


Algorithm Analysis and Design

Bharati Vidyapeeth's Institute of Computer Applications and Management (GGS IP University) New Delhi, India by Dr. Saumya Bansal



Pre-Requisites & Course Outcomes


PRE-REQUISITES:

1. Programming Skills
2. Discrete Structures
3. Data Structures

COURSE OUTCOMES (COs):
After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Demonstrate P and NP complexity classes of the problem.	BTL2	PO1, PO2, PO3
CO2	Apply the concepts of asymptotic notations to analyze the complexities of various algorithms.	BTL4	PO1, PO2, PO3, PO4
CO3	Analyze and evaluate the searching, sorting and tree-based algorithms.	BTL5	PO1, PO2, PO3, PO4, PO5
CO4	Design efficient solutions using various algorithms for given problems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO5	Develop innovative solutions for real-world problems using different paradigms.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10,

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Syllabus (Unit-IV)

- **Backtracking:** n-Queen's Problem, Hamiltonian Circuit Problem, Subset-Sum Problem, Graph Coloring Problem.
- **Branch and Bound:** Assignment Problem, Travelling Salesman Problem.
- **Introduction to Computability, Polynomial-time Verification, NP-Completeness. Complexity Classes:** Reducibility, NP-Completeness Proof, NP-Complete & NP-Hard, Problem Classification-P, NP, NPC, NP-Hard; Circuit Satisfiability, 3SAT, Vertex Cover, Clique, Cook's Theorem..
- **No. of Hours:** 12
- **Books:**
 - T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI, 2nd Edition, 2006. **Chapters[34-35]**
 - S. Dasgupta, C. Papadimitriou and U.Vazirani, "Algorithms", McGraw Hill Higher Education, 1st Edition, 2017. **Chapters[8-9]**
 - J. Kleinberg and E. Tardos, "Algorithm Design", Pearson Education, 2nd Edition, 2009. **Chapters[8]**

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Branch and Bound

- Branch and Bound is a Systematic method for solving optimization problem.
- Branch and Bound applies on those optimization problem where greedy and dynamic programming fails.
- Branching:** Splitting into subregion
- Bound:** Computes a lower bound on the value of any candidate solution in the space represented by branching
- Pruning** is the act of removing whole branches from the tree that cannot fulfill constraints.
- Backtracking is effective for decision problems, but it is not designed for optimization problem.
- Backtracking requires DFS while B&B requires BFS.

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Branch and Bound


- Live Node:** A node which has been generated and whose all children are not been generated.
- E-node:** A live node whose children are currently being generated is called E-node (Expanding node)
- A **dead node** is that which is not going to be expanded further.
 - All children has been generated
 - Bounding function (which computes the lower bound)** has killed live node without generating all its children.
- FIFO Branch and Bound
- LIFO Branch and Bound
- Least Cost search Branch and Bound

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P, NP, NPC, NPH


- Computability:** Computability is the ability to solve a problem in an effective manner.
- Some common synonyms for "computable" are "solvable", "decidable", and "recursive".
- Tractable problem**, in computational complexity theory, a problem that can be solved in polynomial time.
- Intractable problems** are problems for which there exist **no efficient algorithms (i.e. exponential time)** to solve them.
- Most intractable problems have an algorithm, and that algorithm is the brute-force search.
 - Example: TSP, Graph Coloring, N-Queen's Problem, Subset Sum Problem

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 **P, NP, NPC, NPH**


- Problems that can be solved in polynomial time is called easy problem.
- P is the set of problem that can be solved in polynomial time **deterministically**.
 - Deterministic means the algorithm is aware that what will be the next step and not guessing.

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The test can be scheduled in any lecture next week. Be Ready.

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Thank You

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