CS 3120: Discrete Math and Theory 2 **Spring 2026**

Tu/Th 2:00 pm–3:15 pm in **Nau Hall 101**

Instructor: Raymond Pettit
Email: raymond.pettit@virginia.edu
Office: Rice Hall 212
Office Hours: See course website

Teaching Assistants: See course website. Office hours will be held in-person. There may be some online office hours depending on the number of teaching assistants and the preferences of the students and course staff.

Course website: Canvas will be our main course website:
https://canvas.its.virginia.edu/courses/169264/pages/discrete-math-and-theory-2-spring-2026

Prerequisites: CS 3100 with grades of C- or higher. Prerequisites are important to this course and will be enforced.

Overview

Course Description: The goal of this course is to understand the fundamental limits on what can be efficiently computed. These limits reveal properties about information, communication, and computing, as well as practical issues about how to solve problems. Introduces computation theory including grammars, automata, and Turing machines.

Availability: It is important to the course staff to be available to our students, and to address student concerns. If you cannot meet with us during our office hours, e-mail us and we will find the time to meet. That being said, like everybody else we are quite busy, so it may take a day or more to find a time to meet. And if you have any comments on the course—what is working, what is not working, what can be done better, etc.—we are very interested in hearing from you. Please send Prof. Pettit or one of the TAs an e-mail or post privately on Piazza to the instructors. When sending email, include "CS3120" in the subjecdt line. If your question could be answered by either the professor or a TA, please post on Piazza to "instructors" to get the fastest response.

Course Objectives: Students who complete the course will:

Improve their mathematical thinking skill and habits, including thinking precisely about definitions, stating assumptions carefully, critically reading arguments, and being able to write convincingly.

Be able to understand both finite and infinite formal models of computation and to reason about what they can and cannot compute.

Understand both intuitively and formally what makes some problems too expensive to solve, and what can be done in practice when an unsolvable or intractable problem is encountered.

Reason formally about the cost of computation, and be able to prove useful bounds on the costs of solving problems, including showing that certain problems are intractable.

Textbook: *Introduction to the Theory of Computation, Third Edition* by Michael Sipser.

Additional Resources: We will make additional optional resources available on the course website.

Class Delivery:

Lectures and quizzes will be given in-person. If any special circumstances occur, we will follow university guidance in such matters as late openings or cancelled class. We will do our best to make recordings of lectures available through the course site, but it's not unusual to occasionally have technical issues that interfere with recordings.

Coursework and Grading

The course is divided into 5 **modules** that build upon one another:

- Introduction, Review, and Cardinality
- Regular Languages
- Context-Free Grammars
- Turing Machines and Reducibility
- Complexity Theory

Most modules will cover 2-3 weeks of content. The schedule is shown on the course website.

Quizzes:

Each module has one quiz associated with it. Each individual quiz will be written to take about 30-50 minutes. In addition, there is a final exam quiz that contains material from the entire semester (summative) that will be taken during the final exam (more detail in final exam section belwo). The current dates for taking quizzes are as follows:

First quiz day (Module 1): Thu. Feb. 5
Second quiz day (Module 2): Thu. Feb. 26
Third quiz day (Module 3): Tues. Mar. 24
Fourth quiz day (Module 4): Tues. Apr. 14
Final exam quiz day (Modules 5, final exam quiz, and retakes): Fri. May 1

These dates are subject to change. Each quiz will be graded separately, and thus you will earn a different grade for each individual quiz. Up to two quizzes can be retaken to improve your grade (modules 1-4). Some quizzes (module 5 quiz and the 'final exam' comprehensive quiz) can only be taken once due to time constraints.

Final Exam: The final exam will be on the regularly scheduled date and time. During this 3-hour exam period you will take: Quiz 5, the final comprehensive quiz, plus up to two retake quizzes of your choosing. The quizzes are:

> **Module 5 quiz:** Everyone will take this quiz as it is your first and only attempt at the module 5 quiz
>
> **Final Comprehensive quiz:** Everyone will take this quiz. It will cover material from throughout the semester.
>
> **Retake Modules 1-4:** You may choose to take up to two of the retake quizzes from modules 1-4. These will be new versions of quizzes 1-4 made available during the final exam period. Your highest score (first attempt or this second attempt) will be taken regardless. You should prioritize these quizzes depending on which ones you scored lowest on during the initial attempt.

Students will end up taking 2-4 quizzes during the final exam period. Students who missed an earlier quiz will be taking an additional quiz during this time.

Quiz Makeup Policy: In general, students with valid extenuating circumstances (illness, family emergency, etc.) will be allowed to makeup a missed quiz during the final exam period. Students who miss more than one quiz should meet with the instructor.

Homework Assignments: Most of our homework assignments will be "written problem sets" with the occasional programming assignment. These assignments may include small problems, runtime analysis, proofs, etc. See section about LaTeX below.

Grading: There are two major grade categories in this course: quizzes and homework. At the end of the semester, you will receive an average for each of those two categories. The table below shows how final grades are determined based on those two averages. Note that the 'Homework Average' and the 'Quiz Average' will not be averaged together. Homework assignments and quizzes will be graded on a traditional percentage scale.

Final Grade	Minimum Homework Average Required	Minimum Quiz Average Required
A	88	88
A-	85	85
B+	81	82
B	78	78
B-	75	75
C+	71	72
C	68	68
C-	65	65
D+	61	62
D	58	58
D-	55	55
F	none	none

Homework: There will be about 6 homework assignments. The homework assignments will be weighted equally to determine your homework average.

Quizzes: There will be 6 quizzes (Modules 1-5, the final cumulative quiz). To determine your quiz average, module quizzes will be weighted at 15% each and the final quiz will be weighted at 25%.

LaTeX: Written assignments will be given with a LaTeX template. Students must use the given template and modify it in LaTeX to complete the assignment. The submission should be a .pdf of the finished LaTeX file. Tutorials on how to use LaTeX will be made available when the first written problem set is released. LaTeX is easily installable on many computers:

Overleaf, http://overleaf.com: a Web-hosted LaTeX editor which behaves much like Google Docs.

Cygwin has LaTeX packages that can be installed

MiKTeX provides a stand-alone installer for Windows and Mac, miktex.org

Ubuntu and CentOS provide TeXLive packages in their repos

LyX, TexShop, TeXworks, and TeXStudio are GUI editors available either through the MiKTeX and TeXLive repos or available as separate downloads.

We strongly recommend using Overleaf, http://overleaf.com, since it contains all the necessary packages and works in-browser. We generally will not accept LaTeX documents with images of text or formulas; **you must typeset the formulas in LaTeX**, not in another program and have them exported as images.

Submission System: All homework assignments will be submitted via GradeScope. Details will be explained later in the course.

Homework Late Policy: For homework assignments, there will be a traditional due date, and no work will be accepted after this date. However, each student can submit 3 extension requests throughout the semester. The extension requests are made by filling out an online form (link will be provided to students on course website). This request will enable students to earn a 5-day extension. No extensions will be given for any reason beyond this 5-day extension. In addition, extension requests MUST be submitted before the original assignment deadline. Once a student submits an extension request, it is counted as one of the 3 requests that are permitted. Extension requests cannot be revoked by the student. **Failure to submit an extension request by the original due date will result in the extension request being rejected.**

Regrades: There will be a process for requesting regrades on assignments. This policy will be communicated once graded material is returned. Regrades will be submitted through Gradescope. The result of a regrade request may be: no change in grade, an increase in grade, or a decrease in grade.

Collaboration Policy

Quizzes: Quizzes are always individual work; collaboration with others is not allowed. No resources are permitted during quizzes.

Homework Assignments: You are encouraged to collaborate with up to 2 other students in the course on each homework, and you may submit a shared set of solutions online. You are expected to collaborate on the work together, and solutions from homework assignments will appear on exams to ensure you are doing so.

On programming assignments, you can discuss the problem with up to 2 other students, but must work on your implementation individually. In addition, you will submit the assignment individually. In other words, you may not look at another student's code for any reason for programming assignments.

Plagiarism, though, is strictly not allowed and will result in a penalty (see below).

Integrity Violations

Students who are found to have committed an integrity violation will receive a penalty based on the specific violation. Violations include: collaboration beyond what is stated in the Collaboration Policy, lying, any use of resources beyond what is allowed. Special measures will be taken on quiz days to help discourage: looking at another student's quiz, using a phone, looking at a note sheet, and any other form of dishonesty. Quiz day procedures may include any combination of the following: extra exam proctors in the room, checking of ID's either before or after the quiz, instructor/TA taking photos or video recordings of students before or during the quiz, reassigning seat locations. Other day procedures may be modified from quiz to quiz.

Penalties: Assignments or quizzes where violations occur will receive a penalty based on the nature of the violation. A typical penalty may be a zero for the assignment and a 10-point deduction on the final course grade. However, based on severity, some infractions may result in a smaller or larger penalty. More severe infractions may result in an immediate final grade of 'F' in the course. Any infraction, large or small, is subject to being submitted to the Honor Committee.

Additional Information

Syllabus Note: This syllabus is to be considered a general guideline for the course. Due to unforeseen circumstances, changes to the initial syllabus may need to be made during the course of the semester. In such cases, the instructor will post an announcement to the course website containing information about any significant change.

Research: Your class work might be used for research purposes. For example, we may use anonymized scores from student assignments to compare to other student performance

data. Any student who wishes to opt out can contact the instructor or TA to do so after final grades have been issued. This has no impact on your grade in any manner.

Students with disabilities or learning needs
It is my goal to create a learning experience that is as accessible as possible. If you anticipate any issues related to the format, materials, or requirements of this course, please meet with me outside of class so we can explore potential options. Students with disabilities may also wish to work with the Student Disability Access Center (SDAC) to discuss a range of options to removing barriers in this course, including official accommodations. We are fortunate to have an SDAC advisor, Courtney MacMasters, physically located in Engineering. You may email her at cmacmasters@virginia.edu to schedule an appointment. For general questions please visit the SDAC website: *sdac.studenthealth.virginia.edu*. If you have already been approved for accommodations through SDAC, please send me your accommodation letter and meet with me so we can develop an implementation plan together.

Religious accommodations
It is the University's long-standing policy and practice to reasonably accommodate students so that they do not experience an adverse academic consequence when sincerely held religious beliefs or observances conflict with academic requirements.

Students who wish to request academic accommodation for a religious observance should submit their request to me by email as far in advance as possible. Students who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at *UVAEOCR@virginia.edu* or 434-924-3200.

Harassment, Discrimination, and Interpersonal Violence
The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. If you or someone you know has been affected by power-based personal violence, more information can be found on the UVA Sexual Violence website that describes reporting options and resources available - *www.virginia.edu/sexualviolence*.

The same resources and options for individuals who experience sexual misconduct are available for discrimination, harassment, and retaliation. UVA prohibits discrimination and harassment based on age, color, disability, family medical or genetic information, gender identity or expression, marital status, military status, national or ethnic origin, political affiliation, pregnancy (including childbirth and related conditions), race, religion, sex, sexual orientation, or veteran status. UVA policy also prohibits retaliation for reporting such behavior.

If you witness or are aware of someone who has experienced prohibited conduct, you are encouraged to submit a report to Just Report It (justreportit.virginia.edu) or contact EOCR, the office of Equal Opportunity and Civil Rights.

If you would prefer to disclose such conduct to a confidential resource where what you share is not reported to the University, you can turn to Counseling & Psychological Services ("CAPS") and Women's Center Counseling Staff and Confidential Advocates (for students of all genders).

As your professor and as a person, know that I care about you and your well-being and stand ready to provide support and resources as I can. As a faculty member, I am a responsible employee, which means that I am required by University policy and by federal law to report certain kinds of conduct that you report to me to the University's Title IX Coordinator. The Title IX Coordinator's job is to ensure that the reporting student receives the resources and support that they need, while also determining whether further action is necessary to ensure survivor safety and the safety of the University community.

Support for your career development
Engaging in your career development is an important part of your student experience. For example, presenting at a research conference, attending an interview for a job or internship, or participating in an extern/shadowing experience are not only necessary steps on your path but are also invaluable lessons in and of themselves. I wish to encourage and support you in activities related to your career development. To that end, please notify me by email as far in advance as possible to arrange for appropriate accommodations.

Student support team
You have many resources available to you when you experience academic or personal stresses. In addition to your professor, the School of Engineering and Applied Science has staff members located in Thornton Hall who you can contact to help manage academic or personal challenges. Please do not wait until the end of the semester to ask for help!

Learning
Lisa Lampe, Assistant Dean for Undergraduate Affairs
Georgina Nembhard, Director of Student Success
Courtney MacMasters, Accessibility Specialist
Free tutoring is available for most classes.

Health and Wellbeing
Kelly Garrett, Assistant Dean of Students, Student Safety and Support
Elizabeth Ramirez-Weaver, CAPS counselor*
Katie Fowler, CAPS counselor*

*You may schedule time with the CAP counselors through Student Health (https://www.studenthealth.virginia.edu/getting-started-caps). When scheduling, be sure to specify that you are an Engineering student. You are also urged to use TimelyCare for either scheduled or on-demand 24/7 mental health care.

Community and Identity
The Center for Connection (The Connect) is a dedicated student space within UVA Engineering that fosters academic success and personal growth. Through its programs and initiatives, The Connect helps students strengthen their engineering identity while providing resources to help them thrive during their studies and beyond. Our work centers on three key areas: student belonging and development, academic support, and community programming grounded in intentional, data-driven strategies.

The Connect features an open study area, a flexible event space, and on-site staff who provide direct support and advising to students. It is part of the Office of Community, Opportunity, and Engagement.