

Title	Demonstrate knowledge of computer data types and data structures		
Level	5	Credits	7

Purpose	People credited with this unit standard are able to demonstrate an understanding of computer data types; describe computer data structures and demonstrate their operation.
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Classification	Computing > Generic Computing
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Available grade	Achieved
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Guidance Information

1 Definitions

ASCII refers to American Standard Code for Information Interchange, a 7-bit encoding standard enabling 128 characters (alphabetic, numeric, and special characters) to be represented inside a computer.

A *barcode* is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode. Originally barcodes represented data by varying the widths and spacing of parallel lines, and may be referred to as linear or one-dimensional (1D) such as UPC, ISBN. Later, two-dimensional (2D) codes such as QR codes were developed, using rectangles, dots, hexagons and other geometric patterns in two dimensions.

BCD refers to Binary Coded Decimal, a coding format where each digit (0-9) is encoded using four binary digits, thus enabling two digits to be stored per byte.

Data structure refers to a particular way of organising and storing data in a computer so that it can be searched, retrieved and used efficiently. A data structure may consist of multiple data items, which could be of the same type, or a variety of types. Hence, data structures are often referred to as *complex data types*.

Data type refers to a classification of the type of data that can be stored in a field. The type defines the operations that can be done on the data, the meaning of the data, and the way values of that type can be stored.

EBCDIC refers to Extended Binary Coded Decimal Interchange Code.

IEEE 754 (I triple E) refers to the Institute of Electrical and Electronics Engineers standard for floating-point arithmetic.

Integer arithmetic refers to the process of evaluating arithmetic expressions which contain integers (positive and negative whole numbers plus zero) where any fractional intermediate results are discarded, producing an integer result.

Relative/direct refers to a type of file organisation in which the key field of a record maps directly onto its location in the file. This is sometimes referred to as a *table array*.

Unicode is a computing industry standard for the encoding of text expressed in most of the world's writing systems. The latest version of Unicode contains more than 128,000 characters covering 135 modern and historic scripts, as well as multiple symbol sets. The standard has been implemented in many recent technologies, including modern operating systems, XML, Java, and the .NET Framework.

- 2 Number Systems: In order to complete outcome 1, it is assumed that candidates have an in-depth understanding of binary and hexadecimal number systems and their operation, including binary and hexadecimal fractions (bicimals/heximals). It is required that the numeric operations are done without the aid of a calculator.
- 3 Legislation relevant to this unit standard includes but is not limited to the:
 Copyright Act 1994
 Copyright (New Technologies) Amendment Act 2008
 Harmful Digital Communications Act 2015
 Health and Safety at Work Act 2015
 Privacy Act 1993
 Unsolicited Electronic Messages Act 2007
 and any subsequent amendments.
 Current legislation and regulations can be accessed at <http://legislation.govt.nz>.

Outcomes and performance criteria

Outcome 1

Demonstrate an understanding of computer data types.

Performance criteria

- 1.1 Data types are defined in terms of their characteristics and appropriate usage.
- Range data types include – text (char, byte, alphabetic, alphanumeric, digit/byte, string); numeric (BCD, binary, integer, float/real); Boolean/logical/bit, date, time.
- 1.2 The internal representation of data types are explained in terms of their storage requirements, maximum and minimum values, and precision. Variation between data types of the same category (e.g. short int, long int, binary-based floating point, and hex-based floating point) are explained.
- Range signed and unsigned binary integer, Two's complement format; IEEE 754 floating-point standard, IBM floating point architecture (hex-based); fixed and variable-length strings.
- 1.3 Describe the use of coding systems and distinguish the different categories of coding systems in terms of how these coding systems work and are structured.
- Range coding systems include ASCII; Unicode; one-dimensional barcodes such as UPC, ISBN; two-dimensional barcodes such as QR codes; coding systems may include but are not limited to extended ASCII, EBCDIC.

- 1.4 Data manipulation operations are performed on numeric data types.
- Range manipulation operations include – addition, subtraction, multiplication of 3-digit binary numbers; addition of 3-digit hexadecimal numbers; conversions between decimal, binary, and hexadecimal integers and fractions; multiplication and addition of 2-digit precision base-ten floating-point numbers; evaluation of logical and numeric expressions using at least three variables; expressions include a mixture of standard operators (+ - * /; ^ (exponentiation); AND, OR, NOT) and brackets “()”; understanding of the respective operator precedence; (arithmetic expressions only require integer arithmetic).
- 1.5 Data manipulation operations are performed on text based data types.
- Range manipulation operations may include but are not limited to – concatenation, trim, chop, search and replace, length. a minimum of four manipulations are performed on any text based data types.

Outcome 2

Describe computer data structures and demonstrate their operation.

Performance criteria

- 2.1 Computer data structures are described in terms of why they are important and what distinguishes different types in terms of structure, features and use.
- Range data structures include array, stack, queue, list, tree.
- 2.2 Different types of computer files are described identifying what distinguishes them in terms of their appropriate usage, structure, record separation, indexing, and key-field/linking management.
- Range includes database, file/table, record/tuple, field/attribute, key field; includes at least four of – serial, sequential, indexed, relative/direct, random/hash.
- 2.3 Different types of computer databases are described identifying what distinguishes them in terms of computer data structures and access methods.
- Range includes relational and objected-oriented; includes at least one of – hierarchical, network, object-relational, NoSQL.
- 2.4 Demonstrate operations on data structures and describe their relative efficiencies in terms of processing time and storage requirements.
- Range operations include – amend, insert, delete, retrieve; data structures include – array, stack, queue, list, tree.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	8 July 1996	31 December 2015
Revision	2	28 November 2000	31 December 2015
Review	3	19 November 2010	31 December 2017
Rollover and Revision	4	16 April 2015	31 December 2019
Review	5	19 January 2017	31 December 2024
Review	6	26 May 2022	31 December 2024

Consent and Moderation Requirements (CMR) reference	0113
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.