Data Science

The Data Science major, which sits at the intersection of mathematics and computer science, will equip students with the skills to analyze real world data and from it draw useful conclusions. Students will develop the mathematical foundations to understand many algorithms and techniques in modern data science and the computing skills to implement these techniques in meaningful ways. The data science major will further prepare students to write and speak clearly about data and to visualize data in useful ways. Students will also explore ethical considerations of the use and mis-use of data in modern society. The student who majors in data science will be prepared for variety of careers in business, industry, or to pursue graduate education.

Data Science Major

Required:		
CS 105	Fundamentals Of Computer Science	4
CS 106	Data Structures	4
CS 203	Information Ethics	3
CS 215	Data Programming Languages	3
CS 388	Database Systems	4
DS 101	Introduction to Data Science I	3
DS 301	Introduction to Data Science II	3
DS 400	Data Science Techniques I	3
DS 420	Data Science Techniques II	3
MA 162	Discrete Mathematics	3
MA 164	Calculus I	4
MA 165	Calculus II	4
MA 166	Calculus III	3
MA 202	Linear Algebra	3
MA 214	Probability And Statistics	3
MA 380	Senior Seminar in Mathematics	3
or CS 435	Senior Project: Computer Science	
Choose One of the Following:		**3**
CS 389	Algorithm Analysis	
MA 210	Introduction To Graph Theory	
MA 245	Differential Equations	
6 credit hours of upper level coursework from another department		**6**
Total Hours		**62**

The following is the typical sequence of courses required for the major*:

Freshman

Fall	Hours	Winter	Hours	Spring	Hours
MA 164	4	Domain	3	MA 165	4
CS 105	4			CS 106	4
Writing Competency	4			DS 101	3
Portal	3			CO 101	3
	15		**3**		**14**

Sophomore

Fall	Hours	Winter	Hours	Spring	Hours
MA 166	3	CS 215	3	MA 202	3
MA 162	3			MA 214	3
Domain	3			Domain	3
Domain	3			Domain	3
	12		**3**		**12**

Junior

Fall	Hours	Winter	Hours	Spring	Hours
CS 388	4	CS 203	3	DS 400	3
DS 301	3			Domain	3
CS 389, MA 210, or MA 245	3			Domain	3
Domain	3			Domain	3
Elective	3			Elecitve	3
	16		**3**		**15**

Senior

Fall	Hours	Winter	Hours	Spring	Hours
DS 420	3	Elective	3	CS 435 or MA 380	4
Electives	10			ME 450	1
				Electives	9
	13		**3**		**14**

Total Hours: 123

Note: Elective courses could be used for a second major, a minor, a course of interest, internship or study abroad experience.
Note: See the Curriculum section *(*http://catalog.mtmercy.edu/curriculum/#corecurriculumtext*) for more information on Portal, Competency, Domain, and Capstone courses.*

*Disclaimer

The course offerings, requirements, and policies of Mount Mercy University are under continual examination and revision. This *Catalog* presents the offerings, requirements, and policies in effect at the time of publication and in no way guarantees that the offerings, requirements, and policies will not change.
This plan of study represents a typical sequence of courses required for this major. It may not be applicable to every student. Students should contact a department faculty member to be sure of appropriate course sequence.

CS Courses

CS 101 Using Computers in Research Settings: 1 semester hour
The course is designed to make students fluent in the use of common office applications in professional settings. We will learn these skills in the context of the analysis and interpretation of real-world data sets that come from the research of the faculty and students of Mount Mercy University. Students who complete this course will be able to be more productive here at Mount Mercy, and more prepared to enter careers or to attend graduate school.

CS 103 Introduction To Web Site Development: 3 semester hours
In Introduction to Web Site Development, students will learn a wide arrange of web-based technologies and scripting languages that are used for the development of internet web sites. The tools discussed in the course will vary in order to stay current with the rapidly changing environment of web development. These tools could include (but are not limited to): wysiwyg html editors, html, css, xml, Flash, java script and dynamic web programming languages. The intent of the course is to give students a broad experience with a wide range of web-based technologies. This course is intended for non-majors who are interested in careers focused on the development of web sites. Computer Science majors may take the course as an elective, but it cannot be used to fulfill any CS graduation requirement or to complete an area of specialization.

CS 105 Fundamentals Of Computer Science: 4 semester hours
This course focuses on the concepts and constructs of computer programming, including program design and decomposition, data types, interactive and file input/output, control structures, and graphical user interface development. Formerly CS 175.

CS 106 Data Structures: 4 semester hours
This course introduces basic concepts of software development, elementary data structures (including sets, lists, stacks, queues, trees, and graphs), recursion, and elementary algorithm analysis. Formerly CS 205. Prerequisites: CS 105, MA 162 (the latter may be taken as a co-requisite).

CS 112 Introduction to Object Oriented Programming: 3 semester hours
This course teaches the concepts and skills of object oriented programming. Topics to be covered include inheritance, abstract fields, methods and classes, encapsulation and polymorphism. Demonstration of significant experience and skills in object oriented programming can be used to pass out of the course. Prerequisite: CS 105.

CS 190 Computer Organization: 4 semester hours
This course covers various hardware aspects of computers. Topics to be covered include number representation, digital logic, Boolean algebra, memory technologies, and management techniques, interrupts, CPU structure, microprogramming, assembly language, and input/output devices. Prerequisite: CS 105 & MA 162.

CS 203 Information Ethics: 3 semester hours
In this course, students will learn to define and analyze ethical, moral, social, and professional issues related to computing and information technology. Topics to be discussed include ethical frameworks for decision making, regulation of the Internet, intellectual property, privacy, security, and codes of conduct. Prerequisite: sophomore standing or consent of instructor.

CS 215 Data Programming Languages: 3 semester hours
This course is an introductory course for using current programming language techniques for Data Science. Students will learn to use a contemporary programming language, like python or R, to solve various data science challenges. The course reinforces the student's knowledge of objects and control structures. The student will expand this knowledge for data storage, manipulation, visualization, and randomness. These tools and techniques are vital to the data science professional. Prerequisite: CS 105.

CS 226 Programming in Visual Basic: 4 semester hours
This course is an introduction to programming using Visual Basic and the .NET development environment. Topics to be covered include control structures, input/output, graphical user interfaces, and interface with other Microsoft Office applications. This course is for MIS majors. Computer Science majors may take the course as an elective, but it cannot be used to fulfill any CS graduation requirement or to complete an area of specialization.

CS 235 Systems Programming Concepts: 4 semester hours
This course explores topics related to operating systems and network programming, including shell programming, programming with operating systems calls, and programming using network sockets. Other topics include basic structure of operating systems and network software. Prerequisite: CS 190.

CS 302 Programming Languages: 3 semester hours
This course considers the evolution of programming languages. Topics to be discussed include language specification and analysis, syntax, semantics, parameter passing techniques, scope, binding, paradigms (including imperative, functional, and object-oriented), and translation techniques. Prerequisite: CS 235.

CS 326 Information Systems Analysis: 3 semester hours
This course will focus on management issues in the creation and management of information systems. Broad topics will include system investigation, system and feasibility analysis, system design, system implementation, and system maintenance. Various approaches to systems analysis and design will be considered, as well as tools. Prerequisites: CS 106 for CS students or CS 226 and BN 204 for MIS students.

CS 340 Game Design and Development: 4 semester hours
This course is an introductory overview of the video game design and development process. Through detailed study of historical as well as current games, students will learn the language and structure needed to develop their own game ideas. Students will learn the many aspects of a game development team and learn how each of these roles contributes to a game's overall design. Projects, in and out of class, will focus on creating and designing game concepts both digital and non-digital. A strong focus on the elements of game design and process will support class projects. Students will get a basic overview of game studies and integrate those concepts into their work. Prerequisite: CS 106, CS 235, & CS 326.

CS 341 Mobile Development: 4 semester hours
This course is an introductory overview of the mobile application design and development process. Through detailed study of historical as well as current mobile, students will learn the language and structure needed to develop their own mobile applications. Students will learn the many aspects of a mobile development team and learn how each of these roles contributes to an applications overall design. Projects, in and out of class, will focus on creating and designing mobile concepts. A strong focus on the elements of mobile design and process will support class projects. Prerequisite: CS 106, CS 235, & CS 326.

CS 388 Database Systems: 4 semester hours
This course emphasizes the concepts and structures necessary to design and implement a database management system. Topics to be covered include the evolution of database systems, the relational database model, query languages, triggers, constraints, views, and other advanced topics as time permits. Prerequisite: CS 235 or CS 326.

CS 389 Algorithm Analysis: 3 semester hours
This course is an introduction to advanced data structures and algorithm analysis techniques. Topics to be covered include asymptotic notation, empirical and theoretical analysis techniques, complexity classes, algorithmic approaches (divide and conquer, greedy), and advanced tree structures. Three hours lecture. Prerequisites: MA 162, CS 106.

CS 391 Embedded Systems: 3 semester hours
This course is an introductory overview of embedded systems and embedded language. Students will learn the skills needed to develop their embedded solutions through a detailed study of embedded control history and current applications of embedded systems. In and out of class, projects will focus on using, creating, and designing embedded system solutions. Prerequisites: CS 106, CS 235, MA 164.

CS 392 Robotic Systems: 3 semester hours
This course is an introductory overview of robotic systems and sensor networks. Students will learn the skills needed to develop their robotics and sensor network solutions through a detailed study of robotic history and current applications of robotic systems. Students will work with both mobile and stationary robotics. In and out of class, projects will focus on using, creating, and designing robotic solutions. Prerequisites: CS 106, CS 235, MA 164.

CS 393 Cryptology: 3 semester hours
This course is an introductory overview of Cryptology and Secure Programming. Students will learn the skills needed to develop their security solutions through a detailed study of cryptographic history and current cryptographic algorithms. Students will learn the many aspects of a security team and how each role contributes to security's overall design. In and out of class, projects will focus on using, creating, and designing security solutions for both digital and non-digital domains. Prerequisites: CS 106, CS 235, MA 164.

CS 395 Web Programming: 4 semester hours
This course explores the development of web-based applications and dynamic web pages using modern development tools and languages. Topics to be covered include basic web site design, scripting languages, web servers, use of databases and SQL in the development of dynamic web sites and web security. Prerequisite: CS 326 & CS 388.

CS 399 Special Topics in Computer Science: 3 semester hours
This course provides students the opportunity to take electives in an area of special interest in computer science. When possible, the course will be taught by experts from the field. Topics may include educational software development, artificial intelligence, robotics, embedded systems, bioinformatics, and cryptography. Prerequisite: permission of instructor.

CS 415 Field Experience: 3 semester hours
This course provides students the opportunity to take advantage of internship opportunities that become available. The internships include off-campus supervision at local employers and periodic conferences with the on-campus instructor. One semester hour of credit is assigned for each 45 hours of work per semester at the outside agency.

CS 420 Management Information Systems Senior Thesis: 3 semester hours
The MIS Senior Thesis is intended to be one option for the MIS capstone course specifically suited to students with significant professional experience as a team member on at least one large enterprise software development project. Students in this course will work with a faculty member to select a topic relevant to their education and professional experience, design a plan for researching the topic and produce a thesis that reviews and analyzes the research and integrates the research, the learning they have gained from their educational program and from their professional experience into a solution of the problem defined by the chosen topic.

CS 422 IT Security and Risk Management: 3 semester hours
This course introduces the fundamental principles and topics of Information Technology Security and Risk Management at the organizational level. Students will learn critical security principles that enable them to plan, develop, and perform security tasks. The course will address hardware, software, processes, communications, applications, and policies and procedures with respect to organizational IT Security and Risk Management. Prerequisite: BN 340 & CS 326.

CS 425 IT Audit and Controls: 3 semester hours
This course introduces the fundamental concepts of the information technology audit and control functions. This course focuses on understanding information controls, the types of controls, and their impact on the organization and managing and auditing them. The concepts and techniques used in information technology audits will be presented. Students will learn the process of creating a control structure with goals and objectives, audit an information technology infrastructure against it, and establish a systematic remediation procedure for any inadequacies. The course also covers the challenges of dealing with best practices, standards, and regulatory requirements governing information and controls. Prerequisite: BN 340 and CS 326.

CS 430 Senior Project: Management Information Systems: 4 semester hours
This is the capstone course for management information system majors. The student will complete a broad and deep software development project as part of a multi-disciplinary team as project managers. Prerequisites: CS 226, CS 326 and BN 377.

CS 435 Senior Project: Computer Science: 4 semester hours
This is the capstone course for computer science majors. The student will complete a broad and deep software development project as part of a multi-disciplinary team. Prerequisites: CS 388 and (CS 302 or CS 395).

CS 445 Computer Science Independent Study: 3 semester hours
Study topics will be negotiated by the student and his/ her advisor.

DS Courses

DS 101 Introduction to Data Science I: 3 semester hours
Our world is driven by data. In order to navigate this world and understand the influence data and its science has on modern life, students will learn the core concepts of inference, data analysis, and computing. Students will work with real data sets from a variety of fields such as economics, geography, and sociology. Topics will include basic computing techniques using spreadsheets or other computing software, basic statistical concepts such as Bayes' Theorem, and the pitfalls of bias inherent in data sets.

DS 301 Introduction to Data Science II: 3 semester hours
Linear regression and associated techniques are some of the most tested and trusted methods in data science and statistics. In this course, we will develop the skills to apply linear methods to investigate relationships between various types of data, visualize data, and consider the responsible use of such models. Topics may include linear and multiple regression, resampling, model and feature selection, representing analyzed data visually, logistic regression, and the data science life cycle. Python/R will be used throughout. Prerequisites: : MA 162, MA 202, MA 214, CS 106, DS 101.

DS 400 Data Science Techniques I: 3 semester hours
In this course, we will learn a variety of techniques often used in data analysis. Methods for classification and regression may be considered. Students will continue to develop deeper mathematical skills, programming skills using Python/R, the ability to produce high-quality documents conveying the results of data-based analysis, and more. Topics may include classification with tree-based methods and support vector machines, clustering (such as k-means, hierarchical, and spectral), and dimension-reduction (such as principal component analysis). Issues regarding the ethical use of data will be explored. Prerequisite: DS 301.

DS 420 Data Science Techniques II: 3 semester hours
This course will be an introduction to deep learning with artificial neural networks. The course will focus on applications and computations with software such as Python/R but will have significant mathematical content. Issues of appropriate uses, un/interpretability, and ethics in data will be considered in the context of employing neural network models. Topics may include single and multi-layer perceptrons, feedforward networks, recurrent neural networks, convolutional neural networks, and corresponding mathematical foundations. Prerequisite: DS 400.