

Discrete Structures

Sets and set operations: Union, intersection, Complement, Cartesian product, Power sets, Cardinality of finite sets. Relations: Reflexivity, Symmetry, Transitivity, Equivalence relations, partial orders, closure of relations. Functions: Surjections, injections, bijections, Inverses, Composition. Logic and proofs: Propositional logic, Propositional equivalences, Predicates and quantifiers, proof methods and strategy; Direct proof, proof by contraposition, contradiction proof. Mathematical Induction proof. Counting arguments, Set cardinality and counting, Inclusion-exclusion principle, Arithmetic and geometric progressions. The pigeonhole principle. Permutations and combinations, Basic definitions, Pascal's identity, The binomial theorem. Solving recurrence relations, Fibonacci numbers. Basic modular arithmetic. Trees: Properties, Traversal strategies. Graphs: Undirected graphs, Directed graphs, Weighted graphs. Spanning trees/forests, Graph isomorphism.