CS230 Spring 2024
Discrete Math for Computer Science
Overview
What is CS230?

- CS230 is Discrete Math for Computer Science
What is CS230?

- CS230 is Discrete Math for Computer Science
What is CS230?

- CS230 is **Discrete Math** for Computer Science

- MATH230: Probability
- CS330: Introduction to the Design and Analysis of Algorithms
- CS316: Introduction to Database Systems
- CS671D: Theory and Algorithms for Machine Learning
- CS351: Introduction to Computer Security
- MATH356: Ordinary and Partial Differential Equations
- CS445: Introduction to High Dimensional Data Analysis
- MATH375: Linear Programming
- CS371: Elements of Machine Learning
- CS334: Mathematical Foundations of Computer Science
What is CS230?

- CS230 is *Discrete* Math for Computer Science
What is CS230?

• CS230 is some but NOT ALL Discrete Math for Computer Science
  • CS is growing so fast, we can’t agree on what topics are essential

• What should be included in CS230?
The goals of CS230

• Acquire and enhance your ability in abstract thinking and formal mathematical communication.

• Familiarize yourself with math concepts and tools essential for advanced topics in computer science.
How do we go about CS230 in Spring 24

Core Modules (CMs, 8 in total): “What everyone should learn”

Elective Modules (EMs): “Useful for someone/some field”

Your own CS230
CS230 Spring 2024
Discrete Math for Computer Science
Class Components
What happens for a typical CM

- **Self-prepare**
  - Reading
  - Canvas quiz

- **Class Meeting (Wed)**

- **Class Meeting (Fri)**

- **Recitation (Mon)**

- **PL homework (autograded)**

- **Assignment (manually graded)**

*Partially flipped for equity*
Why do we partially flip the material
With the **self-prepare phase**

![Diagram showing self-prepare phase with sections for background and prepare]
A longer CM

- Self-prepare:
  - Reading
  - Canvas quiz

- Class Meeting (Wed)

- Class Meeting (Fri)

- Recitation (Mon)

- Class Meeting (Wed)

- Spring Break

- PL homework (autograded)

- Assignment (manually graded)

- 2/27

- 3/17
What happens for an EM (more ad-hoc)

- Class Meeting
  - Might be in-class, might be a video, might be implemented in a recitation time slot (logistics TBD)

- Assignment (manually graded)

- PL homework (autograded)

No need to prepare CMs already prepared you
Okay what about exams?

CM1: Logic
CM2: Proof Methods
CM3: Math Tools

Exam 1: CM1-3

CM4: Sets, Functions, Relations
CM5: Inductions
CM6: Graph Fundamentals

Exam 2: CM4-6

CM7: Combinatorics
CM8: Probability

Exam 3: CM7-8

EMs are not tested in exams!
The goal of CS230

• Acquire and enhance your ability in abstract thinking and formal mathematic communication.

• Familiarize yourself with math concepts and tools essential for advanced topics in computer science.

They call this “proof-writing” but it applies to more than only proofs.
How do we go about communication

- Communication is an art, so is math communication
- It is usually subjective and context-dependent:
  - Is the writing logically solid?
  - Is the writing clear and easy to understand?
  - Does the writing use too many symbols/too many words?
  - Does the writing contain irrelevant or circular arguments?
  - Everything here needs feedback
What happens for a written assignment

1. **Submit your work**
2. **Teaching team gives feedback**
3. **Revise work based on feedback**
4. **Human-graded**

- **At least 2 full cycles promised**
- **At least 1 full cycle before the relevant exam**
What happens for autograded things

1. Submit your work
2. Revise work based on feedback
3. Autograder gives feedback
4. Unlimited number of cycles until end-of-semester
What happens for exams then?

- Take the exam
- Teaching team gives feedback
- Keep learning based on outcome
- There is a second attempt for every exam, happening in the final exam slot
- You can opt to retake each exam separately
- Similar design in CS201, CS216, CS330…
Okay, now tell me the weights of things?

- There is no weights for anything in our grading.

- Check the next short video on grading
What we want your final grade to measure

**Relevant**
- Your ability in abstract thinking and formal mathematical communication
- Your mastery of important math concepts and tools

**Irrelevant**
- Your time management
- Your ability in avoiding typos and calculation mistakes
- Your ability to perform under immense pressure
What we should do using point weights

**Relevant 100%**
- Your ability in abstract thinking and formal mathematical communication
- Your mastery of important math concepts and tools

**Irrelevant 0%**
- Your time management
- Your ability in avoiding typos and calculation mistakes
- Your ability to perform under immense pressure
What we actually count

CM1: Logic
CM2: Proof Methods
CM3: Math Tools
CM4: Sets, Functions, Relations
CM5: Inductions
CM6: Graph Fundamentals
CM7: Combinatorics
CM8: Probability

How many exams do you complete satisfactorily or exceptionally?
How many CMs do you satisfactorily complete?

Exam 1: CM1-3
Exam 2: CM4-6
Exam 3: CM7-8

Also: how many EMs do you choose to complete?
Finally: be communicative and complete the miscellaneous items (surveys, etc.)
What is satisfactorily complete? (1)

- Follow everything we prepare for you

- Self-prepare
  - Reading
  - Canvas quiz

- Class Meeting (Wed)

- Class Meeting (Fri)

- Recitation (Mon)

- Attend recitations and complete the work there

- PL homework (autograded)

- Assignment (manually graded)

- Get every question right

- Get a satisfactory in every problem in the assignment

- Do the reading, then complete the Canvas quiz, and get most (80%) of the questions correct

- Come to class and complete all class work: Peer Instructions (PI), Peer Discussions (PD), etc.
What is satisfactorily complete? (2)

- What if I need to miss something?

  - Self-prepare
    - Reading
    - Canvas quiz

  - Class Meeting
    - (Wed)

  - Class Meeting
    - (Fri)

  - Recitation
    - (Mon)

  - Attend recitations and Complete the recitation work

  - Get every question right

  - PL homework
    - (autograded)

  - Assignment
    - (manually graded)

  - Get a satisfactory in every problem in the assignment

  - Due on LDoC (or even later)

  - Do the reading, then complete the Canvas quiz, and get most (80%) of the questions correct

  - Come to class and Complete all class work: Peer Instructions (PI), Peer Discussions (PD), etc.
What is **satisfactorily complete**? (3)

- What if I am really good at a CM and don’t want to?

  - Self-prepare
    - Reading
    - Canvas quiz
  - Class Meeting (Wed)
  - Class Meeting (Fri)
  - Recitation (Mon)
  - PL homework (autograded)
  - Assignment (manually graded)

Get every question right

Get an **exemplary/excellent** in every problem in the assignment **SOLO**
What is ESNU?

E (Excellent or Exemplary)

S (Satisfactory, can use minor revisions)

N (Not yet, need major revisions)

U (Unassessable)

You can get an A- by climbing every mountain up to here despite never summiting.
Keep in mind:

• These are about you and your own learning

• Your classmates’ success NEVER factor into your success
  • We don’t curve the class
  • We might lower the standard for satisfactory for individual items

• Your letter grade NEVER decreases
For more information

- You can find details of our grading mechanism in Canvas
  - Due to Canvas not designed for a course like ours, some items may have “fake point values” of 0 or 1 point in Canvas
  - We will configure Gradebook for you to track module completion status

- Next video: course policies
Manually-graded assignment policies

• One for each CM/EM, submit via Gradescope
• You may do the assignments *solo* or *in pairs*
  • You must stick with the same pair throughout the feedback process for the same assignment (i.e., if round 1 is solo, can’t pair for round 2)
  • Can’t collaborate with the same partner in consecutive CMs
    • So your partner for CM2 assignment cannot be the same one in CM1
    • No such rule for EMs (EMs are not ordered at all)
Manually-graded assignment policies

- Gradescope assignments must be *typed*
  - In other words: handwritten and photocopied work is not accepted
  - Exception is when you *augment* your work with figures/diagrams

- Using LaTeX is strongly recommended but not required
- All these policies are consistent with past CS230 semesters as well as CS330
Collaboration policies

• *Open whiteboard* rule:
  • It is okay to discuss stuff at a high concept-level, on an actual or imaginary whiteboard, with anyone (LLMs treated as people)
  • It is prohibited to transcribe from the whiteboard discussion; write-ups should be completed on your own
  • Cite and acknowledge everyone you collaborated/discussed, including if it’s an online resource or it’s a LLM

• Looking at past CS230 material is prohibited
Communication policies

• Check course website before asking a logistical question anywhere

• For technical help (i.e., on course content), use consulting hours and/or Ed discussions (see Help Resources on course website)
  • Don’t ask for technical help via email

• For personal questions about the course (grades, accommodations, etc.) use our course inbox: compsci-230@duke.edu (reaches head staff)
  • Don’t use personal emails unless it’s really between you and that person
Technical help channels

• Ed discussions is open/public, 24/7, more general
  • Consider using Ed if your question may benefit the others
  • All Ed questions are public (viewable by everyone in class) but you may stay anonymous
  • Search before posting

• Consulting hours are one-to-one, synchronous, more personalized
  • Consider attending consulting hours if the help needs to be personal, e.g., about your own approach to an assignment problem
  • Regular TA consulting hours start on 1/23 (Tue)
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Discrete Math for Computer Science
Class starts after this song

Sunset Rollercoaster - Coffee’s on Me (2021)
CS230 Spring 2024
Discrete Math for Computer Science
About your instructor
Shao-Heng Ko

• Ph.D. candidate (4th year)
  • Research area: computing/CS education
  • Previous research experiences in other CS subfields (check website if interested)

• Please call me Shao-Heng
  • This is my full first-name (not Shao)
  • Do NOT use the word PROFESSOR
Shao-Heng Ko

- I was a grad TA for:
  - CS330 [Fall 20] [Fall 21]
  - CS230 [Spring 21*] [Fall 23]
  - CS216 [Fall 22] [Spring 23*]

- I am your instructor for CS230
  - Treat me like your other instructors re: 230
  - and like any other grad student outside of 230
I am like your other professors in:

• I care about your learning
• I also want you to like me (and my policies)

• But if I have to choose one, I take the former every day
I am **unlike** your other professors in:

- I am inexperienced
- ... but I am also less busy and have more time/energy for you
- ...younger?
- ...I am on Reddit and Sidechat?
“Are you experimenting on us”? 

• My research is (so far) **observational**, not **experimental**
  • I collect/analyze data of existing classes
  • I do NOT tweak the classes “to see what works better”

• Every bit of design of this class, is **what I think works the best for our class context and for you, and not an experiment**
  • I didn’t invent anything. All the things like ESNU, discrete grading, peer instructions, partially flipped classes… are existing pedagogical designs that have proven to be useful.
Personal bias

• Every person learns differently (with different styles)
  • Therefore, every instructor injects personal bias into their class design

• When I was an undergrad, the #1 thing I hated was being treated like a baby. So I will try my best to treat you like adults:
  • I think students should own their learning experience
  • I give you as much flexibility/autonomy as I reasonably can; but you should be responsible for your own learning
Gender

Year

<table>
<thead>
<tr>
<th>Gender</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
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</table>
Race

• ~10% of you (that filled out the survey) self-identified as neither Asian nor White.

• ~3% of you (that filled out the survey) preferred not to respond.

• How many % of you are Asian, White, or both?

• Concepts:
  • Logical connectors and De Morgan’s law (CM1)
  • Set difference and universal set (CM4)
Major

- Concepts:
  - Set union and intersection (CM4)
  - Universal set (CM4)
  - Inclusion-exclusion counting (CM7)
Prior experience in proofs

- Concepts:
  - Increasing and decreasing sequences (CM3)
  - Partition (CM4)
Modules you are “more familiar” with happen to be the “more in-depth modules.”
5 clear “winners”

<table>
<thead>
<tr>
<th>Preference</th>
<th>Module = Graph app. in AI</th>
<th>Module = Graph app. in robotics</th>
<th>Module = Prob. app. in hashing and caching</th>
</tr>
</thead>
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<tr>
<td>Extremely interested</td>
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<tr>
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</tr>
<tr>
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<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Preference</th>
<th>Module = Prob. app. in privacy</th>
<th>Module = Num. theory &amp; cryptography</th>
<th>Module = Language, automata, computation</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Preference</th>
<th>Module = Voting and social choice theory</th>
<th>Module = Constraint satisfaction</th>
<th>Module = FSMs and Markov chains</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0, 10, 20, 30, 40</td>
<td>0, 10, 20, 30, 40</td>
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<tr>
<td>Not interested at all</td>
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<td>0, 10, 20, 30, 40</td>
<td>0, 10, 20, 30, 40</td>
</tr>
</tbody>
</table>

In a tie for the last spot
What you liked/disliked

• 100% positive: multiple chances at everything, flexibility
• Mostly positive: groupwork
• Controversial (some like some dislike): grading system
What you liked/disliked

• 100% positive: multiple chances at everything, flexibility
• Mostly positive: groupwork
• Controversial (some like some dislike): grading system
• Negatives:
  • Not knowing what separates E and S in advance
  • Too many details to keep in mind
  • Not being able to “calculate grades” or “see where I stand”
“If getting an excellent required near perfections, it seems like it might be a little unrealistic to get an A.”

For those with some familiarity with the current module, it would be nice to have access to future readings and assignments.

Not being able to look at past CS230 material. I often found it helpful to use material from past classes (eg. exams from last year) to get extra practice.

I still feel slightly unclear on due dates, as well as when it is recommended each assignment be completed by.
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Discrete Math for Computer Science
About the team
Teaching associate: Violet Pang

• Oversees:
  • Your accommodations
  • Your personal concerns/struggles
  • Your feedback to the course
  • Your TAs
TAs

Prince Ahmed
Shawn Ma
Sydney Lester
Vincent Capol
Yiyang Shao
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About the platforms
Day 1: Peer Discussion

• Turn to your neighbor
• Introduce yourself:
  • Name, year, major, etc.
• Then discuss the question in the QR code
  • Or go to the newly published item in Canvas with the title
  • No submission required for PDs, but everyone should have an opinion
Day 1: Peer Instruction

- Answer the question in the QR code on your own
  - Or go to the newly published item in Canvas with the title
- Turns to your neighbors, compare answers and discuss
  - You can submit a second time if your answer changes
MyDigitalHand

• [https://beta.mydigitalhand.org/](https://beta.mydigitalhand.org/)

• Sign in or create new account using a Duke email

• COURSE SEARCH
  • Enter Duke and search for 230
  • Use code **S33L743**
PrairieLearn

- https://plearn.cs.duke.edu/
Recitation sections

• We are looking for volunteers to switch to 10:05-11:20
  • Do that right now, you don’t need a permission number for it
What to do before next Wednesday?

- Don’t go to recitation sections on Monday (MLK holiday)
- Do read the required reading
- Do attempt the Canvas prepare quiz
  - Remember you have unlimited attempts
- Watch the Day 0 videos and complete the survey if you haven’t