Lecture 01
Introduction:
Discrete Mathematics for CSE

Sahana.P.Shankar

sahana.cs.et@msruas.ac.in

Intended Learning Outcomes

At the end of the lecture, the student will be able to

- Describe the nature of Discrete Mathematics
- Enumerate type of problems solved using Discrete Mathematics
- Explain the goals of Discrete Mathematics
- Explain the uses of Discrete Mathematics

Topics

- Nature of Discrete Mathematics
- Type of problems solved using Discrete Mathematics
- Goals of Discrete Mathematics
- Uses of Discrete Mathematics

Discrete Mathematics

- Discrete mathematics is the part of mathematics devoted to the study of discrete (as opposed to continuous) objects.
- Calculus dealing with continuous objects and is not part of discrete mathematics.
- Examples of discrete objects: integers, steps taken by a computer program, distinct paths to travel from point A to point B on a map along a road network, ways to pick a winning set of numbers in a lottery.
- A course in discrete mathematics provides the mathematical background needed for **all subsequent courses in computer science.**

Types of Problems Solved Using Discrete Mathematics

- How many ways can a password be chosen following specific rules?
- How many valid Internet addresses are there?
- What is the probability of winning a particular lottery?
- Is there a link between two computers in a network?
- How can I identify spam email messages?
- How can I encrypt a message so that no unintended recipient can read it?

Types of Problems Solved Using Discrete Mathematics

- What is the shortest path between two cities using a transportation system?
- Find the shortest tour that visits each of a group of cities only once and then ends in the starting city.
- How can we represent English sentences so that a computer can reason with them?
- How can we prove that there are infinitely many prime numbers?
- 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 always correctly sorts a list?

Goals of Discrete Mathematics

- **Mathematical Reasoning**: Ability to read, understand, and construct mathematical arguments and proofs.
- **Combinatorial Analysis**: Techniques for counting objects of different kinds.
- **Working with Discrete Structures**: How to work with discrete structures, which are abstract mathematical structures that represent objects and the relationships between them.
  - Examples are sets, permutations, relations, graphs and trees.

Goals Discrete Mathematics

- **Algorithmic Thinking**: One way to solve many problems is to specify an algorithm. An algorithm is a sequence of steps that can be followed to solve any instance of a particular problem.
  - Algorithmic thinking involves specifying algorithms, analyzing the memory and time required by an execution of the algorithm, and verifying that the algorithm will produce the correct answer.

- **Applications and Modeling**: It is important to appreciate and understand the wide range of applications of the topics in discrete mathematics and develop the ability to develop new models in various domains.
  - Concepts from discrete mathematics have not only been used to address problems in computing, but have been applied to solve problems in many areas such as chemistry, biology, linguistics, geography, business, etc.

Uses of Discrete Mathematics

- Topics in discrete mathematics will be important in many courses that you will take in the future:
  - **Computer Science**: Computer Architecture, Data Structures, Algorithms, Programming Languages, Compilers, Computer Security, Databases, Artificial Intelligence, Networking, Graphics, Theory of Computation, etc.
  - **Mathematics**: Logic, Set Theory, Probability, Number Theory, Abstract Algebra, Combinatorics, Graph Theory, Game Theory, Network Optimization, etc
  - **Other Disciplines**: You may find concepts learned here useful in courses in philosophy, economics, linguistics, and other departments

Summary

- Discrete mathematics deals with *discrete* (as opposed to *continuous)* objects such as sets, algorithm steps, permutations, relations, graphs and algebraic structures
- Discrete Mathematics is used to model and solve most of the problems in CSE
- Discrete Mathematics-1 is meant to teach Mathematical Reasoning, Combinatorics, Discrete Structures, Modelling and Solution of CSE Applications