Artificial Intelligence Engineering, MS (CSE)

The Master of Science (MS) in Artificial Intelligence (AI) Engineering is intended for students interested in developing the core engineering skills that will allow them to build and operate sophisticated AI systems in support of a broad range of applications. This requires deep knowledge of the algorithms on which those systems are based and sophisticated computational skills to implement those algorithms and select and operate the proper computing infrastructure. This can be either a pure course-option program, or it can incorporate a research experience via a project or a thesis. If a student chooses a degree option that incorporates a research experience, this MS degree may provide a solid stepping stone to future doctoral studies. All students in the MS in AI Engineering program must have previously completed (as documented by their undergraduate transcript), successfully test to place out of, or complete at the start of their program the following courses: CSE 1301 Introduction to Computer Science and CSE 2407 Data Structures and Algorithms (or equivalent courses offered at other institutions).

General Degree Requirements

The master's degree requires a minimum of 30 credit units, with 18 credit units of core requirements and 12 credit units of electives. A student may only complete at most 12 credit units at the 4000 level toward these requirements. Per School of Engineering guidelines, students must maintain a grade point average of at least 2.70. In addition, the required core courses must be completed with no more than one grade below a B, and electives must be completed with no more than one grade below a B–. Up to 6 graduate credit units may be transferred with the approval of the department, in alignment with policies from the McKelvey School Graduate Studies Committee and found in the McKelvey Bulletin.

The degree has three completion routes that may appeal to different students' interests: coursework only, project option, or thesis option. Students pursuing the coursework-only route will complete 30 units of traditional coursework via a combination of required core courses and elective courses. Students pursuing the project option will complete 24 to 27 units of traditional coursework and will enroll in 3 to 6 units of CSE 7998 Master's Capstone to complete a project. Students choosing to complete a 6-unit project must complete the work across two semesters. Students pursuing the thesis option will complete 24 units of traditional coursework and 6 units of CSE 7998 Master's Capstone over two semesters. For both a thesis and a project, students will orally defend their work and produce a written document. All project and thesis work will be graded as Pass/No Pass, and the units will not apply toward the student's degree requirements without a successful defense.

Required Core Courses

Students must complete 18 units total, with 3 units required from each area below:

1. Foundations of AI (3 units)

Code	Title	Units
CSE 4102	Introduction to Artificial Intelligence	3

2. Machine Learning Foundations (Choose one)

Code	Title	Units
CSE 4107	Introduction to Machine Learning	3
CSE 5107	Machine Learning	3
ESE 4170	Introduction to Machine Learning and Pattern Classification	3
SDS 4430	Statistical Learning	3

3. Natural Language Processing (Choose one)

Code	Title	Units
CSE 4027	Introduction to Natural Language Processing	3
CSE 4061	Text Mining	3
CSE 5270	Natural Language Processing	3
CSE 5610	Large Language Models	3

4. Computer Vision (Choose one)

Code	Title	Units
BME 5700	Mathematics of Imaging Science	3
CSE 5509	Computer Vision	3
ESE 5932	Computational Methods for Imaging Science	3

5. Human-Centered Computing (Choose one)

Code	Title	Units
CSE 4507	Introduction to Visualization	3
CSE 5108	Human-In-The-Loop Computation	3
CSE 5506	Human-Computer Interaction Methods	3
CSE 5507	Advanced Visualization	3

6. Computational Methods (Choose one)

Code	Title	Units
CSE 4059	Applied Parallel Programming: Gpus for High-Performance Computing On Manycore Architectures	3
CSE 4207	Cloud Computing With Big Data Applications	3
CSE 5114	Data Manipulation and Management at Scale	3

Electives

At least 6 credit units of depth electives and 6 credit units of general elective coursework must be completed. These courses can be chosen from any of the following categories, for a total of at least 12 credit units (exclusive of any courses taken to fulfill the Core Requirements).

Depth Electives (6 units)

Students must choose at least two courses from the following list:

Code	Title	Units
CSE 4101	AI and Society	3
CSE 5100	Deep Reinforcement Learning	3
CSE 5103	Theory of Artificial Intelligence and Machine Learning	3
CSE 5104	Data Mining	3
CSE 5105	Bayesian Methods in Machine Learning	3
CSE 5106	Multi-Agent Systems	3
CSE 5107	Machine Learning	3
CSE 5109	Advanced Machine Learning	3
CSE 5205	Computation in Economics and Social Choice	3
CSE 5505	Adversarial AI	3
CSE 5519	Advances in Computer Vision	3
CSE 5805	Sparse Modeling for Imaging and Vision	3
CSE 5806	Analysis of Imaging Data	3

General Electives (6 units)

Students must choose two courses from any of the subareas below (exclusive of any courses taken to fulfill Core Requirements or Depth Electives):

1. Foundational and Applied AI

Code	Title	Units
CSE 4101	AI and Society	3
CSE 5100	Deep Reinforcement Learning	3
CSE 5103	Theory of Artificial Intelligence and Machine Learning	3
CSE 5105	Bayesian Methods in Machine Learning	3
CSE 5106	Multi-Agent Systems	3
CSE 5109	Advanced Machine Learning	3
CSE 5505	Adversarial AI	3
CSE 5509	Computer Vision	3
CSE 5519	Advances in Computer Vision	3
CSE 5610	Large Language Models	3

2. Theory

Code	Title	Units
CSE 4470	Introduction to Formal Languages and Automata	3
CSE 5401	Advanced Algorithms	3
CSE 5404	Special Topics in Computer Science Theory	3
CSE 5801	Approximation Algorithms	3
CSE 5802	Complexity Theory	3

3. Security and Privacy

Code	Title	Units
CSE 4103	Web Privacy and Security	3
CSE 4303	Introduction to Computer Security	3
CSE 4402	Introduction to Cryptography	3
CSE 5271	Data-Driven Privacy and Security	3
CSE 5619	Recent Advances in Computer Security and Privacy	3

4. Large-Scale Computing

Code	Title	Units
CSE 4059	Applied Parallel Programming: Gpus for High-Performance Computing On Manycore Architectures	3
CSE 4207	Cloud Computing With Big Data Applications	3
CSE 5114	Data Manipulation and Management at Scale	3
CSE 5606	High Performance Computer Systems	3

5. Robotics and Autonomous Systems

Code	Title	Units
CSE 5370	Trustworthy Autonomy	3
CSE 5500	Mobile Robotics	3
ESE 4450	Sensing, Planning, and Control in Robotics	3
ESE 4460	Robotics: Dynamics and Control	3
ESE 4481	Autonomous Aerial Vehicle Control Laboratory	3
ESE 5430	Control Systems Design By State Space Methods	3
ESE 5470	Robust and Adaptive Control	3
ESE 5510	Linear Dynamic Systems I	3
ESE 5530	Nonlinear Dynamic Systems	3

6. Data Science

Code	Title	Units
CSE 4106	Data Science for Complex Networks	3
ESE 5200	Probability and Stochastic Processes	3
ESE 5240	Detection and Estimation Theory	3
SDS 5020	Mathematical Statistics	3
SDS 5070	Stochastic Processes	3
SDS 5071	Advanced Linear Models	3
SDS 5130	Linear Statistical Models	3
SDS 5155	Time Series Analysis	3
SDS 5210	Statistical Computation	3
SDS 5310	Bayesian Statistics	3
SDS 5440	Mathematical Foundations of Big Data	3

7. Imaging Science

Code	Title	Units
CSE 5805	Sparse Modeling for Imaging and Vision	3
CSE 5806	Analysis of Imaging Data	3
ESE 5820	Fundamentals and Applications of Modern Optical Imaging	3
ESE 5931	Mathematics of Imaging Science	3
ESE 5932	Computational Methods for Imaging Science	3
ESE 5933	Theoretical Imaging Science	3

8. Applied AI

Code	Title	Units
CSE 5205	Computation in Economics and Social Choice	3
CSE 5310	AI for Health	3
CSE 5804	Algorithms for Biosequence Comparison	3
CSE 5807	Algorithms for Computational Biology	3

9. Theory and Optimization

Code	Title	Units
CSE 5313	Coding and Information Theory for Data Science	3
CSE 5403	Algorithms for Nonlinear Optimization	3
ESE 4150	Optimization	3
ESE 5130	Large-Scale Optimization for Data Science	3
SDS 5800	Topics in Statistics	3

10. Human-Centered Computing (any course not taken to satisfy the Core requirement)

Code	Title	Units
CSE 4507	Introduction to Visualization	3
CSE 5108	Human-In-The-Loop Computation	3
CSE 5506	Human-Computer Interaction Methods	3
CSE 5507	Advanced Visualization	3

11. MS Project or Thesis Options

CSE 7998 Master's Capstone: AI-related project or thesis

- *Project Option:* Students will enroll in at least one semester of CSE 7998 Master's Capstone (maximum 3 units per semester; maximum 6 units total) to complete a project that achieves a clear end result and/or product. The student will be expected to describe the results and products of the work, to articulate what was learned in an oral defense before a small committee of faculty, and to complete a short write-up about the experience.
- *Thesis Option:* Students will enroll in 6 units of CSE 7998 Master's Capstone (3 units per semester) to complete a master's thesis that produces an original research contribution. Students will orally defend the research and produce a 25- to 30-page document that describes the work itself, its significance, and the related literature in detail.

Additional Notes on the Thesis/Project Option

Each semester, CSE 7998 Master's Capstone will be graded as Pass/No Pass. A passing grade and completion of the progress report are required in the first semester of a 6-unit project or thesis to continue the work in the final semester. As a master's project or thesis is considered to have unique content each semester, CSE 7998 Master's Capstone is not a retakeable course, and a grade from a previous semester cannot be replaced. Students should refer to the department's Master's Program Handbook for additional details and guidance regarding projects and theses.

The Progress Report

Near the end of the first semester of a two-semester thesis or project, the student will submit a written progress report to the committee. The progress report will be used by the committee to evaluate student progress and to provide an opportunity to give feedback to the student. (Progress reports are required for two-semester theses and projects only.)