

Discrete Mathematics

- Computer Science & Engineering intends to solve practical problems.
- Hence, the mathematics used here is constructive & covered by two main areas:
 - 1) Discrete Mathematics, &
 - 2) Probability.
- In this course we'll discuss time-tested tools used in CS. In particular, you'll learn ^{algebra} about proofs, combinatorics, graphs, number theory &

Discrete Maths (Math CS-I)

- Extra classes + Quiz on Saturdays.
- The topics are basic mathematics.
 - ↳ Useful in theory, systems & applns.

<u>Grading:</u>	Assignments: (4)	-	15%
	Quiz : (4)	-	35%
	Midsem : (1)	-	20%
	Endsem : (1)	-	30%

What is DM?

- Discrete objects & key words.
- " refers to 0/1, integers, ..., so that it needs finite storage. ($\sqrt{2}, x$)
 e, π
- Sets with countable "number" of elements.
- $\mathbb{R} \rightarrow$ uncountable / $\mathbb{Z} \rightarrow$ countable.
- Why discrete?
Because computer storage is ultimately 0/1 \equiv OFF/ON.

- The course has five "disjoint" topics:

Proofs

Combinatorics / Counting

Graph theory

Number theory

Abstract algebra.

Proofs

— A sequence of statements s.t. the next one follows from the previous one in an "easy" way.

- Proofs for a result are not unique.
- Reprove things yourself!

- Different techniques to prove?
(eg. axioms, induction, implication, contradiction)
- Examples of intuitive but wrong? [eg. Conjecture]
- Can every statement be proved/disproved? [Counterexample]

Combinatorics

- The art of counting!

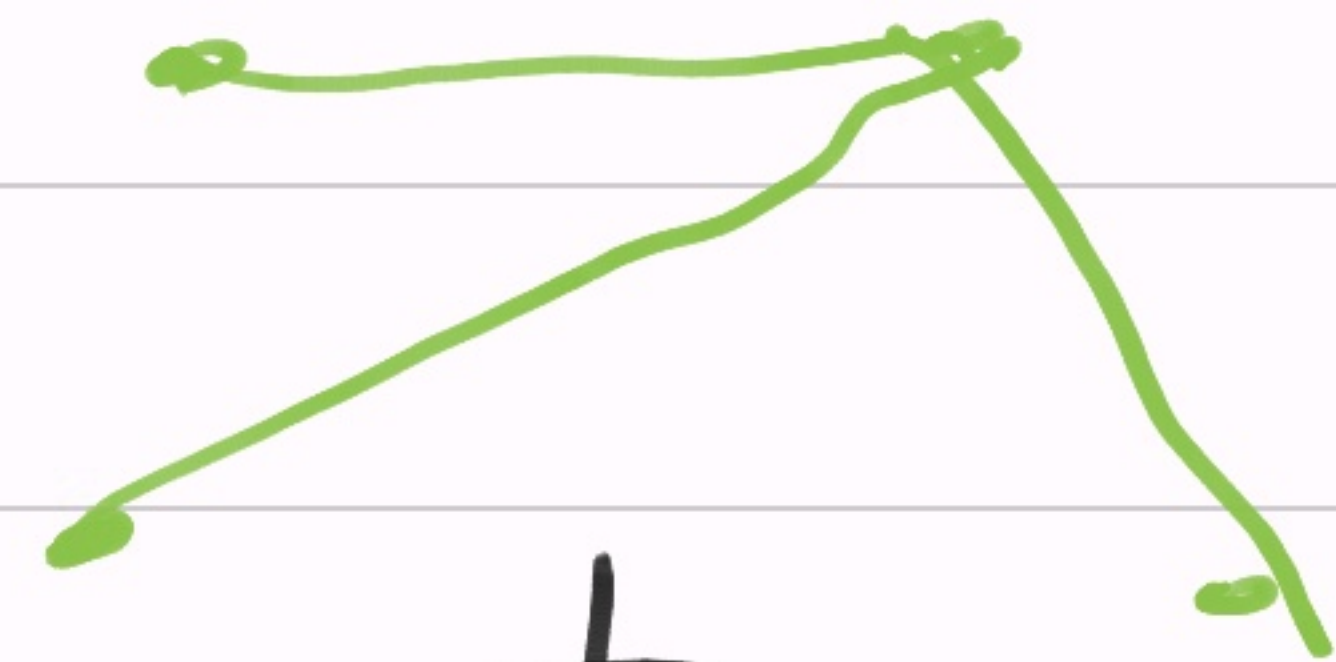
→ Combinatorics is more like a collection of puzzles, that are (seemingly) unrelated.

- $\forall n$, \exists a positive integer in 0/1 digits that is divisible by n ?
- # ways n balls into m bins?
- # ways to permute $\{1, \dots, n\}$ s.t. no element fixed.

- # ways to write a valid parenthesized statement using n (& n) - [eg. $(())(x)$]
[eg. recurrence, generating fns.]

Graphs

eg.



- Combinatorial graphs (and not graphs or diagrams of functions)
- Models in CS: networks / communication / transport / social / ...
- we'll cover some special properties & eg.s:

- Is there a way to go from X to Y s.t. every other city is visited once?
[Hamiltonian Path]

- Matching:
(stable matching)



Number theory

- earliest branches of mathematics.
(easy to ask / hard to answer)
- How many primes are there?

- Practical: cryptography / error-correcting codes.

Algebra

- Abstract operations ($+$, $*$, $/$, $-$)
[common proofs over structures]
- Make proofs more systematic.
[geometry \rightarrow coordinate geometry]