WASC Senior College and University Commission

University of San Diego SHILEY-MARCOS SCHOOL OF ENGINEERING

Master of Science in Applied Artificial Intelligence

CURRICULUM DESIGN

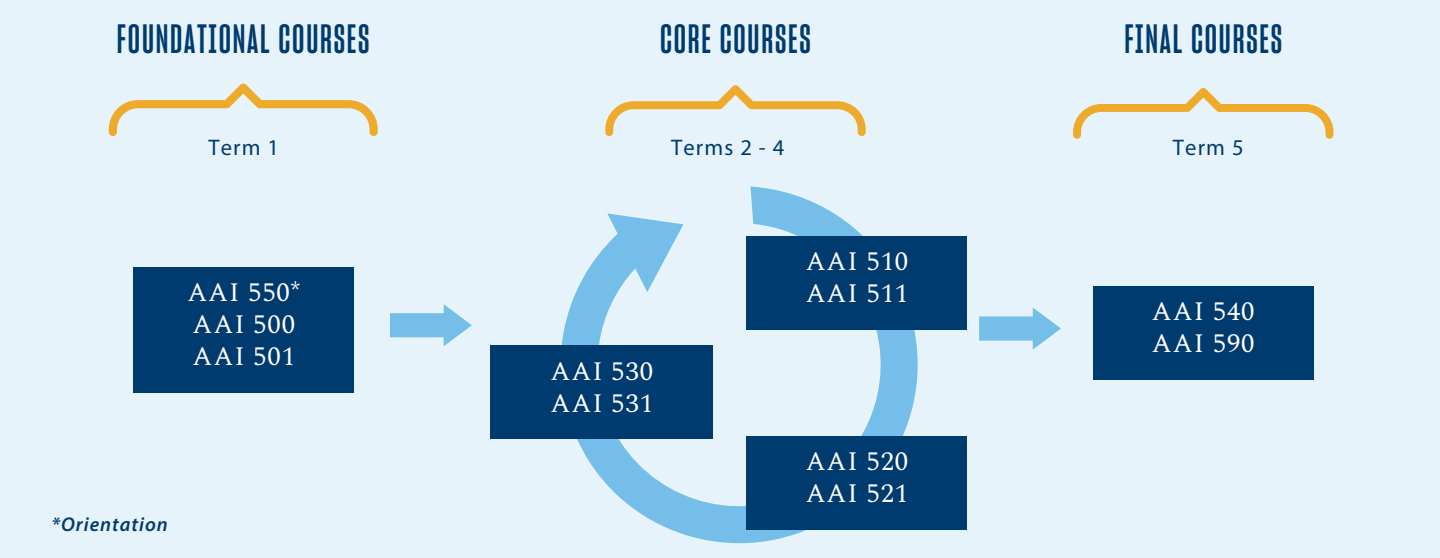
The University of San Diego's 100% online Master of Science in Applied Artificial Intelligence (AAI) is committed to training current and future artificial intelligence professionals for success in this fast-growing field.

This 30-unit program provides asynchronous coursework and can be completed in five terms where students will complete six units per term, focusing on one course at a time. Applications are accepted all year round and students may start the program in either the Fall, Spring or Summer. Program courses place a significant emphasis on real-world applications, ethics, privacy, moral responsibility and social good in designing AI-enabled products.

Below is a visual that represents the course schedule journey that a graduate student will follow. Students will begin with foundational courses, then move forward to the core courses and then conclude the program with the final core course and capstone project where they will work in teams to simulate a real-world experience of identifying and solving an AI-enabled system problem.

PROGRAM OBJECTIVES

- *Develop technologies for the deployment of AI-based systems and software for automated decision making.*
- *Apply principles and techniques of AI such as machine learning, computer vision and NLP and IoT to tackle problems in industry related to technology, operations, health care, defense, finance, marketing and corporate development.*
- *Apply ethical standards, privacy preserving techniques and socially responsible practices to the collection, dissemination and analysis of data for data-driven business decision making.*
- *Be effective leaders and managers in articulating the value of AI-based systems and software for organizations and corporations.*
- *Apply AI-based techniques and decision making for solving engineering problems while advancing the social good.*



ORIENTATION COURSE

AAI 550 - New Student Orientation

This orientation course introduces students to the University of San Diego and provides important information about the MS-AAI program and the technologies that will be used throughout the program. In the orientation, students will learn to successfully navigate through the learning environment and locate helpful resources. Students will practice completing tasks as preparation for success in their online graduate courses. This orientation course will be available to students as a reference tool throughout the entirety of the program.

FOUNDATIONAL COURSES

AAI 500 - Probability and Statistics for Artificial Intelligence

This course is an introduction to probability and statistical concepts and their applications in solving real-world problems, as well as an introduction to coding in Python. This introductory course provides a solid background in the application of probability and statistics that will form the basis for advanced AI methods. Statistical concepts, probability theory, random and multivariate variables, data and sampling distributions, descriptive statistics, and hypothesis testing will be covered. In addition, the use of Python for the performance of basic statistics will be covered in this course. Covered topics include the numerical and graphical description of data, elements of probability, sampling distributions, probability distribution functions, estimation of population parameters, and hypothesis tests. This course will combine the learnings from texts, case studies, and standard organizational processes with practical problem-solving skills to present, structure, and plan the problem as it would be presented in large enterprises and execute the steps in a structured analytics process. Team collaboration, professional presenting, and academic writing will be covered as well through a final team project.

AAI 501 - Introduction to Artificial Intelligence

Recent advances in big data, computational power, smart homes, and autonomous vehicles have rendered artificial intelligence (AI) as a major technological revolution in engineering and computer science. The goal of this course is to introduce students to the fundamental principles, techniques, challenges, and applications of AI, machine learning, and natural language processing. Topics covered include heuristic search and optimization techniques, genetic algorithms, machine learning, neural networks, and natural language understanding. Several applications of AI will be explored, including computer vision, pattern recognition, image processing, biomedical systems, Internet of Things, and robotics.

CORE COURSES

AAI 510 - Machine Learning: Fundamentals and Applications

Machine Learning (ML), as part of Artificial Intelligence, is an interdisciplinary field that combines techniques from learning algorithms and statistics to make predictions or decisions without human intervention. Machine learning applications include business intelligence, biomedical systems, security, and automation. This class will introduce students to the fundamental concepts and algorithms for machine learning. We will learn supervised learning and unsupervised learning techniques such as hidden Markov models, support vector machines, clustering, and dimensionality reduction using Python. Students will acquire skills and knowledge on incorporating ethical issues in machine learning. Students will learn concepts such as dehumanization effects and amplification of human biases that are transferred into training data affecting machine learning.

AAI 511 - Neural Networks and Deep Learning

Neural networks have enjoyed several waves of popularity over the past half-century. The many applications of neural networks include apps that identify people in photos, automated vision systems for large-scale object recognition, smart home appliances that recognize continuous, natural speech, self-driving cars, and software that translates from any language to any other language. In this course, students will learn the fundamental principles and concepts of neural networks and state-of-the-art approaches to deep learning using in-demand Python packages, such as TensorFlow and PyTorch. Students will learn to design neural network architectures and training methods using hands-on assignments and will perform comprehensive final projects in this course.

AAI 520 - Natural Language Processing and GenAI

This course is focused on understanding a variety of ways to represent human language as computational systems and how to exploit those representations to develop programs for translation, summarization, extracting information, question answering, natural interfaces to databases, and conversational agents. This course will include concepts central to Machine Learning (discrete classification, probability models) and to Linguistics (morphology, syntax, semantics). Students will learn computational treatments of words, sounds, sentences, meanings, and conversations. Students will understand how probabilities and real-world text data can help. The course covers some high-level formalisms (e.g., regular expressions) and tools (e.g., Python) that can greatly simplify prototype implementation. Students will learn techniques to address the social impact of natural language processing, such as demographic bias, exclusion, and overgeneralization.

AAI 521 - Applied Computer Vision for AI

This course provides an introduction to computer vision. Computer vision uses a combination of traditional AI, machine learning, image processing, and mathematical theories to provide ways of programming a computer to understand visual imagery, whether a static picture, stereo vision for a robot, or motion from video. Topics covered include fundamentals of feature detection and extraction, motion estimation and tracking, image processing, and object and scene recognition. Students will learn fundamental concepts of computer vision as well as gain hands-on experience in solving real-world vision problems. A variety of tools will be introduced in this course, but the main focus will be on Python and OpenCV, as well as TensorFlow and Keras.

AAI 530 - Data Analytics and Internet of Things

Recent advances in smart devices and technologies have enabled cars, smartphones, TVs, refrigerators, and several other devices to be connected to each other to build, operate, and manage the physical world. The Internet of Things (IoT) has significant potential to impact how individuals live and work by providing the tools necessary for innovative decision-making. The application of AI in IoT requires an understanding of machine learning algorithms, sensors, networking, and data analytics. To prepare our students as forerunners in AI, this course will introduce and practice a wide range of topics in the broad areas of IoT and data analytics and provide hands-on learning experiences and real-world applications. In addition, students will acquire knowledge of the ethics and law in IoT-enabled systems. Concepts in IoT ethics, such as data security, privacy, trustworthiness, and transparency of data, will be discussed in detail.

AAI 531 - Applied AI Ethics

This course explores the ethical, social, and environmental implications of Artificial Intelligence (AI) and related technologies through the lens of core ethical principles, including human dignity, bias, fairness, privacy, safety, explainability (XAI), transparency, responsibility, and governance. Through theoretical discussions, real-world case studies, and hands-on labs, students will examine how AI systems can be designed to mitigate bias, enhance transparency, and protect user privacy while also considering AI's environmental impact, including its role in electronic waste, energy consumption, and resource extraction.

Students will investigate AI's broader social, political, and economic effects, such as labor displacement, economic inequality, and systemic bias reinforcement. The course also examines how AI-driven technologies can perpetuate global power imbalances and disproportionately impact communities. To provide a structured ethical foundation, students will explore philosophical frameworks that inform AI ethics, enabling them to evaluate the ethical dimensions of AI decision-making. Through hands-on practice, students will learn to measure bias using fairness metrics, implement bias mitigation strategies, and apply XAI techniques to improve AI model transparency and accountability. They will also be introduced to ethics impact assessments, guiding them in identifying key stakeholders and evaluating risks and unintended consequences of AI systems. By engaging with real-world case studies, students will critically analyze AI's impact, assess international regulatory frameworks, and explore governance strategies to ensure AI operates within ethical and legal boundaries.

FINAL CORE AND CAPSTONE

AAI 540 - Machine Learning Operations

Interest in and usage of Machine Learning systems has increased dramatically in recent years. More and more innovative products and research rely on Machine Learning systems that leverage data to make predictions and identify trends. However - as with many cutting-edge fields - Machine Learning systems are often implemented improperly. As a result, many Machine Learning systems are unreliable, inefficient, or even useless. Machine Learning Operations (MLOps) is a methodology whose goal is to design, build, deploy, and maintain machine learning models properly. MLOps combines practices from Machine Learning, Data Engineering, and DevOps to assist ensure that Machine Learning models and algorithms are reliable, efficient, and - most importantly - useful.

This course will introduce students to the key concepts of MLOps and a holistic method of designing suitable ML systems. Students will learn and perform the best practices for building Machine Learning systems with hands-on learning experiences and real-world applications. While students will learn about and implement some Machine Learning algorithms in this course, this course is not intended to teach them about the field of Machine Learning. Rather, students will learn how to properly design Machine Learning systems throughout the entire lifecycle.

AAI 590 - Capstone Project

In this course, students learn how the knowledge and skills acquired in the Master's program can be directly applied to develop AI-enabled systems. Students will apply skills acquired in the program to effectively address ethical, moral, and social issues in their design process. Students work in teams and participate in the identification of a problem, develop a project proposal outlining an approach to the problem's solution, implement the proposed solution, and test or evaluate the result in this Capstone using tools and technologies that were taught through the entire program.