DATA SCIENCE (SECOND MAJOR ONLY)

Data Science is open to all students as a second major; this means that the student will have some other discipline as their primary major. Students whose primary major is in Computer Science, Software Engineering or Mathematics will find the Data Science program the easiest since there is considerable overlap between those programs and the Data Science requirements Students from other disciplines are also encouraged to participate, but will have to take more courses. All students are encouraged to take the individual courses in the program, regardless of whether they wish to fulfill the second major requirements. Learn more about Data Science requirements (https://www.rose-hulman.edu/academics/course-catalog/current/programs/Data-Science-SMO/).

Requirements

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Data Science requires 72 course credit hours and a senior capstone experience; these include 36 hours of Fundamental data science topics, 20 hours in Advanced topics, and 16 hours in Electives. The 36 fundamental credit hours and no more than 8 of the elective credit hours may be used to satisfy any requirements for another major (primary or secondary) or minor; students with a second major in Data Science cannot earn a minor in Data Science as well. Thus, the 20 Advanced credit hours and at least 8 Elective credit hours can only be used to satisfy technical and free electives of another major program.

Furthermore, Data Science majors are expected to complete a Senior Project or Senior Thesis in either their primary major or within either the Computer Science and Software Engineering Department or the Mathematics Department, and that this work includes a data science component.

Requirements

Data Science Core (56 hours)

Fundamentals (36 hours) These classes can be used to satisfy any requirements for any major. They can also be used to satisfy degree requirements for any minor, with the exception of the Mathematics Minor; for the Mathematics Minor at most two of these courses can also be used to satisfy those requirements.

Code	Title	Hours
CSSE 120	Introduction to Software Development	4
CSSE 220	Object-Oriented Software Development	4
CSSE 230	Data Structures and Algorithm Analysis	4
CSSE 333	Intro to Database Systems	4
MA 371	Linear Algebra I	4
or MA 373	Applied Linear Algebra for Engineers	
MA 382	Introduction to Statistics with Probability [1]	4
CSSE 286	Introduction to Machine Learning	4
or MA 386	Statistical Programming	
PHIL H202	Business & Engineering Ethics	4

[1] Note: If the primary major requires MA 223 Engineering Statistics, this would be accepted as a standard course substitution.

Advanced (20 hours)

These classes can only be used to satisfy technical or free electives within the primary major, and cannot be used to satisfy any other requirements for other majors or minors.

Code	Title	Hours
CSSE 313	Artificial Intelligence	4
CSSE 433	Advanced Database Systems	4
or CSSE 434	Introduction to the Hadoop Ecosystem	
MA 384	Data Mining	4
MA 415	Machine Learning	4
MA 485	Applied Linear Regression	4

Data Science Electives (16 hours)

At most 8 of these credit hours can be used to satisfy degree requirements for any major or minor sought by the student. The remaining credit hours can only be used to satisfy technical or free electives within the primary major. The student can choose any courses from the following list of approved Data Science Elective courses (or another upper-level course approved by the Director of the Data Science program). The courses below noted by [1] cannot also be used to satisfy the requirements above.

Code	Title	Hours
BMTH 312	Bioinformatics	4
CSSE 314	Bio-Inspired Artificial Intelligence	4
CSSE 315	Natural Language Processing	4
CSSE/MA 416	Deep Learning	4
CSSE 433	Advanced Database Systems [1]	4
CSSE 434	Introduction to the Hadoop Ecosystem [1]	4
CSSE 453	Topics in Artificial Intelligence	4
CSSE 463	Image Recognition	4
ECE 582	Advanced Image Processing	4
MA 332	Introduction to Computational Science	4
MA/CSSE 335	Introduction to Parallel Computing	4
MA 342	Computational Modeling	4
MA 439	Mathematical Methods of Image Processing	4
MA 482	Biostatistics	4
MA 483	Bayesian Data Analysis	4
OE 537	Advanced Image Processing	4
PH 327	Thermodynamics & Statistical Mechanics	4
PH 538	Introduction to Neural Networks	4
ECON S451	Econometrics	4

Senior Capstone

Students should complete a senior project or senior thesis that includes a data science component. In order to use the senior capstone experience of another major as part of the Data Science second major, it must be

approved by the Director of Data Science. Furthermore, the student may need to either include within the capstone report a description of the data science work done or submit a separate report to the Director of Data Science describing the data science component of the capstone.

Program Objectives

Data Science Program Educational Objectives

Graduates from the data science program will be prepared for many types of careers in the world of data and be prepared for graduate study in data science and in closely related disciplines. In the early phases of their careers, we expect Rose-Hulman data science graduates to be:

1. Data Scientists in a variety of organizations, including ones doing traditional software development, technological innovation, and cross-disciplinary work
2. Business and technological leaders within existing organizations
3. Entrepreneurial leaders
4. Recognized by their peers and superiors for their communication, teamwork, and leadership skills
5. Actively involved in social and professional service locally, nationally, and globally
6. Graduate students and researchers
7. Leaders in government and law as government employees, policy makers, governmental advisors, and legal professionals

Learning Outcomes

Data Science Program Student Outcomes

1. Provide leadership in both mathematical and computer science aspects of using data and solving related problems.
2. Recognize ethical and professional responsibilities in data engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
3. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
4. Analyze and interpret data to draw conclusions.
5. Explore and summarize large data sets using summary statistics and data visualization tools.
6. Collaborate with domain experts to use data and machine learning to automate tasks and improve the efficiency of operations
7. Communicate analysis results of large data sets.
8. Acquire and apply new knowledge as needed, using appropriate learning strategies.