Lecture 1A: Introduction, Proposition Logic

UC Berkeley EECS 70
Summer 2022
Tarang Srivastava

Course Overview

Course Webpage: www.eecs70.org

Explains policies, calendar for OH, HW, midterm dates, schedule, etc

Course Format

Lecture → Mon-Thu 12:30-2p Dwinelle 155 (and live Zoom/recorded)

Discussion → Mon-Thu. Will cover content from that day's lecture.

Office Hours → See eecs70.org/calendar for location and times. Submit tickets on oh.eecs70.org

Course Overview (cont.)

Software

bCourses → Lecture

Gradescope → HWs and Vitamins

Piazza → Questions, Communications, Everything else!

Email: cs70-staff@berkeley.edu → Personal questions, extenuating circumstances, etc

Top Bar Attendance Form → Attendance Credit

Weekly Post

On Piazza. It is required reading every week.

Course Overview (cont.)

Check you are enrolled in these services

bCourses, Piazza, Gradescope. Please email cs70-staff@berkeley.edu if not enrolled.

DSP

You should have received an email from Nikki Suzani. Please email us if you have not.

Incomplete

If you are finishing an incomplete this semester please email us with the conditions of your incomplete.

Assignments

Homework → released weekly on Saturday morning

Due every Thursday. No penalty grace period until Friday 11:59 pm. Graded on accuracy.

Material from last WTh and this MTue

Vitamins → released weekly on Saturday morning

Due every Thursday. No penalty grace period until Friday 11:59 pm Graded on accuracy. Instant feedback on your answers.

Material from this week's MTuWTh lecture

Discussion Attendance

1 point for each discussion. 13 needed for full credit

Exams

Midterm 7/15 Time 6-8p, Final 8/12 Time 6-9p.

Discussion Attendance	**5%**
Vitamin	**5%**
Homework	**20%**
Midterm	**30%**
Final	**40%**

Website

https://www.eecs70.org/

Lecture Discussions Calendar Policies Resources Staff Attendance Piazza Queue

Discrete Mathematics and Probability Theory

CS70 at UC Berkeley, Summer 2022
Jingjia Chen, Michael Psenka, and Tarang Srivastava

Lecture: MTuWTh 12:30 pm - 1:59 pm, Dwinelle 155
Jump to current week

Week	Date	Lecture	Resources	Notes	Discussion	Homework
1	Mon 6/20	*Juneteenth*			Disc 1A, solutions	HW 1, solutions
	Tue 6/21	Introduction, Propositional Logic		Note 0 Note 1	Disc 1B, solutions	
	Wed 6/22	Proofs		Note 2	Disc 1C, solutions	
	Thu 6/23	Induction		Note 3		

Instructors

Tarang: First third of the course

Michael: Secord third of the course

Jingjia: Last third of the course

Tarang Srivastava (he/him)

tarang.sriv@ • website

Hi! I'm a fourth year Math and CS double major. I have been a TA for 5 semesters and Head TA for 3, I'm very excited to be teaching yall this semester!

Michael Psenka (he/him)

psenka@ • website

I'm a 2nd year PhD student in BAIR–I currently work on representation learning in computer vision and robotics. I did my undergrad in math, and I continue to enjoy bringing my math nerdiness into my CS research. Outside of work, I play piano (& attempt at music production), Smash, chess, and snowboard.

Jingjia Chen (she/her)

jingjia.chen@

Collaboration

We highly encourage collaboration! So, let's define what that means. (Professor Sinclair)

Discussing approaches to problems is encouraged!

As long as you reach a good understanding of the final solution

You should not allow concerns for cheating to get in the way of discussing problems with your peers

How we recommend collaborating…

- Post on Piazza and read the relevant homework threads
- Come to OH. It's okay to just chill there even if you have no questions

Cases of Academic Misconduct will be dealt with by the course staff and Center for Student Conduct

Why CS70?

Programming + Microprocessors → Superpower

What are your computers doing?

- Logic and Proofs!
- Ex: Induction = Recursion

What can computers do?

- Work with discrete objects
- Discrete Math → immense applications

Computers learn and interact with the world?

- Probability → Ex: machine learning, data analysis, robotics,

Our goal: ***teach you to think more critically and powerfully…and to deal clearly with uncertainty itself.***

Tips for CS70

READ THE NOTES! READ THE NOTES! READ THE NOTES!

- Reading mathematical text is not the same as reading regular non-fiction.
- Read non-linearly. Jump around. Keep a pencil in hand. Work out examples.
- We will hold specific OH this week to give some tips on how to best read the notes. This is a skill we hope you pickup in this class.
- Reading the notes takes time. Allocate 1-2 hours for each note
- There is a myth that you need “mathematical maturity” to do well in this course.
- Give yourself plenty of time to think about homework problems.

Announcements!

- Join Piazza. Read the Welcome Post
- Discussions start today, signup link is on Piazza
- Office Hours start today, see course calendar on website
- **HW 1** and **Vitamin 1** have been released, due Thu (grace period Friday)

Propositions: Statements that are true or false

Statement	**Is it a proposition?**	**true/false?**
Square root of 2 is irrational		
2 + 2 = 4		
2 + 2 = 3		
Tom Hanks is in Forrest Gump		
Tom Hanks is a good actor		
2 + 2		
2 + x = 5		
Any even > 2 is a sum of 2 primes		

Using variables to denote propositions

P = “I am Oski” Q = “I am Carol Christ”

Operation	**Symbol**	**Meaning**	**Example**
Conjunction			
Disjunction			
Negation			

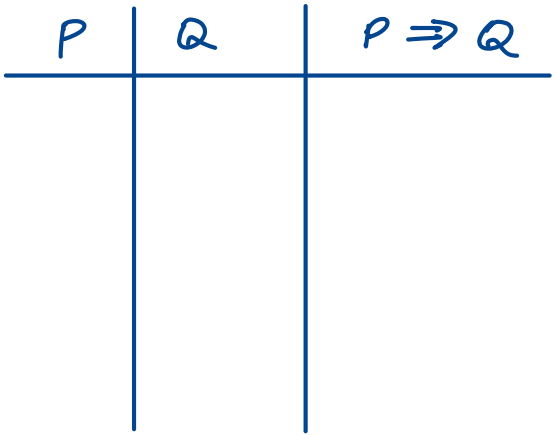
Truth Tables

A way to systematically record what an operation on propositions is doing.

P	Q	$P \wedge Q$	$P \vee Q$	$\neg P \vee Q$

Implications

If P, then Q



P = “You like CS70”

Q = “You like probability”

Converse, Inverse and Contrapositive

P	Q	$\neg P$	$\neg Q$	$P \Rightarrow Q$	Converse $Q \Rightarrow P$	Inverse $\neg P \Rightarrow \neg Q$	Contrapositive $\neg Q \Rightarrow \neg P$

$P \Rightarrow Q \equiv$

Logical Equivalence

Propositional formula is an expression made up of propositional variables combined with logical operators.

Two propositional formulas are **logically equivalent** if they have the same truth table.

Example:

P	Q	$P \Rightarrow Q$	$\neg Q \Rightarrow \neg P$	

DeMorgan's Law

P	Q	$P \wedge Q$	$\neg(P \wedge Q)$	$\neg P \vee \neg Q$

$\neg(P \wedge Q) \equiv$

$\neg(P \vee Q) \equiv$

Predicates and Quantifiers

Predicates: Statements with free variables. Ex: Q(x) = “2x is even”

Predicates by themselves are **not** propositions. Adding a quantifier and a universe allows us to state multiple propositions at once.

Example: for all natural numbers n, $n^2 + n + 41$ is prime

From Note 0:

$\mathbb{N}$ =

$\mathbb{Z}$ =

$\mathbb{Z}^+$ =

$\mathbb{Q}$ =

$\mathbb{R}$ =

$S = \{\heartsuit, \triangle, \square\}$

“For All” and “Exists”

∀ “For all” means for all the values in the universe P(x) is true

∃ “Exists” means there is at least one value x in the universe for which P(x) is true

Practice "Every nonzero rational number can be multiplied by some rational number to get 1"

Logical Equivalence with Quantifiers

$\exists x \, \exists y \quad P(x,y) \quad ? \quad \exists y \, \exists x \quad P(x,y)$

$\forall x \, \exists y \quad P(x,y) \quad ? \quad \exists x \, \forall y \quad P(x,y)$

DeMorgan's Law for Quantifiers

$\neg(\forall x \in S)\, P(x) \quad \equiv$

Example:

$P(x) \quad x^2 > 10$

$S = \{1, 2, 3, 4\}$