Unit 2: Fundamentals of Computer Systems

Level: **3**

Unit type: **External**

Guided learning hours: **90**

Unit in brief

Learners study the fundamental principles of how computer systems work, including the role of hardware and software, the way components of a system work together and how data in a system is used.

Unit introduction

Knowing how and why computer components, and the data they use, perform in certain ways has a significant impact on the work of all computing professionals. In technical support roles, understanding how different parts of a system integrate facilitates accurate identification of problems and efficient solutions. Professional programmers use their understanding of the way the computer operates to develop more efficient software solutions.

In this unit, you will explore the relationship between hardware and software as part of a computer system. You will examine the way computer components work both individually and together to store and process data, and the way in which data is transmitted and used in computer systems. You will explore the impact that computing systems have on organisations and individuals.

In this unit, you will apply the fundamental principles of computers to all areas of computing. This is essential for progression to a computing-related higher education course or for entry to the workplace as a computing professional.

Summary of assessment

This unit is assessed through a written examination set and marked by Pearson.

The examination is one hour and 45 minutes in length. During the supervised assessment period, learners will be assessed on their knowledge and understanding of how computer systems work, including the role of hardware and software, the way components of a system work together and how data in a system is used.

The number of marks for the unit is 80.

The assessment availability is twice a year in January and May/June. The first assessment availability is January 2018.

Assessment outcomes

AO1 Demonstrate knowledge and understanding of computing facts, terms, standards, concepts and processes

Command words: complete, draw, give, identify, name, state

Marks: ranges from 1 to 5 marks

AO2 Apply knowledge and understanding of computing facts, terms, standards, concepts and processes to real-life scenarios

Command words: calculate, complete, demonstrate, describe, draw, explain, produce

Marks: ranges from 1 to 5 marks

AO3 Select and use computing technologies and procedures to explore likely outcomes and find solutions to problems in context

Command words: calculate, demonstrate, develop, explain, produce

Marks: ranges from 1 to 6 marks

AO4 Analyse and evaluate data, information, technologies and procedures in order to recommend and justify solutions to computing problems

Command words: analyse, demonstrate, discuss, produce, write

Marks: ranges from 6 to 12 marks

AO5 Make connections between the application of technologies, procedures, outcomes and solutions to resolve computing problems

Command words: evaluate, produce, write

Marks: ranges from 6 to 12 marks

Essential content

The essential content is set out under content areas. Learners must cover all specified content before the assessment.

A Hardware and software

The concepts and implications of the use of, and relationships between, hardware and software that form computer systems.

A1 Computer hardware in a computer system

- Types of computer systems:
  - multi-functional devices
  - personal computers
  - mobile devices
  - servers.
- The purpose, features and uses of internal components used in:
  - multi-functional devices
  - personal computers
  - mobile devices
  - servers.
- Factors affecting the choice, use and performance of internal components.
- The hardware used in computer systems:
  - input devices
  - output devices
  - storage devices.
- How the features of hardware can affect their performance and the performance of a computer system.
- Factors affecting choice of hardware:
  - user experience – ease of use, performance, availability, accessibility
  - user needs
  - compatibility
  - cost
  - efficiency
  - implementation – timescales, testing, migration to new system
  - productivity
  - security.
- Data storage and recovery systems:
  - redundant array of independent disks (RAID)
  - network attached storage (NAS).

A2 Computer software in a computer system

- Operating systems:
  - types of operating system:
    - real-time operating system
    - single-user single task
    - single-user multi-tasking
    - multi-user

  - the role of the kernel in controlling and managing system components and tasks:
    - program execution
    - interrupts
    - modes
    - memory management
    - multi-tasking
    - disk access
    - file systems
    - device drivers
  - the role of the operating system in managing:
    - networking
    - security
  - factors affecting the choice and use of user interfaces:
    - graphical
    - command line
    - menu based
  - factors affecting the choice of operating system
  - factors affecting the use and performance of an operating system.
- Utility software:
  - the purpose, features and uses of utility software
  - factors affecting the choice, use and performance of utility software.
- Application software:
  - the purpose, features and uses of application software
  - factors affecting the choice, use and performance of application software.
- The principles and implications of open source operating systems and software.

A3 Data processing

- The use, features and implications of computer systems for data processing.
- The role of hardware in collecting data.
- The role of software in collecting data.
- Data processing functions:
  - aggregation
  - analysis
  - conversion
  - reporting
  - sorting
  - validation.
- The impact on individuals and organisations of using and storing data across multiple computer systems:
  - access
  - cost
  - implementation
  - productivity
  - security.
- Backup and data recovery procedures.

B Computer architecture

The implications of computer architecture models and the impact of the relationships between their component parts.

B1 Approaches to computer architecture

- The features and characteristics of different computer architecture models:
  - stored program model:
    - Von Neumann architecture
    - Harvard architecture
  - cluster computing
  - uniform memory access and non-uniform memory access.
- Use and application of emulation.
- Factors affecting the choice of different architecture models.
- The impact of using different architecture models.

B2 The concepts of microarchitecture

- Instruction cycles.
- Execution speeds:
  - factors affecting execution speeds
  - methods of increasing execution speed
  - implications of execution speeds.
- The use and choice of instruction sets.
- Pipelining.
- Cache.
- Registers.
- Multi-processing and multi-threading.
- The features and implications of embedded and mobile central processing unit (CPU) architecture.
- The features and implications of microcomputer CPU architecture.
- The features and implications of server CPU architecture.

B3 Registers and register handling

- Types of register:
  - general purpose register
  - special registers:
    - accumulator
    - instruction register
    - memory address register (MAR)
    - memory data register (MDR)
    - program counter.
- The function and purpose of general and special registers and their impact on the way computer systems perform.
- The role of interrupts in a computer system.

C How data is represented by computer systems

The characteristics, concepts and implications of computer data representation methods.

C1 Number systems

- The use and interpretation of number systems used in computer systems, including:
  - units of digital data (bit, byte, kilobyte and multiples of these)
  - binary
  - binary coded decimal (BCD).
- The use of binary arithmetic (including BCD) to perform calculations: addition, subtraction, multiplication and division.
- The use of binary to represent negative and floating point numbers.

C2 Text representation

- The purpose and implications of using codes to represent character sets.
- The features and uses of common character sets:
  - ASCII
  - UNICODE.

C3 Image representation

- How bitmap/raster image data is stored and represented in a computer system.
- The impact of image resolution on the way images are stored and represented.
- The impact of sample/bit depth on the way that image data is stored and images are displayed.
- The effects of compression on image data.

D How data is organised on computer systems

The characteristics and implications of methods of organising data in computer systems, and its impact on computer processes.

D1 Data structures

- The features, applications and implications of data types used in computer systems:
  - stack
  - queue
  - array
  - list.
- The use and application of data types in computer software.
- The use and implications of data types in computer hardware.

D2 Indices and matrices

Matrix representation in computer systems:

- the relationship between matrices and arrays
- mathematical operations using matrices
- single, two- and multi-dimensional arrays
- row-major and column-major order.

E How data is transmitted by computer systems

The concepts, processes and implications of data transmission in and between computer systems.

E1 Transmitting data

- Types of communication channel:
  - simplex
  - half-duplex
  - full-duplex
  - point-to-point
  - multi-drop.
- Methods of connecting devices and transmitting data across and between computer systems.
- The selection of connection methods to fulfil specified tasks and functions.
- Asynchronous and synchronous data transmission.
- Parallel and serial transmission.
- Use of packet data in transmitting data:
  - contents of a data packet
  - the role of components of a data packet
  - packet switching.
- Protocols used to govern and control data transmission.

- The features, applications and implications of encryption
  - simple encryption ciphers:
    - Caesar cipher
    - Vigenère cipher
  - encryption used in computer systems:
    - symmetric key encryption
    - public key encryption.
- Types of compression:
  - lossy
  - lossless.
- The applications and implications of data compression.

E2 Error detection

- Methods used to detect errors in data transmission:
  - parity schemes
  - checksum
  - repetition schemes
  - cyclic redundancy check (CRC).
- The concepts, implications and applications of error detection.

E3 Error correction

- Commonly-used error correction systems:
  - automatic repeat request (ARQ)
  - forward error correction (FEC).
- The concepts, implications and applications of error correction systems.

F The use of logic and data flow in computer systems

The use, application and interpretation of logical processes and diagrams to represent data flow and relationships in and between computer systems.

F1 Boolean logic

- The use, application and interpretation of Boolean logic to identify data flow and solve problems.
- The use, application and interpretation of Boolean logic to identify logical structures, represent data flow and solve problems.

F2 Flow charts and system diagrams

- The use, application and interpretation of flow charts and diagrams to represent data flow in and between computer systems.
- The use, application and interpretation of flow charts and diagrams to solve problems.

Grade descriptors

To achieve a grade a learner is expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades.

Level 3 Pass

Learners are able to apply knowledge and understanding of key computing concepts to a range of familiar vocational contexts. They are able to use knowledge of computing to deconstruct problems in common situations and apply standard conventions to produce solutions with interpretation. Leaners are able to identify the impact of effective and ineffective computer systems and recommend ways in which a system can be developed and/or improved (using given structures and criteria).

Level 3 Distinction

Learners are able to analyse complex information, data and situations, in vocational contexts, in order to draw conclusions and make valid observations. They are able to synthesise knowledge and understanding of computing to deconstruct problems, drawing on various sources of information to develop effective solutions with justification. Learners are able to evaluate the effectiveness of computer systems to make justified recommendations on their development and future actions that can be taken.

Key terms typically used in assessment

The following table shows the key terms that will be used consistently by Pearson in our assessments to ensure students are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Analyse	Learners examine in detail, a scenario or problem to discover its meaning or essential features. Learners will break down the problem into its parts and show how they interrelate. There is no requirement for any conclusion.
Calculate	Learners apply some form of mathematical or computational process.
Complete	Learners complete a diagram or process. Can apply to problems/solutions of varying complexity.
Demonstrate	Learners illustrate and explain how an identified computer system or process functions. May take the form of an extended writing response, a diagram or a combination of the two.
Describe	Learners provide an account of something, or to highlight a number of key features of a given topic. May also be used in relation to the stages of a process.
Develop	Learners provide a solution to a problem, typically using an existing system or structure that must be improved or refined.
Discuss	Learners investigate a problem or scenario, showing reasoning or argument.
Draw	Learners represent understanding through the use of a diagram or flow chart.
Evaluate	Learners review and synthesise information to provide a supported judgement about the topic or problem. Typically a conclusion will be required.
Explain	Learners make a series of linked points and/or justify or expand on an identified point.
Identify	Learners assess factual information, typically when making use of given stimuli. Requires a single word or short sentence answer.
Produce	Learners provide a solution that applies established constructs to a given computing problem.
Write	Learners produce a solution, or a mechanism used as part of a solution, to a given computing problem.

Links to other units

This mandatory unit supports most of the other units in the qualification and, in particular, the following mandatory units:

- Unit 3: Planning and Management of Computer Projects
- Unit 4: Software Design and Development Project
- Unit 7: IT Systems Security and Encryption
- Unit 9: The Impact of Computing.

Employer involvement

Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit.