Course Descriptions for Courses Offered by the AI&DS Program

CSAI 350   Introduction to Artificial Intelligence   (3:3:0)
Pre-requisite(s): CSCI 215 and STAT 346

This course provides an introduction to the different sub-areas of Artificial Intelligence (AI). In addition, students learn basic concepts, methods, and algorithms of AI and how they can be used to solve practical AI problems. The topics include classical and adversarial search & heuristic, knowledge representation, probabilistic reasoning, convex optimization methods, Bayesian methods, reinforcement learning, and supervised and unsupervised learning techniques. Particular focus will be placed on real-world applications of the material.

CSAI 351   Data Science   (3:3:0)
Pre-requisite(s): CSAI 350 and MATH 203

This course provides an introduction to data science and highlights its importance in real world context. Topics include data science concepts, project lifecycle, tools & programming environment, fundamentals of Python programming, numerical processing, data visualization, exploratory data analysis, data preprocessing, parameter optimization, model performance evaluation, and applications of machine learning algorithms in Python (i.e., Naïve Bayes, k-Nearest Neighbors, Linear/Multiple/Logistic Regressions, Decision Trees, and Clustering Applications), natural language processing, and real-world data science case studies.

CSAI 450   Machine Learning   (3:3:0)
Pre-requisite(s): CSAI 350 and CSAI 351
Co-requisite(s): CSAI 451
This course introduces fundamental concepts of machine learning, and provides students with knowledge and understanding of the methods, mathematics, and algorithms used in machine learning. Topics include statistical learning concepts, linear & quadratic discriminant analysis, resampling methods, model selection and regularization, regression & smoothing splines, generalized additive models, regression trees, bagging and boosting, support vector machines, principal components analysis, k-means clustering, hierarchical clustering, and neural networks.

CSAI 451   Machine Learning Lab   (1:0:3)
Co-requisite(s): CSAI 450
This course, which is conducted within a laboratory environment, aims to familiarize students with several techniques used in machine learning. The topics covered include Linear Regression, Classification, Resampling, Linear Model Selection, Tree-Based Methods, Support Vector Machines, and Neural Networks.

CSAI 452   Natural Language Processing   (3:3:0)
Pre-requisite(s): CSAI 450
This course introduces the fundamental concepts and techniques of natural language processing (NLP). Topics include text corpora and conditional frequency distributions, lexical resources and

WordNet, raw text processing and regular expressions, text normalization and lemmatization, structured natural language processing (NLP) programs, part-of-speech tagging, automatic tagging, n-gram, & transformation-based tagging, document and sequence classification, maximum entropy classifiers and modeling linguistic patterns, information extraction, linguistic structure, named entity recognition, & relation extraction, grammatical structure & context free grammar, context free grammar parsers & dependency grammar, and feature based grammars.

CSAI 453   Data Visualization   (3:3:0)
Prerequisite(s): CSAI 350
Data visualization is an essential skill required in today's data-driven world. This course presents principles and techniques to design and create data visualization based on gathered data and the goals of the task at hand. Topics include the value of visualization, data, tasks, validation, marks and channels, design guidelines, tables, networks and trees, spatial, temporal and textual data, interaction and navigation, and data reduction.

CSAI 490   Professional Software Practice   (2:0:2)
Pre-requisite(s): Senior Standing
Co-requisite(s): CSCI 492
The course develops student understanding about various non-technical issues related to the field of computing. The course covers the field from economic, legal, ethical, and professional perspectives. Covered topics include code of conduct, ethics, intellectual property, cyber security, privacy, risk management, and teamwork.

CSCI 492   Senior Design Project I   (2:0:6)
Senior Standing
The course requires seniors to work in small teams to solve significant problems. Over the duration of CSCI 492 and CSCI 493, students design, implement, and evaluate a solution to the problem in conjunction with a faculty advisor. The course reinforces programming principles and serves as a capstone for computing knowledge obtained in the BSCS and BAIDS curricula. The recognition of the ethical and legal principles are also aspects of the course.

CSCI 493   Senior Design Project II   (4:0:12)
Pre-requisite(s): CSCI 492
Implementation of the project for which preliminary work was done in CSCI 492. Project includes designing and constructing software and/or hardware, conducting experiments or studies, and testing and validating a complete system. At the end of the term, each team presents to a committee information related to its project in both written and oral formats.

CSAI 480   Big Data   (3:3:0)
Pre-requisite(s): CSCI 326
This course provides an in-depth coverage of various topics in big data from data generation, storage, management, transfer, to analytics. Topics include Hadoop ecosystem, Hadoop architecture, YARN & HDFS, Sqoop, Apache Hive & Impala, Apache Flume, Apache Spark, resilient distributed datasets (RDDs) in Spark, map reduce in Spark, Spark applications, Spark parallel

processing, SparkSQL, workflow management with Apache Oozie, machine learning in Spark, and big data applications.

CSAI 481   Computer Vision   (3:3:0)
Pre-requisite(s): CSAI 450

This course provides introduction to fundamental topics in computer vision and the application of statistical estimation techniques in this field. It is intended to give students a good basis for work in this important field. Topics include image representation, image processing, image analysis, image segmentation, object tracking, 3D shape reconstruction, feature detection and tracking, object detection, and convolutional neural networks.

CSAI 482   Data Mining   (3:3:0)
Pre-requisite(s): CSAI 350

Data Mining studies algorithms and computational paradigms that allow computers to find patterns and regularities in datasets, then perform prediction/forecasting and generally improve their performance through interaction with data. The course introduces the fundamental concepts of data mining techniques. Topics include data preparation, data classification, performance measures, association rule mining, clustering, outlier detection, collaborative filtering and data mining case studies.

CSAI 483   Information Retrieval   (3:3:0)
Pre-requisite(s): CSCI 326

The course covers basic and advanced techniques necessary to define, design, and implement Information Retrieval (IR) systems, including the following topics: basic IR models, basic tokenizing, indexing, and implementation of vector-space retrieval, experimental evaluation of IR, query operations and languages, text representation, web search, text categorization, language-model based retrieval, recommender systems, information extraction, and integration.

CSAI 484   Internet of Things System   (3:3:0)
Pre-requisite(s): CSCI 232 and CSCI 462

The Internet of Things is an emerging technology in which interconnected devices are embedded within everyday objects enabling them to send and receive data. This course introduces core concepts and networking protocols for IoT applications. Topics covered include: IoT architectures, smart objects, sensing and actuation, displaying information, WPANs, WBANs, IoT clouds, security and privacy for IoT systems, IoT robustness and reliability, and IoT applications.

CSAI 485   Introduction to Deep Learning   (3:3:0)
Pre-requisite(s): CSAI 450

The course provides an introduction to neural networks and deep learning. The topics to be covered include basic conceptual understanding of neural networks, deep learning programming environments, shallow neural networks, radial basis function networks, recurrent neural networks, convolutional neural networks, and deep reinforcement learning.

CSAI 486   Special Topics in Artificial Intelligence   (3:3:0)
Pre-requisite(s): CSAI 350

This course gives instructors the opportunity to cover the latest developments and contemporary issues in Artificial Intelligence. Instructors will provide a detailed course outline at the beginning of the semester.

CSAI 487   Introduction to Robotics   (3:3:0)
Pre-requisite(s): ECEN 331 and CSAI 350

This course introduces fundamentals of robot modelling and control. Topics include forward and inverse kinematics, Jacobians, trajectory design, motion planning, in addition to relevant applications and technologies such as mobile robotics, industrial robotics and computer vision.