Data Structures and Algorithms ¹

A Study Guide for Students of Sorsogon State University - Bulan Campus 2

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 $^{^2}$ This book is a study guide for students of Sorsogon State University - Bulan Campus taking up the course Data Structures and Algorithms.

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Preface

"Bad programmers worry about the code. Good programmers worry about data structures and their relationships."

– Linus Torvalds

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Introduction to Data Structures and Algorithms

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- 1.1.2 Visual Studio Code Installation
- 1.1.3 Testing the Installation
- 1.2 What are Data Structures?
- 1.3 What are Algorithms?
- 1.4 Why Study Data Structures and Algorithms?
- 1.5 Basic Terminologies
- 1.5.1 Data
- 1.5.2 Data Object
- 1.5.3 Data Structure
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- 1.5.4.1 Primitive Data Types
- 1.5.4.2 Non-primitive Data Types
- 1.5.5 Abstract Data Type
- 1.5.6 Algorithm
- 1.5.7 Complexity of an Algorithm
- 1.5.7.1 Time Complexity
- 1.5.7.2 Space Complexity

1.6 Asymptotic Notations

- 1.6.1 Big-O Notation
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- 1.6.3 Theta Notation

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- 2.1.2 Array Operations
- **2.1.2.1** Insertion
- 2.1.2.2 Deletion
- 2.1.2.3 Searching
- 2.1.3 Complexity Analysis of Arrays
- 2.2 Linked Lists
- 2.2.1 Types of Linked Lists
- 2.2.1.1 Singly Linked List
- ${\bf 2.2.1.2}\quad {\bf Doubly\ Linked\ List}$
- 2.2.1.3 Circular Linked List
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Implementation of Queues Using Linked Lists

Comparison of Stacks and Queues



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- 4.1.2 Parent Node
- 4.1.3 Child Node
- 4.1.4 Leaf Node
- 4.1.5 Ancestors
- 4.1.6 Siblings
- 4.1.7 Descendants
- 4.1.8 Height of a Tree
- 4.1.9 Depth of a Node
- 4.1.10 Degree of a Node
- 4.1.11 Level of a Node
- **4.1.12** Subtree

4.2 Types of Trees

- 4.2.1 Binary Tree
- 4.2.1.1 Types of Binary Trees

Left-skewed Binary Tree

Right-skewed Binary Tree

Complete Binary Tree

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Digraph

Directed Acyclic Graph (DAG)

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- 7.2 Hash Function
- 7.3 Collision Resolution Techniques
- 7.3.1 Separate Chaining
- 7.3.2 Open Addressing
- 7.3.2.1 Linear Probing
- 7.3.2.2 Quadratic Probing
- 7.3.2.3 Double Hashing
- 7.4 Complexity Analysis of Hashing
- 7.5 Summary

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- 8.1.3 Suffix Tree
- 8.1.4 Suffix Array
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- 8.1.6 Heap
- 8.1.7 Disjoint Set
- 8.1.8 Skip List
- 8.1.9 Splay Tree
- 8.1.10 Bloom Filter
- 8.1.11 KD Tree
- 8.1.12 Quad Tree
- 8.1.13 Octree
- 8.1.14 B-Tree
- 8.1.15 B+ Tree
- 8.1.16 R-Tree
- 8.1.17 X-Tree
- 8.1.18 Y-Tree
- 8.1.19 **Z-Tree**

8.2 Advanced Algorithms

- 8.2.1 Dynamic Programming
- 8.2.2 Greedy Algorithms
- 8.2.3 Backtracking
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Applications of Data Structures and Algorithms

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- 9.1.1 Operating Systems
- 9.1.2 Database Management Systems
- 9.1.3 Compiler Design
- 9.1.4 Networking
- 9.1.5 Artificial Intelligence
- 9.1.6 Machine Learning
- 9.1.7 Computer Graphics
- 9.1.8 Computer Vision
- 9.1.9 Robotics
- 9.1.10 Web Development
- 9.1.11 Mobile Development
- 9.1.12 Game Development
- 9.1.13 Cybersecurity
- 9.1.14 Quantum Computing

9.2 Applications in Real Life

- 9.2.1 Social Media
- 9.2.2 E-commerce
- 9.2.3 Healthcare
- **9.2.4** Finance
- 9.2.5 Transportation
- 9.2.6 Education
- 9.2.7 Agriculture
- 9.2.8 Manufacturing
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