

Unit 9: Computer Systems Architecture

Unit code J/618/7416

Unit level 4

Credit value 15

Introduction

As technology develops, it is important to have a working foundation of computer systems architecture on which to build technical knowledge. Despite hardware and software being constantly updated and seemingly becoming more complex, students with a solid, underpinned knowledge of computer systems architecture will not only be able to answer questions such as, 'How does a central processor work?', 'What does an operating system do?', 'How is information stored?', 'What is an instruction set?' and 'How do I actually connect to the internet?', but will also be able to transfer and apply their knowledge and skills to many other areas.

This unit introduces students to the foundations of computer systems architecture, and the integrated hardware and software components and subsystems that enable and allow data to be input, processed and output. Students will explore the concepts of operating systems, hardware management and computer networks, and gain the practical skills needed to be able to diagnose, troubleshoot and maintain computer systems, taking the security of these systems into consideration.

Among the topics included in this unit are CPUs, memory, input and output devices, ALU operations, program execution, operating systems (including kernel, file systems, API and system calls), hardware management, installation, firmware, device drivers, networking (including OSI and TCP/IP models), error and information gathering, fault diagnostics, security and problem resolution.

On successful completion of this unit, students will be able to explain the purpose and role of operating systems, the relationship between the subsystems embedded in a central processing unit and the core hardware and software components associated with computer operations. Students will be able to configure the hardware and systems needed to establish a computer network, together with practical diagnostic and troubleshooting techniques. As a result, they will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1 Explain the relationships between hardware components and the subsystems used in a computer system
- LO2 Categorise the key features and services provided by different computer operating systems and hardware
- LO3 Use network communication technology and the associated services to connect computer systems
- LO4 Demonstrate diagnostic and troubleshooting skills to solve hardware, software and networking related issues.

Essential Content

LO1 Explain the relationships between hardware components and the subsystems used in a computer system

Hardware components and subsystems:

The four main subsystem of Von Neumann Architecture including memory, input and output systems, arithmetical & logic unit (ALU) and control unit.

The CPU.

Review memory subsystems in terms of programs and data (variable) storage (ROM, RAM, size, speed, operation and structure).

Explore input/output systems and structure (communicating with other devices (screen, keyboard, printers etc.), storage (hard disk drives (HDD), DVDs etc.), IO controllers and data transfer (speed, buffers, interrupts etc.).

Discuss ALU subsystems (mathematical and logical operations, registers, bus etc.).

Investigate how the control unit works (program code and language, fetch, decode, execute, halt), including an introduction to machine language instructions (reduced instruction and complex instruction sets: arithmetic, compare, branch, control, Program Counter (PC), Instruction Register (IR) and Instruction Decoder (ID).

LO2 Categorise the key features and services provided by different computer operating systems and hardware

Operating system types and hardware:

Introduce different operating systems and types (desktop and server/network, mobile, embedded systems, e.g. Windows 10, Windows Server 2012/2016, Linux, Unix, MacOS, IOS, Android).

Hardware management and connections, including the hardware abstraction layer, firmware and device drivers (network cards, video cards, optical drives, magnetic disks, solid state drives, RAID etc.).

Installing and configuring common peripheral devices (mouse, keyboard, scanners, biometrics, webcams, smartcards, motion sensor, printers, speakers, display devices etc.).

Features and services:

Introduce Operating Systems Architecture (Kernel, File Systems, API).

Review how operating systems function and provide services (user interface, memory management (Direct Memory Access), file management).

LO3 Use network communication technology and the associated services to connect computer systems

Networking technology and services:

Network protocols HTTP, SMTP, TCP, UDP, ports etc.

Layers of the TCP/IP model: application layer, transport layer, internet layer, network access layer.

7-layer OSI model, including purpose, architecture, functionality.

Hardware and network addresses: physical/MAC addresses, forward frame using MAC address tables, address resolution protocol (ARP), logical/IP addresses.

Network devices and components: network interface cards (NIC), network cables, switches, wireless access points, routers, network services.

Connecting computer systems to a network:

Introduce topologies, including physical and logical: bus, star (extended star), ring and mesh.

Establishing network connections including wired/wireless client configuration. Security of networking systems and its importance.

Explain characteristics of cellular mobile networks.

Explore LPWA communication technology in comparison to WCT.

LO4 Demonstrate diagnostic and troubleshooting skills to solve hardware, software and networking related issues

Hardware, software and networking issues and maintenance:

Different hardware- and software-related problems and the implication of choices with regard to system administration, impact on users and business operations.

Explore methods of maintenance with regard to hardware and software; diagnostic and troubleshooting skills:

Discuss information gathering methods and techniques (such as system documents, user information, error codes, error messages, failure domain, problem history).

Consider solutions to security problems.

Analyse evidence and establish possible problem domains, complexity, priority and impact; introduce 'Research, Determine, Implement, Review, Document (and Repeat)'.

Creating and updating system documentation.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Explain the relationships between hardware components and the subsystems used in a computer system		LO1 and LO2 D1 Evaluate the structure and functions of an operating system, including memory, processor, device, file, security, performance and error management with regard to functionality, operation and dependency.
P1 Identify the main subsystems of a computer and explain how they are organised and connected. P2 Explain the purpose of the Central Processing Unit (CPU) and include details on its operation.	M1 Review the operation of the CPU and assess its dependency and performance with regard to associated systems and subsystems.	
LO2 Categorise the key features and services provided by different computer operating systems and hardware		
P3 Describe a range of different operating systems, including the purpose, use and hardware requirements of each. P4 Discuss the key features associated with the architecture of an operating system.	M2 Analyse the services provided by an operating system with regard to user interaction, memory management, file management and hardware support.	
LO3 Use network communication technology and the associated services to connect computer systems		D2 Evaluate the OSI and TCP/IP models with regard to hierarchy, layers and services, including information on the associated protocols and hardware.
P5 Explain the relationships between hardware and network addresses, including their use with regard to networking devices and components. P6 Set up, configure and document appropriate hardware and software systems to establish computer-based network connectivity.	M3 Compare common physical and logical networking topologies and explain the differences and purposes of each.	

Pass	Merit	Distinction
L04 Demonstrate diagnostic and troubleshooting skills to solve hardware, software and networking related issues.		D3 Assess any future improvements that may be required to ensure the continued effectiveness of a computer system.
<p>P7 Use information gathering methods to assess, troubleshoot and document solutions to a number of different technical hardware, software and networking issues.</p> <p>P8 Conduct and document a range of maintenance activities with regard to computer hardware and software.</p>	M4 Review different diagnostic and troubleshooting skills, including data gathering methods and techniques.	

Recommended Resources

Textbooks

Docter, Q., Dulaney, E. and Skandier, T. (2015) *CompTIA A+ Complete Study Guide: Exams 220-901 and 220-902*. USA: John Wiley & Sons Inc.

Mueller, S. (2015) *Upgrading and Repairing PCs*. USA: Que Publishing.

Patterson, D. and Hennessy, J. (2013) *Computer Organization and Design: The Hardware/Software Interface*. USA: Elsevier.

Links

This unit links to the following related units:

Unit 2: Networking

Unit 27: Transport Network Design

Unit 29: Network Security

Unit 39: Network Management

Unit 40: Client/Server Computing Systems.