Master of Science in Data Science

Courses Description and Prerequisites

1- CS501 Research Methods in Computational Studies (3 credits)

This course provides an overview of the important concepts of research design, data collection, statistical and interpretative analysis, and final report presentation. The focus of this course is not on mastery of statistics but on the ability to use research in Computational Studies. Students will prepare a preliminary research design for projects in their subject matter areas and how to accurately collect, analyze and report data. Students will focus on the steps needed to design an individual research project or thesis. The course provides real world active learning assignments that seek to integrate the knowledge and skills gained through undergraduate course work. The course focuses on scientific writing, and oral, written, and graphical presentation of data and research results.

Prerequisite: None

2- DS510 Statistics for Data Science (3 credits)

This course provides an overview of data analysis, data production, and statistical inference. Areas of study include: surveys and designed experiments, randomization, causation, regression, and inference using hypothesis tests. This course also explores using statistical methods for data analysis to improve enterprise performance and quality, effectiveness, and marketability. Statistical software will be utilized to conduct a predictive analysis, analyze the results, and document the findings. The preparation of input data for analysis using R analytical package is also performed.

Prerequisite: None

3- DS540 Advanced Python for Data Science (3 credits)

In this course students will gain an advanced knowledge of programming, design, and testing concepts using Python. Students are introduced to the fundamentals of Python scripting and will become proficient in writing modular Python classes. At the core of class method development, students will write Python methods using lists, dictionaries, conditional logic, and looping controls. Students will also cover how to manipulate and analyze un-curated datasets, utilizing basic statistical analysis and machine learning methods, and visualization results.

Prerequisite: None

4- DS520 Big Data Processing and Analytics (3 credits)

In this course students will identify the tools and techniques for analyzing big data for organizations to follow in creating and sustaining an effective data science function. Students will apply forecasting, simulation, and data modeling for complex problem analysis in medium to large organizations including the use of Apache Hadoop and Spark, and NoSQL Databases.

Prerequisite: DS510 & DS540

5- DS560 Advanced Data Mining (3 credits)

In this advanced course students will investigate various statistical approaches used for data mining analyses. Students will prepare data suitable for analysis from an enterprise data warehouse using SQL and document results. Students will also create a data mining analysis project to demonstrate their understanding of the concepts.

Prerequisite: None

6- DS630 Artificial Intelligence for Data Science (3 credits)

This course explores recent advances in artificial intelligence and incorporates multiple ideas from basic machine learning and assumes familiarity with machine learning concepts. Topics range from human-computer interfaces, computational methods for intelligent control of autonomous agents, programming for pattern recognition, planning for flexible and reactive systems. Core techniques and applications may include game playing, multi-agent coordination; negotiation planning, logical representation, minimax search, Markov decision processes, and other relevant approaches.

Prerequisite: DS540

7- DS610 Advanced Applied Statistics for Data Science (3 credits)

In this course, students will develop a level of competency in applying R for data science. The course covers the basic and intermediate topics in R including variables and basic operations, vectors, matrices, data frames and lists. In addition, students will dive deeper into the graphical capabilities of R and create data visualizations.

Prerequisite: DS510

8- DS620 Data Visualization (3 credits)

This course teaches the essential and practical skills in data visualization and knowledge representation, including computer graphics, visual data representation, physical and human vision models, numerical representation of knowledge and concepts, animation techniques, pattern analysis, and computational methods. Students will gain essential and practical skills in visualization.

Prerequisite: DS560

9- DS550 Machine Learning Algorithms for Data Science (3 credits)

This course focuses on the concepts and constructs of data structures and algorithms that are widely used in machine learning in data science. Data structures is a key computer science discipline that focuses on understanding how to efficiently and effectively organize data. This course will present a number of advanced conceptual and algorithmic topics related to software maintainability, efficiency, and algorithm analysis for machine learning. The topics presented in this course will range from introducing abstract data types (ADTs) such as bags, stacks, queues, deques, and priority queues, to further analyzing the efficiency associated with the ADTS and other algorithms.

Prerequisite: DS520, DS630

10- DS650 Predictive Analytics for Business (3 credits)

This course covers the fundamental predictive analytics and data mining approaches applied in business. It introduces basic concepts and techniques to discover patterns in data, identify variables with the most predictive power, and develop predictive models. Advanced predictive models from business cases will be examined.

Prerequisite: DS560, DS610

11- DS660 Deep Learning Techniques (3 credits)

This course provides an overview of deep learning including the deep neural networks and related machine learning methods. Different deep learning models are reviewed including fundamentals such as Linear Regression and logistic/softmax regression. This course covers Feedforward deep neural networks, the role of different activation functions, normalization and dropout layers. Additional topics include convolutional neural networks, transfer learning (pre-trained models), and other advanced deep learning methods. The course uses Python and PyTorch to provide a practical platform for applying this knowledge.

Prerequisite: DS630

12- DS698 Capstone Project in Data Science (3 credits)

This capstone course provides students with the opportunity to demonstrate competency on the key domains of data science. Students will integrate concepts learned throughout the entire program to develop a comprehensive project in a specific domain of analytics, such as web analytics, social media analytics, big data analytics, or healthcare analytics. Students will undertake a data science problem from data collection and model construction through analysis and presentation of results and recommendations for specific business decisions culminating in a final, publishable paper.

Prerequisite: Department Approval