CS 270 Mathematical Foundations in Computer Science - Syllabus

Spring 2023
3 Credits

Room and Time

Section	Days	Room	Instructor
001	Tuesday/Thursday 9:30am – 11:20am	3675 Market Street (CCI bldg.) classroom #1056	Steve Earth
002	Tuesday/Thursday 11:30am – 1:20pm	3675 Market Street (CCI bldg.) classroom #1056	Steve Earth
003	Tuesday/Thursday 1:30pm – 3:20pm	3675 Market Street (CCI bldg.) classroom #1056	Mark Boady

Instructors
Professor Steve Earth, se435@drexel.edu
Office: 3675 Market Street Room #1169
Phone: 408-218-0880 (cell, so text preferred)
Office Hours: Mon, Wed, Fri at 9:00-10:00am and other times by appointment

Professor Mark Boady, mwb33@drexel.edu
Office: 3675 Market Street Room #1058
Phone: 215-895-2347
Office Hours: Tue 4-5pm

Teaching Assistants
Hung Do, hd386@drexel.edu, *Office Hours:* Wed 4-6pm, and Tues/Thur in classroom for sections 1&2
Siddhanth Agrawal, sa3724@drexel.edu, *Office Hours*: Mon and Thurs 6-8pm (online)
Yash Jain, yj395@drexel.edu, Office Hours: Fri 6-8 (online)

Course Description
Introduces formal logic and its connections to Computer Science. Students learn to translate statements about the behavior of computer programs into logical claims and to prove such assertions using both traditional techniques and automated tools. Considers approaches to proving termination, correctness, and safety for programs. Discusses propositional and predicate logic, logical inference, recursion and recursively defined sets, mathematical induction, and structural induction.

Course Objective and Goals

- use recursion and divide and conquer to solve problems
- provide recursive definitions of patterns and data structures
- formally specify the input/output requirements of programs
- use induction and other proof techniques to prove properties of algorithms, data structures, programs, and computer systems
- use logic to describe the state of systems and to use logical deduction (by hand and using tools) to prove properties of systems
- understand the power and limitations of formal logic.

Course Topics

- Functional Programming
- Recursion, Recursive Definitions and Induction
- Propositional and Predicate Logic
- Formal Proof using Natural Deduction
- Applications of Logic to Computer Science
- Divide and Conquer Algorithms and Recurrence Relations
- Program Specification and Verification
- Automated Reasoning
- Test Case and Counter Example Generation

Audience and Purpose within Plan of Study

This is a required course for all Computer Science and Software Engineering students. It should also be of interest to Computer Engineering, Mathematics students and students with an interest in logic and computation.

Prerequisites

CS 172 Minimum Grade: D or CS 176 Minimum Grade: D or CS 265 Minimum Grade: D or SE 103 Minimum Grade: D or ECEC 301 Minimum Grade: D or ECEC 201 Minimum Grade: D

What Students Should Know Prior to this Course

- Ability to read and understand code.
- Basic understanding of program execution.
- Ability to write simple recursive programs.

What Students will be able to do upon Successfully Completing this Course:

- Use Proofs by Deduction to Justify Logical Statements
- Be able to write and analyze Recursive Functions
- Be able to implement and use a SAT solver.
- Use Inductive Proofs to Justify the correctness of programs and statements.
- Use logic to describe the state of systems.

Textbook

We will use free resources for this class.

Jupyter book notes of Drexel Colleague, Mark Boady:
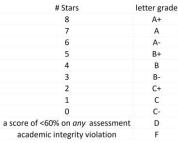https://mwb33.gitlab.io/mathfoundations/README.html

Book of Proof (Second Edition)
Richard Hammack
Paperback: ISBN 978-0-9894721-0-4
Hardcover: ISBN 978-0-9894721-1-1
Available for Free online at: http://www.people.vcu.edu/~rhammack/BookOfProof/
The Racket Guide
Matthew Flatt, Robert Bruce Findler and PLT
https://docs.racket-lang.org/guide/index.html

Optional:

If you want to learn more about functional programming.
The Little Schemer - 4th Edition
Daniel P. Friedman and Matthias Felleisen
ISBN-13: 978-0262560993
ISBN-10: 0262560992
Available at: Amazon
If you want to learn more about recursive proofs.
The Little Prover - 1st Edition
Daniel P. Friedman and Carl Eastlund
ISBN-13: 978-0262527958
ISBN-10: 0262527952
Available at: Amazon

Grading and Policies

This course will use Standards Based Grading. There is no averaging of numerical scores or weighted categories which determine an overall numerical value for this course. Instead, you can determine which letter grade you wish to aim for and then put in as little or as much work as you wish to do in order to earn that goal. Your grade is solely determined by the number of Stars you earn by the end of the quarter, according to the following table:

# Stars	letter grade
8	A+
7	A
6	A-
5	B+
4	B
3	B-
2	C+
1	C
0	C-
a score of <60% on *any* assessment	D
academic integrity violation	F

There are several ways to earn Stars in the course:
On Labs -- getting a 80% or higher on the majority of the labs earns you one star. Getting 90% or higher on ALL labs is worth two stars.
On Quizzes -- getting a 80% or higher on the majority of quizzes earns you one star. Getting 90% or higher on ALL quizzes is worth two stars.
On Homework -- getting a 80% or higher on the majority of hw earns you one star. Getting 90% or higher on ALL hw is worth two stars.
On Tests -- a star is earned for each test (i.e. midterm and final) for which your score is a 90% or higher.

CAUTION: It is important to note that scoring less than a 60% on any assessment (lab, quiz, homework, or test) overrides any amount of stars earned. Note: since the timing of the final exam prevents corrections, the 60% minimum requirement will be waived (however, stars can still be earned for it)

For example, a student with 100% on their midterm and final exam, but with a 55% on a single lab would result in a D for the course

Customizable Due Dates

- The default due date for homework assignments are the Monday after the labs on that content were due (unless Monday is a university holiday, in which case the default due date is Tuesday). This typically gives you two weeks to work on an assignment since they are posted (along with the associated lecture videos) a week before the labs.
- You can postpone a due date by up to a week, as long as you inform the Instructor/TA before the due date has passed.
- Multiple extensions on the same assignment are possible, but if this occurs, the instructor/TA will likely require a meeting to see if the source of the delays can be resolved.
- Customized due dates cannot be extended past the start of Finals week (Monday June 12th). In particular, this means the last homework assignment cannot be extended. (Note: the last homework assignment does not contain any new concepts; it is a just a culmination of putting together previous material)
- There is no limit to how many assignments can be extended or to how many extensions a single assignment can have. There is no penalty for turning something in by an extended customized due date. However, there is a -20% penalty (which can NOT be fixed by corrections) for each day late passed the promised due date. Submissions more than two days passed the agreed upon due date are not accepted (note: this would result in a 0 for that assignment, and thus it would not be possible to pass the course).

Attendance Policy

Students are expected to be present during class time, as this is when the labs are performed and submitted. With the exception of the very first class, video lectures are presumed to have already been watched *before* the lab.

Academic Honesty Policy

Unless specified otherwise (e.g. labs) all work is to be done individually and without reference to any outside resources (websites, classmates, tutors etc). Any time that resources are permitted, they must be cited or it likely constitutes plagiarism. The CCI Academic Honesty policy is in effect for this course. Please see the policy at http://drexel.edu/cci/resources/current-students/undergraduate/policies/cs-academic-integrity/. Academic Honesty Violations will be reported to the University, unless the Regret Clause is invoked. A student may not invoke the Regret Clause more than once in a given course. This clause states that if you committed an infraction of the integrity policy on an assignment/test but bring it to the attention of the professor within 48 hours, the professor may impose lesser sanctions than the standard penalties. Punishments for those that do not avail themselves of the Regret Clause opportunity will be dealt with in the most serious manner and are determined by the severity of the incident. Typical consequences include, but are not limited to: receiving a Failing grade for class or deduction of one letter grade

Programming Language

- This class will primarily be using the Racket Programming Language, and the DrRacket IDE for development.
- Download Racket

Lectures

- Lectures and slides will be recorded and posted on bbLearn the week before each class meeting.
- Watching the lecture videos ahead of time is critical to understanding the lab material; you will not be able to contribute meaningfully to your lab team during class without watching them. Not watching the videos is essentially cutting class. You may watch the lecture videos at any time (and at any speed you can properly comprehend) but they must be watched before their accompanying lab. Your lab score is subject to a -10 pt reduction for each unwatched video.
- You may work in pairs on labs (or in some cases a group of three); collaboration with other students during labs is encouraged.
- Labs are intended to help you learn the material. Do **NOT** divvy up the lab questions between your partners!
- While it is ideal of labs are turned in by the end of class, the actual due time for both of a week's labs is on Friday at 11:59pm.

Homeworks

- Every week (with the exception of the midterm week) will have a homework assignment that must be independent work. *External websites/AI/resources or humans (other than the professors/TAs) must not be used.*
- You have a total of two weeks to do each homework assignment (with the exception of the first assignment, which has a default duedate of one week). The assignments, along with the videos teaching the material required for that assignment, get posted on the Monday the week before the labs covering that material. The default due date for each assignment (with one exception due to Memorial Day) is then due to be submitted on 11:59pm Monday of the week after the labs were completed. (note that 11:59:01pm is considered 1 day late, so do not try to submit at the very last minute as network lag could result in a late timestamp). See the course schedule for more details on dates

Quizzes/Exams

- There will be quizzes given during class time every Thursday (except for the week of the midterm), so 9 quizzes total.
- There will be two in-class exams (midterm on Tues May 9th, and a final during the week of June 12th).
- Exams/Quizzes will be open notes (but you can only use your own notes, not those of anyone else).
- Exams/Quizzes must be done individually. *External websites/AI/resources or humans (other than the professor/TA) must not be used.*
- It is possible (but not guaranteed) that this correction policy could be applied to the Midterm. However, for logistical reasons, it cannot be done with the Final Exam.

Corrections

- All assessments (labs, quizzes, tests, homeworks) have a corrections policy: you may earn back lost points by scheduling a 10minute block with the professor or TA during office explaining why you got something wrong and how to fix it. In some cases, solving a similar replacement question might be requested. You are expected to come to the appointment already prepared with the solution, rather than trying to figure it out on the fly during office hours.
- You do not need to correct every problem that was missed. It is possible to do corrections on just a single problem, or even just a partial solution to a single part of one problem.
- Corrections on an assessment are restricted to within one week after getting your score back. However, similar to the customized due date, you may push that back up to an additional week if need be by requesting an extension to the professor/TA.
- Multiple attempts at corrections on the same problem/assessment may be made (although you will likely have to set up a separate appointment since will probably not be enough time to do more than one during your allotted 10min time period)
- There is no penalty associated with doing corrections: getting a 100% on a quiz the first time through is recorded the same in the grade book as getting 100% weeks later after multiple corrections.

Discord Workspace

- This term, we will be using a Discord server instead of a discussion board.
- You can find all the signup instructions (and links to tutorials about usage) at https://support.cci.drexel.edu/getting-connected/discord/

University Policies

In addition to the course policies listed on this syllabus, course assignments or course website, the following University policies are in effect:

- Academic Honesty: http://www.drexel.edu/provost/policies/academic_dishonesty.asp
- Judicial Affairs Academic Integrity: http://drexel.edu/studentlife/community_standards/facultystaff/integrity/
- Official Final Exam Schedule: http://www.drexel.edu/registrar/scheduling/exams/
- Students with Disability Statement: http://drexel.edu/oed/disabilityResources/overview/
- Course Drop Policy: http://www.drexel.edu/provost/policies/course_drop.asp
- Drexel Student Learning Priorities: http://www.drexel.edu/provost/irae/assessment/outcomes/dslp/
- The instructor may, at his/her/their discretion, change any part of the course during the term, including assignments, grade breakdowns, due-dates, and the schedule. Such changes will be communicated to students via the course web site Announcements page. This page should be checked regularly and frequently for such changes and announcements. Other announcements, although rare, may include class cancellations and other urgent announcements.