Data Science, BS

Learning Outcomes

Data Curation Skills

Graduates will be able to:

- understand issues associated with data collection, management, provenance, storage, merging, sharing, and preparation;
- work with multiple-source, multiple-format data;
- investigate the quality of the data; and
- have a basic understanding of ethical and confidentiality issues associated with data collection, storage, merging, and sharing.

Computational Skills

Graduates will be able to:

- use critical thinking skills to translate substantive questions into well-defined computational problems and choose appropriate computational techniques for a given problem;
- understand the foundational software skills and associated algorithmic and computational problem-solving methods used in computer science;
- be proficient in computational methods for collecting, managing, storing, preparing, sharing, and describing data numerically and graphically from a variety of sources to design and carry out basic simulation studies; and
- use professional statistical software and understand the principles of programming and algorithmic problem-solving that underlie these packages.

Statistical/Probabilistic Skills

Graduates will be able to:

- use critical thinking skills to translate substantive questions into well-defined statistical or probability problems and choose the appropriate graphical or numerical descriptive and/or inferential statistical techniques for a given problem;
- understand the importance of, and issues related to, the choice of the study design, such as designed experiment versus probability sample versus convenience sample, used to produce data;
- understand that uncertainty, variability, and randomness play significant roles in data-driven decision-making;
- understand how to measure and display uncertainty, the effect of randomness, confidence/credibility, and the likelihood of incorrect inferences;
- understand and be able to explain common misperceptions, paradoxes, and fallacies of probability and statistics; and
- understand basic regression, prediction, simulation, and visualization methods.

Mathematical Skills

Graduates will:

- have a firm grasp of the mathematical tools underlying statistical and computational methods which are primarily based on ideas in calculus, linear algebra, and discrete mathematics, including distribution theory, uncertainty quantification (e.g., probability theory), the probabilistic basis of formal statistical inference, models, and algorithms, and combinatorial analysis and recursion, which are used for algorithmic analysis, design, and for distribution theory.

Communication Skills

Graduates will be able to:

- clearly justify and communicate study results to a non-technical audience;
- write accurate and meaningful reports that describe the statistical and computational analyses and summarize important findings; and
- work effectively as part of a team to address substantive questions that can be handled using statistical and computational methods.

Requirements

The Bachelor of Science with a major in data science requires a minimum of 120 s.h., including at least 64 s.h. of work for the major. Students must maintain a grade-point average of at least 2.00 in all courses for the major and in all UI courses for the major. They also must complete the College of Liberal Arts and Sciences GE CLAS Core.

Data science majors may not earn a major or minor in computer science or statistics, a major in computer science and engineering, or the Certificate in Social Science Analytics.

The BS with a major in data science requires the following coursework.

Requirements	Hours
Prerequisite Courses	16
Core Courses	36
Advanced Electives	9
Capstone Course	3

Prerequisite Courses

Course #	Title	Hours
MATH:1850	Calculus I	4
MATH:1860	Calculus II	4
MATH:2700	Introduction to Linear Algebra	4
MATH:2850	Calculus III	4

Core Courses

Course #	Title	Hours
All of these:		
DATA:3200/ IGPI:3200/ISE:3760/ STAT:3200	Applied Linear Regression	3
DATA:4580/ IGPI:4580/ STAT:4580	Data Visualization and Data Technologies	3
CS:1210	Computer Science I: Fundamentals	4
CS:2210	Discrete Structures	3
CS:2230	Computer Science II: Data Structures	4
CS:3330	Algorithms	3
CS:4400	Database Systems	3

STAT:2010	Statistical Methods and Computing	3
STAT:3100/ IGPI:3100	Introduction to Mathematical Statistics I	4
STAT:3101/ IGPI:3101	Introduction to Mathematical Statistics II	3
One of these:		
DATA:4540/ BAIS:4540/ IGPI:4540/ STAT:4540	Statistical Learning	3
CS:5430	Machine Learning	3

Advanced Electives

Course #	Title	Hours
9 s.h. from these, with at least one computer science course (prefix CS) and one statistics course (prefix STAT):		
DATA:4600/ STAT:4600	Causal Inference for Data Science	3
DATA:4610	Data Acquisition and Management	3
DATA:4620	Text Data Analysis	3
DATA:4750/ STAT:4750	Probabilistic Statistical Learning	3
DATA:4880	Data Science Creative Component	1
DATA:6200/ ACTS:6200/ STAT:6200	Predictive Analytics	3
BIOS:4510	Data Science Foundations in R	2
CS:4420	Artificial Intelligence	3
CS:4440	Web Mining	3
CS:4470	Health Data Analytics	3
CS:4510	Human-Computer Interaction for Computer Science	3
CS:4630	Mobile Computing	3
CS:4700/ MATH:4860	High Performance and Parallel Computing	3
CS:5630	Cloud Computing Technology	3
MATH:4840	Mathematics of Machine Learning	3
STAT:3210	Experimental Design and Analysis	3
STAT:4520/ IGPI:4522/ PSQF:4520	Bayesian Statistics	3
STAT:4560	Statistics for Risk Modeling I	3
Other advanced computer science or statistics courses approved by advisor		

Capstone Course

Course #	Title	Hours
DATA:4890	Data Science Practicum	3

The Department of Statistics and Actuarial Science and the Department of Computer Science collaborate to offer the major in data science.

Combined Programs

Undergraduate to Graduate (U2G) Program

Bachelor of Science students in data science may pair their degree with an Undergraduate to Graduate (U2G) program, which allows a student to earn a bachelor's and master's degree in five years of study. See the Undergraduate to Graduate website for available programs.

Honors

Honors in the Major

Students majoring in data science have the opportunity to graduate with honors in the major. They must maintain a grade-point average (GPA) of at least 3.67 in their major and a cumulative University of Iowa GPA of at least 3.33. Students must complete an honors thesis.

Students are responsible for finding a faculty member willing to supervise their honors project. The faculty member must approve the proposed project and a timetable for the work. Credit for thesis work must be earned in either CS:3990 Honors in Computer Science or Informatics for work supervised by a computer science faculty member or an honors course supervised by a statistics and actuarial science faculty member.

Honors in data science also satisfies the 12 s.h. experiential learning requirement for University of Iowa honors students.

University of Iowa Honors Program

In addition to honors in the major, students have opportunities for honors study and activities through membership in the University of Iowa Honors Program. Visit Honors at Iowa to learn about the university's honors program.

Membership in the UI Honors Program is not required to earn honors in the data science major.

Career Advancement

Today, nearly every business, government, social media platform, and educational institution collects and analyzes data about its users, logistics and operations, and media presence, in the hope of extracting valuable insights and utilizing the resulting efficiencies.

As an example, Amazon is the company most closely identified with a data-driven business model. Starting just over 25 years ago as an online bookseller with a relatively crude crowdsourced book review platform and simple recommender system technology, it was subsequently augmented with extensive tracking of customer page views, advertising hits, data about prior purchases, and an aggressive emphasis on data-driven operational efficiencies. Amazon has become the major player in U.S. retail and a prime example of the strategic value of big data.

Data science graduates may pursue careers as data scientists. This position allows them to apply their understanding of statistics, as well as algorithm and software design, to create and develop the next generation of data analysis tools.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

Academic Plans

Four-Year Graduation Plan

The Four-Year Graduation Plan is not available to students majoring in data science. Students work with their advisors on individual graduation plans.

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

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Course	Title	Hours
Academic Career		
Any Semester		
GE CLAS Core: Sustainability [a]		
	Hours	**0**
First Year		
Fall		
CS:1210	Computer Science I: Fundamentals	4
RHET:1030 or ENGL:1200	Rhetoric: Writing and Communication or The Interpretation of Literature	3 - 4
MATH:1550	Engineering Calculus I [b]	4
GE CLAS Core: World Languages First Level Proficiency or elective course [c]		4 - 5
CSI:1600	Success at Iowa	1
	Hours	**16-18**
Spring		
RHET:1030 or ENGL:1200	Rhetoric: Writing and Communication or The Interpretation of Literature	3 - 4
STAT:2010	Statistical Methods and Computing	3
CS:2210	Discrete Structures	3
MATH:1560	Engineering Calculus II	4
GE CLAS Core: World Languages Second Level Proficiency or elective course [c]		4 - 5
	Hours	**17-19**
Second Year		
Fall		
CS:2230	Computer Science II: Data Structures	4
GE CLAS Core: Understanding Cultural Perspectives [d]		3
GE CLAS Core: Natural Sciences without Lab [d]		3
GE CLAS Core: World Languages Third Level Proficiency or elective course [c]		4 - 5
Elective course [e]		3
	Hours	**17-18**
Spring		
CS:3330	Algorithms	3
MATH:2700	Introduction to Linear Algebra	4

Course	Title	Hours
GE CLAS Core: International and Global Issues [d]		3
GE CLAS Core: World Languages Fourth Level Proficiency or elective course [c]		4 - 5
DATA:3200	Applied Linear Regression	3
	Hours	**17-18**
Third Year		
Fall		
STAT:3100	Introduction to Mathematical Statistics I [f]	4
GE CLAS Core: Natural Sciences with Lab [d]		4
GE CLAS Core: Social Sciences [d]		3
CS:5430 or DATA:4540	Machine Learning [f] or Statistical Learning	3
Elective course [e]		3
	Hours	**17**
Spring		
DATA:4580	Data Visualization and Data Technologies [g]	3
STAT:3101	Introduction to Mathematical Statistics II [g]	3
GE CLAS Core: Literary, Visual, and Performing Arts [d]		3
CS:4400	Database Systems	3
Elective course [e]		3
	Hours	**15**
Fourth Year		
Fall		
DATA:4890	Data Science Practicum	3
Major: advanced elective I course [h]		3
Major: advanced elective II course [h]		3
GE CLAS Core: Historical Perspectives [d]		3
Elective course [e]		3
	Hours	**15**
Spring		
Major: advanced elective III course [h]		3
GE CLAS Core: Values and Society [d]		3
Elective course [e]		1
Elective course [e]		3
Elective course [e]		3
Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall) [i]		
	Hours	**13**
	Total Hours	**127-133**

a Sustainability must be completed by choosing a course that has been approved for Sustainability AND for one of these General Education areas: Natural Sciences; Quantitative and Formal Reasoning; Social Sciences; Historical Perspectives; International and Global Issues; Literary, Visual, and Performing Arts; or Values and Society.

b Enrollment in math courses requires completion of a placement exam.

c Students who have completed four levels of a single language or two levels of two different languages in high school or college have satisfied the GE CLAS Core World Languages requirement. Students who have completed three levels of a single language may complete a fourth-level course in the same language or may choose an approved World Language and Cultural Exploration course. Enrollment in world languages courses requires a placement

exam, unless enrolling in a first-semester-level course. Contact your academic advisor or CLAS Undergraduate Programs Office with questions concerning the World Languages requirement.

d GE CLAS Core courses may be completed in any order unless used as a prerequisite for another course. Students should consult with an advisor about the best sequencing of courses.

e Students may use elective courses to earn credit towards the total s.h. required for graduation or to complete a double major, minors, or certificates.

f   Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.

g Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.

h Students should select at least one computer science course and one statistics course for their advanced electives.

i   Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Degree Services.