Computer Science 234
Mathematical Foundations of Computer Science

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Description

The goal of this course is to understand the mathematical techniques and theoretical models that underlie the discipline of computer science. You will learn mathematical proof techniques, such as induction and proof by contradiction, and how to write rigorous proofs. This course also serves as an introduction to the fundamentals of the theory of computation. You will learn about models of computation, namely finite automata and Turing machines, with the goal of understanding what tasks computers are and are not capable of performing.

Required Texts

An Introduction to Formal Languages and Automata, Sixth Edition by Peter Linz, Jones & Bartlett, 2017.

Book of Proof, Second Edition by Richard Hammack, 2013.
(also available online at `http://www.people.vcu.edu/~rhammack/BookOfProof/`)

The Annotated Turing by Charles Petzold, Wiley, 2008.

Online Resources

I will maintain all course materials this semester on a new online social learning platform called *NoteBowl* (`notebowl.denison.edu`). Here you will find all daily reading assignments, exercises, exam dates, and links to useful resources. You will also hand in all assignments through NoteBowl. Refer to `notebowl.denison.edu` daily for updates.

Outside of class, we will also use NoteBowl for Q&A and discussion. When you have a question, instead of sending me an email, please post it to our class' Bulletin on NoteBowl. This way, everyone can benefit from the answer. You are also strongly encouraged to answer your classmates' questions. I will answer them too; but, if you see it first and know the answer, go for it!

Attendance and Other Responsibilities

Your **active participation** is absolutely essential to your success in this class. I cannot emphasize this enough! By simply attending class and doing a minimal amount of work, you will both learn very little and earn a very poor grade.

It is very important that you keep up with the coursework (see NoteBowl calendar) on a **daily** basis; **consistency is the key**. Like other classes at Denison, it is expected that you devote at least 2–3 hours outside of class for each hour of class time. We will use the reading as a starting point for each class discussion rather than rehash everything that you read the night before. To ensure that you do the reading, there will be short **quizzes** at the beginning of many class periods.

Your attendance is expected at each class meeting. Your grade will almost certainly suffer indirectly if you choose not to attend. In addition, I may consider attendance when assigning grades, especially in borderline situations. Of course, previously arranged and unavoidable absences (sickness, family emergencies, varsity athletic participation) will not be held against you. To the extent possible, absences should be communicated to me in advance. You are responsible for the content of reading assignments, lectures and handouts, as well as announcements and schedule changes made in class whether or not you are present. If you must miss a class, be sure to check with me or another student to get what you missed. Exams will be given in class on the day scheduled and may not be made up.

Written assignments

There will be written work assigned every week. These assignments are designed to provide you with multiple opportunities to develop techniques for effective communication of mathematical ideas. You will compose proofs, analyze models of computation, and describe the operation of simple computational devices. Your written assignments will be graded on both *correctness* and *clarity*.

Each writing assignment is due in class about one week after it is assigned. You may rewrite and resubmit each assignment up to two days after it is returned, but you may not resubmit solutions to questions that you did not attempt in the first place. Your final score on each question will be the average of the scores on your original and resubmitted submission.

All writing must be typed up in LaTeX. For an introduction to LaTeX, read at least chapters 2–3 of the online resource *The Not So Short Introduction to LaTeX* at `http://tobi.oetiker.ch/lshort/lshort.pdf`.

Academic Integrity

Proposed and developed by Denison students, passed unanimously by DCGA and Denisons faculty, the Code of Academic Integrity requires that instructors notify the Associate Provost of cases of academic dishonesty, and it requires that cases be heard by the Academic Integrity Board. Further, the code makes students responsible for promoting a culture of integrity on campus and acting in instances in which integrity is violated. Academic honesty, the cornerstone of teaching and learning, lays the foundation for lifelong integrity. Academic dishonesty is intellectual theft. It includes, but is not limited to, providing or receiving assistance in a manner not authorized by the instructor in the creation of work to be submitted for evaluation. This standard applies to all work ranging from daily homework assignments to major exams. Students must clearly cite any sources consulted not only for quoted phrases but also for ideas and information that are not common knowledge. Neither ignorance nor carelessness is an acceptable defense in cases of plagiarism. It is the students responsibility to follow the appropriate format for citations. Students should ask their instructors for assistance in determining what sorts of materials and assistance are appropriate for assignments and for guidance in citing such materials clearly.

You can find further information about Denisons Code of Academic Integrity on Denisons web site at `denison.edu/academics/curriculum/integrity`.

In this class, you may discuss problems with other students in the class, but written (and typed) work must be your own. In other words, you may talk about problems with your peers, but when it comes time to write your solutions, you (and your partner) are on your own. You may have general conversations about problem strategies, but you must leave these conversations without having written anything down. Keep in mind that it is quite easy for me to tell when students have been working too closely. You may not get help from students outside the class, except for departmental tutors. If you have questions, come see me and I will be happy to help. You are also quite welcome to send me email or call if you would like to discuss an assignment.

Students found responsible for breaches of academic integrity may earn a failing grade for the course.

Grade Determination

The following relative weights will be used to determine your final grade:

Homework assignments	40%
Quizzes (2 lowest dropped)	10%
Exams	30%
Final exam	20%

Accommdations

Any student who feels he or she may need an accommodation based on the impact of a disability should contact me privately as soon as possible to discuss his or her specific needs. I rely on the Office of Academic Support in 104 Doane to verify the need for reasonable accommodations based on documentation on file in their office.

Coarse course outline

In the following outline,

- BoP = *Book of Proof*,
- FLA = *An Introduction to Formal Languages and Automata*, and
- TAT = *The Annotated Turing*.

A traditional course on the theory of computation assumes that you have already taken a discrete mathematics course. The topics from such a course are reviewed *very* briefly in section 1.1 of FLA. In this course, we will instead intertwine discrete mathematics topics and mathematical proof techniques into the course. The following outline lists the planned topics from FLA with an approximation of when we might insert chapters from BoP. This plan will likely change over the course of the semester.

Introduction to the theory of computation	FLA 1.0
Sets and logical statements	BoP 1 – 2, FLA 1.1
Relations and equivalence relations	BoP 11.1 – 11.2
Languages, grammars, and automata	FLA 1.2 – 1.3
Finite automata	FLA 2.1 – 2.3
Direct proofs	BoP 4 and 7
Mathematical induction	BoP 10
Regular languages and grammars	FLA 3
Proof by contradiction	BoP 6
The pigeonhole principle	BoP 12.3
Properties of regular languages	FLA 4
Turing machines	FLA 9, TAT 1–6
Variations on Turing machines	FLA 10.1
A Universal Turing machine	FLA 10.4
Counting	BoP 3
Proofs involving sets	BoP 8
Cardinality of sets	BoP 13
Undecidable problems	FLA 12.1

Course Evaluations

At the end of the semester, you will be asked to evaluate this course and the instructor. These evaluations are an important tool for helping Denison faculty achieve and maintain excellence in the classroom; it will also help you reflect on your learning, participation, and effort in the course. A key purpose of course evaluations, then, is to constantly improve the level of teaching and learning at Denison by instructors and students. Your ratings and comments will also be included as one element of an instructor's overall teaching portfolio. Together with peer observations and other means of assessing teaching effectiveness, this portfolio will be considered by the instructor's colleagues and college administrators in making recommendations for contract renewal, tenure, promotion, and salary decisions.

Have a great semester! If you need anything, please let me know.