CSE 30151 Theory of Computing Syllabus
Last Updated: Mar 7, 2022

Course Description

Introduction to formal languages and automata, computability theory, and complexity theory with the goal of developing understanding of the power and limits of different computational models. Topics covered include:

- regular languages and finite automata
- context-free grammars and pushdown automata
- Turing machines; undecidable languages
- the classes P and NP; NP completeness

Prerequisites

Discrete Math (CSE 20110) and Data Structures (CSE 20312/24312). You especially need to be comfortable with sets, tuples, functions, relations, and graphs; and writing proofs by contradiction and by induction.

Course Webpage

The official course webpage is `https://theory.bdusell.com/`. Please bookmark this page and check it often. All assignments will be posted there, as well as all revisions of this syllabus.

Schedule

Time: Tue/Thu 2:00-3:15pm, Jan 11-Apr 21, 2022
Location: DeBartolo Hall 138
Final Exam: 10:30am-12:30pm, May 4, 2022 in DeBartolo Hall 138

Instructor

Brian DuSell
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Office: Fitzpatrick 150A
Office hours: Mon 4-5; Wed 5-7

Graduate Teaching Assistants

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Undergraduate Teaching Assistants

Jonathan Abbott
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Office Hours

Please always check the course webpage for up-to-date office hours, as times and locations may change.

Day	Time	Person	Location
Mon	4-5	DuSell	Fitzpatrick 150A
	5-7	Mitcheff	Fitzpatrick 150B
	7-8	Miller	Fitzpatrick 150
Tue	3:30-5:30	Manfreda	DeBartolo B011
	5:30-7:30	Liu	Fitzpatrick 150B
	7:30-9:30	McDonald	DeBartolo B011
Wed	3-5	Lin	Fitzpatrick 150
	5-7	DuSell	Fitzpatrick 150A
	7-8	Miller	Fitzpatrick 150
	8-10	Simões	DeBartolo B011
Thu	4-6	Abbott	DeBartolo B011
	6-8	Sible	Fitzpatrick 150B

Textbook

The following textbook is required and will be an integral component of the course:

Michael Sipser, *Introduction to the Theory of Computation*, 3rd Edition

Note that the 3rd edition of this book has both a domestic hardcover version and an international softcover version. Although the numbering of problems differs between the two, their contents are otherwise the same. You may use either one for this course, but please ensure that in either case, you get the 3rd edition and not an earlier edition.

Digital copies of the book can be rented from the bookstore[1] for \$35. However, all exams will be open-book, so it will be most convenient for you to obtain a physical copy (digital copies may not be used during exams unless printed out).

Grading

Grading for this course will be based on eight homework assignments, three programming assignments, two midterm exams, and the final exam. The final grade for the course will be based on the following point system:

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[1] `https://www.bkstr.com/notredamestore/course-materials-results?shopBy=course&divisionDisplayName=` `&departmentDisplayName=CSE&courseDisplayName=30151&sectionDisplayName=01&programId=949&termId=100072572`

Component	Points
Homework	8 assignments $\times$ 24 points each
Programming Assignments	3 assignments $\times$ 36 points each
Midterm Exam 1	90
Midterm Exam 2	90
Final Exam	120
Total	600

Points will be converted to final letter grades according to the following scale:

Grade	Point Interval
A	$[560, \infty)$
A–	$[540, 560)$
B+	$[520, 540)$
B	$[500, 520)$
B–	$[480, 500)$
C+	$[460, 480)$
C	$[440, 460)$
C–	$[420, 440)$
D	$[360, 420)$
F	$[0, 360)$

Academic Integrity

In this course, we will be probing fundamental mathematical truths that underpin computer science, and so this class will be an important part of your formation into professional computer scientists. The search for truth, whether in academics or professional work, requires intellectual honesty and integrity. All work you submit in this course must represent your personal intellectual contribution or that of approved project partners. No behavior that compromises academic integrity (such as using someone else's solutions, using prohibited materials during tests, or making your work available to others) will be tolerated. If you need assistance with anything, please do not hesitate to contact the instructor or avail yourself of the teaching staff's office hours.

Students must abide by the Academic Code of Honor: "As a member of the Notre Dame community, I acknowledge that it is my responsibility to learn and abide by principles of intellectual honesty and academic integrity, and therefore I will not participate in or tolerate academic dishonesty." The following table summarizes how you may work with other students and use print/online sources:

	Resources	Solutions
Consulting	allowed	not allowed
Copying	must be cited	not allowed

See the CSE Guide to the Honor Code[2] for definitions of the above terms.

If an instructor sees behavior that is, in his judgment, academically dishonest, he is required to file either an Honor Code Violation Report or a formal report to the College of Engineering Honesty Committee.

Attendance

Students are expected to attend all classes. Foreseeable unexcused absences should be discussed with the instructor ahead of time. Further information about excused absences, including those related to illness and interviews, can be found in the Undergraduate Academic Code[3] in Section 3.1. Classroom lectures may be recorded so that recordings can be made available to students with excused absences.

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[2]`https://cse.nd.edu/undergraduate/cse-guide-to-the-honor-code/`
[3]`https://facultyhandbook.nd.edu/assets/388802/undergraduate_academic_code_final_december_2019.pdf?d=20200717`

Per university policy[4], students who fall ill (with anything, not just COVID) must refrain from coming to class and should consider obtaining an excused absence if their illness impairs their work. Students must inform the instructor as soon as possible if they are placed into quarantine or isolation so that accommodations can be made for them to view the lectures.

COVID-19-related Policies

Class is expected to take place in person throughout the semester. Masks are not required in the classroom, although you are welcome to wear one if you wish.

Assignment Policies

This course will involve three types of assignment: reading assignments, homework assignments, and programming assignments.

Reading Assignments The textbook by Sipser is exceptionally well-written and will be an indispensable resource for you to gain mastery of this course. Readings from the textbook will be assigned before most lectures. Students are expected to do these readings before the lectures for which they are assigned.

Homework Assignments All homework assignments must be completed individually and submitted digitally (either scanned or typed) through Canvas. You may submit individual problems as separate files, in which case late penalties will only apply to problems that are late. You are allowed, and encouraged, to discuss homework problems with others until you begin to formulate and write down individual solutions. You are *not* allowed to share your written solutions with other students, or to view the written solutions of others. Instances where students appear to have copied solutions from other students or outside sources will be investigated as honor code violations.

Programming Assignments All programming assignments will be done in groups of up to three students. Each team member should contribute a roughly equal amount of work. You may write your assignments in C++ (including all standard libraries except `<regex>`) or Python (including all standard libraries except `re`). Python is recommended. You may also write in another language with permission from the instructor. Your submissions may not include code copied from other groups or outside sources.

Late Policy

Unless otherwise stated, all assignments will be due at 11:59pm on Thursday on the week they are due. In the case of homework assignments, you may submit individual problems as separate files, in which case late penalties will only apply to problems that are late. Problems cannot be submitted for grading more than once. For excused absences, assignments will be accepted late by the same number of days as the excused absence (criteria for excused absences can be found in the Undergraduate Academic Code[5] in Section 3.1). Late assignments will be accepted past the deadline for a 10% reduction in grade per day late, up to a maximum penalty of 50% (days late will be rounded up to the nearest day). In other words, the points you earn on a late assignment or problem will be multiplied by

$$\max(1 - 0.1 \times \lceil \text{days late} \rceil, 0.5)$$

The countdown for days late is frozen going from Sunday into Monday. So if an assignment is due on Thursday, then the late penalties on the following days would be as follows:

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[4]`https://covid.nd.edu/contact-tracing/`
[5]`https://facultyhandbook.nd.edu/assets/388802/undergraduate_academic_code_final_december_2019.pdf?d=20200717`

Day	Penalty
Thu	None
Fri	10%
Sat	20%
Sun	30%
Mon	30%
Tue	40%
Wed	50%
Thu	50%
. . .	50%

This late policy exists to encourage you to complete problems even if you miss the original deadline. The instructor will release solutions to assignments about a week after their original deadline, and although you may consult them, you may not simply copy the official solutions to your submission for a late assignment.

Exams

Students will take exams in-person during lecture periods and the final exam period. Exams will be open-book and open-notes. No electronic devices (phones, tablets, smart watches, etc.) may be used during exams. If you are using a digital copy of the textbook, you must print out the relevant sections beforehand.

Resources

Course Webpage The official course webpage is `https://theory.bdusell.com/`. All assignments will be posted there.

Canvas We will use Canvas for collecting homework assignments, releasing grades and solutions, and online Q&A.

Changes to Course Policies

Although I have done my best to describe the expectations for this course in this document, it is not a contract. I reserve the right to change course policies at any time.

Acknowledgments

The design and materials for this course were strongly influenced by past instructors, including: Dr. David Chiang, Dr. Marina Blanton, Dr. Peter Kogge, and Dr. Satyaki Sikdar.

Changelog

- **Jan 24**: Finalized office hours and fixed a broken link.
- **Jan 29**: Updated late policy.
- **Mar 7**: Updated final exam location and office hours.