CS 3102: Theory of Computation

Spring 2019

T/Th 2:00-3:15, Minor Hall 125

Instructor: Nathan Brunelle

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Office: Rice Hall 209

Office Hours: W 3:30p-5:30p Regrade Hours: M 5:00p-7:00p

Teaching Assistants: Posted on the course calendar

Overview

Course Description: Introduces computation theory including grammars, finite state machines, pushdown automata, and Turing machines.

Availability: It is important to me to be available to my students, and to address their concerns. If you cannot meet with me during my office hours, e-mail me and we will find the time to meet. That being said, like everybody else I am 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.—I are very interested in hearing about them.

Prerequisites: CS 2102 and 2110 with grades of C- or higher.

Course Objectives: Students who complete the course will:

- Learn the mathematical foundations of computing.

- Be able to apply mathematical rigor to their computing practice.

- Understand the limits of computation.

- Understand the advantages and disadvantages of different models of computation, both in theoretical domains as well as practice.

Textbook:

- **Required:** *Introduction to the Theory of Computation, Third Edition* by Sipser (ISBN 978-1133187790). (The second edition is also acceptable)

Lectures: Lecture attendance is expected, but not enforced. I will make a best effort to post video recordings of lectures online in the case that you must be absent or if you wish to review a lecture later, but please do not use this as license to skip class. If attendance becomes

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unreasonably low, I may cease posting the recordings. All lecture materials (recordings, slides documents, etc.) will be accessible at: `www.cs.virginia.edu/~njb2b/cs3102/`.

Grading and Assignments

Grades: Grades will be computed by the following formula:

- 60% Assignments
- 20% Midterm
- 20% Final Exam
- 10% Extra Credit
- 1% Start of Semester Questionnaire (as extra credit)

We recognize that we cannot expect to produce assignments which are perfect evaluations of your fluency in course material. As such, grade breakdowns will be determined after all assignments are graded. This adjustment will occur prior to assessing extra credit.

Exams: There will be one midterm exam, as well as a final. The midterm will have both an in-class (consisting mostly of exercises) and take-home (consisting mostly of proofs) component. The final exam will be held during the time scheduled by the University Registrar. The (tentative) exam dates are as follows:

- Midterm: Tuesday, March 5, 2:00pm-3:15pm in Minor 125
- Final: Monday, May 6, 9:00am-12:00pm in Minor 125

Assignments: This course will emphasize how theoretical concepts describe the practice of computer science, and how the practice of computer science can be approached using theory. The homework assignments will consist of roughly 1/3 programming tasks and 2/3 traditional pen-and-paper problems. Expect about 9 homework assignments throughout the semester (subject to change depending on pacing of the course).

Language for the programming assignments will be determined based on results of our "Start-of-Semester Questionnaire".

The pen-and-paper (a.k.a. "written") assignments are not really pen-and-paper: they must be typeset with LaTeX, a professional formatting system. Tutorials on how to use LaTeXwill be made available when the first written problem set is released. LaTeXis easily installable on many computers:

- Cygwin (which you may have seen in CS 2150) has LaTeXpackages 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

I personally recommend using Overleaf. This is an in-browser LaTeXeditor which behaves much like Google Docs. I generally will not accept LaTeXdocuments with images of text or formulas; **you must typeset the formulas in LaTeX**, not in another program (or by hand) and have them exported as images. Images of drawing, diagrams, etc. are acceptable.

Extra Credit: Extra credit will principally be awarded for using the course content in *practice*. Accordingly, any extra credit submission must have some component that is demonstrable, i.e. you must be able to "show it off" in some fashion. Examples include but are not limited to: Turing machine simulators using Lego, expanding upon the programming assignments, implementing a GUI for some aspect of a programming assignment, web apps demonstrating course content, or high-quality videos explaining course content. Other extra credit opportunities may be announced throughout the semester. The amount of extra credit awarded will be commensurate with the course staff's perception of the effort it required (group work on the extra credit is allowed, but this calculation will account for it), and will be scaled so that your grade will not be improved by doing extra credit in lieu of homework. Submit extra credit via email to `extracredit.cs3102@gmail.com`. Your submission must include a brief discussion of which course concepts apply and how, a clear and concise description of what your submission does, and instructions and materials we need run your submission (e.g. code and a ReadMe for how we can run it, if it must be demonstrated in person then mention that and we will make an appointment for an up to 10-minute demo). No extra credit will be accepted after Thursday, April 18.

Submission System: All homeworks will be submitted via Collab. You will submit zip file containing all materials necessary to evaluate your assingment. For written portions, the zip file must contain both your `.tex` mark-up file as well as a PDF of your write-up. For programming tasks, your zip file will contain all of your code. Some assignments may have both written and programming portions, and so those materials should share the same zip file. More specific details will be given with each assignment. Submit extra credit via email to `extracredit.cs3102@gmail.com`.

Late Policy: $grade = grade_{earned}e^{-\frac{1}{\varphi}days}$.

Your grade for each assignment is given by the above formula (this is an exponential decay formula). To calculate your grade, let $grade_{earned}$ be your earned grade (the remaining grade after scoring), let $days$ be the (fractional) number of days late, let $\varphi = \frac{1+\sqrt{5}}{2}$ be the golden ratio, and e be Euler's constant. To give you an idea of the result of this scheme, submitting an assignment 4 hours late ($days = 1/6$) will result in a grade penalty of 10%, submitting 1 day late will result in an $\approx 45\%$ penalty, and submitting 2 days late will result in an $\approx 70\%$ penalty.

Regrades: All regrades are conducted in person with the course staff. Regrade office hours will be listed at the top of this syllabus, please attend these office hours to discuss your assignments. If you are unable to make this time, then please schedule an appointment.

Note: We reserve the right to modify the weighting (changing the curve, adding pop quizzes, etc.), especially if attendance drops off significantly. If this happens, it will be clearly announced in lecture. However, attendance in this class is not mandatory. You can still receive

an A if you are not present in lecture. If you do attend class, then you must agree to limit computer usage to things directly helping you understand the lectures, such as following the slides online, etc. We reserve the right to forbid using laptops/phones in class.

Collaboration

Collaboration Policy: You are encouraged to collaborate with up to 3 other students in the course on each homework, but all work submitted must be your own independently written solution. Any solutions that share similar text/code will be considered in breach of this policy. You must list the names of all of your collaborators.

Please **do not** seek published solutions for any assignments. Any submission which is discovered to be similar to a published solution will be considered in breach of this policy. If you use any published resources when completing your assignments, be sure to cite them.

Exams are always individual assignments; collaboration with others is not allowed for the midterm and final.

Note that it is a violation of this policy to submit a problem solution that you are unable to explain orally to a member of the course staff, and we reserve the right to spot-check for this requirement.

Each assignment or exam on which a violation of this policy occurs will receive a **zero** grade for that entire assignment or exam, and incur a **full letter-grade** penalty on the course grade. Such infractions will also be submitted to the Honor Committee if deemed appropriate.

There is no upper bound on collaborator count for extra credit, but the reward for the effort will be distributed evenly among all contributors.

Additional Information

Special Circumstances: The University of Virginia strives to provide accessibility to all students. If you require an accommodation to fully access this course, please contact the Student Disability Access Center (SDAC) at (434) 243-5180 or `sdac@virginia.edu`. If you are unsure if you require an accommodation, or to learn more about their services, you may contact the SDAC at the number above or by visiting their website `http://studenthealth.virginia.edu/sdac`.

For this course, we ask that students with special circumstances let us know as soon as possible, preferably during the **first week of class**.

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 require-

ments. Students who wish to request academic accommodation for a religious observance should submit their request in writing to Prof. Brunelle or Prof. Hott as far in advance as possible. If you have questions or concerns about academic accommodations for religious observance or religious beliefs, visit

`https://eocr.virginia.edu/accommodations-religious-observance`

or contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at `UVAEOCR@virginia.edu` or 434-924-3200. Accommodations do not relieve you of the responsibility for completion of any part of the coursework missed as the result of a religious observance.

Safe Environment: The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. To that end, it is vital that you know two values that we and the University hold as critically important:

1. Power-based personal violence will not be tolerated.

2. Everyone has a responsibility to do their part to maintain a safe community on Grounds.

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`.

As your professor and as a person, know that we each care about you and your well-being and stand ready to provide support and resources as we can. As a faculty member, we are responsible employees, which means that we are required by University policy and federal law to report what you tell us 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 reviewing the information presented to determine whether further action is necessary to ensure survivor safety and the safety of the University community. If you would rather keep this information confidential, there are Confidential Employees you can talk to on Grounds (See `http://www.virginia.edu/justreportit/confidential_resources.pdf`). The worst possible situation would be for you or your friend to remain silent when there are so many here willing and able to help.

Well-being: If you are feeling overwhelmed, stressed, or isolated, there are many individuals here who are ready and wanting to help. The Student Health Center offers Counseling and Psychological Services (CAPS) for all UVA students. Call 434-243-5150 (or 434-972-7004 for after hours and weekend crisis assistance) to get started and schedule an appointment. If you prefer to speak anonymously and confidentially over the phone, Madison House provides a HELP Line at any hour of any day: 434-295-8255.