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
Core Requirements		
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
Specialization (choose one from below)		**18**
Total Credits		**66-69**

Specializations:
General Specialization

Course	Title	Credits
Required Course:		
CSAI473	(Capstone in Artificial Intelligence)	3
Electives (take five of the following):		**15**
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	
Total Credits		**18**

Generative AI Specialization

Course	Title	Credits
Required Courses:		
CSAI370	(Multilingual Text Processing and Evaluation)	3
LING200	Introductory Linguistics	3
LING240	Language and Mind	3
CSAI424	(Multimodal Generation)	3
Electives (take two of the following):		**6**
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	
Total Credits		**18**

AI, Society, and Decision Making Specialization

Course	Title	Credits
Required Courses:		
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
Electives (take two of the following):		**6**
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	
Total Credits		**18**

AI Algorithms Specialization

Course	Title	Credits
Required Courses:		
CMSC422	Introduction to Machine Learning	3
CMSC472	Introduction to Deep Learning	3
CSAI427	(Reinforcement Learning)	3
CSAI461	(Multiagent Systems)	3
Electives (take two of the following):		
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)	
Total Credits		**12**

Accessibility Specialization

Course	Title	Credits
Required Courses:		
CMSC434	Introduction to Human-Computer Interaction	3
INST401	Design and Human Disability and Aging	3
WGSS105	Introduction to Disability Studies	3
Electives (take three of the following):		**9**
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	
Total Credits		**18**

*****The material below is for the proposal and will not appear in the catalog in the above format*****

In listing requirements for the proposed program we use CSAI to refer to all courses even those also developed for the BA in AI (which uses the prefix HCAI) to reduce confusion (e.g., we would envision these shared courses to be cross-listed).

Course Subject	Courses
Introductory Seminar [1 Credits]	CSAI 101
Calculus: Derivatives and Limits [4 Credits]	MATH 340 or MATH 140
Intro to Programming [4 Credits]	CMSC 141, CMSC 131, DATA 120, or INST 326
Calculus: Integrals and Series [4 Credits]	MATH 141
Preferences and Rankings [3 Credits]	CSAI 220 or STAT 400
AI Ethics [3 Credits]	PHIL 211
AI Fairness [3 Credits]	INST 204
Foundations of Artificial Intelligence Algorithms [4 Credits]	CSAI 221 or CMSC 421
Continuation of Programming [4 Credits]	CMSC 142 or CMSC 132
Sampler [3 Credits]	CSAI 102, CSAI 103, or CSAI 104
Discrete Math [4 Credits]	CMSC 250 or DATA 250
Linear Algebra [3 Credits]	MATH 461, DATA 250, MATH 240, MATH 243, MATH 341, or ENEE 290
Algorithms [3 Credits]	CMSC 351
Classification / Data Science [3 Credits]	INST 414, CMSC 320, DATA 320, or STAT 426
Systems and Programming Languages for Automatic Optimization of AI Models [4 Credits]	CSAI 216

Total Credits for Core: 50

* Sampler: Courses that expose students to applications of AI across the curriculum, allowing them to explore new interests that might encourage them to explore new research paths or to help them pick a specialization.

General

After completing the core, students can take upper level courses in AI across the curriculum, potentially combining with a minor or certificate.

Course Subject	Courses
General AI Required [3 Credits]	CSAI 473
General AI Electives [15 Credits Total] (Take 5 of the courses)	CMSC 474, CMSC 425, CSAI 427, CMSC 426, CSAI 461, CMSC 454, CMSC 427, CMSC 470, CMSC 422, CMSC 477, CMSC 498E, CMSC 498Y, IMDM 498E, INST 461, INST436, or PSYC 431

Total Credits (including core): 68

While we have only listed CS courses here, the goal is for units across campus to identify AI-relevant courses that would be eligible for AI+X degrees, so that the AI program could easily be combined with a minor.

Students are required to complete a capstone project that would combine AI with students' interests.

Specialization: Generative AI

Students learn how to build and use, train, and evaluate AIs for generating text, images, and other modalities.

Course Subject	Courses
Generative AI Required [12 Credits Total] (Take 4 of the courses)	CSAI 370, LING 200, LING 240, and CSAI 429
Generative AI Electives [6 Credits Total] (Take 2 of the courses)	LING 311, LING 410, CMSC 470, CMSC 474, CMSC 426, CMSC 427, LING 320, LING 321, LING 322, LING 444, CSAI 432, or CSAI 473

Total Credits (including core): 68

Specialization: AI, Society, and Decision Making

This specialization equips students with a strong technical foundation in AI emphasizing ethical considerations, policy, and AI in governance and social systems.

Course Subject	Courses
AI, Society, and Decision Making Electives [6 Credits Total] (Take 2 of the courses)	CSAI 473, CSAI 491, CMSC 474, WGSS 115, SOCY 100, SOCY 216, SOCY 455, SOCY 456, SOCY 462, PLCY 201, PLCY 215, PLCY 240, CSAI 435, or CSAI 433
AI, Society, and Decision Making Required [12 Credits Total] (Take 4 of the courses)	GEOG 398E, CSAI 460, INST 366, and CMSC 401

Total Credits (including core): 68

Specialization: AI Algorithms

This specialization focuses on understanding the various algorithms that are used in AI applications across different modalities and applications.

Course Subject	Courses
AI Algorithms Required [12 Credits Total] (Take 4 of the courses)	CSAI 461, CSAI 427, CMSC 472, and CMSC 422
AI Algorithms Electives [6 Credits Total] (Take 2 of the courses)	CMSC 474, CSAI 429, CMSC 426, CMSC 470, CMSC 477, CMSC 401, CMSC 454, or CMSC 426

Total Credits (including core): 68

Specialization: Accessibility

This specialization addresses questions of equity and digital accessibility related to AI to develop accessible/assistive technologies to help

populations affected by situational disability, injury, age, or congenital conditions.

Course Subject	Courses
AI-enabled Accessible Technologies Required [9 Credits Total] (Take 3 of the courses)	WGSS 105, CMSC 434, and INST 401
AI-enabled Accessible Technologies Electives [9 Credits Total] (Take 3 of the courses)	INST 402, CMSC 471, CMSC 436, CMSC 470, INST 362, AMST 320, or CSAI 431

Total Credits (including core): 68

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