

What 4XX Should I Take?!

* Wondering what to take in Spring 2025? The CS Advising Team has put together some pointers and resources to help you pick your CMSC courses.

Info Session PDF

View the Spring 2024 4xx Info Session PDF
([/sites/undergrad.cs.umd.edu/files/2401%204xx%20info%20session.pdf](https://sites/undergrad.cs.umd.edu/files/2401%204xx%20info%20session.pdf))

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Course Number ▲	Course Name ▲	Math or Programming? ▲	Languages ▲	Distributive Area ▲	Exam or Project Based
CMSC320 –	Introduction to Data Science	Programming	Python	Elective	Project
Overview This course focuses on (i) data management systems, (i) exploratory and statistical data analysis, (ii) data and information visualization, and (iv) the presentation and communication of analysis results. It will be centered around case studies drawing extensively from applications, and will yield a publicly-available final project that will strengthen course participants' data science portfolios.					
Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466					
CMSC335 –	Web Application Development with JavaScript	Programming	JavaScript	Elective	Project
Overview Introduction to modern ways of developing web applications/services using JavaScript for both front-end and back-end. Topics include fundamental JavaScript languages and constructs, server-side Javascript, back-end data persistence, and client-side JavaScript to build web applications that interact with web services and back-end databases.					
Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466					
CMSC411 –	Computer Systems Architecture	Neither, theory based	MIPS computing language, C, Ruby	1	Both
Overview Study topics in computer systems architecture. Start with pipelining, instruction set principles, and memory hierarchy. Then, shift to super-scalar execution, branch prediction, dynamic scheduling, hardware multi-threading, shared memory architecture, and GPL					
Recommended Pairings All					

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Overview Study processes, threads, scheduling, synchronization, memory management, file system interface and implementation, disk and storage systems, and other topics (security, networking, etc.). Very rigorous, the only upper level course for 4 credits.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC474, CMSC460, CMSC466

CMSC414	Computer and Network Security	Programming	C, Javascript/SQL	1	Project
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Overview Introduction to computer system and network security. Work on network-related security problems in computer systems. Fundamentals of number theory, authentication, and encryption technologies through practical problems.

Recommended Pairings CMSC456

CMSC416	Introduction to Parallel Computing	Programming	C, C+, Fortran, MPE	1	Project
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Overview Introduction to parallel computing for computer science majors. Topics include programming for shared memory and distributed memory parallel architectures, and fundamental issues in design, development and analysis of parallel programs.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC474, CMSC460, CMSC466

CMSC417	Computer Networks	Programming	C, possibly Ruby	1	Both, with emphasis on projects
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Overview Introduction to the core concepts of wired and wireless networking, focused on layered architecture and protocol stacks. Covered concepts include internet architecture, HTTP, DNS, P2P, Sockets, and more. Quite rigorous.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

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Overview Description, properties, and storage allocation functions of data structures including heaps, balanced binary trees, B-Trees, hash tables, skiplists, tries, kd-trees, quadrees and many more. Algorithms for manipulating structures.

Recommended Pairings All

CMSC421	Introduction to Artificial Intelligence	Programming	Python	2	Project
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Overview Introduction to AI, including search, inference, knowledge representation, learning, vision, natural languages, expert systems, and robotics, Implementation and application of programming languages, programming techniques, and control structures.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC422	Machine Learning	Both	Python	2	Both, with emphasis on projects
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Overview Machine Learning studies representations and algorithms that allow machines to improve their performance on a task from experience. This is a broad overview of existing methods for machine learning and an introduction to adaptive systems in general. Emphasis is given to practical aspects of machine learning and data mining.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC423	Bioinformatic Algorithms, Databases, and Tools	Programming	Some student choice with languages used	2	Project
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Overview This course will focus on algorithmic, and computational aspects of biological data analysis, and specifically on genomics.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

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Overview Introduction to database systems and the database approach as a mechanism for modeling the real world. In-depth coverage of the relational model, logical database design, query optimization, concurrency control, transaction management, and log based crash recovery.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC425	Game Programming	Programming	Unity/C#	Elective	Project
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Overview An introduction to the principles and practice of computer game programming and design. This includes an introduction to game hardware and systems, the principles of game design, object and terrain modeling, game physics, artificial intelligence for games, networking for games, rendering and animation, and aural rendering.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC426	Computer Vision	Programming	MATLAB	2	Project
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Overview Introduction to basic concepts and techniques in computer vision, including low-level operations like image filtering, edge detection, 3D reconstruction of scenes using stereo and structure from motion, and object recognition/detection/classification.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC427	Computer Graphics	Programming	Java, OpenGL	2	Project
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Overview Introduction to 3D computer graphics, focusing on the underlying building blocks and algorithms. Topics include 3D image generation and modeling, interactive applications, representation of 3D geometry, 3D transformations, projections, rasterization, texture lighting models, and Graphics Processing Units.

Recommended Pairings All

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Compilers

Overview Topics include lexical analysis, parsing, intermediate representations, program analysis, optimization, and code generation. If you enjoyed CMSC330, you will likely enjoy this class.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC433	Programming Language Technologies and Paradigms	Programming	Java	3	Project
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Overview Topics include programming language technologies, their implications, and their use in software design and implementation. This course often involves significant group work.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC434	Introduction to Human-Computer Interaction	Programming and Writing	Java, HTML5, Javascript, C#, Objective C, Swift	3	Project, emphasis on writing
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Overview Assess usability by quantitative and qualitative methods, Conduct task analysis, usability tests, expert reviews, and continuous assessments of working products. Apply design processes and guidelines. Build low-fidelity paper mockups and a high-fidelity prototype. This course is especially recommended for students with an interest in 3D printing, arduino, and/or accessibility software.

Recommended Pairings All

CMSC435	Software Engineering	Programming		3	Project
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Overview Topics include state-of-the-art techniques in software design and development. Lab experience in applying the techniques

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This is considered a capstone course.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC436 –	Programming Handheld Systems	Programming	Kotlin, Swift, Java	3	Project
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Overview Fundamental principles and concepts that underlie the programming of handheld systems, such as mobile phones, personal digital assistants, and tablet computers. Particular emphasis will be placed on concepts such as limited display size, power, memory and CPU speed; and new input modalities, where handheld systems differ substantially from non-handheld systems, and thus require special programming tools and approaches.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC451 –	Design and Analysis of Computer Algorithms	Math	MATLAB	4	Exam
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Overview Fundamental techniques for designing efficient computer algorithms, proving their correctness, and analyzing their complexity. General topics include sorting, selection, graph algorithms, and basic algorithm design paradigms (such as divide-and-conquer, dynamic programming and greedy algorithms), lower bounds and NP-completeness. If you enjoyed CMSC351, you will likely enjoy this class.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

CMSC452 –	Elementary Theory of Computation	Math	MATLAB	4	Exam
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Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

– CMSC454	Algorithms for Data Science	Math	MATLAB	4	Exam
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Overview Topics include fundamental methods for processing a high volume of data. Methods include stream processing, locally sensitive hashing, web search methods, page rank computation, network and link analysis, dynamic graph algorithms, and methods to handle high dimensional data/dimensionality reduction.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

– CMSC456	Cryptography	Math	MATLAB	4	Exam
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Overview The theory, application, and implementation of mathematical techniques used to secure modern communications. Topics include symmetric and public-key encryption, message integrity, hash functions, block-cipher design and analysis, number theory, and digital signatures.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

– CMSC457	Intro to Quantum Computing	Math	MATLAB	4	Exam
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Overview The theory, application, and implementation of mathematical techniques used to secure modern communications. Topics include symmetric and public-key encryption, message integrity, hash functions, block-cipher design and analysis, number theory, and digital signatures.

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CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

CMSC460	Computational Methods	Math	MATLAB	5	Exam
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Overview Basic computational methods for interpolation, least squares, approximation, numerical quadrature, numerical solution of polynomial and transcendental equations, systems of linear equations and initial value problems for ordinary differential equations. Emphasis on methods and their computational properties rather than their analytic aspects. Intended primarily for students in the physical and engineering sciences.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

CMSC466	Introduction to Numerical Analysis	Math	MATLAB	5	Exam
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Overview Floating point computations, direct methods for linear systems, interpolation, solution of nonlinear equations.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

CMSC471	Introduction to Data Visualization	Programming	JavaScript	2 or 3	Project
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Overview Topics include the techniques and algorithms used for creating effective data visualizations used on principles from graphic design, perceptual psychology, and cognitive science. Design and build interactive visualizations for the web using the Data-Drive Documents framework.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

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DEEP LEARNING

Overview This course is an elementary introduction to a machine learning technique called deep learning, as well as its applications to variety of domains. Along the way, the course also provides an intuitive introduction to machine learning such as simple models, learning paradigms, optimization, overfitting, importance of data, training caveats, etc. The assignments explore key concepts and simple applications, and the final project allows an in-depth exploration of a particular application area.

Recommended Pairings CMSC411, CMSC451, CMSC452, CMSC454, CMSC456, CMSC457, CMSC474, CMSC460, CMSC466

CMSC473	Capstone in Machine Learning	Programming	Some Flexibility	Elective	Project
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Overview Semester-long project course in which each student will identify and carry out a project related to machine learning, with the goal of publishing a research paper or software tool. Students will be paired with project advisors the UMD faculty or the industry.

Recommended Pairings All

CMSC474	Introduction to Computational Game Theory	Math	MATLAB	4	Exam
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Overview Game theory deals with interactions among agents (either human or computerized) whose objectives and preferences may differ from the objectives and preferences of other agents. This course will provide a comprehensive introduction to game theory, concentrating on its computational aspects.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

CMSC475	Combinatorics and Graph Theory	Math	MATLAB	Elective	Exam
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of graphs, applications of graph theory to transport networks, matching theory and graphical algorithms.

Recommended Pairings CMSC411, CMSC412, CMSC414, CMSC416, CMSC417, CMSC420, CMSC421, CMSC422, CMSC423, CMSC424, CMSC426, CMSC427, CMSC470, CMSC471, CMSC420, CMSC433, CMSC434, CMSC435, CMSC436, CMSC471

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Which degree track/specialization am I following?

Some CS major specializations have more strict requirements than others. For example, Data Science will require CMSC320, whereas CMSC320 will be an elective for General track or a Cybersecurity specialization. The degree requirements for each specialization are listed here. Check with your advisor if you're unsure which upper level courses your specialization requires.

What about prerequisites?

Pay close attention to course descriptions on Testudo for prerequisites, the upper level courses that are required for some upper level CMSC courses. For example, if you want to take CMSC422 Introduction to Machine Learning, be sure that your 4 year plan includes CMSC320 before the semester you plan to take CMSC422.

Which courses will help me meet my “big picture” or long term goals?

You'll want to choose courses that will challenge you and allow you to explore your specific interests as well as potentially open opportunities when interviewing for internships and jobs.

This is a great conversation to have with your advisor! Let them know what your interests are and what you want to explore. They can help you find courses that would help prepare you.

<https://www.cs.umd.edu/researcharea> (<https://www.cs.umd.edu/researcharea>) is a good place to take a look at different areas of study in the department, and to see which faculty members are focused on which research areas.

That's ok! Think back to what CMSC lower level courses you liked. If you liked CMSC216, you might like CMSC41x area courses, for example. Love CMSC330? Try CMSC43x courses. Do you like the theory side of things, like CMSC250 / CMSC351? Try CMSC45x theory area courses. The reality is that other factors, such as your schedule, your registration date, prereqs., and course availability will impact what courses you take, too. Run your ideas by your advisor if you get stuck.

Which courses will help strengthen areas I may not be very strong in?

It's important to choose upper level courses where you are most interested and where you feel you can be successful. Also keep in mind some courses that may help close the gaps. For example, you may feel confident in your resume and technical skills, but how about the soft skills involved in interviewing? Consider CMSC389O: The Coding Interview.

Which faculty best match my learning style?

Try to choose your section based not only on time the class is offered, but also by instructor. Think about how you learn best and try to choose faculty that will be a good fit for you. If you're unfamiliar with the professor, refer to the Class Webpages (<http://www.cs.umd.edu/class/>) to see syllabi and instructor contact information.

How do I make sure my workload isn't too heavy?

The main thing to do is balance Theory with Programming courses. Be careful not to overload yourself with all heavy

theoretical, etc.

How much should I rely on classmates' opinions and advice about classes?

Definitely consult your classmates and ask your upperclassmen peers about their experiences but ideally that won't be your only source of information! Classmates may be willing to share vital information straight from the student perspective. The CS Piazza page is one place you can connect.

And of course, connect with your advisor!

We are an important resource for you as you pick classes. Don't hesitate to reach out via email with any questions.

Resources

BS/MS Program: <https://undergrad.cs.umd.edu/combined-bsms-program> (<https://undergrad.cs.umd.edu/combined-bsms-program>)

CMSC499A Information (Undergrad Research for Academic Credit): <https://undergrad.cs.umd.edu/research-professorial-faculty-cmsc499a> (<https://undergrad.cs.umd.edu/research-professorial-faculty-cmsc499a>)

CS Research Areas and Faculty: <https://www.cs.umd.edu/research> (<https://www.cs.umd.edu/research>)

CS Class Websites: <http://www.cs.umd.edu/class/> (<http://www.cs.umd.edu/class/>)

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