

CAS CS 131: Combinatoric Structures

Fall 2024

Official Description

Representation, analysis, techniques, and principles for manipulation of basic combinatoric structures used in computer science. Rigorous reasoning is emphasized.

Prerequisites

None.

Course Staff

Instructors:

- Preethi Narayanan
- Leonid Reyzin

Teaching Fellows:

- Adrish Dey
- Jongin Kim

Teaching Assistants:

- Di Chen
- Aditya Chowdhri
- William Huang
- Mike Lott

Course Assistants:

- Isha Borkar
- Khoa Cao
- Ethan Cappelleri
- Nathaniel Clizbe
- Berk Komurcuoglu
- Charles Li
- Tiffany Liu
- Winter Lou
- Iris Ren
- Jerry Ying

Office hours

The official office hour schedule will be maintained in [this google calendar](#). We will keep the office hours consistent from week to week, but sometimes things happen. **Office hours are subject to change without notice: always check the calendar before coming.**

Communication and All Questions: Piazza

Materials (including HW assignments), Q&A (including questions to the instructor), class announcements, and other communication will be handled via Piazza ([piazza.com](#); apps for mobile devices also available). Use this link <https://piazza.com/bu/fall2024/cs131> to sign up with Piazza ASAP, using your BU email address. Piazza has different notification options; choose one that works for you. Missing or not seeing an announcement is not an acceptable excuse for any course related events/assignments.

Piazza is the place to post and answer HW questions; even though anonymous posts are allowed, we encourage you to post publicly as much as possible.

Please do not send course staff individual emails: class-related but non-public questions should go to private posts on Piazza to all instructors rather than to email. Email will get easily lost in overcrowded inboxes.

Textbook

The textbook is Discrete Mathematics by ZyBooks.

This is a required textbook, as there are reading assignments that you will need to complete for credit that are embedded in the book. The cost for a semester subscription to the textbook is \$64.80 for a semester access.

You can follow the instructions [here](#) to access and subscribe to the textbook. These are the summarized main steps:

1. Sign in or create an account at learn.zybooks.com
2. Enter zyBook code: BUCS131Fall2024
3. Subscribe

Our course access code is: **BUCS131Fall2024**

Lectures

This course has two lecture sections. You must attend your registered section.

- Section A1: KCB 101 TR 2:00–3:15
- Section A2: KCB 101 TR 3:30–4:45

We require you to come to lecture and encourage you to participate. Lectures are your primary source of information. Readings will be available, but may not always match perfectly with what we discuss in lecture.

Attendance is mandatory. Lecture notes and lecture recordings, when available, will be posted to supplement your studying.

Labs

Labs will be held on Wednesdays. You must be registered for a lab section in order to receive credit for the course.

Labs will be hands on sessions where you can work through problems pertaining to recent lecture content. The problems solved in lab often will assist with the upcoming problem set.

Grades

Your final grade will be allocated as follows:

HW	40%
Attendance and Participation	5%
Readings	5%
2 Exams	15% each
Final Exam	20%

We will not assign letter grades to individual assignments and exams. When assigning final letter grades, we will look at the total points you earned and decide on the cut-offs for A, B, C, etc. Those cutoffs will either be at or lower than the usual US high school cut-offs (90, 80, 70, etc.). It will never be higher than those standard cutoffs.

To help you determine where you stand in the course, we will post averages of every assignment. If you are at the average, you are roughly around a B.

We reserve the right to deviate from the grading formula in unusual circumstances.

The last day to drop a class without a 'W' is October 8th. The last day to drop a class with a 'W' is November 12th. After that, you must receive a letter grade for the course.

Attendance and Participation (Top Hat): 5% of your grade

To aid you in absorbing the material as its introduced, we will be using [Top Hat](#), which is an app that will allow us to ask multiple choice questions during lectures. You are *highly* encouraged to discuss these questions with your neighbors.

During lecture, you will be accessing Top Hat from your web browser or via a mobile app (if you want the latter option, please install it ahead of the first class); you must sign in using your BU credentials at <https://app.tophat.com/e/631171> for the A1 lecture and <https://app.tophat.com/e/321407> for the A2 lecture. You will need a functional device to use Top Hat in class.

All questions will be graded 80% for participation and 20% for correctness unless noted otherwise. Scores will be rounded up as follows: if you score at least an 80%, your score will be rounded up to 100. If you score less than 80%, your score will be normalized out of 80. So if you scored 80%, you would receive full credit. If you scored 79%, you would receive $79/80 = 98.75\%$.

This is to allow for classes missed due to illness. Please do not ask about missed Top Hat points unless you are missing more than two weeks of classes for a justifiable reason. However, please do not attend class if you are contagious — being sick for more than two weeks is a justifiable reason for missing work, and we will work with you in such a circumstance.

A Top Hat subscription, which is required for this class, costs you \$33 for the semester, regardless of how many classes use it. Do not pay for any add-ons. If you are expecting to use it again in Spring or Summer 2025 (CS 111, 132, 210, 237, and 330 are likely to use it), you can save a bit by buying a year-long subscription for \$53 instead of two semester-long subscriptions for \$33 each. A four year subscription costs \$96. In case of technical issues with Top Hat, they have tech support available at <https://success.tophat.com/s/contact-main>.

Readings: 5% of your grade

The textbook for this course is [Discrete Mathematics](#) by Zybooks. This is an online interactive textbook with examples and exercises you will need to complete with each chapter.

There will be weekly reading assignments that cover the week ahead and are due the following Monday before lecture. This gives you the option of either pre- or post-reading the material for lectures. Each reading will be assigned on the Zybooks page itself. You will need to complete the assigned exercises to get credit.

Problem Sets and Labs: 40% of your grade

There will be roughly 12 weekly problem sets, containing written problems to be handed in electronically via gradescope (we'll provide submission instructions on the first assignment). They will be typically due on Mondays at 11:59pm, but see each problem set for details.

To get you started with each week's homework, the weekly discussion section/lab will guide you through similar problems.

Late homework will be typically accepted within 24 hours after the original deadline, for a 15% penalty (i.e., you will be graded as usual and then your grade will be multiplied by 0.85).

We will not provide extensions beyond that, not because we are unsympathetic to your time pressures, but because we need to be able to post solutions and discuss the problems in lecture.

We understand, however, that sometimes circumstances are beyond your control. For just such an occasion, we will replace the lowest homework grade with the maximum of your final exam grade and the average of the remaining homework grades. This will happen automatically when we assign grades.

We will consider exceptions to this policy in cases of extended illnesses and other extenuating circumstances.

How to Approach the Homework

The best way to tackle the problem sets is to do them over time rather than once a week. You wouldn't starve for six days and then attempt to consume your weekly calorie needs on the seventh. Similarly, don't deprive your brain of thinking about CS 131 for six days and then attempt to solve the problem set on the seventh.

Labs help you start the homework. Every homework problem relates to something we covered; if unsure how to start, look through what we covered in the last few lectures.

We encourage you to work with others, subject to limitations of the collaboration policy below. We also encourage you to come to office hours, where you can work with others with the help of the course staff.

Two Exams: 15% of your grade each

There will be two exams tentatively scheduled for the below dates. These dates may be subject to change. Each exam will be 1 hour and 15 minutes. Due to the nature of the course material, each exam will be naturally cumulative, but focus on more recent material.

The exams will be held from 6:30pm to 7:45pm on Thursdays:

1. October 3rd
2. November 7th

If you have a conflict with these times or require extra time on exams, please notify us (via a private Piazza post, as described above) as soon as possible.

“Cheat Sheets” and Calculators

The exams are closed-book. However, we encourage you to study for the exam by creating a cheat sheet, which you can use during the exam. To be allowed for use during the exam, a cheat sheet must be written by you personally (handwritten on paper or handwritten on a tablet device and printed). Typed up cheat sheets or copies of other people's cheat sheets are not allowed. The sheet may consist of only a single double-sided piece of paper, of size US Letter or A4.

You may bring one double-sided cheat sheet to the first exam, and two double-sided cheat sheets to both the second exam and final exam. You do not need to hand these in. You are encouraged to keep and re-use them.

You may also, if you like, bring a calculator; though it will not be needed to answer any of the questions on the exams in this course.

L^AT_EX

You may find it easier to type up your homework assignments if you invest a bit of effort into learning using L^AT_EX, which is the platform of choice for scientific writing. Most writing by scientists is done in L^AT_EX, so it may be useful to you later in life. For this course, if you invest an hour or so of your time, you'll be able to type up truth tables with little effort. If you invest just a little more time, you'll be able to type up your proofs as well. Otherwise you'll have to write them out by hand. It's up to you to decide which you find more convenient. A guide can be found on [the course piazza page](#).

Collaboration Policy

Collaboration policy for this class is as follows.

- You are encouraged to collaborate with one another in studying the notes and lecture material.
- As long as it satisfies the following conditions, collaboration on the homework assignments is permitted and will not reduce your grade:
 1. Before discussing each homework problem with anyone else, you must give it an honest half-hour of serious thought.
 2. You must write up your solutions completely on your own, without looking at other people's write-ups. That means, in particular, that you should not write out a solution on the board, take a picture of it, and transcribe it.
 3. In your solution to each problem, you must write the names of those with whom you discussed it.
 4. You may not consult solution manuals, other people's solutions from similar courses or prior years of this course, etc. You may not work with people outside this class (but come and talk to us if you have a tutor) or get someone else to do it for you. If you accidentally stumble onto an online solution, acknowledge it (see next section).
- You are not permitted to collaborate on the exams.

The last point is particularly important: if you don't make an honest effort on the homework but always get ideas from others, your exam scores will reflect it.

Violations of Collaboration Policy

Violations of collaboration policy fall into two categories: ones that are *acknowledged* in your write-up and ones that are *unacknowledged*.

Acknowledged violations (e.g., reading someone else's solution before writing your own and saying so in your own solution) will result in an appropriate reduction in the grade, but will not be considered cheating.

Unacknowledged violations of the collaboration policy—for example, not stating the names of your collaborators, or any other attempt to represent the work of another as your own—will result in an automatic failing grade and will be reported to the Academic Conduct Committee (ACC). The ACC often suspends or expels students deemed guilty of plagiarism or other forms of cheating.

We will assume that you understand the [BU Academic Conduct Code](#); read it if you haven't.

If you are uncertain as to whether a particular kind of interaction with someone else constitutes illegal collaboration or academic dishonesty, please ask us *before* taking any action that might violate the rules; if you can't reach one of us in time, then at the very least include a clear explanation of what happened in your homework write-up to avoid being treated as a cheater. Citing your sources is usually the easiest way out of trouble.

Generative AI Policy

Any use of generative AI such as ChatGPT will be considered a violation of the collaboration policy and will be treated no differently than any other violation as described in the preceding section, i.e. if caught you will at a minimum receive no credit for your submission and you risk being reported to the ACC.

Tentative Course Schedule

This is just to give a rough idea of the course content. It is very much subject to change.

Week	Day	Date		Lecture Topic	Problem Sets	Readings	Exams	Notes
Week 1	M	9/2/2024						
	T	9/3/2024	Lecture 1	Syllabus, Intro to Logic		1.1-1.2		
	W	9/4/2024						
	R	9/5/2024	Lecture 2	Logic cont., Logical Equivalences		1.3-1.5		
	F	9/6/2024						
Week 2	M	9/9/2024						
	T	9/10/2024	Lecture 3	Logical Equivalences		1.4-1.5		
	W	9/11/2024	Lab 1					
	R	9/12/2024	Lecture 4	Predicates and Quantifiers		2.1-2.3		
	F	9/13/2024						
Week 3	M	9/16/2024			PS1 due			
	T	9/17/2024	Lecture 5	Proofs		4.1-4.7		
	W	9/18/2024	Lab 2					
	R	9/19/2024	Lecture 6	Proofs cont.		4.1-4.7		
	F	9/20/2024						
Week 4	M	9/23/2024			PS2 due			
	T	9/24/2024	Lecture 7	Divisibility		5.1-5.3		
	W	9/25/2024	Lab 3					
	R	9/26/2024	Lecture 8	Euclid's Algorithm		5.1-5.3		
	F	9/27/2024						
Week 5	M	9/30/2024			PS3 due			
	T	10/1/2024	Lecture 9	Sets		6.1-6.6		
	W	10/2/2024	Lab 4					
	R	10/3/2024	Lecture 10	Sets cont., Functions		6.1-6.6, 7.2-7.4	Exam 1	
	F	10/4/2024						
Week 6	M	10/7/2024			PS4 due			
	T	10/8/2024	Lecture 11	Functions		7.2-7.4		Drop without 'W' deadline
	W	10/9/2024	Lab 5					
	R	10/10/2024	Lecture 12	Nested Quantifiers, Functions cont.		2.4-2.5, 7.8-7.9		
	F	10/11/2024						
Week 7	M	10/14/2024						Indigenous People's Day (No class)
	T	10/15/2024			PS5 due			Monday schedule substitute (No class)
	W	10/16/2024	Lab 6					
	R	10/17/2024	Lecture 13	Relations		7.1, 7.5		
	F	10/18/2024						
Week 8	M	10/21/2024			PS6 due			
	T	10/22/2024	Lecture 14	Equivalence Classes		7.6-7.7		
	W	10/23/2024	Lab 7					
	R	10/24/2024	Lecture 15	Sequences/Series, Math Induction		8.1-8.3, 8.4		
	F	10/25/2024						
Week 9	M	10/28/2024			PS7 due			
	T	10/29/2024	Lecture 16	Math Induction		8.4-8.5		
	W	10/30/2024	Lab 8					
	R	10/31/2024	Lecture 17	Strong Induction		8.6		
	F	11/1/2024						

Week	Day	Date		Lecture Topic	Problem Sets	Readings	Exams	Notes
Week 10	M	11/4/2024			PS8 due			
	T	11/5/2024	Lecture 18	Well-ordering, Structural Induction		8.6-8.7		
	W	11/6/2024	Lab 9					
	R	11/7/2024	Lecture 19	Well-ordering, Structural Induction cont.		8.6-8.7	Exam 2	
	F	11/8/2024						
Week 11	M	11/11/2024			PS9 due			
	T	11/12/2024	Lecture 20	Boolean Algebra		9.1-9.3		Drop with 'W' deadline
	W	11/13/2024	Lab 10					
	R	11/14/2024	Lecture 21	Boolean Functions		9.4-9.5		
	F	11/15/2024						
Week 12	M	11/18/2024			PS10 due			
	T	11/19/2024	Lecture 22	Combinatorics		10.1-10.9		
	W	11/20/2024	Lab 11					
	R	11/21/2024	Lecture 23	Combinatorics cont.		10.1-10.9		
	F	11/22/2024						
Week 13	M	11/25/2024			PS11 due			
	T	11/26/2024	Lecture 24	Combinatorics cont.		10.1-10.9, 12.1		
	W	11/27/2024						Thanksgiving (no class)
	R	11/28/2024						Thanksgiving (no class)
	F	11/29/2024						Thanksgiving (no class)
Week 14	M	12/2/2024						
	T	12/3/2024	Lecture 25	Applications of Material				
	W	12/4/2024	Lab 12					
	R	12/5/2024	Lecture 26	Applications of Material				
	F	12/6/2024						
Week 15	M	12/9/2024			PS12 due			
	T	12/10/2024	Lecture 27	Review				Last instructional day