# ARTIFICIAL INTELLIGENCE - MASTER OF SCIENCE (MSAI) ONLINE

The Master of Science in Artificial Intelligence (MSAI) is a professional degree that prepares engineers, applied scientists and technical professionals for career advancement in advanced technical and technical leadership roles in the rapidly growing field of artificial intelligence engineering. The core curriculum addresses a breadth of areas central to AI engineering expertise including machine learning, statistical learning, data mining and ethics.

## Program Policies

This CU Boulder on Coursera program does not align with standard campus policies. Please refer to the Online Programs (https://catalog.colorado.edu/online/) section of the catalog for more information.

## Requirements

The MSAI on Coursera is a non-thesis degree program that requires 30 credit hours of graduate-level coursework. This includes 15 credits of required breadth coursework and a choice of 15 credits hours of elective coursework from the options listed below. Students must complete 5 elective specializations or a combination of 4 complete elective specializations and three 1-credit elective courses totaling 15 credits.

### Outside Electives

Up to 6 graduate-level credit hours of courses offered by other CU degrees on Coursera may be applied as elective credits toward the MSAI on Coursera degree. All courses must be graduate level, offered through Coursera, and meet all applicable academic standards. This includes all courses offered by the ME-EM (https://catalog.colorado.edu/graduate/colleges-schools/engineering-applied-science/programs-study/engineering-management/engineering-management-master-engineering-me-online/), MS-DS (https://catalog.colorado.edu/graduate/colleges-schools/interdisciplinary-programs/data-science-master-science-ms-online/), and MS-EE (https://catalog.colorado.edu/graduate/colleges-schools/engineering-applied-science/programs-study/electrical-engineering/electrical-engineering-master-science-online-msee/) programs on Coursera that do not start with a "CSCA" prefix, with the exception of the following courses. Credit from these courses *cannot* be applied toward MS-AI on Coursera requirements:

- DTSA 5302 Cybersecurity for Data Science
- DTSA 5303 Ethical Issues in Data Science
- DTSA 5501 Algorithms for Searching, Sorting, and Indexing
- DTSA 5502 Trees and Graphs: Basics
- DTSA 5707 Deep Learning Applications for Computer Vision /CSCA 5812

Cross-listed courses do not count as outside electives. Note that courses cross-listed with the MS-AI electives listed below are not considered outside electives and do not count against this six-credit limit.

Courses may ***not*** be double-counted toward two credentials of the same level. This means students can apply credit from a particular course toward one graduate certificate and one graduate degree, but they cannot apply credit from a particular course toward two graduate certificates or two graduate degrees. If you want to complete degrees in more than one program, you must complete all the requirements for both degrees with no shared or overlapping course work. CU certificates on Coursera are automatically conferred once all requirements are met.

The MSAI on Coursera requires a minimum cumulative GPA of 3.00 and a grade of B or better in each breadth class (including the two required pathway specializations and the three additional required breadth specializations). Courses in which grades below C (2.0) are received may not be applied toward degree requirements.

| Code | Title | Credit Hours |
|---|---|---|
| **Breadth Courses (required)** | | **15** |
| Take all 5 complete specializations listed below, for a total of 15 credits. | | |
| *Machine Learning (Pathway Specialization)* | | |
| CSCA 5622 | Introduction to Machine Learning: Supervised Learning | |
| CSCA 5632 | Unsupervised Algorithms in Machine Learning | |
| CSCA 5642 | Introduction to Deep Learning | |
| *Foundations of Probability and Statistics (Pathway Specialization)* | | |
| APPA 5001 | Probability Foundations for Data Science and AI | |
| APPA 5002 | Discrete-Time Markov Chains and Monte Carlo Methods | |
| APPA 5003 | Statistical Estimation for Data Science and AI | |
| *Introduction to Artificial Intelligence* | | |
| CSCA 5002 | Intelligent Agents and Search Algorithms | |
| CSCA 5012 | Knowledge Representation and Reasoning Under Uncertainty | |
| CSCA 5022 | Introduction to Learning | |
| *Artificial Intelligence Ethics* | | |
| CSCA 5204 | Current Issues in Ethics and AI | |
| CSCA 5274 | AI Regulation | |
| CSCA 5284 | AI and the Future of Society | |
| *Reinforcement Learning* | | |
| CSCA 5902 | Mastering Classic Reinforcement Learning Algorithms | |
| CSCA 5912 | Deep Reinforcement Learning: From Theory to Practice | |
| CSCA 5922 | Reward Programming: Optimizing RL Efficiency and Safety | |
| **Electives** | | **15** |
| Choose five specializations from the options below or combination of four complete specializations and three 1-credit courses totaling 15 credits | | |
| *Data Mining Foundations and Practice* | | |
| CSCA 5502 | Data Mining Pipeline | |
| CSCA 5512 | Data Mining Methods | |
| CSCA 5522 | Data Mining Project | |
| *Natural Language Processing* | | |
| CSCA 5832 | Fundamentals of Natural Language Processing | |

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| CSCA 5842 | Deep Learning for Natural Language Processing |
| CSCA 5852 | Model and Error Analysis for Natural Language Processing |
| *Robotics* | |
| CSCA 5312 | Basic Robotic Behaviors and Odometry |
| CSCA 5332 | Robotic Mapping and Trajectory Generation |
| CSCA 5342 | Robotic Path Planning and Task Execution |
| *Fair Machine Learning* | |
| INFA 5101 | Fair Machine Learning: Foundations |
| INFA 5102 | Fair Machine Learning: Algorithms |
| INFA 5103 | Fair Machine Learning: Applications |
| *Brains & Machines: Modeling Intelligence with Neural Networks* | |
| APPA 5401 | Foundations of Computational Neuroscience and Neural Models |
| APPA 5402 | Learning, Inference, and Neural Data Analysis |
| APPA 5403 | Advanced Topics in Neuroscience-Inspired AI |
| *Computer Vision* | |
| CSCA 5222 | Introduction to Computer Vision |
| CSCA 5322 | Deep Learning for Computer Vision |
| CSCA 5422 | Modern AI Models for Vision and Multimodal Understanding |
| *Generative AI* | |
| CSCA 5112 | Introduction to Generative AI |
| CSCA 5122 | Modern Applications of Generative AI |
| CSCA 5132 | Advances in Generative AI |
| *Software Architecture for Big Data* | |
| CSCA 5008 | Fundamentals of Software Architecture for Big Data |
| CSCA 5018 | Software Architecture Patterns for Big Data |
| CSCA 5028 | Applications of Software Architecture for Big Data |
| *Network Systems: Principles and Practice (Linux and Cloud Networking)* | |
| CSCA 5063 | Network Systems Foundation |
| CSCA 5073 | Network Principles in Practice: Linux Networking |
| CSCA 5083 | Network Principles in Practice: Cloud Networking |
| *Linux System Administration* | |
| CSCA 5113 | Users, Permissions and Command Line Use |
| CSCA 5123 | Installing and Maintaining Software and Hardware |
| CSCA 5133 | Networking and Security |
| *Computing, Ethics, and Society* | |
| CSCA 5214 | Computing, Ethics, and Society Foundations |
| CSCA 5224 | Ethical Issues in AI and Professional Ethics |
| CSCA 5234 | Ethical Issues in Computing Applications |
| *Security and Ethical Hacking* | |
| CSCA 5303 | Security and Ethical Hacking: Attacking the Network |
| CSCA 5313 | Security and Ethical Hacking: Attacking Unix and Windows |
| CSCA 5323 | Security and Ethical Hacking: Attacking Web and AI Systems |
| *Foundations of Data Structures and Algorithms* | |
| CSCA 5414 | Dynamic Programming, Greedy Algorithms |
| CSCA 5424 | Approximation Algorithms and Linear Programming |
| CSCA 5454 | Advanced Data Structures, RSA and Quantum Algorithms |
| *Object-Oriented Analysis & Design* | |
| CSCA 5428 | Object-Oriented Analysis and Design: Foundations and Concepts |
| CSCA 5438 | Object-Oriented Analysis and Design: Patterns and Principles |
| CSCA 5448 | Object-Oriented Analysis and Design: Practice and Architecture |
| *Internet Policy: Principles and Problems* | |
| CSCA 5433 | When to Regulate? The Digital Divide and Net Neutrality |
| CSCA 5443 | Protecting Individual Privacy on the Internet |
| CSCA 5453 | Cybersecurity in Crisis: Information and Internet Security |
| *Foundations of Autonomous Systems* | |
| CSCA 5834 | Modeling of Autonomous Systems |
| CSCA 5844 | Requirement Specifications for Autonomous Systems |
| CSCA 5854 | Verification and Synthesis of Autonomous Systems |
| *Introduction to Human-Computer Interaction* | |
| CSCA 5859 | Ideating and Prototyping Interfaces |
| CSCA 5869 | User Interface Testing and Usability |
| CSCA 5879 | Emerging Topics in HCI: Designing for VR, AR, AI |
| **Standalone Electives** | |
| CSCA 5702 | Fundamentals of Data Visualization |

# Learning Outcomes

Through the completion of the program, students will be able to:

- Demonstrate an understanding of the mathematical and computational foundations of AI.
- Design state of the art AI techniques to solve problems of relevance to industry and society at large.
- Use existing AI tools and techniques with an expert understanding of the principles behind their design and operation, and advance new AI tools and techniques to push the boundaries of AI.
- Apply AI techniques to diverse areas including healthcare, finance, education, engineering design and government.

- Keep up with the evolution of AI technology and maintain a lifelong professional readiness to adapt with the changing technology landscape.
- Appreciate the ethical implications of AI technology and the potential pitfalls behind specific deployments of AI techniques.