

# ARTIFICIAL INTELLIGENCE: COMPUTATIONAL STRUCTURES FOR AI SYSTEMS MAJOR

Artificial Intelligence (AI) is the study of creating computer systems that learn from data and interactions to create systems that can reason, generate text and images, and interact in ways that resemble humans. The Bachelor of Science in Artificial Intelligence: Computational Structures for AI Systems (BSAI) is a highly technical program that trains students to build new AI systems and algorithms from the ground up, understand the training of models from both a data and systems perspective, and then use those techniques in interdisciplinary applications. The first two years of the program develop a strong technical foundation in programming and understanding the theory of statistical learning, symbolic reasoning, and optimization. The following two years focus on deploying those techniques in interdisciplinary applications enabling students to build state-of-the-art AI systems and also think critically about the effective, ethical application of AI.

The BSAI will offer specializations in:

- Generative AI;
- AI Algorithms;
- Accessibility; and
- AI, Society, and Decision Making

## Program Learning Outcomes

1. Understand and apply core principles of modern and classic AI.
2. Design and build efficient, scalable and effective algorithms and systems for real-world applications.
3. Configure, train and deploy existing models for real-world applications.
4. Critically assess AI tools and outputs to ensure reliability, efficiency, safety and alignment with intended goals.
5. Apply insights from ethics and social sciences to interdisciplinary applications of AI to address societal challenges and risks of AI such as bias, transparency, fairness and accountability.
6. Collaborate and communicate effectively in multidisciplinary teams to design AI solutions that address diverse perspectives and priorities.

## REQUIREMENTS

### Requirements:

Course	Title	Credits
<b>Core Requirements</b>		
CSAI101	(Introductory Seminar)	1
MATH140	Calculus I	4
or MATH340	Multivariable Calculus, Linear Algebra and Differential Equations I (Honors)	
Introduction to Programming (one of the following):		3-4
CMSC141	(Programming with Purpose I: Data-Centric Computing)	

CMSC131	Object-Oriented Programming I	
INST326	Object-Oriented Programming for Information Science	
MATH141	Calculus II	4
Preferences and Rankings (one of the following):		3
CSAI220	(Measuring Preferences and Rankings)	
STAT400	Applied Probability and Statistics I	
PHIL211	AI & ETHICS	3
INST204	Designing Fair Systems	3
Foundations of Artificial Intelligence Algorithms (one of the following):		3-4
CSAI221	(Classical AI Algorithms)	
CMSC421	Introduction to Artificial Intelligence	
Continuation of Programming (one of the following):		4
CMSC132	Object-Oriented Programming II	
CMSC142	(Programming with Purpose II: Data Structures and Algorithms)	
Sampler (one of the following):		3
CSAI102	(Introduction to AI and the Law)	
CSAI103	(Introduction to AI and Food)	
CSAI104	(Introduction to AI and Creativity)	
CMSC250	Discrete Structures	4
or DATA250	Discrete Mathematics	
Linear Algebra (one of the following):		3-4
ENEE290	Introduction to Differential Equations and Linear Algebra for Engineers	
MATH240	Introduction to Linear Algebra	
MATH243	Introduction to Linear Algebra and Differential Equations	
MATH341	Multivariable Calculus, Linear Algebra, Differential Equations II (Honors)	
MATH461	Linear Algebra for Scientists and Engineers	
CMSC351	Algorithms	3
Classification/Data Science (one of the following):		3
INST414	Data Science Techniques	
CMSC320	Introduction to Data Science	
DATA320	Introduction to Data Science	
STAT426	Introduction to Data Science and Machine Learning	
CSAI216	(Efficient Systems for AI Applications)	4
<b>Specialization (choose one from below)</b>		<b>18</b>
<b>Total Credits</b>		<b>66-69</b>

### Specializations: General Specialization

Course	Title	Credits
<b>Required Course:</b>		
CSAI473	(Capstone in Artificial Intelligence)	3
<b>Electives (take five of the following):</b>		<b>15</b>
CMSC422	Introduction to Machine Learning	
CMSC425	Game Programming	
CMSC426	Computer Vision	
CMSC427	Computer Graphics	

CMSC454	Algorithms for Data Science
CMSC470	Introduction to Natural Language Processing
CMSC474	Introduction to Computational Game Theory
CMSC477	Robotics Perception and Planning
CMSC498	Selected Topics in Computer Science (CMSC498E Robotics)
CMSC498	Selected Topics in Computer Science (CMSC498Y Statistical Inference and Machine Learning Methods for Genomics Data)
CSAI427	(Reinforcement Learning)
CSAI461	(Multiagent Systems)
IMDM498	Special Topics in Immersive Media (IMDM498E Creative Experiments with AI)
INST461	Emerging Technologies and Risk Management
INST436	(User Modeling and Personalization)
PSYC431	Human and Animal Intelligence
<b>Total Credits</b>	<b>18</b>

## Generative AI Specialization

Course	Title	Credits
<b>Required Courses:</b>		
CSAI370	(Multilingual Text Processing and Evaluation)	3
LING200	Introductory Linguistics	3
LING240	Language and Mind	3
CSAI424	(Multimodal Generation)	3
<b>Electives (take two of the following):</b>		<b>6</b>
CMSC426	Computer Vision	
CMSC427	Computer Graphics	
CMSC470	Introduction to Natural Language Processing	
CMSC474	Introduction to Computational Game Theory	
CSAI432	(AI and Human Creativity)	
CSAI473	(Capstone in Artificial Intelligence)	
LING311	Syntax I	
LING320	Phonetics	
LING321	Phonology I	
LING322	Phonology II	
LING410	Grammar and Meaning	
LING444	Child Language Acquisition	
<b>Total Credits</b>		<b>18</b>

## AI, Society, and Decision Making Specialization

Course	Title	Credits
<b>Required Courses:</b>		
CMSC401	Algorithms for Geospatial Computing	3
CSAI460	(AI and the Life of Great Cities)	3
GEOG398	Special Topics in Geography (GEOG398E Introduction to Spatial Artificial Intelligence)	3
INST366	Privacy, Security and Ethics for Big Data	3
<b>Electives (take two of the following):</b>		<b>6</b>
CMSC474	Introduction to Computational Game Theory	
CSAI433	(Trust, Design, and AI)	

CSAI435	(Are Robots Taking our Jobs?)
CSAI473	(Capstone in Artificial Intelligence)
CSAI491	(AI Clinic)
PLCY201	Public Leaders and Active Citizens
PLCY215	Innovation and Social Change: Creating Change for Good
PLCY240	Ethical, Policy and Social Implications of Science and Technology
SOCY100	Introduction to Sociology
SOCY216	Social Aspects of Artificial Intelligence
SOCY455	Social Dimensions of Privacy and Surveillance
SOCY456	Smart Machines and Human Prospects
SOCY462	Digital Technology and Society
WGSS115	Gender, Race and Computing
<b>Total Credits</b>	<b>18</b>

## AI Algorithms Specialization

Course	Title	Credits
<b>Required Courses:</b>		
CMSC422	Introduction to Machine Learning	3
CMSC472	Introduction to Deep Learning	3
CSAI427	(Reinforcement Learning)	3
CSAI461	(Multiagent Systems)	3
<b>Electives (take two of the following):</b>		
CMSC401	Algorithms for Geospatial Computing	
CMSC426	Computer Vision	
CMSC454	Algorithms for Data Science	
CMSC470	Introduction to Natural Language Processing	
CMSC474	Introduction to Computational Game Theory	
CMSC477	Robotics Perception and Planning	
CSAI424	(Multimodal Generation)	
<b>Total Credits</b>		<b>12</b>

## Accessibility Specialization

Course	Title	Credits
<b>Required Courses:</b>		
CMSC434	Introduction to Human-Computer Interaction	3
INST401	Design and Human Disability and Aging	3
WGSS105	Introduction to Disability Studies	3
<b>Electives (take three of the following):</b>		<b>9</b>
AMST320	(Dis)ability in American Film	
CMSC471	Introduction to Data Visualization	
CMSC436	Programming Handheld Systems	
CMSC470	Introduction to Natural Language Processing	
CSAI431	(AI and UX)	
INST362	User-Centered Design	
INST402	Designing Patient-Centered Technologies	
<b>Total Credits</b>		<b>18</b>

## GRADUATION PLANS

Click here (<https://cmns.umd.edu/undergraduate/advising-academic-planning/academic-planning/four-year-plans/four-year-plans-gened/>) for

roadmaps for graduation plans in the College of Computer, Mathematical, and Natural Sciences.

Additional information on developing a graduation plan can be found on the following pages:

- <http://4yearplans.umd.edu>
- the Student Academic Success-Degree Completion Policy (<https://academiccatalog.umd.edu/undergraduate/registration-academic-requirements-regulations/academic-advising/#success>) section of this catalog