What Is Discrete Math?

**Definition: Discrete Mathematics**

Contrast this with ‘the calculus,’ which was developed by Newton and Leibniz to study objects in motion. As a result:

- ‘The Calculus’ tends to focus on real values
- Discrete Mathematics tends to focus on integer values
Sample Discrete Math Topics

Topics that fall under the umbrella of discrete math include:

- Integral Functions and Relations
- Matrix Operations and Representations
- Sets
- Sequences and Summations
- Discrete Probability
- Counting (Permutations/Combinations, Recurrence Relations)

To understand those, you also need:

- First-Order Logic
- Logical Arguments
- Proof Techniques
- ... and a fair amount of pre-calculus mathematics

“But Why Do I Have To Take Discrete Math?”

Discrete Structures is an ACM/IEEE core curriculum topic

- See:

  https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf

DM topics underlie much of Computer Science, including:

- Logic → Knowledge Representation, Reasoning, Natural Language Processing, Computer Architecture
- Proof Techniques → Algorithm Design, Code Verification
- Relations → Database Systems
- Functions → Hashing, Programming Languages
- Recurrence Relations → Recursive Algorithm Analysis
- Probability → Algorithm Design, Simulation
Topics You May Need To Review

- Mathematical concepts, including, but not limited to:
  - Fractions
  - Rational Numbers
  - Basics of Sets
  - Associative, Commutative, Distributive, and Transitive Laws
  - Properties of Inequalities
  - Summation and Product Notation
  - Integer Division (Modulo, Divides, and Congruences)
  - Even and Odd Integers
  - Logarithms and Exponents
  - Working with Quadratic Equations
  - Positional Number Systems

  Please read the Math Review appendix (available from the class web page) to review these topics.

- Coding with basic data structures in Java or Python

  We trust that you can review this on your own!

Notations for Sets of Values

\[ \mathbb{Z} \quad \text{All integers} \quad \{ \ldots, -2, -1, 0, 1, 2, \ldots \} \]

\[ \mathbb{Z}^+, \mathbb{N}^+ \quad \text{All positive integers} \quad \{1, 2, 3, \ldots\} \]

\[ \mathbb{Z}^*, \mathbb{N}_0 \quad \text{The non–negative integers} \quad \{0, 1, 2, 3, \ldots\} \]

\[ \mathbb{Z}_{\text{even}} \quad \text{Even integers} \quad \{\ldots, -4, -2, 0, 2, 4, \ldots\} \]

\[ \mathbb{Z}_{\text{odd}} \quad \text{Odd integers} \quad \{\ldots, -3, -1, 1, 3, \ldots\} \]

\[ \mathbb{Q} \quad \text{Rational numbers} \quad \frac{a}{b}, \ a, b \in \mathbb{Z}, b \neq 0 \]

\[ \overline{\mathbb{Q}} \quad \text{Irrational Numbers} \quad \{i \mid i \notin \mathbb{Q}\} \]

\[ \mathbb{R} \quad \text{The real values} \quad \{\mathbb{Q} \cup \overline{\mathbb{Q}}\} \]

Note: Avoid the term “natural numbers” and the plain \( \mathbb{N} \).
Remember!

All of the math review topics are fair game for quizzes and exams (including the final!).

If you are not confident in your knowledge of them:

- Work the sample Math Review exercises from the class web page,
- Study your notes from section this week, and
- Review the topics on your own!