Introduction to Algorithms & Data Structures 3

Learn Linear Data Structures with Videos & Interview Questions

Bolakale Aremu

Charles Johnson Jr.

Ojula Technology Innovations

Introduction to Algorithms & Data Structures 3

First Edition

ISBN: 978-1-0879-2526-4

Ojula Technology Innovations is a leading provider of customized learning solutions with employees residing in nearly 45 different countries and sales in more than 130 countries around the world. For more information, please contact OjulaTech@gmail.com.

Printed in the United States of America

Print Number: 01

Print Year: September 2023

I am indebted to all the contributors of this great work for their hard work and support throughout the time of producing this book and the accompanying videos.

Bolakale Aremu

Table of Contents

7.9. Hash Functions – 23:24 min.

7.9.1. How HashCode Works

7.10. Collisions – 29:19 min.

7.10.1. How to Handle Collisions

7.11. Chaining – 30:26 min.

7.12. Linear Probing – 32:06 min.

7.12.1. Linear Probing

7.13. Quadratic Probing – 34:48 min.

7.14. Double Hashing – 36:17 min.

7.14.1. Review of All the Probing Algorithms Theory

7.15. Exercise: Building a Hash Table – 39:37 min.

7.16. Solution: put( ) – 42:14 min.

7.17. Solution: get( ) – 48:21 min.

7.18. Solution: remove( ) – 52:51 min.

7.19. Solution: Refactoring & Automated Testing– 55:22 min.

7.20. Wrap up – 1:06:26 min.

7.21. Coming up Next

7.22. How to Download Tutorial Videos & Other Resources

About The Authors & Contributors

We are software developers. We've spent over 17 years as software developers, and have done a bunch of other things too. We've been involved in SDLC/process, machine learning, data science, operating system security and architecture. Our most recent project is serverless computing where we simplify the building and running of distributed systems. We always use a practical approach in our projects and courses.

Bolakale Aremu & Charles Johnson Jr.
Ojula Technology Innovations
Web developers and Software Engineers
Ojulaweb.com

0. What You Get

This playbook is the third volume of the series *Introduction to Algorithms & Data Structures*. It is written in the form of a course. It is a very comprehensive data structures and algorithms book, packed with

- text tutorials with a lot of illustrations
- 5 hours of HD video tutorials,
- popular interview questions asked by Google, Microsoft, Amazon and other big companies,
- practice exercises,
- codes written during the course and
- screenshots used in this book.

Most data structure books and courses are too academic and boring. They have too much math and their codes look ugly, old and disgusting! This book is bundled with tutorial videos that are fun and easy to follow along, and show you how to write beautiful code like a software engineer, not a mathematician.

Mastering data structures and algorithms is essential to getting your dream job. So, don't waste your time browsing disconnected tutorials or super long, boring courses.

0.1. Requirements

In this volume, we use Java to teach the concepts but you can apply these concepts in any programming language. Our focus is on problem-solving, not programming languages and tools.

All you need to understand the codes are some basic programming skills, which were already taught in the first and second volumes of the series. Alternatively, if you already know variables, loops, and conditional statements, you're good to go.

0.2. Benefits of Learning Algorithms and Data Structures

First, it can help you get your dream software engineering job. If you studied Computer Science but never really understood the complex topic of data structures and algorithms, this playbook will help you. If you are a self-taught programmer, with little to no knowledge of this important topic, you too will find this course very helpful.

If you failed a job interview because you couldn't answer basic data structure and algorithm questions, just study this book and its accompanying videos. Understanding data structures and algorithms is crucial to excel as a software engineer. That’s why companies like Google, Microsoft and Amazon, always include interview questions on data structures and algorithms.

I will teach you everything you need to know about data structures and algorithms so you can ace your coding interview with confidence. This course is a perfect mix of theory and practice, packed with over 100 popular interview questions.

Another benefit is that data structures and algorithms will make you think more logically. They can help you design better systems for storing and processing data. They also serve as a tool for optimization and problem-solving.

As a result, the concepts of algorithms and data structures are very valuable in any field. For example, you can use them when building a web app or writing software for other devices. You can apply them to machine learning and data analytics, which are two hot areas right now. If you are a hacker, algorithms and data structures are also important for you everywhere.

Now, whatever your preferred learning style, I've got you covered. If you're a visual learner, you'll love my HD videos, and illustrations throughout this book. If you're a practical learner, you'll love my **hands-on lessons and practice exercises** so that you can get practical with algorithms and data structures and learn in a hands-on way.

0.3. How This Course is Structured

The contents of this course are divided into six parts so you can easily complete it.

The following linear data structures are covered in this course:

- Big O Notation
- Arrays
- Linked Lists
- Stacks
- Queues
- Hash Tables (Dictionaries)

At the end of many sections of this course, short practice exercises are provided to test your understanding of the topic discussed. Solutions are also provided so you can check how well you have performed in each section. At the end of this book, you will find a **link to download all the helpful resources, such as videos, all the codes and screenshots used in the tutorials, and a bunch of practice exercises**. You can use them for quick references and revision as well. My **support link is also provided** so that you can contact me any time if you have questions or need further help.

After you have studied this course, you will understand what data structures are, how they are measured and evaluated, and how they are used to solve real-life problems. So, everything you need is right here. I really hope you'll enjoy it. Are you ready? Let's dive in!

1. Introduction to Linear Data Structures

In this volume, you will learn **linear data structures** such as arrays, linked lists, stacks, queues, and hash tables. In volume four, we will look at **non-linear data structures** such as trees, heaps and graphs. This volume and other volumes in the series are great for computer science students whose lectures failed at explaining these concepts or anyone who is preparing for a job interview.

A lot of companies, especially big companies like Google, Microsoft, and Amazon, ask data structure and algorithm questions in their interviews to see if you know how to think like a programmer. The materials in this series will change how you think about coding. They teach you how to think like a programmer and design fast and scalable algorithms.

I'll be using Java in this course because that's a universal understood language, but you can use any language you're familiar with. This is because our focus is on data structures and algorithms, not programming languages. If you're a C# developer, you can get started immediately because Java and C# are very similar. Furthermore, the java compiler I'll be using is **intelliJ**, an IDE (code editor) that you can download from https://www.jetbrains.com/idea/download/. However, you can use any code editor you are comfortable with. Our focus is on algorithm design, not tooling.

In the "Getting Started" folder, I included a video that teaches you step by step how to install Java and other necessary tools such as intelliJ for building Java applications.

Video reference*: Part 3 > 1. Getting Started > 1. Java_and_intelliJ_Installation > Installing Java.mp4 (14:07 min)*

In case Java is completely new to you, the video also explains how to write a simple Java program. Alternatively, you can watch one of the tons of videos available for free on YouTube on how to install Java and intelliJ on your Windows or Mac computer.

Now, this volume is a bit different from volumes 1 and 2 where you simply read and learn new things. In this volume, you also have to solve problems – a lot of problems – and that's how you will learn the art of problem solving. All the exercises you see in this volume are popular interview questions. These are the exercises that teach you how to think like a programmer. So, every single one of them is important.

Some of these exercises might be a bit challenging. Don't quickly jump to my solution. Do your best to solve the problem on your own. What matters is that you spend time thinking about various ways to solve a problem. This process will activate certain parts of your brain, and that's what matters, not the solution.

If you can't complete the exercise in a timely manner, that's perfectly fine. Don't get

disappointed. You're a student of this course, so you're learning. If you could complete every exercise immediately, you wouldn't be learning this course, right? So, here's the bottom line. This course is going to change how you think about programming. You'll learn how to solve problems and write beautiful code like a professional software engineer.

I worked really hard for this series to be the ultimate data structures course in the world, and I hope you think that too. Use the support link at the bottom of this book to let me know your thoughts. I cannot wait to hear what you think. Now let's jump in and get started!

1.1. What is an Algorithm?

Simply put, an algorithm is a set of steps or instructions for completing a task. As explained in volume one of this series, an algorithm is a step-by-step set of instructions or a well-defined procedure for solving a specific problem or performing a task. It's a fundamental concept in computer science and mathematics, used to describe the process of solving problems in a systematic and repeatable way. Algorithms can be represented in various forms, such as natural language descriptions, flowcharts, pseudocode, or programming code.

1.2. What is Data Structure?

Data structure is the process of organizing and storing the data. A data structure is a way of organizing and storing data in a computer's memory so that it can be efficiently accessed, manipulated, and managed. It provides a framework for organizing and storing data in a structured manner, which enables various operations to be performed on that data efficiently. Data structures play a crucial role in computer science and programming, as they influence the efficiency and effectiveness of algorithms and software systems.

Data structure is classified into two types:

1. Linear Data Structure – In this type of data structure, the data elements are arranged in a linear sequential order, but we don’t have to store the elements sequentially. Examples are Array, Linked List, Stacks & Queue.

2. Non-Linear Data Structure – In this type of data structure, the data elements are arranged in a non-linear order. Examples are Tree and graphs.