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, Data Analytics and Similarly Named Computing Programs.

Program Educational Objectives

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

1. Analyze real-world problems and create data-driven solutions based on the fundamentals of data science and computing.
2. Work effectively, professionally, collaboratively, and ethically.
3. Assume leadership roles in industry, academia, public service, and entrepreneurship.
4. 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.

Mathematics, Science and Engineering Courses

Code	Title	Credit Hours
Required 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 307	Linear Algebra	3
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

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

Code	Title	Credit Hours
Required Courses:		
CSDS 133	Introduction to Data Science	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 340	Introduction to Machine Learning	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
STAT 302	Introduction to Statistical Inference	3
or STAT 312	Basic Statistics for Engineering and Science	
or STAT 312R	Basic Statistics for Engineering and Science Using R Programming	
or STAT 313	Statistics for Experimenters	
STAT 325	Data Analysis and Linear Regression Models	3
MATH 380	Introduction to Probability	3
Total Credit Hours		**44**

Foundations

Each student must supplement their competence in foundational technical areas by taking at least two additional courses, totaling at least 6 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.

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:		
Any STAT 300 level or above course		3-4
Analytics: Artificial Intelligence Courses:		
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 Manipulation Courses:		
CSDS 305	Files, Indexes and Access Structures for Big Data	3
CSDS 317	Data Engineering	3
CSDS 335	Data Mining for Big Data	3
or CSDS 435	Data Mining	
Theory Courses:		
CSDS 323	Numerical Algorithms for Machine Learning	3
CSDS 477	Advanced Algorithms	3
MATH 224	Elementary Differential Equations	3
or MATH 228	Differential Equations	
MATH 327	Convexity and Optimization	3
MATH 356	Math in Machine Learning	3
MATH 382	High Dimensional Probability	3
MATH 408	Introduction to Cryptology	3
MATH 444	Mathematics of Data Mining and Pattern Recognition	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:		
ASTR 222	Galaxies and Cosmology	3
ASTR 306	Astronomical Techniques	3
BAFI 351	Financial Data Science: Data Analytics & Machine Learning Fundamentals	3
BAFI 361	Empirical Analysis in Finance	3
DSCI 330	Cognition and Computation	3
DSCI 351	Exploratory Data Science	3
ECON 326	Econometrics	4
ECON 327	Advanced Econometrics	3
ECON 380	Computational Economics	3
ECON 395	Capstone Research in Economics	3
CSDS 458	Introduction to Bioinformatics	3
CSDS 459	Bioinformatics for Systems Biology	3
MATH/BIOL 319	Applied Probability and Stochastic Processes for 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

MPHP 484	Global Health Epidemiology	1 - 3
OPMT 377A	Business Forecasting	1.5
OPMT 377B	Enterprise Resource Planning in the Supply Chain	1.5
SASS 471	Introduction to Data Science for Social Impact	3
SASS 472	Semester Research Project in Data Science for Social Impact	3
SYBB 311 or SYBB 411	Technologies in Bioinformatics Technologies in Bioinformatics	3
SYBB 412	Survey of Bioinformatics: Programming for Bioinformatics	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		**Credit Hours**
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	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 307	Linear Algebra	3
Breadth, or Elective course [a]		3
Statistics Course [b]		3
	Credit Hours	**15**
Third Year		
Fall		
CSDS 313	Introduction to Data Analysis	3
CSDS 344	Computer Security (or Foundations) [c]	3
STAT 325	Data Analysis and Linear Regression Models	3
Breadth, or Elective course [a]		3
Open Elective		3
	Credit Hours	**15**
Spring		
CSDS 312	Introduction to Data Science Systems	3
CSDS 356	Data Privacy (or Foundations) [c]	3
MATH 380	Introduction to Probability	3
ENGR 399	Impact of Engineering on Society	3
Breadth, or Elective course [a]		3
Open Elective		3
	Credit Hours	**18**
Fourth Year		
Fall		
Breadth, or Elective course [a]		3
CSDS 340	Introduction to Machine Learning	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 One of STAT 302 or STAT 312 or STAT 312R or STAT 313.
c Two courses and six credit hours required from the Foundations list.
d Two courses and six credit hours required from the Applications list.