

ARTIFICIAL INTELLIGENCE MAJOR, BS IN ENGINEERING

Students must also complete the Undergraduate Registration Requirement (<https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement/>) and the degree requirements of their home school.

Requirements (48 units)

Core Courses (26 units)¹

Course	Title
4 mathematics courses	
MATH 220-1	Single-Variable Differential Calculus
MATH 220-2	Single-Variable Integral Calculus
MATH 228-1	Multivariable Differential Calculus for Engineering
COMP_SCI 212-0	Math Foundations of CS Part 1: Discrete Math for CS
4 units of basic science (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext) ²	
PHYSICS 135-1	General Physics ³
Plus an additional 3 units from the list of basic science courses	
3 engineering foundations courses (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext)	
3 design, communications, and innovation courses (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext)	
7 social sciences/humanities courses (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext)	
5 unrestricted electives (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext)	

Major Program (22 units)

Course	Title
5 required courses	
COMP_SCI 180-0 or COMP_SCI 111-0	Software Design & Composition Fundamentals of Computer Programming
COMP_SCI 208-0	Data Structures & Algorithms (Formerly Comp_Sci 214)
COMP_SCI 211-0	Programming in Systems-Level Languages
COMP_SCI 348-0	Introduction to Artificial Intelligence
COMP_SCI 349-0	Machine Learning
4 advanced elective courses	
Any 300-level or higher class, or introductory courses that directly support computer science (COG_SCI 207-0, COMP_ENG 203-0, COMP_ENG 205-0, COMP_SCI 1CA, COMP_SCI 260-0, COMP_SCI 262-0, COMP_SCI 265-0, COMP_SCI 296-0, COMP_SCI 298-0, GEN_ENG 211-0, GEN_ENG 251-0, MATH 228-2, MATH 230-2, MECH_ENG 233-0) ⁴	
5 breadth courses (p. 1)	
1 societal impact course (p. 2)	
7 technical electives (p. 2)	

¹ See general requirements (<https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/#requirementstext>) for details.

² PHYSICS 125-1 General Physics for ISP or PHYSICS 140-1 Fundamentals of Physics may be substituted for PHYSICS 135-1 General Physics.

³ PHYSICS 135-1 General Physics can be replaced by GEN_ENG 212-0 Engineering Physics - Dynamics.

⁴ Scores of 4 or 5 on the AP CS A exam or scores of 5, 6, or 7 on the IB CS HL exam transfer to Northwestern as COMP_SCI 1CA.

Breadth Courses

Domain Area requirements (students must take one course in five of the six categories)

Advanced ML/NLP

Course	Title
COMP_SCI 337-0	Natural Language Processing: Classical Approaches
COMP_SCI 449-0	Deep Learning
COMP_SCI 461-0	Large Language Models
IEMS 351-0	AI-Enabled Sequential Decision Making

Theoretical Foundations

Course	Title
COMP_SCI 332-0	Online Markets
COMP_SCI 336-0	Design & Analysis of Algorithms
COMP_SCI 496-0	Special Topics in Computer Science (Foundations of Reliable Machine Learning)
COMP_SCI 496-0	Special Topics in Computer Science (Theoretical Foundations of Data Science)

Symbolic AI

Course	Title
COMP_SCI 325-0	Artificial Intelligence Programming
COMP_SCI 344-0	Design of Computer Problem Solvers
COMP_SCI 371-0	Knowledge Representation and Reasoning
COMP_SCI 396-0	Special Topics in Computer Science (Declarative Programming for Game AI)
COMP_SCI 396-0	Special Topics in Computer Science (Reasoning and Planning in the Foundation Model Era)
COMP_SCI 496-0	Special Topics in Computer Science (Agent AI)
COMP_SCI 496-0	Special Topics in Computer Science (Logic in AI)

Software and Systems Engineering for AI

Course	Title
COMP_SCI 303-0	Full Stack Software Engineering
COMP_SCI 310-0	Scalable Software Architectures
COMP_SCI 358-0	Introduction to Parallel Computing
or COMP_ENG 358-0	Introduction to Parallel Computing
COMP_SCI 368-0	Programming Massively Parallel Processors with CUDA
or COMP_SCI 468-0	Programming Massively Parallel Processors with CUDA
or COMP_ENG 368-0	Programming Massively Parallel Processors with CUDA
or COMP_ENG 468-0	Programming Massively Parallel Processors with CUDA
COMP_SCI 394-0	Agile Software Development
ES_APPM 344-0	High Performance Scientific Computing

Systems that Interact with Humans

Course	Title
COMP_SCI 317-0	Sports, Technology and Learning
COMP_SCI 329-0	HCI Studio
COMP_SCI 330-0	Human Computer Interaction
COMP_SCI 333-0	Interactive Information Visualization

COMP_SCI 347-0	Conversational AI
or COMP_SCI 447-0	Conversational AI
COMP_SCI 396-0	Special Topics in Computer Science (Mobile and Ubiquitous Computing)
or COMP_SCI 496-0	Special Topics in Computer Science
COMP_SCI 497-0	Special Projects in Computer Science (Explanation and reproducibility in data-driven science)
COG_SCI 207-0	Introduction to Cognitive Modeling
DSGN 395-0	Special Topics (Designing with AI)

Systems that Navigate the World

Course	Title
COMP_SCI 301-0	Introduction to Robotics Laboratory
or MECH_ENG 301-0	Introduction to Robotics Laboratory
COMP_SCI 353-0	Natural & Artificial Vision
COMP_SCI 396-0	Special Topics in Computer Science (Machine Learning and Sensing)
or COMP_SCI 496-0	Special Topics in Computer Science
COMP_SCI 469-0	Machine Learning & Artificial Intelligence for Robotics
or MECH_ENG 469-0	Machine Learning and Artificial Intelligence for Robotics
COMP_ENG 395-0	Special Topics in Computer Engineering (Embedded Artificial Intelligence)
or COMP_ENG 495-0	Special Topics in Computer Engineering
ELEC_ENG 332-0	Introduction to Computer Vision
MECH_ENG 455-0	Active Learning in Robotics
MECH_ENG 495-0	Selected Topics in Mechanical Engg (Sensing, Navigation, and Machine Learning for Robotics)

Societal Impact Course

Societal impact course list

Course	Title
Majors must take one course from this list.	
COMP_SCI 260-0	Introduction to Law and Digital Technologies
COMP_SCI 265-0	AI and International Security
COMP_SCI 311-0	Inclusive Making
COMP_SCI 314-0	Technology and Human Interaction
COMP_SCI 387-0	Responsible Software Engineering
COMP_SCI 396-0	Special Topics in Computer Science (Computing, Ethics, and Society)
COMM_ST 358-0	Algorithms and Society
COMM_ST 378-0	Online Communities and Crowds
COMM_ST 379-0	Digital Propaganda and Repression

Technical electives

Majors must take seven technical electives. **Any 300- or 400-level COMP_SCI course** may be taken as a technical elective. In addition the following courses may also be taken as technical electives:

Technical electives list

Course	Title
COMP_SCI 213-0	Introduction to Computer System
IEMS 301-0	Introduction to Statistical Learning
IEMS 304-0	Statistical Learning for Data Analysis
IEMS 305-0	Foundations of Modern Machine Learning
ES_APPM 345-0	Applied Linear Algebra
ES_APPM 479-0	Data Driven Methods for Dynamical Systems

COMP_ENG 303-0	Advanced Digital Design
COMP_ENG 329-0	The Art of Multicore Concurrent Programming
COMP_ENG 334-0	Fundamentals of Blockchains and Decentralization
or ELEC_ENG 334-0	Fundamentals of Blockchains and Decentralization
COMP_ENG 346-0	Microcontroller System Design
COMP_ENG 355-0	ASIC and FPGA Design
COMP_ENG 356-0	Introduction to Formal Specification & Verification
COMP_ENG 357-0	Design Automation in VLSI
COMP_ENG 358-0	Introduction to Parallel Computing
COMP_ENG 361-0	Computer Architecture I
COMP_ENG 362-0	Computer Architecture Projects
COMP_ENG 364-0	CyberPhysical Systems Design and Application
or COMP_ENG 464-0	Cyber-Physical Systems Design and Application
COMP_ENG 365-0	Internet-of-things Sensors, Systems, And Applications
or COMP_ENG 465-0	Internet-of-things Sensors, Systems, And Applications
COMP_ENG 366-0	Embedded Systems
or COMP_ENG 466-0	Embedded Systems
COMP_ENG 368-0	Programming Massively Parallel Processors with CUDA
or COMP_ENG 468-0	Programming Massively Parallel Processors with CUDA
COMP_ENG 452-0	Adv Computer Architecture
COMP_ENG 453-0	Parallel Architectures
COMP_ENG 456-0	Modern Topics in Computer Architecture
COMP_ENG 459-0	VLSI Algorithmics
ELEC_ENG 326-0	Electronic System Design I
ELEC_ENG 332-0	Introduction to Computer Vision
ELEC_ENG 375-0	Machine Learning: Foundations, Applications, and Algorithms
ELEC_ENG 433-0	Statistical Pattern Recognition
ELEC_ENG 435-0	Deep Learning: Foundations, Applications, and Algorithms