



# Business & Bytes: Your Essential Computer Guide



# Business & Bytes: Your Essential Computer Guide

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Welcome to *Business & Bytes: Your Essential Computer Guide*.

Think for a moment about the world around you. From the way you pay for your morning *kopi* with a QR code, to how you shop for new clothes on Lazada, to the way businesses manage their sales and communicate with customers, technology is everywhere. In today's business landscape, understanding how to use computers and their applications is no longer an optional skill for IT specialists; it is a fundamental requirement for everyone.

It is understandable that computer technology can sometimes seem complex or intimidating. This textbook was written to change that. It is designed specifically for you, a Malaysian undergraduate student, to serve as a clear and friendly starting point for mastering the technology that powers the modern business world.

The approach in this book is simple. It avoids confusing jargon and explains concepts using direct English and familiar, day-to-day examples from our lives in Malaysia. The goal is not to turn you into a programmer or an IT expert, but to build your confidence and give you a strong, practical understanding of the tools you will be using throughout your future career.

This guide will take you on a logical journey. We will begin by exploring the essential role computers play in businesses of all sizes. From there, you will learn the fundamental concepts of how a computer works, looking at the physical hardware you can touch and the powerful software that brings it to life. We will cover everything from navigating the internet and keeping your data safe, to understanding the ethical responsibilities of using technology, and finally, we will look ahead to the emerging technologies that will shape the future of business.

Each chapter is structured to help you learn effectively, with clear learning objectives, practical examples, engaging activities, and review questions to test your knowledge. By the end of this book, you will be prepared to use technology effectively, efficiently, and responsibly in your future business career.

Let's begin.

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# Chapter 1: Computers in Our Daily Business Life

## Learning Objectives

Welcome to the first step of your journey! This chapter introduces the essential role of computers in the business world. After studying this chapter, you will be able to:

- Explain the four key reasons why computers are essential for modern business: speed, accuracy, reach, and decision-making.
- Identify the five main categories of computer users: Home, SOHO, Mobile, Power, and Enterprise.
- Provide examples of how different types of users interact with technology in various business and personal settings.

## Introduction

Think about your day so far. Did you use an app to wake up? Did you check your messages on WhatsApp or Telegram? Maybe you paid for your nasi lemak this morning by scanning a DuitNow QR code.

Or perhaps you browsed Shopee or Lazada to look for a new pair of shoes.

All these activities, communicating, shopping, and banking, are possible because of computers. Computers are not just the desktops or laptops we see in an office. They are in our phones, in the ATMs we use, and in the cash registers at the supermarket.

In the business world, computers are everywhere. From a small local *kedai runcit* (sundry shop) that uses a simple system to track its sales, to a large company like Petronas that uses powerful computers to find oil, technology is essential. Understanding how computers work is no longer just for IT experts; it is a basic skill for everyone in business today. This chapter will be our starting point to understand these amazing tools.



Figure 1.1: Computers in Daily Life. From corporate offices and schools to small businesses and mobile payments, technology is an essential part of modern Malaysian society. (Image generated with AI assistance using Gemini Pro 2.5.)

## Why Computers are Essential for Business

In today's world, it is almost impossible for a business to survive, let alone succeed, without using computers. They are no longer just a helpful tool; they are a fundamental part of a company's operations. Let's explore in more detail the four main reasons why computers are so essential.

# Speed

The most obvious advantage of a computer is its incredible **speed**. A modern computer can process millions of instructions every second, a task that would be impossible for a human. For a business, this speed translates directly into efficiency and better customer service.

**Scenario:** Think about a busy GrabFood rider. When an order comes in, the app on their phone instantly calculates the fastest route, processes the customer's payment, and updates the restaurant, all in a matter of seconds. If this process were manual, it would be too slow to work, and the entire food delivery industry would not be possible. In an office, tasks that used to take hours, like sending a physical letter, can now be done in seconds with an email.

# Accuracy

Humans make mistakes, especially when they are tired or have to repeat the same task many times. Computers, on the other hand, do not. When given the correct instructions, a computer will perform calculations with 100% **accuracy**, every single time. This is critical in business, where small errors can lead to big problems.

**Scenario:** When you transfer money using an online banking app like Maybank2u, the system calculates your new balance perfectly every time. Imagine if a bank employee had to do this by hand for thousands of customers a day; mistakes would be unavoidable. This guaranteed accuracy is what gives us the confidence to trust digital banking and what allows businesses to manage complex finances without costly errors.

## Reach

Before the internet, a business's customers were usually limited to the people who lived in the local area. Computers and the internet have completely changed this.

**Scenario:** Consider a small business in Labuan that makes beautiful handmade pearl jewelry. In the past, they could only sell to tourists or local residents. Today, by setting up a simple online store on Instagram or a platform like Shopee, they have a global **reach**. They can use their computer to market their products, communicate with customers, and ship their jewelry to someone in Kuala Lumpur, Singapore, or even London. The computer has turned their small local shop into a potential international business.

## Decision-Making

Successful businesses make smart **decision-makings** based on good information. Computers are incredibly powerful tools for helping managers make these decisions.

**Scenario:** Let's go back to the coffee shop owner. At the end of the month, the owner can use their point-of-sale (POS) system to analyze all the sales data. The computer can quickly create a simple chart that shows that *Iced Lattes* are the best-selling drink, but that sales of *cakes* are very low on Mondays. This is valuable information. Based on this, the owner can make smart decisions, like creating a "Monday Cake Combo" promotion to increase sales on that slow day, or ordering more milk because they know *Iced Lattes* are so popular.

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Categories of Computer Users

Not everyone uses a computer in the same way or for the same reasons. The type of computer and software a person needs depends heavily on the tasks they perform. We can group computer users into five general categories, each with different needs and goals.

## Home User

A **home user** is anyone who uses a computer for personal activities at home. This is perhaps the most common category. Their computer is a central tool for managing their personal life, for entertainment (watching movies, playing games), and for learning (helping children with homework).

A home user might pay their electricity or water bills online through a banking website, help their children with school homework using online resources, or use social media like Facebook to connect with friends and family. They also use their computers for entertainment, such as watching movies on Netflix, listening to music on Spotify, or playing games. They usually have a standard desktop computer, an all-in-one PC, or a laptop that is powerful enough for everyday tasks but not necessarily for highly demanding professional work.



Figure 1.2: The Home User. A family uses a laptop for educational purposes, a common activity for home users who utilize computers for learning, entertainment, and managing personal life. (Image generated with AI assistance using Gemini Pro 2.5.)

## Small Office/Home Office (SOHO) User

This category includes individuals who run a business from their home or a very small office. A **SOHO user** can be a small business owner, a freelancer (like a writer, graphic designer, or social media manager), or an employee who works remotely. Their computer is their primary tool for earning an income.

SOHO users perform a wide range of basic business tasks. They

use software like Microsoft 365 (Word, Excel) to write invoices and track finances, and email to communicate with clients. They might also use social media for marketing their business or a simple cloud-based accounting software to manage their accounts. For example, a person in Labuan who runs a small online business selling local snacks from home is a perfect example of a SOHO user. They use their laptop to manage their Shopee store, reply to customer messages on WhatsApp, design promotional images using a tool like Canva, and keep a record of their sales in a spreadsheet.



*Figure 1.3: A SOHO User at Work. This picture shows a typical SOHO user, who uses technology to run a small business or work for a company from their home. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Mobile User

A **mobile user** is a professional who needs to work while on the move, away from a main office. They rely on portable devices like smartphones, tablets, and lightweight laptops to stay connected and productive from any location. Constant access to the internet via 4G/5G or public Wi-Fi is essential for them.

A mobile user needs to check emails, join online meetings on platforms like Zoom or Google Meet, and access company information stored in the cloud (e.g., Google Drive or Microsoft OneDrive). For example, a sales agent visiting different clients is a mobile user. They use a tablet to show product presentations and take new orders directly from the client's office. As a university student who brings a laptop to class to take notes and access the e-learning portal, you are also a mobile user.



*Figure 1.4: The Mobile User. This picture shows a mobile user, who relies on portable devices like tablets to work effectively and collaborate with colleagues outside of a traditional office setting. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Power User

A **power user** requires a high-performance computer for very demanding and specialized tasks. Standard computers are often not fast or powerful enough for their work, which usually involves processing huge amounts of data or creating complex graphics.

Their work often involves 3D modelling, video editing, or complex scientific calculations. They need top-of-the-line hardware, such as

the fastest CPUs, a large amount of RAM (often 32GB or more), and powerful, dedicated graphics cards. For example, an engineer using AutoCAD software to design a detailed 3D model of a bridge is a power user. Their computer must be powerful enough to render the complex graphics without slowing down. A video editor working on a 4K movie or a data scientist training an Artificial Intelligence (AI) model are also power users.



*Figure 1.5: The Power User. This engineer requires a high-performance computer with multiple monitors to run specialized and demanding software for tasks like designing complex structures. (Image generated with AI assistance using Gemini Pro 2.5.)*

# Enterprise User

An **enterprise user** is an employee who works for a large organisation, which is often called an enterprise. This can be a large company like a bank or Petronas, a university, or a government department.

An enterprise user performs their job on a computer that is connected to the company's large and complex network. They often use specialized, custom-built software that is not available to the public. For example, a bank employee will use a special banking system to manage customer accounts, and a university staff member will use a student information system to manage student records. The main difference is that an enterprise user works as part of a very large system with hundreds or even thousands of other users. Their computer is managed by the company's IT department, and there are usually strict security rules about what software they can install and what websites they can visit.



Figure 1.6: The Enterprise User. An employee in a large organization, such as a bank or corporation, works on a computer connected to the company's private network. (Image generated with AI assistance using Gemini Pro 2.5.)

## Check Your Understanding: Q3



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## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Chapter Summary

In this chapter, we explored why computers are an essential part of our daily business lives. We learned that businesses depend on computers for their speed, accuracy, global reach, and ability to help with decision-making. We also identified the five main categories of computer users, from the home user managing their personal life to the enterprise user working within a large corporate network. Understanding this context is the first step to learning how we can apply computer skills in a business environment.

## Review Questions

1. List the four main reasons why computers are essential for business, as discussed in the chapter.
2. Provide a real-world example of how a business uses computers for “Decision-Making.”
3. In your own words, what is the main difference between a Mobile User and a Power User?
4. Explain how a computer helps a small business in a place like Labuan achieve a global “Reach.”
5. Think of a large company in Malaysia (like Petronas or Maybank). Which category of computer user would its employees fall into, and why?

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# Chapter 2: Core Concepts of Computing

## Learning Objectives

Welcome to Chapter 2! In this chapter, we will learn the core concepts of computing. Understanding these concepts is the key to feeling more confident with technology. After studying this chapter, you will be able to:

- Define the term computer
- Explain the difference between data and information.
- Explain the four parts of the computing cycle: Input, Process, Output, and Storage.
- Tell the difference between hardware and software.
- Define common computer terms like file, folder, and network.
- Understand how computers measure data using bits and bytes.

# Introduction

Every special subject has its own words. Doctors, lawyers, and chefs all have a special vocabulary for their work. The world of technology is no different. Learning these common computer words is like learning a new language. It helps us all communicate clearly and understand technology better. This chapter will explain the most important concepts and terms in a simple way, so we can all speak the same tech language.

## What is a Computer?

Fundamentally, a **computer** can be defined as an electronic device that operates under the control of **instructions** to process raw items and produce a useful result. To make this formal definition clear, let's use a modern, everyday analogy that is very familiar: ordering an item from an online store like Shopee or Lazada.

## Instructions

To perform any task, a computer needs a set of specific rules to follow. In computing, these rules are called instructions. The Shopee app, for example, is a **program** containing thousands of instructions that tell your phone exactly what to do at every step, such as how to display products, what to do when you click “Add to Cart,” and how to calculate the final price. A computer cannot think for itself; it is entirely dependent on these instructions.

## Data

The raw details you provide to the computer are called **data**. When you use the Shopee app, the data you provide includes the product you select, the size and color you choose, and your shipping address. By themselves, these are just separate pieces of **information**. In the same way, computer data can be text, numbers, or images that are not yet organized into something meaningful.

## Process

The action of the computer taking the raw data and following the instructions to work on it is called the process. When you click “Place Order,” the app begins processing. It takes the data you entered, communicates with Shopee’s servers to confirm the item is in stock, calculates the total cost including shipping, and prepares your order for the seller. This is the “work” being done behind the scenes.

## Information

The final, organized result that the computer shows you is the information. The raw data has been transformed through the process into something that is now meaningful and useful to you. After the app has processed your order, it presents you with information: an order confirmation number, a summary of the items you purchased, the total price, and an estimated delivery date. This is a complete, organized answer to your action.

## Store

Finally, after your order is complete, the details are saved in your account's "Order History." This is **storage**. The app saves the information about your purchase so that you can look at it again later, for example, to track your package or to request a return. A computer's ability to save information for future use is one of its most important functions.

## The Basic Cycle of Computing: IPOS

Every computer, from the most powerful server to the smartphone in your pocket, performs four fundamental operations to get any task done. We call this the **IPOS cycle**, which stands for **Input**, **Process**, **Output**, and **Storage**.

- **Input:** You provide data and instructions to the computer using an input device like a keyboard or mouse.
- **Process:** The computer's brain, the CPU, works on the data according to the instructions.
- **Output:** The computer shows you the result (the information) on an output device like a screen.
- **Storage:** The computer saves the data or information for future use.

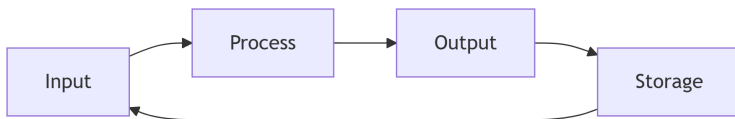


Figure 2.1: The Basic Cycle of Computing (IPOS). This shows how a computer takes in data (Input), works on it (Process), and produces a result (Output), which can then be saved (Storage). Stored information can also be used as new input for another task. (Image generated with AI assistance using Deepseek-V2.)

# A Day-to-Day Example: Withdrawing Money from an ATM

The common task of withdrawing money from an Automated Teller Machine (ATM) serves as a practical illustration of the complete IPOS cycle. Although the transaction feels instantaneous to the **user**, the computer inside the ATM, in coordination with the bank's central system, executes these four distinct steps in a precise order.

## i. Input

This is the stage where you provide all the necessary data and instructions for the task. When you use an ATM, you are giving the computer multiple pieces of input.

- **First Input (Data):** You insert your bank card. The chip on your card contains data, specifically your account number, which the machine reads.
- **Second Input (Data and Instruction):** The screen asks for your PIN. When you type your secret number, you are providing more data. You are also giving the instruction to verify your identity.
- **Third Input (Instruction):** You select “Withdraw” from the menu on the screen. This is a clear instruction telling the computer what main task you want to perform.
- **Fourth Input (Data):** You enter the amount you wish to withdraw, for example, RM100. This is the final piece of data the computer needs.

At this point, you have given the computer all the raw materials it needs to begin its work.

## 2. Process

This is the “thinking” stage where the work happens behind the scenes. The ATM itself is a computer, but it needs to communicate with the bank’s main computer, which is a powerful server.

- The ATM takes all the input you provided (your account number, PIN, and the RM100 request) and sends it securely over a **network** to the bank’s central server.
- The server then processes this request. It follows a set of instructions to perform several checks. First, it verifies that the PIN you entered is the correct one for your account. Next, it checks your account balance to make sure you have enough money for the withdrawal.
- Once everything is confirmed, the server approves the transaction and sends an instruction back to the ATM, telling it that it is okay to give you the money. This complex verification and approval is the process.

## 3. Output

After the process is complete, the computer presents the results to you. This is the output, and it can happen in several forms at once.

- **Physical Output:** The ATM’s cash dispenser, which is a piece of **hardware**, receives the instruction from the process and gives you RM100 in cash.
- **Printed Output:** The machine’s printer produces a receipt. This receipt contains meaningful **information**, such as the amount you withdrew, the date and time, and your new account balance.
- **Digital Output:** The screen displays a message, such as “Transaction complete,” and may show your new balance. This

is also information presented to you.

## 4. Storage

While the transaction at the ATM is now finished for you, the final and most important step for the bank is storage. This step ensures a permanent record of the event is created.

- The bank's central server updates its main database. It permanently records that your account balance has been reduced by RM100. This is not a temporary change; it is the final, official record of the transaction. This ensures that if you check your balance from another ATM or on your phone's banking app, it will show the correct, updated amount. This permanent recording of the result is the storage step.



Figure 2.2: The IPOS Cycle in Action. Withdrawing money from an ATM is a perfect real-world example of the complete Input, Process, Output, and Storage cycle that every computer performs. (Image generated with AI assistance using Gemini Pro 2.5.)

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Hardware and Software: The Body and the Brain

Every complete computer system is made of two essential parts that work together: hardware and **software**.

- **Hardware:** These are the physical, touchable parts of a computer system. It is the body of the machine. Examples include the screen (monitor), keyboard, mouse, and the phone itself.
- **Software (or a Program):** This is a set of instructions that tells

the hardware what to do. You cannot touch software. It is the mind of the machine. Examples include Microsoft Windows, Google Chrome, and the TikTok app.

It is critical to understand this point: **Hardware cannot work without software, and software is useless without hardware.** They absolutely need each other to perform any useful job.



*Figure 2.3: Examples of Computer Hardware. Hardware provides the physical 'body' of a computer system. This collection includes a desktop computer, a printer, a laptop, and a smartphone, all of which are tangible components you can see and touch. (Image generated with AI assistance using Gemini Pro 2.5.)*



Figure 2.4: Using Software for Business Tasks. Application software, like the spreadsheet program shown here, is a vital tool for completing common business activities such as creating budgets and analyzing sales figures. (Image generated with AI assistance using Gemini Pro 2.5.)

## Essential Computing Terminology

Here are some basic terms you will see and hear all the time when working with computers.

- **File:** A **file** is a named collection of stored data. Think of it as a single digital item. A report you write, a picture you save, or a song you download are all files. Each file has a name, like

MyAssignment.docx or HolidayPhoto.jpg.

- **Folder:** A **folder** is a digital container used to organise files. Just like you put paper documents into a physical folder in a cabinet, you put digital files into folders on a computer to keep your work tidy. For example, you can create a folder called “University Notes” to keep all your subject files organised.
- **Program and Application (App):** A program, or an **application (app)**, is a set of instructions that tells a computer how to perform a specific task. We use these tools to get our work done. The words are often used to mean the same thing, but “app” has become more common for software on smartphones and modern computers. For example, Microsoft Word is a program you use to write and edit documents, and WhatsApp is an app you use to send messages.
- **Network:** A network is a collection of computers and devices connected together. This connection allows them to share resources like an internet connection, files, or printers. For example, the Wi-Fi at your university connects all the students’ laptops and phones to the internet. This is a network. When you send a file to a classroom printer, you are using the network.
- **User:** A user is anyone who interacts with a computer or mobile device. If you are reading this on a screen, you are a user!

## Bits and Bytes: How Computers Measure Digital ‘Stuff’

Have you ever wondered what MB or GB means when you look at your phone’s storage? These are units used to measure the size of digital data. It all starts with a “**bit**”.

- **Bit:** The smallest unit of data in a computer is called a bit. A bit is like a tiny light switch that can only be in one of two states: ON (represented by a 1) or OFF (represented by a 0).

- **Byte:** A group of 8 bits is called a **byte**. A single byte can represent one character, like the letter A or the number 5.

Because a single byte is very small, we use larger units to measure the size of our files and storage space.

Unit	Abbreviation	Approximate Size	Example of
<b>Kilobyte</b>	KB	1,000 bytes	A very short email of text.
<b>Megabyte</b>	MB	1 million bytes	A high quality photo in format.
<b>Gigabyte</b>	GB	1 billion bytes	A full high definition storage of a typical
<b>Terabyte</b>	TB	1 trillion bytes	The storage of a hard drive, holding thousands of

## Check Your Understanding: Q6



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## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## Chapter Summary

In this chapter, we learned the fundamental language of technology. We defined what a computer is and explored the important difference between raw data and meaningful information. We detailed the four steps of the computing cycle: Input, Process, Output, and Storage (IPOS). We also distinguished between the physical hardware and the instructional software. Finally, we defined key terms like file, folder, and network, and learned how computers measure data size using bits and bytes.

## Review Questions

1. What is the difference between data and information?
2. List the four steps of the IPOS cycle in the correct order.
3. Give one example of hardware and one example of software on your smartphone.
4. In your own words, what is the relationship between hardware and software?
5. Which is larger: a Megabyte (MB) or a Gigabyte (GB)?
6. Is your music playlist on Spotify an example of data or information? Explain your answer.
7. What is the smallest unit of data in a computer called?
8. How many bits are in one byte?
9. Using the ATM withdrawal as an example, what is the “Process” step?
10. What is a computer network? Give a real-world example mentioned in the chapter.

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# Chapter 3: How Computers Do Their Job

## Learning Objectives

Welcome to Chapter 3! In this chapter, we will look inside the computer to understand how it works its magic. After studying this chapter, you will be able to:

- Identify the Central Processing Unit (CPU) as the computer's brain.
- Explain the role of Random Access Memory (RAM) as the computer's temporary workspace.
- Describe the basic process of how a computer loads and executes instructions.
- Understand the importance of the User Interface (UI) for interacting with a computer.
- Recognise the role of software developers and programming languages.

# Introduction

Have you ever tapped on an app icon on your phone and wondered what happens next? How does a simple touch on a piece of glass make a program start? It seems like magic, but it is actually a very fast and organised process happening inside the device.

In this chapter, we will open the “box” and take a simple look at the computer’s most important internal parts. Understanding how these parts work together will help you understand why some computers are faster than others and how your commands are turned into results on the screen.

## The Computer’s Brain: The Central Processing Unit (CPU)

The most important component inside a computer is the **Central Processing Unit, or CPU**. You can think of the CPU as the brain of the computer. Just like your brain does all the thinking and makes all the decisions, the CPU’s job is to carry out the commands and run the programs.

Every time you do something on your computer, from moving the mouse to typing a word, the CPU is processing those instructions. The speed of the CPU is a major factor in how fast your computer feels. A faster CPU can perform more instructions per second, which means your programs will run more smoothly and quickly.

For example, imagine a busy cashier at a supermarket during a holiday sale. A fast, modern CPU in the cash register can calculate prices, apply discounts, and process credit card payments very quickly, keeping the customer line moving. An old, slow CPU would cause delays, leading to frustrated customers. This is why businesses invest in computers with powerful CPUs to improve their efficiency.

The speed of a CPU is measured in **Gigahertz (GHz)**. A CPU with a higher GHz number can perform more calculations per second, making it faster. You might also see terms like **dual-core** or **quad-core** CPU. A “core” is like an individual processing unit within the main CPU. A quad-core CPU has four cores, allowing it to work on multiple tasks at the same time, much like a supermarket opening up four checkout counters instead of just one to serve more customers at once.

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## The Computer's Workspace: Memory (RAM)

If the CPU is the brain, then **Random Access Memory, or RAM**, is the computer's desk or temporary workspace. RAM is a form of computer memory that temporarily holds the data and instructions that the CPU is actively working on.

Think about it this way: when you want to work on a project, you take your books and papers out of your bag (which is like long term storage) and put them on your desk (which is like RAM). Your desk is where the active work happens. A bigger desk allows you to have more books and papers open at the same time, so you can switch between them easily.

Similarly, the more RAM a computer has, the more programs and files it can have open and ready to use at once without slowing down. When you close a program, it gets cleared from the RAM, just like clearing your books off the desk when you are finished.

If you try to have too many programs open and your computer runs out of RAM, it will slow down significantly. This is like having a desk so cluttered with books that to open a new one, you first have to pack another one away into your bag. The constant swapping slows down your work.

Important: RAM is volatile, which means it is temporary. Its

contents are erased when the computer is turned off. This is different from a hard drive or SSD (which we will learn about in Chapter 4), where your files are stored permanently.

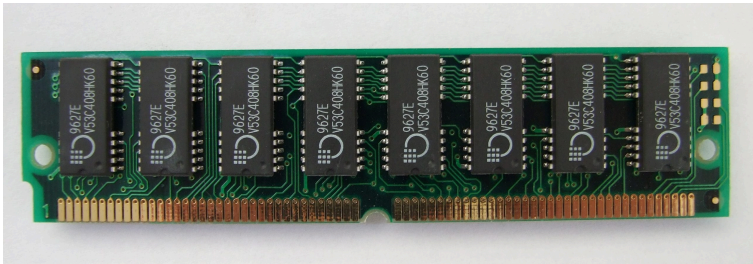


Figure 3.1: Random Access Memory (RAM). A close-up view of a RAM stick. This component acts as the computer’s high-speed temporary workspace, holding data and programs the CPU is actively using. Image Credit: “PS2 RAM Module” by Joey H. is licensed under CC BY-NC 2.0, via Wikimedia Commons.

## The Computer’s Filing Cabinet: Permanent Storage

While RAM is the temporary workspace, the computer also needs a place to keep your files and programs permanently. This is the role of permanent storage, which acts like the computer’s filing cabinet or bookshelf. The two most common types of storage today are the Hard Disk Drive (HDD) and the Solid-State Drive (SSD).



*Figure 3.2: Hard Disk Drive (HDD). A Hard Disk Drive (HDD) is a primary example of a computer's permanent storage. It holds the operating system, all your installed programs, and personal files such as documents and photos. Unlike RAM, an HDD is non-volatile, meaning it retains all this information even when the computer is turned off. Image Credit: "Desktop Hard Drive" by George D. Darrin is licensed under CC BY-SA 4.0, via Wikimedia Commons.*

Unlike RAM, storage is non-volatile. This means it keeps all your information such as your documents, photos, and installed programs like Microsoft Word, even when the computer is turned off. When you want to use a program, the computer finds it in the filing cabinet (storage) and puts a copy of it on the desk (RAM) for the CPU to work on.



Figure 3.3: Solid-State Drive (SSD). A Solid-State Drive (SSD) is a modern type of permanent storage. Unlike a traditional hard drive, an SSD has no moving parts, which allows it to access and transfer data much faster. This speed significantly improves a computer's overall performance, from starting up the operating system to launching applications. Just like an HDD, an SSD is non-volatile, meaning it stores your files and programs permanently even when the power is off. Image Credit: "Samsung 840 EVO SSD" by Tostatronic is licensed under CC BY-SA 3.0, via Wikimedia Commons.

## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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## How It All Works: Loading and Executing a Program

So, how do the CPU (the brain) and RAM (the workspace) work together? Let's look at the simple steps that happen when you click on an app icon, like Microsoft Word.

1. Your Command (Input): You use your mouse or finger to click on the Microsoft Word icon. This sends an instruction to the computer.

2. Finding the Program: The computer finds the Microsoft Word program file, which is kept in its permanent storage (like a hard drive).
3. Loading into RAM: The computer copies the necessary parts of the Word program from storage into the RAM. This is like putting your textbook on your desk to get ready to study.
4. Executing by the CPU: The CPU now takes the instructions for the Word program from the RAM, one by one, and **executes** them. It processes the code that tells the computer to display the Word window, the blank page, and the menu buttons.
5. Ready for You (Output): You see the Microsoft Word program open on your screen, ready for you to start typing. As you type, your document is also held in RAM while you work on it.

This entire process happens in a fraction of a second!

## Talking to the Computer: The User Interface (UI)

All this work by the CPU and RAM happens inside the box where you cannot see it. So how do we, the users, give commands and see the results? We do this through the **User Interface**, or UI.

The User Interface is what you see on the screen that allows you to interact with the computer. It is the bridge between you and the internal hardware. Most modern computers use a Graphical User Interface (GUI), which includes:

- Icons and Tiles: These are small pictures that represent programs, files, or actions. You click on the WhatsApp icon to open the app. You click on the trash bin icon to delete a file.
- Windows: The rectangular areas on the screen where programs are displayed.
- Menus: Lists of commands you can choose from, like “File,” “Edit,” and “View.”

A good UI is easy to understand and use. For businesses, having software with a simple and clear UI is very important. It means employees can learn to use the software quickly without needing a lot of training, which saves time and money.



*Figure 3.4: A Mobile User Interface. The screen of a smartphone provides a clear example of a modern Graphical User Interface (GUI). The grid of small pictures, or icons, allows the user to launch applications with a simple touch. (Image generated with AI assistance using Gemini Pro 2.5.)*

# The People Behind the Programs: Developers and Languages

Where do all the complex instructions that the CPU follows actually come from? They do not appear out of thin air. They are carefully crafted by highly skilled people called **software developers**, who are also known as **programmers**.

## Who Creates Software?

A **software developer** is a professional who designs, writes, and tests computer programs. Think of them as the architects and builders of the digital world. Every application you use, from the operating system on your computer to the Grab app on your phone, was created by a team of developers. Their job is to solve problems by creating software solutions.

## The Tools of the Trade: Programming Languages

To build software, developers need special tools. Their main tool is a **programming language**. A programming language is a set of words, symbols, and strict grammatical rules used to write instructions that a computer can understand.

You can think of a programming language like a very detailed recipe. If you write a recipe for a friend, you can be a little informal. But when you write instructions for a computer, you must be perfectly precise. The computer will only do exactly what you tell it to do. The instructions written in a programming language are called **code**.

## Why Are There So Many Languages?

You may have heard of popular programming languages like **Python**, **Java**, or **C++**. There are hundreds of different languages because different tasks require different tools.

- **Python** is very popular today, especially for working with data, artificial intelligence (AI), and for building web applications.
- **JavaScript** is the main language used to make websites interactive.
- **Swift** (for Apple) and **Kotlin** (for Android) are languages used specifically to build the mobile apps on your phone.

A company like Grab, for example, has large teams of developers who use different languages. They use some languages to build the mobile app you use on your phone, other languages to manage the powerful servers that find you a driver, and still others to analyze business data.

## The Process of Creating Software

Creating a high quality application is a complex process that involves more than just writing code. It usually follows a series of steps:

1. **Planning:** The developers work with the business to understand the problem they need to solve. What should the app do? Who will use it?
2. **Designing:** They create a blueprint for the application, deciding how it will look, how the user interface will work, and how the different parts will connect.
3. **Writing the Code:** This is the programming stage, where developers write the instructions in a programming language.

4. **Testing:** The program is tested thoroughly to find and fix any errors or “bugs.”
5. **Deployment and Maintenance:** The finished program is released to users. The developers then continue to update and improve it over time.

## A Simple Code Example in Python

To help you understand what “writing the code” looks like, here is a very simple program written in Python. This program asks for a user’s name and then prints a personalized welcome message.

### The Code:

```
# 1. Ask the user for their name and store it.
user_name = input("Please enter your name: ")
# 2. Create a welcome message.
welcome_message = "Welcome to the world of business
computing, " + user_name + "!"
# 3. Print the final message to the screen.
print(welcome_message)
```

### Explanation:

- **Line 1:** The `#` symbol means this line is a comment, just a note for humans to read. The `input()` function displays the message “Please enter your name: ” on the screen and waits for the user to type something. Whatever the user types is stored in a variable called `user_name`.
- **Line 2:** This line creates the welcome message. It combines a standard greeting with the name that the user provided.
- **Line 3:** The `print()` function takes the message we created and displays it on the screen.

**How to Practice:** You can try this code yourself without installing any software!

1. Go to an online Python compiler like the one at [Programiz](#).
2. Copy the code above and paste it into the code editor on the website.
3. Click the “Run” button.
4. The program will ask for your name. Type it in and press Enter to see the result!

As a business student, you do not need to learn how to write code. But it is very useful to understand that all the software and apps we enjoy every day are the result of this careful and creative process.

## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Chapter Summary

In this chapter, we looked inside the computer to understand its core operations. We learned that the CPU acts as the computer's brain, processing all the commands. RAM serves as the temporary workspace for the CPU, holding active programs and data. When you start a program, it is loaded from storage into RAM, and then the CPU executes its instructions. We interact with this process through the User Interface (UI), which includes the icons and windows we see on the screen. Finally, we learned that all software is created by software developers using programming languages.

## Review Questions

1. In your own words, explain the difference between the CPU and RAM using the brain and desk analogy.
2. Why does a computer with more RAM often perform better when you have many applications open?
3. What does it mean when we say that RAM is “volatile”? Where are your files saved permanently?

4. What is a User Interface (UI)? Name two elements of the UI on your smartphone.
5. Briefly describe what a software developer does.

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# Chapter 4: Computer Hardware

## Learning Objectives

Welcome to Chapter 4! We will now explore the physical components of a computer system. After studying this chapter, you will be able to:

- Identify the common types of computers, from laptops and desktops to servers and embedded devices, and describe their typical users.
- Distinguish between input and output devices and provide examples of each.
- Explain the critical difference between temporary memory (RAM) and permanent storage using the “desk and filing cabinet” analogy.
- Compare the features and uses of various storage devices, including Hard Disk Drives (HDDs), Solid-State Drives (SSDs), and Cloud Storage.
- Identify common physical ports and wireless technologies used to connect computer peripherals.

# Introduction

In the last chapter, we looked at the invisible processes that happen inside a computer. Now, we will focus on the parts you can actually see and touch. This is the **hardware**. Hardware includes everything from the large screen on your desk to the tiny parts inside your phone. Understanding what each piece does is important for choosing the right computer for your needs and for getting your work done efficiently.

## Types of Computers and Mobile Devices

Computers are not a “one size fits all” tool. They come in many different shapes and sizes, each designed for specific purposes and users. From the powerful machines that run large corporations to the tiny computers inside our home appliances, let's explore the most common types and who uses them.

### Laptops

A **laptop** is a portable, all-in-one computer that combines the screen, keyboard, touchpad, and internal computer parts into a single, hinged unit. They are designed for mobility, allowing you to work from almost anywhere. A typical laptop has a screen size between 13 and 15 inches.

- **Ultrabook/Ultrathin Laptops:** These are a very popular type of laptop known for being extremely lightweight and thin, often weighing less than 1.5 kg.
- **Who uses them?** Laptops are the primary tool for **Mobile Users**, such as sales agents or students who need to work from

different locations. They are also very popular with **Home Users** for personal tasks and entertainment.

- **Advantages:** The primary advantages of a laptop are its portability, all-in-one design, and power efficiency. Its main benefit is portability, which allows you to work from almost anywhere. The all-in-one design is also a key feature, as the screen, keyboard, and touchpad are all built into a single unit. Furthermore, laptops are very power-efficient, consuming less electricity than desktop computers because they are designed to run on a battery.
- **Disadvantages:** Laptops also have several disadvantages, which are often related to their compact design. Compared to a desktop with similar power, they are typically more expensive and can be difficult or impossible to upgrade. The fixed position of the screen and keyboard can lead to poor ergonomics and physical strain during long periods of use. Additionally, because their internal parts are so tightly integrated, repairs can be difficult and costly. Finally, laptops may have performance limitations, as their small size makes it challenging to cool powerful components.
- **Pricing:** Prices in Malaysia can range from around RM1,500 for a basic model to over RM8,000 for a high-performance machine.



Figure 4.1: An IBM Thinkpad R51 Laptop. Laptops, or notebook computers, have been a primary tool for business and education for decades. This model from 2004 shows a classic design, including features like the red TrackPoint pointing stick in the center of the keyboard. Image Credit: “IBM Thinkpad R51” by Sebastian Stabinger is licensed under CC BY-SA 3.0, via Wikimedia Commons.

## Tablets

A **tablet** is a highly portable mobile computer that is even lighter and smaller than a laptop. Its main feature is a large touch screen. Tablets typically have screen sizes from 8 to 11 inches and can weigh less than 500 grams.

- **Slate Tablet:** This is the most common type, consisting of a

single screen like an Apple iPad.

- **Convertible Tablet:** This is a hybrid device with a keyboard that can be folded back or detached.
- **Stylus:** Many tablets support a **stylus**, which is a digital pen for writing or drawing.
- **Who uses them?** Tablets are ideal for **Mobile Users** who need a very lightweight device for presentations or taking notes. They are also very popular with **Home Users** for browsing the web and entertainment.
- **Advantages:** They are extremely portable, have an intuitive touch interface, and often have a long battery life.
- **Disadvantages:** They are generally less powerful than laptops and are not ideal for tasks that require a lot of typing.
- **Pricing:** Prices can range from a few hundred Ringgit for basic models to several thousand for high-end devices like an iPad Pro.



Figure 4.2: A Tablet Computer. Tablets are portable computers that feature a touchscreen as the primary way to interact with the device. They are known for their light weight and long battery life, making them popular for media consumption, browsing, and casual work. Image Credit: "Tablet computer" by KK IN HK is licensed under CC0 1.0, via Wikimedia Commons.

# Desktops

A **desktop computer** is designed to stay in one location, such as on a desk in a home or office. Because they are not limited by size or battery life, desktops can often be more powerful and easier to upgrade.

- **Tower Model:** The traditional setup with a separate case (the **tower**) for the computer parts.
- **All-in-One (AIO) Model:** A modern design that combines the computer's components into the same case as the monitor, like an Apple iMac.
- **Who uses them?** Desktops are the workhorse for many **SOHO (Small Office/Home Office) Users** who need a reliable and powerful machine for their business. They are also essential for **Power Users**, like engineers or video editors, who need the maximum performance and the ability to use multiple large monitors.
- **Advantages:** For the same price, a desktop is usually more powerful than a laptop. They are also much easier to repair and upgrade.
- **Disadvantages:** They are not portable and take up significant desk space.
- **Pricing:** A complete desktop system can start from around RM2,000 and go much higher for specialized machines.

## Desktop computer system

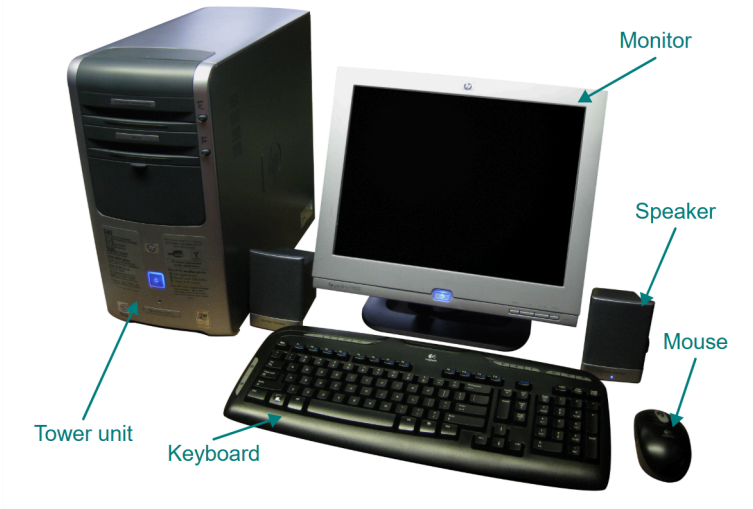


Figure 4.3: A Typical Desktop Computer System. A desktop computer consists of several separate hardware components working together. This includes the main tower unit (which contains the CPU and storage), a monitor for output, and a keyboard and mouse for input. Image Credit: “A typical desktop computer system” by kjarrett is licensed under CC BY 2.0, via Wikimedia Commons.

## Servers, Mainframes, and Supercomputers

These are highly powerful and specialized computers that are not used by individuals directly.

- **Servers:** A **server** is a computer that provides services to other computers over a network. Large companies like Google have huge data centers called **server farms** containing thousands of servers.
- **Mainframes:** These are very large and expensive computers used by major organizations like banks and airlines to process millions of transactions.

- **Supercomputers:** These are the fastest computers in the world, used for complex scientific research and weather forecasting.
- **Who uses them?** These powerful machines are used by **Enterprise Users**. The employees of a large bank or university do not use the mainframe directly, but the specialized software on their desktop computers connects to these central machines to get its work done.



Figure 4.4: A Server Room in a Data Centre. A server is a powerful computer designed to manage network resources and provide services to other computers. Businesses and organizations use rooms like this, called data centres, to house servers that run their websites, store customer information, and manage company data. Image Credit: “IBM storage servers (1)” by NOAA Photo Library is licensed under CC BY 2.0, via Wikimedia Commons.

# Embedded Computers

An **embedded computer** is a special-purpose computer that functions as one component within a larger product. You interact with them every day, often without even realizing it. Unlike a desktop or laptop, you do not interact with an embedded computer directly; it works in the background to control the device it is built into. They are designed to do one specific job reliably and efficiently.

- **Characteristics:** Embedded computers are typically small, have low power consumption, and are not designed for general tasks. They often do not have a screen, keyboard, or any of the typical parts you associate with a computer. Their software is permanently installed and rarely updated.
- **Usage Examples at Home:** Your home is filled with embedded computers. The system in your modern digital rice cooker that manages the cooking time and temperature is an embedded computer. The same is true for your microwave, washing machine (which controls the wash cycles), and smart TV (which manages the apps and internet connection).
- **Usage Examples in Daily Life:** The system in your car that controls the engine and the anti-lock braking system (ABS) are powerful embedded computers. The chip in your Touch 'n Go card that stores your balance is a very simple one. Even the traffic light system that manages the flow of cars is controlled by an embedded computer.
- **Usage Examples in Business:** In a retail store, the point-of-sale (POS) terminal that the cashier uses is an embedded computer. In a factory, the robotic arms that build products are each controlled by their own embedded computer system.

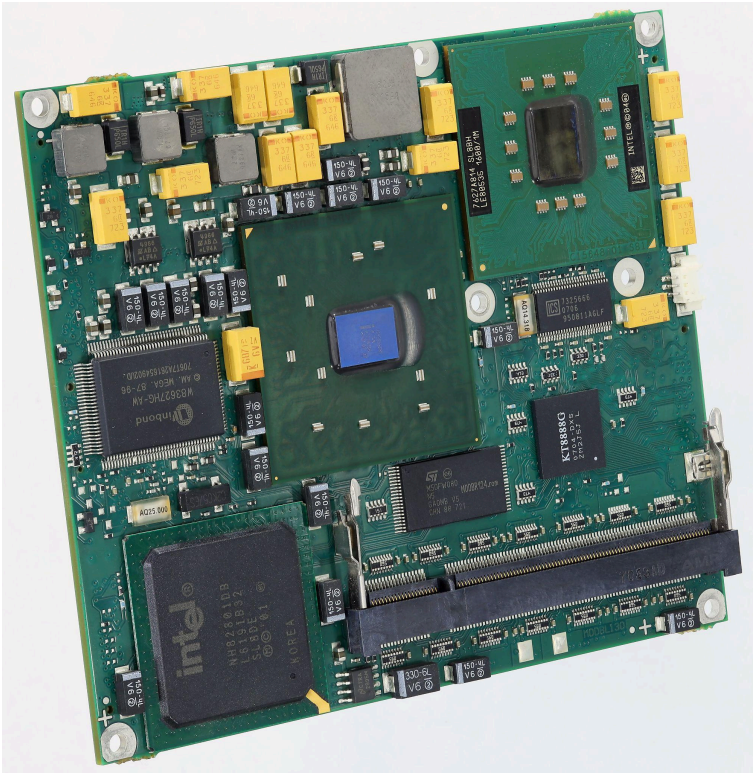


Figure 4.5: The Motherboard of a Computer. The motherboard is the main printed circuit board in a computer. It acts as the backbone that connects all of the computer’s main components—such as the CPU, RAM, and storage—allowing them to communicate with each other. Image Credit: “Kontron 18008-1024-16 05” by Mister rf is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Check Your Understanding: QR



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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# Input Devices: Giving the Computer Instructions

An **input device** is any piece of hardware you use to enter data and instructions into a computer. These devices are the bridge that allows us to communicate our intentions to the machine. Let's look at the most common types in more detail.

## Keyboards: The Primary Tool for Text

The **keyboard** is the most common input device, used for typing text, numbers, and symbols. While most keyboards look similar, there are several different types.

- **Physical Keyboards:** These are the standard keyboards you find on desktop and laptop computers, with physical keys that you press.
- **On-Screen Keyboards:** These are the keyboards that appear on the touch screen of a tablet or smartphone, allowing you to type by tapping the screen.
- **Virtual Keyboards:** This is a more advanced technology where an image of a keyboard is projected onto a flat surface, and sensors detect your finger movements as you “type.”
- **Mini Keyboards:** These are smaller, more compact keyboards often used with mobile devices or for presentations.



Figure 4.6: A Standard QWERTY Keyboard. The keyboard is one of the primary input devices for a computer, allowing users to type text and issue commands. This image shows a typical “QWERTY” layout, named for the first six keys on the top row of letters. Image Credit: “Computer keyboard US” by Mysid and Incnis Mrsi is in the Public Domain, via Wikimedia Commons.

## Pointing Devices: Controlling the Cursor

**Pointing devices** are used to control the movement of the pointer (or cursor) on the screen, allowing you to select icons, click on buttons, and interact with the graphical user interface.

- **Mouse:** The most common pointing device for desktop computers. It allows you to move the cursor by moving the mouse on a flat surface.
- **Touchpad:** The built-in pointing device on most laptops. It is a small, touch-sensitive surface that you slide your finger across to move the cursor.
- **Touch Screen:** On smartphones and tablets, the screen itself is both an input and an output device. You can use your finger to directly touch and select items on the screen.



Figure 4.7: A Computer Mouse. The mouse is a pointing device that allows the user to move a cursor on the screen and interact with graphical elements. It is an essential input device for navigating the Graphical User Interface (GUI). Image Credit: “2023 Mysz komputerowa Logitech G903 Lightspeed” by Jacek Halicki is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Voice and Audio Input: Speaking to Your Computer

**Voice input** is the process of entering data by speaking into a microphone. This technology has become much more common in recent years.

- **Microphone and Headset:** A **microphone** captures sound waves and converts them into a digital format. A **headset** is a combination of headphones and a microphone, which is very common for online calls and meetings.
- **Usage Examples:** In business, voice input is essential for video conferencing on platforms like Zoom or Microsoft Teams. In

daily life, many people use it to give commands to virtual assistants like Google Assistant or Siri on their smartphones.



*Figure 4.8: A Headset. A headset is a device that combines headphones (an output device for sound) and a microphone (an input device for sound) into a single unit. Headsets are commonly used for online meetings, gaming, and customer service calls. Image Credit: “Headphones with Microphone” by Zephyris is licensed under CC BY-SA 3.0, via Wikimedia Commons.*

## Video Input: Capturing Moving Images

**Video input** is the process of capturing full-motion video and converting it into a digital signal.

- **Webcam:** A **webcam** is a small digital video camera that is either built into your laptop or sits on top of your monitor. It is the primary tool for participating in online classes, virtual meetings, and making video calls to friends and family.
- **Digital Cameras:** You can also connect a standard digital

camera to a computer to transfer the videos you have recorded.



Figure 4.9: A Webcam. A webcam is an input device that captures video. It is essential for modern business communication, allowing for video conferencing and online meetings. Most laptops have a built-in webcam, but external webcams like this one often provide higher quality video. Image Credit: “Webcam on computer screen” by Peterhcharlton is licensed under CC BY 4.0, via Wikimedia Commons.

## Scanners: From Physical to Digital

A **scanner** is an input device that converts printed material, such as text and pictures, into a digital format that a computer can store, display, and process.

- **Document Scanners:** In an office, a scanner is used to create digital copies of paper documents like contracts, invoices, or letters. This is a key part of creating a “paperless office,” as

it allows businesses to store all their important documents as digital files, which are easier to organize, search, and back up.

- **Barcode Scanners:** When a cashier scans the barcode on an item at a supermarket, they are using a special type of scanner. This scanner reads the barcode (the data) and sends it to the computer to find the product's price (the information).



*Figure 4.10: A Flatbed Scanner. A scanner is an input device that converts physical documents, such as papers or photographs, into a digital format. The user places the document on the glass surface, and the scanner creates a digital image that can be saved on the computer. Image Credit: “Epson V850 scanner open 20230920” by Santeri Viinamäki is licensed under CC BY-SA 4.0, via Wikimedia Commons.*

## Output Devices: Seeing the Results

An **output device** is any hardware component that takes the

processed information from the computer and presents it to you in a way you can understand. After the CPU has done its work, the output devices are how you see, hear, or even feel the results.

## Displays: Your Window to the Digital World

A **display** is the most common output device, visually presenting text, graphics, and video.

- **Types of Displays:** The screen on a computer **monitor**, laptop, or smartphone are all displays. Many people also connect their computers to a **Smart TV** to watch movies or give presentations on a larger screen.
- **Understanding Display Quality:** The quality of a display is determined by several factors:
  - **Resolution:** This is the number of individual dots, or **pixels**, used to create the image on the screen. Higher resolution means more pixels, which results in a sharper, clearer, and more detailed image. You will often see resolution described with terms like **HD (High Definition)**, **Full HD (FHD)**, and **4K (Ultra HD)**, with 4K being one of the sharpest resolutions commonly available today.
  - **Screen Size:** This is measured diagonally across the screen in inches.
  - **Camera Quality:** The quality of the camera on your phone is also related to pixels. It is often measured in **megapixels**, which means millions of pixels. A camera with more megapixels can capture a more detailed photograph.



*Figure 4.11: A Desktop Computer Monitor. The monitor is an output device that displays visual information from the computer. The quality of the image is determined by its resolution, which is the number of pixels used to create the image on the screen. Image Credit: “Dell Computer Monitor” by IT Photography is licensed under CC BY-SA 4.0, via Wikimedia Commons.*

## Printers: From Digital to Physical

A **printer** is an output device that produces a physical copy of text and graphics, which we call a “hard copy.” There are several types of printers, each with different strengths.

- **Inkjet Printers:** These printers spray tiny droplets of ink onto paper to create an image. They are excellent for printing high-quality color photos and are very common for home use.
- **Laser Printers:** These printers use a laser beam and powdered ink (called toner) to create an image. They are much faster than

inkjet printers and are the standard choice for offices that need to print large volumes of black-and-white documents quickly and cheaply.

- **3D Printers:** This is a new and exciting type of printer that can build physical, three-dimensional objects from a digital design. Instead of ink, they use materials like plastic, resin, or metal. 3D printers are used in many industries, from creating prototypes for new products to making custom medical implants.



*Figure 4.12: An Inkjet Printer. A printer is an output device that produces a physical copy, or 'hard copy,' of digital documents and images. Inkjet printers, like the one shown, are common for home and small office use and work by spraying tiny droplets of ink onto paper. Image Credit: "Canon S520 ink jet printer" by André Karwath aka Aka is licensed under CC BY-SA 2.5, via Wikimedia Commons.*

## Audio Output: Hearing the Sound

These devices produce audio output, allowing you to hear music, the sound from videos, and the voices of people in online meetings.

- **Speakers:** These are the standard devices for producing sound for a group of people to hear. They can be built into a laptop or monitor, or they can be separate, external devices.
- **Earbuds and Headphones:** These are small, personal audio devices designed for a single user to listen privately. They come in many forms, from tiny wireless earbuds that fit in your ear to large, over-ear headphones. Many modern headphones also include **noise-cancelling** technology, which uses a microphone to block out background noise, making them great for working or studying in noisy environments.



*Figure 4.13: A Set of Computer Speakers. Speakers are output devices that produce sound from the computer. They are used to listen to music, watch videos, and hear audio from presentations and online meetings. Image Credit: “Logitech-usb-speakers” by Evan-Amos is in the Public Domain, via Wikimedia Commons.*

## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Memory vs. Storage: The Desk and the Filing Cabinet

In computing, the terms “memory” and “**storage**” are often used, but they mean very different things. Understanding this difference is one of the most important concepts for knowing how a computer works. One is a temporary workspace, and the other is a permanent library.

### Memory (RAM): The Computer’s Temporary Workspace

As we learned in Chapter 3, **memory**, or **Random Access Memory (RAM)**, is the computer’s high-speed, temporary workspace.

- **How it works:** RAM is made up of microchips that use electricity to hold data. The CPU can access any piece of data in RAM directly and almost instantly, which is why it is called “Random Access.” This direct electronic access makes RAM incredibly fast.
- **The “Desk” Analogy:** Think of RAM as your physical desk. When you want to work on a project, you take your books and papers (your files) out of your filing cabinet (storage) and spread them out on your desk (RAM). Your desk is where the active work happens. A bigger desk allows you to have more books open at the same time, so you can switch between them easily. Similarly, the more RAM a computer has, the more applications it can run smoothly at once without slowing down.
- **It is Volatile:** The most critical characteristic of RAM is that it is **volatile**. This means it needs a constant supply of power to hold data. As soon as you turn off the computer, everything in RAM is erased. It is like clearing everything off your desk at the end

of the day.

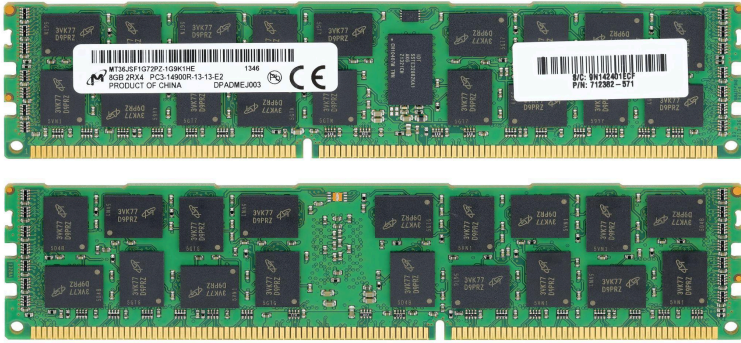


Figure 4.14: A RAM Module. This image shows both sides of a RAM (Random Access Memory) stick. RAM is a form of high-speed volatile memory that acts as the computer’s temporary workspace. The black squares are the memory chips that hold the data for the programs you are actively using. Image Credit: “MT36JSF1G72PZ-1G9K1HE” by Mister rf is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Storage Devices: Saving Your Work

There are several types of devices a computer uses for permanent storage. Each has its own technology, advantages, and best use cases. Let’s explore them in more detail.

### *Hard Disk Drives (HDD)*

A **Hard Disk Drive (HDD)** is a traditional storage device that has been used in computers for decades.

- **How it works:** An HDD uses magnetism to store data. Inside its case, there are one or more rapidly spinning platters coated with magnetic material. A read/write head on a mechanical arm

moves across the platters to read data from them or write new data to them.

- **Advantages:** The main advantage of an HDD is its low cost per gigabyte. It offers very large storage capacities (often several terabytes) for a relatively cheap price.
- **Disadvantages:** Because it has moving parts, an HDD is slower, noisier, and more fragile than newer technologies. It can be damaged if the computer is dropped or bumped while it is running.
- **Usage Example:** HDDs are still commonly used in desktop computers and large external drives where having a massive amount of storage for a low price is more important than speed. For example, a video editor might use a large external HDD to store many terabytes of raw video files.



Figure 4.15: An HDD Platter. This image shows a close-up of the highly reflective platter inside a Hard Disk Drive (HDD). Data is stored magnetically on the surface of these spinning platters. A read/write head on a moving arm accesses the data, which is why HDDs are slower than SSDs that have no moving parts. Image Credit: “Hard disk drive platter, Western Digital Caviar 250Gb WD2500AAKS” by Mk2010 is licensed under CC BY 4.0, via Wikimedia Commons.

## Solid-State Drives (SSD)

A **Solid-State Drive (SSD)** is the modern standard for internal storage in most new computers, especially laptops.

- **How it works:** An SSD has no moving parts. Instead, it stores data on interconnected flash memory chips, similar to a very large and fast USB flash drive.
- **Advantages:** SSDs are significantly faster than HDDs. This means your computer will start up in seconds, and programs will launch almost instantly. They are also silent, use less power (which is good for laptop battery life), and are much more durable because they have no moving parts to break.
- **Disadvantages:** The main disadvantage is that SSDs are more expensive per gigabyte than HDDs. While their prices are decreasing, you will typically get less storage space for the same amount of money compared to a traditional hard drive.
- **Usage Example:** Most modern laptops, from ultrathin models to gaming machines, use an SSD as their main drive. The operating system (like Windows or macOS) is installed on the SSD to ensure the computer runs as fast as possible.



Figure 4.16: An M.2 NVMe Solid-State Drive. This image shows a modern M.2 NVMe SSD, a type of permanent storage that is even faster than a traditional SSD. It connects directly to the computer's motherboard, resembling a stick of RAM more than a traditional drive. This direct connection allows for incredibly high data transfer speeds, making it ideal for high-performance computers. Image Credit: "Samsung 980 PRO PCIe 4.0 NVMe SSD 1TB-top PNR<sup>o</sup>0915" by D-Kuru is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## External Hard Drives

An **external hard drive** is a portable storage device that you connect to your computer, usually with a USB cable. These can be either an HDD or an SSD inside a protective case.

- **How it works:** It functions just like an internal drive but connects from the outside.
- **Advantages:** They provide a simple way to add more storage to your computer or to transfer large amounts of data between machines. Their most important use is for creating backups of your important files.
- **Disadvantages:** You need to remember to carry it with you, and like any physical device, it can be lost, stolen, or damaged.
- **Usage Example:** A student might use an external hard drive to back up all their university assignments and projects. If their laptop is ever lost or broken, they will still have a safe copy of all their important work.



Figure 4.17: An External Hard Drive. An external hard drive is a portable storage device that connects to a computer, usually via a USB cable. It provides a convenient way to back up important files, store large amounts of data, and transfer files between different computers. Image Credit: “My Passport Ultra Metal Edition-2969” by Raimond Spekking is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## *USB Flash Drives*

A **USB flash drive**, also known as a thumb drive or pendrive, is a small, ultra-portable storage device that plugs into a USB port.

- **How it works:** It uses the same flash memory technology as an SSD, but in a much smaller package.
- **Advantages:** They are very small, inexpensive, and convenient for moving files from one computer to another.
- **Disadvantages:** They have a smaller capacity compared to external hard drives and can be easy to lose due to their small size.
- **Usage Example:** You might save a presentation file on a USB flash drive to take it from your home computer to the computer in your university's lecture hall.



*Figure 4.18: A USB Flash Drive. A USB flash drive, also known as a thumb drive or pen drive, is a small, portable data storage device. It connects to a computer via a USB port and is a popular way to transfer and store personal files. Image Credit: "SanDisk-Cruzer-USB-4GB-ThumbDrive" by Evan-Amos is in the Public Domain, via Wikimedia Commons.*

## *Memory Cards*

A **memory card** is a small, flat storage card that uses flash memory.

- **How it works:** They are designed to be used in portable electronic devices. There are many different formats, such as SD (Secure Digital) and microSD.
- **Advantages:** They are tiny and provide a way to easily expand the storage of devices that have a memory card slot.
- **Disadvantages:** Their small size makes them easy to lose, and they can be more expensive than other forms of storage for the same capacity.
- **Usage Example:** A digital camera uses an SD card to store photos and videos. Many Android smartphones have a microSD card slot, allowing you to add more storage for your apps, photos, and music.

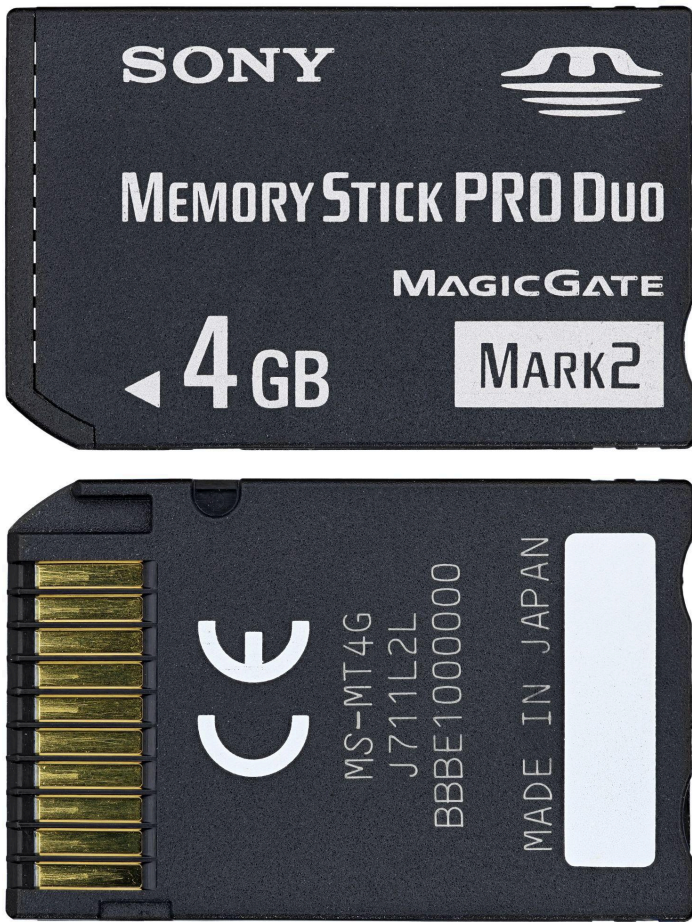


Figure 4.19: A Flash Memory Card. Flash memory cards, such as this Sony Memory Stick, are small, portable storage devices commonly used in digital cameras, smartphones, and other mobile devices. They are a form of non-volatile solid-state storage. Image Credit: “Sony Memory Stick Pro Duo 4GB” by Mister rf is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## *Optical Discs*

An **optical disc** is a flat, circular disc that stores data which is read by a laser.

- **How it works:** A laser beam creates tiny pits in the surface of the disc to represent data. Another laser reads these pits to retrieve the data. The most common types are **CDs (Compact Discs)** and **DVDs (Digital Versatile Discs)**.
- **Advantages:** They are very cheap to produce in large quantities.
- **Disadvantages:** They have a very small storage capacity compared to modern devices, they can be easily scratched, and most new computers no longer include a disc drive to read them.
- **Usage Example:** While they are much less common now, you might still buy official software or a movie on a DVD. Some businesses also use them for long-term archiving of data.



Figure 4.20: An Optical Disc (Blu-ray). Optical discs, such as CDs, DVDs, and Blu-ray discs, are a form of portable storage that are read by a laser. While less common for personal data storage today, they are still widely used for distributing software, movies, and video games. Image Credit: “Blu-ray 200GB” by Rtty66uyuyty is in the Public Domain, via Wikimedia Commons.

## Cloud Storage

- **Cloud storage** is a modern and increasingly popular way to store files on the internet instead of on your local computer.
- **How it works:** When you use a cloud storage service, you are saving your files on the powerful servers of a company like Google, Microsoft, or Apple. You can then access these files from any device that has an internet connection.

- **Advantages:** It is extremely convenient. You can access your files from anywhere, on any device. It also makes sharing files with others very easy. Most services also automatically back up your files, keeping them safe if something happens to your computer.
- **Disadvantages:** You need an internet connection to access your files. There can also be privacy concerns, as you are trusting another company with your data. While many services offer a small amount of free storage, you usually have to pay a monthly or yearly subscription fee for larger amounts.
- **Usage Example:** A student can write an assignment in Google Docs on their laptop at home. The file is saved to **Google Drive** (a cloud storage service). The next day, they can open and edit the exact same file on a university computer, and then view it on their smartphone on the bus ride home.

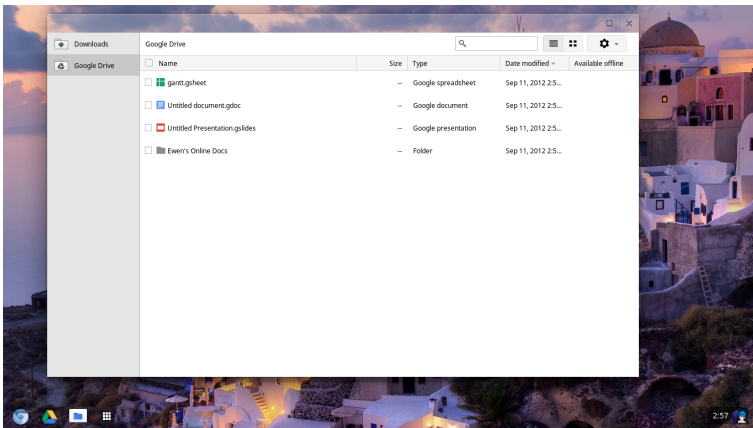


Figure 4.21: A Cloud Storage Interface (Google Drive). Cloud storage is a service that stores your data on remote servers that you access through the internet. Services like Google Drive, Microsoft OneDrive, and Dropbox allow you to save your files online, making them accessible from any device and easy to share with others. Image Credit: “Chromium OS Google Drive NRLTY” by Google Inc., NotinREALITY is released under a BSD License, via Wikimedia Commons.

## Check Your Understanding: Q10



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## Check Your Understanding: Q11



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## Check Your Understanding: Q12



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# Ports and Connections: Plugging Things In

A **port** is a connection point or interface on a computer where you can connect an external device. Think of ports as the doorways that allow your computer to communicate with the outside world. Different ports have different shapes and are used for different purposes, from transferring data to displaying video.

## USB Ports: The Universal Connector

The most common and versatile type of port is the **Universal Serial Bus**, or **USB port**. You can use it to connect almost everything, from your mouse and keyboard to printers, external hard drives, and smartphones.

- **USB Type-A:** This is the classic rectangular port that you are most familiar with. It is still very common on desktops, laptops, and chargers for connecting devices like a mouse, keyboard, or a **USB flash drive**. If your computer does not have enough of these ports, you can use a **USB hub**, which is a small device that plugs into one USB port and gives you several more.
- **USB Type-C:** This is the newer, smaller, oval-shaped port. It has two major advantages: it is reversible, so you do not have to worry about plugging it in upside down, and it is much more powerful. A single USB-C port can handle data transfer, video output, and charging all at the same time. Many modern ultrathin laptops and Android phones use USB-C.
- **Thunderbolt:** This is a high-speed connection technology that uses the USB-C connector. A Thunderbolt port looks exactly like a USB-C port but is much faster, making it ideal for power users who need to connect multiple high-resolution monitors or transfer very large files quickly.



*Figure 4.22: A USB-A Connector and Port. The Universal Serial Bus (USB) is a standard connection used for many types of computer hardware, including keyboards, mice, printers, and storage devices. The rectangular USB-A connector shown here is one of the most common and recognizable types. Image Credit: “USB port” by Google Inc., NotinREALITY is licensed under CC0 1.0 Universal Public Domain Dedication, via Wikimedia Commons.*

## Display Ports: Connecting Your Screen

These ports are specifically designed to send video and audio from your computer to a monitor, TV, or projector.

- **HDMI (High-Definition Multimedia Interface):** This is the most common port for connecting to modern TVs and monitors. It carries both high-definition video and audio in a single cable.
- **DisplayPort:** This is another popular standard for connecting to computer monitors, especially for high-performance displays used by gamers or designers.

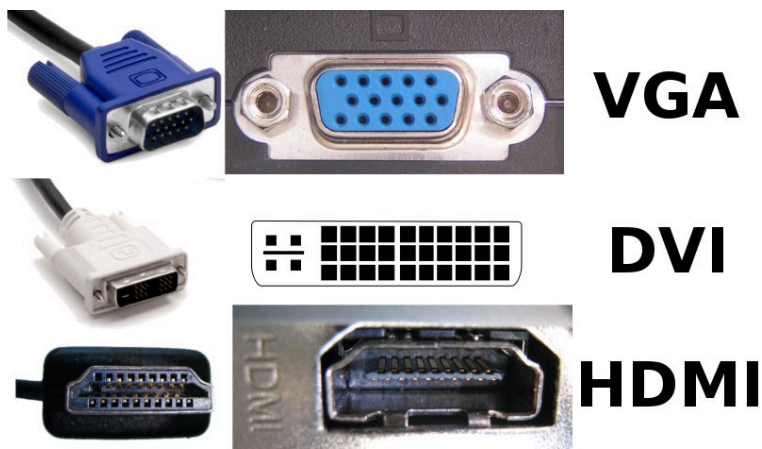


Figure 4.23: Common Video Connectors (VGA, DVI, and HDMI) and Ports. Computers use different types of ports to send video signals to a display. The image shows three common types: VGA (an older, analog standard), DVI (a digital standard), and HDMI (a modern standard that carries both digital video and audio). Image Credit: “Connection screen” by Evan-Amos is licensed under CC BY-SA 3.0, via Wikimedia Commons.

## Other Common Ports

- **Audio Port (Headphone Jack):** This is a small, round port used to connect headphones, earbuds, or external speakers.
- **Ethernet Port:** This port is used for a wired network connection. Plugging an Ethernet cable from your router to this port on your computer will usually give you a faster and more stable internet connection than **Wi-Fi**.



*Figure 4.24: An Ethernet Port. An Ethernet port, also known as a LAN port, is used to connect a computer to a wired network using an Ethernet cable. While Wi-Fi is common, a wired connection often provides a faster and more stable internet connection, which is important for online gaming, streaming high-definition video, and transferring large files. Image Credit: “LAN Port – Ethernet Jack on Cable Modem (Networking Equipment)” by Tony Webster is licensed under CC BY 2.0, via Wikimedia Commons.*

## Making Connections Easier: Port Replicators and Docking Stations

For laptop users who frequently work at a desk, the process of constantly plugging and unplugging many cables (power, monitor, keyboard, mouse, network cable) can be inconvenient and messy. **Port replicators** and **docking stations** are designed to solve this exact problem, creating a more efficient and organized workspace.

These devices are essentially hubs that contain many different types of ports. The idea is simple: you leave all your permanent desk devices, like your full-size monitor, keyboard, mouse, and printer, plugged into the docking station. Then, when you arrive at your

desk with your laptop, you only need to make a single connection from the laptop to the docking station.

With modern laptops, this is often done with a single **USB-C or Thunderbolt cable**. This one connection can instantly:

- Charge your laptop.
- Send video to one or more external monitors.
- Connect to your keyboard and mouse.
- Connect to a wired Ethernet network.
- Connect to any other USB devices, like an external hard drive.

This powerful feature effectively turns your portable laptop into a full desktop system in seconds, making it ideal for hybrid workers or anyone who wants the convenience of a laptop with the power of a full desk setup.



*Figure 4.25: A Laptop Docking Station. A docking station is a device that allows a laptop computer to easily connect to other devices, such as a full-size monitor, keyboard, mouse, and a wired network. It turns a portable laptop into a more complete desktop setup, which is very common in modern business offices. Image Credit: “ThinkPad Mini Dock Series 3, Type 4337-9663” by Raimond Spekking is licensed under CC BY-SA 4.0, via Wikimedia Commons.*

## Wireless Device Connections

While ports provide physical connections, many devices now connect without any wires at all using radio waves. This creates a cleaner workspace and offers much more freedom of movement.

- **Bluetooth:** This technology is designed for short-range wireless communication, typically with a range of about **10 meters**. It is used to create a “Personal Area Network” (PAN) that connects your personal devices together. Before they can communicate, you must “pair” them, which is a one-time setup process to create a secure connection. Bluetooth uses very little power, making it perfect for connecting peripherals. **Common Examples:** Connecting wireless headphones or earbuds to your phone, using a wireless mouse or keyboard with your laptop, or connecting your smartphone to your car’s audio system to play music.
- **Wi-Fi:** This technology uses more powerful radio signals to provide high-speed internet and network connections over a much larger area than Bluetooth, with a typical indoor range of up to **100 meters**. When you connect to a Wi-Fi network, you are joining a Wireless Local Area Network (WLAN) that is connected to the internet. **Common Examples:** Connecting your laptop, smartphone, and Smart TV to your home internet router. Public Wi-Fi is also available in many places like cafes, airports, and universities.
- **NFC (Near Field Communication):** This is a very short-range wireless technology that works only when two devices are extremely close, typically **4 centimeters or less**. This extremely short range is a key security feature, as it prevents accidental communication. **Common Examples:** NFC is the technology that powers “tap-to-pay” systems. When you tap your Touch ‘n Go card or your bank card to pay for something, you are using NFC. It is also used in smartphones for mobile payment services

like Apple Pay and Samsung Pay, allowing you to pay by simply tapping your phone on the payment terminal.



Figure 4.26: A Laptop Docking Station. Modern businesses use Point-of-Sale systems to process customer payments. These systems often include a tablet and a card reader, and can accept various payment methods, including credit cards and contactless payments from smartphones. This ‘tap-to-pay’ method, as shown here, uses a short-range wireless technology called Near-Field Communication (NFC). Image Credit: “Apple-payment-square” by Mybloodtypeiscoffee is licensed under CC BY 4.0, via Wikimedia Commons.

## Check Your Understanding: Q13



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## Check Your Understanding: Q14



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## Check Your Understanding: Q15



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## Chapter Summary

In this chapter, we explored the physical world of computer hardware. We identified the many types of computers, from large servers to tiny embedded devices. We learned about input devices like keyboards and mice that let us give commands, and output devices like displays and printers that show us the results. We clarified the important difference between temporary memory (RAM) and permanent storage. We also looked at different storage

devices, common ports, and the wireless connections like Bluetooth and Wi-Fi that help us connect everything together.

## Review Questions

1. What is the main advantage of a laptop computer?
2. What are the main disadvantages of a laptop compared to a desktop computer?
3. Who is a “Power User,” and what type of computer would they typically use?
4. In your own words, what is an “All-in-One (AIO)” desktop computer?
5. What is the difference between a server, a mainframe, and a supercomputer?
6. What is an embedded computer?
7. Give two examples of embedded computers you might find in a Malaysian home or car.
8. What is the difference between an input device and an output device?
9. Name three different types of pointing devices.
10. Is a headset an input device, an output device, or both? Explain your answer.
11. What is the main purpose of a scanner in a business office?
12. What is “resolution” and how does it affect the quality of a display?
13. Name three different types of printers and describe their main use.
14. Using the “desk and filing cabinet” analogy, explain the difference between RAM (memory) and storage.
15. What does it mean when we say that RAM is “volatile”?
16. Where are your computer’s programs, like Microsoft Word, kept when the power is turned off?
17. Your friend is buying a new laptop and asks you to explain the

difference between an SSD and a traditional HDD. What would you say?

18. What is the most important use for an external hard drive?
19. What is the main difference between a USB flash drive and an external hard drive?
20. What is cloud storage?
21. What are two advantages and two disadvantages of using cloud storage?
22. What are two advantages of a USB-C port compared to the traditional USB-A port?
23. What is the main purpose of a laptop docking station?
24. In your own words, explain the main difference between Bluetooth and Wi-Fi.
25. What wireless technology powers the “tap-to-pay” system used by a Touch ‘n Go card?

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# Chapter 5: Computer Software

## Learning Objectives

Welcome to Chapter 5! Now that we understand the physical hardware, we will explore the software that brings it to life. After studying this chapter, you will be able to:

- Identify the two main categories of software: system software and application software.
- Describe the key functions of an operating system.
- Recognise the different types of application software and their uses.
- Explain the different ways software is licensed and distributed.
- Understand the importance of software updates and the dangers of malware.
- Outline the common steps involved in developing a software project.

# Introduction

If computer hardware is the body, then software is the mind. The screen, keyboard, and CPU are all physical objects, but they cannot do anything on their own. They need instructions to tell them what to do. That is the job of **software**. This chapter explains the different kinds of programs that make a computer a useful tool, from the basic system that manages the computer itself to the specific apps we use for work and fun every day.

## The Two Main Categories of Software

Every program on your computer, from the moment you turn it on to the moment you shut it down, can be placed into one of two main categories: **system software** or **application software**. Understanding the difference is key to understanding how a computer works as a whole.

Think of it like a restaurant. The **system software** is the kitchen crew, the manager, and the waiters. They work in the background, managing the restaurant, taking orders, and making sure everything runs smoothly. You, the customer, don't usually interact with the chef directly. The **application software** is the menu. It presents you with specific options (the dishes) that you can choose from to get what you want, whether it's a meal, a drink, or a dessert.

Let's look at each category in more detail.

## System Software: The Manager of the Computer

**System software** is the set of programs that manages and controls the computer's hardware and provides a platform for application software to run. It works in the background, coordinating all the

computer's essential activities. You usually do not interact with it directly, but without it, your computer would be a useless box of parts.

The most important type of system software is the **operating system**.

## *The Operating System (OS)*

The **operating system**, or **OS**, is the most important piece of software on any computer. It is the first program that loads when you turn on your device and the last one to close when you turn it off. Its job is to be the master controller, managing all the hardware and software resources.

Common examples of operating systems include:

- **For Desktops and Laptops:** Microsoft Windows, Apple's macOS, Linux.
- **For Mobile Devices:** Google's Android, Apple's iOS.

The OS performs several critical jobs:

- **Starting the Computer:** It manages the boot-up process, checking all the hardware to make sure it is working correctly.
- **Providing the User Interface:** The OS is what gives you the desktop, icons, and menus that you use to interact with the computer.
- **Managing Programs:** When you open multiple applications at once, like having a web browser, a music player, and a word processor all running, it is the OS that manages them. It makes sure each program gets a fair share of the CPU's attention and the computer's memory (RAM) so that everything can run smoothly without crashing. This is called **multitasking**.
- **Managing Memory:** The OS is responsible for moving programs and data in and out of RAM, ensuring there is always enough

space for your active tasks.

- **Coordinating Hardware:** It allows all the different hardware parts to communicate with each other. When you click “Print,” the OS takes the document from your word processor and sends it to the printer.
- **Providing File Management:** The OS is in charge of how your files are stored and organized. It allows you to create folders, and to copy, move, and delete files.

## *Utility Programs*

Another type of system software is a **utility program**. These are small tools designed to perform a specific maintenance task to help manage and protect the computer, and many are built directly into the operating system. For example, think of the maintenance crew in a building. They are not the main business, but they are essential for keeping the building safe, clean, and running efficiently. Utility programs are the maintenance crew for your computer, performing important background tasks to keep it in good working order.

One of the most important utilities is **antivirus software**, which runs in the background to protect your computer from malicious software (malware) by scanning files and blocking threats. Another essential utility is the **File Manager**, which is the tool that lets you see all your files and folders, allowing you to organize your digital life. Examples include “File Explorer” on Windows or “Finder” on a Mac. Finally, **backup tools** are critical utilities that help you create copies of your important files. You can use them to back up your data to an external hard drive or to a cloud storage service, ensuring you don’t lose your work if your computer is damaged or lost.

# Application Software: The Tools for Your Tasks

**Application software**, or an **app**, is the software you use to complete a specific task or for entertainment. This is the software you are most familiar with and interact with directly every day.

There are thousands of different applications, which can be grouped by their purpose.

## *Productivity Software*

This type of software is designed to help you be more efficient and effective at work, school, or home.

- **Word Processing:** Used for creating and editing text-based documents like letters, reports, and assignments. With programs like Microsoft Word or Google Docs, you can format text (changing fonts and colours), create tables, add images, and check for spelling and grammar errors.
- **Spreadsheet:** Used for organizing data in rows and columns and performing calculations. Software like Microsoft Excel or Google Sheets is essential for tasks like creating a budget, tracking sales figures, or managing a project timeline. Its power comes from the ability to use formulas to automatically calculate totals, averages, and other complex equations.
- **Presentation:** Used for creating slideshows for presentations. With programs like Microsoft PowerPoint or Google Slides, you can combine text, images, and charts into a series of slides to present information to an audience in a clear and engaging way.

## *Communication Software*

This software is used to communicate with others, a vital function in today's connected world.

- **Email:** For sending and receiving electronic mail (e.g., Microsoft Outlook, Gmail). It is a primary tool for professional communication in business.
- **Messaging:** For real-time text, voice, and video chats (e.g., WhatsApp, Telegram). These apps have become essential for both personal and professional group communication.
- **Video Conferencing:** For holding online meetings with people in different locations (e.g., Zoom, Google Meet, Microsoft Teams). This became an essential business tool, allowing for remote work and virtual collaboration.

## *Media and Entertainment Software*

This software is for creating, viewing, and organizing media, as well as for entertainment.

- **Media Players:** For watching videos or listening to music (e.g., VLC Player, Spotify).
- **Photo and Video Editors:** For editing and organizing digital photos and videos. Simple tools like Canva are great for creating social media graphics, while professional tools like Adobe Photoshop are used for advanced photo manipulation.
- **Web Browsers:** Your gateway to the internet. A web browser, like Google Chrome, Mozilla Firefox, or Safari, is an application that allows you to access and view websites.

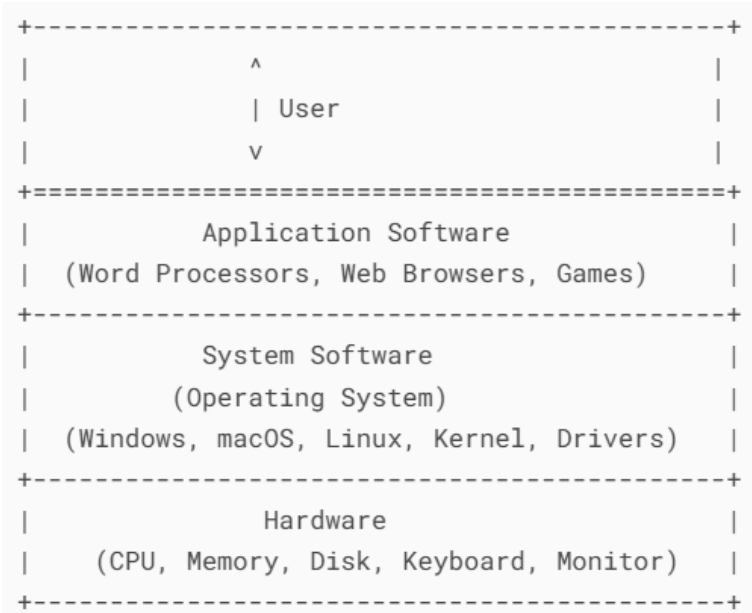


Figure 5.1: The Layers of a Computer System. This diagram shows the relationship between hardware, software, and the user. The hardware forms the physical base of the computer. The system software (or operating system) acts as a middle layer that manages the hardware. Application software runs on top of the operating system, and this is the layer that the user directly interacts with. (Image generated with AI assistance.)

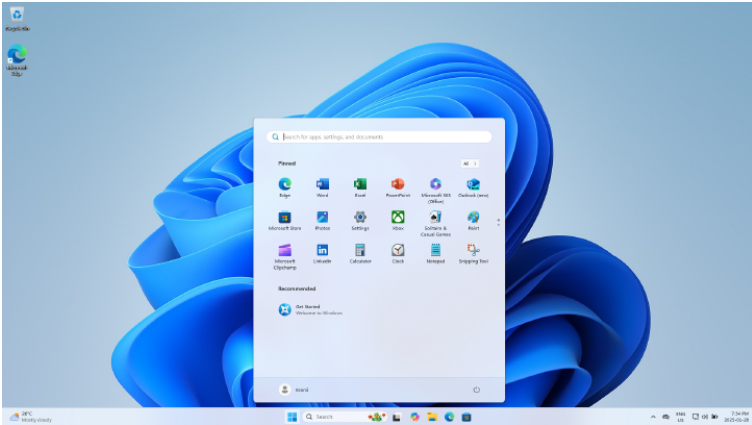


Figure 5.2: The Windows 11 desktop and Start Menu. This image shows the modern look of Windows 11 (Version 24H2). Notice that the Start Menu and app icons on the taskbar are centered, which is different from older versions of Windows. (Used with permission from Microsoft.)

9:45



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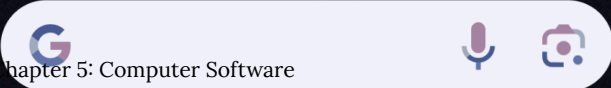


Figure 5.3: The Android 15 user interface. The home screen is the starting point for navigating Android 15. While it looks simple, this version includes major updates focused on security and user experience. Key improvements in Android 15 include the “Privacy Sandbox” to protect user data from advertisers, better support for foldable devices, and new controls for the camera and other hardware. The clean layout with the Google Search bar at the bottom is designed for easy and quick access to information. Image Credit: “Android\_15\_Homescreen\_Screenshot” by The Android Open Source Project is licensed under the Apache License, Version 2.0, via Wikimedia Commons.



Figure 5.4: The Operating System Managing Multiple Tasks. A key function of any modern operating system (OS) is multitasking. As shown here, the OS allows many different applications, like a web browser, a video player, and a word processor, to run simultaneously. The OS manages the computer's memory and processing power, ensuring that each application gets the resources it needs to run smoothly without interfering with the others. This is all managed through the Graphical User Interface (GUI), which lets the user arrange and interact with these application windows. (Image generated with AI assistance.)

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## A Closer Look at Business Application Software

While the productivity and communication tools we have discussed are used by everyone, many businesses rely on specialized application software to manage their specific operations. These programs are designed to handle complex tasks and large amounts of data, helping companies to be more organized and profitable.

### Accounting Software

This is one of the most essential types of software for any business, from a small local *kedai runcit* (sundry shop) to a large corporation. **Accounting software** helps a business record and report its financial transactions. It is used to manage sales and expenses, create invoices for customers, handle payroll for employees, and generate financial reports. For example, many small and medium-sized enterprises (SMEs) in Malaysia use accounting software like SQL Account or AutoCount to manage their finances and comply with tax regulations set by the *Lembaga Hasil Dalam Negeri (LHDN)*.

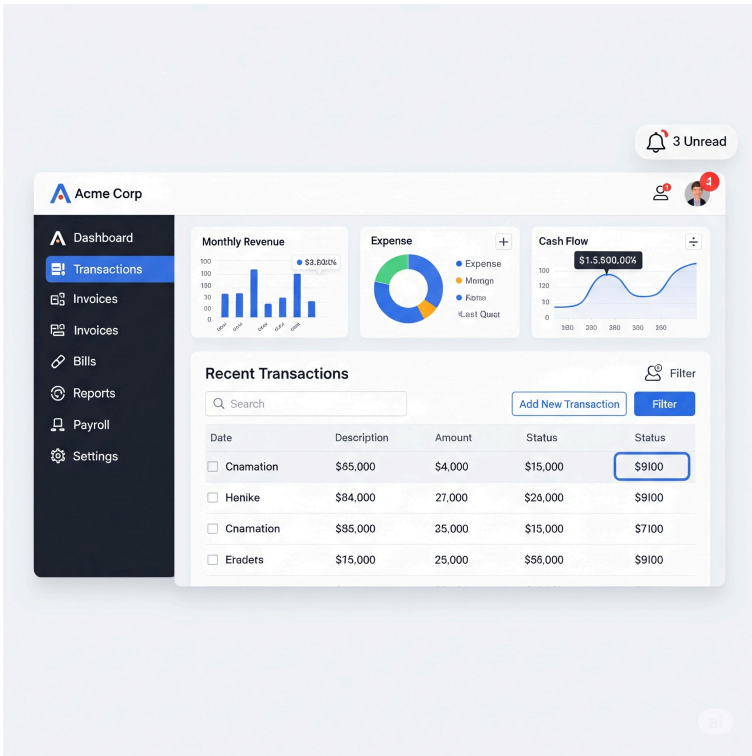


Figure 5.5: Managing Business Finances with Accounting Software. Modern accounting software provides a comprehensive set of tools to manage a company's finances. This screenshot displays a central dashboard with key financial indicators, such as monthly revenue and cash flow, for quick analysis. Below the dashboard, the "Recent Transactions" table is used to record and track all financial activities. The navigation panel on the left provides access to other critical functions, including creating invoices for customers, managing bills from suppliers, and generating detailed financial reports. (Image generated with AI assistance.)

## Customer Relationship Management (CRM) Software

A **Customer Relationship Management (CRM)** system is a tool that

helps companies manage all their interactions with current and potential customers, with the goal of improving business relationships and fostering loyalty. A CRM stores customer contact information, tracks their purchase history, and records any interactions they have had with the company, such as phone calls or emails. This helps the sales and customer service teams provide a more personalized and efficient service. For instance, imagine a hotel in Kota Kinabalu that uses a CRM. When a returning guest makes a booking, the system can instantly show the front desk staff that this guest has stayed before and prefers a room with a sea view. This allows the hotel to provide a better experience that encourages the guest to return.

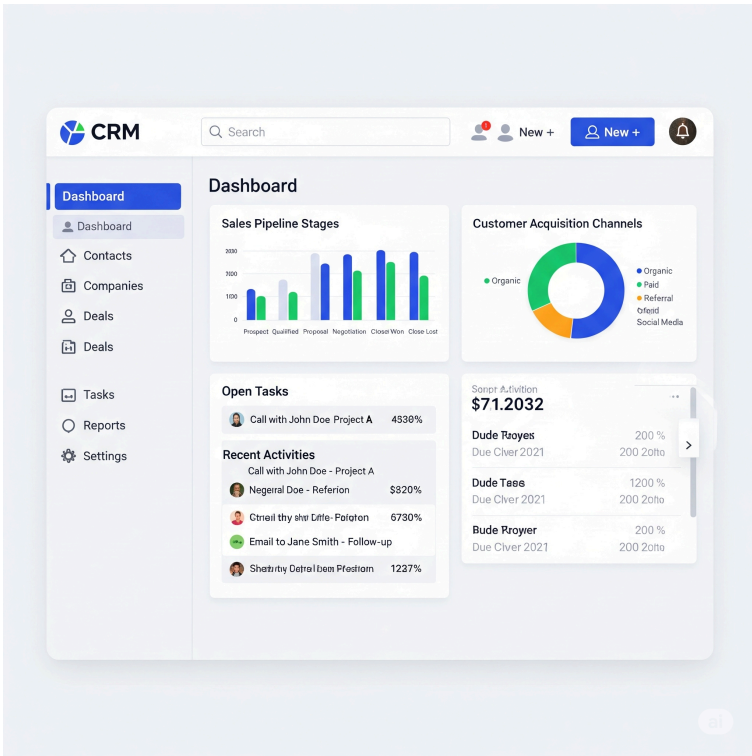


Figure 5.6: Managing Customer Data with a CRM System. A Customer Relationship Management (CRM) system is a powerful tool for businesses to track and analyze customer interactions. The dashboard shown here provides a visual summary of key business activities. The “Sales Pipeline” chart helps the sales team track their progress with potential customers, while the “Customer Acquisition Channels” chart shows where new customers are coming from. The system also helps employees manage their daily work with task lists and activity logs, ensuring that all customer information is organized and up-to-date. (Image generated with AI assistance.)

## Enterprise Resource Planning (ERP) Software

An **Enterprise Resource Planning (ERP)** system is a very large and complex piece of software that integrates all the essential functions of a business into one single system. Instead of having separate

software for accounting, human resources (HR), manufacturing, and sales, an ERP system combines them all. This allows for better communication and data sharing between different departments. For example, a large manufacturing company in Penang might use an ERP system. When the sales team receives a large order, the system automatically checks the inventory levels, schedules the production in the factory, and orders the necessary raw materials from suppliers, all from within the same integrated platform.

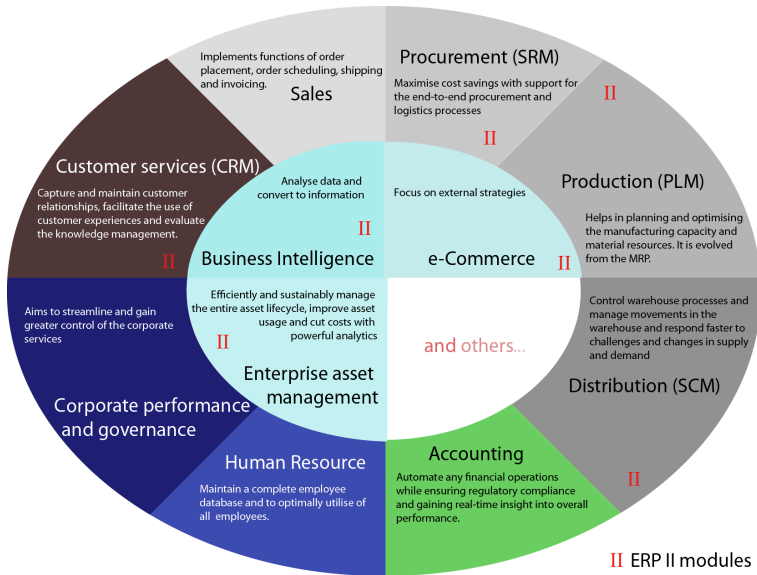


Figure 5.7: An Integrated View of ERP Modules. An Enterprise Resource Planning (ERP) system helps a company manage its entire business from one central platform. This diagram illustrates how different departments and functions are integrated as “modules.” For example, it includes modules for internal operations like Accounting and Human Resources, as well as modules for managing external relationships with suppliers (Procurement) and customers (Customer Services). The goal of an ERP system is to improve efficiency by allowing all these modules to share information. Image Credit: “ERP Modules” by Shing Hin Yeung is licensed under CC BY-SA 3.0, via Wikimedia Commons.

# Project Management Software

**Project management software** is used by teams to plan, execute, and track the progress of projects to ensure they are completed on time and within budget. It allows a project manager to assign tasks to team members, set deadlines, and monitor the project's progress. For example, a team of university students working on a final year project could use a tool like Trello or Asana. They can create a board for their project, add cards for each task (like “Write Chapter 1” or “Create Presentation Slides”), assign each card to a team member, and set a due date.

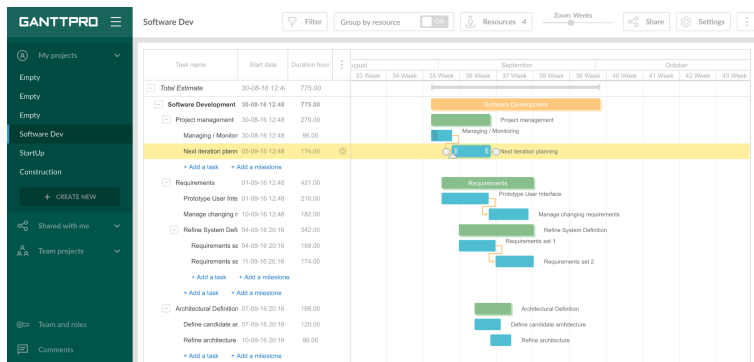


Figure 5.8: Planning a Project with a Gantt Chart. This screenshot from the GanttPRO software shows a typical Gantt chart. This is a powerful tool for project management that visually represents the project's schedule. On the left is a list of tasks, and on the right, the horizontal bars show the start date, end date, and duration of each task. This allows a project manager to see the project's timeline, dependencies between tasks, and overall progress at a glance. Image Credit: “GanttPRO\_Gantt\_Chart\_Software” by Alex Chatfield is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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# How Software is Licensed and Distributed

Software is not just a product; it is a piece of intellectual property. The way it is made available to users is controlled by a **software license**, which is a legal agreement that specifies how the software can be used and distributed.

## Commercial Software Models

**Retail software** is mass-produced software that you buy a license for, either from a physical store or by downloading it online. Traditionally, you would buy a “perpetual license,” which meant you paid once and owned that version of the software forever. A more common model today is **subscription software**, where you pay a monthly or yearly fee, much like subscribing to a service like Astro or Netflix. This model, used by popular software like Microsoft 365 and Adobe Creative Cloud, often includes access to the latest updates and cloud storage. Another type is **shareware**, which is distributed for free on a trial basis. You can use it for a limited time, and if you want to continue using it after the trial period, you are required to pay for a license.

## Free Software Models

**Freeware** is software that is provided completely free of charge, with no time limit. The creator still owns the copyright, so you cannot sell it or claim it as your own, but you can use it for free. Many popular programs, like the VLC media player, are freeware. In rare cases, you might find **public-domain software**, which has been donated for public use and has no copyright restrictions at all.

# Open-Source Software

**Open-source software** is a special category where the original source code—the human-readable instructions written by the programmers—is made available to the public for free. The philosophy behind this is collaboration, much like a community recipe book where everyone can see the recipe, suggest improvements, and share their new versions. This collaborative approach has led to some of the world’s most successful software, including the Linux and Android operating systems and the Firefox web browser.

## How We Get and Use Software

There are several ways we can access and use software, each with its own advantages. A **native app** is a program that you install directly onto your computer or mobile device, making it “native” to that specific hardware. For example, the WhatsApp application you download from the Google Play Store is a native app that is stored on your phone. In contrast, a **web application**, or **web app**, is a program that runs on a remote server, which you access using your web browser. This means you do not need to install anything on your computer. Using Maybank2u or CIMB Clicks for online banking is a perfect example of using a web app; the entire banking program is on the bank’s servers, and your browser is just the window you use to access it. A **mobile app** is simply a native app designed specifically for a mobile device, which you download from an app store like the Google Play Store or Apple’s App Store. Finally, a **mobile web app** is a website that has been specially designed to look and feel like a native mobile app when you access it from a phone’s browser, using a technique called responsive design to automatically adjust its layout to fit your screen.

When you get a new native program, you usually have to **install** it first, which is the process of setting up the program to work with your computer’s operating system. Once installed, you can **run** the program. As we learned in Chapter 3, this involves the operating system copying the program from permanent storage into RAM, where the CPU begins to carry out its instructions, eventually displaying the program’s user interface on the screen.

It is also very important to keep your software updated. You have probably seen notifications on your phone or computer telling you that “updates are available.” A **software update** is a new version of a program that offers improvements over the old one. The most important reason to update is for **security**, as updates often include patches that fix weaknesses and protect your computer from viruses and other attacks. Updates also fix small errors, or “bugs,” to make the software more stable, and often introduce new features to improve the application’s performance.

## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Understanding Malicious Software (Malware)

While most software is designed to be helpful, some is created with a malicious purpose. **Malicious software**, or **malware**, is any software that is intentionally designed to cause damage to a computer, steal data, or disrupt a system. Understanding the common types of malware is the first step in protecting yourself.

## Common Types of Malware

**Virus:** A computer virus is a type of malware that attaches itself to a legitimate program or file. When you run that program, the virus activates and spreads to other files on your computer.

**Worm:** A worm is similar to a virus, but it is much more dangerous because it can spread by itself across a computer network without any human help. It does this by exploiting security vulnerabilities.

**Trojan Horse:** A Trojan horse is a type of malware that disguises itself as a harmless or useful program. It tricks you into installing it, but once it is on your computer, it can perform malicious actions in the background, such as stealing your passwords or giving a hacker remote access to your computer.

**Ransomware:** This is a particularly nasty type of malware that encrypts your personal files, making them completely unusable. The attackers then demand a ransom payment (usually in cryptocurrency) in exchange for the key to decrypt your files.

**Spyware:** This is malware that secretly installs itself on your computer to spy on your activities. It can record your keystrokes to steal passwords, monitor your browsing habits, or even turn on your webcam without your knowledge.

## How to Protect Yourself from Malware

Protecting your devices from malware is a critical part of using technology safely. Here are the most important steps you can take:

- **Use Security Software:** You should always have a reputable antivirus and anti-malware program installed on your computer. This software can detect and remove threats.
- **Keep Everything Updated:** As we learned, software updates often contain critical security patches. Always keep your operating system and all your applications updated to the latest

version.

- **Be Careful with Emails and Downloads:** Be very suspicious of unexpected emails, especially those with attachments or links. A common tactic used by hackers is **phishing**, where they send fake emails that look like they are from a legitimate company (like a bank or a delivery service) to trick you into clicking a malicious link or downloading a virus. Never download software from untrustworthy websites.
- **Use a Firewall:** A firewall is a security tool that monitors the traffic coming into and out of your computer network and can block suspicious connections. Most modern operating systems have a built-in firewall.

## The Software Development Life Cycle (SDLC)

Creating a high-quality application is a complex process that involves much more than just writing code. Professionals follow a structured process called the **Software Development Life Cycle (SDLC)**. This is a series of steps that provides a model for the development and management of a project.

Let's imagine a local business in Labuan wants to create a new mobile app called "LabuanEats" for ordering food delivery from local restaurants. Here is how they might follow the SDLC.

- **Planning & Analysis:** The team first identifies the goal. They need to solve the problem of making it easier for people in Labuan to order food from their favourite local restaurants. They research the market, identify who the users will be (students, office workers, families), and define the main features the app must have (e.g., list of restaurants, menus, online payment, delivery tracking).
- **Designing:** Next, the team designs the app. This is like creating an architect's blueprint. They design the **user interface (UI)**,

deciding how the app will look and feel. They also design the **system architecture**, figuring out how the app on a user's phone will communicate with the restaurant and the delivery riders.

- **Implementation (Writing the Code):** This is the programming stage. The software developers write the instructions in a programming language to build the actual app. They might use Swift or Kotlin to build the mobile app, and other languages like Python to build the server that manages all the orders.
- **Testing:** Once the app is built, it is tested thoroughly to find and fix any errors or “bugs.” A testing team will try to “break” the app by placing strange orders, testing the payment system with different cards, and making sure the delivery tracking is accurate. This is a critical step to ensure the app is reliable.
- **Deployment:** After all the bugs are fixed, the finished app is released to the public. The “LabuanEats” app would be uploaded to the Google Play Store and Apple’s App Store for users to download.
- **Maintenance:** The work is not over after the app is released. The developers must continuously maintain it. This involves fixing any new bugs that are discovered, providing regular security updates, and sometimes adding new features based on feedback from users in Labuan.

This structured process helps ensure that complex software projects are completed on time, within budget, and meet the needs of the users.

## Check Your Understanding: Q10





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## Check Your Understanding: Q11



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## Check Your Understanding: Q12



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## Check Your Understanding: Q13



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## Check Your Understanding: Q14



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## Chapter Summary

In this chapter, we explored the world of computer software that brings hardware to life. We identified the two main categories: system software that manages the computer and application software for user tasks. We learned about the critical functions of the operating system, and recognized various types of application software for productivity, communication, and business needs. We explained the different ways software is licensed and distributed, including commercial, free, and open-source models. We also

understood the importance of software updates for security , the dangers of malware , and the steps needed to protect our devices. Finally, we outlined the structured process of the Software Development Life Cycle (SDLC) used to create high-quality applications.

## Review Questions

1. In your own words, what is the difference between system software and application software? Give one example of each.
2. List three important jobs that an operating system (OS) performs.
3. Name one type of productivity software and one type of communication software. Give a specific example for each one.
4. Imagine a local business in Labuan, like a hotel or a shop. Name one type of business software they could use and explain in one sentence how it would help them.
5. What is the main difference between subscription software (like Microsoft 365) and open-source software (like Linux)?
6. Explain the difference between a native app and a web app. Give an example of a web app you might use for online banking in Malaysia.
7. Why is it important to always keep your software updated?
8. What is malware? Name two common types of malware described in the chapter.

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# Chapter 6: Managing Your Digital Workspace and Files

## Learning Objectives

Welcome to Chapter 6! In this section, we will take a deep dive into the most important software on your computer: the operating system. It is the silent manager that works tirelessly in the background to make your digital life possible. After studying this chapter, you will be able to:

- Explain the main roles of an operating system in managing a computer's resources.
- Identify and compare common operating systems for desktops, laptops, and mobile devices.
- Understand and navigate the structure of a file system using a file manager.
- Describe the purpose of common tools used for system maintenance and optimisation.
- Recognise the importance of backing up your data and the tools available to do so.

# Introduction

Imagine a busy office in a Kuala Lumpur skyscraper. There are many employees, each working on different tasks with different equipment such as computers, printers, phones, and projectors. For this office to function efficiently, it needs a manager. This manager doesn't do every task themselves, but instead coordinates everything. They make sure the right documents go to the right people, that the printer is available when someone needs it, and that the office itself is organised so people can find what they are looking for.

The **operating system (OS)** is the manager of your computer. It is the essential software that helps you organise your digital files, run your programs, and use all your connected devices, from your mouse to your printer. It is the first thing that greets you when you turn your computer on and the last thing you see when you shut it down.

Whether you are writing an email, browsing a shopping website like Lazada, or attending an online class, the OS is the silent partner that makes it all happen. This chapter will teach you how to navigate your digital workspace, understand the powerful tools the OS provides, and use them to keep your computer tidy, efficient, and safe.



Figure 6.1: The Operating System's User Interface in Action. The Graphical User Interface (GUI) is the friendly visual environment that the operating system provides for you to interact with your computer. It allows you to run many different applications at the same time, such as writing a document, browsing a shopping website, sending an email, or printing a file. The OS is the silent partner that manages all these tasks in the background, making modern multitasking possible. (Image generated with AI assistance using Gemini Pro 2.5.)

## The Core Functions of an Operating System

The operating system is a powerful and complex piece of system software that handles several critical jobs to make your computer usable. Without it, your laptop would be a collection of plastic and

metal, unable to do anything. Let's explore its main roles in more detail.

1. **Provides a User Interface (UI)** The most visible job of the OS is to provide the **user interface (UI)**: This is the way you interact with your computer. The friendly desktop, the icons you click on, and the menus you navigate are all created and managed by the OS. In the past, users had to type complex text commands to get the computer to do anything. Today, modern operating systems use a Graphical User Interface (GUI) with visuals that make the computer easy and intuitive to use. It acts as the helpful bridge connecting you, your applications, and the computer's hardware.
2. **Manages and Coordinates Hardware Resources:** The OS is the master controller of all the computer's physical components (hardware). It manages the Central Processing Unit (CPU), memory (RAM), storage drives, and all connected devices like the keyboard, mouse, and printer. For example, when you are watching a YouTube video while downloading a file and your antivirus software is running a scan in the background, the OS is carefully managing the CPU's time. It gives a small slice of time to each task, switching between them so quickly that it appears they are all running at once. This coordination ensures that all the computer's activities happen smoothly and do not interfere with each other.
3. **Manages Software and Applications:** When you double-click an icon to open a program, it is the OS that finds that program on your storage drive (like an SSD or hard drive) and loads it into the computer's main memory, or RAM. RAM is where programs "live" while they are running, as it is much faster for the CPU to access. The OS is also responsible for properly closing applications and clearing them from RAM when you are finished, freeing up resources for other tasks.
4. **Provides File Management and Organisation:** Your computer might contain thousands of files such as documents, photos,

music, and videos. The OS is responsible for organising all of this data. It creates a file system, which is a structure of drives, folders, and files that allows you to store and find your information logically. We will explore this in more detail later in the chapter.

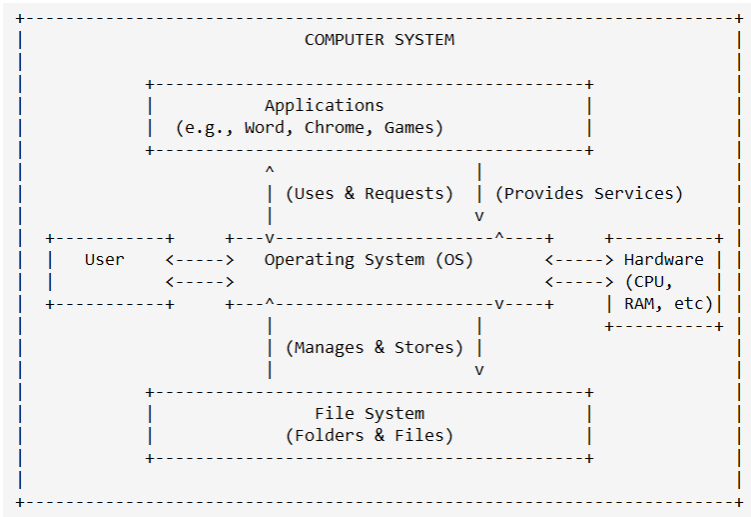


Figure 6.2: The Central Role of the Operating System. This diagram illustrates how the operating system (OS) acts as the core manager of a computer system. It serves as a critical bridge, handling interactions between the User, the computer's physical Hardware (like the CPU and RAM), the Applications (like Word or Chrome), and the File System. The OS provides the user interface, manages and coordinates hardware resources, provides services to applications, and organizes data in the file system, making the entire computer a usable tool. (Image generated with AI assistance using Deepseek-V2)

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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# Waking Up the Computer: The Boot Process

Have you ever wondered what actually happens when you press the power button on your computer? That moment between pressing the button and seeing your familiar desktop is a critical start-up procedure managed by the operating system, often called the boot process. It is like the opening ceremony for your computer's daily work.

The process happens in a few simple steps:

1. **Power On:** When you press the power button, an electrical signal is sent to the computer's components, including a special chip on the motherboard that contains the BIOS (Basic Input/Output System) or the more modern UEFI (Unified Extensible Firmware Interface).
2. **The System Checks Itself:** The BIOS/UEFI wakes up and performs a quick test, called the Power-On Self-Test (POST). It quickly checks that all the essential hardware components, like the CPU, memory (RAM), and storage drive, are connected and working correctly. You might hear a small "beep" sound, which on many computers signals that the test was successful.
3. **Finding the Operating System:** After the hardware check is complete, the BIOS/UEFI looks for the operating system. It checks your main storage drive (your SSD or HDD) for a special program called a bootloader.
4. **Loading the Operating System:** The bootloader is a small program whose only job is to start the operating system. Once found, it begins to load the main part of the OS—called the kernel—from the storage drive into RAM. The kernel is the heart of the operating system; it manages the most important functions. As the OS loads, you will typically see the logo for your operating system appear on the screen, like the Windows or Apple logo.
5. **Desktop Appears:** Once the operating system is fully loaded

into memory, it takes control of the computer. It starts up all the necessary background services and then displays the user interface—your familiar login screen or desktop, ready for you to begin working.

This entire process, which feels almost instant on modern computers with fast SSDs, is a perfectly coordinated sequence that brings your computer from a silent box of parts to a powerful, interactive tool.

# The Boot Process

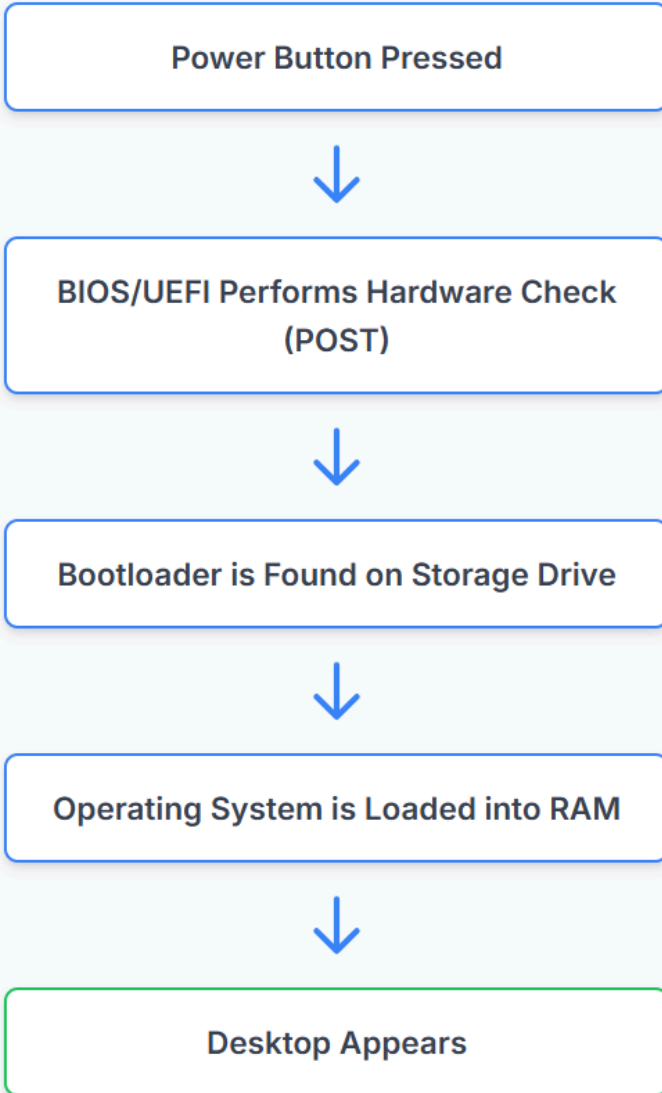


Figure 6.3: The Boot Process Flowchart. This flowchart illustrates the critical

start-up procedure that occurs when a computer is turned on. The process begins when the power button is pressed, which activates the BIOS/UEFI to perform a Power-On Self-Test (POST) to check the hardware. Once the hardware is confirmed to be working, the BIOS/UEFI locates the bootloader on the storage drive. The bootloader then loads the core of the operating system into RAM. Finally, the operating system takes control and displays the desktop, making the computer ready for the user. (Image generated with AI assistance using Deepseek-V2.)

## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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# The User Interface: Your Window to the Digital World

The user interface (UI) is the part of the operating system that you see and interact with. It is the visual bridge that translates your clicks and taps into commands the computer can understand. Over the years, the way we interact with computers has changed dramatically.

## From Text to Graphics: CLI vs. GUI

In the early days of computing, there was no desktop, no icons, and no mouse. To use a computer, you had to type specific text commands. This was called a **Command-Line Interface (CLI)**. You had to memorise commands to do everything, like `COPY C:\file.txt D:\` just to copy a file. It was powerful but not very friendly for beginners.

Today, nearly all personal computers use a **Graphical User Interface (GUI)**. A GUI uses visual elements like icons, windows, and menus to make the computer much easier and more intuitive to use. Instead of typing a command, you simply use a mouse to click, drag, and drop icons and files. The GUI is what most people think of when they think of using a computer.

## Common Elements of a Modern GUI

- **The Desktop:** This is your main work area, like the top of a physical desk. It is where you can place shortcuts to your most used files, folders, and applications.
- **Icons:** Small pictures that represent a program, a file, or a

function. Double-clicking an icon opens the corresponding item.

- **Windows:** The rectangular boxes that contain your running applications. You can have multiple windows open at once, and you can move, resize, or minimise them.
- **Menus:** Lists of commands and options that you can choose from within an application. You usually find them at the top of the screen or a window (e.g., File, Edit, View).
- **Taskbar or Dock:** A bar, usually at the bottom of the screen, that shows which applications are currently running and allows you to switch between them quickly.

This graphical environment, managed by the OS, is what makes modern computing accessible to everyone, not just computer experts.

```
Welcome to FreeDOS

CuteMouse v1.9.1 alpha 1 [FreeDOS]
Installed at PS/2 port
C:\>ver

FreeCOM version 0.82 pl 3 XMS_Swap [Dec 18 2003 06:49:21]

C:\>dir
Volume in drive C is FREEDOS_C95
Volume Serial Number is 0E4F-19EB
Directory of C:\

FDOS          <DIR>    08-26-04  6:23p
AUTDEXEC     BAT         435    08-26-04  6:24p
BOOTSECT     BIN         512    08-26-04  6:23p
COMMAND      COM    93,963    08-26-04  6:24p
CONFIG       SYS         801    08-26-04  6:24p
FDOSBOOT     BIN         512    08-26-04  6:24p
KERNEL       SYS    45,815    04-17-04  9:19p
             6 file(s)          142,038 bytes
             1 dir(s)    1,064,517,632 bytes free

C:\>_
```

Figure 6.4: An Example of a Command-Line Interface (CLI). This image shows a Command-Line Interface (CLI), where the user must type specific text commands to interact with the computer. In the early days of computing, this was the only way to operate a machine. While powerful, this method is not very friendly for beginners because it requires the user to memorize a wide range of commands to perform tasks. Image Credit: “FreeDOS\_Beta\_9\_pre-release5\_(command\_line\_interface)\_on\_Bochs\_ssh of20040912” by Jim Hall and others is in the Public Domain, via Wikimedia Commons.

# A Tour of Common Desktop Operating Systems

While there are many operating systems, a few major players dominate the world of desktop and laptop computers. Each has its own history, strengths, and is known for different things.

## Microsoft Windows

Microsoft Windows is, by a large margin, the most popular and widely used desktop operating system in the world. If you have used a computer at a school, government office, or business in Malaysia, it was almost certainly running a version of Windows.

The first version of Windows was released in 1985, but it was Windows 95 that truly made the GUI popular with its introduction of the Start menu and taskbar. Since then, many versions have been released, including the very popular Windows XP, Windows 7, Windows 10, and the current Windows 11.

### **Key Strengths:**

- **Hardware and Software Compatibility:** Because it is so dominant in the market, nearly all hardware manufacturers and software developers make products that are compatible with Windows. This means you have the widest possible choice of programs and devices.
- **Familiarity:** It is the OS that most people learn first, making it very familiar and easy to use for a majority of the world's computer users.

Windows is the standard for most business and personal computing tasks, from writing documents and creating spreadsheets to playing games.

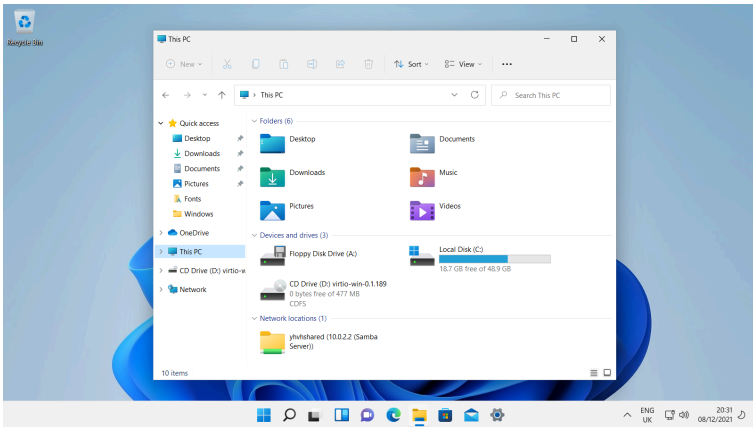


Figure 6.5: The Windows 11 desktop and File Explorer. This image shows the modern look of Windows 11. A key feature is the centered Start Menu and application icons on the taskbar, which is a change from older versions of Windows. The open window is File Explorer, the file manager application used to navigate the computer's drives, folders, and files. Image Credit: "Windows 11 Screenshot" by okubax is licensed under CC BY 2.0, via Wikimedia Commons.

## Apple macOS

Apple's macOS is the operating system that runs exclusively on Apple's line of Macintosh computers, such as the MacBook, iMac, and Mac Pro. Apple has always been known for its focus on design and ease of use, and macOS reflects this philosophy.

Originally released in 1984 as the Macintosh Operating System, it was one of the first commercially successful operating systems to feature a graphical user interface. Over the years, it has evolved, with major versions being named after big cats (like Leopard and Tiger) and now, locations in California (like Monterey and Sonoma).

### Key Strengths:

- **User-Friendly Design:** macOS is widely praised for its clean, elegant, and intuitive interface. Many users find it very easy to

learn and navigate.

- **Strong Graphics and Creative Capabilities:** Historically, Macs have been the preferred choice for professionals in creative fields like graphic design, video editing, and music production. The OS is highly optimised for these tasks.
- **Integration with Apple Ecosystem:** macOS works seamlessly with other Apple products like the iPhone and iPad, allowing for easy syncing of files, photos, and messages between devices.

While it has a smaller market share than Windows, macOS has a very loyal user base, especially within the creative industries.



Figure 6.6: The macOS Desktop Environment. This screenshot shows the clean and graphical user interface of Apple's macOS. Key features include the menu bar at the very top of the screen (with options like File, Edit, View) and the Dock at the bottom, which provides easy access to frequently used applications. Image Credit: "Screenshot\_of\_macOS\_Sequoia", used under fair use, from Wikipedia.

## Linux

Linux is unique among the major operating systems. It is not owned

by a single company like Microsoft or Apple. Instead, Linux is **open-source**, which means its source code (the original instructions written by the programmers) is freely available for anyone to view, modify, and distribute.

It was created in 1991 by Linus Torvalds and has since been developed by a massive global community of volunteer programmers. Because it is open-source, Linux comes in many different versions, called **distributions** (or “distros”). Some of the most popular and user-friendly distributions include Ubuntu, Linux Mint, and Fedora.

**Key Strengths:**

- **Stability and Reliability:** Linux is known for being extremely stable and reliable. It rarely crashes, which is why it is the most popular operating system for web servers that need to run 24/7. In fact, the majority of the world’s internet, including the servers that power Google and Facebook, runs on Linux.
- **Free and Customisable:** Most Linux distributions are completely free to download and use. Because it is open-source, users have complete freedom to customise almost every aspect of the operating system to their liking.
- **Security:** The open-source nature of Linux means that many developers around the world are constantly reviewing the code for security flaws, making it generally less of a target for viruses compared to Windows.

While it has a smaller share of the desktop market, Linux is a dominant force in the world of servers and is loved by programmers and tech enthusiasts.



## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## The World of Mobile Operating Systems

The principles of an operating system are the same on a mobile device as on a desktop, but they are optimised for a smaller, touch-based screen and for tasks we do on the go. The mobile OS market is dominated by two major players.

# Google Android

Android is the world's most popular operating system for mobile phones and tablets. It was developed by Google and, like Linux, its core is open-source. This means that any manufacturer can take the Android OS and modify it for their own devices.

This is why Android is found on a huge variety of phones from many different companies, such as Samsung, Xiaomi, Oppo, and Vivo—all brands that are very popular in Malaysia. While the core system is the same, each company often adds its own customised user interface on top, which is why a Samsung phone looks and feels slightly different from a Xiaomi phone, even though both are running Android.

## **Key Strengths:**

- **Wide Variety of Devices:** Because so many companies use Android, customers have a massive choice of phones at all different price points.
- **Customisation:** Android is known for being highly customisable. Users can change everything from the home screen layout to the default applications.



Figure 6.8: The Android 15 user interface. The home screen is the starting point for navigating Android 15. While it looks simple, this version includes major updates focused on security and user experience. Key improvements in Android 15 include the “Privacy Sandbox” to protect user data from advertisers, better support for foldable devices, and new controls for the camera and other hardware. The clean layout with the Google Search bar at the bottom is designed for easy and quick access to information. Image Credit: “Menu\_de\_inicio\_en\_Android\_15\_en\_un\_Google\_Pixel\_7a” by Cobreti21 is licensed under CC0 1.0 Universal Public Domain Dedication, via Wikimedia Commons.

# Apple iOS

iOS is the operating system that runs exclusively on Apple's mobile hardware: the iPhone and the iPad. Unlike Android, iOS is a closed-source system. Apple controls both the hardware (the iPhone) and the software (iOS), creating a tightly integrated ecosystem.

This approach means that Apple can ensure the OS is perfectly optimised for the hardware it runs on, leading to a very smooth and consistent user experience across all its devices.

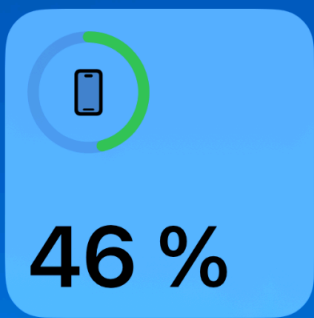
## **Key Strengths:**

- **Simplicity and Ease of Use:** iOS is famous for its simple, clean, and intuitive user interface. It is very easy for new users to learn and navigate.
- **Security and Privacy:** Apple places a strong emphasis on security. The closed nature of the system and the strict review process for apps on the App Store make iOS generally very secure from malware.
- **Ecosystem Integration:** Just like macOS, iOS works seamlessly with other Apple products. Photos taken on an iPhone appear on a MacBook automatically, and you can start writing an email on your iPad and finish it on your Mac.

While Android offers more choice in hardware, iOS offers a very consistent, secure, and easy-to-use experience for users who are invested in the Apple ecosystem.

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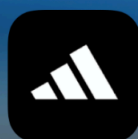


Figure 6.9: The iOS 18 4.1 user interface. This screenshot shows the home screen of Apple's iOS, the operating system for the iPhone. It features a grid of application icons, such as Photos, Camera, and the App Store, which launch programs with a single tap. At the bottom is the dock, which holds frequently used apps. The clean, simple layout is a key characteristic of the iOS user experience. Image Credit: "IOS\_18.4.1\_screenshot\_%282025%29" by Lopatalopez is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Check Your Understanding: Q9



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## Check Your Understanding: Q10



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## Check Your Understanding: QUIZ



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## Managing Your Digital Life: The File Manager

Every operating system includes a crucial **utility** program called a **File Manager**. This is your primary tool for organising the thousands of files on your computer. In Microsoft Windows, this tool is called **File Explorer**, and on Apple's macOS, it is called **Finder**.

### The Filing Cabinet Analogy

Think of your computer's storage drive like a large filing cabinet. If you just threw every piece of paper into the cabinet randomly, it would be almost impossible to find anything. Instead, you use folders to organise your documents. You might have a main folder for "Work," and inside that, sub-folders for "Projects" and "Reports." Inside the "Projects" folder, you might have another folder for each specific project.

A file manager allows you to create this same kind of **hierarchical structure** on your computer. It starts with the main drive (like the C: drive in Windows), which contains folders. Those folders can contain more folders (sub-folders) and individual files. This system

allows you to keep your digital life organised and find what you need quickly.

## Common File Management Tasks

Using a file manager, you can perform all the essential tasks for organising your data:

- **View and Open:** See the contents of folders and open files with the correct application.
- **Copy and Move:** You can copy a file to create a duplicate in another location, or move a file to a new folder.
- **Rename:** Change the name of a file or folder to make it more descriptive.
- **Delete:** Remove files and folders that you no longer need. (They usually go to a Recycle Bin or Trash, giving you a chance to recover them if you make a mistake).

Mastering the use of your file manager is a fundamental skill for using a computer effectively.

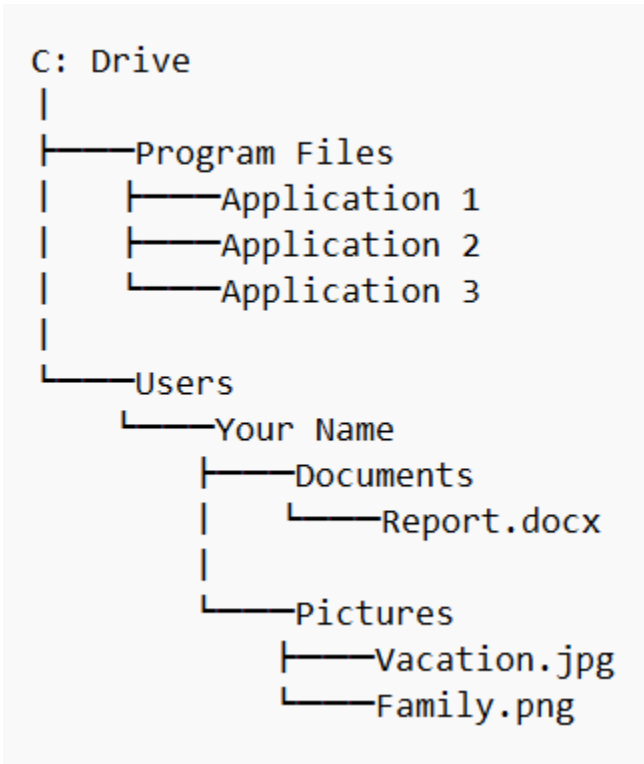


Figure 6.10: A Hierarchical File System. This diagram shows a hierarchical file system, which is how an operating system organizes data. It starts with a main drive (like the C: Drive), which contains folders. These folders can contain sub-folders and individual files, creating a logical structure that makes it easy to find your information, much like an organized filing cabinet. (Image generated with AI assistance using Deepseek-V2.)

## Keeping Your Workspace Tidy: System Maintenance Utilities

Just like a physical office or a car, your computer needs regular maintenance to keep it running at its best. Operating systems

include several utility tools designed to perform these maintenance tasks, helping to keep your system clean, organised, and fast.

**Disk Cleanup** As you use your computer, temporary files are created by your web browser and applications. These are like the rough drafts and scrap paper you might leave on your desk after finishing a project. Over time, these unnecessary files can build up and take up valuable storage space. The **Disk Cleanup** utility scans your storage drive and finds these temporary files, allowing you to safely delete them and free up space. Running this tool every few months is like tidying up your storeroom—it gets rid of the clutter and gives you more room to work.

**Disk Defragmenter** This tool is mainly for older computers that use a traditional Hard Disk Drive (HDD). An HDD stores data on a spinning platter. Sometimes, a large file might be saved in many small pieces scattered all across the platter. This is called **fragmentation**. When you want to open that file, the drive has to work hard to find all the scattered pieces, which can slow your computer down. Imagine a book whose pages have been torn out and scattered around a room, then it would take a long time to gather them all in the right order to read. The **Disk Defragmenter** is like a helpful librarian that gathers all the scattered pages and puts them back in order. It reorganises the files on the disk so that all the pieces are stored next to each other in a continuous block. This makes it much faster for the computer to read the files. It's important to note that modern Solid-State Drives (SSDs) work differently and do not need to be defragmented.

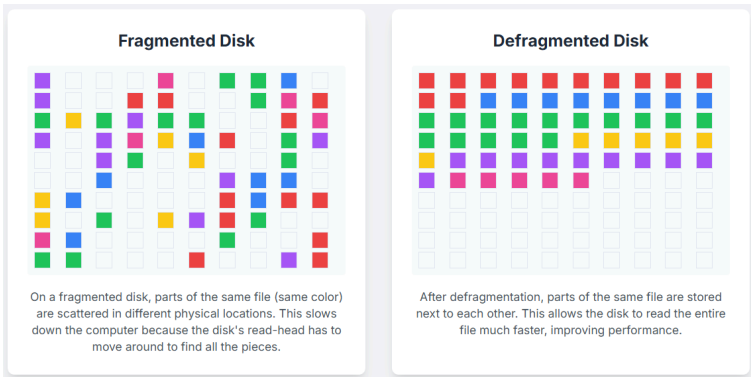


Figure 6.11: Disk Fragmentation and Defragmentation. This diagram illustrates how disk defragmentation works. On the left, a fragmented disk has parts of the same file (represented by color) scattered in different locations, which slows down the computer. On the right, a defragmented disk has organized the files into continuous blocks, making them much faster to read. (Image generated with AI assistance using Deepseek-V2.)

## Protecting Your Workspace: Backup and Security Tools

Perhaps the most important maintenance task of all is protecting your valuable data. Your files—from important work reports to precious family photos—are often irreplaceable. Operating systems provide essential tools to help you keep them safe.

**Backup and Restore Tools** A **backup** is a copy of your files that is stored in a separate, safe location. It is your safety net. If your computer is ever lost, stolen, damaged by a power surge, or infected with ransomware, your original files could be gone forever. But if you have a backup, you can **restore** your files onto a new computer and continue your work.

Imagine you have spent months working on your final year project for your studies at Universiti Malaysia Sabah, and the day before you need to submit it, your laptop’s hard drive fails. If you do not have a

backup, all that hard work is lost. It is a terrible situation that can be easily avoided.

There are two main ways to back up your data:

1. **Local Backup:** This involves copying your files to an external storage device, like an external hard drive or a large USB flash drive, which you keep in a safe place.
2. **Cloud Backup:** This involves using a service that copies your files over the internet to be stored on remote servers. This is very convenient because it often happens automatically in the background. Popular services include Google Drive, Microsoft OneDrive, and Dropbox.

For maximum safety, it is a good idea to use both methods.

**Security Utilities** Modern operating systems also have built-in security tools. A **firewall**, for example, acts like a security guard for your internet connection, monitoring the data coming in and out of your computer and blocking potential threats. Tools like Windows Security or macOS's Gatekeeper also help to protect you from malware and suspicious applications.

## Check Your Understanding: Q12



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## Check Your Understanding: Q13



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## Check Your Understanding: Q14



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## Check Your Understanding: Q15



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## Chapter Summary

In this chapter, we learned that the operating system (OS) acts as the essential manager of the computer, making it a usable and productive tool. Its main jobs are to provide the user interface that we interact with, and to coordinate all the computer's hardware and software so they can work together efficiently. We toured the most common operating systems for desktops, such as the widely compatible Windows, the user-friendly macOS, and the open-source Linux. We also looked at the dominant mobile operating systems, Android and iOS, which are optimised for our devices on the go.

Beyond these core functions, we explored the many useful utility tools that operating systems provide to help us manage our digital workspace. We learned how the File Manager helps us organise our files and folders in a logical structure, and how system maintenance tools like Disk Cleanup can keep our computers running smoothly. Finally, we understood the critical importance of protecting our data with Backup and Restore tools, which create safe copies of our irreplaceable files.

## Review Questions

1. In your own words, describe two of the main jobs of an operating system.
2. What is the main difference between a Command-Line Interface (CLI) and a Graphical User Interface (GUI)?
3. What is the key difference between how the Android OS and the iOS are used by phone manufacturers?
4. Explain the concept of a hierarchical file system using the analogy of a filing cabinet.
5. What is file fragmentation, and which maintenance tool is used

- to fix it? Why is this tool not needed for an SSD?
6. Why would you use a file compression tool like the one that creates a zipped file?
  7. What is a backup, and why is it important for a student working on a final year project to back up their data regularly?
  8. Explain what a File Manager allows you to do. What is this tool called in Microsoft Windows and Apple macOS?

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# Chapter 7: The Internet and the Web

## Learning Objectives

Welcome to Chapter 7! In our last discussion, we learned how the operating system manages our personal digital workspace. Now, we are going to zoom out and explore the global network that connects all our devices together, changing how we learn, work, and connect with each other. After studying this chapter, you will be able to:

- Describe the evolution of the Internet and the various ways we connect to it.
- Explain the role of an Internet Service Provider (ISP) and how data travels across the globe.
- Clearly differentiate between the physical Internet and the content-rich World Wide Web.
- Identify the parts of a web address and describe how to navigate the web effectively and safely.
- Recognise the wide range of services available on the internet beyond the web, such as email, messaging, and VoIP.
- Understand and apply the basic rules of netiquette for respectful and professional online

communication.

- Discuss the concept of the digital divide and its impact.
- Identify common online security threats and the basic practices to keep your data safe.

## Introduction

For any university student today, daily life is deeply intertwined with a massive, invisible infrastructure that connects them to a world of information and communication. This global system of connected computer networks is, of course, **the internet**.

The internet allows a student to find research papers from international universities, watch tutorial videos on YouTube, access their university's online portal, and communicate with lecturers and classmates instantly. It allows for collaboration on documents in real-time with group members who may be in different cities. The internet is the platform that makes modern education and work possible.

In this chapter, we will explore what the internet is, how we connect to it, the difference between the internet and the World Wide Web, and the many powerful services it offers. We will look at how a fast campus Wi-Fi connection compares to a mobile data plan in a rural area, highlighting the different ways we interact with this incredible digital world.

# The Evolution of the Internet: From Secret Project to Global Network

The internet we use so effortlessly didn't just appear overnight. Its story begins not in a modern tech company, but in the context of the Cold War in the 1960s. The United States government, concerned about national security, funded a project through its Advanced Research Projects Agency (ARPA). The project, which became known as **ARPANET**, had a clear and vital goal: to create a decentralized computer network. This meant building a communication system that could survive a major attack. If one part of the network was destroyed, the rest of it had to be able to reroute information and keep functioning. It was a network designed for survival and resilience.

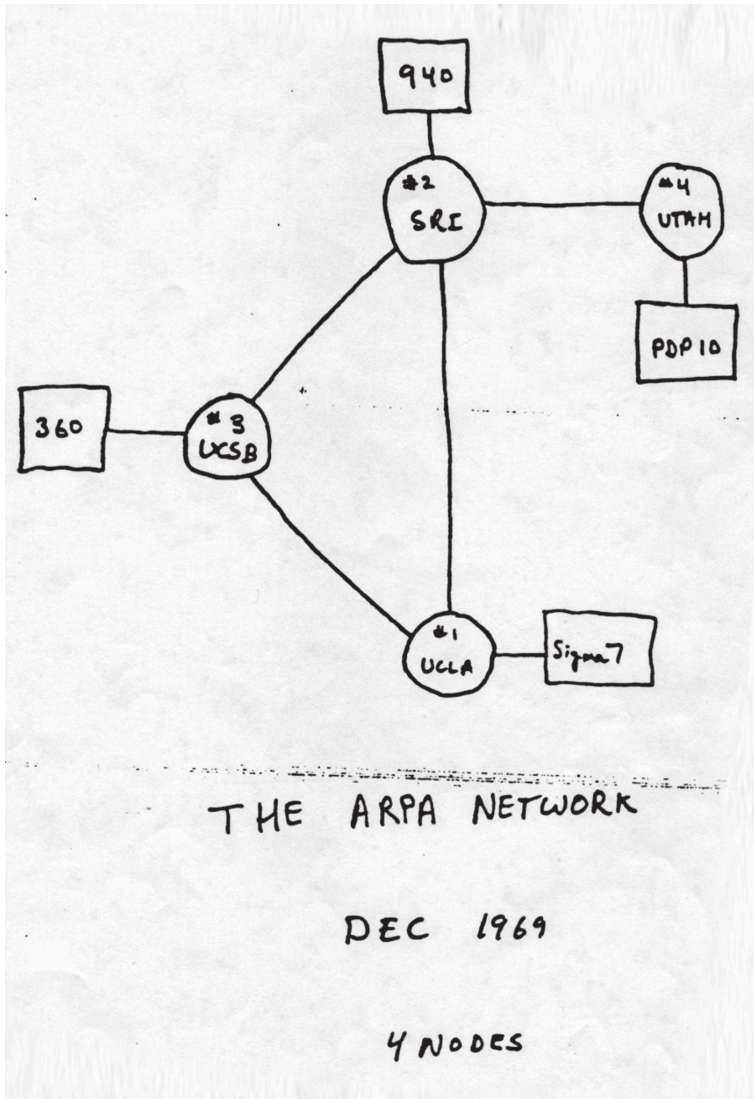
## The First Connection: A Humble Beginning

The very first connection on ARPANET was established in late 1969. It was a historic moment, linking just two locations. The first message was sent from a host computer at the **University of California, Los Angeles (UCLA)** to another at the **Stanford Research Institute (SRI)**. The plan was to type the word "LOGIN" to sign into the remote system. A researcher at UCLA typed "L" and asked his colleague at SRI over the phone, "Did you see the L?" The colleague confirmed he had. Then he typed "O" and asked again, "Did you see the O?" Again, the answer was yes. When he typed the "G," the system crashed!

So, the very first message ever sent over what would become the internet was "LO". It was a humble, almost comical start, but it proved the fundamental concept worked: two computers, hundreds of miles apart, could communicate over a network.

By the end of 1969, the network had grown to include two more

key locations: the **University of California, Santa Barbara (UCSB)** and the **University of Utah**. These four institutions formed the original four “nodes” of ARPANET. These powerful computers, which stored and shared information, were called **hosts** or **servers**.



**Figure 7.1:** A sketch of the ARPANET in December 1969. This

simple sketch shows the original design of the ARPANET, the network that would eventually become the internet. It illustrates the first four “nodes” that were connected: the University of California, Los Angeles (UCLA), the Stanford Research Institute (SRI), the University of California, Santa Barbara (UCSB), and the University of Utah.

Image Credit: “A\_sketch\_of\_the\_ARPANET\_in\_December\_1969” by DARPA is in the Public Domain, via Wikimedia Commons.

## Packet Switching: The Secret Sauce of the Internet

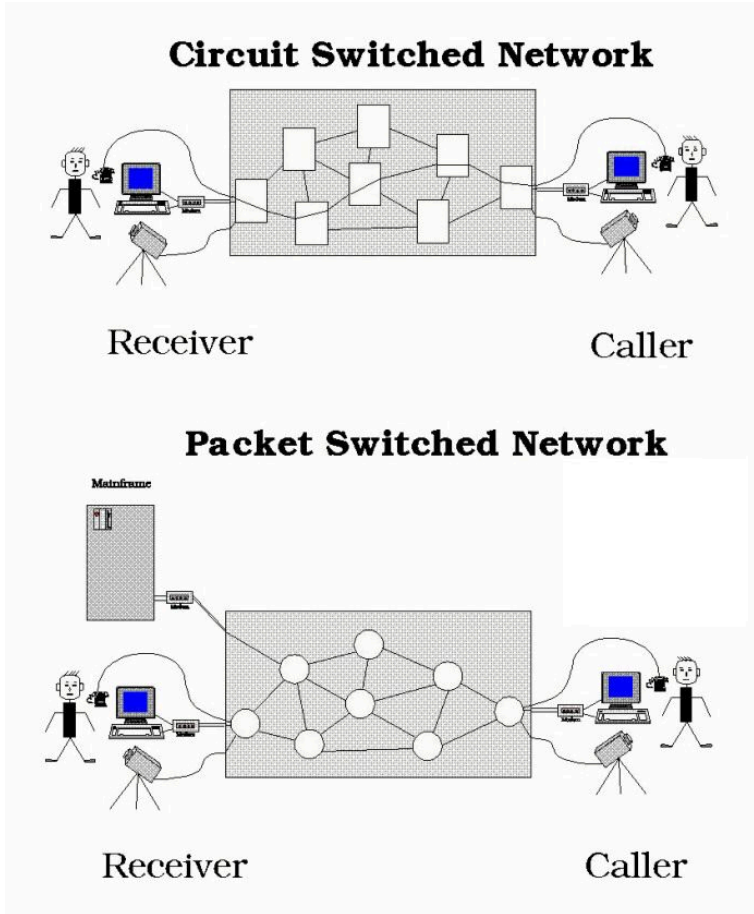
To make this decentralized network possible, ARPANET pioneered a revolutionary technology called **packet switching**. Before this, most communication networks used “circuit switching,” like a traditional phone call. When you called someone, the telephone exchange created a dedicated, unbroken connection (a circuit) between you and the other person for the entire duration of your call. This was inefficient, as the line was tied up even during moments of silence.

Packet switching worked differently. It broke down a large message (like an email or a file) into many small, equally sized blocks of data called **packets**. Each packet was given a digital “address label” with information about its destination and its place in the original message (e.g., “packet 3 of 10”). These packets were then sent out onto the network individually.

Imagine sending a book from Labuan to Kuala Lumpur. Instead of sending the whole book in one big box, you tear out every page, put each page in a separate envelope with the final address and a page number, and mail them all. The pages might travel on different lorries and planes and arrive out of order, but because they are numbered, the person in KL can reassemble them into the correct book.

This is exactly how packet switching works. The packets from a single message can travel along different routes on the network. If

one route is congested or broken, a packet can be rerouted. This made the network incredibly robust and efficient, as there was no single point of failure. This same fundamental technology of packet switching is still at the heart of how data travels across the internet today.



**Figure 7.2: Circuit Switching vs. Packet Switching.** This diagram illustrates two different ways of sending information. The top image, Circuit Switching, shows a single, dedicated, and unbroken connection, like a traditional phone call. The bottom image, Packet Switching, is the technology used by the internet. It breaks a

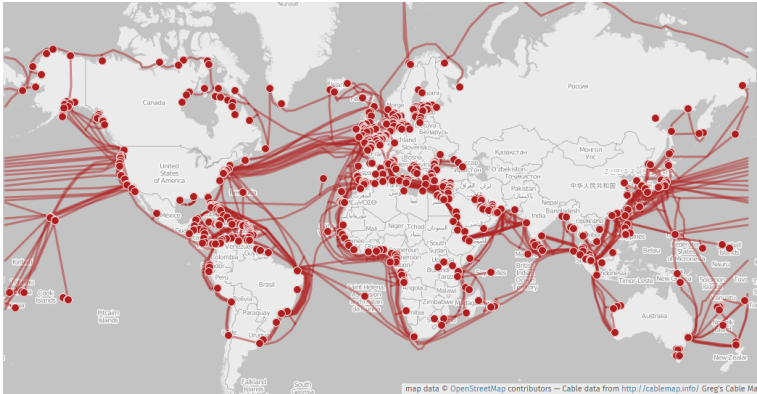
message into small packets that can travel along different routes before being reassembled at the destination. This method is more efficient and makes the network more resilient to disruptions.

Image Credit: “PK Switched Vs Circuit Switched” by Sajidur89 is licensed under CC BY-SA 3.0, via Wikimedia Commons.

## Growth and the Birth of TCP/IP

As more universities and research groups saw the value in sharing information this way, they began connecting their own networks to ARPANET. Imagine it like building a national road system. ARPANET was the first major highway. Over the next two decades, other organizations built their own smaller road networks. Eventually, to ensure all these separate networks could communicate flawlessly, two brilliant computer scientists, Vinton Cerf and Robert Kahn, developed a universal set of traffic rules. This communication standard, called **TCP/IP (Transmission Control Protocol/Internet Protocol)**, was officially adopted by ARPANET in 1983. It is the language that allows all the different networks in the world to connect to the main highway and talk to each other.

The adoption of TCP/IP was the final key step. As more and more networks interconnected using this standard, they formed a massive “network of networks.” This is what we now call the internet. The main highways of this system are formed by incredibly high-speed data lines, often fibre optic cables laid under the oceans, that connect continents. This is known as the **internet backbone**. When someone sends a WhatsApp message from a kampung in Labuan to a cousin studying in London, their data is broken into packets that travel from their phone, through local networks, and eventually hit this global backbone to be reassembled in London in a fraction of a second.



**Figure 7.3: The Global Internet Backbone.** The internet is a physical ‘network of networks’ connected by incredibly high-speed fibre optic cables. This map shows the vast web of submarine (undersea) cables that form the backbone of the global internet, connecting continents and countries like Malaysia to the rest of the world.

Image Credit: “Submarine\_cable\_map\_unmap” by Greg Mahlknecht, map by Openstreetmap contributors, is licensed under CC BY-SA 2.0, via Wikimedia Commons.

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Connecting to the Internet: The On-Ramp to the Digital Highway

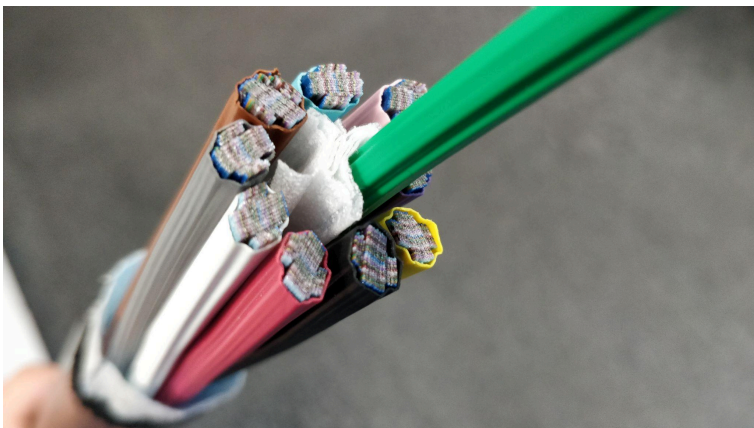
To get online, every user needs a connection—an on-ramp to the global digital highway. Today, most connections are **broadband**, which simply means they are high-speed and always on, unlike the old “dial-up” connections that were slow and required you to dial a phone number.

Let’s look at the different ways we connect:

### Wired Connections (Using a Physical Cable)

- **Fibre to the Premises (FTTP):** This is the gold standard for home and office internet in Malaysia. It uses fibre optic cables, which are tiny strands of glass that transmit data as pulses of light, making them incredibly fast and reliable. A university campus accommodation is often connected via **Unifi**, a popular FTTP service from Telekom Malaysia (TM). This provides a very fast and stable connection, perfect for streaming high-definition videos for research and having smooth video calls.

- **Cable:** In some areas, the same coaxial cable network that delivers television channels can also provide a high-speed internet connection.
- **DSL (Digital Subscriber Line):** This technology uses the existing copper telephone lines to provide an internet connection. It is generally slower than fibre but was a very common type of broadband before FTTP became widespread.



**Figure 7.4: A Close-Up of a Fibre Optic Cable.** This image shows a cross-section of a modern fibre optic cable. Each of the smaller coloured ribbons contains dozens of tiny strands of glass, each thinner than a human hair. Data travels through these strands as pulses of light, which is what makes fibre connections like Unifi incredibly fast and reliable compared to older copper cables.

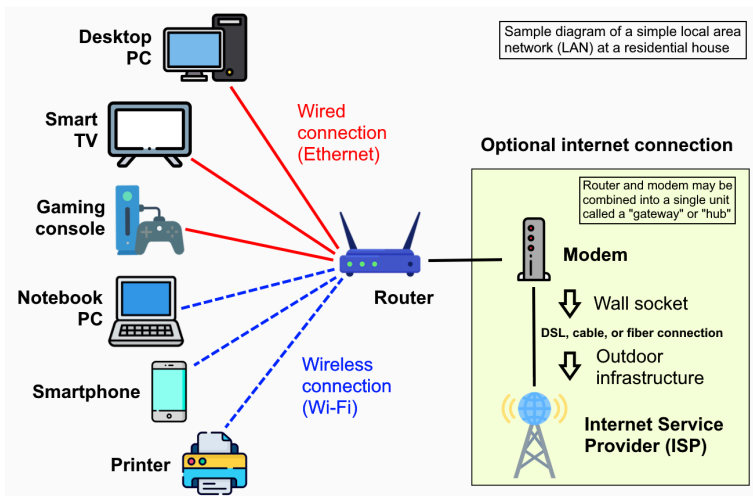
Image Credit: “RibbonCutout2” by Infestor is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Wireless Connections (Using Radio Waves)

- **Wi-Fi:** This is a technology that uses radio waves to provide a wireless connection over a short distance. A laptop can connect to a **router** in a dorm or home, which is physically connected

to a fibre line. The router creates a wireless network, or **Wi-Fi**, allowing internet use without being plugged in with a cable. This is the same technology used in cafes, airports, and public libraries across Malaysia.

- **Mobile Broadband:** This is how most of us connect to the internet on the go, using our smartphones. A student at a cafe in Kota Kinabalu might use their phone's **4G** or **5G** data plan to get online. These "G"s stand for "generation," with 5G being the latest and fastest standard. This is a crucial service provided by companies like Maxis, CelcomDigi, and U Mobile.
- **Fixed Wireless:** This is a solution for places where laying a physical cable is difficult. A provider mounts an antenna on a building that communicates wirelessly with a nearby tower to provide an internet connection. This can be a good option for some businesses or homes in suburban areas.
- **Satellite:** This is the ultimate solution for very remote areas. A satellite dish at the location communicates with a satellite orbiting the Earth to provide an internet connection. This is essential for connecting remote villages in the interior of Sabah and Sarawak, or for operations like offshore oil rigs, but it is generally more expensive and can be affected by bad weather.



**Figure 7.5: A Typical Home Network (LAN).** This diagram shows how a home network, or Local Area Network (LAN), connects various devices. A central router is the heart of the network, allowing devices like a desktop PC to connect via a stable wired (Ethernet) connection, while devices like a notebook or smartphone connect wirelessly using Wi-Fi. The router then connects to the internet through a modem provided by an Internet Service Provider (ISP).

Image Credit:

“Home\_LAN\_local\_area\_network\_example\_diagram” by Own Work is licensed under CC0 1.0 Universal Public Domain Dedication, via Wikimedia Commons.

## Hotspots: Creating Your Own Internet Bubble

When a student is out with their laptop, for example at a cafe, the laptop may have no internet connection of its own. There are two common options:

1. **Wi-Fi Hotspot:** The cafe may offer free Wi-Fi to its customers. This is a **public Wi-Fi hotspot**, a physical location where you can get wireless internet access. These are incredibly common in malls like Suria Sabah, airports like KLIA, and even on some public buses. While convenient, public Wi-Fi can sometimes be slow if many people are using it, and it’s important to be careful about security.
2. **Mobile Hotspot (Tethering):** If the cafe’s Wi-Fi is too slow to download a large research paper, a student can turn their smartphone into a **mobile hotspot**. This feature, also known as **tethering**, uses the phone’s 4G or 5G mobile data connection and shares it wirelessly with the laptop. In an instant, the phone becomes a personal, portable Wi-Fi router. This is a lifesaver for students and professionals who need to get online with their

laptops when there is no other Wi-Fi available. However, it uses up the data from the monthly mobile plan, so one must be mindful of data usage.



**Figure 7.6: Stay Connected at a Public Wi-Fi Hotspot.** Enjoy seamless browsing and productivity at a public Wi-Fi hotspot such as cafes and restaurants.

(Image generated with AI assistance using Gemini Pro 2.5.)



**Figure 7.7: Mobile Hotspot or Tethering.** This shows a student using his smartphone as a personal mobile hotspot to connect his laptop to the internet. This method, known as tethering, shares the phone's mobile data (e.g., 4G or 5G) and is useful when public Wi-Fi is slow, unavailable, or not secure.

(Image generated with AI assistance using Gemini Pro 2.5.)

## Internet Service Providers (ISPs): The Gatekeepers of the Internet

No one can get online without a very important type of company: an **Internet Service Provider (ISP)**. An ISP is a business that provides

the connection between our homes, campuses, and phones, and the rest of the global internet.

Think of them as the company that builds and manages the on-ramps to the digital highway. In Malaysia, the main ISPs are household names:

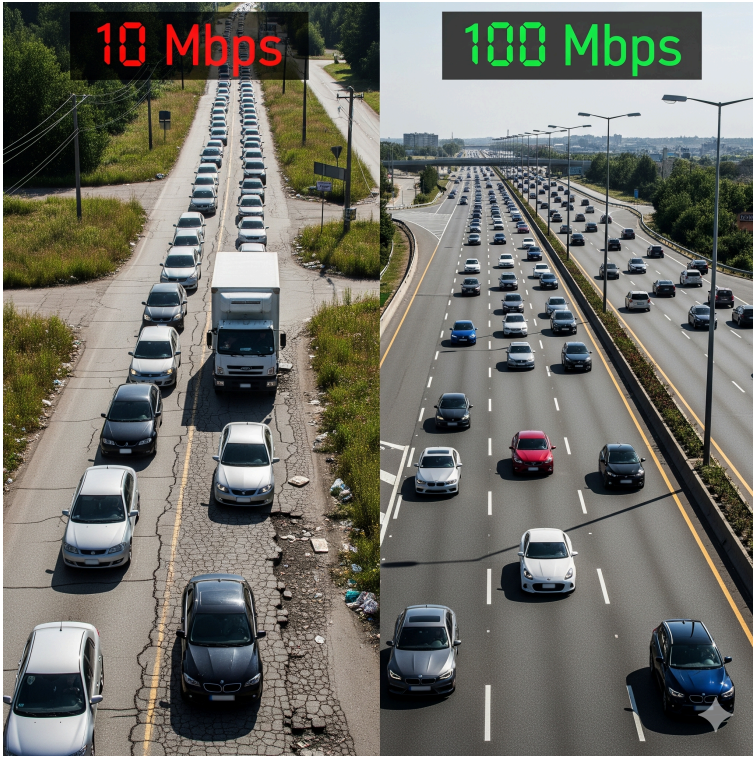
- **TM (Telekom Malaysia):** The largest provider, known for its Unifi fibre broadband service.
- **Maxis, CelcomDigi, U Mobile:** These are major players in both home fibre broadband and mobile data plans. They are often called **mobile service providers** when referring to their phone services.

The “speed” of the internet connection they provide is measured by its **bandwidth**. Bandwidth is the maximum amount of data that can be transferred over a connection in a given amount of time. It is usually measured in **Megabits per second (Mbps)**.

## Understanding Bandwidth: From a Single Path to a Superhighway

A great way to understand bandwidth is to think of the digital highway again.

- A low bandwidth connection (like a 10 Mbps mobile data plan) is like a single-lane kampung road. It works, but traffic moves slowly, and if too many cars (data) try to use it at once, you get a traffic jam. This is why video calls can be choppy or “laggy.”
- A high bandwidth connection (like a 100 Mbps home fibre plan) is like a multi-lane superhighway. Many cars (lots of data) can travel at high speed at the same time without causing a jam. This is why it’s easy to stream high-definition lecture videos, download large files, and have a smooth video call all at once.



**Figure 7.8: Understanding Bandwidth.** Imagine your internet as a road. A low 10 Mbps connection, much like a busy kampung road, can quickly become congested, leading to choppy video calls. In contrast, a high 100 Mbps connection offers the equivalent of a multi-lane superhighway, ensuring smooth HD streaming and fast downloads for everyone.

(Image generated with AI assistance using Gemini Pro 2.5.)

## Bits vs. Bytes: Why Download Speeds Can Be Confusing

Here is a very important point that often confuses people.

- **Bandwidth (Speed)** is measured in **Megabits** per second (Mbps).
- **File Size** is measured in **Megabytes** (MB).

The key is that **1 Byte = 8 bits**. This means that to download a 1 Megabyte (MB) file, you need to transfer 8 Megabits (Mb) of data.

So, when you sign up for a 100 Mbps plan, your connection can theoretically transfer 100 megabits of data every second. This does not mean you can download a 100 MB file in one second. To find the theoretical best-case download time, you would calculate:  $\text{File Size (in MB)} * 8 / \text{Bandwidth (in Mbps)} = \text{Time (in seconds)}$ .

## Bandwidth in Action: A Practical Comparison

Let's see how this works in the real world. Imagine a student needs to download a one-hour lecture video from the UMS portal. Let's compare the download time on a standard mobile data plan versus a home fibre plan.

File Type	Typical Size (Megabytes)	Download Time on a 10 Mbps Mobile Data Plan (Theoretical)
<b>MP3 Song</b> (4 minutes)	4 MB	3.2 seconds
<b>High-Quality Photo</b> (from a trip to Kundasang)	8 MB	6.4 seconds
<b>1-Hour HD Lecture Video</b>	1,000 MB (1 GB)	~13 minutes
<b>Large Video Game</b> (e.g., Genshin Impact)	50,000 MB (50 GB)	~11 hours

As you can see, the difference is huge. With a fast connection, the lecture video can be downloaded in just over a minute. On a slower connection, it's a 13-minute wait, during which the connection might be too slow for anything else. This practical example shows how bandwidth directly impacts a student's ability to learn and work efficiently.

It is also important to note that most internet plans have different **download** and **upload** speeds. Download speed is how fast you can receive data (e.g., watching Netflix, browsing websites). Upload speed is how fast you can send data (e.g., submitting a large assignment, posting a video to TikTok). For many plans in Malaysia, the upload speed is slower than the download speed.

## Check Your Understanding: Q3



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## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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## Check Your Understanding: Q7



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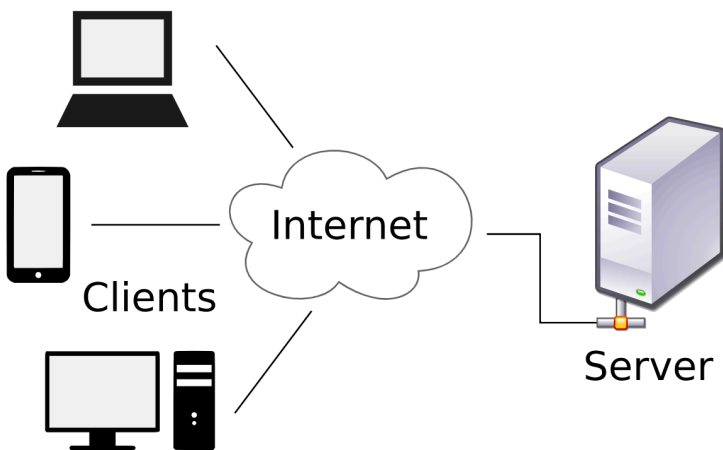
<https://openbook.ums.edu.my/businessbytescomputerguide/?p=522#h5p-79>

## How Data Travels: From a Click in Labuan to a Server in California

When a student searches Google for “e-commerce statistics Malaysia,” they are initiating an amazing journey of data. Let’s break down how it works.

## Clients and Servers

In this interaction, the student's computer is a **client**. It is *requesting* information. The powerful computer at Google's data centre that stores all the search information and sends it back is the **server**. The internet is fundamentally a global network of clients requesting data from servers. This data travels over **transmission media**, which can be wired (like the undersea fibre optic cables) or wireless (like a 4G signal to a phone).



**Figure 7.9: How the Internet Works.** This diagram shows the client-server model. Your device is the ‘client,’ and it asks for data from a ‘server,’ like Google’s data centre. This request and the data’s return journey travel across the internet’s network.

Image Credit: “Client-server-model” by David Vignoni is licensed under GNU Lesser General Public License, via Wikimedia Commons.

## IP Addresses: Every Device’s Unique Postal Code

For a request to get to the right Google server, and for the results

to come back to a specific computer, every device connected to the internet needs a unique address. This is called an **IP Address (Internet Protocol Address)**. It is like a postal code for your device in the digital world.

- **IPv4:** This is the older format, which looks something like 172.217.22.14. However, the world was running out of IPv4 addresses, just like we can run out of phone numbers. It has been in use since the early 1980s.
  - It uses a **32-bit** address, which means it's made of 32 binary digits (ones and zeros).
  - For humans to read it more easily, it's written as four decimal numbers separated by dots. Each number can range from 0 to 255.
  - **Example:** 172.217.22.14
- **IPv6:** This is the newer format, which allows for a vastly larger number of addresses, ensuring we won't run out for a very long time.
  - It uses a 128-bit address, which is astronomically larger than IPv4's 32-bit system.
  - It's written in hexadecimal (which uses numbers 0-9 and letters A-F) and separated by colons .:
  - **Example:** 2a00:1450:400f:80c::200e

## Domain Names and the DNS: The Internet's Phonebook

Remembering a long string of numbers like 172.217.22.14 is difficult. That is why we use **Domain Names**, which are easy-to-remember text-based names like google.com or ums.edu.my.

But how does your computer know that google.com means 172.217.22.14? It uses the **Domain Name System (DNS)**. A DNS server

acts like a massive, super-fast phonebook for the internet. When you type google.com into your **browser**, your computer sends a request to a DNS server, which looks up google.com in its directory and finds the corresponding IP address. It then tells your computer the correct address to send its request to. This entire process happens in milliseconds.

A domain name is made up of several parts, including the **Top-Level Domain (TLD)**. Common TLDs include:

- .com (originally for commercial businesses)
- .org (for non-profit organizations)
- .edu (for educational institutions)
- .gov (for government bodies)

There are also **country code TLDs (ccTLDs)**, such as .my for Malaysia, .sg for Singapore, and .jp for Japan. So when you see a web address ending in .my, like lazada.com.my, you know it is the Malaysian version of that website.

## The World Wide Web (WWW): The Universe of Information on the Internet

This is one of the most important distinctions to understand. Many people use the terms “internet” and “web” as if they are the same thing, but they are not.

- **The Internet** is the physical infrastructure: the global network of computers, cables, routers, and satellites. It is the hardware. It is the highway system.
- **The World Wide Web (or simply, the web)** is a system of public documents on the internet that are linked together. It is the information, the content, the things that travel on the highway system.

Think of it this way: the internet is the bookstore, with all its shelves and buildings. The web is the collection of all the books, magazines, and documents within that bookstore.

Let's look at the components of the web:

- **Webpages:** These are the individual documents on the web. A university's portal, a Lazada product page, and an online news article are all webpages.
  - A **static webpage** always looks the same for every visitor.
  - A **dynamic webpage** can change its content. For example, the homepage of *The Star* newspaper (thestar.com.my) is dynamic because it is constantly updated with the latest news.
- **Website:** A collection of related webpages. The Universiti Malaysia Sabah website (ums.edu.my) is a website that contains many different webpages for faculties, admissions, and news.
- **Web Server:** A computer that is always connected to the internet and is designed to **host** (store and deliver) a website. When you visit ums.edu.my, your browser is sending a request to UMS's web server.
- **Web 2.0:** This term refers to the modern, interactive web. In the early days, the web was mostly a one-way street where we would just read information. Web 2.0 is about participation. When someone posts a photo on Instagram, writes a product review on Shopee, or collaborates on a Google Doc, they are participating in Web 2.0. Social media, blogs, and wikis are all key parts of Web 2.0.

## Navigating the Web: Your Browser and Web Addresses

To access the vast world of the web, we need a special piece of software called a **web browser**.

- **Common Browsers:** The most popular browsers are Google **Chrome**, Apple's **Safari** (the default on iPhones and Macs), Mozilla **Firefox**, and Microsoft **Edge**.
- **Mobile Browser:** A version of a browser specifically designed for the smaller touch screens of phones and tablets.
- **Home Page:** The first page that appears when you open your browser. Many people set this to their favourite search engine or news site.
- **Tabbed Browsing:** A crucial feature of modern browsers that allows you to have multiple webpages open in a single window, each in its own tab. This is essential for research, as a student can have a tab open for their university library, another for a research paper, and a third for Google Scholar.

Every single webpage on the web has a unique address, just like every house in Malaysia has a unique postal address. This is called a **URL (Uniform Resource Locator)**. Let's break down a typical URL:

**<https://www.ums.edu.my/fkal/index.php/about-fkal/labuan-faculty-of-international-finance>**

- **Protocol:** `https://`
  - This is the set of rules for how data is exchanged. `http` is the standard, but `https` (the 's' stands for **secure**) means the data being sent between your browser and the server is encrypted and safe. Always look for `https` when you are on banking or shopping websites.
- **Hostname (Domain Name):** `www.ums.edu.my`
  - This tells the browser which web server to contact.
- **Path and File Name:** `/fkal/index.php/about-fkal/labuan-faculty-of-international-finance`
  - This specifies the exact location of the webpage on the server, just like specifying a room number in a large building.

## Digital Media on the Web: More Than Just Text

The modern web is a rich, multimedia experience. When students are doing their research, they are not just reading text.

- **Graphics:** These are visual images. A small, clickable version of a larger image is called a **thumbnail**. An **infographic** is a popular type of graphic that presents information and data in a visually engaging way.
  - **JPEG:** The most common file type for photos.
  - **PNG:** A popular format for graphics, especially those that need a transparent background, like logos.
- **Animation:** Images that create the illusion of movement.
- **Audio:** Sound, music, or voice. **MP3** is a very common format for music files. **Streaming audio** (like on Spotify) allows you to listen to music as the file is downloading, so you don't have to wait for the whole song to download first.
- **Video:** Moving pictures with sound. **Streaming video** is the technology that powers services like YouTube and Netflix, allowing you to watch a video instantly.
- **Virtual Reality (VR):** The use of computers to create a simulated, 3D environment that a user can interact with, usually through a special headset.
- **Plug-ins (or Add-ons/Extensions):** These are small programs you can add to your web browser to give it more features. A popular example is an ad-blocker.

## Other Internet Services: More Than Just the Web

The World Wide Web is the most popular service on the internet, but it is not the only one. The internet infrastructure supports many other vital services that students and professionals use daily.

- **Email (Electronic Mail):** This is one of the oldest and most essential internet services. To communicate formally with a lecturer, students often use their university email addresses. An email address has two parts: a **username** (e.g., student.name) and a **domain name** (e.g., @ums.edu.my).
- **Internet Messaging:** This is real-time text communication. For informal group discussions, students often use a **WhatsApp** group. This is much faster and more conversational than email. Other popular services in Malaysia include Telegram.
- **VoIP (Voice over IP):** This is a technology that lets you make voice calls using an internet connection instead of a traditional phone line. When a student needs to ask a quick question, they can make a **WhatsApp call**. This uses internet data, not regular phone credit, making it very popular for both local and international calls.
- **FTP (File Transfer Protocol):** This is a standard used for transferring large files between computers. While less common for everyday users now, it is still used by web developers to **upload** website files to a server. **Uploading** means sending a file from your computer to a server. **Downloading** means receiving a file from a server to your computer.

## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Check Your Understanding: Q10



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## Check Your Understanding: Q11



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## Check Your Understanding: Q12



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## Check Your Understanding: Q13



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## Check Your Understanding: Q14



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## Check Your Understanding: Q15



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### The Digital Divide in Malaysia: Not Everyone Connects the Same Way

The different internet experiences available highlight an important real-world issue: the **digital divide**. This refers to the gap between those who have reliable, affordable access to the internet and digital technology, and those who do not.

- A student on a university campus in a city like Labuan likely has access to fast, reliable fibre broadband. They are on the privileged side of the divide.
- A student in a rural kampung, however, might struggle with an unstable mobile connection that makes video calls difficult. This experience is a perfect example of the **urban-rural divide** that exists in Malaysia. While cities like Kuala Lumpur and Labuan town have excellent infrastructure, many rural areas in Kelantan, Pahang, Sabah and Sarawak still lack consistent, high-speed internet access.
- A student relying on mobile data represents the growing dependence on this technology. However, access is dependent on having a good data plan and being in an area with strong 4G or 5G coverage.

The Malaysian government has been actively working to bridge this divide through initiatives like the **Jalinan Digital Negara (JENDELA)** plan, which aims to expand broadband coverage and improve the quality of service across the country, especially in rural and remote areas. The goal is to ensure that every Malaysian, whether in a KL skyscraper or a longhouse in Sarawak, has the opportunity to participate in the digital economy.

## Staying Safe Online: Basic Cybersecurity


Using the internet for university projects and personal life also exposes users to certain risks. It is crucial for every internet user to understand the basics of **cybersecurity**.

- **Strong Passwords:** The first line of defence for any online account (email, social media, university portal) is a strong password. A good password should be long (at least 12 characters) and include a mix of uppercase letters, lowercase letters, numbers, and symbols. Avoid using easily guessable information like your name or birthday.
- **Phishing Scams:** This is a very common type of online scam. A student might receive an email that looks like it is from their bank, asking them to click a link and “verify” their account details. This is a **phishing** attempt to steal their username and password. A key rule is to never click on suspicious links in emails and to always go directly to the official website by typing the address yourself.
- **Malware:** This is a general term for malicious software, including **viruses**, that can harm your computer or steal your information. It is essential to have a good antivirus program installed and to be careful about downloading files from untrusted websites.
- **Public Wi-Fi Dangers:** When using free Wi-Fi at a cafe, one

should avoid doing sensitive activities like online banking. Public networks are often not secure, and a skilled hacker could potentially intercept the data being sent over the network. Using a **VPN (Virtual Private Network)** can add a strong layer of security when using public Wi-Fi.

## Netiquette: The Rules of the Road for Online Communication

Just as there are rules for driving on a real highway, there are unwritten rules for behaving properly on the digital highway. This code of acceptable online behaviour is called **netiquette**. For students to collaborate effectively and professionally, they need to follow these simple guidelines in group chats and emails.

- **Be Polite and Respectful:** The golden rule applies online too. Treat others as you would like to be treated.
- **Avoid “Flames”:** Do not send angry, insulting, or aggressive messages. It is easy to be brave behind a screen, but these “flames” can damage relationships and create a toxic environment.
- **Be Careful with Sarcasm and Humour:** It can be very difficult to understand the tone of a message without seeing someone’s face or hearing their voice. What you think is a funny joke might be easily misunderstood as an insult.
- **AVOID TYPING IN ALL CAPS:** IT LOOKS LIKE YOU ARE SHOUTING AT THE OTHER PERSON.
- **Use Emoticons Sparingly:** Emoticons  or emojis can help to show emotion, but in a professional or academic context, like an email to a lecturer, it is best to use them sparingly or not at all.
- **Check the FAQ:** In online forums or group chats, always check the **FAQ (Frequently Asked Questions)** or search for an answer

before asking a question that has likely been answered many times before.

- **Forgive Other People's Mistakes:** Everyone was a beginner once. If someone makes a spelling mistake or asks a simple question, be kind and helpful.

## Check Your Understanding: Q16



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## Check Your Understanding: Q17



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## Check Your Understanding: Q18



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## Check Your Understanding: Q19



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## Chapter Summary

In this chapter, we followed a group of students in Labuan to explore the vast world of the internet. We learned that the internet is the global physical network that connects us all, evolving from a government project into the backbone of our modern world. We saw the different ways we connect to it, from fast Unifi fibre in the city to mobile data in more remote areas, and understood the crucial role of ISPs in providing this access.

We clearly distinguished the **internet** (the infrastructure) from

the **World Wide Web** (the information on it) and learned how to navigate the web using browsers and URLs. We also explored the many other services the internet provides, such as email and VoIP calls, which are essential for collaboration.

Finally, we discussed the real-world challenge of the digital divide in Malaysia and the importance of good **netiquette** and basic **cybersecurity** practices to ensure our online interactions are both respectful and safe. The internet is a powerful tool, and understanding how it works allows us to use it effectively, responsibly, and securely.

## Review Questions

1. In your own words, what is the main difference between the internet and the World Wide Web? Use an analogy to explain it.
2. What is an ISP? Name two major ISPs that provide home broadband and two that provide mobile data in Malaysia.
3. Aina has a fast Unifi connection in her dorm, while Ben has an unstable connection in his kampung. What is this difference in access called, and why is it an important issue in Malaysia?
4. Your friend wants to use their laptop at a cafe in Labuan, but the cafe's Wi-Fi is not working. What is the other way they can get their laptop online using their smartphone? What is this process called?
5. What is the purpose of a DNS server? Why do we need it?
6. You are buying a new pair of shoes from a local online store. You notice the web address starts with `http://` instead of `https://`. Why should this be a cause for concern?
7. List three examples of good netiquette to follow when communicating with your project group in a WhatsApp chat.
8. What is phishing, and what is a simple rule you can follow to avoid becoming a victim?

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# Chapter 8: Digital Security

## Learning Objectives

Welcome to Chapter 8! In this important section, we will learn how to protect our digital world. After studying this chapter, you will be able to:

- Identify common digital security risks that businesses and individuals face.
- Define cybercrime and recognise different types of perpetrators.
- Describe various types of malicious software (malware), such as viruses and spyware.
- Explain common internet and network attacks.
- List several safeguards to protect against digital threats, hardware theft, and system failure.

## Introduction

Imagine a small but successful logistics company based in Labuan. Every day, this company handles sensitive information: client shipping manifests, employee payroll data, confidential contracts, and financial records. This data is their most valuable asset. They

communicate with clients in Singapore, manage accounts through Maybank2u, and coordinate deliveries using a cloud-based system. Their entire operation runs on a network of computers, servers, and mobile devices.

Now, imagine what would happen if one morning, they arrived at the office to find all their client files were encrypted and locked, with a message demanding a ransom payment in Bitcoin to get them back. Or what if they discovered a competitor in Kuala Lumpur had somehow accessed their client list and was now undercutting their prices? Or if a simple power surge during a thunderstorm destroyed their main server, wiping out all their unsaved accounting data for the month?

These are not scenes from a movie. These are **digital security risks**, and they are a daily reality for businesses of all sizes, from a small kedai runcit using a point-of-sale system to a multinational corporation headquartered in the Petronas Towers.

In our connected world, we share huge amounts of information online every day. While this is very convenient, it also comes with risks. Keeping our computers and our private information safe is super important for everyone, especially for businesses that hold valuable customer data. This chapter will teach you about common dangers like viruses and online scams, and the simple, practical steps we can all take to protect our digital lives.

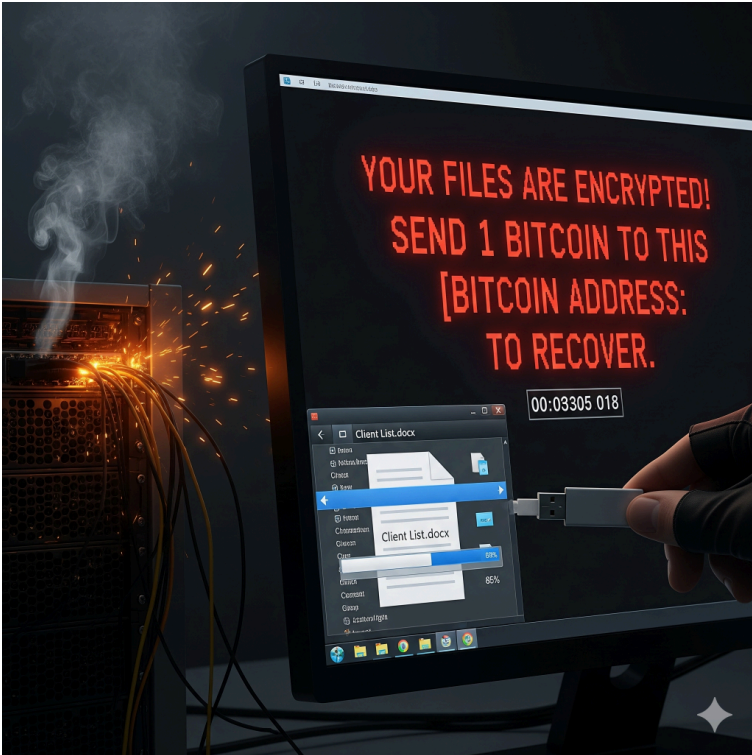


Figure 8.1: An illustration of a business facing multiple security threats at once. The computer screen in the foreground displays a ransomware message, demanding a Bitcoin payment to unlock encrypted files. To the right, a person is actively stealing a confidential “Client List” by copying it to a USB drive, representing a data breach. In the background, a server is smoking and sparking, symbolizing data loss from physical hardware failure. (Image generated with AI assistance using Gemini Pro 2.5.)

## Digital Security Risks

A digital security risk is any event or action that could cause a loss of or damage to a computer system, its software, data, or processing capabilities. For a business, these risks can lead to financial loss,

damage to reputation, and even legal trouble. Let's explore these major risks in more detail.

- **Internet and network attacks:** These are malicious, deliberate attempts to disrupt or gain unauthorized access to computer systems. This could be an attack that crashes a company's e-commerce website during a major online sale like 11.11, preventing any customers from making purchases.
- **Unauthorized access and use:** This occurs when someone uses a computer or network without permission. For example, a former employee who still knows the company's Wi-Fi password could sit in a nearby cafe and access the internal network.
- **Hardware theft:** This is the physical act of stealing computer equipment. A thief breaking into an office and stealing laptops is a clear example, but it also includes an employee leaving a company smartphone in a Grab car. The loss is not just the device, but all the sensitive company data on it.
- **Software theft:** This is the act of illegally copying or stealing software. This can happen when an employee installs a licensed copy of Adobe Photoshop (paid for by the company) onto their personal computer at home, which is a violation of the software license agreement.
- **Information theft:** This involves stealing personal or confidential information. A classic example is a cybercriminal hacking into a company's database to steal a list of customer names, email addresses, and credit card numbers, which they can then sell on the dark web.
- **System failure:** This is the complete malfunction of a computer system. This can be caused by an aging hard drive in a server finally breaking down, or a critical software update that contains a bug, causing the entire system to crash.

# Cybercrime and Its Perpetrators

**Cybercrime** refers to any illegal act involving a computer, network, or digital device. It is a massive and growing industry. The software used by cybercriminals to commit these acts is sometimes called crimeware. Understanding who these perpetrators are and what motivates them is the first step in defending against them.

- **Hacker:** Originally, this term had a positive meaning, describing a skilled and curious computer enthusiast who enjoyed exploring and understanding the inner workings of computer systems. However, in modern media, the term is now commonly used to describe someone who accesses a computer or network illegally. They might do it for the challenge, for bragging rights, or to expose a security flaw they discovered.
- **Cracker:** This term is more specific than “hacker.” A cracker is a person who accesses a computer system illegally with malicious intent. Their goal is often to destroy data, steal valuable information for profit, or cause disruption. While a hacker might break in to look around, a cracker breaks in to cause damage.
- **Script Kiddie:** This is a derogatory term for an amateur attacker who has very limited technical skill. They don’t write their own programs. Instead, they use pre-written hacking and cracking programs and scripts that they have downloaded from the internet. While they may not be sophisticated, they can still cause significant damage, like a person who finds the keys to a bulldozer and starts randomly crashing into buildings without knowing how to properly operate the machine.
- **Corporate Spy:** A corporate spy is a highly skilled individual hired specifically to conduct corporate espionage by breaking into a competitor’s computer systems to steal proprietary data such as trade secrets, client lists, or marketing plans; for example, in a local Malaysian scenario, one telecommunication

company might hire such a spy to infiltrate a rival's network and obtain early details about their upcoming 5G data plan pricing and coverage areas, thereby gaining a critical advantage by launching a more competitive product first.

- **Unethical Employee:** Sometimes the biggest threat comes from within. An unethical employee is someone who illegally accesses their employer's computer system for personal gain or revenge. This could be a salesperson who is about to leave the company and copies the entire customer database to take to their new job. It could also be a disgruntled employee who was just fired and uses their still-active password to log in remotely and delete important project files.
- **Cyberextortionist:** A cyberextortionist is an attacker who demands payment to halt an ongoing assault on a technology system, with **ransomware** being the most prevalent form today, as illustrated by a global scenario in which a manufacturing company in Penang finds all its servers encrypted and its production line forced to a complete stop by a criminal gang operating from abroad, who then demand \$500,000 in Bitcoin for the decryption key, leaving the organization with the terrible choice of paying the ransom without certainty of recovery or facing weeks of downtime and millions in losses while attempting to restore systems from backups.
- **Cyberterrorist:** This is someone who uses the internet or a network to destroy or damage computers for political or ideological reasons. Their goal is to cause fear and disrupt critical infrastructure, such as a country's power grid, water supply, or financial systems. This is a serious act of cyberwarfare.



Figure 8.2: A hacker. Often depicted in a hooded sweatshirt to obscure their identity, illegally accessing a secure computer network. The multiple monitors display complex data, code, and network schematics, illustrating the sophisticated nature of cyber intrusions. (Image generated with AI assistance using Gemini Pro 2.5.)

## Malware: Malicious Software

**Malware**, short for **malicious software**, is any software that is intentionally designed to disrupt computer operations, gather sensitive information, or gain unauthorized access to private computer systems. The harmful effect or action that malware

carries out is called the payload. Let's explore the most common types of malware.

- **Virus:** A computer virus is a piece of code that attaches itself to a legitimate program or file. You can think of it like the flu; just as the flu needs a host person to spread by interacting with others (for example, by sneezing), a computer virus cannot spread on its own. It requires a human to do something, like open an infected email attachment or run an infected program. Once the host file is opened, the virus activates and can start to damage files, corrupt the system, or spread itself to other files on the computer.
- **Worm:** A worm is similar to a virus as it is designed to copy itself from one computer to another, but it does so automatically without any human action. A good analogy is to think of a single, self-replicating robot that can travel through the air vents of a building (the network). It moves on its own by taking advantage of security vulnerabilities in software, creating copies of itself in every room it enters. As it spreads, it consumes a lot of system resources, like memory or network bandwidth, which can cause servers and computers to slow down or even crash, much like the robots eventually clogging up all the hallways.
- **Trojan Horse:** A Trojan horse is a destructive program disguised as a legitimate, useful application, getting its name from the ancient Greek story where soldiers hid inside a giant wooden horse to get past city walls. For example, an employee might download a "Free Video Editor" to create a social media post for their company. The program works for editing videos, but it also secretly carries out a malicious action in the background. This hidden function could be a keylogger, which records every keystroke the employee makes and sends all their typed passwords, including for their company email and bank login, directly to a cybercriminal.
- **Rootkit:** A rootkit is a particularly dangerous type of malware that is designed to hide itself deep within a computer's

operating system. Once a rootkit is installed, it can allow an attacker to gain “root” or administrative-level control over the computer from a remote location. Because it is so deeply hidden, a rootkit can be very difficult to detect and remove, even for some **antivirus programs**.

- **Spyware:** Spyware is a type of malware that is installed on a computer without the user’s knowledge and secretly collects information about their activities. It can track websites visited, record keystrokes (a keylogger is a type of spyware), and capture sensitive information like usernames, passwords, and credit card numbers. This information is then sent back to the attacker.
- **Adware:** Adware is software that is designed to automatically display or download online advertisements to a user’s computer. While it is often just annoying, some adware can be more malicious. It can track your browsing habits to show you targeted ads, and it can significantly slow down your computer and internet connection. It is often bundled with free software that you download from the internet.
- **Zombie (Botnet):** A compromised computer that is being controlled by a remote user (the “bot-herder”) without the owner’s knowledge is called a zombie or a bot. The cybercriminal can use this zombie computer to perform malicious tasks, such as sending spam emails or participating in network attacks. A network of thousands of these zombie computers, all under the control of a single attacker, is called a botnet. This botnet can be rented out to other criminals or used to launch massive, coordinated attacks.



Figure 8.3: Adware: An illustration of a computer infected with adware. The screen is flooded with numerous pop-up advertisements, which makes it difficult for the user to see the original content. This type of software is not only annoying but also slows down the computer, as shown by the loading icon in the center. The eye symbol represents how some adware can also track a user's online activity to show them targeted ads, creating a privacy risk. (Image generated with AI assistance using Gemini Pro 2.5.)

## Check Your Understanding: QR



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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## Check Your Understanding: Q7



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## Internet and Network Attacks

Beyond infecting individual computers with malware, cybercriminals also launch attacks on entire networks and servers.

- **Denial of Service (DoS) attack:** The goal of a Denial of Service (DoS) attack is to make an online service unavailable to its legitimate users. A good analogy is to imagine a single person calling a pizza delivery shop and tying up the phone line for hours by asking pointless questions, which prevents any real customers from placing an order. In the same way, a DoS attacker floods a target server, like a company's website, with so much meaningless traffic and so many requests that the server becomes overwhelmed. As a result, the service either slows down to a crawl or crashes completely, blocking access for anyone who genuinely needs it.
- **Distributed DoS (DDoS) attack:** A Distributed Denial of Service (DDoS) attack is a much larger and more powerful version of a DoS attack. Instead of the attack coming from a single computer, the attacker uses a "botnet"—a network of thousands or even millions of infected "zombie" computers, to launch the attack from multiple locations all at once, making it much

harder to defend against. For example, on the day a popular airline launches a big ticket sale, a competitor could hire a cybercriminal to launch a DDoS attack. The airline's servers would suddenly be flooded with traffic from a botnet of 50,000 computers around the world, causing the website to crash. As a result, thousands of legitimate customers would be unable to buy tickets, leading to huge financial losses and damage to the airline's reputation.

- **Back Door:** A back door is a hidden way for a program developer or an attacker to bypass the normal security controls and gain access to a program or computer. Sometimes, developers build these into a system for testing purposes and forget to remove them. Other times, they are created by malware like a Trojan horse, allowing an attacker to access the system at any time.
- **Spoofing:** Spoofing is a technique where an intruder makes their network or internet transmission appear to be from a legitimate and trusted source.
  - **IP Spoofing:** Attackers disguise their computer's IP address to hide their identity or to trick a system into thinking they are a trusted device that is already on the internal network.
  - **Email Spoofing:** This is very common in business scams. The attacker changes the sender's address to make an email look like it came from someone else. For example, an accounts employee might receive an email that looks like it's from the CEO, with the correct name and email address, instructing them to urgently transfer a large sum of money to a new supplier's bank account. The email is a fake, and the bank account belongs to the criminal.



*Figure 8.4: Distributed DoS (DDoS) attack. A visual representation of a Distributed Denial of Service (DDoS) attack. A central server is overwhelmed and crashes, indicated by the red glow and error symbol. The attack is a flood of data traffic coming from thousands of computers all over the world, representing a botnet. In the corner, a single attacker controls this entire network to take the server offline, making the service unavailable to legitimate users. (Image generated with AI assistance using Gemini Pro 2.5)*

## Safeguards: How to Protect Yourself

The world of digital threats can seem scary, but the good news is that you can take many practical and effective steps to protect your digital world. A good security plan involves multiple layers of protection.

# Safeguards Against Digital Attacks

- **Use Virus Protection Software:** An antivirus program is an essential piece of software that protects a computer against viruses, worms, and other malware. It works by scanning files and programs and comparing them against a database of known malware definitions (also called virus signatures). When it finds a threat, it can block it, delete it, or place the infected file in quarantine, which is a separate, isolated area of the hard disk where the infected file cannot spread or cause any harm. It is crucial to keep your antivirus software constantly updated so it has the latest definitions to protect against new threats. Popular antivirus programs include Norton, McAfee, Kaspersky, and even the built-in Microsoft Defender in Windows.
- **Use a Firewall:** A firewall is hardware or software that acts like a security guard for your network. It stands between your internal network (your home or office) and the public internet, monitoring all the incoming and outgoing traffic. It can be configured with rules to block suspicious traffic or prevent unauthorized access. A **hardware firewall** is a separate physical device (often part of your internet router). A **software firewall** is a program that runs on your computer. A **personal firewall** is a software firewall that is designed to protect a single computer.
- **Be Cautious with Emails and Downloads:** This is one of the most important human safeguards.
  - Be very suspicious of unexpected emails or text messages, especially those that create a sense of urgency and ask you to click a link or open an attachment.
  - Never download software from untrustworthy or illegal sources. Always get it from the official developer's website or a legitimate app store.
  - Look for the signs of a phishing email: generic greetings (like "Dear Valued Customer"), spelling and grammar mistakes, and email addresses that look slightly wrong.

- **Manage Pop-up Windows:** Be very careful when closing pop-up ad windows. Some malicious pop-ups are designed with fake “Close” or “X” buttons that, when clicked, will actually install adware or other malware onto your computer. It is often safer to close the entire browser tab or use the Alt+F4 key combination on Windows.
- **Scan Removable Media:** Before you plug a USB flash drive or an external hard drive from a friend or colleague into your computer, make sure your antivirus software is set to automatically scan it for malware. This is a very common way for viruses to spread in an office or university environment.
- **Keep Software Updated:** Always install the latest updates for your operating system (Windows, macOS) and your applications (your browser, Microsoft Office, etc.). Cybercriminals are constantly looking for security holes in software. These updates often include important security patches that fix these holes, making it much harder for attackers to get in.
- **Make Regular Backups:** As we learned in Chapter 6, keeping a regular **backup** of your important data is one of the best ways to recover from a security incident. If your business is hit by a ransomware attack and all your files are locked, you can refuse to pay the ransom, wipe the infected computers, and restore your data from a recent backup, saving you a huge amount of money and stress.
- **Keep Software Updated:** Always install the latest updates for your operating system (Windows, macOS) and your applications (your browser, Microsoft Office, etc.). Cybercriminals are constantly looking for security holes in software. These updates often include important security patches that fix these holes, making it much harder for attackers to get in.
- **Make Regular Backups:** As we learned in Chapter 6, keeping a regular backup of your important data is one of the best ways to recover from a security incident. If your business is hit by a ransomware attack and all your files are locked, you can refuse to pay the ransom, wipe the infected computers, and restore

your data from a recent backup, saving you a huge amount of money and stress.



*Figure 8.5: Use a Firewall. A firewall acting as a security barrier for a computer network. The glowing wall separates the secure internal network (the calm office on the left) from the untrusted public internet (the chaotic storm on the right). The firewall inspects all incoming data, blocking malicious traffic (represented by the red sparks and lightning) while allowing safe, legitimate traffic (the blue lines) to pass through to the protected network. (Image generated with AI assistance using Gemini Pro 2.5.)*

# Safeguards Against Hardware Theft and Vandalism

- **Physical Access Controls:** For a business, this is the first line of defence. It means using strong locks, security alarm systems, and CCTV cameras to protect the rooms where computers and servers are kept. Access to the server room should be restricted to only authorized IT personnel.
- **Physical Security Devices:** You can use simple but effective devices like a steel security cable to physically lock a laptop or a desktop computer to a heavy desk or an immovable object. This is very useful in an open office environment or at a public event or trade show at a place like the Kuala Lumpur Convention Centre.
- **Security and Tracking Apps:** For mobile devices like smartphones and tablets, you can install apps that can help you locate the device on a map if it is lost or stolen. These apps also often give you the ability to remotely lock the device or even completely erase all its data to ensure that if it is stolen, the thief cannot access any of the sensitive company information on it.
- **Biometric Authentication (Fingerprint Readers):** Many modern laptops and smartphones now use fingerprint readers or facial recognition for authentication. This is much more secure than just a password, as it is very difficult for a thief to fake your fingerprint.



Figure 8.6: Biometric Authentication (Fingerprint Readers). An example of a laptop with a built-in fingerprint reader for biometric authentication. The tiny yellow arrow points to the small sensor on the palm rest, where a user would place their finger to log in instead of typing a password. Image Credit: “ThinkPad\_X230-9671” by Raimond Spekking is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Safeguards Against Hardware Failure

Hardware can fail for many reasons, but one of the most common and damaging is a problem with the electrical power supply.

- **Protect from Electrical Power Variations:** The electrical power from the wall socket is not always stable.
  - An overvoltage, or spike, is a significant and sudden

increase in power. This can be caused by a nearby lightning strike and can instantly destroy sensitive electronic components.

- A brownout is a prolonged period of undervoltage (low power).
- A blackout is a complete power failure.
- **Use a Surge Protector:** A surge protector is a device that looks like a normal extension cord but contains special electrical components that protect against power spikes. It does this by absorbing the extra electricity during an overvoltage, sacrificing itself to save the connected computer equipment. Every important piece of computer hardware, from a server to a desktop PC, should be plugged into a surge protector, not directly into the wall.
- **Use an Uninterruptible Power Supply (UPS):** A UPS is a more advanced device that is essential for critical systems like servers or important workstations. It contains surge protection circuits and a built-in battery. If there is a power failure like a blackout, the battery instantly kicks in and provides power for a short period of time (usually 5-15 minutes). This doesn't give you enough time to keep working for hours, but it gives you the crucial window of time you need to save all your work and shut down the computer properly, preventing any data loss. For a business server, this is an absolutely essential piece of equipment.



Figure 8.7: A surge protector. An example of a surge protector as an essential device that protects electronics from power spikes. While it may look like a normal power adapter or extension cord, it contains special electrical components that absorb the extra electricity during an overvoltage, sacrificing itself to save the connected equipment. The small light labeled “Protected” indicates that the safety feature is active. Every important piece of computer hardware, from a server to a desktop PC, should be plugged into a surge protector rather than directly into the wall outlet. Image Credit: “Belkin-Surge-Protector” by Evan-Amos is in the Public Domain, via Wikimedia Commons.



Figure 8.8: An Uninterruptible Power Supply (UPS). An essential device for critical systems like servers and important workstations. A UPS contains both surge protection circuits and a built-in battery. If there is a power failure, like a blackout, the battery instantly kicks in to provide power for a short time (usually 5-15 minutes). This isn't enough time to keep working for hours, but it gives you a crucial window to save all your files and shut down the computer properly, preventing any data loss. For a business server, this is absolutely essential equipment. Image Credit: "UPS\_mini\_350T" by Project Kei is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Check Your Understanding: Q10



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## Chapter Summary

In this chapter, we learned about the critical importance of digital security in our modern, connected world. We identified the common risks that businesses and individuals face, from network attacks to physical hardware theft. We explored the different motivations and skill levels of cybercrime perpetrators, from the amateur script kiddie to the professional corporate spy. We took a deep dive into the world of malware, learning to distinguish between a virus that needs a host to spread, a worm that can spread

on its own, and a Trojan horse that tricks you into installing it. We also looked at common network attacks like DDoS, which can bring a business's website to its knees.

Most importantly, we discussed the practical and layered safeguards we can all use to protect ourselves. We learned that a good security strategy includes technical solutions like using antivirus software and firewalls, human diligence like being cautious with emails and keeping software updated, and physical protection for our hardware from both theft and power failures with devices like security cables and a UPS. By understanding the threats and implementing these safeguards, we can navigate the digital world with confidence and keep our valuable information safe.

## Review Questions

1. What is the difference between a hacker and a cracker?
2. Explain what a Trojan horse is using a simple, everyday analogy (other than the Greek story).
3. A small business in your town has all its files locked by ransomware. What is ransomware, and what is the single most important safeguard they should have had in place to recover without paying the criminals?
4. What is the difference between a virus and a worm in terms of how they spread?
5. What is a DDoS attack, and how could it be used to harm a Malaysian e-commerce business?
6. Why is it important to keep your operating system and applications updated?
7. Your friend is worried about losing their important university work during one of Labuan's frequent power outages. What two devices would you recommend they use to protect their computer, and what does each device do?
8. Explain the difference between IP spoofing and email spoofing.

Which one is more likely to be used in a scam to trick an employee into transferring money?

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# Chapter 9: Ethics and Privacy in the Digital Age

## Learning Objectives

Welcome to Chapter 9! In this chapter, we will discuss how to use technology in a responsible and ethical way. After studying this chapter, you will be able to:

- Understand the importance of authorized use and access controls.
- Describe different methods of authentication, including biometrics and two-step verification.
- Define software theft and the safeguards used to prevent it.
- Explain how encryption and other technologies protect information.
- Recognise privacy, health, and environmental issues related to technology.

## Introduction

Imagine you are a new intern at a large company in Kuala Lumpur.

On your first day, you are given a company laptop, a smartphone, and access to the company's internal network. You can access the company's client database, its financial reports, and its marketing plans. With a few clicks, you hold a huge amount of valuable and confidential information in your hands.

This access comes with a great deal of responsibility. Should you use the high-speed office internet to download movies for yourself? Is it okay to use your work laptop to check your personal Facebook account? What would happen if you lost your company phone in a Grab car? What are the company's rules about sharing information, and what are your personal ethical obligations to protect that data?

As we use technology more and more in our daily lives and in business, it becomes very important to think about *how* we use it. Using technology is not just about being efficient; it is also about being responsible, professional, and ethical. This chapter talks about **digital ethics**, which means doing the right thing online and with digital tools. We will discuss the crucial methods businesses use to control who can access their valuable data. We will explore how to protect our personal information and respect the privacy of others, and we will look at the wider impact that our constant use of technology has on our health and the environment.



*Figure 9.1: Keeping Our Information Safe Online. Protecting our personal information online. The digital symbols on the face represent our data, and the lock shows the importance of keeping that data private. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Unauthorized Access and Use: Defining the Boundaries

At its core, the first rule of digital ethics in a business context is about permission. **Unauthorized access** is the use of a computer, server, or network without permission. **Unauthorized use** is the act of using a computer or network for activities that are not approved, even if you have permission to be on the system.

## Scenario: A Day at the Office

- **Unauthorized Access:** A person from another department who does not have permission to view payroll information tries to guess the password for the Human Resources server. This is unauthorized access.
- **Unauthorized Use:** An HR employee, who *does* have permission to access the payroll server, uses their computer during work hours to run a side business selling products on Shopee. This is unauthorized use.

To prevent confusion and set clear expectations for employees, many companies and organisations create an **Acceptable Use Policy (AUP)**. An AUP is a formal document that outlines the specific rules and guidelines for using the company's computers, networks, internet connection, and other IT resources.

- An AUP is a critical document for any modern business. It typically answers questions like:
- Can employees use their work computers for personal emails?
- Are employees allowed to access social media sites like Instagram or TikTok on the company network?
- Is it okay to install personal software (like a video game) on a company laptop?
- What are the rules about sending confidential company information via email?

By signing an AUP, employees acknowledge that they understand the rules. If they break these rules, the AUP gives the company the right to take disciplinary action. This protects the company from both security risks and legal problems.



*Figure 9.2: Unauthorized Access Attempt. An individual from another department attempting to guess the password to access the Human Resources server, highlighting a critical cybersecurity risk. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Access Controls and Authentication: Who Are You?

To enforce the rules set out in an AUP, companies use **access controls**. These are technical security measures that define who can access a computer or network, when they can access it, and what specific actions they are allowed to take. For example, an access control policy might state that a marketing intern can only log in

during business hours and can only view the marketing folders, but cannot delete any files.

## Identifying Yourself: The First Step

The most basic access control is user identification. The system needs to know who you are.

**User Names and Passwords:** A **user name** (or User ID) is a unique name that identifies a specific user on a network, like siti.rahman. A **password** is a secret word, phrase, or combination of characters that, when combined with the user name, allows access. A common weakness is that people often choose simple, easy-to-guess passwords. To combat this, many systems now require more complex passwords or encourage the use of a **passphrase**, which is a longer password that is easier for a human to remember but much harder for a computer to guess (e.g., MyFirstCarWasABlueProton!).

- **PIN (Personal Identification Number):** A PIN is a numeric passcode. It is shorter and simpler than a password and is often used for systems that require quick access, such as unlocking your smartphone or using your Maybank ATM card.
- **CAPTCHA:** This stands for “Completely Automated Public Turing test to tell Computers and Humans Apart.” It is a simple challenge-response test designed to determine whether the user is a human or an automated computer program (a bot). You have likely encountered these when signing up for a new online account. You might be asked to type a series of distorted letters and numbers or to click on all the pictures that contain a traffic light. This is used to prevent bots from creating thousands of fake accounts or posting spam comments.
- **Audit Trail:** For businesses, it’s not enough to just control access; they also need to know what people are doing on the system. An **audit trail** is an electronic log file that records all the

activity on a computer or network. It tracks who accessed the system, what files they opened, what changes they made, and when they did it. If a data breach occurs, the IT security team can use the audit trail to investigate what happened, much like a detective reviewing CCTV footage after a crime.

### CAPTCHA Security check (what is this?)

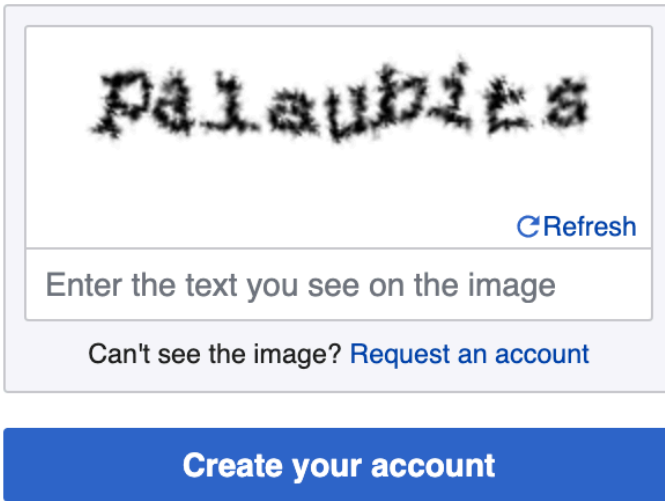


Figure 9.3: CAPTCHA Security Check. A common test used on websites to make sure the user is a real person and not a computer program (a bot). The person must type the hard-to-read text from the picture to proceed. Image Credit: “CAPTCHA\_test” by Mover of molehills is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Proving Your Identity: Authentication Methods

Knowing a username is not enough. The system needs to be sure that the person entering the username is the real owner of that account. **Authentication** is the process of verifying a user’s identity.

There are three main categories of authentication methods, often described as: “something you have,” “something you are,” and “something you know.”

- **Possessed Objects (Something You Have):** This is a physical item that an individual must carry and present to gain access to a secured area. A common local scenario can be observed at a secure office in a building like KL Sentral, where an employee is required to tap their employee badge or identity card on a reader. This form of security is widely implemented in modern office doors and even university hostels through the use of smart cards, which are plastic cards embedded with a microchip that contains the user’s specific access permissions.
- **Biometric Devices (Something You Are):** These devices authenticate a person’s identity by translating a unique personal characteristic into a digital code. This is a very secure method because it is very difficult to fake a biological trait.
- **Fingerprint Readers:** The most common biometric device, now built into most smartphones and many modern laptops.
  - **Face Recognition Systems:** Used on many smartphones (like Apple’s Face ID) and for automated gates at airports like KLIA.
  - **Hand Geometry Systems:** Measures the shape and size of a person’s hand.
  - **Voice Verification Systems:** Analyzes a person’s unique voice patterns.
  - **Signature Verification Systems:** Analyzes the shape, speed, and pressure of a person’s signature.
  - **Iris or Retinal Scanners:** These are extremely secure systems that scan the unique patterns in a person’s iris (the coloured part of the eye) or the pattern of blood vessels in their retina. These are often used for very high-security locations.
- **Two-Step Verification (Combining Methods):** This method, often called **two factor authentication** or **2FA**, provides

significantly stronger security by requiring two distinct methods to verify an identity, typically combining “something you know” with “something you have.” A common global business scenario occurs when an employee of a multinational company attempts to log into their work email from a new device. They first provide their password, which qualifies as something they know. The system then sends a temporary, single use code to an authenticator app on their company issued smartphone, which represents something they have. The employee must enter this code to finalize the login. Consequently, even if a criminal steals the password, they cannot access the account without also physically possessing the employee’s phone. This powerful security practice has become a standard for protecting important online services, including Google accounts and online banking platforms.



*Figure 9.4: Biometric Screening at Airport Security. A traveler undergoes an iris scan at an airport security checkpoint. This form of biometric identification uses a high-resolution camera to capture the unique patterns of a person's iris, providing a quick and secure method for identity verification. The process is designed to enhance security and streamline passenger flow in modern airports. (Image generated with AI assistance using Gemini Pro 2.5.)*

# Log in

---

Please enter a verification code from your authentication device

Token

676345

Continue login

*Figure 9.5: Two-Factor Authentication (2FA). For extra security, after typing a password, Two-Factor Authentication requires a second step. The user must enter a special, one-time code (also called a 'token') from another device, like a phone, to complete the login. Image Credit: "Logging\_in\_with\_2FA\_on\_Wikipedia" by Newslinger is licensed under CC0 1.0, via Wikimedia Commons.*

## Digital Forensics: The Detectives of the Digital World

What happens when an access control fails and a cybercrime is committed? That is where **digital forensics** comes in. Also called **cyber forensics**, this is the discovery, collection, and analysis of evidence found on computers and networks.

Digital forensics specialists function as high tech detectives, specializing in recovering deleted data, tracing the origins of network attacks, and analyzing digital artifacts to reconstruct the

events of a security incident. Their expertise is critical in both law enforcement and corporate environments. For instance, the Polis Diraja Malaysia (PDRM) utilizes a dedicated digital forensics unit to investigate cybercrimes by examining evidence from seized devices like computers and phones for use in legal proceedings. Similarly, in the business world, a company that experiences a data breach will frequently enlist a digital forensics team to determine how the attackers infiltrated their systems, identify what information was compromised, and recommend strategies to prevent future occurrences.



*Figure 9.6: Digital Forensics Analysis. A digital forensics investigator is shown analyzing complex data on an advanced, transparent interface. This process involves meticulously examining digital evidence from various sources to uncover the details of a cyber incident, identify perpetrators, and reconstruct the timeline of events for investigative and legal purposes. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Check Your Understanding: Q1



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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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# Software Theft and Its Safeguards

**Software theft** occurs when someone steals software media, intentionally erases programs, or illegally copies a program. The most common form of software theft is **software piracy**, which is the unauthorized and illegal duplication of copyrighted software.

It might seem harmless to download a “cracked” version of an expensive program like Microsoft Office or Adobe Photoshop from an illegal website, but it is a crime. It is the digital equivalent of shoplifting. Another common tool used in software piracy is a **keygen** (key generator), which is a small program that generates fake registration numbers or activation codes to trick the software into thinking it was legally purchased.

To protect themselves from software theft, software companies use several safeguards:

- **Product Activation:** This is a process that requires you to connect to the internet or enter a unique serial number (often called a product key) to verify that the software was legally purchased before it can be fully used. This helps to prevent a single copy of the software from being installed on hundreds of different computers.
- **License Agreements:** When you install a piece of software, you are asked to agree to a **license agreement**. This is a legal contract that specifies the rules for using the software.
  - A **single-user license agreement**, also known as an **EULA (End-User License Agreement)**, is the most common type. It typically allows the user to install the software on only one computer.
  - A **network license** is for businesses and allows a specific number of computers on a company network to use the software at the same time.
  - A **site license** is a more expensive option for large organizations, like a university. It provides a flat-fee

permission for all users or all computers at a particular location to use the software.

## Information Theft and Its Safeguards

While software theft is a problem for software companies, **information theft** is a risk for everyone. Information theft occurs when someone steals personal or confidential information. This is often the primary goal of a cyber attack. Businesses and individuals use many powerful safeguards to protect their information, with the most important being encryption.

### Encryption: The Art of Scrambling Data

**Encryption** is the process of converting readable data into an unreadable, scrambled form to prevent anyone without the secret key from reading it. The readable data is called **plaintext**, and the unreadable, scrambled data is called **ciphertext**.

To convert from plaintext to ciphertext, you use an **encryption algorithm** (or **cypher**) and an **encryption key**, which is a secret code or set of characters.

Imagine you have a secret message. You use a secret rule (the algorithm) and a secret keyword (the key) to change every letter in the message. The resulting scrambled message is the ciphertext. Only someone who knows both the rule and the keyword can unscramble it back into plaintext.

There are two main types of encryption:

- **Private key encryption**, also known as **symmetric key encryption**, is a method that uses a single, identical secret key to both encrypt and decrypt information, making it a very fast

and efficient process. A practical scenario for its use would involve sending a confidential report to your manager. In this case, both parties would need to agree upon a secret password, which acts as the key, ahead of time. You would use this password to encrypt the file before emailing it, and your manager would then use the same password to decrypt it for reading. The primary challenge with this method is the initial secure distribution of the secret key itself, as any compromise during its exchange would undermine the entire encryption process.

- **Public key encryption**, also known as **asymmetric encryption**, is a more complex system designed to solve the fundamental problem of securely sharing a key. It operates using a mathematically linked pair of keys: a **public key**, which can be freely distributed to anyone, and a **private key**, which must be kept secret by its owner. The core principle is that any data encrypted with the public key can only be decrypted by its corresponding private key. A practical scenario illustrates this effectively: to send a confidential report to your manager, you first request their public key. Using this key, you encrypt the sensitive file. Once encrypted, the report becomes scrambled and secure. The only way to decipher it is with your manager's unique private key, which they alone possess. This elegant solution for securing communication without a pre-shared secret is the foundational technology that protects modern internet activities, from emails to online banking.

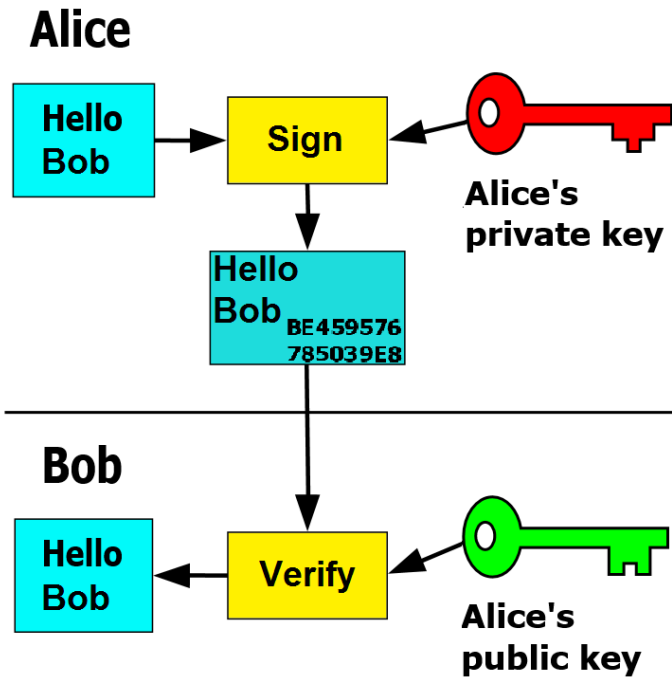


Figure 9.7: The Digital Signature Process. This diagram shows how a digital signature is created and verified using public-key cryptography. Alice uses her private key to sign a message, which generates a unique signature. Bob then uses Alice's corresponding public key to verify that the message is authentic and has not been altered. Image Credit: "Private\_key\_signing" by FlippyFlink is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Other Key Safeguards

- **Virtual Private Network (VPN):** A VPN establishes a secure, encrypted connection over a public network such as the internet. For example, if you are working remotely from a public location like a ZUS Coffee in Labuan and using their unsecured Wi-Fi, your internet traffic could be vulnerable to eavesdropping by hackers. By connecting to your company's

VPN, an encrypted tunnel is created from your device through the public network directly to your company's private network. This ensures that all transmitted data remains scrambled and unreadable to anyone who might intercept it, thereby safeguarding your online activities and sensitive information.

- **Digital Signatures and Certificates:**
  - A **digital signature** is an encrypted code that a person or company attaches to a file or email to verify their identity and to ensure the document has not been altered. It's like a tamper-proof digital seal.
  - A **digital certificate** is an electronic notice that guarantees a user or, more commonly, a website is legitimate. It is issued by a trusted third party called a Certificate Authority (CA).
- **Secure Sites (HTTPS):** When you are browsing the web, especially on banking or e-commerce sites like Lazada or Shopee, always look at the web address in your browser. If it starts with **https://**, it means the website is secure. The 's' stands for "secure" and indicates that the site is using a digital certificate and encryption to protect the data you send to it, such as your password or credit card number. If a site that asks for personal information only uses **http://** (without the 's'), you should not trust it.

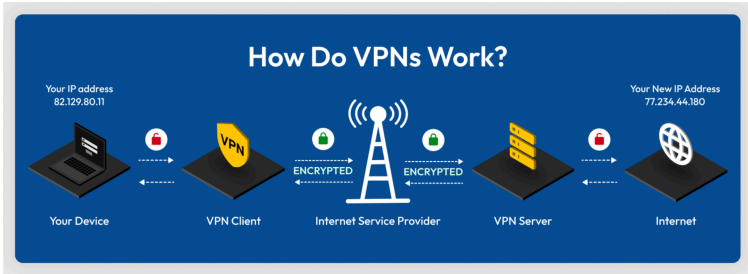


Figure 9.8: How a VPN Secures an Internet Connection. This diagram illustrates the operation of a Virtual Private Network (VPN). The user's device connects to a VPN server through an encrypted tunnel, which protects their internet traffic from being monitored by the Internet Service Provider (ISP). The VPN server then communicates with the internet, masking the user's original IP address with its own, thereby enhancing online privacy and security. Image Credit: "How\_vpn\_works" by Shashikabir87 is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Wider Implications of Technology

Using technology ethically and responsibly goes beyond just security. It also means we need to consider its effect on our personal privacy, our health, and the environment.

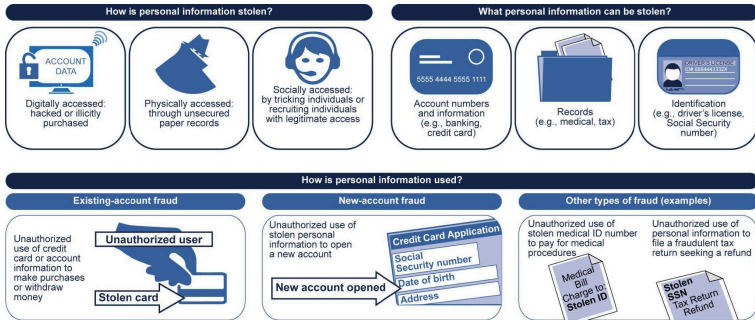
## Privacy Concerns in the Digital Age

In the modern economy, data is incredibly valuable. Many companies collect vast amounts of information about our online behaviour.

- **Personal Data Protection:** In Malaysia, the **Personal Data Protection Act (PDPA) 2010** is the main law that governs how businesses can collect, use, and store our personal data. Businesses must get our consent before collecting our

information, and they are responsible for keeping it secure. Recent updates to this law, which came into effect in 2025, require businesses to notify users and the authorities much more quickly if a data breach occurs. This shows how seriously data privacy is now being taken.

- **Identity Theft:** This is a serious crime where someone steals your personal information (like your MyKad number, address, or bank details) and uses it to impersonate you, often for financial gain. They might use your identity to apply for a loan, make online purchases, or commit other crimes in your name.
- **Online Social Networks:** Be very careful about what you share on social media platforms like Facebook, Instagram, and TikTok. Information, photos, and opinions posted online can sometimes be seen by anyone, including future employers, and can stay on the internet forever, even if you delete the original post. It is important to regularly check your privacy settings to control who can see what you share.



Source: GAO. | GAO-17-264

Figure 9.9: *The Lifecycle of Identity Theft.* This infographic provides an overview of identity theft by illustrating three key stages: how personal information is stolen (digitally, physically, or socially), what types of information are targeted (account numbers, records, and identification), and how the stolen information is used to commit fraud (such as unauthorized use of existing accounts or opening new ones). Image Credit: “Figure\_1\_Examples\_of\_How\_Personal\_Information\_Is\_Obtained\_and\_Used\_to\_Commit\_Identity\_Theft\_(34085055812)” by U.S. Government Accountability Office is licensed under Public Domain, via Wikimedia Commons.

# Health Concerns of Using Technology

Spending many hours a day using computers and smartphones can have a real impact on our physical health.

- **Repetitive Strain Injuries (RSI):** These are injuries to the muscles, nerves, and tendons caused by performing the same action over and over again. For computer users, this often affects the hands and wrists.
  - **Tendonitis** is the inflammation of a tendon, which can be caused by too much typing.
  - **Carpal tunnel syndrome (CTS)** is a painful condition caused by pressure on a nerve in your wrist, which can also result from prolonged and improper keyboard use.
- **Computer Vision Syndrome (CVS):** This is a condition that includes a range of eye problems from spending too much time looking at a digital screen. Symptoms can include eye strain, headaches, dry eyes, and blurred vision. A simple tip to help prevent this is the **20-20-20 rule**: every 20 minutes, take a 20-second break to look at something 20 feet (about 6 meters) away.
- **Ergonomics: Designing for Health and Safety: Ergonomics** is the science of designing equipment, furniture, and workspaces to be as comfortable, efficient, and safe as possible. An ergonomic workspace can help prevent many of these health issues. This includes:
  - An adjustable chair that provides good back support.
  - A desk at the correct height.
  - Placing the monitor at eye level to avoid straining your neck.
  - Using an ergonomic keyboard and mouse that keep your wrists in a natural position.



*Figure 9.10: Poor Office Ergonomics. This image illustrates poor posture at a workstation, a common ergonomic issue. The individual is hunched forward with a curved back and neck, which can lead to strain, discomfort, and long-term musculoskeletal problems. Proper ergonomics, including maintaining a neutral spine and ensuring screens are at eye level, is crucial for health and safety in an office environment. (Image generated with AI assistance using Gemini Pro 2.5.)*



*Figure 9.11: Proper Office Ergonomics. This image demonstrates an ideal ergonomic setup in an office environment. The individual maintains a healthy posture with a straight back, supported by an adjustable chair. The desk is at the correct height, and the monitor is positioned at eye level to prevent neck strain. The use of an ergonomic keyboard and mouse helps to keep the wrists in a neutral and comfortable position, contributing to a safe and productive workspace. (Image generated with AI assistance using Gemini Pro 2.5.)*

## Environmental Issues

Our love for the latest technology also has a significant impact on the environment.

- **E-waste:** Old, discarded electronic equipment like computers,

smartphones, and printers is called **e-waste**. This is a growing global problem. E-waste often contains toxic materials like lead, mercury, and cadmium. If these devices are just thrown into a normal landfill, these toxic materials can leak into the soil and water, causing serious environmental damage and health risks.

- **Green Computing: Using Technology Sustainably:** **Green computing** involves practices that reduce the environmental impact of computers and technology. This includes:
  - **Recycling:** Taking old devices to a proper e-waste recycling centre where they can be safely disassembled and the materials recovered.
  - **Energy Efficiency:** Choosing computer products that have an energy-saving certification and remembering to turn off devices when they are not in use.
  - **Extending the Life of Computers:** Upgrading components like RAM or the storage drive to make an older computer last longer, instead of buying a new one.
  - **Proper Disposal:** Ensuring that when a device reaches the end of its life, it is disposed of through a certified e-waste program and not just thrown in the rubbish bin.



Figure 9.12: Electronic Waste (E-Waste). This image shows a large accumulation of discarded electronic devices, commonly known as e-waste. It includes obsolete or broken computers, monitors, printers, and mobile phones. E-waste is a growing environmental concern due to the hazardous materials it contains and the challenges of proper disposal and recycling. (Image generated with AI assistance using Gemini Pro 2.5.)

## Check Your Understanding: Q7



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## Check Your Understanding: Q8



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## Check Your Understanding: Q9



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## Check Your Understanding: Q10



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## Check Your Understanding: Q11



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## Check Your Understanding: Q12



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## Chapter Summary

In this chapter, we have explored the critical importance of digital ethics and responsibility in our personal and professional lives. We learned about the need for **Acceptable Use Policies** in businesses and the technical **access controls** used to enforce them. We saw how **authentication** methods, from simple passwords to advanced biometrics and **two-step verification**, are used to prove our identity and secure our accounts.

We discussed the problems of **software theft** and **information theft**, and the powerful safeguards used to prevent them, such as software license agreements and, most importantly, **encryption**. We learned how tools like VPNs and secure websites (HTTPS) help to protect our data as it travels across the internet.

Finally, we considered the wider impact of technology on society. We looked at our right to privacy under laws like Malaysia's PDPA, the real health concerns of prolonged computer use and how **ergonomics** can help, and the growing environmental challenge of **e-waste** and the importance of adopting **green computing** practices. Using technology is not just about what we can do, but about what we *should* do to be safe, respectful, and responsible digital citizens.

## Review Questions

1. What is the purpose of an Acceptable Use Policy (AUP) in a business, and why is it important?
2. Explain two-step verification using a real-world example, such as logging into your online banking account.
3. Your friend wants to download a popular software program for free from an illegal website. What is this action called, and what are two different risks they are taking by doing this?

4. You are about to enter your credit card details on a Malaysian e-commerce website. What is the single most important thing you should look for in the website's address bar to ensure the connection is secure?
5. What is one health concern related to using computers for long periods, and what is one specific ergonomic adjustment you can make to your workspace to help prevent it?
6. Explain the difference between private key encryption and public key encryption. Which one is better for sending a secure message to someone you have never met before, and why?
7. What is the difference between unauthorized access and unauthorized use? Provide a simple example of each in a university setting.
8. Why is e-waste a serious environmental problem, and what is one example of a green computing practice?

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# Chapter 10: Emerging Technologies and the Future of Business

## Learning Objectives

Welcome to the final chapter! Technology is always moving forward, creating new opportunities and challenges. After studying this chapter, you will be able to:

- Describe Artificial Intelligence (AI) and the Internet of Things (IoT) and their business applications.
- Explain the growing role of cloud computing in modern business.
- Identify other emerging technologies like big data and blockchain.
- Understand the importance of continuous learning and adaptability in a technology-driven world.
- Recognise the need for critical and responsible thinking when using future technologies.

# Introduction

Throughout this book, we have explored the foundational concepts of computing, from the hardware inside your laptop to the vast network of the internet. But technology does not stand still. The tools we use today are vastly more powerful than those from just a few years ago, and the technology of tomorrow promises even more profound changes.

For anyone preparing to enter the business world, understanding the next wave of technological innovation is not just an interesting academic exercise; it is an essential requirement for success. The forces of automation, data analysis, and hyper-connectivity are fundamentally reshaping industries, creating new business models, and demanding new skills from the workforce.

In this final chapter, we will look forward, exploring some of the exciting emerging technologies that are already beginning to transform how businesses operate in Malaysia and around the globe. We will demystify complex topics like Artificial Intelligence and the Internet of Things, explore the foundational role of cloud computing, and touch upon other game-changing concepts like big data and blockchain.

This is not just a tour of futuristic gadgets. This is a guide to understanding the forces that will shape your future career. It will help you prepare for a world where being adaptable, curious, and committed to lifelong learning is the most valuable skill you can possess.



Figure 10.1: The Next Wave of Technological Innovation in Business. A conceptual illustration of a futuristic Malaysian workplace where professionals interact with emerging technologies. The image depicts the integration of Artificial Intelligence (AI) through data on holographic displays, the Internet of Things (IoT) connecting devices, and cloud computing infrastructure, symbolized by the glowing cloud icon and server racks. Automation, represented by the robot and drones, highlights how these forces are reshaping industries against the backdrop of the Kuala Lumpur skyline. (Image generated with AI assistance using Gemini Pro 2.5.)

## Artificial Intelligence (AI): The New Engine of Business

We introduced the concept of **Artificial Intelligence (AI)** earlier in

the book. At its core, AI is a broad field of computer science focused on creating smart machines and software capable of performing tasks that typically require human intelligence. This is not about creating conscious robots like in the movies. Instead, it is about developing systems that can perform specific intelligent functions, such as learning from data, solving complex problems, understanding human language, and recognizing patterns.

AI is no longer a futuristic concept confined to research labs; it has become a powerful and practical business tool that is being integrated into almost every industry.

## The Business of AI: From Chatbots to Fraud Detection

Companies are leveraging AI to become more efficient, make smarter decisions, and provide better experiences for their customers.

A very common application that you have likely interacted with is the **customer service chatbot**. When you visit the website of a Malaysian telecommunications company like Maxis or a bank like CIMB, a small chat window often pops up, asking if you need help. This is usually an AI-powered chatbot. It uses a branch of AI called **Natural Language Processing (NLP)** to understand your typed questions and provide instant answers to common queries, 24 hours a day, 7 days a week. This frees up human customer service agents to handle more complex problems, improving efficiency and customer satisfaction.

Another powerful application is in e-commerce. When you browse a site like Lazada or Shopee, the platform is constantly analyzing your behaviour: what you search for, what you click on, what you buy. It uses a type of AI called **machine learning** to build a **recommendation engine**. This is the system that shows you a personalized list of “Products you might like.” By predicting what

you are likely to be interested in, these companies can significantly increase their sales.

In the financial world, AI is a crucial tool for security. Banks use sophisticated AI algorithms to analyze thousands of transactions per second, looking for patterns that might indicate fraud. If a transaction suddenly occurs on your Maybank credit card in a different country while you are in Malaysia, an AI system can instantly flag it as suspicious and block the transaction, protecting you from theft.

The Malaysian government recognizes the transformative potential of AI. Through agencies like the Malaysia Digital Economy Corporation (MDEC), it is actively promoting AI adoption across key sectors to boost the nation's competitiveness. The goal is to use AI to improve everything from the efficiency of manufacturing plants in Penang to the accuracy of medical diagnoses in hospitals in Kuala Lumpur..

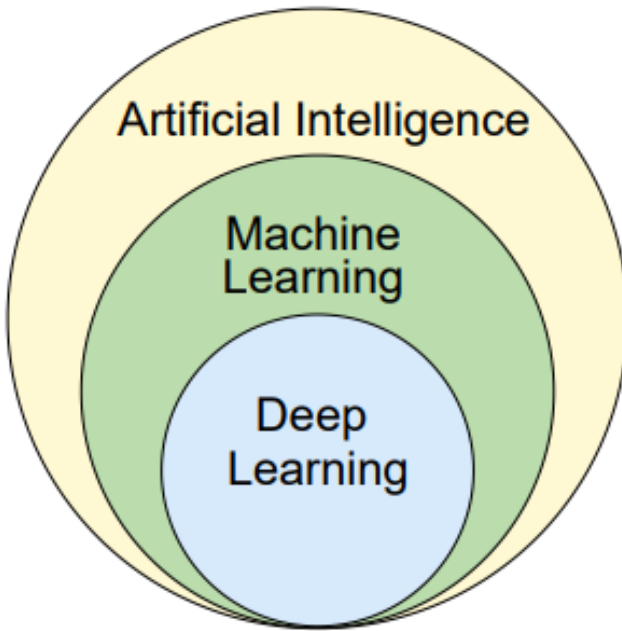


Figure 10.2: The Relationship Between AI, Machine Learning, and Deep Learning. This diagram illustrates how these three important concepts are related. Artificial Intelligence (AI) is the broadest field, focused on creating smart machines. Machine Learning (ML) is a subfield of AI, which uses data to enable systems to learn and improve on their own. Deep Learning (DL) is a further specialization within Machine Learning that uses complex structures called neural networks to handle vast amounts of data, enabling even more advanced capabilities. Image Credit: “AI\_hierarchy” by Lollixzc is licensed under CC0 1.0, via Wikimedia Commons.

## The Internet of Things (IoT): A World of Connected Devices

The **Internet of Things (IoT)** refers to the vast and growing network of physical devices, vehicles, home appliances, and other items embedded with sensors, software, and other technologies that

connect them to the internet, allowing them to collect and share data. These are not just your computer and smartphone. They are everyday objects that have been given a digital “voice.”

Think of it this way: the original internet was a network connecting computers. The mobile internet connected our personal devices. The IoT is the next evolution, where the internet connects almost *everything*.

## The Impact of IoT on Business: Creating “Smart” Industries

The true power of IoT for business is its ability to gather immense amounts of real-time data from the physical world. This data allows companies to monitor their operations, automate processes, and make data-driven decisions with a level of precision that was previously impossible.

A great local example is in the Malaysian logistics industry. A company that transports frozen goods from a port in Klang to supermarkets across the country can use IoT to create a “smart” supply chain. Each of their refrigerated trucks can be equipped with IoT sensors that constantly monitor and transmit data about the truck’s exact GPS location, the temperature inside the cargo container, and even the fuel level of the truck. A manager in the head office can view all of this information in real-time on a single dashboard. If the temperature in one of the trucks starts to rise, the system can send an automatic alert to the driver and the manager, allowing them to fix the problem before the valuable cargo spoils.

In agriculture, a farmer managing a large palm oil plantation in Sabah can use IoT devices to create a “smart farm.” IoT sensors can be placed in the soil to monitor moisture levels and nutrient content. Drones equipped with cameras can fly over the plantation to check for signs of disease. This data is all sent to a central system, which can then automatically control the irrigation system to

deliver water only when and where it is needed, conserving a precious resource and improving the health and yield of the crops.

This ability to connect the physical and digital worlds is creating “smart factories,” “smart cities,” and “smart agriculture,” all of which are more efficient, productive, and sustainable.



*Figure 10.3: A Smart Palm Oil Plantation. This image depicts a technologically advanced palm oil plantation where IoT sensors are embedded in the soil to track moisture and nutrient levels. Drones can be seen flying over the vast plantation to monitor the health of the palm trees, providing real-time data to a central system for analysis and action. This integration of technology helps to optimize resource management and improve crop yield. (Image generated with AI assistance using Gemini Pro 2.5.)*

# Cloud Computing Revisited: The Foundation of Modern Business

We have mentioned **cloud computing** before, but it is impossible to overstate its importance to the future of business. Cloud computing is the delivery of a wide range of computing services—including servers, storage, databases, networking, software, and analytics—over the internet (“the cloud”).

Instead of a company buying, owning, and maintaining its own physical computing infrastructure (which is very expensive), it can rent access to these services from a **cloud provider**. The three largest global cloud providers are Amazon Web Services (AWS), Google Cloud, and Microsoft Azure.

## The Growing Role of the Cloud in the Digital Economy

The cloud has become the essential backbone of the modern digital economy. For businesses, especially **Small and Medium Enterprises (SMEs)**, which are the heart of the Malaysian economy, cloud computing is a game-changer.

Imagine a group of recent university graduates in Labuan who want to start a new e-commerce business. In the past, they would have needed a huge amount of money to buy their own powerful servers to run their website, hire an IT team to manage them, and rent a secure, air-conditioned room to store them in. This massive upfront cost would have been a major barrier to starting their business.

With cloud computing, they don't need any of that. They can simply rent a “virtual server” from a provider like AWS for a small monthly fee. They get access to world-class, powerful computing

infrastructure without the large capital investment. This dramatically lowers the barrier to entry for new startups.

The cloud also provides incredible **flexibility and scalability**. During a normal month, the startup might only need a small amount of computing power. But during a big sales event like Hari Raya, they expect a huge surge in traffic to their website. With the cloud, they can instantly “scale up” their services, renting more computing power for just the few days they need it, and then “scale down” again afterwards. They only pay for what they use, just like electricity.

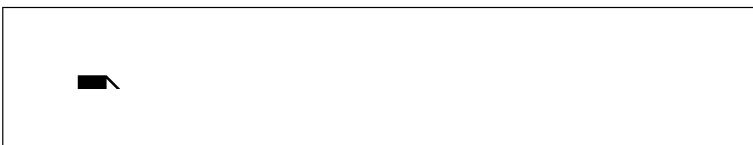
Furthermore, the cloud enables modern, flexible work. By using cloud-based software like Microsoft 365 or Google Workspace, employees can access their files and collaborate on documents from anywhere in the world, as long as they have an internet connection. This is what makes remote work possible.

Malaysia is rapidly becoming a major hub for **data centers** in Southeast Asia, with global giants like Microsoft and Google investing billions of Ringgit to build massive facilities here. This shows just how central cloud computing is to the region’s current and future economic growth.



Figure 10.4: Cloud Computing Empowers Young Entrepreneurs. This image shows a group of young entrepreneurs starting their e-commerce business. In the past, they would have needed a lot of money to buy and manage their own powerful servers. But now, with cloud computing, they can rent virtual servers for a small monthly fee. This means they can access top-quality computing power without a big initial investment. Cloud computing makes it much easier for new startups like theirs to get started and succeed. (Image generated with AI assistance using Gemini Pro 2.5.)

## Check Your Understanding: QR





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## Check Your Understanding: Q2



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## Check Your Understanding: Q3



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## Other Emerging Technologies Shaping the Future

Several other powerful technologies are also converging to shape the future of business.

- **Big Data:** This term refers to the extremely large and complex sets of data that are generated every second by all of our online activity, the billions of IoT devices, and countless business transactions. The sheer volume, velocity, and variety of this data are so great that it cannot be managed or analyzed using traditional data-processing tools. The key is not just collecting the data, but using powerful computers and AI algorithms to perform **data analytics**. This means sifting through the noise to find hidden patterns, market trends, and valuable insights that can help businesses make smarter, evidence-based decisions.
- **Blockchain:** To understand the revolutionary nature of blockchain, it is helpful to first consider a traditional system for recording information, such as a bank's ledger.
  - This familiar system is **centralized**, meaning a single entity, the bank, owns, controls, and is solely responsible for the accuracy of all transaction records. We trust the bank to maintain this ledger honestly and securely. Blockchain technology reimagines this entire concept by creating a system that does not require trust in a central authority. At its core, a **blockchain** is a secure, **decentralized**, and **distributed** digital ledger. Instead of being held in one private location, this unique ledger is shared identically across a vast network of computers, with each participant holding a complete copy.
  - The true innovation lies in how new information is added. When a new transaction or record is created, it is bundled together with other recent transactions into a new "block." This block is then cryptographically sealed, creating a unique digital fingerprint. It is then permanently linked

to the block that came before it, forming an unbreakable and chronological “chain.” A full and updated copy of this entire growing chain is then distributed to every computer participating in the network.

- This distribution is what makes the blockchain so incredibly secure and transparent. For a bad actor to secretly alter a past transaction, they would face an impossible task. They could not simply change the record on one computer; they would need to simultaneously find and alter the majority of the identical copies of the ledger spread across the global network, all while continuously recalculating the cryptographic links of every subsequent block in the chain. The sheer scale of this computational challenge makes the system effectively tamper proof. This creates a shared history of events that everyone on the network can see and agree upon without needing to trust a middleman.
- While blockchain technology is most famous for powering **cryptocurrencies** like Bitcoin, its potential for business extends far beyond digital money. Companies are now exploring its ability to create unprecedented levels of transparency and security in fields like supply chain management. Consider a company in Malaysia that exports premium Musang King durians to a discerning market in China. By using a blockchain, the company can create a verifiable and unchangeable story for its product. The initial certification of the farm in Pahang could be the first block. The date of harvest and batch number could form the next. Each step, from clearing customs at the port to the temperature logs inside the shipping container, would be added as a new, permanent block in the chain. A customer in a Shanghai supermarket, curious about the product’s origin, could then simply scan a QR code on the fruit to see its entire secure journey, providing absolute proof of its authenticity and quality.

- **Automation:** This is the use of technology to perform tasks that were previously done by humans. This ranges from physical **robotics** (like the robotic arms that assemble cars in a Proton factory) to **Robotic Process Automation (RPA)**, which is software that can be programmed to automate repetitive digital tasks, like processing invoices or transferring data between different software systems. The goal of automation is to help businesses increase efficiency, reduce errors, and free up human employees to focus on more creative and strategic work.
- **Cybersecurity Trends:** As businesses become more digital and connect more devices to the internet, their “attack surface” grows, making them more vulnerable to cyber threats. Consequently, the need for advanced **cybersecurity** becomes more critical than ever. New and more sophisticated threats appear all the time, so cybersecurity is a field that is constantly evolving. Future trends include using AI to predict and automatically respond to cyberattacks and developing new security models for the vast and complex world of IoT devices.

## HOW THE BLOCKCHAIN WORKS

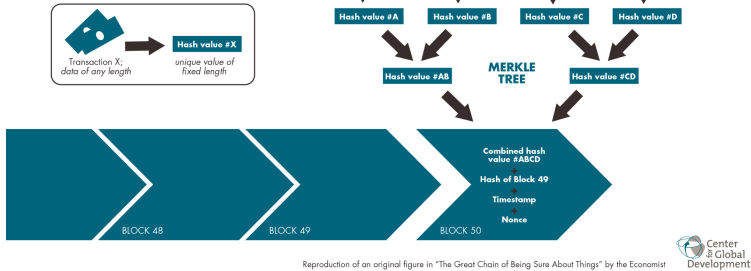


Figure 10.5: How Transactions Form a New Block in the Blockchain. This infographic explains how individual transactions are grouped together to create a new block that gets added to the blockchain. First, every transaction (like Transaction A, B, C, and D) is put through a process that creates a unique, fixed-length code called a “hash value”. Think of it as a unique digital fingerprint for each transaction. Next, these hash values are paired up and combined to create a new hash. This process is repeated until there is only one single hash left, called the combined hash or Merkle root. This single hash now represents all the individual transactions. Finally, this combined hash is packaged into a new block (in this case, Block 50). This new block also contains the hash of the previous block (Block 49), which links them together, plus a timestamp and a “nonce” (a number used for security). This linking process is what forms the strong, secure “chain” in a blockchain. Image Credit: “Blockchain\_workflow” by B140970324 is licensed under CC BY-SA 4.0, via Wikimedia Commons.

## Staying Updated: The Importance of Continuous Learning

With the pace of technological change accelerating so rapidly, the single most important skill you can possess for a successful career is the ability and willingness to **learn and adapt**.

The specific software you master in university today might be outdated in five years. The programming language that is in high demand now might be replaced by a new one in the next decade.

However, if you have a strong foundation in the fundamental concepts of computing (like the ones covered in this book) and, more importantly, a mindset of **continuous learning**, you will always be able to adapt to what comes next.

Continuous learning means actively seeking out new knowledge and skills throughout your career. This could involve taking online courses, attending industry workshops and seminars, reading books and articles about new technologies, and earning professional certifications.

In Malaysia, there is a widely recognized “**digital skills gap**.” This means that there are not enough workers who possess the advanced technology skills that modern companies desperately need. This situation presents a huge opportunity for students and young professionals who are committed to keeping their skills up to date. By becoming a lifelong learner, you are not just keeping yourself relevant; you are making yourself highly valuable in the job market.

## Critical Thinking and Responsible Technology Use

Finally, as we stand on the cusp of this new technological era, we must do more than just learn how to use these powerful new tools. We must also think critically and act responsibly.

The rise of AI, automation, and big data collection raises profound and important ethical questions that society is still grappling with.

- **Privacy:** How much of our personal data are we willing to give up in exchange for convenient services?
- **Fairness and Bias:** AI systems learn from the data they are trained on. If that data reflects existing societal biases, the AI can learn and even amplify those biases, leading to unfair outcomes in areas like hiring or loan applications.

- **The Future of Jobs:** As automation technology becomes more capable, what will be the impact on the human workforce? Which jobs will be replaced, and what new jobs will be created?

As a future business professional, it will be your responsibility to use these tools not just to create profit, but to do so in a way that is **ethical, transparent, and benefits society**. The future of technology is not just about what technology *can* do; it is about what we, as responsible humans, *choose* to do with it.

## Check Your Understanding: Q4



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## Check Your Understanding: Q5



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## Check Your Understanding: Q6



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## Chapter Summary

In this final chapter, we have taken a look into the near future of business and technology. We explored powerful and transformative emerging technologies like **Artificial Intelligence (AI)**, the **Internet of Things (IoT)**, the ever-important **cloud computing**, **big data**, and **blockchain**. We learned that these are not just buzzwords; they are powerful tools that are already being used to create smarter, more efficient, and more data-driven ways of doing business in Malaysia and across the globe.

Most importantly, we understood that in a world of constant and accelerating change, technical skills alone are not enough. The commitment to **continuous learning** and the practice of **responsible, critical, and ethical technology use** are the true keys to building a successful and meaningful career in the exciting and challenging decades to come.

## Review Questions

1. Describe one way a business in Malaysia could use **AI** and one

way it could use the **Internet of Things (IoT)**.

2. What is **cloud computing**? Explain why it is particularly useful for a small or new business (SME) compared to the traditional way of owning IT infrastructure.
3. Using the analogy of a shared digital notebook, explain in your own words what a **blockchain** is and why it is so difficult to tamper with.
4. Why is **continuous learning** so important for a career in the modern business world? What is the “digital skills gap”?
5. What is one ethical question that a business should consider before implementing a new technology like AI in its hiring process?

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# Glossary of Terms

## **Acceptable Use Policy (AUP)**

A document that outlines the rules for the use of a company's computers and networks.

## **Accuracy**

The ability of a computer to perform calculations with 100% accuracy, which is critical for financial tasks

## **Antivirus Programs**

Software that detects and removes viruses and other malware.

## **Application (app)**

A set of instructions that tells a computer how to perform a specific task. The word “app” is more common for software on smartphones and modern computers.

## **Application Software**

A program designed for a user to perform a specific task, like writing a document or browsing the internet.

## **Artificial Intelligence (AI)**

A broad field of computer science focused on creating machines and software that can perform tasks requiring human intelligence, such as learning, problem-solving, and understanding language.

**Authentication**

The process of verifying a user's identity to ensure they are who they claim to be.

**Automation**

The use of technology to perform tasks with reduced human assistance.

**Backup**

A copy of files made for safety in case the originals are lost or damaged.

**Bandwidth**

The measure of how much data can be transferred over a connection in a specific amount of time, usually measured in Mbps.

**Big Data**

Extremely large and complex data sets that can be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behaviour and interactions.

**Biometrics**

The use of a unique personal characteristic, like a fingerprint or facial scan, for identification.

**Bit**

The smallest unit of data in a computer, represented as either ON (1) or OFF (0).

**Blockchain**

A secure, decentralized, and distributed digital ledger

technology that records transactions in a way that is highly resistant to modification.

**Bluetooth**

A short-range wireless technology for connecting personal devices together over a range of about 10 meters.

**Browser**

The software application used to access and view webpages on the World Wide Web (e.g., Google Chrome, Safari).

**Byte**

A unit of digital information that consists of 8 bits. A group of 8 bits is called a byte, which can represent a single character.

**Central Processing Unit, or CPU**

Figure 3.4: A Mobile User Interface. The screen of a smartphone provides a clear example of a modern Graphical User Interface (GUI). The grid of small pictures, or icons, allows the user to launch applications with a simple touch.

(Image generated with AI assistance.)

**Client**

A computer or device that requests information from a server.

**Cloud Backup**

An internet service for storing data on remote servers as backup.

**Cloud Computing**

The delivery of on-demand computing services—including servers, storage, databases, and software—over the internet from a cloud provider.

**Cloud Storage**

A service that stores your data on internet servers, allowing you to access it from any device with an internet connection.

**Computer**

An electronic device that operates under the control of instructions to process raw items and produce a useful result. It processes data based on a set of instructions.

**Continuous Learning**

The ongoing, voluntary, and self-motivated pursuit of knowledge for either personal or professional reasons.

**Cryptocurrency**

A digital or virtual currency that uses cryptography for security, with Bitcoin being the most well-known example.

**Cybercrime**

An illegal act involving a computer.

**Cybersecurity**

The practice of protecting computers, networks, and data from attack, damage, or unauthorized access.

**Data**

The raw details you provide to the computer. They are raw, unprocessed facts and figures.

**Data Analytics**

The process of examining large data sets to find trends, draw conclusions, and make informed decisions.

**Decision-making**

The process of using computer-analyzed information to make smarter business choices.

**Desktop Computer**

A computer designed to stay in one location, which is often more powerful and easier to upgrade than portable models.

**Digital Divide**

The gap between people who have ready access to computers and the internet, and those who do not.

**Digital Security Risks**

Any event or action that could cause loss or damage to a computer system or its data

**Digital Skills Gap**

The difference between the digital skills that employers need and the skills that the current workforce possesses.

**Display**

The most common output device, which visually presents text, graphics, and video on a screen.

**Domain Name System (DNS)**

The internet's phonebook, which translates human-readable domain names (like google.com) into computer-readable IP addresses.

**E-waste**

Discarded electronic equipment, such as old computers, smartphones, and printers.

**Embedded Computer**

A special-purpose computer that functions as one component within a larger product, such as a rice cooker or a car's braking system.

**Encryption**

The process of converting readable data (plaintext) into an unreadable, scrambled code (ciphertext) to protect it.

**Enterprise user**

An employee who works for a large organisation on a managed company network, often using specialized, custom-built software.

**Ergonomics**

The science of designing a workspace and its equipment to be safe, comfortable, and efficient for human use.

**Executes**

To carry out the instructions of a computer program.

**File**

A named collection of stored data, which can be thought of as a single digital item.

**File Manager**

A utility that helps users manage their files and folders.

**Firewall**

Hardware or software that acts as a security guard to protect a network from unauthorized access.

**Folder**

A digital container used to organise files.

**fragmentation**

The state of a file being stored in separate, non-contiguous parts on a disk.

**Gigabyte**

A unit of data measurement approximately equal to 1 billion bytes.

**Green Computing**

The practice of using computing resources in a more environmentally responsible and sustainable way.

**Hard Disk Drive (HDD)**

A traditional storage device that uses magnetism and spinning platters to store data permanently.

**Hardware**

The physical, touchable parts of a computer system.

**Headset**

A device that combines headphones (output) and a microphone (input) into a single unit, commonly used for online calls.

**Home user**

A person who uses a computer for personal activities at home, such as managing personal life, entertainment, and learning.

**Hotspot**

A physical location where you can get wireless internet access. A mobile hotspot uses a smartphone's data connection.

**HTTPS**

A protocol that indicates a secure and encrypted connection to a website, often shown by a padlock icon in the browser.

**Information**

The final, organized result that the computer shows you. It is processed data that is meaningful and useful.

**Input**

The act of providing data and instructions to the computer.

**Input Device**

Any piece of hardware used to enter data and instructions into a computer, such as a keyboard or mouse.

**Instructions**

A set of specific rules a computer follows to perform any task.

**Internet**

The massive, worldwide collection of interconnected computer networks that share information.

**Internet of Things (IoT)**

A vast network of physical devices (not just computers) that are embedded with sensors and connected to the internet, allowing them to collect and share data.

**Internet Service Provider (ISP)**

A business that provides access to the internet (e.g., TM Unifi, Maxis).

**IP Address**

A unique number that identifies each computer or device connected to the internet.

**IPOS**

The four-step cycle of Input, Process, Output, and Storage.

**Keyboard**

The most common input device, used for typing text, numbers, and symbols.

**Kilobyte**

A unit of data measurement approximately equal to 1,000 bytes.

**Laptop**

A portable, all-in-one computer that combines the screen, keyboard, and internal parts into a single unit for mobility.

**Malware**

Short for "malicious software," it is any software intentionally designed to cause damage to a computer or steal data.

**Megabyte**

A unit of data measurement approximately equal to 1 million bytes.

**Memory Card**

A small, flat storage card that uses flash memory, commonly used in portable devices like digital cameras and smartphones.

**Microphone**

An input device that captures sound waves and converts them into a digital format.

**Mobile App**

A native application designed specifically to be installed and run on a mobile device like a smartphone or tablet.

**Mobile user**

A professional who works while on the move, relying on portable devices like smartphones and tablets to stay connected and productive.

**Mouse**

The most common pointing device for desktop computers, used to control the cursor on the screen.

**Multitasking**

The ability of an operating system to run multiple applications at the same time, sharing the computer's resources among them.

**Native App**

A program that is installed directly onto a specific computer or mobile device.

**Netiquette**

The code of acceptable and polite behavior for online communication.

**Network**

A collection of computers and devices connected together, which allows them to share resources.

**NFC (Near Field Communication)**

A very short-range wireless technology (4 cm or less) that powers "tap-to-pay" systems.

**Open-Source Software**

Software where the source code is made available for free, allowing anyone to view, modify, and share it.

**Operating System**

The main system software that manages all the computer's hardware and software resources.

**Operating System (OS)**

The main system software that manages a computer's hardware and software resources.

**Output**

The result that a computer shows after processing data.

**Output Device**

Any hardware component that presents the processed information from a computer to a user, such as a monitor or printer.

**Phishing**

A common cyberattack where hackers send fake emails, pretending to be from a legitimate company, to trick people into revealing personal information or downloading malware.

**Port**

A connection point or interface on a computer where you can connect an external device.

**Power user**

A user who requires a high-performance computer for demanding and specialized tasks, such as 3D modelling or scientific calculations.

**Printer**

An output device that produces a physical copy ("hard copy") of text and graphics.

**Process**

The action of the computer taking raw data and following instructions to work on it.

**Program**

A set of instructions that tells the hardware what to do. It is also known as software.

**Programming Language**

A formal language used to write instructions for a computer.

**Random Access Memory (RAM)**

The computer's high-speed, temporary, and volatile workspace that holds data and instructions the CPU is actively using.

**Random Access Memory, or RAM**

Temporary storage for data and programs that are currently in use. It is volatile.

**Ransomware**

A type of malware that encrypts a user's files and demands a ransom payment to unlock them.

**Reach**

The ability of a business to connect with customers and partners globally through the internet.

**Resolution**

The number of individual dots, or pixels, used to create the image on a screen, which determines the sharpness and clarity.

**Restore**

The process of copying files from a backup back to their original location.

**Retail Software**

Mass-produced software that is available for purchase in a store or online.

**Scanner**

An input device that converts printed material, such as text and pictures, into a digital format.

**Server**

A powerful computer that provides services to other computers over a network.

**Software**

A set of instructions (a program) that tells the hardware what to do.

**Software Developers**

A group of people who write computer programs.

**Software Development Life Cycle (SDLC)**

A structured process that professionals follow for planning, creating, testing, and maintaining software.

**Software License**

A legal agreement that defines how a piece of software can be used and distributed.

**Software Piracy**

The illegal and unauthorized copying, distribution, or use of copyrighted software

**Software Update**

A new version of a program that can fix errors, improve security, and add new features.

**SOHO User**

An individual who runs a business from home or a small office, using a computer as their primary tool for earning an income.

**Solid-State Drive (SSD)**

A modern and fast storage device that stores data on flash memory chips and has no moving parts.

**Speed**

The ability of a computer to process millions of instructions every second, which translates into business efficiency and better customer service.

**Spyware**

Software that secretly collects information about a user's activities.

**Storage**

The act of saving data or information for future use.

**Surge Protector**

A device that protects computer equipment against electrical power spikes.

**System Software**

The set of programs that operates and controls the computer's hardware and provides a platform for applications to run.

**Tablet**

A highly portable mobile computer with a large touch screen as its main feature.

**Terabyte**

A unit of data measurement approximately equal to 1 trillion bytes.

**Trojan Horse**

Destructive software that is disguised as a legitimate, useful program.

**Two-Step Verification**

A security method that requires two different forms of identification to log in.

**Uninterruptible Power Supply (UPS)**

A device that contains a battery and provides temporary power during a blackout, allowing for a safe shutdown.

**URL (Uniform Resource Locator)**

A webpage's unique address.

**USB Flash Drive**

A small, ultra-portable storage device that plugs into a USB port, also known as a thumb drive or pendrive.

**Use**

Anyone who interacts with a computer or mobile device.

**User Interface**

The visual part of a program or device that a user interacts with.

**User Interface (UI)**

The visual part of an operating system or software that a user interacts with, including the desktop, icons, and menus.

**Utility**

A program that performs a specific task related to managing or maintaining a computer.

**Utility Program**

A type of system software that performs a specific maintenance task to help manage, protect, or improve the computer.

**Virtual Private Network (VPN)**

A service that provides a secure, encrypted connection over a public network like the internet.

**Virus**

A malicious program that attaches itself to a file to spread.

**VoIP (Voice over IP)**

A technology that allows you to make voice calls over the internet instead of a traditional phone line.

**Web App**

An application that runs on a remote server and is accessed through a web browser, so nothing needs to be installed on the user's computer.

**Webcam**

A small digital video camera used to capture video for online meetings, classes, or video calls.

**Wi-Fi**

A wireless technology that uses radio signals to provide high-speed internet and network connections over a large area.

**World Wide Web**

A system of public, interlinked documents and other web resources that are accessed via the internet.

**Worm**

A malicious program that can copy itself to spread across a network without human interaction.

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