

Algorithms and Data Structures

Exam Information	Description
Exam number 845 Items 30 National Career Cluster Information Technology Certification available Yes	The Algorithms and Data Structures industry certification exam builds on the object-oriented programming principles taught in Computer Programming 1, 2, and Advanced. The exam covers ideas, tools, structure, syntax, libraries, and object-oriented design techniques for developing well-formed programs using data structures. Learners are assessed on concepts such as problem-solving, program structure, classes, methods, data types, control constructs, file and console I/O. Other tested topics include designing object-oriented programs containing data structures and designing and using common data structures including arrays, hash tables, stacks, queues, linked lists, binary trees, multiway trees, and graphs. They define and use common algorithms including traversals, searching, sorting, compression, and paths. Learners must have knowledge of several programs to understand these concepts using an appropriate programming language.

Exam Blueprint and Performance Skills

Standard	Percentage of exam score
1. Object-Oriented Design	6%
2. Object-Oriented Program Development	16%
3. Program Testing & Documentation	6%
4. Linear & Non-Linear Data Structures	29%

5. Algorithms	29%
6. Data Structure Appropriation	13%

*Includes performance skill evaluations

Standard 1 - Object-Oriented Design

Candidates will increase their ability to do object-oriented design and implement object-oriented programs using a programming language.

Objective 1 Analyze and perform algorithmic analysis of data operations including:

1. Insert
2. Remove
3. Search
4. Sort

Standard 2 - Object-Oriented Program Development

The candidates will apply good object-oriented design and analysis methods to develop programs and refine their programming skills.

Objective 1 Using an integrated development environment (IDE) and appropriate design procedures, construct reasonably complex programs.

1. Understand the concept of pointers and reference variables
2. Use inheritance and polymorphism
3. Create and use function templates or generics
4. Create and use class templates or generics
5. Use standard exception-handling techniques
6. Use recursion
7. Use appropriate built-in structures and algorithms from the language in use, including but not limited to:
 - a. C++ Standard Template Library
 - b. Java Collections Framework
 - c. Python Standard libs
 - d. C# Collections
 - e. Swift Standard Library

Objective 2 Use appropriate design procedures

1. Design and use simple and complex data structures to solve sophisticated problems
2. Provide reporting from data

Objective 3 List the Big-O notation categories and match them to a program with its Big-O notation.

Standard 3 - Program Testing & Documentation

The candidates will be able to test and document their programs.

Objective 1 Test and debug programs to assure their quality and usability

1. Use language specific unit testing libraries:
 - a. JUnit www.youscience.com Algorithms and Data Structures | 2024
 - b. NUnit c. PyUnit d. XCTest

Objective 2 Document programs for understandability and maintainability.

1. By providing in-line comments
2. By standardized class and file headers
3. By using elements of good programming style including multiline comments to provide documentation
4. C++:
 - a. `/** to */`
5. C#: Documentation Comments
 - a. `///`
6. Java: Javadoc Comments
 - a. `/** to */`
7. Python: Docstrings
 - a. `""" to """`
8. Swift
 - a. Markup Documentation

Standard 4 - Linear & Non-Linear Data Structures

The candidates will demonstrate an understanding of different linear and non-linear data structures.

Objective 1 Use Arrays

Objective 2 Use dynamic linear structures

1. Linked Lists
2. Stacks

3. Queues

Objective 3 Use binary trees and multiway (n-ary) trees.

Objective 4 Use graphs

Objective 5 Use hash tables

Optional: Standard performance evaluations on the final page of this document

Standard 5 - Algorithms

Candidates will explore and implement multiple algorithms including at least the following:

Objective 1 Sorting

Objective 2 Searching

Objective 3 Traversal

Objective 4 Compression

Objective 5 Dynamic Programming

Objective 6 Shortest Path

Standard 6 - Data Structure Appropriation

The candidates will use appropriate data structures.

Objective 1 Discuss the basic principles of many software data structures, including efficiencies and tradeoffs including size, speed, complexity

Objective 2 Implement and use several data structures in programs.

1. Using large data sets (greater than 10K entries)
2. Read and write to a file
3. Timing of code execution

Optional: Standard performance evaluations on the final page of this document.

Performance Skills Evaluation

Exam name: Algorithms and Data Structures

Candidate Name: _____

Performance assessments may be completed and evaluated any time before the certification is issued. The following performance skills can be used in connection with the associated standards and exam. The evaluator will function as the subject matter expert to determine if the candidate meets the skills requirements with a Yes/No for passing.

Standard 4 – Linear and Non-Linear Data Structures

- Candidates will list the benefits and issues of using arrays, linked lists, etc. in relation to computer architecture and performance.

Pass:

Standard 6 – Data Structure Appropriation

- Create applications/programs highlighting proper use of linear and non-linear data structures and demonstrating correct use of standard algorithms including:
 - Using a stack to process postfix notation
 - Timing execution of events in a priority queue
 - Traversing a graph of nodes representing a real-world location

Pass:

Evaluator Name:

Date:
