

# uCertify

## Course Outline

**Essential Algorithms: A Practical Approach to Computer  
Algorithms Using Python and C#**



19 May 2024

1. Course Objective
2. Pre-Assessment
3. Exercises, Quizzes, Flashcards & Glossary  
Number of Questions
4. Expert Instructor-Led Training
5. ADA Compliant & JAWS Compatible Platform
6. State of the Art Educator Tools
7. Award Winning Learning Platform (LMS)
8. Chapter & Lessons

Syllabus

Chapter 1: Introduction

Chapter 2: Algorithm Basics

Chapter 3: Numerical Algorithms

Chapter 4: Linked Lists

Chapter 5: Arrays

Chapter 6: Stacks and Queues

Chapter 7: Sorting

Chapter 8: Searching

Chapter 9: Hash Tables

Chapter 10: Recursion

Chapter 11: Trees

Chapter 12: Balanced Trees

Chapter 13: Decision Trees

Chapter 14: Basic Network Algorithms

Chapter 15: More Network Algorithms

Chapter 16: String Algorithms

Chapter 17: Cryptography

Chapter 18: Complexity Theory

Chapter 19: Distributed Algorithms

Chapter 20: Interview Puzzles

Chapter 21: Appendix A: Summary of Algorithmic Concepts

Videos and How To

9. Practice Test

Here's what you get

Features

10. Performance Based labs

Lab Tasks

Here's what you get

11. Post-Assessment

## 1. Course Objective

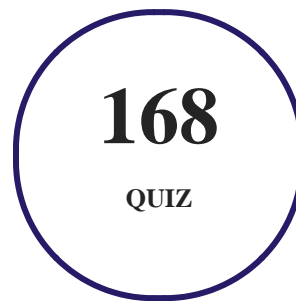
Enroll yourself in the Essential Algorithms: A Practical Approach to Computer Algorithms Using Python and C# course and lab to learn algorithms techniques. The course and lab provide expertise over the concepts such as algorithms, linked lists, arrays, stacks and queues, sorting, searching, hash tables, recursion, trees, cryptography, complexity theory, interview puzzles, and more.

## 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.

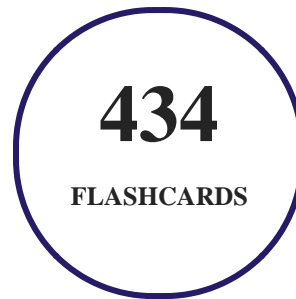
## 3. Quiz

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.



## 4. 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.



## 5. 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.



## 6. 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.

## 7. 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.

## 8. 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.

## 9. 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

## 10. 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: Introduction

- Why You Should Study Algorithms
- Algorithm Selection
- Who This Course Is For
- Getting the Most Out of This Course
- How This Course Is Structured
- What You Need to Use This Course
- Conventions



## Chapter 2: Algorithm Basics

- Approach
- Algorithms and Data Structures
- Pseudocode
- Algorithm Features
- Practical Considerations
- Summary
- Exercises

## Chapter 3: Numerical Algorithms

- Randomizing Data
- Finding Greatest Common Divisors
- Performing Exponentiation
- Working with Prime Numbers
- Performing Numerical Integration
- Finding Zeros
- Gaussian Elimination
- Least Squares Fits

- Summary
- Exercises

## Chapter 4: Linked Lists

- Basic Concepts
- Singly Linked Lists
- Doubly Linked Lists
- Sorted Linked Lists
- Self-Organizing Linked Lists
- Linked-List Algorithms
- Multithreaded Linked Lists
- Linked Lists with Loops
- Summary
- Exercises

## Chapter 5: Arrays

- Basic Concepts
- One-Dimensional Arrays

- Nonzero Lower Bounds
- Triangular Arrays
- Sparse Arrays
- Matrices
- Summary
- Exercises

## Chapter 6: Stacks and Queues

- Stacks
- Queues
- Binomial Heaps
- Summary
- Exercises

## Chapter 7: Sorting

- $O(N^2)$  Algorithms
- $O(N \log N)$  Algorithms
- Sub  $O(N \log N)$  Algorithms
- Summary

- Exercises

## Chapter 8: Searching

- Linear Search
- Binary Search
- Interpolation Search
- Majority Voting
- Summary
- Exercises

## Chapter 9: Hash Tables

- Hash Table Fundamentals
- Chaining
- Open Addressing
- Summary
- Exercises

## Chapter 10: Recursion

- Basic Algorithms

- Factorial
- Fibonacci Numbers
- Rod-Cutting
- Tower of Hanoi
- Graphical Algorithms
- Koch Curves
- Hilbert Curve
- Sierpiński Curve
- Gaskets
- The Skyline Problem
- Backtracking Algorithms
- Eight Queens Problem
- Knight's Tour
- Selections and Permutations
- Selections with Loops
- Selections with Duplicates
- Selections Without Duplicates

- Permutations with Duplicates
- Permutations Without Duplicates
- Round-Robin Scheduling
- Recursion Removal
- Tail Recursion Removal
- Dynamic Programming
- Bottom-Up Programming
- General Recursion Removal
- Summary
- Exercises

## Chapter 11: Trees

- Tree Terminology
- Binary Tree Properties
- Tree Representations
- Tree Traversal
- Sorted Trees
- Lowest Common Ancestors

- Threaded Trees
- Specialized Tree Algorithms
- Interval Trees
- Summary
- Exercises

## Chapter 12: Balanced Trees

- AVL Trees
- 2-3 Trees
- B-Trees
- Balanced Tree Variations
- Summary
- Exercises

## Chapter 13: Decision Trees

- Searching Game Trees
- Searching General Decision Trees
- Swarm Intelligence
- Summary

- Exercises

## Chapter 14: Basic Network Algorithms

- Network Terminology
- Network Representations
- Traversals
- Strongly Connected Components
- Finding Paths
- Transitivity
- Shortest Path Modifications
- Summary
- Exercises

## Chapter 15: More Network Algorithms

- Topological Sorting
- Cycle Detection
- Map Coloring
- Maximal Flow



- Network Cloning
- Cliques
- Community Detection
- Eulerian Paths and Cycles
- Summary
- Exercises

## Chapter 16: String Algorithms

- Matching Parentheses
- Pattern Matching
- String Searching
- Calculating Edit Distance
- Phonetic Algorithms
- Summary
- Exercises

## Chapter 17: Cryptography

- Terminology
- Transposition Ciphers

- Substitution Ciphers
- Block Ciphers
- Public-Key Encryption and RSA
- Other Uses for Cryptography
- Summary
- Exercises

## Chapter 18: Complexity Theory

- Notation
- Complexity Classes
- Reductions
- 3SAT
- Bipartite Matching
- NP-Hardness
- Detection, Reporting, and Optimization Problems
- Detection  $\rightarrow$  Reporting
- Reporting  $\rightarrow$  Optimization
- Reporting  $\rightarrow$  Detection

- Optimization ?p Reporting
- Approximate Optimization
- NP-Complete Problems
- Summary
- Exercises

## Chapter 19: Distributed Algorithms

- Types of Parallelism
- Distributed Algorithms
- Summary
- Exercises

## Chapter 20: Interview Puzzles

- Asking Interview Puzzle Questions
- Answering Interview Puzzle Questions
- Summary
- Exercises

## Chapter 21: Appendix A: Summary of Algorithmic Concepts

- Lesson 1: Algorithm Basics
- Lesson 2: Numeric Algorithms
- Lesson 3: Linked Lists
- Lesson 4: Arrays
- Lesson 5: Stacks and Queues
- Lesson 6: Sorting
- Lesson 7: Searching
- Lesson 8: Hash Tables
- Lesson 9: Recursion
- Lesson 10: Trees
- Lesson 11: Balanced Trees
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- Lesson 18: Distributed Algorithms
- Lesson 19: Interview Puzzles

## 11. Practice Test

Here's what you get

**60**

PRE-ASSESSMENTS QUESTIONS

**57**

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.

## 12. 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:

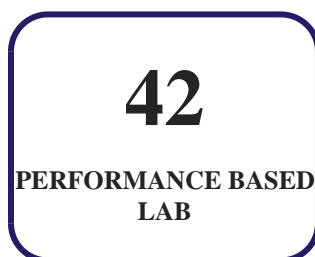
- Provide hands-on experience in a safe, online environment
- Labs simulate real world, hardware, software & CLI environment
- Flexible and inexpensive alternative to physical Labs
- Comes with well-organized component library for every task
- Highly interactive - learn by doing
- Explanations and remediation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

## Lab Tasks

- Discussing about Algorithms, Numerical Algorithms, and Arrays
- Learning Common Run Time Functions
- Understating about Big O Notation
- Creating Pseudorandom Numbers
- Making Random Walks
- Calculating Greatest Common Divisors
- Testing of Primality
- Performing Numerical Integration
- Using Back Substitution
- Finding Cells
- Discussing about Arrays, Stacks and Queues, and Sorting
- Finding Median
- Finding Average
- Learning about Array Types
- Adding Matrices
- Reversing An Array
- Understanding Stacks
- Understanding Queues

- Merging Trees
- Understanding Binomial Trees
- Understanding the Heap Sort Algorithm
- Understanding Sorting Algorithm
- Summarizing the Algorithms
- Understanding the Linear Search Algorithm
- Understanding Binary Search
- Understanding Interpolation Search
- Discussing about Searching, Hash Tables, and Recursion
- Understanding Open Addressing
- Understanding the Factorial
- Learning about the Koch Curves
- Understanding Eight Queens Problem
- Understanding about Balanced and Decision Trees
- Understanding Tree Terminology
- Calculating Number of Nodes
- Learning About Tree Traversal
- Deleting Values
- Understanding Random Search
- Understanding Network Terminology
- Using the Brute Force Approach
- Understanding Pattern Matching
- Discussing about Network and String Algorithms
- Calculating the Euler's Totient Function
- Discussing about Cryptography, Complexity Theory, and Distributed Algorithms

**Here's what you get**



### 13. 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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