Introduction to Discrete Mathematics

- Ms. Rajanpreet Kaur Chahal
Assistant Professor
CSE Department
Thapar Institute of Engineering and Technology
rajanpreet@thapar.edu

Target Audience

- Undergraduate students who have discrete mathematics in their syllabus.
- Students who are preparing for GATE and other competitive exams.
- Students who want to learn competitive programming.
- Everyone who wants to learn discrete mathematics as a whole or may be a small subset of their subject.

What is Discrete Mathematics?

- Discrete mathematics is the part of mathematics devoted to the study of discrete objects.
- *Discrete* means consisting of distinct or unconnected elements.
- More generally, discrete mathematics is used whenever objects are counted, when relationships between finite (or countable) sets are studied, and when processes involving a finite number of steps are analyzed.
- A key reason for the growth in the importance of discrete mathematics is that information is stored and manipulated by computing machines in a discrete fashion.

Discrete vs Continuous Data

- Data can be envisioned to be divided into two categories:
  - ✓ Discrete: Data that can only take specific values.
    - Natural numbers
    - Number of persons in a room
    - Results of rolling a dice
  - ✓ Continuous: Data that can take on any value within a range.
    - Real numbers
    - Height and weight of a person
    - Time
    - Length of an object
    - All these quantities can be measured up to a fraction!

Why study Discrete Mathematics ?

- To develop your mathematical maturity, i.e., your ability to understand and create mathematical arguments.
- It provides the mathematical foundations for many computer science courses including:
  - ✓ Data structures
  - ✓ Algorithms
  - ✓ Database theory
  - ✓ Automata theory
  - ✓ Formal languages
  - ✓ Compiler theory
  - ✓ Computer security
  - ✓ Operating systems

Why study Discrete Mathematics ?

- It improves your problem solving ability.
  - ✓ An important problem-solving skill is the ability to count or enumerate objects.
  - ✓ For this, we need basic techniques of counting.
  - ✓ The stress is on performing combinatorial analysis to solve counting problems and analyze algorithms, not on applying formulae.
- A course in discrete mathematics teaches students how to work with discrete structures which include:
  - ✓ Sets
  - ✓ Permutations
  - ✓ Relations
  - ✓ Graphs
  - ✓ Trees
  - ✓ Finite-state machines

Why study Discrete Mathematics ?

- Certain classes of problems are solved by the specification of an algorithm. After an algorithm has been described, a computer program can be constructed implementing it. Discrete mathematics plays its part in the mathematical portions of this activity, which include:
  - ✓ The specification of the algorithm
  - ✓ The verification that it works properly
  - ✓ The analysis of the computer memory and time required to perform it

Why study Discrete Mathematics ?

- Many problems can be solved using discrete mathematics.
  - ✓How many ways are there to choose a valid password on a computer system?
  - ✓ What is the probability of winning a lottery?
  - ✓ Is there a link between two computers in a network?
  - ✓ How can I identify spam e-mail messages?
  - ✓ How can I encrypt a message so that no unintended recipient can read it?
  - ✓ What is the shortest path between two cities using a transportation system?
  - ✓ How can a list of integers be sorted so that the integers are in increasing order?
  - ✓ How many steps are required to do such a sorting?
  - ✓ How can it be proved that a sorting algorithm correctly sorts a list?
  - ✓ How can a circuit that adds two integers be designed?
  - ✓ How many valid Internet addresses are there?

Syllabus

- Set Theory
- Functions
- Relations
- Propositional Logic
- Graph Theory
- Proof Techniques and Counting
- Group Theory

References

- Rosen H. K., Discrete Mathematics and its Applications, McGraw Hill (2011) 7th ed.

Thank You !