

# uCertify

## Course Outline

### Data Structure and Algorithm with C++



06 Jul 2024

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## 1. Course Objective

Master data structures and algorithm analysis with the Data Structure and Algorithm with C++ course. Gain insight into efficient data handling, algorithmic analysis, and programming in C++. This course offers interactive lessons and hands-on labs, making complex algorithms and data structures accessible. Whether you're an advanced learner or a first-year graduate student, you'll enhance your programming skills and tackle real-world challenges with maximum efficiency.

## 2. Pre-Assessment

Pre-Assessment lets you identify the areas for improvement before you start your prep. It determines what students know about a topic before it is taught and identifies areas for improvement with question assessment before beginning the course.

## 3. Exercises

There is no limit to the number of times learners can attempt these. Exercises come with detailed remediation, which ensures that learners are confident on the topic before proceeding.

**125**  
EXERCISES

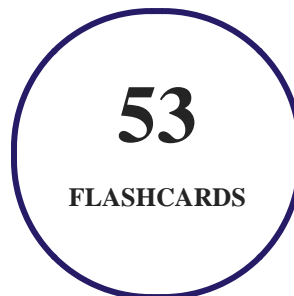
## 4. Quiz

Quizzes test your knowledge on the topics of the exam when you go through the course material. There is no limit to the number of times you can attempt it.



## 5. flashcards

Flashcards are effective memory-aiding tools that help you learn complex topics easily. The flashcard will help you in memorizing definitions, terminologies, key concepts, and more. There is no limit to the number of times learners can attempt these. Flashcards help master the key concepts.



## 6. Glossary of terms

uCertify provides detailed explanations of concepts relevant to the course through Glossary. It contains a list of frequently used terminologies along with its detailed explanation. Glossary defines the key terms.



## 7. Expert Instructor-Led Training

uCertify uses the content from the finest publishers and only the IT industry's finest instructors. They have a minimum of 15 years real-world experience and are subject matter experts in their fields. Unlike a live class, you can study at your own pace. This creates a personal learning experience and gives you all the benefit of hands-on training with the flexibility of doing it around your schedule 24/7.

## 8. ADA Compliant & JAWS Compatible Platform

uCertify course and labs are ADA (Americans with Disability Act) compliant. It is now more accessible to students with features such as:

- Change the font, size, and color of the content of the course
- Text-to-speech, reads the text into spoken words
- Interactive videos, how-tos videos come with transcripts and voice-over
- Interactive transcripts, each word is clickable. Students can clip a specific part of the video by clicking on a word or a portion of the text.

JAWS (Job Access with Speech) is a computer screen reader program for Microsoft Windows that reads the screen either with a text-to-speech output or by a Refreshable Braille display. Student can easily navigate uCertify course using JAWS shortcut keys.

## 9. State of the Art Educator Tools

uCertify knows the importance of instructors and provide tools to help them do their job effectively. Instructors are able to clone and customize course. Do ability grouping. Create sections. Design grade scale and grade formula. Create and schedule assessments. Educators can also move a student from self-paced to mentor-guided to instructor-led mode in three clicks.

## 10. Award Winning Learning Platform (LMS)

uCertify has developed an award winning, highly interactive yet simple to use platform. The SIIA CODiE Awards is the only peer-reviewed program to showcase business and education technology's finest products and services. Since 1986, thousands of products, services and solutions have been

recognized for achieving excellence. uCertify has won CODiE awards consecutively for last 7 years:

- **2014**

1. Best Postsecondary Learning Solution

- **2015**

1. Best Education Solution
2. Best Virtual Learning Solution
3. Best Student Assessment Solution
4. Best Postsecondary Learning Solution
5. Best Career and Workforce Readiness Solution
6. Best Instructional Solution in Other Curriculum Areas
7. Best Corporate Learning/Workforce Development Solution

- **2016**

1. Best Virtual Learning Solution
2. Best Education Cloud-based Solution
3. Best College and Career Readiness Solution
4. Best Corporate / Workforce Learning Solution
5. Best Postsecondary Learning Content Solution
6. Best Postsecondary LMS or Learning Platform
7. Best Learning Relationship Management Solution

- **2017**

1. Best Overall Education Solution
2. Best Student Assessment Solution
3. Best Corporate/Workforce Learning Solution
4. Best Higher Education LMS or Learning Platform

- **2018**

1. Best Higher Education LMS or Learning Platform

2. Best Instructional Solution in Other Curriculum Areas
3. Best Learning Relationship Management Solution

- **2019**

1. Best Virtual Learning Solution
2. Best Content Authoring Development or Curation Solution
3. Best Higher Education Learning Management Solution (LMS)

- **2020**

1. Best College and Career Readiness Solution
2. Best Cross-Curricular Solution
3. Best Virtual Learning Solution

## 11. Chapter & Lessons

uCertify brings these textbooks to life. It is full of interactive activities that keeps the learner engaged. uCertify brings all available learning resources for a topic in one place so that the learner can efficiently learn without going to multiple places. Challenge questions are also embedded in the chapters so learners can attempt those while they are learning about that particular topic. This helps them grasp the concepts better because they can go over it again right away which improves learning.

Learners can do Flashcards, Exercises, Quizzes and Labs related to each chapter. At the end of every lesson, uCertify courses guide the learners on the path they should follow.

### Syllabus

#### Chapter 1: Preface

- Purpose/Goals
- Approach
- Summary of the Most Significant Changes in the Fourth Edition



- Overview
- Exercises

## Chapter 2: Programming: A General Overview

- What's This Course About?
- Mathematics Review
- A Brief Introduction to Recursion
- C++ Classes
- C++ Details
- Templates
- Using Matrices
- Summary
- Exercises
- References

## Chapter 3: Algorithm Analysis

- Mathematical Background
- Model

- What to Analyze
- Running-Time Calculations
- Summary
- Exercises
- References

## Chapter 4: Lists, Stacks, and Queues

- Abstract Data Types (ADTs)
- The List ADT
- vector and list in the STL
- Implementation of vector
- Implementation of list
- The Stack ADT
- The Queue ADT
- Summary
- Exercises

## Chapter 5: Trees

- Preliminaries

- Binary Trees
- The Search Tree ADT—Binary Search Trees
- AVL Trees
- Splay Trees
- Tree Traversals (Revisited)
- B-Trees
- Sets and Maps in the Standard Library
- Summary
- Exercises
- References

## Chapter 6: Hashing

- General Idea
- Hash Function
- Separate Chaining
- Hash Tables without Linked Lists
- Rehashing
- Hash Tables in the Standard Library

- Hash Tables with Worst-Case  $O(1)$  Access
- Universal Hashing
- Extendible Hashing
- Summary
- Exercises
- References

## Chapter 7: Priority Queues (Heaps)

- Model
- Simple Implementations
- Binary Heap
- Applications of Priority Queues
- d-Heaps
- Leftist Heaps
- Skew Heaps
- Binomial Queues
- Priority Queues in the Standard Library
- Summary

- Exercises
- References

## Chapter 8: Sorting

- Preliminaries
- Insertion Sort
- A Lower Bound for Simple Sorting Algorithms
- Shellsort
- Heapsort
- Mergesort
- Quicksort
- A General Lower Bound for Sorting
- Decision-Tree Lower Bounds for Selection Problems
- Adversary Lower Bounds
- Linear-Time Sorts: Bucket Sort and Radix Sort
- External Sorting
- Summary
- Exercises

- References

## Chapter 9: The Disjoint Sets Class

- Equivalence Relations
- The Dynamic Equivalence Problem
- Basic Data Structure
- Smart Union Algorithms
- Path Compression
- Worst Case for Union-by-Rank and Path Compression
- An Application
- Summary
- Exercises
- References

## Chapter 10: Graph Algorithms

- Definitions
- Topological Sort
- Shortest-Path Algorithms

- Network Flow Problems
- Minimum Spanning Tree
- Applications of Depth-First Search
- Introduction to NP-Completeness
- Summary
- Exercises
- References

## Chapter 11: Algorithm Design Techniques

- Greedy Algorithms
- Divide and Conquer
- Dynamic Programming
- Randomized Algorithms
- Backtracking Algorithms
- Summary
- Exercises
- References

## Chapter 12: Amortized Analysis

- An Unrelated Puzzle
- Binomial Queues
- Skew Heaps
- Fibonacci Heaps
- Splay Trees
- Summary
- Exercises
- References

## Chapter 13: Advanced Data Structures and Implementation

- Top-Down Splay Trees
- Red-Black Trees
- Treaps
- Suffix Arrays and Suffix Trees
- k-d Trees
- Pairing Heaps
- Summary
- Exercises



- References

## Chapter 14: Appendix A: Separate Compilation of Class Templates

- Everything in the Header
- Explicit Instantiation

## 12. Practice Test

### Here's what you get

**37**  
PRE-ASSESSMENTS QUESTIONS

**37**  
POST-ASSESSMENTS QUESTIONS

### Features

Each question comes with detailed remediation explaining not only why an answer option is correct but also why it is incorrect.

#### **Unlimited Practice**

Each test can be taken unlimited number of times until the learner feels they are prepared. Learner can review the test and read detailed remediation. Detailed test history is also available.

Each test set comes with learn, test and review modes. In learn mode, learners will attempt a question and will get immediate feedback and complete remediation as they move on to the next question. In test mode, learners can take a timed test simulating the actual exam conditions. In review mode, learners can read through one item at a time without attempting it.

## 13. Performance Based Labs

uCertify's performance-based labs are simulators that provides virtual environment. Labs deliver hands on experience with minimal risk and thus replace expensive physical labs. uCertify Labs are cloud-based, device-enabled and can be easily integrated with an LMS. Features of uCertify labs:

- Provide hands-on experience in a safe, online environment
- Labs simulate real world, hardware, software & CLI environment
- Flexible and inexpensive alternative to physical Labs
- Comes with well-organized component library for every task
- Highly interactive - learn by doing
- Explanations and remediation available
- Videos on how to perform

### Lab Tasks

- Using Recursive Function
- Resizing a Matrix
- Implementing the Bisection Method
- Finding Minimum Subsequence Sum
- Implementing Binary Search
- Implementing the STL find Routine
- Working with Lists
- Converting an Infix Expression to Postfix
- Checking for Balancing Brackets
- Reversing a Singly Linked List
- Implementing a Stack Class

- Implementing a Dequeue using a Linked List
- Implementing a Depth-First Traversal in the Child-Sibling Tree
- Converting a Tree into Graph-Assembler Instructions
- Using the findMax Function
- Generating an AVL Tree
- Inserting a Node into an AVL Tree
- Implementing a Splay Tree
- Working with Binary Tree
- Implementing a B-Tree
- Inserting Keys into the B-Tree
- Implementing the map Class
- Implementing a Splay Tree
- Counting Number of Collisions
- Implementing Hopscotch Hashing
- Implementing Cuckoo Hashing
- Implementing Extendible Hashing
- Merging Two Max Heaps
- Implementing Insert Operation in a Binomial Queue
- Implementing Insertion Sort using STL
- Implementing Mergesort without Recursion
- Implementing the Selection Sort Algorithm
- Printing a Maze
- Implementing a Topological Sorting Algorithm
- Solving a Single Source Shortest Path Problem
- Implementing Union Function in Kruskal's Algorithm
- Solving the Longest Common Subsequence Problem

**Here's what you get**



## 14. Post-Assessment

After completion of the uCertify course Post-Assessments are given to students and often used in conjunction with a Pre-Assessment to measure their achievement and the effectiveness of the exam.

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