UCAMPUS
STUDY GUIDE

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Unit specifications can be found on the UE Campus Portal: https://uecampus.com/

Contents

Using your Study Guide4
Level 4 Units4
Level 4 PC Technology and Operating Systems5
About this unit5

Chapter One – Understanding a Range of Operating Systems and PC Hardware6
Introduction6
Learning Outcomes6
Assessment Criteria7
1.1 Analysing the functionalities of PC hardware7
1.2 Installing and commissioning a working personal computer14
1.3 Optimising the operating system environment17
1.4 Conducting troubleshooting to identify and solve common PC problems19
Reading List21
Summary21

Chapter Two – Understanding Windows and Linux Operating Systems22
Introduction22
Learning Outcomes22
Assessment Criteria22
2.1 The usage and role of an operating system23
2.2 Establishing a disc operating environment26
2.3 Configuring Windows and Linux operating systems29
2.4 Using common utilities and programs to configure file systems and manage users31
Reading List34
Summary34

Glossary35
MCQs and True & False Questions (self-assessment)37

Using your Study Guide

Welcome to the study guide, designed to support you in completing your Level 4 Diploma in Information Technology.

This study guide follows the order of the syllabus, which is the basis for your studies. Each chapter starts by listing the syllabus learning outcomes covered and the assessment criteria.

Level 4 Units

Unit Reference	Mandatory Units	Level	TQT	Credit	GLH
L/617/6692	Information Technology and IT Ethics	4	200	20	100
R/617/6693	Mathematics and Statistics for IT	4	200	20	100
Y/617/6694	PC Maintenance and Operating Systems	4	200	20	100
D/617/6695	Computer Graphics Editing and Database Concepts	4	200	20	100
M/617/6698	Web Design 1	4	200	20	100
T/617/6699	Web Programming	4	200	20	100

The study guide includes a number of features to enhance your studies:

📝	**'Over to you:'** activities for you to apply what you have learned.
🌍	**'Industry Insights:'** discover up-to-date trends, expert opinions, and real-world examples from leading organisations in the IT industry.
🧭	**'Did you know?'** highlights interesting facts or surprising information to deepen your understanding of PC hardware and operating systems.
💼	**'Case studies:'** realistic business scenarios to reinforce and test your understanding.
📱	**'Revision on the go:'** use your phone camera to capture key pieces of learning and save them as revision notes.
❗	**'Need to know:'** key pieces of information highlighted in the text.
💡	**'Examples:'** illustrating points made in the text to show how it works in practice.

Note: Website addresses current as of March 2026.

Level 4 PC Technology and Operating Systems

About this unit

This unit aims to provide you with knowledge of personal computer hardware. Successful completion will enable you to install a computer system unit and operating system and conduct troubleshooting. The unit provides the essential knowledge of computer hardware, the software needed to make hardware work, the components of the hardware and the technologies and principles that support those components. You will also learn to assemble computer hardware to build a full PC, understand how to install operating systems and how to conduct troubleshooting on faulty hardware.

This unit also provides the basic concepts about operating systems and enables you to install, configure and operate two commonly used operating systems. It includes an overview of Windows and Linux operating systems, the installation and configuration of these systems, the use of proper file systems, managing groups and users, installing and uninstalling applications on these two operating systems, operating a basic command-line environment, and manipulating simple files and printer-sharing.

By the end of this unit, you will be confident in building, configuring, maintaining, and troubleshooting PC systems – skills that form the backbone of any IT support or systems administration career.

Chapter One – Understanding a Range of Operating Systems and PC Hardware

Introduction

This chapter explores the hardware components of a personal computer and the practical skills needed to build, configure, optimise, and troubleshoot PC systems. Whether you are assembling a workstation for a graphic designer, configuring a server for a small business, or diagnosing a fault in a user's laptop, the knowledge in this chapter is fundamental to your role as an IT professional.

You will analyse the functionalities of key PC hardware components, from processors and motherboards to storage devices and power supplies. You will learn how to install and commission a working personal computer to the required standard, optimise the operating system environment for performance and security, and conduct systematic troubleshooting to identify and solve common PC problems.

Hands-on experience is essential for this chapter. Where possible, you should practise the skills described using real hardware or virtualised environments.

Learning Outcomes

On completing the chapter, you will be able to:

1. **Understand a range of operating systems.**

Assessment Criteria

1.1 Analyse the functionalities of PC hardware.

1.2 Install and commission a working personal computer to the required standard.

1.3 Optimise the operating system environment to the required standard.

1.4 Conduct troubleshooting to identify and solve common PC problems.

1.1 Analysing the functionalities of PC hardware

📝 Over to you – Video Watch: Inside a Computer

Watch this YouTube video:

Title: Computer Science Basics: Inside a Computer – Code.org

Duration: 5:04

Link: https://www.youtube.com/watch?v=AkFi90IZmXA

After watching, list the four main functions of a computer (input, storage, processing, output) and identify which hardware component performs each function.

Form Factors

The form factor of a computer refers to the physical size, shape, and layout specification of the motherboard and case. The form factor determines which components are compatible with each other and how the system is assembled. Understanding form factors is essential when selecting or building a PC because you must ensure that the motherboard, case, and power supply are all compatible.

- ATX (Advanced Technology Extended) – the most common desktop form factor. ATX motherboards measure 305 × 244 mm and support full-size expansion slots, multiple RAM slots, and extensive connectivity. Most standard desktop towers use ATX.
- Micro-ATX (mATX) – a smaller variant (244 × 244 mm) that fits in smaller cases while remaining compatible with ATX cases. It offers fewer expansion slots but is popular for budget and mid-range builds.
- Mini-ITX – the smallest common form factor (170 × 170 mm), designed for compact builds such as home theatre PCs (HTPCs) and small form factor (SFF) systems. Typically has only one expansion slot.
- Extended ATX (E-ATX) – larger than standard ATX, used in workstations and high-end gaming systems that require additional expansion slots, RAM, or multi-GPU configurations.

Power Supplies (PSU)

The power supply unit (PSU) converts mains AC electricity into the low-voltage DC power that computer components require. Choosing the right PSU is critical for system stability, efficiency, and longevity. Key considerations include:

- Wattage – the total power output, measured in watts. A typical home PC requires 400–600W, while high-end gaming or workstation systems may need 750–1000W or more.
- Efficiency rating (80 PLUS certification) – indicates how efficiently the PSU converts AC to DC power. Ratings range from 80 PLUS (basic) to 80 PLUS Titanium (the most efficient), meaning less energy is wasted as heat.

- Modular vs non-modular – modular PSUs allow you to connect only the cables you need, improving airflow and tidiness inside the case. Non-modular PSUs have all cables permanently attached.
- Form factor compatibility – the PSU must physically fit the case and match the motherboard's power connector requirements (typically 24-pin main connector and 4/8-pin CPU power connector).

Did you know?

An inefficient power supply not only wastes electricity but also generates excess heat, which can reduce the lifespan of components and increase cooling costs. A PSU rated at 80 PLUS Gold efficiency wastes only about 10–13% of the power drawn from the wall, compared to up to 20% for a basic 80 PLUS unit. Over the lifetime of a PC, this can represent a significant saving in energy costs – and a meaningful reduction in carbon footprint.

Processor (CPU) and Chipsets

The Central Processing Unit (CPU) is the brain of the computer, responsible for executing instructions and performing calculations. Modern CPUs contain billions of transistors on a single chip and can perform billions of operations per second. Key CPU concepts include:

- Clock speed – measured in gigahertz (GHz), indicating how many cycles per second the CPU can perform. Higher clock speeds generally mean faster processing, though architecture also plays a major role.
- Cores and threads – modern CPUs have multiple cores (e.g. 4, 8, 16, or even 64 cores), each capable of processing instructions independently. Hyper-threading (Intel) or SMT (AMD) allows each core to handle two threads simultaneously, improving multitasking performance.
- Cache memory – small, extremely fast memory built into the CPU (L1, L2, L3 cache) that stores frequently accessed data and instructions. Larger caches improve performance by reducing the need to access slower main memory (RAM).
- Thermal Design Power (TDP) – the maximum amount of heat the CPU generates under load, measured in watts. This determines the cooling solution required (air cooler, liquid cooling, etc.).
- Socket type – the physical interface between the CPU and the motherboard. Intel and AMD use different socket types (e.g. Intel LGA 1700, AMD AM5), and the motherboard must match the CPU's socket.

The chipset is a set of electronic components on the motherboard that manages data flow between the CPU, memory, storage, and peripherals. The chipset determines which features the motherboard supports, including the number of USB ports, PCIe lanes, SATA connections, and overclocking capability. Major chipset manufacturers include Intel and AMD.

🌍 Industry Insight – The CPU Market in 2025

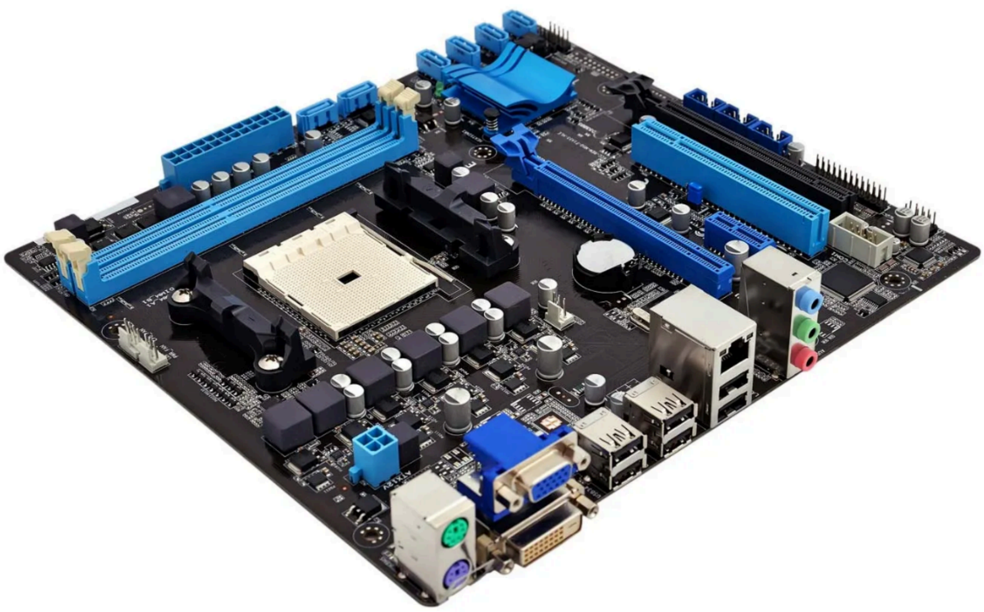
The desktop CPU market is dominated by two companies: Intel and AMD. Intel's latest generation processors (Raptor Lake Refresh / Arrow Lake) compete directly with AMD's Ryzen 7000 and 9000 series (based on the Zen 4 and Zen 5 architectures). AMD has gained significant market share in recent years due to its competitive multi-core performance and energy efficiency. Meanwhile, Apple has transitioned its entire Mac lineup to custom ARM-based chips (M1, M2, M3, M4 series), demonstrating that the x86 architecture no longer has a monopoly on high-performance computing.

Read more: AnandTech archives – https://www.anandtech.com/ and Tom's Hardware – https://www.tomshardware.com/

Motherboard

The motherboard is the main printed circuit board (PCB) in a computer. It provides the physical and electrical connections between all other components. Key motherboard features include:

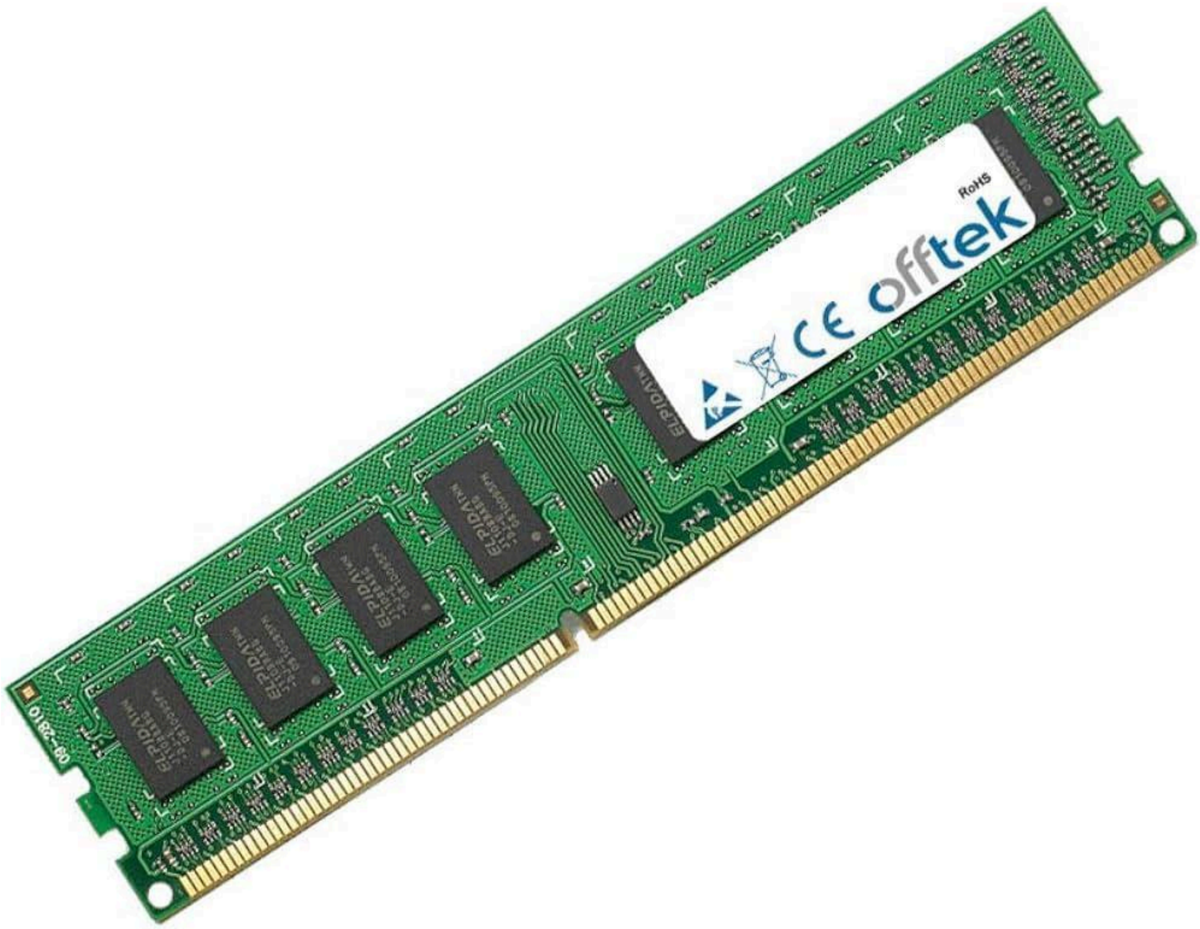
- CPU socket – the physical slot that holds the processor. Must match the CPU's socket type.
- RAM slots (DIMM slots) – typically 2 or 4 slots supporting DDR4 or DDR5 memory. The number and type of slots determine the maximum amount and speed of RAM.
- Expansion slots (PCIe) – used for graphics cards, network cards, sound cards, and NVMe SSD adapters. PCIe 4.0 and 5.0 offer progressively higher bandwidth.
- Storage connectors – SATA ports for traditional drives and M.2 slots for high-speed NVMe SSDs.
- I/O ports – rear panel connections including USB (Type-A, Type-C), HDMI/DisplayPort, Ethernet, and audio jacks.
- BIOS/UEFI – firmware stored on a chip on the motherboard that initialises hardware during boot and provides a setup interface for configuring hardware settings.



Memory (RAM)

Random Access Memory (RAM) is volatile, high-speed memory that the CPU uses to store data and instructions currently in use. When you open an application, it is loaded from storage into RAM because RAM is many times faster than even the fastest SSD. Key concepts:

- DDR (Double Data Rate) – current standards are DDR4 and DDR5. DDR5 offers higher bandwidth and capacity per module, but DDR4 remains widely used.
- Capacity – measured in gigabytes (GB). 8 GB is the minimum for basic use; 16 GB is recommended for most users; 32 GB or more is needed for professional workloads (video editing, software development, virtualisation).
- Speed – measured in megatransfers per second (MT/s) or MHz. Faster RAM reduces latency and improves performance, particularly in memory-intensive tasks.
- Dual-channel and quad-channel – installing matched pairs (or sets of four) of RAM modules in the correct slots enables higher bandwidth by allowing simultaneous access to multiple memory channels.



🧭 Did you know?

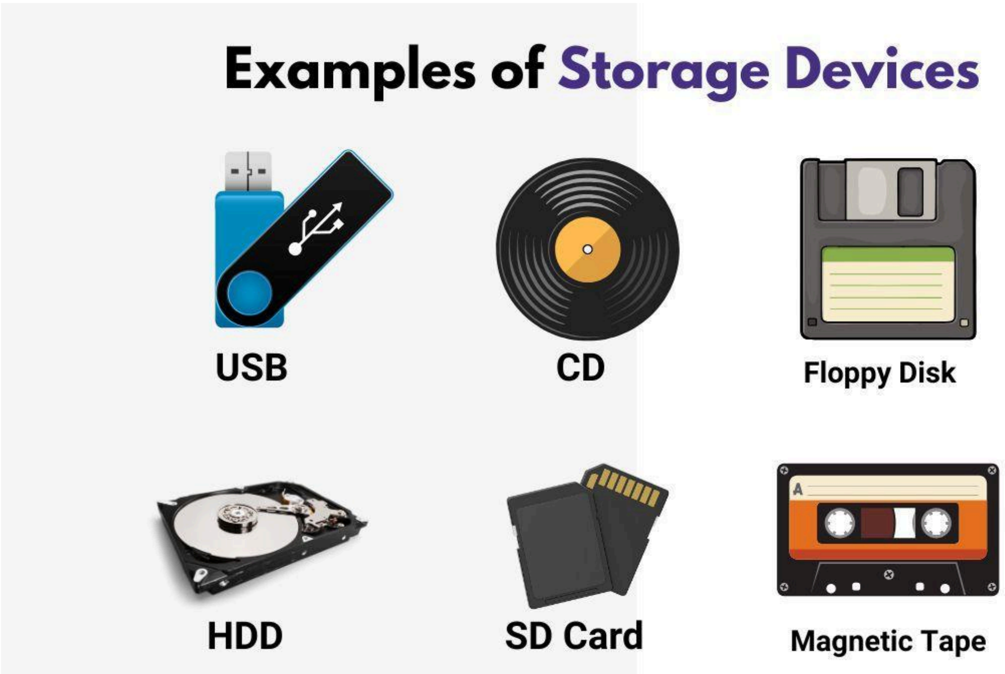
The first commercially available RAM chip (Intel 1103, released in 1970) could store just 1 kilobit (128 bytes) of data. A modern DDR5 module can store 64 gigabytes – that is over 500 million times the capacity of the Intel 1103 on a single module. This extraordinary increase in density is a direct result of decades of advances in semiconductor manufacturing.

Storage Devices

Storage devices retain data permanently, even when the computer is powered off. The two main types of internal storage are:

- Hard Disk Drive (HDD) – uses spinning magnetic platters and a read/write head. HDDs offer large capacities (up to 20+ TB) at low cost per gigabyte, but are slower, heavier, and more fragile than SSDs. Best suited for archival storage and bulk data.
- Solid State Drive (SSD) – uses NAND flash memory with no moving parts. SSDs are significantly faster (especially NVMe SSDs connected via M.2 or PCIe), more durable, quieter, and more energy-efficient than HDDs. NVMe SSDs can achieve sequential read speeds exceeding 7,000 MB/s, compared to approximately 150 MB/s for a typical HDD.

Many modern systems use a combination: a fast NVMe SSD as the boot drive (for the operating system and frequently used applications) and a larger HDD for bulk storage (documents, media, backups).



Input/Output and Multimedia Devices

Input/output (I/O) devices allow you to interact with the computer and receive output. Input devices include keyboards, mice, touchscreens, scanners, microphones, webcams, and biometric sensors. Output devices include monitors, printers, speakers, and projectors. Multimedia devices combine input and output capabilities, such as VR headsets, interactive whiteboards, and digital drawing tablets.

Understanding the connectivity standards for I/O devices is important: USB (Universal Serial Bus) is the most common, with USB 3.2 and USB4 offering speeds up to 40 Gbps. Thunderbolt 4 (found on many modern laptops) provides 40 Gbps with daisy-chaining support. Display connections include HDMI 2.1, DisplayPort 2.0, and USB-C with DisplayPort Alt Mode.

📝 Over to you – Video Watch: PC Components Explained

Watch this YouTube video:

Title: What does what in your computer? Computer parts Explained – Techquickie

Duration: 5:11

Link: https://www.youtube.com/watch?v=ExxFxD4OSZ0

After watching, create a labelled diagram of the inside of a PC, identifying the CPU, motherboard, RAM, GPU, storage drives, PSU, and cooling system.

📝 Over to you – Component Research

Using a reputable hardware review website (e.g. Tom's Hardware, AnandTech, or PCPartPicker), research and specify the components for a PC build within a £800 budget suitable for a university student studying IT. Your specification must include: CPU, motherboard, RAM, storage (SSD and/or HDD), PSU, case, and GPU (if needed). Justify each choice in terms of performance, compatibility, and value for money. Present your findings in a table.

1.2 Installing and commissioning a working personal computer

Building a PC from individual components is one of the most valuable hands-on skills you can develop as an IT professional. The process requires careful planning, attention to detail, and an understanding of how each component connects to the others. This section walks you through the key stages of PC assembly.

Pre-Assembly Preparation

Before you begin assembling, you should:

- Verify component compatibility – ensure the CPU matches the motherboard's socket, the RAM type (DDR4/DDR5) is supported, the PSU has sufficient wattage and the correct connectors, and the case accommodates the motherboard form factor.
- Prepare your workspace – use a clean, well-lit, static-free surface. Wear an anti-static wrist strap or regularly ground yourself by touching the metal case to prevent electrostatic discharge (ESD), which can damage sensitive components.
- Gather tools – a Phillips-head screwdriver (size #2 is standard for PC assembly), cable ties for cable management, and thermal paste (if not pre-applied on the CPU cooler).
- Read the manuals – the motherboard manual is particularly important, as it shows the location of connectors, the correct RAM slots for dual-channel configuration, and jumper settings.

Assembly Steps

While the exact procedure varies depending on the components, a typical PC build follows these steps:

- Step 1: Install the CPU – lift the retention arm on the CPU socket, align the CPU using the alignment triangle or notches, gently place it in the socket, and close the retention arm. Never force the CPU.
- Step 2: Install RAM – open the clips on the DIMM slots, align the notch on the RAM module with the slot, and press firmly until the clips snap into place. For dual-channel, use the slots recommended in the motherboard manual (usually slots 2 and 4).
- Step 3: Install the CPU cooler – apply thermal paste (a pea-sized dot in the centre of the CPU, if not pre-applied), position the cooler, and secure it. Connect the fan cable to the CPU_FAN header on the motherboard.
- Step 4: Install M.2 SSD (if applicable) – insert the drive into the M.2 slot at a 30-degree angle and secure with the retaining screw.
- Step 5: Install the motherboard in the case – install the I/O shield (if separate), align the motherboard with the standoffs in the case, and secure with screws.
- Step 6: Install the PSU – mount the PSU in the case (usually at the bottom rear) and route cables for tidy cable management.

- Step 7: Install storage drives – mount HDDs/SSDs in drive bays or brackets and connect SATA data and power cables.
- Step 8: Install the GPU – remove the appropriate PCIe slot covers from the case, insert the GPU into the top PCIe x16 slot, secure with screws, and connect any required power cables from the PSU.
- Step 9: Connect all cables – 24-pin motherboard power, 4/8-pin CPU power, front panel connectors (power button, reset, LEDs, USB, audio), and any case fan connectors.
- Step 10: First boot test – connect a monitor, keyboard, and mouse. Power on the system and enter the BIOS/UEFI to verify that all components are detected correctly.

📝 **Over to you – Video Watch: How to Build a PC**

Watch this YouTube video:

Title: How to Build a PC, the Last Guide You'll Ever Need! – Linus Tech Tips

Duration: 1:00:38

Link: https://www.youtube.com/watch?v=BL4DCEp7blY

After watching (you may wish to watch in stages), note three safety precautions taken during the build. What was the most challenging step, and how was it handled?

🧭 **Did you know?**

Electrostatic discharge (ESD) is one of the most common causes of premature component failure. A static shock as small as 100 volts – far below the threshold you can feel (around 3,000 volts) – can damage or destroy sensitive electronic components. This is why professional technicians always use ESD protection such as anti-static wrist straps, mats, and bags.

Installing the Operating System

Once the hardware is assembled and passes the initial boot test, the next step is to install an operating system. The most common desktop operating system is Microsoft Windows, though Linux distributions are widely used in servers, development, and specialist applications. The general process for installing Windows involves:

- Creating a bootable USB drive using the Windows Media Creation Tool.
- Booting from the USB drive (changing the boot order in BIOS/UEFI if necessary).
- Following the installation wizard: selecting language, entering the product key, choosing the installation type (custom/clean install), selecting the target drive, and partitioning if required.
- Completing the initial setup (user account, privacy settings, network connection).
- Installing device drivers – while Windows installs many drivers automatically via Windows Update, you may need to install specific drivers from the motherboard, GPU, and peripheral manufacturers' websites for optimal performance.

- Installing essential software and applying all available Windows updates.

📝 Over to you – Practical Task

If you have access to a spare PC or can use a virtual machine (using VirtualBox or VMware Workstation Player), practise building a system and installing Windows 11 from a bootable USB. Document each step with screenshots. Alternatively, watch a full Windows 11 installation walkthrough on YouTube and write a step-by-step guide in your own words (minimum 500 words).

1.3 Optimising the operating system environment

Once an operating system is installed, it needs to be configured and optimised for performance, security, and usability. Optimisation ensures the system runs efficiently, is protected from threats, and meets the specific needs of its users.

Performance Optimisation

Key techniques for optimising Windows performance include:

- Managing startup programs – disabling unnecessary applications that launch at startup reduces boot time and frees up system resources. Use Task Manager (Ctrl+Shift+Esc) > Startup tab to manage these.
- Adjusting visual effects – reducing visual effects (animations, transparency, shadows) can improve performance on lower-specification hardware. Access via System Properties > Advanced > Performance Settings.
- Disk cleanup and defragmentation – removing temporary files, old Windows installations, and cached data frees up storage space. While SSDs should not be defragmented (the OS automatically runs TRIM), HDDs benefit from periodic defragmentation.
- Virtual memory (page file) management – Windows uses a portion of the hard drive as an extension of RAM. Adjusting the page file size or moving it to a faster drive can improve performance.
- Keeping the system updated – Windows Update delivers performance improvements, bug fixes, and security patches. Keeping the system current is one of the simplest and most effective optimisation steps.
- Driver updates – ensuring that all hardware drivers (especially GPU drivers) are up to date can resolve performance issues and improve stability.

Security Hardening

Optimisation is not just about speed – it also includes securing the system against threats:

- Windows Defender and firewall – ensure Windows Security (Defender Antivirus and Firewall) is enabled and up to date.
- User Account Control (UAC) – keep UAC enabled to prevent unauthorised changes to the system.
- BitLocker encryption – encrypt the system drive to protect data if the device is lost or stolen (available on Windows Pro and Enterprise editions).
- Automatic updates – enable automatic updates to ensure security patches are applied promptly.
- Strong passwords and multi-factor authentication (MFA) – enforce strong password policies and enable MFA wherever possible, particularly for administrator accounts.

- Removing unnecessary software (bloatware) – uninstall pre-installed applications that are not needed, reducing the attack surface and freeing resources.

🌍 Industry Insight – The Cost of Unpatched Systems

The WannaCry ransomware attack in May 2017 infected over 200,000 computers across 150 countries, including a significant portion of the UK's National Health Service (NHS). The attack exploited a known vulnerability in Windows for which Microsoft had already released a patch two months earlier. Organisations that had applied the patch were protected; those that had not were devastated. The estimated global cost of WannaCry exceeded $4 billion. This case powerfully illustrates why keeping systems updated is not optional – it is a fundamental professional responsibility.

Read more: BBC News – https://www.bbc.co.uk/news/technology-39901382

Power Management

Configuring power settings appropriately can extend hardware lifespan, reduce energy costs, and improve user experience. Windows offers power plans (Balanced, High Performance, Power Saver) that control when the display turns off, when the system enters sleep mode, and how aggressively the CPU throttles under light loads. In enterprise environments, Group Policy can be used to enforce power management settings across multiple machines.

📝 Over to you – Optimisation Checklist

Create a comprehensive optimisation checklist for a newly installed Windows 11 system. Your checklist should cover: startup management, visual effects, disk cleanup, driver updates, security settings (Defender, firewall, UAC, BitLocker), power management, and any other steps you consider important. Aim for at least 15 items, and for each, briefly explain why it matters.

1.4 Conducting troubleshooting to identify and solve common PC problems

Troubleshooting is the systematic process of diagnosing and resolving problems in a computer system. It is one of the most important practical skills for any IT professional. Effective troubleshooting requires a methodical approach, strong analytical thinking, and a solid understanding of how hardware and software interact.

The Troubleshooting Methodology

CompTIA's A+ certification recommends a six-step troubleshooting methodology:

- Step 1: Identify the problem – gather information from the user, identify symptoms, determine what has changed recently, and reproduce the problem if possible.
- Step 2: Establish a theory of probable cause – based on the symptoms, hypothesise what might be causing the problem. Start with the most common or simplest causes first (the 'simplest explanation' principle).
- Step 3: Test the theory – verify your hypothesis by performing a targeted test. If the theory is confirmed, proceed to resolution. If not, return to Step 2 and formulate a new theory.
- Step 4: Establish a plan of action – once the cause is confirmed, plan the resolution. Consider potential side effects and ensure you have the necessary resources (replacement parts, software, administrator access).
- Step 5: Implement the solution – carry out the fix and verify that the problem is resolved. Test related systems to ensure nothing else was affected.
- Step 6: Document the findings – record the problem, cause, and solution in a ticketing system or knowledge base. Good documentation helps resolve similar issues faster in the future.

📝 Over to you – Video Watch: Troubleshooting Common PC Issues

Watch this YouTube video:

Title: Troubleshooting Common Computer Problems – Professor Messer (CompTIA A+)

Duration: 18:02

Link: https://www.youtube.com/watch?v=AEuiLISByGE

After watching, choose one of the problems discussed and write a detailed troubleshooting walkthrough using the six-step methodology described above.

Common Hardware Problems and Solutions

The following table summarises some of the most common hardware issues you will encounter as an IT professional:

Symptom	Possible Causes	Troubleshooting Steps

PC won't turn on	Faulty PSU; loose power cable; dead motherboard; failed power button	Check power cable and outlet; test PSU with a multimeter or PSU tester; try a different power cable; check front panel connections
No display output	GPU not seated properly; monitor cable loose; monitor on wrong input; RAM not detected	Reseat GPU and RAM; try a different video output; check monitor input source; test with onboard graphics if available
Blue Screen of Death (BSOD)	Faulty RAM; driver issues; corrupted system files; overheating	Run Windows Memory Diagnostic; update/rollback drivers; run sfc /scannow; check CPU/GPU temperatures
System overheating	Dust buildup; failed fan; dried thermal paste; poor airflow	Clean dust from fans and heatsinks; replace failed fans; reapply thermal paste; improve case airflow
Slow performance	Insufficient RAM; failing HDD; too many startup programs; malware	Upgrade RAM; replace HDD with SSD; disable unnecessary startup items; run antivirus scan
Strange noises	Failing HDD; loose fan; coil whine from GPU/PSU	Back up data immediately if HDD clicking; tighten or replace fans; coil whine is usually harmless
USB device not recognised	Driver issue; faulty port; insufficient power	Try different port; update/reinstall drivers; use a powered USB hub

💼 Case Study – The Overheating Workstation

A graphic designer reports that her workstation shuts down unexpectedly during intensive rendering tasks. She says the problem started about two weeks ago and is getting worse. The PC is three years old and has never been opened for maintenance.

Task: Using the six-step troubleshooting methodology, write a detailed plan for diagnosing and resolving this issue. Include the questions you would ask the user, the tests you would perform, the most likely cause, and the steps to fix it. Consider what preventative maintenance should have been performed and recommend a schedule going forward. Write approximately 500 words.

Reading List

- Andrews, J., Dark, J. & West, J. (2023). *CompTIA A+ Guide to IT Technical Support.* 11th edn. Boston: Cengage Learning.
- Meyers, M. (2023). *CompTIA A+ Certification All-in-One Exam Guide.* 11th edn. New York: McGraw-Hill.
- Prowse, D.L. (2023). *CompTIA A+ Core 1 (220-1101) and Core 2 (220-1102) Cert Guide.* Hoboken, NJ: Pearson.
- Schmidt, C. (2025). *Complete A+ Guide to IT Hardware and Software.* 9th edn. Hoboken, NJ: Pearson.
- Soper, M.E., Prowse, D.L. & Mueller, S. (2023). *CompTIA A+ 220-1101 and 220-1102 Exam Cram.* 7th edn. Hoboken, NJ: Pearson.
- Stallings, W. (2024). *Operating Systems: Internals and Design Principles.* 10th edn. Harlow: Pearson.

Summary

In this chapter, you have explored the core hardware components of a personal computer, including form factors, power supplies, processors, chipsets, motherboards, memory, storage devices, and I/O peripherals. You have learned how to install and commission a working PC from individual components, including installing an operating system. You have studied techniques for optimising the operating system environment for performance, security, and power management. Finally, you have applied a systematic troubleshooting methodology to diagnose and resolve common PC hardware and software problems. These practical skills are the foundation of IT support and systems administration careers.

Chapter Two – Windows and Linux Operating Systems

Introduction

This chapter examines two of the most widely used operating systems in the world: Microsoft Windows and Linux. You will explore the fundamental role and functions of an operating system, learn how to establish an appropriate disc operating environment, configure both Windows and Linux to meet specific requirements, and use common utilities and programs to manage file systems, users, and groups.

Windows dominates the desktop market (with approximately 72% market share as of 2025), while Linux powers the vast majority of web servers, cloud infrastructure, supercomputers, and Android smartphones. As an IT professional, you need to be competent in both environments.

Learning Outcomes

On completing the chapter, you will be able to:

1. **Understand Windows and Linux operating systems.**

Assessment Criteria

2.1 Analyse the usage and role of an operating system.

2.2 Establish a disc operating environment that is appropriate to the required functionality.

2.3 Configure the Windows and Linux operating systems to the required standard.

2.4 Use common utilities and programs in the Windows and Linux operating systems correctly to configure file systems and to manage users and groups.

2.1 The usage and role of an operating system

An operating system (OS) is the most important piece of software on any computer. It acts as an intermediary between the hardware and the user, managing all hardware resources and providing an environment in which application software can run. Without an operating system, you would have to interact with the hardware directly using machine code – an impractical and error-prone process.

> 📝 **Over to you – Video Watch: Operating Systems**
>
> Watch this YouTube video:
>
> **Title:** Operating Systems: Crash Course Computer Science #18
>
> **Duration:** 13:35
>
> **Link:** https://www.youtube.com/watch?v=26QPDBe-NB8
>
> *After watching, list five key functions of an operating system. For each function, explain why it is important for both the user and the hardware.*

Core Functions of an Operating System

- Process management – the OS manages the execution of programs (processes), allocating CPU time, managing multitasking (running multiple programs simultaneously), and handling process priorities and scheduling.
- Memory management – the OS allocates RAM to running processes, manages virtual memory (using a page file or swap space), and ensures that one process cannot access another process's memory space (memory protection).
- File system management – the OS organises data on storage devices using file systems (e.g. NTFS for Windows, ext4 for Linux), providing a hierarchical structure of directories and files with permissions controlling access.
- Device management – the OS communicates with hardware devices through device drivers, managing input/output operations and ensuring that peripherals (printers, USB devices, network adapters) function correctly.
- User interface – the OS provides the interface through which you interact with the computer. This can be a graphical user interface (GUI) with windows, icons, menus, and pointers, or a command-line interface (CLI) where you type text commands.
- Security and access control – the OS enforces user authentication (login credentials), file permissions, and security policies. It also provides firewalls, encryption, and auditing capabilities.
- Networking – the OS manages network connections, protocols (TCP/IP), and shared resources (file and printer sharing).

Types of Operating Systems

- Desktop operating systems – designed for personal computers. Examples: Windows 11, macOS Sequoia, Ubuntu Desktop, Fedora.

- Server operating systems – optimised for running network services, databases, web servers, and enterprise applications. Examples: Windows Server 2022, Ubuntu Server, Red Hat Enterprise Linux (RHEL), CentOS Stream.
- Mobile operating systems – designed for smartphones and tablets. Examples: Android (based on the Linux kernel), iOS.
- Embedded operating systems – built into specialised devices such as routers, smart TVs, industrial controllers, and IoT devices. Examples: FreeRTOS, Embedded Linux.
- Real-time operating systems (RTOS) – designed for applications requiring guaranteed response times, such as medical devices, automotive systems, and industrial robotics.

🧭 Did you know?

Linux, created by Linus Torvalds in 1991, powers approximately 96% of the world's top 1 million web servers, all of the world's top 500 supercomputers, the majority of cloud infrastructure (AWS, Google Cloud, Azure VMs), and over 70% of all smartphones (via Android). Despite being free and open source, Linux is arguably the most commercially important operating system in the world.

Features of Operating Systems

When comparing operating systems, key features to consider include:

- Multitasking – the ability to run multiple processes simultaneously. All modern desktop OSes support pre-emptive multitasking.
- Multi-user support – the ability to manage separate user accounts with individual settings, files, and permissions.
- Hardware support – the range of hardware devices and drivers the OS supports. Windows has the widest hardware driver support; Linux relies on community and manufacturer contributions.
- Security model – how the OS handles permissions, encryption, firewalls, and malware protection.
- Software ecosystem – the range of applications available. Windows has the largest desktop software library; Linux excels in development tools and server software.
- Cost – Windows requires a licence; Linux distributions are generally free (though enterprise support may cost extra).
- Customisability – Linux is highly customisable (you can change the desktop environment, kernel parameters, and virtually anything); Windows offers less flexibility.

📝 Over to you – Comparison Task

Create a comparison table evaluating Windows 11 and Ubuntu 24.04 LTS across the following criteria: cost, user interface, hardware support, security model, software availability, customisability, and suitability for (a) a home user, (b) a software developer, and (c) a web server. Write a 300-word conclusion recommending which OS is best for each use case and justifying your choices.

2.2 Establishing a disc operating environment

Before an operating system can be installed and used effectively, you need to establish an appropriate disc (disk) operating environment. This involves understanding file systems, disk partitioning, and how the OS organises data on storage devices.

File Systems

A file system defines how data is stored, organised, and accessed on a storage device. The choice of file system affects performance, reliability, security, and compatibility:

Windows File Systems

- NTFS (New Technology File System) – the standard file system for modern Windows installations. Supports large file sizes (up to 16 TB), file and folder permissions (ACLs), encryption (EFS), disk quotas, compression, and journaling (which protects against data corruption during power failures).
- FAT32 (File Allocation Table 32) – an older, simpler file system with a maximum file size of 4 GB. Still used for USB flash drives and SD cards due to its wide cross-platform compatibility.
- exFAT (Extended FAT) – designed to replace FAT32 for removable media. Supports large files without the limitations of FAT32. Compatible with Windows, macOS, and Linux.
- ReFS (Resilient File System) – a newer Microsoft file system designed for data integrity and resilience, primarily used in Windows Server and Storage Spaces.

Linux File Systems

- ext4 (Fourth Extended File System) – the default file system for most Linux distributions. Supports volumes up to 1 exabyte and files up to 16 TB. Features include journaling, extents (for efficient large file storage), and backward compatibility with ext3 and ext2.
- XFS – a high-performance journaling file system originally developed by SGI. Commonly used for large files and high-throughput workloads. Default in RHEL/CentOS.
- Btrfs (B-tree File System) – a modern copy-on-write file system with features including snapshots, built-in RAID, and data integrity checking. Used by some Linux distributions as an alternative to ext4.
- swap – a dedicated partition or file used as virtual memory (similar to Windows' page file).

Disk Partitioning

Partitioning divides a physical disk into logically separate sections, each of which can be formatted with a different file system. Common reasons for partitioning include separating the OS from user data, creating a dedicated swap partition in Linux, dual-booting multiple operating systems, and isolating recovery environments.

Two partitioning schemes are in common use:

- MBR (Master Boot Record) – the legacy scheme, supporting up to 4 primary partitions and a maximum disk size of 2 TB. Being phased out in favour of GPT.
- GPT (GUID Partition Table) – the modern standard, supporting up to 128 partitions and disk sizes of 9.4 zettabytes (effectively unlimited for current technology). Required for UEFI boot and recommended for all new installations.

📝 Over to you – Video Watch: Files and File Systems

Watch this YouTube video:

Title: Files & File Systems: Crash Course Computer Science #20

Duration: 12:02

Link: https://www.youtube.com/watch?v=KN8YgJnShPM

After watching, explain the difference between a file and a file system. Why might you choose NTFS over FAT32 for a Windows installation?

🌍 Industry Insight – Dual-Booting and Virtualisation

Many IT professionals run both Windows and Linux on the same machine, either through dual-booting (installing both OSes on separate partitions and choosing which to boot at startup) or through virtualisation (running one OS inside a virtual machine on the other). Virtualisation tools such as Oracle VirtualBox, VMware Workstation, and Microsoft Hyper-V allow you to run multiple operating systems simultaneously without rebooting. This is particularly useful for testing, development, and learning.

Cloud platforms like AWS, Azure, and Google Cloud also rely heavily on virtualisation, running thousands of virtual machines on shared physical hardware. Understanding partitioning and file systems is essential for managing these environments.

📝 Over to you – Practical Partitioning

Using VirtualBox (free download from https://www.virtualbox.org/), create a new virtual machine and practise partitioning a virtual hard disk during the installation of Ubuntu Linux. Create at least three partitions: / (root), /home, and swap. Document the process with screenshots and explain why separating / and /home is considered good practice.

2.3 Configuring Windows and Linux operating systems

Once installed, both Windows and Linux require configuration to meet the specific needs of the user or organisation. This section covers the key configuration tasks for each operating system.

Configuring Microsoft Windows

Installation of Windows

Windows 11 installation is covered in Section 1.2. After installation, the following configuration tasks are typically performed:

- System settings – configure display resolution, power management, date/time, and regional settings via Settings > System.
- Network configuration – connect to Wi-Fi or Ethernet, configure IP settings (DHCP or static), and join a domain or workgroup if in an enterprise environment.
- Windows Update – install all pending updates to ensure the system has the latest security patches and feature improvements.
- User accounts – create user accounts with appropriate permission levels (Standard or Administrator). In enterprise environments, accounts are typically managed through Active Directory.
- Device drivers – install any missing drivers from manufacturer websites, particularly for the GPU, network adapter, and audio.
- File and printer sharing – configure shared folders and printers through Network & Sharing Center or the Settings app. Set appropriate share permissions and NTFS permissions.

Distribution, Strengths and Weaknesses of Linux

Linux is not a single operating system but a family of distributions (distros), each built on the Linux kernel but differing in their package management, desktop environment, default software, and target audience:

- Ubuntu – the most popular desktop distribution, known for its ease of use and extensive community support. Based on Debian. Uses APT package manager and the GNOME desktop environment by default.
- Fedora – a cutting-edge distribution sponsored by Red Hat, often incorporating the latest software and technologies. Uses DNF package manager.
- CentOS Stream / Rocky Linux / AlmaLinux – enterprise-grade distributions derived from Red Hat Enterprise Linux (RHEL). Widely used on servers.
- Debian – one of the oldest and most stable distributions. Known for its rigorous testing process and used as the base for Ubuntu and many other distros.
- Linux Mint – a user-friendly distribution based on Ubuntu, designed to be familiar to Windows users. Features the Cinnamon desktop environment.

- Arch Linux – a minimalist, rolling-release distribution for advanced users who want complete control over their system configuration.

Strengths of Linux

- Free and open source – no licence fees. The source code is freely available under the GNU General Public License (GPL), meaning anyone can view, modify, and distribute it.
- Highly secure – Linux's permission model, regular security updates, and smaller attack surface (compared to Windows) make it inherently more resistant to malware.
- Customisable – you can choose your desktop environment (GNOME, KDE Plasma, XFCE, etc.), modify the kernel, and configure virtually every aspect of the system.
- Excellent for servers and development – Linux dominates the server market and is the preferred platform for web development, DevOps, and cloud computing.
- Strong community support – extensive documentation, forums, and community resources are available for most distributions.

Weaknesses of Linux

- Smaller desktop software library – some popular applications (e.g. Microsoft Office, Adobe Creative Suite) are not natively available on Linux, though alternatives exist (LibreOffice, GIMP).
- Hardware compatibility challenges – while improving, some hardware (particularly newer or specialised devices) may lack Linux driver support.
- Steeper learning curve – while modern distributions like Ubuntu are user-friendly, advanced tasks often require command-line knowledge.
- Gaming – while Linux gaming has improved dramatically thanks to Valve's Proton/Steam Deck, the Windows gaming ecosystem remains larger and better supported.

📝 Over to you – Video Watch: Linux in 100 Seconds

Watch this YouTube video:

Title: Linux in 100 Seconds – Fireship

Duration: 2:54

Link: https://www.youtube.com/watch?v=rrB13utjYV4

After watching, explain in your own words what 'open source' means and why it is important. What does the GNU General Public License (GPL) guarantee?

Installing Linux

The process for installing a Linux distribution (using Ubuntu as an example) involves:

- Download the ISO image from the official website (e.g. https://ubuntu.com/download).

- Create a bootable USB drive using a tool like Rufus (Windows) or Balena Etcher (cross-platform).
- Boot from the USB and select ‘Try Ubuntu’ or ‘Install Ubuntu’.
- Follow the installation wizard: choose language, keyboard layout, installation type (alongside Windows for dual boot, or erase disk for clean install), partition the disk, set timezone, and create a user account.
- Complete the installation, remove the USB, and reboot into the new system.
- Update the system immediately: open a terminal and run sudo apt update && sudo apt upgrade.

📝 Over to you – Linux Installation

Install Ubuntu 24.04 LTS in a virtual machine using VirtualBox. After installation: (1) update the system using the terminal, (2) install a text editor (e.g. sudo apt install nano), (3) create a new user account, and (4) take a screenshot of the desktop showing the terminal with the output of the command uname -a. Document each step.

2.4 Using common utilities and programs to configure file systems and manage users and groups

As an IT professional, you need to be proficient in using the tools and utilities provided by both Windows and Linux for managing file systems, user accounts, and groups. This section covers the essential utilities and commands for each platform.

Windows Utilities

File System Management

- File Explorer – the primary GUI tool for navigating, creating, moving, copying, and deleting files and folders.
- Disk Management (diskmgmt.msc) – a GUI tool for viewing and managing disk partitions, formatting drives, changing drive letters, and extending or shrinking volumes.
- chkdsk (Check Disk) – a command-line utility that checks the integrity of the file system and can repair logical file system errors. Run from an elevated Command Prompt: chkdsk C: /f /r.
- diskpart – an advanced command-line tool for disk partitioning and management, offering more control than the GUI Disk Management tool.

User and Group Management

- Settings > Accounts – create and manage user accounts, change account types (Standard/Administrator), and configure sign-in options.
- Computer Management (compmgmt.msc) > Local Users and Groups – a more advanced tool for managing users and groups, setting password policies, and controlling group memberships (available on Pro and Enterprise editions).
- net user and net localgroup commands – command-line tools for creating users, setting passwords, and managing group membership.

File and Printer Sharing

To share a folder in Windows: right-click the folder > Properties > Sharing tab > Share. Set appropriate permissions. To share a printer: Settings > Bluetooth & devices > Printers & scanners > select the printer > Printer properties > Sharing tab. Ensure Network Discovery and File and Printer Sharing are enabled in the Network and Sharing Center.

Linux Utilities and Shell Commands

Types of Shell

The shell is the command-line interface (CLI) through which you interact with the Linux kernel. Common shells include:

- Bash (Bourne Again Shell) – the default shell on most Linux distributions. Widely used and extensively documented.
- Zsh (Z Shell) – an enhanced shell with features like auto-completion, spelling correction, and theming (default on macOS).
- Fish (Friendly Interactive Shell) – a user-friendly shell with syntax highlighting and auto-suggestions.
- sh (Bourne Shell) – the original Unix shell, still used for scripting compatibility.

Fundamental Shell Commands

The following are essential Linux commands you must know:

Navigation and File Management

- pwd – print working directory (shows your current location in the file system).
- ls – list directory contents. ls -la shows all files (including hidden) with detailed permissions.
- cd – change directory. cd /home moves to the /home directory; cd .. moves up one level.
- mkdir – create a new directory. mkdir projects creates a folder called ‘projects’.
- cp – copy files or directories. cp file.txt /home/user/backup/ copies a file to a backup location.
- mv – move or rename files. mv old.txt new.txt renames the file.
- rm – remove (delete) files. rm -r directory/ removes a directory and its contents. Use with extreme caution.
- cat, less, head, tail – view file contents. cat shows the entire file; less allows scrolling; head/tail show the first/last lines.
- chmod – change file permissions. chmod 755 script.sh gives the owner full permissions and others read/execute.
- chown – change file ownership. chown user:group file.txt.

User and Group Management

- useradd / adduser – create a new user. sudo adduser jsmith.
- passwd – set or change a user’s password. sudo passwd jsmith.
- usermod – modify user properties. sudo usermod -aG sudo jsmith adds jsmith to the sudo group.
- userdel – delete a user. sudo userdel -r jsmith removes the user and their home directory.
- groupadd / groupdel – create or delete groups.
- groups – display which groups a user belongs to.
- /etc/passwd and /etc/group – system files storing user and group information.

Package Management

- APT (Debian/Ubuntu): sudo apt update (refresh package lists), sudo apt install package_name, sudo apt remove package_name, sudo apt upgrade (upgrade all installed packages).
- DNF (Fedora/RHEL): sudo dnf install package_name, sudo dnf remove package_name.
- snap and flatpak – universal package formats that work across multiple distributions.

📝 Over to you – Video Watch: Linux Command Line Basics

Watch this YouTube video:

Title: The 50 Most Popular Linux & Terminal Commands – freeCodeCamp

Duration: 5:00:18

Link: https://www.youtube.com/watch?v=ZtqBQ68cfJc

This is a comprehensive reference. Watch the first 30 minutes covering basic navigation and file commands. Then practise these commands in a Linux terminal (either a VM or an online terminal like https://bellard.org/jslinux/). Note five commands you found most useful.

💼 Case Study – Setting Up a Shared File Server

A small design agency with 12 employees needs a shared file server running Ubuntu Server. The server should have three shared directories: /shared/design (accessible to the 'designers' group), /shared/admin (accessible to the 'admin' group), and /shared/public (accessible to all employees). The system administrator account should have access to all directories.

Task: Write the Linux commands needed to: (1) create the three directories, (2) create the 'designers' and 'admin' groups, (3) create three user accounts (one designer, one admin, one general employee), (4) assign users to the appropriate groups, and (5) set the correct directory permissions so that only the intended groups can access each directory. Test your commands in a VM and document the output.

📝 Over to you – Windows vs Linux Commands

Create a two-column comparison table showing equivalent commands in Windows (Command Prompt/PowerShell) and Linux (Bash) for the following tasks: list files, change directory, create a directory, copy a file, move a file, delete a file, view file contents, check disk space, view running processes, and shut down the system. Include at least 12 command pairs.

Reading List

- Barrett, D.J. (2024). *Efficient Linux at the Command Line.* 2nd edn. Sebastopol, CA: O'Reilly Media.
- Blum, R. & Bresnahan, C. (2023). *Linux Command Line and Shell Scripting Bible.* 5th edn. Indianapolis, IN: Wiley.
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- Stallings, W. (2024). *Operating Systems: Internals and Design Principles.* 10th edn. Harlow: Pearson.
- Tanenbaum, A.S. & Bos, H. (2023). *Modern Operating Systems.* 5th edn. Harlow: Pearson.

Summary

In this chapter, you have explored the fundamental role and functions of operating systems, including process management, memory management, file system management, device management, and security. You have compared types of operating systems and evaluated their features. You have learned how to establish a disc operating environment, understanding file systems (NTFS, ext4, FAT32, and others) and partitioning schemes (MBR and GPT). You have studied the configuration of both Windows and Linux, including installation, network settings, user management, and file sharing. Finally, you have developed practical skills using Windows utilities and Linux shell commands for managing file systems, users, and groups. These dual-platform skills are essential in virtually every modern IT role, from desktop support to cloud infrastructure management.

Glossary

Word / Term	Explanation
ATX	Advanced Technology Extended; the most common desktop motherboard form factor.
BIOS/UEFI	Firmware that initialises hardware during boot and provides a setup interface for system configuration.
Bash	Bourne Again Shell; the default command-line interpreter on most Linux distributions.
BitLocker	A Windows feature that encrypts entire disk volumes to protect data from unauthorised access.
Chipset	Electronic components on the motherboard that manage data flow between the CPU, memory, and peripherals.
CLI	Command-Line Interface; a text-based interface for interacting with the operating system by typing commands.
CPU	Central Processing Unit; the primary processor that executes instructions and performs calculations.
DDR	Double Data Rate; a type of RAM technology. Current standards are DDR4 and DDR5.
Device Driver	Software that enables the operating system to communicate with a specific hardware device.
Dual-Boot	A configuration where two operating systems are installed on the same computer, with the user choosing which to boot.
ESD	Electrostatic Discharge; a sudden flow of static electricity that can damage electronic components.
ext4	The fourth extended file system; the default file system for most Linux distributions.
FAT32	File Allocation Table 32; a simple, widely compatible file system with a 4 GB maximum file size.
Form Factor	The physical specification (size and layout) of a motherboard, case, or power supply.
GPL	GNU General Public License; a free software licence that guarantees users the freedom to run, study, modify, and share software.
GPU	Graphics Processing Unit; a specialised processor for rendering graphics and parallel computation.
GPT	GUID Partition Table; the modern disk partitioning scheme supporting large disks and many partitions.
GUI	Graphical User Interface; a visual interface with windows, icons, menus, and pointer-based interaction.
HDD	Hard Disk Drive; a storage device using spinning magnetic platters.
Kernel	The core component of an operating system that manages hardware resources and system calls.

Linux	A free, open-source operating system kernel created by Linus Torvalds, used in a wide range of distributions.
MBR	Master Boot Record; the legacy disk partitioning scheme, limited to 2 TB disk sizes.
NVMe	Non-Volatile Memory Express; a high-speed storage protocol for SSDs connected via PCIe.
NTFS	New Technology File System; the standard file system for Windows, supporting large files, permissions, and encryption.
Operating System	Software that manages hardware resources and provides a platform for applications to run.
Partition	A logically separate section of a physical disk, formatted with its own file system.
PCIe	Peripheral Component Interconnect Express; a high-speed interface for connecting expansion cards to the motherboard.
PSU	Power Supply Unit; converts mains AC power to low-voltage DC power for computer components.
RAM	Random Access Memory; volatile high-speed memory used for data and programs currently in use.
Shell	A command-line interpreter that provides a text-based interface to the operating system.
SSD	Solid State Drive; a storage device using flash memory, offering faster speeds than HDDs.
TDP	Thermal Design Power; the maximum heat generated by a CPU under load, measured in watts.
Virtualisation	Running multiple operating systems simultaneously on the same physical hardware using a hypervisor.

MCQs and True & False Questions (self-assessment)

True or False Questions

1. The ATX form factor is the most common for desktop motherboards.
2. A PSU converts DC power from the wall to AC power for the computer.
3. DDR5 RAM is backward compatible with DDR4 motherboard slots.
4. NVMe SSDs are faster than SATA SSDs.
5. The BIOS/UEFI initialises hardware before the operating system loads.
6. ESD can damage electronic components even if you cannot feel the static shock.
7. Linux is a proprietary operating system owned by Microsoft.
8. NTFS supports file permissions and encryption.
9. FAT32 can store files larger than 4 GB.
10. The Linux kernel was created by Linus Torvalds in 1991.
11. GPT supports larger disks than MBR.
12. The ‘chmod’ command is used to change file ownership in Linux.
13. Windows Defender provides built-in antivirus and firewall protection.
14. In Linux, the root user has unrestricted access to the entire system.
15. A dual-boot setup allows two operating systems on the same computer.
16. The ‘ls’ command in Linux is equivalent to ‘dir’ in Windows Command Prompt.
17. An 80 PLUS Gold PSU is more efficient than an 80 PLUS Bronze PSU.
18. ext4 is the default file system for Windows 11.
19. Virtualisation allows multiple OSes to run simultaneously on one machine.
20. The ‘sudo’ command in Linux runs a command with administrator privileges.

Multiple Choice Questions

1. Which component is considered the 'brain' of the computer?

A. RAM

B. GPU

C. CPU

D. PSU

2. What does the PSU do?

A. Processes graphics

B. Stores data permanently

C. Converts AC to DC power

D. Manages network connections

3. Which file system is the default for modern Windows installations?

A. FAT32

B. ext4

C. NTFS

D. exFAT

4. What is the maximum file size supported by FAT32?

A. 2 GB

B. 4 GB

C. 16 GB

D. Unlimited

5. Which Linux command lists directory contents?

A. pwd

B. cd

C. ls

D. mkdir

6. What does ESD stand for?

A. Electronic System Design

B. Electrostatic Discharge

C. Enhanced Storage Device

D. Extended Software Driver

7. Which partitioning scheme supports disks larger than 2 TB?

A. MBR

B. FAT32

C. GPT

D. NTFS

8. The ‘sudo’ command in Linux is used to:

A. Shut down the system

B. Run commands as root/administrator

C. Create a new file

D. List running processes

9. Which of the following is a Linux distribution?

A. macOS

B. Windows Server

C. Ubuntu

D. iOS

10. What does the chipset on a motherboard control?

A. Power conversion

B. Data flow between components

C. Display output

D. Internet connectivity

11. Which storage device has no moving parts?

A. HDD

B. Floppy disk

C. SSD

D. Optical drive

12. The UEFI replaced which older firmware system?

A. NTFS

B. BIOS

C. GPT

D. MBR

13. What is the purpose of thermal paste?

A. To glue the CPU to the socket

B. To improve heat transfer between CPU and cooler

C. To insulate the CPU from electricity

D. To clean the CPU surface

14. Which command creates a new user in Linux?

A. newuser

B. useradd

C. mkuser

D. createuser

15. What is the first step in the troubleshooting methodology?

A. Implement the solution

B. Document findings

C. Identify the problem

D. Establish a theory

16. Bash is an example of a:

A. File system

B. Desktop environment

C. Shell

D. Package manager

17. Which Windows tool is used for disk partition management?

A. Task Manager

B. Device Manager

C. Disk Management

D. Control Panel

18. The GPL licence ensures that software is:

A. Paid and proprietary

B. Free to use, modify, and distribute

C. Only available on Linux

D. Restricted to educational use

19. Which RAM configuration provides the highest bandwidth?

A. Single-channel

B. Dual-channel

C. No channel

D. Half-channel

20. What is the Linux equivalent of Windows' C:\ drive?

A. /home

B. /root

C. /

D. /mnt

Answers to True/False Questions

1. *True.* ATX is the most widely used desktop motherboard form factor.

2. *False.* The PSU converts AC mains power to DC power, not the other way around.

3. *False.* DDR5 and DDR4 use different physical slots and are not interchangeable.

4. *True.* NVMe SSDs use the PCIe interface, offering significantly higher speeds than SATA SSDs.

5. *True.* BIOS/UEFI firmware runs before the OS loads, initialising and testing hardware.

6. *True.* ESD below the human perception threshold (3,000V) can still damage components.

7. *False.* Linux is a free, open-source operating system kernel, not owned by Microsoft.

8. *True.* NTFS supports ACL-based file permissions and EFS encryption.

9. *False.* FAT32 has a maximum file size of 4 GB.

10. *True.* Linus Torvalds created the Linux kernel in 1991 while a student at the University of Helsinki.

11. *True.* GPT supports disks much larger than MBR's 2 TB limit.

12. *False.* chmod changes file permissions; chown changes file ownership.

13. *True.* Windows Security includes Defender Antivirus and Windows Firewall.

14. *True.* The root user (UID 0) has unrestricted access to all system commands and files.

15. *True.* Dual-booting installs two OSes on separate partitions of the same machine.

16. *True.* Both commands list the contents of the current directory.

17. *True.* 80 PLUS Gold wastes less energy as heat than 80 PLUS Bronze.

18. *False.* ext4 is the default file system for Linux; NTFS is the default for Windows.

19. *True.* Virtualisation uses hypervisors to run multiple OSes on shared hardware.

20. *True.* sudo (superuser do) temporarily elevates a command to root/administrator privileges.

Answers to Multiple Choice Questions

1. (C) CPU
2. (C) Converts AC to DC power
3. (C) NTFS
4. (B) 4 GB
5. (C) ls
6. (B) Electrostatic Discharge
7. (C) GPT

8. (B) Run commands as root/administrator
9. (C) Ubuntu
10. (B) Data flow between components
11. (C) SSD
12. (B) BIOS
13. (B) To improve heat transfer between CPU and cooler
14. (B) useradd
15. (C) Identify the problem
16. (C) Shell
17. (C) Disk Management
18. (B) Free to use, modify, and distribute
19. (B) Dual-channel
20. (C) /