

# CAP: Computer Applications (For Computer Scientists) Courses

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## Courses

### **CAP 4136 Malware Analysis**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: CDA 3101

This course covers software reverse engineering of executable code (or malware) to determine its function and affects or to recover the source code implementation.

### **CAP 4520 Containers and Kubernetes**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

Prerequisite: CTS 4348

Containers and Kubernetes are increasingly utilized for agile development and application deployment to improve application time-to-market and maintainability. This course helps students build core knowledge and skills in managing containers through hands-on experience with containers, Kubernetes and container platforms needed for multiple roles, including developers, administrators and site reliability engineers.

### **CAP 4601 Introduction to Artificial Intelligence**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: COP 3022 AND COP 3530

Introduction to Artificial Intelligence principles and techniques. Students will learn about core AI techniques for solving complex problems, including search strategies, knowledge-based techniques, and agent-based systems. Overview of AI topics such as intelligent agents, machine learning, as well as AI applications. May be offered concurrently with CAP 5600. Graduate students will be assigned additional work.

### **CAP 4755 Tools for Data Science**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

An 8-Week course on tools for data science using R, Python, SQL, and Spark. Throughout the course, there will be hands-on exercises with computing resources. The course will include introductions to several packages in R, particularly Tidyverse, libraries in Python such as Pandas/NumPy/Statsmodels, SQL clauses and summary statistics, and Spark framework for distributed computing. Offered concurrently with CAP 5756. Graduate students will be assigned additional work.

### **CAP 4770 Data Mining**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: COP 4710

Exposes students to data mining concepts and techniques and different data mining software. Covers data pre-processing and cleaning, concept hierarchy generation, attribute relevance analysis, association rule mining, classification algorithms, and cluster analysis.

### **CAP 4774 Databases for Data Science**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

Prerequisite: STA 2023 OR MAC 1140

Organizations can generate copious amounts of data. Extracting useful knowledge from data warehouses for use in decision making can provide a competitive advantage for the organization by identifying strengths and weaknesses. In this course, students will learn how the data in data warehouses are organized for both relational and NoSQL databases, analyze the data through analytical queries, and apply machine learning algorithms to build predictive models. Offered concurrently with CAP 5775. Graduate students will be assigned additional work.

### **CAP 4786 Introduction to Big Data Analytics**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: ((COP 4710 AND STA 4321)) AND (COP 3530 OR COP 3022)

This course introduces students to the handling of Big Data on Hadoop's MapReduce environment. Students also learn Spark architecture and programming with the aim of doing big data analytics with machine learning algorithms in Spark.

### **CAP 4905 Directed Study**

College of Sci and Engineering, Department of Computer Science

1-12 sh (may be repeated indefinitely for credit)

### **CAP 5326 Trends in Data Analytics**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

This course focuses on the processing and analysis of the copious amounts of data generated in various domains. Students will utilize standard programming languages and available software packages to design and implement solutions to acquire, process and analyze data in multiple formats. Offered concurrently with CTS 4910. Graduate students will be assigned additional work.

### **CAP 5600 Introduction to Artificial Intelligence**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Introduction to Artificial Intelligence principles and techniques. Students will learn about core AI techniques for solving complex problems, including search strategies, knowledge-based techniques, and agent-based systems. Overview of AI topics such as intelligent agents, machine learning, as well as AI applications. May be offered concurrently with CAP 4601. Graduate students will be assigned additional work.

**CAP 5668 Human Agent/Robot Teamwork**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

Prerequisite: COP 5416 OR COP 5417

This course provides an introduction to human interaction with intelligent systems and robotics. It is a study of how intelligent systems cooperate with humans to achieve a common objective. The course includes seminar discussions and a paper with a practical computer programming assignment.

**CAP 5756 Tools for Data Science**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

An 8-Week course on tools for data science using R, Python, SQL, and Spark. Throughout the course, there will be hands-on exercises with computing resources. The course will include introductions to several packages in R, particularly Tidyverse, libraries in Python such as Pandas/NumPy/Statsmodels, SQL clauses and summary statistics, and Spark framework for distributed computing. Offered concurrently with CAP 4755. Graduate students will be assigned additional work.

**CAP 5775 Databases for Data Science**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

Organizations can generate copious amounts of data. Extracting useful knowledge from data warehouses for use in decision making can provide a competitive advantage for the organization by identifying strengths and weaknesses. In this course, students will learn how the data in data warehouses are organized for both relational and NoSQL databases, analyze the data through analytical queries, and apply machine learning algorithms to build predictive models. Offered concurrently with CAP 4774. Graduate students will be assigned additional work.

**CAP 5905 Directed Study**

College of Sci and Engineering, Department of Computer Science

1-12 sh (may be repeated indefinitely for credit)

**CAP 6579 Advanced Data Mining**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

This course will cover advanced topics in data mining on high dimensional data, including advanced feature selection techniques, advanced pattern mining, similarity searches (including minwise hashing and locality sensitive hashing), advanced classification methods, advanced cluster analysis, mining data streams, mining social networks, tree/graph mining, and privacy-preserving issues in data mining. Students are expected to have a course in data mining before taking this course.

**CAP 6606 Machine Learning for Intelligent Systems and Robotics**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

Machine learning is the study of algorithms and statistical models that computer systems can use to perform tasks relying on patterns and inference without using explicit instructions. It uses interdisciplinary techniques to create automated systems that can sift through volumes of data to make predictions or decisions without human intervention.

This course will introduce students to the fundamental concepts, provide in depth details on theories, models and algorithms of machine learning and review examples of real-world applications.

**CAP 6610 Machine Learning**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

This course provides a broad introduction to modern machine learning, including supervised learning (multiple linear regression, logistic regression, decision trees, and neural network, deep learning, deep sequence modeling, deep convolutional models), unsupervised learning (clustering, dimensionality reduction, anomaly detection, and deep generative models), model evaluation (k-fold cross validation & performance evaluation metrics) and hyper-parameter tuning. The goal of the course is for the students to master the key theoretical concepts and gain the practical know-how to quickly and powerfully apply machine learning to challenging real-world problems via hands-on projects.

**CAP 6624 Introduction to Machine Learning and Data Science**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may be repeated for up to 9 sh of credit)

Models and methods of intelligent systems and robotics focusing on computational methods and their algorithmic performance. Optimization theory, sampling theory, partially observable Markov decision processes, recursive Bayesian filters including Kalman and particle filters supervised and unsupervised machine learning, deep learning, incremental sampling and search.

**CAP 6665 Computer Vision**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

This course introduces and demonstrates the applications and algorithms in Computer Vision. The course includes fundamentals of image processing and formation, feature detection, recognition, and reconstruction. Activities and projects will be used to develop intelligent image processing algorithms. The class provides instructions and practical exercises in detection and segmentation, representation, and understanding geometric structures for computer vision applications. The class will focus on mathematical and theoretical foundations of computer vision methods.

**CAP 6667 Advanced Topics in Intelligent Systems & Robotics**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may be repeated for up to 12 sh of credit)

Prerequisite: EEE 6672 OR EML 6805

This seminar-style course provides doctoral students with an overview of trends in Intelligent Systems and Robotics and prepares them to conduct independent research in the field. Permission of the Instructor is required.

**CAP 6671 Intelligent Agents**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

The course will cover the underlying theory of intelligent agents, both software agents and embodied agents, their implementation, and applications of single and multi-agent systems. The course will address common agent architectures and various methods of agent cooperation. The course will also explore how a range of other Artificial Intelligence techniques such as knowledge representation, reasoning, machine learning, planning, ontologies, and natural language interaction are leveraged by agents. Students will construct their own agents in order to solve a range of problems. The course will employ simulations of multi-agent systems involving both cooperating and competing agents. Students are expected to have a background with computer networks.

**CAP 6771 Data Mining**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: COP 5725

The course addresses methods to discover patterns and trends in large datasets. With the aid of contemporary data mining software, students will apply the theoretical skills they acquire in the course to go through the complete data mining process starting from data pre-processing and cleaning, concept hierarchy generation, attribute relevance analysis to frequent itemset mining and association rule mining. Traditional methods such as Bayesian decision theory as well as modern approaches in classification and unsupervised clustering will be covered as well.

**CAP 6772 Data Warehousing**

College of Sci and Engineering, Department of Department of Information Tech

3 sh (may not be repeated for credit)

Prerequisite: COP 5725

The primary focus of this course is on Data Warehousing and its applications to business intelligence. Some areas of concentration are: requirements gathering for data warehousing; data warehouse architecture; dimensional model design for data warehousing; physical database design for data warehousing; extracting, transforming, and loading strategies; introduction to business intelligence; design and development of business intelligence applications; expansion and support of a data warehouse. Prerequisites are COP 4710 or COP 5725 with a minimum grade of C.

**CAP 6789 Advanced Big Data Analytics**

College of Sci and Engineering, Department of Computer Science

3 sh (may not be repeated for credit)

Prerequisite: CAP 6771 AND COP 5725

In this course students study advanced methods to handle and analyze very large data sets in Hadoop's Big Data environment. Students work with the Spark architecture in the MapReduce framework. Students also learn to apply machine learning algorithms in Spark.

**CAP 6905 Directed Study**

College of Sci and Engineering, Department of Computer Science

1-12 sh (may be repeated indefinitely for credit)

**CAP 7640 Topics in Natural Language Processing**

College of Sci and Engineering, Department of Intelligent Systems & Robotics

3 sh (may not be repeated for credit)

This course covers fundamental concepts in processing natural language text. It provides an in-depth examination of state-of-the-art knowledge-based and statistical methods to process unstructured text, perform word and sentence-level syntactic and semantic analysis, and build machine representations to perform different natural language tasks. The course covers a variety of applications of these methods including syntactic parsing, word sense disambiguation, text classification, information extraction, text summarization, language generation, language translation, and dialogue systems. Students taking this course are expected to have a background in computer programming and mathematical statistics. Successful completion of coursework is necessary to enroll in the dissertation.