CS420-01: An Introduction to the Theory of Computation
FALL 2026 30 Sep 2026 Rev2

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Office hours: 2:00pm-3:30pm Mon and Wed and by appt

Lectures and Class	Mon & Wed 4:00-5:15pm, Wheatley-Peters W01-0004 (course 1407)
Instructor Email	jane.deblois@umb.edu
Instructor Website	Syllabus, lectures, assignments: https://www.cs.umb.edu/~hdeblois/cs420/f26
Grades:	Grades are on canvas https://www.umb.edu/canvas linked to Gradescope
Grader:	Greg Blike
Portal:	**Register for cs420-01 course directory**: https://portal.cs.umb.edu/
Piazza:	Join and post questions: https://piazza.com/umb/fall2026/cs42001

Course Description: Introduction to theoretical aspects of computing including models of computation, inherent limits on computation, and feasible computation. Topics studied will include definition of computable functions (recursive functions, functions computable by Turing machines, functions computable in a programming language), insolvability of the halting problem and related problems, the classes P and NP, finite automata, and context-free grammars.

Prerequisites: CS 220/CS 320L Use skills from CS220 Applied Discrete Math, which teaches: An introduction to the mathematical structures and concepts used in computing: sets, mathematical induction, ordered sets, Boolean algebras, predicate calculus, trees, relations and lattice theory. Formal and informal theories and corresponding mathematical proofs are taught. **You will need to use Linux on the CS servers and latex. We offer optional CS server hw0 on the class website to review CS server skills. You will need to use your applied math skills so we require prerequisite hw0 on canvas linked to gradescope.**

Attendance: Mandatory. **If you miss >5 classes, your final grade will be lower.** If you miss 6 or 7 classes, you lose 1 letter grade step (e.g., B to B-). If you miss 8 or more classes, you lose 2 letter grade steps (e.g., B to C+). Because you are allowed to miss 5 classes, requests to be excused from class are rarely needed. If you need to be excused more, you must submit documentation. See https://www.umb.edu/registrar/policies/attendance/ . Being late to class or leaving class for more than a few minutes will lower your participation points. **See Participation, p3.**

Course Objectives/Outcomes: We shall cover the following topics:

- Definitions;
- Mathematical statements;
- Writing Proof Tables with statements and justifications;
- Proofs of different types;
- Theorems;
- Automata and Languages;
- Computability theory;
- Complexity theory – Time complexity.

By the end of the course, the student will be able to explain computation using different models discern the solidness of a proof by explaining statements and justifications and understand the topics of the theory of computation.

Textbooks, required:
(1) Purchase or rent: Michael Sipser, *Introduction to the Theory of Computation, 3rd edition (2013, Cengage Learning, Inc.)*
(**2**) Purchase or rent: Hopcroft, John E., Motwani, Rajeev and Ullman, Jeffrey D., *Automata Theory, Languages and Computation, 3rd edition (2007, Pearson Education, Inc.)*

Note: No courses required by the CS major, minor or certificate may be taken pass/fail.

Bring Computer and Pencil to Class. You must bring a computer to class each day, capable of accessing your CS course directory and doing in class assignments there, which will be script-collected and graded. For handwritten work, bring a pencil or pen. A page of paper with the assignment will be provided. Fill in your name as it is in wiser and your student id. Hand it in. The instructor or grader will scan all pages into gradescope which will post to canvas.

Avoid Lost Points on Submitting In-Class (IC) Exercises. There are two types of IC assignments. For submitting On-Server work, you will get zero points if you do not create the files in your course directory during class. For Handwritten work, use the given assignment page. Fill it in carefully. You will get zero points if you do not hand in the page during class.

Be careful when Uploading or Rearranging Files in your Course Directory. Homework and some In-Class assignments require uploading files to your course directory. Always use the linux copy commands ("cp -p <file>") or ("scp -p <file>") and not the Linux move command ("mv"), which can disrupt permissions. Use "ls -la" or "ls -l" to check all file information. **Allow extra time ahead of when due.** You get zero points if permissions are incorrect on your course directory or subdirectory so graders cannot run your code or copy your files. You also get zero points if scripts cannot find your subdirectories and files (Linux is case-sensitive so "HW1" is NOT the same file as "hw1" and "Proj1" is NOT "proj1"). Some work will be submitted on canvas through gradescope.

Collaboration policy: You are encouraged to ask questions in class and may consult with your fellow students about assignments. Be careful not to help another student too much, either by giving specifics of your proof design or by giving answers to your homework questions – keep your laptop closed while conversing and don't share videos that picture proofs, calculations or diagrams.

Grading: Your score is a weighted average of assignments. They are defined here, shown on the Schedule below to some extent and listed in canvas as assigned. In each group, your score is a fraction, the sum of points earned divided by the total points on all assignments in the group. See the table for conversion of score to grade, p6. An assignment may have multiple parts to submit. Part weights are set by the number of points designated in each assignment. Here are the groups and weights:

- **H**omework assignments, 12 of them (**80%**) each including 3 parts:
  - subdirectory in course dir named hw<n> ("hw1" etc.),
  - readMe<n>.txt (in-class handwritten page and on-server edited file),
  - hw<n>.pdf (uploaded, including photos of handwritten parts of proof tables),
- **T**extbook reading and citing as homework proof justifications presented in class **5%.**
- **S**tartup **3%:**
  - **I**nitial hw0 – posted on canvas
  - **A**ccess and Command-Line-Interface (CLI) server skills (in-class on-server)
  - **E**diting using Latex compile and run (in-class on-server)
  - **U**se cases (in-class photo of partial handwritten readMe, uploaded for each homework)
- **P**articipation: whether you participate during class (**2%**), and
- **A**ttendance: whether you miss >5 classes, **described above on p1** (**10%**).

Dropped Scores. Because 5 missed classes are allowed, 5 of your lowest in-class exercise scores will be dropped **at mid-semester**, one each from assignment groups **T, I, A, E, and U above**. Also, your lowest hw score will be dropped at the end of the course.

Avoid Lost Points by Doing Incrementals. Upload your homework to the server whenever you work. To save an earlier version of your <file>.c, login to the server and copy it to a name with a date indicator ('cp -p <file>.c <file_23jul>.c'). Then edit <file>.c. Incrementals' timestamps must match comments about starting the next version in your handwritten readMe. You get zero points if you forget to make, mention and submit at least two incrementals.

Avoid Lost Points by Keeping Enough Disk Space on the Server. Using VSCode is not enough. You need to be proficient "on" the servers. VSCode can cause you to exceed your given disk space and be literally unable to submit. Type 'du -h' to check your usage. Delete unneeded files to fix or email operator@cs.umb.edu for help.

Homeworks: With <n> as the homework number, the Schedule shows when each of the 12 Homeworks will be posted. The posting location will be class website or canvas linked to gradescope. You may use latex or another editor to prepare these files but the justification of each line in your proofs must be handwritten. Or you may handwrite the entire homework, take photos of each answer and upload to the CS server. Each one has 3 parts:
1) Create a subdirectory , "hw<n>", in your course directory. The first one is named hw1 exactly.
2) In class, given a formatted page called readMe<n>.txt, you handwrite and/or type on the server the required information. It will be collected in class for scanning and script-collected from your course directory on the server. Be aware of **Avoid Lost Points by Keeping Enough Disk Space** above. Include your AI Use_case, names of people collaborated with, books and sources used and hours spent. See **Use_cases** below.
3) Upload your homework pdf file to the server. Justifications in the homework are handwritten, photographed, and included in your typeset document converted to PDF by an editor. Be sure to login to the server and use "ls -la" to check that your filenames are correct and your files are located in the right directory and subdirectory.

Access and CLI server skills. Several **A**<n> assignments will be given. These are in-class on-server early work to be sure you know how to use client-server setup and move around on the servers.

Editing using Latex. These are in-class on-server tasks using Latex. Be aware of **Avoid Lost Points by Keeping Enough Disk Space on the Server above**, since unable to save would mean losing points on in-class work.

Use case for sources is your choice for how to use AI in this course. You specify your Use_case in your readMe for each hw1-12. AI research is dual-sphered, part with only looking at prompt engineering, part with looking at 'full-stack' including neural networks. Photo your readMe including your choice of use case for assignment <n> and upload (in-class photo of early handwritten readMe, uploaded). Note: National Institute of Standards and Technology (NIST) AI Standards Zero Drafts Project is requesting input including use cases. **Use Cases** identified (so far) include:
Case 1-none) You can do the project without using any AI, but you must say that Case1 is what you chose and you must cite the traditional sources you used, if any, and the code you copied, if any, or say you didn't use any.
Case 2-ahead) You can use AI before you start writing or get your design together and then write the proof and answers yourself without using any generated information from AI. Also, say

whether you used any traditional sources before you start writing your proofs and answering questions, and whether you copied any of that information, in which case you must cite it.
Case 3-during) You can use AI when your encounter something in your work doesn't seem correct or complete, and then correct your work by inserting sections that are generated additions marked by START and END markers with a prompt accompanying the START marker. Also cite traditional sources and copied information if you use any.
Case 4-entire) You can use AI to generate the entire assignment but then you have to handwrite each justification in your proof tables and supply handwritten reasoning and handwritten comments in a separate document to show you understand your work. You will likely be called in to demo your reasoning and explain the design and details of what your work produced.

Participation: The instructor may deduct participation points if you are late, leave early or leave the classroom for too long or too often. We use 1 pt per 10 mins, so you earn 8-9 points per session minus the deduction. The Schedule shows 25 sessions total, since there is no class on the Tuesday of the test periods. It is participation to be sure the instructor and your classmates know your name, so please say it ahead of asking or answering question or requesting or giving help.

Late Work/Missed Work. In-class exercises, homework, C code projects and tests are scheduled for precise times. Late test arrival means you will be given proportionately less of the test and thus a lower grade. Late class arrival means you may lose participation points or miss hand-written work and be graded zero. UMB-mandated extensions will be given, but you must write the instructor before the work is due. If you are ill, write the instructor and we will work something out. If you are ill enough to miss a test, your make-up can only earn 50% of the full grade unless you provide a doctor's note. Traveling or delayed flights are not valid reasons for extensions. Joining the class late earns you 48 hours extension on hwk1 and an opportunity to make-up in-class assignments you missed. **You will see a zero posted for work that is not submitted when due.** Ross Center students must request an extension on an assignment before the work is due; when graded, their score will be posted in place of the zero. If a student is excused from doing an assignment on-time, their score will be posted in place of the zero when the work is graded. **Late penalty is 1% per hour down to half the score.** The instructor reserves the right to correct a grade up or down if it has been posted in error.

Academic integrity will be strongly enforced. Your homework must be your own product, may include some information copied or modified from outside sources or generated by Large Language Models (LLMs), but must have sources identified and be work that you understand well. See https://www.umb.edu/academics/provost/academic-integrity.

AI Policy. This course DOES allow the use of AI in generating answers for homework, but not for the handwritten justification lines which must be filled in by hand and photographed. When using AI, we recommend not allowing any LLM to store results for retraining. Note: Google search bar is "staffed" by Gemini. UMB provides student access to Microsoft 365 Copilot. Student access to LLM Claude Code is being explored, but not yet provided by UMB. Free-tier Claude does not include features of Claude Code. ChatGPT is also available.

Required Statement from Provost: AI is allowed with attribution: Use of AI tools, including ChatGPT, is permitted in this course on certain assignments [either detail assignments or types of assignments here, or clarify how they will know which ones! **See above**.] To adhere to our scholarly values and to the Student Code of Conduct, students must cite any AI-generated material that informed their work; citations should include not only in-text citations and listing in the references, but also the full text of cited ChatGPT (or other Large Language Model (LLM) generator) as an appendix to the assignment. Using an AI tool to generate content without proper attribution qualifies as academic dishonesty. Students are also responsible for making sure that any

AI generated text does not contain false or erroneous information. If students are unsure about whether or not a source is appropriate to use in the assignment, they should contact the instructor.

Student Conduct: You must be honest in all your conduct. The University presupposes that work for academic credit is the student's own and complies with University policies above and here**:** **https://www.umb.edu/dean-of-students/student-conduct . You may not post the work that you submit for this class publicly either during or after the semester is concluded.** It may be useful in applying for jobs, but you can supply it privately if asked.

Accommodation: Section 504 of the Rehabilitation Act of 1973 offers guidelines and support for curriculum modifications and adaptations for students with documented disabilities. Contact the Ross Center by email, ross.center@umb.edu, by phone, 617-287-7430, or in person, Campus Center, UL, Room 211. The Ross Center will write your instructor regarding your accommodations, not your specific disability. Please discuss accommodations with the instructor. If Ross Center students are entitled to extensions, they must write the instructor each time before the work is due.

Student Assistance for Health, Well-being and Success:

- Are you in emotional distress? Call 617.287.5690 to speak with a licensed clinician 24/7 who can offer support, crisis recommendations, and assistance with finding resources.
- Have a campus question or issue? Use Here4U in the UMass Boston app or via www.umb.edu/here4U.
- Want advice in navigating a university or life situation? Contact the Dean of Students Office at www.umb.edu/deanofstudents.
- Want to connect with housing and food insecurity support, student life groups and events, or recreation activities? Visit Campus Life - UMass Boston.
- Want to access resources specifically for immigrant-origin, DACA, TPS, and undocumented students? Visit Immigrant Student Programs - UMass Boston.
- Want to make the most of your academic experience? Visit Student Equity, Access & Success.
- Looking for additional identity-based community support? Find more resources at Inclusive Identity - UMass Boston.
- Unable to attend class on a specific date or participate in an exam or class requirement due to a religious observance? Fill out the excused absence form (requires 2-weeks' notice) to request religious accommodation at Right To Excused Absence Because Religious Belief - UMass Boston

Schedule. Not all assignments other than homework are entered here. The Schedule:

WEEK	Class#/Date	Topic Class lectures are recorded.	Reading	HW out
1	Mon Sep 7	Labor Day (holiday)		

	Tues Sept 8th	Semester Begins		
	#1-Wed Sep 9	Intro to Theory of Computation [slides]	S0.2-0.4 HMU 1.2-1.4	0
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2	#2-Mon Sep 14	Using and Proving Logical Statements [slides]	HMU1.2-1.4	1
	Tues Sep 15	Add/Drop Ends		
	#3-Wed Sep 16	Deterministic Finite Automata (DFA) [slides]	S1.1	
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3	#4-Mon Sep 21	Computing with DFAs [slides]	HMU2.2	2
	#5-Wed Sep 23	Regular Languages [slides]	S1.1 HMU2.2	
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4	#6-Mon Sep 28	Combining DFAs, Closed Ops [slides]	S1.1 HMU2.2	3
	#7-Wed Sep 30	Nondeterminism and NFAs [slides] also presentations of a definition read aloud	S1.2 HMU2.3, 2.5	
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5	#8-Mon Oct 5	Computing with NFAs [slides]	S1.2 HMU2.3, 2.5	4
	#9-Wed Oct 7	NFA → DFA [slides]	S1.2 HMU2.3	
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6	Mon Oct 12	Indigenous Peoples Day (holiday)		
	#10-Wed Oct 14	Regular Expressions [slides]	S1.3	5
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7	#11-Mon Oct 19	Proof by Induction [slides]	S0.4, 1.3 HMU1.4	
	#12-Wed Oct 21	Non-Regular Languages [slides]	S1.4	6
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8	#13-Mon Oct 26	Context-free Grammars (CFG)	S2.1 HMU5.1	7
	#14-Wed Oct 28	Pushdown Automata (PDA)	S2.2 HMU6.1	
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9	#15-Mon Nov 2	CFG vs PDA, sub CFLs, DPDAs, non CFLs	S2.2-2.4 HMU6.1	8
	#16-Wed Nov 4	Turing Machines (TM)	S3.1-3.3	
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10	#17-Mon Nov 9	Nondeterministic TMs, TM configs	S3.2	9
	Wed Nov 11	Veteran's Day (holiday)		

-- 11	---- #18 Mon Nov 16 #19 Wed Nov 18 Thu Nov 19	---- Decidability Decidability for DFAs Pass/Fail & Course Withdraw Deadline	---- S4.1 S4.1	---- 10
-- 12	---- #20 Mon Nov 23 #21 Wed Nov 25 Thu Nov 26 – Sun Nov 29	---- Decidability for CFLs Undecidability Thanksgiving Recess	---- S2.1,4.1 S4.2, 5.1 HMU9.3	---- 11
-- 13	---- #22-Mon Nov 30 #23-Wed Dec 2	---- Intro to Time Complexity P	---- S7.1 S7.2-7.3	--
-- 14	---- #24-Mon Dec 7 #25-Wed Dec 9 Fri Dec 11	---- NP NP-Completeness Semester Ends	---- S7.2-7.3 S7.3-7.4	-- 12
	14 weeks	3 holidays on Mon or Wed	25 lessons	

Revisions: Rev1 correct the error in the percentage for attendance, Rev2 to correct version of Sipser textbook to 3rd ed, not 2nd, correct typo in hwk list and add mention of presentations.

Grading: Table of score to grade conversions (default grading scheme "UMB letter" in canvas):

93 <= S = A
90 <= S < 93 = A-
87 <= S < 90 = B+
83 <= S < 87 = B
80 <= S < 83 = B-
77 <= S < 80 = C+
73 <= S < 77 = C
70 <= S < 73 = C-
67 <= S < 70 = D+
63 <= S < 67 = D
60 <= S < 63 = D-
S < 60 = F