

As per the New

NEP Syllabus

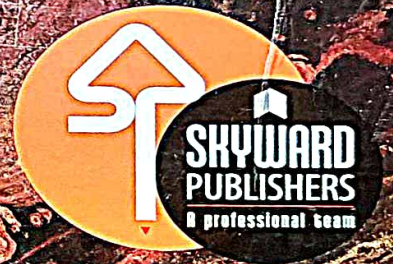
THE DESIGN AND ANALYSIS OF ALGORITHMS

An Illustrative Approach

As Per the New NEP Syllabus for BCA 4th Semester Course of
Bengaluru City University & Bangalore University

Srikanth S

Rekha C



Rekha/2023/Books-1

FOR BULK ORDERS & DISCOUNT
CONTACT: + 91-96111859

THE DESIGN AND ANALYSIS OF ALGORITHMS

-An Illustrative Approach

As per the New NEP Syllabus for BCA 4th Semester Course of
Bengaluru City University and Bangalore University

Authored By

Srikanth. S

&

Prof. Rekha. C

M.C.A., M.Phil., B.Ed., ADSE (Ph.D), K.SET

HOD in Department of Computer Science

Soundarya Institute of Management and Science,
Bangalore.

COMPLIMENTARY COPY
NOT FOR SALE



Skyward Publishers

#157, 7th Cross, 3rd Main Road, Chamarajpet
Bangalore-18. Phone : 080-26603535 / 43706620,
Mob: 9611185999
E-mail: skyward.publishers@gmail.com
Website: www.skywardpublishers.co.in

A Text Book of "The Design and Analysis of Algorithms" - As per the New NEP Syllabus for B.Tech. Semester III A Course of Bangalore University & Bangalore City University by Shikanta, S. B. Rakha et al.

© Author

Copyright: No part of this book may be reproduced, stored in a retrieval system or transmitted in any form or by any means, without the prior permission of the copyright holder. Every effort has been made to avoid errors in this publication. In case of any errors or omissions, the publisher shall be liable to the extent of the error in the next edition. The publisher shall not verify the originality, authenticity, ownership, and infringement of the data, content, and information. The Authors are the sole owners of the copyright of the Work. It shall be Authors sole responsibility to ensure the lawfulness of the content and publisher is not responsible for any copyright issues. It is notified that publisher will not be responsible for any damage or loss of action anyone of any kind. In any manner, there from all disputes are subject to Bangalore jurisdiction only.

ISBN : 978-93-95085-58-8

First Edition : 2023

Pages: 412

Price : ₹ 375/-

Published by:

Skyward Publishers
#157, 7th Cross, 3rd Main Road, Chamarajpet,
Bengaluru-18. Phone : 080-26603535 / 080-43706620,
Mob: 9611185999
E-mail: skyward.publishers@gmail.com
Website: www.skywardpublishers.co.in

Skyward Publishers
Bengaluru-18
Phone : 080-26603535 / 080-43706620
Mob: 9611185999
E-mail: skyward.publishers@gmail.com
Website: www.skywardpublishers.co.in

CONTENTS

Unit - I

Chapter - 1

Introduction to Algorithm

1.1 - 1.26

1.1	What is an Algorithm?	1.2
1.2	The Notion of the Algorithm	1.3
1.3	Characteristics of an Algorithm	1.3
1.4	What is Design and Analysis of Algorithms? Why We Need to Study?	1.4
1.5	Algorithm Examples	1.5
1.6	Fundamentals of Algorithm Problem Solving	1.11
1.7	Problem Types	1.14
1.8	Fundamental Data Structures	1.18
1.8.1	Classification of Data Structures	1.19
1.8.2	Primitive Data Structures	1.19
1.8.3	Non-Primitive Data Structures	1.20
1.8.4	Operations on Data Structures	1.24
1.8.5	Abstract Data Type (ADT)	1.24
1.8.6	Importance of Data Structures in Designing Algorithm	1.24
1.9	Review Questions	1.25

Chapter - 2

Fundamentals of the Analysis of Algorithm Efficiency

2.1 - 2.42

2.1	The Analysis Framework	2.2
2.1.1	Space Complexity	2.2
2.1.2	Time Complexity	2.6
2.1.2.1	Measuring an Input's Size	2.7
2.1.2.2	Units for Measuring Running Time	2.7
2.1.3	Orders of Growth	2.11
2.1.4	Worst Case, Best Case and Average Case Efficiencies	2.13
2.2	Asymptotic Notations	2.15
2.2.1	Big O Notation (O)	2.16
2.2.2	Omega Notation (W)	2.19
2.2.3	Theta Notation(θ)	2.20
2.2.4	Comparison of O, W and θ Notations	2.22
2.2.5	Using Limits for Comparing Orders of Growth	2.22
2.3	Basic Efficiency Classes	2.24
2.4	What is Iterative and Recursive Algorithms?	2.25
2.5	Mathematical Analysis of Non-Recursive Algorithms	2.26
2.5.1	General Plan for Analyzing the Time Efficiency of Non-recursive Algorithms	2.26
2.5.2	Finding the Largest Element in an Array	2.27
2.5.3	Checking the Uniqueness in an Array	2.28

2.5.4	Matrix Multiplication	2.29
2.6	Mathematical Analysis of Recursive Algorithms	2.30
2.6.1	General Plan for Analysing the Time Efficiency of Recursive Algorithms	2.31
2.6.2	Factorial of a Number	2.31
2.6.3	Tower of Hanoi Problem	2.32
2.6.4	Fibonacci Series	2.34
2.7	Empirical Analysis of Algorithms	2.37
2.7.1	General Plan for the Empirical Analysis of Algorithm Time Efficiency	2.37
2.7.2	Advantages and Disadvantages of Empirical Analysis of Algorithms	2.39
2.7.3	Difference between Mathematical & Empirical Analysis	2.40
2.8	Review Questions	2.40

Unit - II

Chapter - 3

Brute Force Method & Exhaustive Search

3.1 - 3.34

3.1	Introduction	3.2
3.2	Brute Force Method	3.2
3.2.1	Selection Sort	3.3
3.2.2	Bubble Sort	3.9
3.2.3	Sequential Search or Linear Search	3.14
3.2.4	Brute-Force String Matching	3.16
3.2.5	Advantages and Disadvantages of Brute-Force Method	3.20
3.3	Exhaustive Search	3.20
3.3.1	Graph Traversals	3.21
3.3.2	Depth First Search (DFS)	3.21
3.3.3	Breadth First Search (BFS)	3.27
3.3.4	Advantages and Disadvantages of Exhaustive Search	3.32
3.4	Review Questions	3.32

Chapter - 4

Decrease and Conquer

4.1 - 4.34

4.1	Decrease-and-Conquer	4.2
4.2	Decrease-by-a-Constant	4.4
4.2.1	Insertion Sort	4.4
4.2.2	Topological Sorting	4.8
4.2.3	Algorithm for Generating Combinatorial Objects	4.16
4.2.3.1	Generating Permutations	4.16
4.2.3.2	Generating Subsets	4.19
4.3	Decrease-by-a-Constant-Factor	4.23
4.3.1	Binary Search	4.25
4.3.2	Fake-Coin Problem	4.28
4.3.3	Russian Peasant Multiplication	4.30

- 4.3.4 Josephus Problem
- 4.4 Advantages and Disadvantages of Divide and Conquer Technique
- 4.5 Review Questions

Chapter - 5 Divide and Conquer

- 5.1 Divide and Conquer Technique
- 5.2 Merge Sort
- 5.3 Quick Sort
- 5.4 Binary Tree Traversal and Related Properties
 - 5.4.1 What is Binary Tree?
 - 5.4.2 Properties of Binary Tree
 - 5.4.3 Binary Tree Traversals
- 5.5 Strassen's Matrix Multiplication
- 5.6 Advantages and Disadvantages of Divide and Conquer Technique
- 5.7 Review Questions

Unit - III

Chapter - 6 Space and Time Tradeoffs

- 6.1 Space and Time Tradeoffs
 - 6.1.1 Precomputing or Input Enhancement
 - 6.1.2 Prestructuring
- 6.2 Sorting by Counting
- 6.3 Input Enhancement in String Matching
 - 6.3.1 Horspool's Algorithm (Simplified Version of Boyer Moore Algorithm)
 - 6.3.2 Boyer Moore Algorithm
- 6.4 Hashing
 - 6.4.1 Hash Table
 - 6.4.2 Hash Function
 - 6.4.3 Hash Collision
 - 6.4.4 Choosing a Hash Function
 - 6.4.5 Collision Resolution
 - 6.4.5.1 Open Addressing
 - 6.4.5.2 Collision Resolution by Chaining
 - 6.4.6 Time and Space Complexity of Hashing
- 6.5 Review Questions

Chapter - 7 Dynamic Programming

- 7.1 What is Dynamic Programming ?
- 7.2 Divide and Conquer Vs Dynamic Programming

7.3	Applications of Dynamic Programming	7.3
7.4	The Process of Solving Problems Using Dynamic Programming	7.4
7.5	Computing a Binomial Co-efficient	7.5
7.6	Principle of Optimality	7.9
7.7	Optimal Binary Search Tree	7.10
7.8	The Knapsack Problem	7.15
7.9	Memory Functions	7.21
7.10	Warshall's Algorithm	7.26
7.11	Floyd's Algorithm (All Pairs Shortest Path Algorithm)	7.32
7.12	Advantages and Disadvantages of Dynamic Programming	7.40
7.13	Review Questions	7.41

Chapter - 8 Greedy Technique

8.1 - 8.38

8.1	Introduction to Greedy Technique	8.2
8.1.1	Characteristics of Greedy Technique	8.3
8.1.2	Control Abstraction For Greedy Method or General Procedure	8.3
8.1.3	Difference Between Dynamic Programming and Greedy Technique	8.4
8.1.4	Applications of Greedy Technique	8.4
8.2	Minimum Spanning Tree	8.5
8.2.1	Prim's Algorithm	8.7
8.2.2	KRUSKAL'S Algorithm	8.12
8.2.3	Difference Between Prim's and Kruskal's Algorithm	8.17
8.3	Dijkstra's Algorithm (Single Source Shortest Path Algorithm)	8.18
8.4	Huffman Tress and Huffman Codes	8.27
8.4.1	Data Compression	8.27
8.4.2	Fixed Length Codes	8.27
8.4.3	Variable Length Codes	8.28
8.4.4	Prefix Codes	8.29
8.4.5	Meaning of Huffman Trees and Huffman Codes	8.30
8.4.6	Huffman Algorithm	8.30
8.5	Advantages and Disadvantages of Greedy Technique	8.34
8.6	Review Questions	8.35

Unit - IV

Chapter - 9 Limitations of Algorithm Power

9.1 - 9.20

9.1	Introduction	9.2
9.2	Lower-bound Arguments	9.3
9.2.1	Trivial Lower Bounds	9.4
9.2.2	Information Theoretic Arguments	9.5
9.2.3	Adversary Arguments	9.6

9.2.4	Problem Reduction	9.7
9.3	Decision Trees	9.8
9.3.1	Decision Trees for Sorting Algorithms	9.9
9.3.2	Decision Trees for Searching a Sorted Array	9.12
9.4	P, NP and NP-Complete Problems	9.14
9.4.1	The Class P Problems	9.15
9.4.2	The Class NP Problems	9.16
9.4.3	The Class NP Complete Problems	9.17
9.5	Review Questions	9.19

Chapter - 10 Coping with the Limitation of Algorithm Power

10.1	Introduction	10.1 - 10.38
10.2	Backtracking	10.2
10.2.1	General Backtracking Methods and Algorithms	10.4
10.2.2	N-Queens Problem	10.6
10.2.3	Hamiltonian Circuit Problem	10.13
10.2.4	Sum of Subsets	10.16
10.3	Branch and Bound	10.20
10.3.1	The Assignment Problem	10.21
10.3.2	Knapsack Problem	10.25
10.3.3	Travelling Sales-man Problem	10.31
10.4	Review Questions	10.35

Appendix A Lab Programs using C

A.1 - A.32

Appendix B Lab Programs using Python

B.1 - B.24

Appendix - C Model Question Papers

C.1 - C.4

Model Question Paper - 1
Model Question Paper - 2
Model Question Paper - 3

ABOUT THE AUTHORS



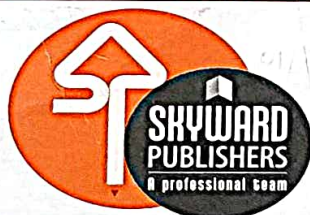
Mr. Srikanth S is currently working as a Director in IT Services Company. He has worked as Software Engineer, Project Leader, Technical Leader, Corporate Trainer and Project Manager in various MNC companies. He has worked as HOD of BCA & MCA department in SRN Adarsh College and worked as Guest Faculty in various colleges in Bangalore. He has 23 years of experience in Academic and IT Profession. He trains huge number of students in Programming languages like C, C++, Data Structures, Java, Python, DBMS, Oracle, Web Programming and J2EE. The author has written more than 15 technical text books in the field of computer science & mathematics and all his books have been well received by both student and teachers community. He is a passionate about creative and innovative content creation.

Prof. Rekha.C is currently working as Head of the Department in the department of Computer Science at Soundarya Institute of Management and Science, Bangalore University, Bangalore. She has 21 years of experience in teaching. She is well known for her innovative teaching practices amongst the student and teaching community. She has guided more than 50+ innovative projects both at UG and PG levels. She is great a orator and has delivered talks on emerging technologies & quality education w.r.t NAAC in various workshops and conferences. Her area of interest includes Algorithm designing, Data Structures, Automata theory, Artificial Intelligence, Cyber Security & Neural networks. Presently, she is also an Executive member of Computer Society of India – Bangalore Chapter



Our Other Books for BCA

- | | | |
|-------------------------------|--------------------------------------|---------------------------------------|
| 1. Discrete Structures | 8. Computer Architecture | 16. Python Programming |
| 2. Data Structures Using C | 9. Java | 17. Database Management Systems |
| 3. Problem Solving Techniques | 10. Database Management Systems | 18. C# and DOT NET Framework |
| 4. Programming in C | 11. Discrete Mathematical Structures | 19. Computer Communication & Networks |
| 5. Mathematical Foundation | 13. Data Structures Using C | 20. Software Engineering |
| 6. Computer Fundamentals | 14. Operating Systems | 21. Internet Technologies |
| 7. Environmental Studies | 15. Computer Networks | |



Skyward Publishers

157, 3rd Main, 7th Cross
Chamarajpet, Bengaluru - 18
Ph : + 91 80 2660 3535 / 43706620
Mob : + 91 96111 85999
Email : skyward.publishers@gmail.com
Website : www.skywardpublishers.com

ISBN : 978-93-95085-58-8



₹ 375.00/-

978-93-95085-58-8