

ARTIFICIAL INTELLIGENCE, BS

Degree: Bachelor of Science (BS)

Major: Artificial Intelligence

Program Overview

The Bachelor of Science degree program in Artificial Intelligence is designed to give a student a strong background in the fundamentals of artificial intelligence and machine learning. The curriculum is designed according to the latest ACM/AAAI curriculum guidelines for the artificial intelligence knowledge area. A graduate of this program will be able to determine when an artificial intelligence approach is appropriate for a given problem, identify appropriate representations and reasoning mechanisms, implement them, and evaluate them with respect to both performance and their broader societal impact, including potential risks. A graduate will be able to design and implement systems that are state-of-the-art solutions to a variety of problems that arise in artificial intelligence, including problems that are sufficiently complex to require the evaluation of design alternatives and engineering trade-offs. In addition to these program-specific objectives, students can use their technical and open electives to pursue interests in fundamental issues, knowledge representation and reasoning, machine learning, probabilistic representation and reasoning, planning and decision making, natural language processing, robotics, perception, and computer vision. All students in the Case School of Engineering are exposed to societal issues, professionalism, and are provided opportunities to develop leadership skills.

Mission

The mission of the Bachelor of Science degree program in Artificial Intelligence is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communication skills to become leaders in creating the new techniques and technologies that will advance the field of artificial intelligence and its application to other disciplines.

Program Educational Objectives

Graduates from the Bachelor of Science in Artificial Intelligence program will be prepared to:

1. Analyze real-world problems and create solutions based on the fundamentals of artificial intelligence, mathematics, and computing.
2. Work effectively, professionally, collaboratively, and ethically.
3. Assume leadership roles in industry, academia, public service, and entrepreneurship.
4. Successfully progress in advanced degree programs in artificial intelligence, computing, and related fields.

Learning Outcomes

- Be able to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- Be able to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- Be able to communicate effectively in a variety of professional

contexts.

- Be able to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- Be able to function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- Be able to apply the theory, techniques, and tools of artificial intelligence, to understand the assumptions implicit in the tools, to make informed judgements about the societal benefits and risks of the applications they are building, and to employ the resulting knowledge to satisfy stakeholders' needs.

Co-op and Internship Programs

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition but maintain their full-time student status while earning a salary. Alternatively or additionally, students may obtain employment as summer interns.

Undergraduate Policies

For undergraduate policies and procedures, please review the **Undergraduate Academics** section of the General Bulletin.

Combined Bachelor's/Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the **Undergraduate Academics** section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the **general requirements for bachelor's degrees** and the **Unified General Education Requirements**. Students completing this program as a **secondary major** while completing another undergraduate degree program do not need to satisfy the **school-specific requirements** associated with this major.

The AI BS Major consists of 22 AI and AI-related courses totaling 68 units. In addition to the general degree requirements and a minimum of 123 total units, each AI BS major student must complete the Math and Engineering Requirement, the Science Requirement, and the following major requirements:

- AI Core
- Foundations
- AI Breadth
- Societal Impact
- Secure Computing
- Technical Electives

AI-related courses not listed here may be used to satisfy specific requirements with prior permission from the student's academic advisor.

Math and Engineering Requirement

Code	Title	Credit Hours
MATH 121	Calculus for Science and Engineering I	4
MATH 122 or MATH 124	Calculus for Science and Engineering II Calculus II	4
MATH 223 or MATH 227	Calculus for Science and Engineering III Calculus III	3
ENGR 399	Impact of Engineering on Society	3
Total Credit Hours		14

Science Requirement

The Science Requirement can be satisfied by completing one of the sequences listed below. Students wishing to combine AI with other science disciplines can alternatively satisfy the Science Requirement either by completing one of the following minor programs: Biology, Chemistry, or Geological Sciences; or by completing one of the following major programs: Biology, Biochemistry, Chemistry, Geological Sciences, or Neuroscience.

Code	Title	Credit Hours
Choose one of the following:		4
PHYS 115	Introductory Physics I	
PHYS 121	General Physics I - Mechanics	
PHYS 123	Physics and Frontiers I - Mechanics	
Choose one of the following:		4
PHYS 116	Introductory Physics II	
PHYS 122	General Physics II - Electricity and Magnetism	
PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
Total Credit Hours		8

AI Core Requirement

Code	Title	Credit Hours
Choose one of the following:		3-4
CSDS 134	Programming in Python	
CSDS 132 & CSDS 237	Programming in Java and The Python Programming Language	
CSDS 233	Introduction to Data Structures	4
CSDS 302	Discrete Mathematics	3
CSDS 310	Algorithms	3
CSDS 330	Introduction to Artificial Intelligence	3
CSDS 340	Introduction to Machine Learning	3
CSDS 395A	Senior Project in Artificial Intelligence	4
Total Credit Hours		23-24

Foundations Requirement

Students must demonstrate competence across a range of mathematical disciplines used in different areas of AI. Students wishing to have a more in-depth and rigorous background can consider using Group 2 Technical Electives to complete a two-course sequence in probability and statistical

inference (STAT 301 and STAT 302), numerical methods and optimization (MATH 431 and MATH 433), or both.

Code	Title	Credit Hours
MATH 307	Linear Algebra	3
Choose one of the following:		3
MATH 380	Introduction to Probability	
STAT 301	Introduction to Probability for Statistics	
Choose one of the following:		3
CSDS 323	Numerical Algorithms for Machine Learning	
MATH 327	Convexity and Optimization	
STAT 327	Statistical Computing	
MATH 431	Introduction to Numerical Analysis I	
Total Credit Hours		9

AI Breadth Requirement

Code	Title	Credit Hours
Choose six from the following:		18
CSDS 346	Machine Learning on Graphs	
CSDS 347	Responsible AI Engineering	
CSDS 350	Programming for AI/ML	
CSDS 352	Causality and Machine Learning	
CSDS 364	Computational Perception	
CSDS 365	Computer Vision	
CSDS 375	Designing High Performant Systems for AI	
CSDS 440	Machine Learning	
CSDS 443	Algorithmic Fairness	
CSDS 463	AI in Medical Imaging	
CSDS 480	Large Language Models	
CSDS 491	Probabilistic Models in AI	
CSDS 496	Sequential Decision Making	
CSDS 497	Foundations of Statistical Natural Language Processing	

Societal Impact Requirement

AI BS students must demonstrate competence in assessing both the risks and benefits of AI technology by completing at least one of the courses listed below.

Code	Title	Credit Hours
Choose one of the following:		3
CSDS 225	Current Issues in Artificial Intelligence, For Better or Worse	
CSDS 347	Responsible AI Engineering	
CSDS 443	Algorithmic Fairness	
PHIL 393	Ethics of Artificial Intelligence and Emerging Technology	
HUMN 250	Responsible AI: Cultivating a Just and Sustainable Socio-technical Future through Data Citizenship	

Secure Computing Requirement

Students must demonstrate competence in the principles and practices

of secure computing by completing one of the following courses.

Code	Title	Credit Hours
Choose one of the following:		3
CSDS 344	Computer Security	
CSDS 356	Data Privacy	
CSDS 427	Internet Security and Privacy	
MATH 408	Introduction to Cryptology	

Technical Electives

Four technical electives are required. The list of approved technical electives is divided into groups according to how closely a course is related to the core knowledge areas as defined in the ACM/AAAI computer science curriculum guidelines in the AI knowledge area.

Students may use at most two courses from Group 2 to count as technical electives toward the AI BS degree. Courses may not be double counted.

AI-related courses not listed below may be used as technical electives but require prior permission from the department chair or their designee.

Group 1

Code	Title	Credit Hours
Any AI Breadth course, in addition to the following:		
<i>Data Science</i>		
CSDS 234	Structured and Unstructured Data	3
CSDS 312	Introduction to Data Science Systems	3
CSDS 313	Introduction to Data Analysis	3
CSDS 335	Data Mining for Big Data	3
CSDS 435	Data Mining	3
CSDS 438	High Performance Data and Computing	3
<i>Image Processing</i>		
CSDS 361	Biomedical Image Processing and Analysis	3
CSDS 490	Digital Image Processing	3
MATH 444	Mathematics of Data Mining and Pattern Recognition	3
PQHS 416	AI in Medicine: Knowledge Representation and Deep Learning	3
<i>Robotics</i>		
CSDS 376	Mobile Robotics	4
CSDS 499	Algorithmic Robotics	3
CSDS 589	Robotics II	3
ECSE 373	Introduction to Modern Robotics	4
<i>Applied AI</i>		
CSDS 102	Artificial Intelligence for All Disciplines	3
DSCI 353	Statistical and Machine Learning for Inference, Prediction and Reasoning	3
SYBB 464	Artificial Intelligence for Biomedical Research	3

Group 2

Students may use at most two courses from Group 2 to count as

technical electives toward the AI BS degree. Courses may not be double counted.

Code	Title	Credit Hours
Any CSDS course, in addition to the following:		
MATH 330	Introduction to Scientific Computing	3
MATH 382	High Dimensional Probability	3
MATH 406	Mathematical Logic and Model Theory	3
MATH 408	Introduction to Cryptology	3
MATH 433	Numerical Solutions of Nonlinear Systems and Optimization	3
PHIL 306	Mathematical Logic and Model Theory	3
STAT 302	Introduction to Statistical Inference	3

Sample Plan of Study

First Year

Fall		Credit Hours
MATH 121	Calculus for Science and Engineering I	4
CSDS 134	Programming in Python	3
<u>Academic Inquiry Seminar, Breadth, or Elective course</u>		3
Open Elective		3
Open Elective		3
Credit Hours		16
Spring		
MATH 122 or MATH 124	Calculus for Science and Engineering II or Calculus II	4
PHYS 121	General Physics I - Mechanics	4
CSDS 233	Introduction to Data Structures	4
<u>Academic Inquiry Seminar, Breadth, or Elective course</u>		3
Credit Hours		15

Second Year

Fall		
MATH 223 or MATH 227	Calculus for Science and Engineering III or Calculus III	3
MATH 307	Linear Algebra	3
PHYS 122	General Physics II - Electricity and Magnetism	4
Technical Elective		3
<u>Breadth, or Elective course</u>		3
Credit Hours		16
Spring		
MATH 380 or STAT 301	Introduction to Probability or Introduction to Probability for Statistics	3
CSDS 302	Discrete Mathematics	3
CSDS 330	Introduction to Artificial Intelligence	3
<u>Breadth, or Elective course</u>		3
Open Elective		3
Credit Hours		15

Third Year**Fall**

CSDS 310	Algorithms	3
CSDS 340	Introduction to Machine Learning	3
AI Foundations Elective		3
AI Breadth Elective		3
<u>Breadth, or Elective course</u>		3
Credit Hours		15

Spring

ENGR 399	Impact of Engineering on Society	3
AI Breadth Elective		3
Societal Impact or AI Breadth Elective		3
AI Secure Computing Elective		3
<u>Breadth, or Elective course</u>		3
Credit Hours		15

Fourth Year**Fall**

AI Breadth Elective		3
Societal Impact or AI Breadth Elective		3
Technical Elective		3
Technical Elective		3
<u>Breadth, or Elective course</u>		3
Credit Hours		15

Spring

CSDS 395A	Senior Project in Artificial Intelligence	4
AI Breadth Elective		3
AI Breadth Elective		3
Technical Elective		3
<u>Breadth, or Elective course</u>		3
Credit Hours		16

Total Credit Hours		123
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