Hardware &
Operating Systems

A Practical Guide for Getting Job-ready Skills in Information Technology

Ojula Technology Innovations

Hardware & Operating Systems

A Practical Guide for Getting Job-ready Skills

in Information Technology

(*Updated regularly*)

ISBN: 9798837976933

Published in the United States

Limit of Liability/Disclaimer of Warranty

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. All information given in this book is based on the author's own knowledge and research, and does not constitute technical, financial or professional advice. The author and publisher have attempted to trace the copyright holders of all material reproduced in this publication, and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Table of Contents

How this Book can Help You

This is not just another hardware and operating systems book. It is an *intensive* and *practical* guide that is **updated regularly** to stay abreast of the latest technology of hardware and software tools. It is a self-paced book that is excellent for beginners and accomplished experts alike.

This guide will help you launch a rewarding new career in technology. It will prepare you with job-ready skills valued by employers in as little as two months, if not sooner. You don't need a degree or prior experience to understand the contents of this book.

Whether you're skilling up to become a Help Desk Support Specialist, IT Support Specialist, Virtual Customer Service Agent, Technical Support Representative, or if you just want to learn the basics of working with and managing the latest IT systems, you need a strong foundation in IT skillsets.

As you go through this book, you're also going to get tested on the materials we are covering by following best practices. Although this is a self-paced course, I strongly recommend that you complete it in not more than 6 weeks. For example, if you can complete one module every week, you can finish the course in 6 weeks.

Practice quizzes and answers are included at the end of most chapters to help you test yourself and see how much you have improved. In Chapter 5, you will find the link to the **course resources folder**. Once you open the link, you will be able to **download assessment tests and their solutions, and all the screenshots used in this book** (for your quick revision**).**

1.0. Introduction

If you're ready to enter the amazing world of IT (Information Technology), you need job-ready skills. My book will help you develop the skills you need to work with computer hardware and operating systems. It is your first step to prepare for all types of technology-related careers that require IT Fundamental skills.

First, you'll learn the essential software brain of a computer (the operating system software you use when you explore Microsoft Windows). Next, you'll discover internal key hardware computer components, including motherboard components, the CPU (central processing unit) memory, hard drives, expansion slots, and so much more.

I'll help you become skilled at identifying the various hardware connections which includes various categories of ports, add-on peripherals like mice, and other hardware components. I'll teach you the essentials of basic workstation setup, commonly used operating system settings, screen capture commands, and job-essential best troubleshooting practices.

As you're learning about operating systems such as Windows, you'll discover the basics of file and folder management, how to evaluate hardware performance, and explore the BIOS (Basic Input/Output System). You'll also learn about printers, scanners, input and pointing devices, and hard drives. You'll understand how the optical drives, external storage, display devices, audio, and video devices work.

You'll be able to identify ports and connectors, graphics devices, and audio connectors. You'll also learn the difference between wired and wireless connections, peripheral and printer connections, and installation types.

Furthermore, you'll learn how to manage the information that a computer processes, internal storage, display cards versus sound cards, and network interface cards. You'll also explore how systems can be cooled.

Now, are you ready to combine your hardware and operating systems knowledge to set up and troubleshoot malfunctioning computer systems? If yes, move on to

the first section and start taking notes!

1.1. Organization of this Guide

This guide is divided into five modules:

- Operating System Fundamentals
- Computing Devices and Peripherals
- Interfaces and Connectors
- Internal Computer Components
- Getting Started with a Workstation and Operating System

To successfully complete this guide, you should be familiar with:

- Basic computer operating skills
- Basic knowledge of computer terminology
- Microsoft Windows Operating System

After you've completed this guide, you will be able to:

- Explain operating system fundamentals.
- Recognize hardware components and devices.
- Identify interfaces and peripherals.

2.0. Operating System Fundamentals

Did you know that computers have been around for centuries? Some of the earliest computers include a stone wheel calculator used in ancient Greece to track solar and lunar eclipses, Jacquard fabric looms from 1803 that used punch card technology and even a 20-digit manual calculator that was invented in the early 1800s.

But we're going to fast forward to 20th and 21st century computing and provide you with an easy and informative introduction to the fundamentals of computing and operating systems. When you complete this module, you'll be able to classify computing devices based on size and usage.

You'll become knowledgeable about operating system history, operating system installation, and operating system components. You'll explore the notational (numeric) systems used for processing content, storing data, and the display of onscreen text, hardware addresses, website colors, web addresses, and more. You'll also discover two easy ways to remember notation conversion methods. You'll round out this module with practical knowledge that you'll use when it's time to evaluate computing performance and storage.

2.1. Learning Objectives

- Identify and classify computers by size and usage, and describe their benefits.
- List the four functions of computing.
- Describe what operating systems do, explore their history, and identify the current four leading operating system vendors.
- Install and set up a Windows 10 operating system and describe the operating system's service, disk, memory, file, folder, management features, security options, and communication options.

- Categorize computing devices and identify the operating systems platforms associated with these devices.
- Learn how computers use notational systems and how to convert values between notational systems.
- Discover how computers use the two most widely used character types, ASCII, and Unicode.
- Identify four critical central processor unit (CPU) performance criteria; evaluate and troubleshoot random access memory (RAM) performance; assess a computer's storage capacity; and establish, evaluate, and troubleshoot network connectivity.

2.2. Introduction to Computing Fundamentals

Fig 2.1 is a summary of what you will learn in this chapter.

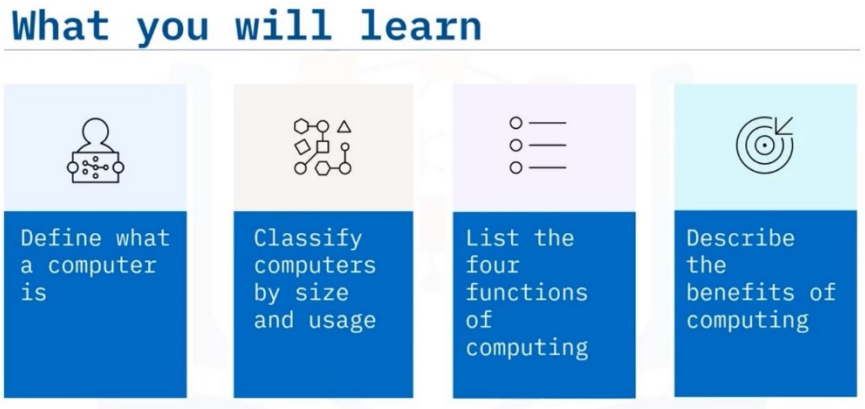

Figure 2.1: What you will learn in this chapter

A computer is a device or system that includes

1. Hardware
2. operating system software
3. application software, and
4. peripheral devices.

Hardware is the platform that processes data based on the provided instructions and stores data.

Software includes the operating system software that enables and configures hardware capabilities and the application software that enables the computer to perform tasks.

Peripheral devices, such as keyboards and monitors, enable user input and output.

Users are who provide instructions.

The *first* way to classify computers is by their size and speed.

Supercomputers are the fastest computers and are used for the most complex mathematical and analytical computations.

Mainframe computers function “at the speed of business” and are used to perform transactions and more.

Minicomputers: Next in size and speed are minicomputers, which enable more than one person to access the same data.

Microcomputers: Finally, the smallest computers are microcomputers. This category includes personal computers, laptops, smartphones, and other single-user devices.

The *second* way to classify computers is by use.

General-purpose computers perform functions such as creating documents, saving files, web conferencing, working online, financial analysis, data analytics, coding,

and other multi-function capabilities. Even smartphones can be considered general-purpose computers.

Special-purpose computers, which perform defined limited use functions, include IoT devices, such as sensors that report water quality, lights that activate during occupancy, sensors that report building occupancy, and IoT devices that monitor manufacturing processes.

Other types of computers include: Wi-Fi-enabled appliances, weather stations, alarm systems, and both wired and wireless gaming consoles.

2.3. Tasks Computers Perform

Computers perform many tasks, but we can simplify and categorize those tasks into 4 easy-to-remember functions:

1. Input
2. Processing
3. Output and
4. Storage.

Let's learn more.

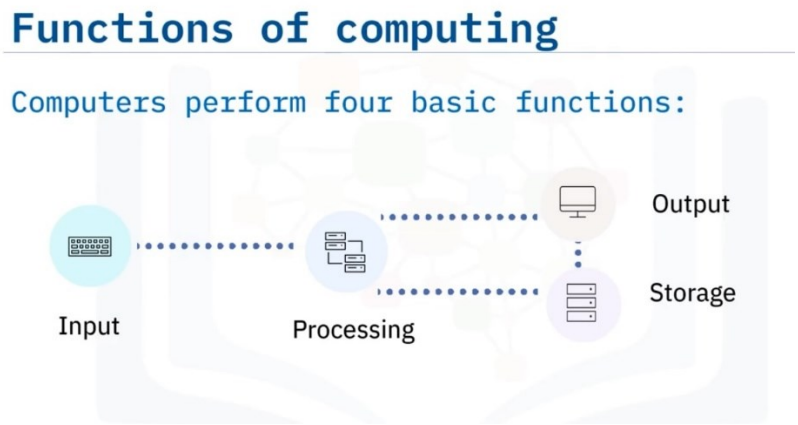

Figure 2.2: Four tasks a computer performs

Input is the function, or action, of getting data into the computer. Input happens when you type or tap on a keyboard, use a touchscreen, or speak a voice-to-text command. Clicking the *Send* button for an email is also input. Input is also the information and instructions a programmer provides to perform calculations using a set of programs.

Next, **processing** happens when the computer receives the input and then converts that data into a format or action that a user can recognize and use. Examples include downloading an app, document, or photo, and moving data from one drive to another.

Processing also occurs when the computer performs programming instructions, such as data calculations, or even instructions to fly a rocket to the stratosphere and back. Technically, processing happens when raw data changes into usable formats such as email, documents, and photos.

Processors, also called central processing units or **CPU**s, are located inside computers on a system board, also called a **motherboard**. This board and its processor are usually located centrally within the devices.

Next, the computer delivers the processed results to the default or configured **output** devices. These include monitors, speakers, and printers. Output means what you see, hear, or understand, and is what makes the data apparent and valuable.

Figure 2.3: A desktop and laptop computers with their output devices

At the same time, or just after the processing function completes, and while output is happening, computers can use the storage function.

Storage is the saving of data to disk space on your computer, an external hard drive, or on network or cloud storage for an indefinite or undefined time, unless you explicitly specify a data expiration date or delete the data. Storage saves data for reuse.

Server, desktop, and laptop computer storage is usually located inside and to the side of the case. Storage is often welded onto the system board for phones, IOT, and gaming devices.

What are the advantages of using computers?

2.4. Benefits of Computing

Capability	Benefit
Reuse content	Helps eliminate manual errors
Use network, wireless, cellular, and other communication paths	Speeds communication
Apply programming languages, processors, and memory	Enables exponential and complex computations

Figure 2.4: Benefits of computing

Manual entry errors are eliminated by using capabilities such as **copy-and-paste** and data duplication to reuse data or content. Communication is sped up by using network, wireless, cellular, and other communication technologies.

Exponential and complex computations such as those used for medical research, civil engineering and space exploration are enabled by processors, memory, and programming languages.

Capability	Benefit
Save data and documents to storage	Saves space
Save digital images for perpetuity	Provides longer-lasting access
Edit documents, spreadsheets, and others	Eliminates the drudgery of redundant tasks

Figure 2.5: Benefits of computing continued

Computers enable the saving of documents and data to disk storage, eliminating the extra storage space needed for stacks of paper.

Businesses thrive on digital data storage. Whether it's medical images, car claims, research records, or family photos, saving digital images provides durable and long-lasting access to that information.

Finally, editing capabilities eliminate the time-consuming drudgery of having to erase and rewrite work manually.

2.5. Introduction to Operating System

After studying this section, you will be able to:

1. Describe an operating system's purpose and functions (describe the functions operating systems manage)
2. Classify types of operating systems
3. Describe operating system generations,
4. Describe the history of 4 modern operating systems (Linux, Windows, macOS, and ChromeOS operating systems)

Operating systems provide standardized backbone code for managing input, output, processing, and storage. These efforts help keep data error-free and mitigate data loss. Operating systems can have more than one environment.

The first environment, the **command line interface** (or CLI), is an environment where the user can type commands.

Figure 2.6: The Command Line Interface - CLI

The second environment is known as a **graphical user interface** (GUI) or a graphic shell. See Figure 2.7.

Figure 2.7: The Graphic User Interface - GUI

These environments provide menus, links, buttons, and fields that help users manage the operating system.

History groups operating systems into four generations.

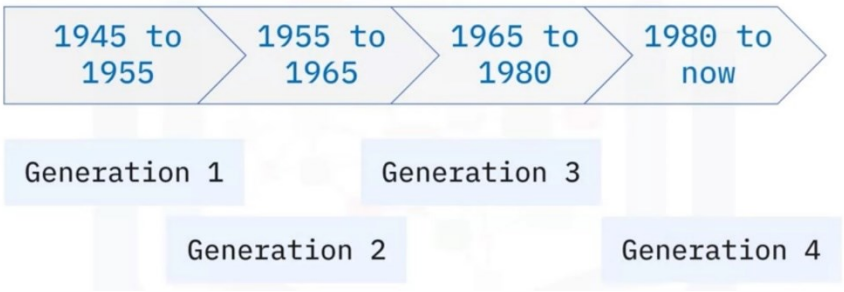

Figure 2.8: Generations of operating systems

The first generation was from 1945 to 1955. The second generation happened from 1955 to 1965. The third generation lasted 15 years, from 1965 to 1980. 1980 ushered in the fourth and current generation.

During the first generation of modern computing (from 1945 to 1955), operating systems that worked for multiple computers did not yet exist. Each computer's parameters were uniquely created for every job, or task, using machine language. However, some of the code developed during this era became the basis for future operating systems.

During the second generation of operating systems, mainframe computers became available for commercial and scientific use. Tape drives, a relatively new invention, provided input and output storage.

In 1956, General Motors Research produced the first single-stream batch operating system, notably for its IBM 704 computing system. Subsequently, IBM became the first company to create operating systems to accompany computers.

Embedded operating systems, developed in the early 1960s and still in use, focus on a single task, providing split-second response times, also known as **low latency**. In case of a system error, these operating systems can restart where the task needs to resume.

Real-time operating systems are a type of embedded operating system. Airplanes, air traffic control systems, and space exploration were among the first to use real-

time operating systems. As time passed, satellite systems, robotics, and even our cars implemented real-time operating systems.

Then, during the third generation of operating system development, additional companies began creating batch file operating systems specifically for their large computing needs. This generation of operating systems saw the development of **network operating systems** that

provided scalable, fast, accurate and secure network traffic and communications, and enabled each workstation within the network to operate independently.

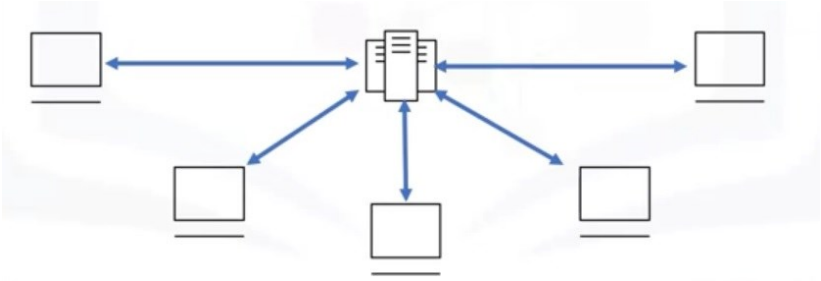

Figure 2.9: A network of systems

In 1969, the UNIX operating system offered a new innovation, an operating system that was installable on multiple computer systems and featured **processor timesharing**. Processor timesharing enabled multiple users with different programs to interact nearly simultaneously with a central computer, such as a mainframe.

The fourth and current generation of operating systems brought computing into a new age with **multitasking** operating systems including Linux, Windows, macOS, and ChromeOS operating systems that enable computers to perform multiple, complex tasks simultaneously.

Mobile operating systems including Android, Windows, iOS, and ChromeOS (which is also considered a mobile operating system) fit the definition of multitasking operating systems. Let’s learn more about some of these operating systems.

In 1991, Linus Torvalds created a small, open-source operating system for a PC, releasing version 1.0 of Linux in 1994. In 1996, the version 2.0 released with support for network-based symmetric multiprocessing (or SMP) provided a serious technical benefit for commercial and scientific data processing, evolving Linux into a powerful network and server operating system.

Throughout the next 10 years, Linux gained market acceptance and its distributions continued to mature. In 2013, Google's Linux-based mobile operating system, Android, took 75% of the market share. When evaluating the value of Linux, consider that in 2018, IBM acquired Red Hat for 34 billion US dollars.

The operating systems PC-DOS and MS-DOS once existed, with MS-DOS launching in 1981. In 1985, Windows offered the consumer market a graphical user interface version of the Windows operating system, written in variations of the C language.

In 1995, the debut of Windows 95 catapulted Microsoft's dominance in the consumer operating system software market, with Microsoft holding about 70% of the consumer desktop operating system market share in 2021.

Microsoft also offers network, server management, mobile, and phone operating systems. Apple, with its OS X and macOS based on Unix, began its foray into the operating system market in 1999 with PowerPC-based Macs. In 2006, Apple began selling Macs using Intel core processors. In 2020, Apple began the Apple silicon chip transition, using self-designed, 64-bit, ARM-based Apple M1 processors on new Mac computers.

Apple also offers the iOS operating system for its tablet and smartphone devices. In 2011, Google debuted ChromeOS built atop Linux. ChromeOS offers a lightweight, primarily browser-based operating system for mobile devices including laptops, taking about 10% of the laptop market. Laptops and tablets running ChromeOS require less local storage and cost less, making them ideal for students.

2.6. Features and Functions of an Operating System, Part 1

After studying this section, you will be able to:

- Explain how to install and set up a Windows 10 operating system (Windows 11 is similar)
- Describe essential workstation management tasks
- Describe the purpose of drivers and how to update them
- Identify five useful Windows utilities.

How are operating systems installed on a computer? Usually, the computer manufacturer loads, installs, and partially preconfigures the operating system. However, in corporate environments, IT support installs operating systems on both new and reconfigured computers.

If you are self-installing the Windows operating system from an external drive, first attach the external drive that contains the installer version of the operating system to the computer. For most computers, immediately after starting, press the Esc or F12 key repeatedly. When you start the computer, the **b**asic **i**nput-**o**utput **s**ystem, known as the BIOS, displays. The steps to follow are summarized in Figure 2.10.

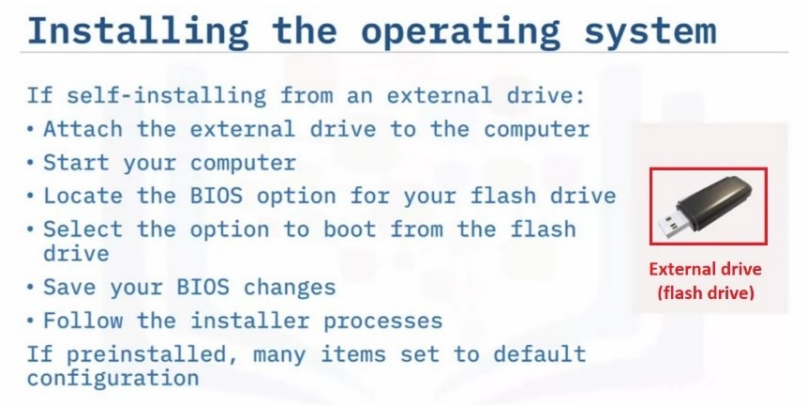

Figure 2.10: How to install Windows 10 system

Select the boot option that uses the external drive where you attached the drive containing the operating system software. Save your BIOS changes. The computer should automatically restart. Follow the installer processes.

If the computer manufacturer preinstalled the operating system, many options are preconfigured.

2.6.1. How to Configure the Operating System

Now, follow the prompts to complete the following 10 steps:

1. Activate the Microsoft operating system.
2. Select the operating system version.
3. Select the target installation drive.
4. Select your region,
5. Specify your keyboard type and create or connect your Microsoft account ID and password.
6. Continue following the prompts and select three security questions.
7. Decide if you want to connect with Cortana, Microsoft's onboard assistant.
8. Select the option to sync your device history and
9. Accept your privacy settings, which is part of creating system security.
10. Apply Windows software update

With most of your configuration tasks completed, follow the prompts to update Windows.

Next,

- Select the BitLocker option to encrypt the local hard drive. Encryption is an important data privacy and security capability.

Note that your machine may restart several times during the configuration process.

2.6.2. Policy Management

Policy management applies rules for passwords, password retries, allowed programs, and other settings specific to the machine or group. Here's how to access policy management:

Type "group policy" in the Taskbar search box (on the bottom left for Windows 10; on the bottom center for Windows 11). See Figure 2.11.

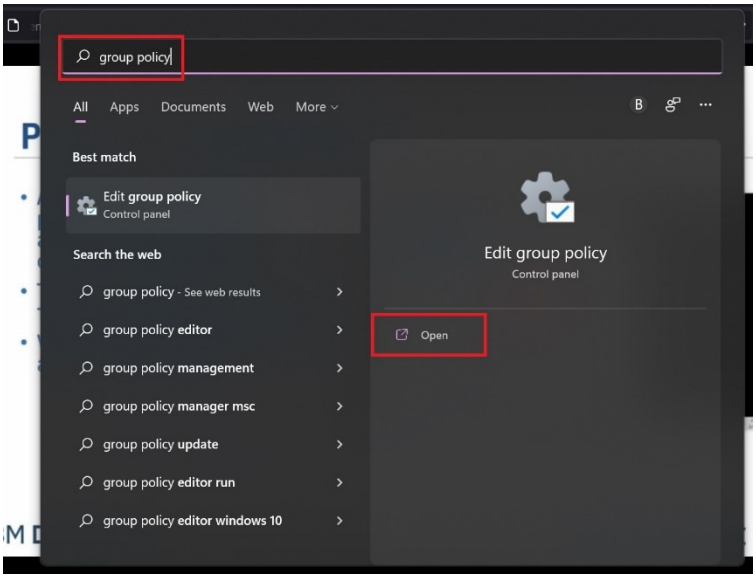

*Figure 2.11: How to open **Group Policy** in Windows 10/11*

The Edit group policy control panel option displays. Click Open. Select the User Configuration settings to view its details and edit policy settings. Windows automatically schedules processes and allocates resources, most of the time uneventfully. Sometimes though, a task might stall, and you need to end it and stop the process.

Type "Task Manager" in the Taskbar search box. Open it to view apps and their background processes. Steps to follow are 1, 2, 3 and 4 in Figure 2.12.

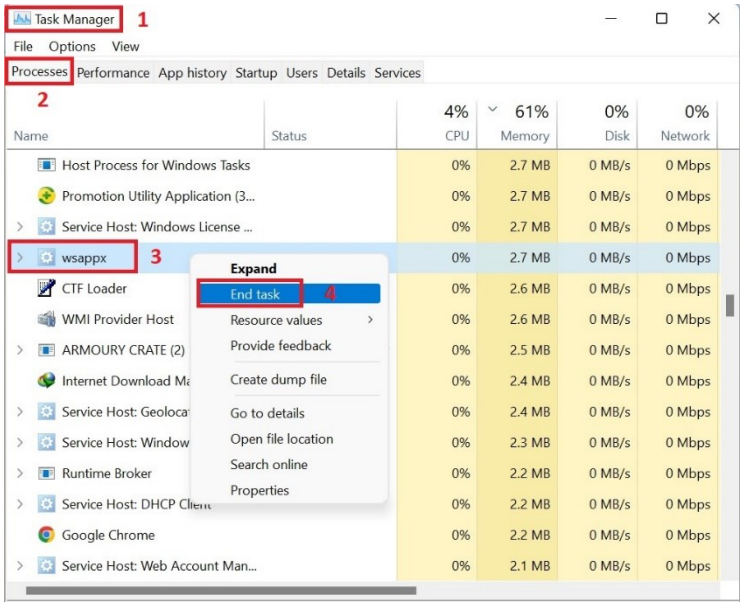

Figure 2.12: The Task Manager in Windows 10/11

When you locate the troublesome software or process, select **End task** (4) to stop the process.

2.6.3. Interface/Computer Management: The Device Manager

Perhaps you want to verify the installation and performance of a new hard drive, or that the computer recognizes memory or recognizes another computer component, such as an add-on card, which includes interfaces. In the Windows Taskbar search box/field, type “device manager”. Select Open to launch the **Device Manager** app. Alternatively, (for Windows 10 or 11), right-click on the Windows logo and select Device Manager.

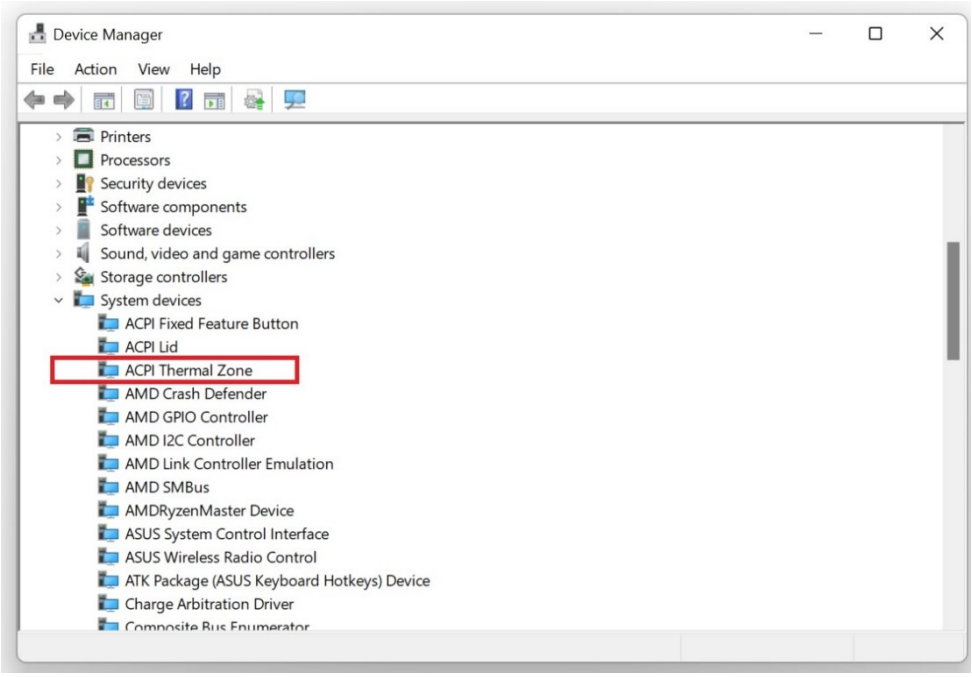

Figure 2.13: The Device Manager in Windows 10/11

Scroll the list, and you'll see the computer's system devices (hardware, components, and interfaces), such as the ACPI Thermal Zone shown in Figure 2.13. If your system uses Intel, check the Intel Management Engine Interface. Double click to view the interface's properties.

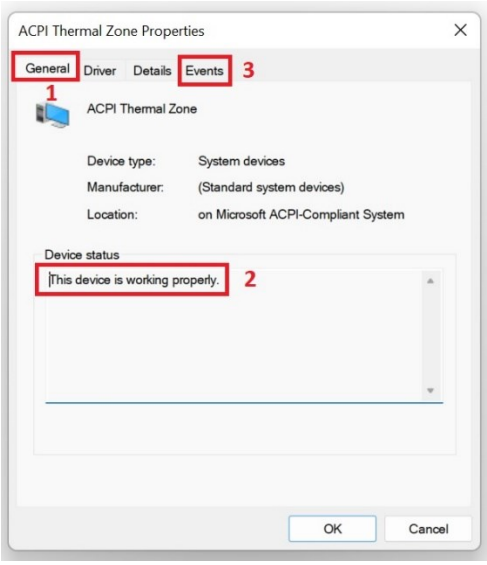

Figure 2.14: The ACPI Thermal Zone properties

In Figure 2.14, on the General tab (1), you can confirm that the interface is working properly (2). You can also view Events (3), evaluate resources, set power management options, update driver software (Figure 2.15), which works with the computer for external capabilities, update firmware, which is "onboard" device software, and view additional device details.

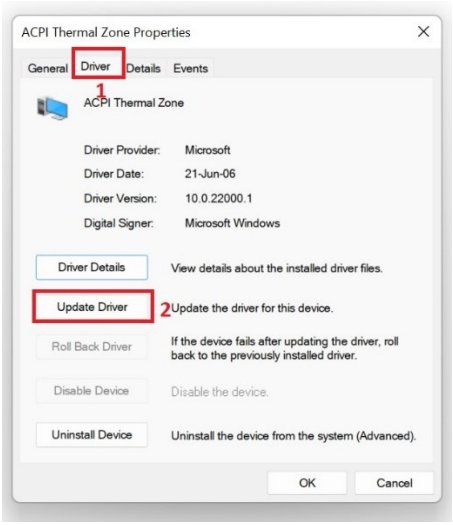

Figure 2.15: The Update button for updating drivers

2.6.4. Memory Management

Windows uses RAM for frequent memory tasks (Figure 2.16), and virtual memory for less-frequent tasks (Figure 2.17).

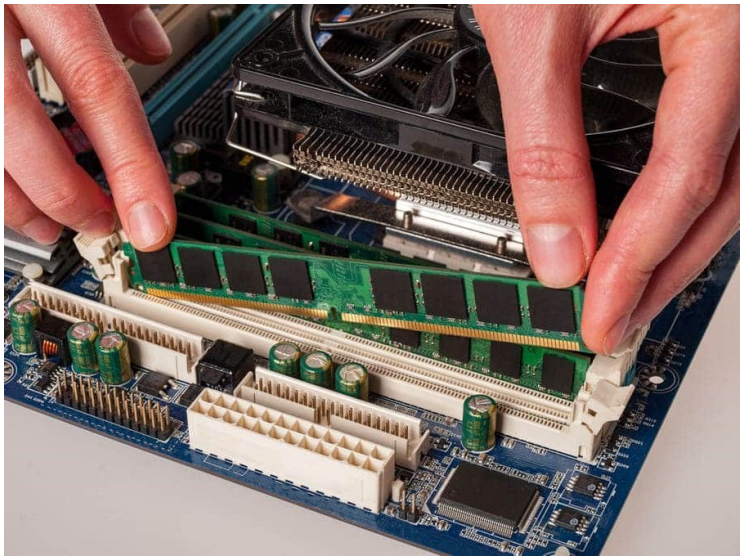

Figure 2.16: How to Fix a RAM (Random Access Memory)

Figure 2.17: Computer's hard disk is used as virtual memory

If the computer's performance is slow, or the computer is displaying "low on

virtual memory" errors, it's time to take action. You need to evaluate memory performance based on the installed RAM hardware. So, open the Task Manager (shown earlier in Figure 2.12), and view the memory resource usage (follow steps 1, 2, 3 and 4 in Figure 2.18).

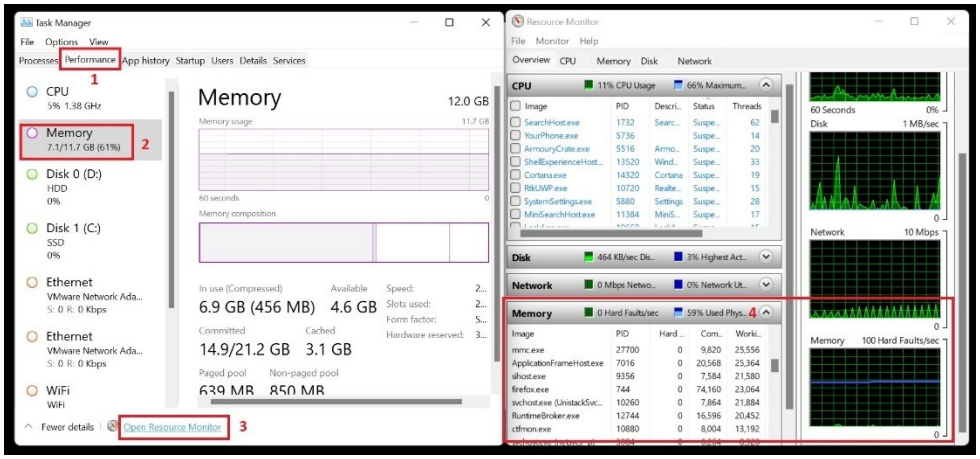

Figure 2.18: How to view the memory usage

Alternatively, you can run the Windows Memory Diagnostic app. To quickly find this app, just search it in the Taskbar search box and open it.

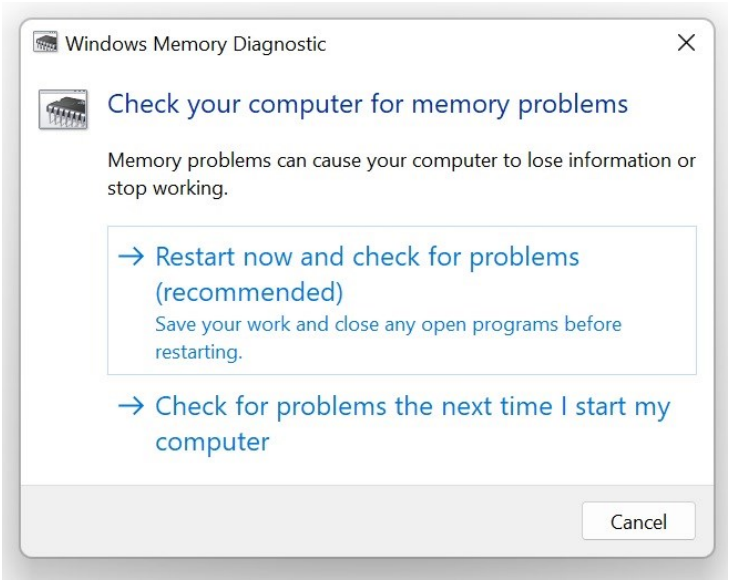

Figure 2.19: The Windows Memory Diagnostic app

Sometimes an installed program needs more virtual memory. To manage virtual memory, select Settings and About.

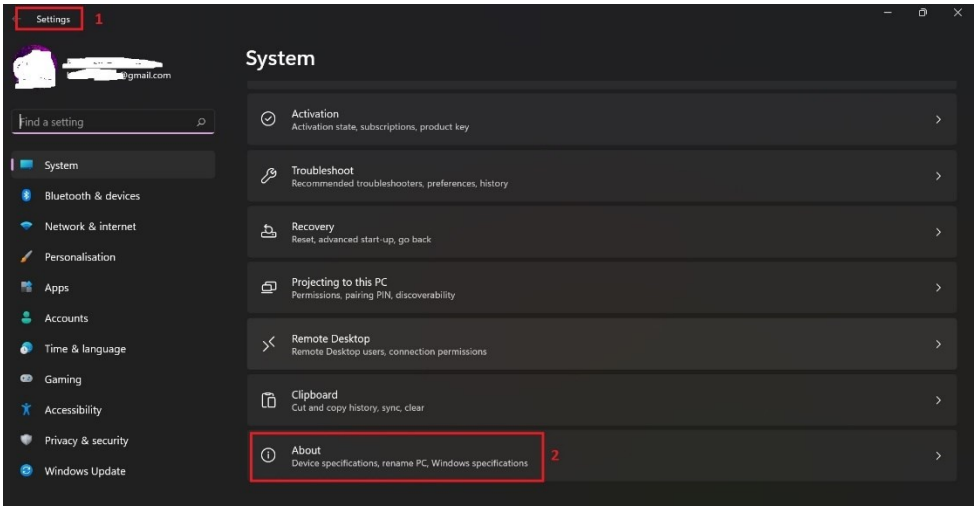

Figure 2.20: How to adjust the performance of Windows, step 1

Then begin typing the word Performance.

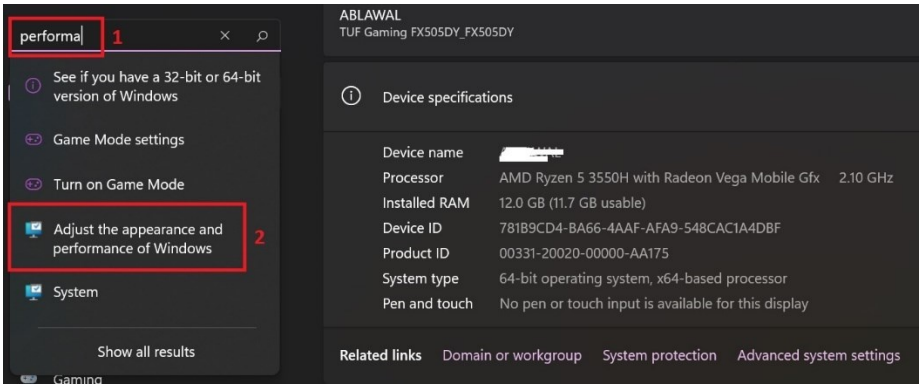

Figure 2.21: How to adjust the performance of Windows, step 2

Select the option to "Adjust the appearance and performance of Windows." The Performance options window displays. See Figure 2.22.

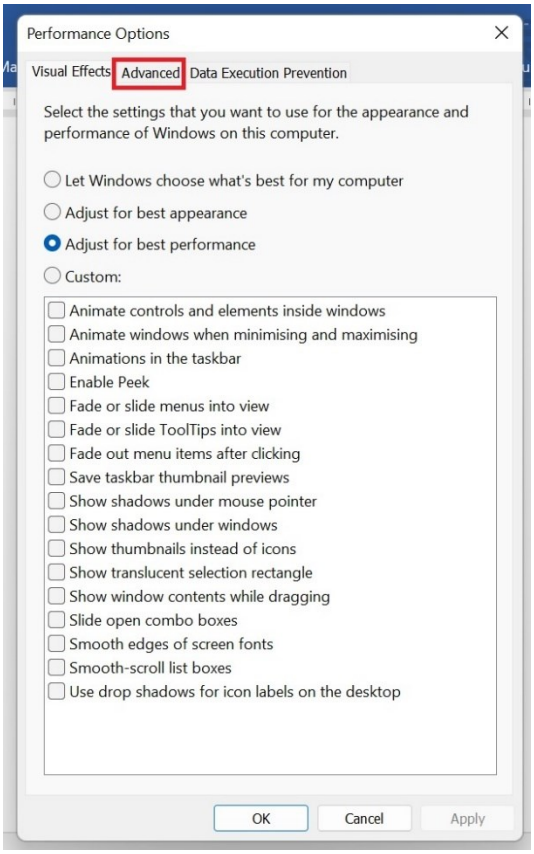

Figure 2.22: How to adjust the performance of Windows, step 3

Open the “Advanced” tab. If this tab is missing in your copy of Windows, just move on to the next the “Virtual memory” section and select Change.

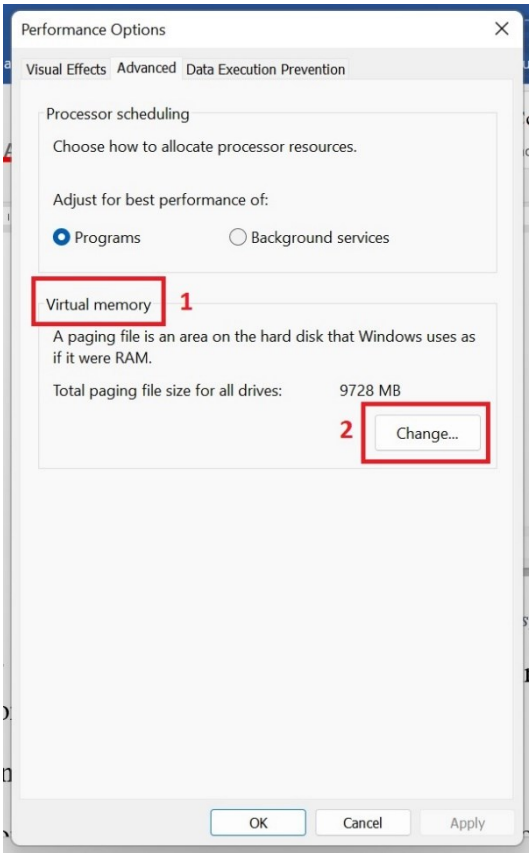

Figure 2.23: How to adjust the performance of Windows, step 4

In most instances, Windows automatically adjusts virtual memory. But if you do find that you need to adjust virtual memory, such as for a memory-intensive application like graphics or a video editor, Figure 2.24 shows the steps to follow in the Windows operating system location where you can adjust those settings.

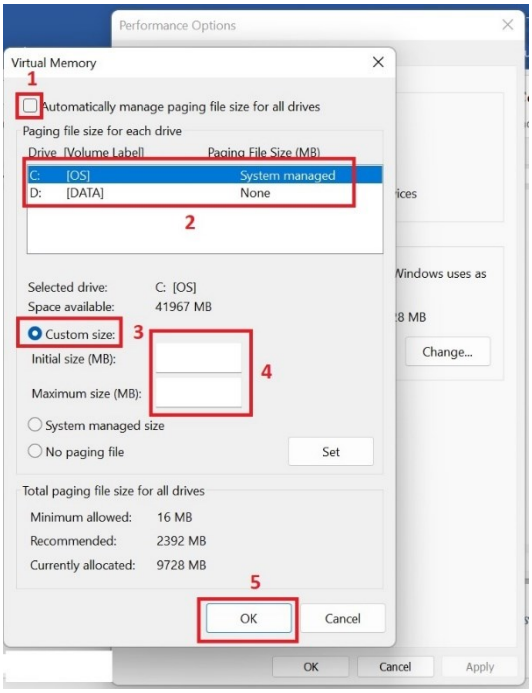

Figure 2.24: How to adjust the performance of Windows, step 5 (virtual memory management)

Step 1: Uncheck “Automatically manage paging file size for all devices”.

Step 2: Select the drive (C or D in Figure 2.24) you want to use as virtual memory (paging file)

Step 3: Select the Custom size option.

Step 4: Enter the initial and maximum size (in Megabytes) in your drive that you want to allocate to virtual memory.

Step 5: Click the OK button to enter your changes.

2.6.5. Service Management

To see this app, search “Services” in the Taskbar search box and open it. Service Management automatically handles background tasks. You can see a few tasks

running in Figure 2.25.

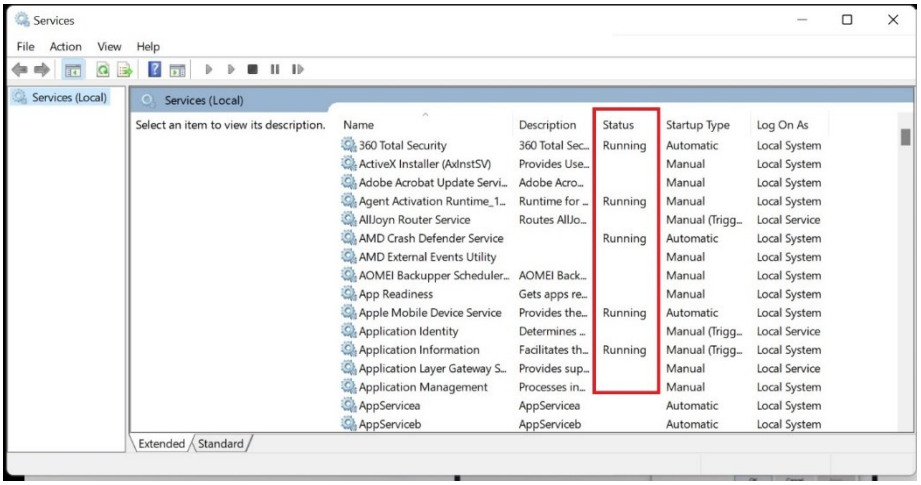

Figure 2.25: The Service Management app

However, sometimes a program just won't close, or perhaps you see a program using so much memory that other programs can't run. Service Management enables you to troubleshoot and manage these situations. When you right-click (1) on the offensive program, you can see the capabilities of this app (2). Some are shown in Figure 2.26.

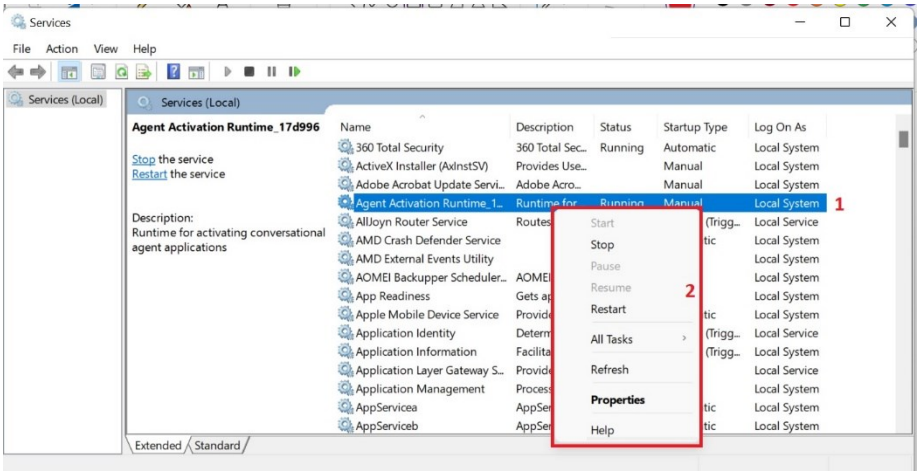

Figure 2.26: Some capabilities of the Service Management app

I want you to explore some of the options (be careful though). Some of them include:

- Stopping the service.
- Restarting the service
- Properties of the service
- Running a program
- Taking no action
- Restarting the computer.

2.6.6. Driver Configuration

Drivers are software components that enable communications between the operating system and the device.

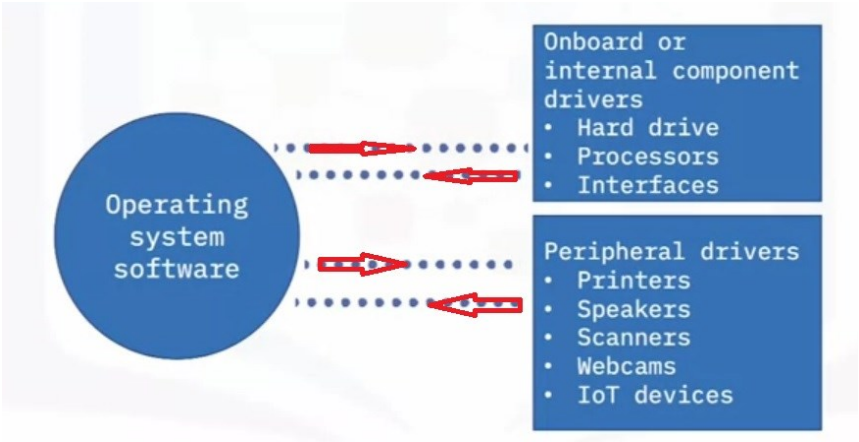

Figure 2.27: Some examples of operating system drivers (onboard and peripheral drivers)

If a device suddenly stops working, aside from a power issue or other hardware issue, it's possible that the driver is outdated. Perhaps a printer suddenly stopped working because the printer needs a new driver to communicate with the computer.

To update or configure a new driver, access Windows Device Manager (see section 2.6.3).

- Scroll up/down to locate your device
- Right-click to view the device's details.
- If needed, select Update Driver.

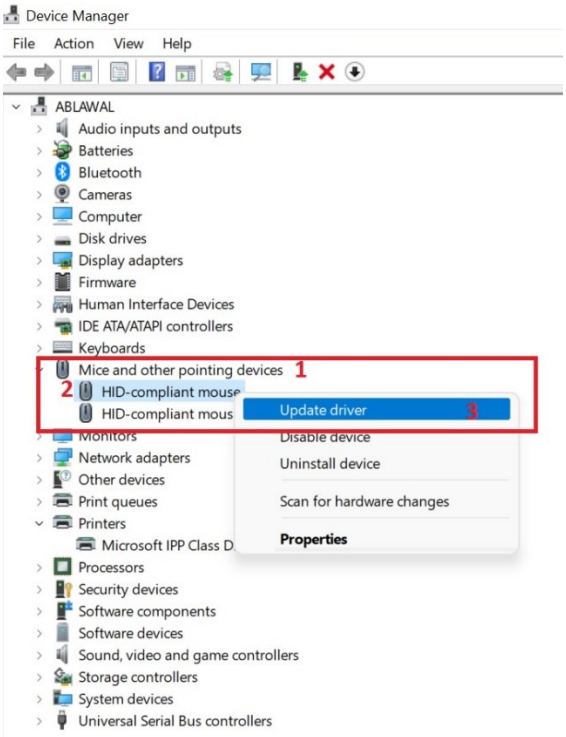

Figure 2.28: How to update/configure a peripheral driver

2.6.7. Utilities

Utilities help you administer and manage the operating system. Some of them are explained as follows:

1. **Windows Diagnostics** locates hardware memory errors.

2. Windows Performance Monitor provides performance details for processes, applications, and hardware.

3. Windows Event Viewer provides detailed activity logs to diagnose errors, installation problems, and other issues.

4. Windows Registry Editor enables the correction of embedded software registration information such as the disk location for a program's files, and