

Unit 34: Data Structures and Algorithms

Unit code: H/601/1456

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

This unit provides learners with an understanding of how data structures are used in algorithms and enables them to design and implement data structures.

- **Unit abstract**

The unit starts by introducing abstract data types and explores their use in data structures. Based on this knowledge and understanding, learners should be able to develop solutions, using data structures for a range of commercial needs. Data structures may be implemented using a variety of programming paradigms and learners may use one or more areas for their implementations.

Finally, learners will research commercial applications that incorporate data structures and evaluate their use.

On completion of this unit the learner should be able to design and implement a variety of data structures and be able to evaluate different algorithms that implement data structures.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand data structures and algorithms
- 2 Be able to implement data structures
- 3 Understand how strings are structured and processed.

Unit content

1 Understand data structures and algorithms

Data structures: array; set; stack; queue; list; tree; types eg active, passive, recursive.

Operations: types eg create, empty, push, pop, insert, delete, search, sort.

Design specification: using non-executable programme specification language eg pseudo code; issues eg complexity in software development; interfaces; information hiding.

Creation: pre-conditions, post-conditions, error-conditions.

Algorithms: sort eg insertion, quick, shell, merge, heapsort, selection sort; search eg linear, binary, binary search tree; recursive eg binary tree traversals (preorder, inorder, postorder).

2 Be able to implement data structures

Implementation: sorting, searching and recursive algorithms; using eg arrays (single and/or multi dimensional), handle, pointer, class, methods; using an executable programming language.

3 Understand how strings are structured and processed

String: structure eg sequence of characters, data type, character encoding.

Operations: types eg concatenation, find character, length, lowercase, substring, trim.

Algorithms: processing eg string searching, string sorting, string manipulation.

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand data structures and algorithms	1.1 produce design specification for data structures explaining the valid operations that can be carried out on the structures 1.2 explain the operation and performance of sorting and search algorithms 1.3 explain the operation of recursive algorithms and identify situations when recursion is used
LO2 Be able to implement data structures	2.1 implement data structures in an executable programming language in the context of well-defined problems 2.2 implement opportunities for error handling and reporting 2.3 test results to enable comparison with expected results
LO3 Understand how strings are structured and processed	3.1 explain common string operations and their practical applications 3.2 demonstrate the outcome of string operations in specified algorithms.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
	Unit 18: Procedural Programming	Unit 40: Distributed Software Applications
	Unit 19: Object Oriented Programming	Unit 41: Programming in Java
	Unit 20: Event Driven Programming Solutions	Unit 42: Programming in .NET
	Unit 21: Software Applications Testing,	
	Unit 22: Office Solutions Development	
	Unit 23: Mathematics for Software Development	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Data Design
- Software Development.

Resources

Books

Goodrich M, Tamassia R – *Data Structures and Algorithms in C++* (Wiley, 2010)
ISBN-10: 0470383275

Goodrich M, Tamassia R – *Data Structures and Algorithms in Java* (Wiley, 2005)
ISBN-10: 0471738840

Melhorn K, Sanders P – *Algorithms and Data Structures: The Basic Toolbox* (Springer, 2008)
ISBN-10: 3540779779

Websites

<http://ww3.datastructures.net>

<http://www.itl.nist.gov/div897/sqg/dads/>

Employer engagement and vocational contexts

To further enrich the content of this unit and to provide more of a vocational context it would be beneficial to bring in programmers or designers from organisations that have engaged with data structures and algorithms within their systems.

