSDS 312	Introduction to Data Science Systems	3
CSDS 356	Data Privacy (or Foundations) [c]	3
ENGR 399	Impact of Engineering on Society	3
Breadth, or Elective course [a]		3
Probability or Statistics [b]		3
Open Elective		3
	Credit Hours	**18**
Fourth Year		
Fall		
Breadth, or Elective course [a]		3
Foundations [c]		3
Foundations [c]		3
Applications [d]		3
Open Elective		3
	Credit Hours	**15**
Spring		
CSDS 398	Senior Project in Data Science	4
Breadth, or Elective course [a]		3
Applications [d]		3
Technical Elective		3
Technical elective		3
	Credit Hours	**16**
	Total Credit Hours	**127**

a Unified General Education Requirement.

b Probability (MATH 380) or Statistics (One of STAT 243 or STAT 312, and one of STAT 244 or STAT 325)

c Three courses and nine credit hours required from the Foundation list

d Two courses and six credit hours required from the Applications list