

AAI-APPLIED ARTIFICIAL INTELLIGENCE

AAI 3103 Robotic Systems 3 Credit Hours

Prerequisite: C S 1213 and MATH 1914 or MATH 2123 or MATH 2423.

This course introduces the field of robotics and robotic control systems.

The course reviews the history of robotics and then focuses on the concepts of reactive and deliberative paradigms. It then presents concepts and practical examples of guidance systems. Much of the course is dedicated to a major project involving the construction of a robotic system. (F)

AAI 3113 Data Visualization 3 Credit Hours

Prerequisite: C S 1213 or C S 1321 or C S 1323 or C S 1324 or equivalent.

This course provides a practical overview of data visualization techniques. It describes visualization types, including bar charts, time series, scatter plots, maps, etc. Students learn how to build visualizations using a standard software package. Visualization of data using Python packages and the incorporation of data visualization into Python notebooks are presented. The course focuses on effective data presentation and storytelling. (Sp)

AAI 3213 Big Data Computing 3 Credit Hours

Prerequisite: CYBS 3913. This course provides an overview of systems used to manage and process big data. It describes GPU architecture and their use in computing. Students learn how to configure CUDA and use of GPUs in Python programming. The course presents an overview of distributed computing and applications. A practical description of Apache Hadoop is provided, including Hive, MapReduce, and Spark. (Sp)

AAI 3303 Machine Learning I 3 Credit Hours

Prerequisite: C S 1213 and MATH 1914 or MATH 2123 or MATH 2423.

This course reviews the machine learning (ML) process and presents a set of basic ML methods. The course describes proper modeling techniques, including model evaluation and hyperparameter tuning. The course presents some methods from basic ML categories: supervised learning including regression and classification, and unsupervised learning. For each method, its mathematical intuition is presented with applied programming. (F)

AAI 3313 Machine Learning II 3 Credit Hours

Prerequisite: AAI 3303 and AAI 3333. Mathematical optimization methods are introduced. Common methods in regression, classification, and unsupervised learning are explored. The mathematical theory of each model is presented in detail, and its hyperparameters are described. Feature reduction is described, including its foundation in linear algebra. Mathematical optimization techniques, including linear programming, integer programming, and non-linear optimization are presented. (Sp)

AAI 3323 Reinforcement Learning 3 Credit Hours

Prerequisite: CS 1213 and MATH 1914 or MATH 2123 or MATH 2423.

This course will introduce reinforcement learning (RL), a computing method in which agents solve problems, through repeated attempts resulting in penalties or rewards based on trial outcomes. The course discusses multi-armed bandits and progresses to other topics including Markov decision processes, on-policy and off-policy learning. The course reviews practical applications of RL. Lectures are supported by coding assignments in Python. (F)

AAI 3333 Mathematics of Artificial Intelligence 3 Credit Hours

Prerequisite: MATH 1914 or MATH 2123 or MATH 2423. This course introduces two mathematical disciplines that form a foundation for AI/ML algorithms. Linear algebra lessons cover systems of linear equations, matrices, determinants, vector spaces, bases, dimension, eigenvalues, and eigenvectors. Probability theory covers counting, conditional probability, discrete and continuous random variables, probability distributions, likelihood, curve fitting, and regression. This course focuses on applications and emphasizes conceptual understanding and application. (F)

AAI 3440 Mentored Research Experience 3 Credit Hours

0 to 3 hours. Prerequisite: ENGL 1113 or equivalent, and permission of instructor; May be repeated, maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

AAI 3990 Independent Study 1-3 Credit Hours

1 to 3 hours. Prerequisite: Permission of instructor and junior standing. May be repeated once with change of content. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)

AAI 4103 Natural Language Processing 3 Credit Hours

(Slashlisted with AAI 5103) Prerequisite: AAI 4303. This course will provide a review of natural language processing (NLP) methods. It presents the intuition behind major approaches to NLP problems such as translation. Concepts include word corpora, probabilistic methods, and Python libraries including NLTK and SpaCy. The course presents generative AI with a focus on transformers and modern tools such as OpenAI. No student may earn credit for both 4103 and 5103. (Sp)

AAI 4113 Computer Vision and Image Recognition 3 Credit Hours

(Slashlisted with AAI 5113) Prerequisite: AAI 3313. This course introduces the field of computer vision. Topics include image recognition and formation, reconstruction of 3D images from 2D renderings, scene understanding, and motion tracking. It includes reviews and overviews of the mathematics behind computer vision. It also includes a conceptual overview of convolutional neural networks and their application to image recognition. No student may earn credit for both 4113 and 5113. (F)

AAI 4203 Advanced Database Systems 3 Credit Hours

(Slashlisted with AAI 5203) Prerequisite: CYBS 3913. This course focuses on technologies used for massive datasets and unstructured data. Students learn how to implement Spark RDBs with distributed computing resources. The course presents NoSQL databases, their use and implementation. Graph databases and management of unstructured data and its incorporation into databases are presented. In all cases, students will build and manage databases using current common application frameworks. No student may earn credit for both 4203 and 5203. (Sp)

AAI 4303 Deep Learning I 3 Credit Hours

(Slashlisted with AAI 5303) Prerequisite: AAI 3313. This course will introduce deep learning through neural network programming. The course introduces the concept of the artificial neuron and progresses to describe multi-layer neural networks with a focus on the mathematics that make them work. The course describes how TensorFlow and PyTorch solve neural networks, and students build basic neural networks using these tools. No student may earn credit for both 4303 and 5303. (F)

- AAI 4313 Deep Learning II** **3 Credit Hours**
 (Slashlisted with AAI 5313) Prerequisite: AAI 4303. This course reviews various modifications to basic neural networks. Topics include convolutional neural networks (CNNs), recurrent neural networks (RNNs), and long short-term memory neural networks (LSTMs). The intuition behind the algorithms is presented and the mathematics for each compute element are reviewed. Students program the methods in TensorFlow or PyTorch. This course emphasizes the practical applications for each method. No student may earn credit for both 4313 and 5313. (F, Sp)
- AAI 4323 Ethics of AI and Machine Learning** **3 Credit Hours**
 (Slashlisted with AAI 5323) Prerequisite: AAI 3313. This course provides a survey of legal and ethical topics associated with AI and ML. Global laws and regulations associated with AI and ML are reviewed and their impact on practitioners will be discussed. The algorithmic causes of bias will be reviewed, and methods to alleviate those will be discussed. Methods for bias measurement in AI/ML models will be presented. No student may earn credit for both 4323 and 5323. (F)
- AAI 4333 Applications of Deep Learning** **3 Credit Hours**
 (Slashlisted with AAI 5333) Prerequisite: AAI 4303. This course builds upon the concepts presented in Deep Learning I by reviewing various modifications to basic neural networks. Topics include convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory neural networks (LSTMs), and transformers. In each case, the intuition behind the algorithm is presented and students construct basic models using PyTorch and/or TensorFlow. No student may earn credit for both 4333 and 5333. (Sp)
- AAI 4903 AAI Capstone Project** **3 Credit Hours**
 Prerequisite: AAI 4303 and Senior Standing. Provides the students with an experience to exhibit their knowledge and skills in areas of artificial intelligence. Students work in small groups to identify and scope an artificial intelligence problem and/or challenges. Required to write a proposal about their project and asked to create a work plan to develop solutions to solve the problem/challenge. Create a final report and presentation. (Sp)
- AAI 4990 Independent Study** **1-3 Credit Hours**
 1 to 3 hours. Prerequisite: permission of instructor and senior standing; May be repeated once with change of content, maximum credit 6 hours. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)
- AAI 5103 Natural Language Processing** **3 Credit Hours**
 (Slashlisted with AAI 4103) Prerequisite: Graduate Standing. This course will provide a review of natural language processing (NLP) methods. It presents the intuition behind major approaches to NLP problems such as translation. Concepts include word corpora, probabilistic methods, and Python libraries including NLTK and SpaCy. The course presents generative AI with a focus on transformers and modern tools such as OpenAI. No student may earn credit for both 4103 and 5103. (Sp)
- AAI 5113 Computer Vision and Image Recognition** **3 Credit Hours**
 (Slashlisted with AAI 4113) Prerequisite: Graduate Standing. This course introduces the field of computer vision. Topics include image recognition and formation, reconstruction of 3D images from 2D renderings, scene understanding, and motion tracking. It includes reviews and overviews of the mathematics behind computer vision. It also includes a conceptual overview of convolutional neural networks and their application to image recognition. No student may earn credit for both 4113 and 5113. (F)
- AAI 5203 Advanced Database Systems** **3 Credit Hours**
 (Slashlisted with AAI 4203) Prerequisite: Graduate Standing. This course focuses on technologies used for massive datasets and unstructured data. Students learn how to implement Spark RDBs with distributed computing resources. The course presents NoSQL databases, their use and implementation. Graph databases and management of unstructured data and its incorporation into databases are presented. In all cases, students will build and manage databases using current common application frameworks. No student may earn credit for both 4203 and 5203. (Sp)
- AAI 5303 Deep Learning I** **3 Credit Hours**
 (Slashlisted with AAI 4303) Prerequisite: Graduate Standing. This course will introduce deep learning through neural network programming. The course introduces the concept of the artificial neuron and progresses to describe multi-layer neural networks with a focus on the mathematics that make them work. The course describes how TensorFlow and PyTorch solve neural networks, and students build basic neural networks using these tools. No student may earn credit for both 4303 and 5303. (F)
- AAI 5313 Deep Learning II** **3 Credit Hours**
 (Slashlisted with AAI 4313) Prerequisite: Graduate standing and AAI 5303. This course reviews various modifications to basic neural networks. Topics include convolutional neural networks (CNNs), recurrent neural networks (RNNs), and long short-term memory neural networks (LSTMs). The intuition behind the algorithms is presented and the mathematics for each compute element are reviewed. Students program the methods in TensorFlow or PyTorch. This course emphasizes the practical applications for each method. No student may earn credit for both 4313 and 5313. (F, Sp)
- AAI 5323 Ethics of AI and Machine Learning** **3 Credit Hours**
 (Slashlisted with AAI 4323) Prerequisite: Graduate Standing. This course provides a survey of legal and ethical topics associated with AI and ML. Global laws and regulations associated with AI and ML are reviewed and their impact on practitioners will be discussed. The algorithmic causes of bias will be reviewed, and methods to alleviate those will be discussed. Methods for bias measurement in AI/ML models will be presented. No student may earn credit for both 4323 and 5323. (F)
- AAI 5333 Applications of Deep Learning** **3 Credit Hours**
 (Slashlisted with AAI 4333) Prerequisite: Graduate Standing. This course builds upon the concepts presented in Deep Learning I by reviewing various modifications to basic neural networks. Topics include convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory neural networks (LSTMs), and transformers. In each case, the intuition behind the algorithm is presented and students construct basic models using PyTorch and/or TensorFlow. No student may earn credit for both 4333 and 5333. (Sp)
- AAI 5903 Master's Practicum** **3 Credit Hours**
 Prerequisite: Graduate Standing. The course provides students with knowledge and skills in all areas of artificial intelligence. Students will work in small groups to identify and solve current artificial intelligence challenges. Students will be required to write a proposal about their project, create a work plan to solve the problem/challenge, and create a final report, with final presentation. (Sp)
- AAI 5960 Directed Readings** **1-3 Credit Hours**
 1 to 3 hours. Prerequisite: Graduate standing and departmental permission. Directed readings and/or literature reviews under the direction of a faculty member. May be repeated; maximum credit six hours. (F, Sp, Su)

AAI 5980 Research for Master's Thesis 2-9 Credit Hours

2 to 9 hours. Prerequisite: Graduate Standing and Instructor Permission. Directed research culminating in the completion of the master's thesis. Variable enrollment, permission of instructor required, two to nine hours; maximum credit required for degree, six hours. (F, Sp)

AAI 5990 Independent Study 1-3 Credit Hours

1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. May be repeated; maximum credit six hours. (Irreg.)