IDMA 2026: Summary of Course Contents

The Basic Computer Model

RAM model (memory consisting of big array of fixed-size words)
Unit time cost for (essentially) all simple operations that can be performed on a single word

Asymptotic analysis

Big-oh notation: Meaning and use
Complexity analysis for algorithms (algorithms covered in the course + simple algorithms in exercises)

Basic Data Structures

Stacks
Queues
Lists (implemented as arrays and as singly or doubly linked lists)
Heaps (min heaps and max heaps)
Priority queues

Sorting and Searching

Linear search
Binary search
Insertion sort
Merge sort
Heap sort

Basic Arithmetic and Set Theory

Quotient, remainder, mod function, divisibility
Prime numbers and prime factorization
Greatest common divisor (GCD), Euclidean algorithm
Least common multiple (LCM)
Representation of numbers in different bases (decimal, binary, octal, hexadecimal)
Sets, subsets, power sets, intersection, union, complement, Venn diagrams
Inclusion-exclusion principle
Different functions: polynomials, exponentials, logarithms
Sequences and sums and ways to specify them (explicit, recursive)
Connections to asymptotic analysis
Sums of n first numbers, n first squares, n first cubes; geometric sums

Logic, Mathematical Proofs, and Proof Techniques

Propositional logic, connectives, truth tables, satisfiability, tautologies, contradictions
Predicate logic, universal and existential quantifiers
Direct proofs
Proofs by contraposition
Proofs by contradiction
Mathematical induction (and reasoning with invariants)

Combinatorics and Probability

Multiplication principle
How to choose k elements out of k with and without repetition and caring or not caring about order
Sequences, permutations, multisets, sets
Binomial coefficients (“n choose k”)
Combinatorial proofs (show that two sets have the same size b exhibiting a bijection)
Pigeonhole principle
Basic probability theory (for uniform distribution, with outcomes equally likely, this is just counting)

Matrices and Linear Algebra

Matrices, square matrices, diagonal matrices, and identity matrices
Addition and multiplication of matrices
Boolean multiplication
Matrix transpose and symmetric matrices

Relations

Cartesian product of sets
Relations as subsets of Cartesian products
Domain, range, R-relative sets, in-degree and out-degree
Representation or relations as matrices or directed graphs
Relations R^n and R^∞
Functions: total and partial, surjective/onto, injective/one-to-one, bijective
Reflexive and irreflexive relations
Symmetric, asymmetric, and antisymmetric relations
Transitive relations
Equivalence relations (reflexive, symmetric, transitive) and partitions
Complement and inverse relations
Reflexive, symmetric, and transitive closure
Partial orders (reflexive, antisymmetric, transitive) and partially ordered sets (posets)
Hasse diagrams
Lattices, greatest lower bound, least upper bound

Graph Theory

Graph representation: adjacency matrix, adjacency lists; graphs as binary relations
Directed and undirected graphs; weighted graphs
Neighbours, vertex degree (in-degree, out-degree), paths/walks, simple paths
Connected (undirected) graphs
Graph isomorphism
Trees: root, leaves, children, parents, siblings, ancestors, descendants
Spanning trees of (undirected) graphs
Forests
Graph traversal: Breadth-first search and depth-first search
Topological sort
Strongly connected components
Minimum spanning trees, Prim and Kruskal
Single-source shortest path, Dijkstra