Draft Study Material

ASSISTANT INSTALLATION COMPUTING AND PERIPHERALS

(Job Role)

(Qualification Pack: Ref. Id. ELE/Q4609)
Sector: Electronics

(Grade IX)

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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Date: 05 August, 2024

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Module 1	Fundamental of Computer and Peripherals

Module Overview

Computer has become indispensable in today's life. It has become difficult to imagine the world without computer. Everywhere computers are used whether it is office, bank, school, college, business, hospitals etc. You must have seen Computers at your home, school or office.

Computer is an electronic device which accepts input, processes it and produces the desired results. Computer is a machine which performs mathematical operations and logical decisions at an extremely fast speed. Computer not only do calculations but also handles different applications at a time. In this unit, you will learn about computers, its parts, and its uses in real life.

Learning Outcomes

After completing this module, you will be able to:

- Understand the core components of a computer system and how they work together to perform basic functions.
- Identify various input and output devices, understanding their functionalities and significance in user-computer interaction.
- Explore different types of storage and peripheral devices, recognizing their roles in data management and system performance.

Module Structure

Session 1: Basic Functionality of Computer system

Session 2: Input and Output Devices

Session 3: Storage and Peripheral Devices

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Session 1: Basic Functionality of Computer system

Computers are an essential tool of information technology (IT). They are multi-purpose machines that are used to solve a variety of problems in different fields. The basic working principle of a modern computer is based on the analytical engine designed by Charles Babbage in the 19th century. Computers have changed our daily routine as the entire task performed by us in our daily routine is automated. Our lives are directly or indirectly affected by the computers. It was in the past era where computers were used in industries. In this era of information, we are dependent on the storage, flow, and processing of data and information which can only be possible with the help of computers. This is the reason a computer is called a multi-purpose machine. The purpose of this Session is to introduce you to a computer.

Computer System

The term 'computer' is derived from the word 'compute', meaning 'to calculate'. A computer is a programmable electronic machine that accepts data from the user, processes it by performing calculations and operations on it, and generates the desired output results. Computer performs both simple and complex operations, with speed and accuracy as shown in Figure 1.1.

Computing is not restricted to only mathematical computing but to a variety of logic-based tasks. Computer, process the data as per the given set of instructions. It can perform operations like generating bills, reserving tickets, printing mark-sheets, printing business reports, or communicating messages. Data can be text, number, audio, video, graphs, or animations.

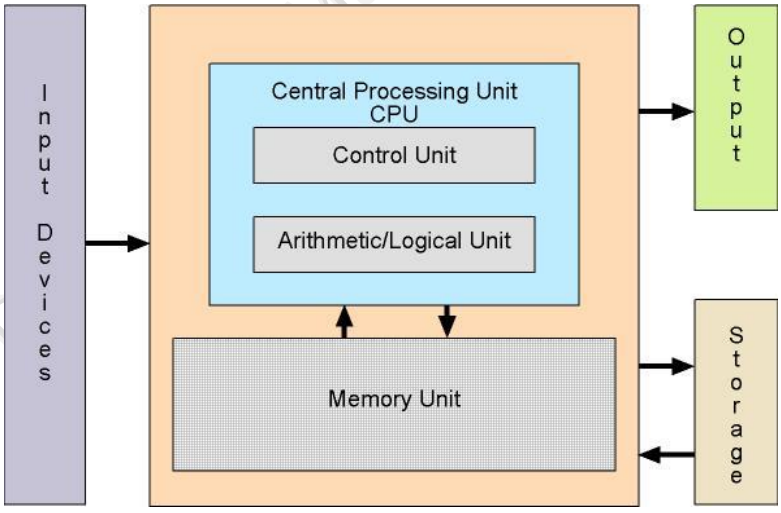

Fig. 1.1: Block diagram of computer system

Characteristics of A Computer

Speed: Computers work at very high speed and are much faster than humans. Computers can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is microseconds and nanoseconds.

Storage: Computer can store large amount of data (text, video, picture etc) permanently.

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we can use this data at any time. computer memory storage capacity is measured in Bytes, Kilobytes (KB), Megabytes (MB), Gigabytes (GB), and Terabytes (TB).

Accuracy: When a computer performs a computation or operation, the chances of errors occurring are low. Errors in a computer are caused by human's submitting incorrect data. A computer can do a variety of operations and calculations fast and accurately.

Communication: Today's Computers have capability of communicating with other Computers. we can connect two or more computers.

Automatic: A computer as a machine cannot start itself but it can perform some work without human intervention. For example, our have large amount of data and we want to perform some calculation on it. For getting the result, we have to run the appropriate software and all the calculation will be done by Computer.

Diligence: Unlike human being, computer is free from dullness and lack of concentration. It can work for hours without any error until job is finished.

Versatility: Versatility is a most important characteristic of computer. we may use computer to prepare salary slip and at the same time we can use the same computer for paying electricity bill and etc. It means we can perform completely different type of work on a single computer simultaneously.

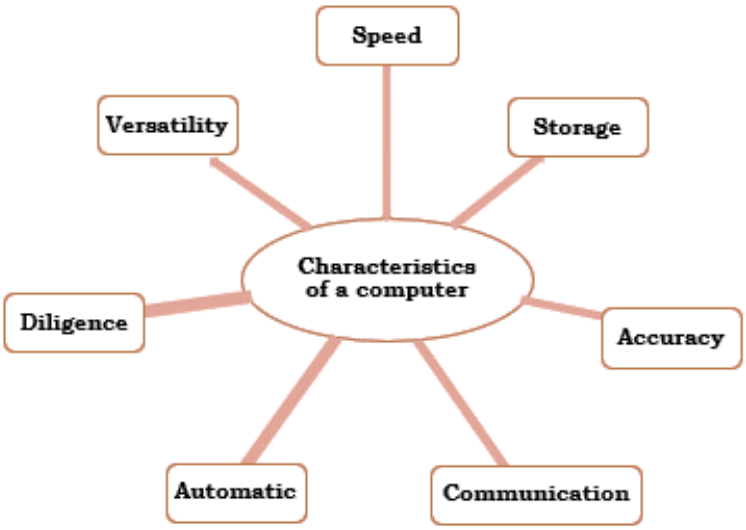

Fig. 1.2: Characteristics of a computer

Development of Computers

Computation has been done since earlier times with the aid of devices, when generally there was interaction at one-to-one level utilizing fingers. A form of tally stick was possibly the first counting device. Later, people in the Fertile Crescent region began record keeping by using calculi with aids such as clay spheres and cones. These aids were, possibly, representations of items such as livestock or containers of grains. Counting rods and stones were used with passing of time. People, gradually, began to follow certain steps to calculate with stones, giving birth to digital counting devices. These proved to be the predecessor of the first device invented for calculation, called as the ABACUS. With the evolution of human intellect and the advancement of technology, more computing devices

were produced. There are mechanical calculators used by humans before computers. Some of the most famous mechanical calculators are:

1. Abacus
2. Pascal's Calculator
3. Leibniz calculator
4. Arithmometer
5. Comptometer & Comptograph
6. Difference Engine
7. Analytical Engine
8. The Millionaire

The ABACUS

Abacus was used to do quick additions and subtractions mechanically. Although it was initially developed in the 10th century by the Egyptians, it was the Chinese who gave it its proper shape in the 12th century. It comprised of a wooden frame with rods fitted from one end to the other. The rods had round beads slid onto them, which represented different numbers according to their position. The abacus had an upper section called Heaven and a lower section called Earth.

NAPIER'S BONES

Napier Bones was invented by John Napier of Scotland in the year 1617. This device had bone rods with numbers printed on them and enabled easy calculations.

PASCAL'S CALCULATOR

Pascal's calculator was invented by Blaise Pascal of France in the year 1642. It was an adding machine which had gears on it to represent the position of the digits.

LEIBNZ CALCULATOR

Leibnz calculator was a modification of the Pascal's calculator and could do multiplication and division operations. It was devised by Gottfried Leibniz of Germany in the year 1671.

Difference Engine

Charles Babbage, known as the "Father of Modern Computer designed the Difference engine in the early 1820s. The Difference Engine was a mechanical computer that could perform simple calculations. It was a steam-driven calculating machine designed to solve tables of numbers like logarithm tables.

ANALYTICAL ENGINE

Sir Charles Babbage of England, also called father of the computer, invented the Analytical engine in the year 1833. It is considered as the first mechanical computer, which could safeguard data. Charles Babbage added such features in it which are similar to the present day computer language.

Tabulating Machine

Herman Hollerith, an American statistician invented the Tabulating Machine in the 1890s which was a mechanical tabulator based on punch cards that was capable of tabulating

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statistics and recording or sorting data or information.

Differential Analyzer

The Differential Analyzer was the first electronic computer introduced in the United States in 1930. It was an analog device invented by Vannevar Bush. This machine could perform 25 calculations in a few minutes.

Mark I

The major changes in the history of computers began in 1937 when Howard Aiken aimed to invent a machine that could perform calculations of larger numbers. In 1944, IBM and Harvard partnered to build the Mark I computer. The Mark 1 was the first programmable digital computer.

The Von Neumann model

The architecture of computer has been modified many times over the last 20 years according to new developments. The way the algorithms are mapped to the hardware of a computer has been modernized and the quantity of circuits which can be added to the silicon wafers too has changed. However, the basic concept of computer design has remained unchanged. Von Neumann devised the computer architecture in such a way so as to enable it to store the program instructions and data in its memory.

Earlier, every computing device was made for a single, specific purpose. The programming entailed the circuits to be rewired manually and snags were difficult to detect or rectify.

Von Neumann's architecture had the computer with three main components:

- A central processing unit (CPU)
- Memory
- Input/output (I/O) interfaces

GENERATIONS OF COMPUTER

The computer has evolved from a large simple calculating machine to a smaller but much more powerful machine. The evolution of the computer to the current state is defined in terms of generations of the computer. Each generation of the computer is designed based on a new technological development, resulting in better, cheaper, and smaller computers that are more powerful, faster, and efficient than their predecessors. There are five generations of the computer.

1. First Generation Computers (1940-1956)
2. Second Generation Computers (1956-1963)
3. Third Generation Computers (1964-1971)
4. Fourth Generation Computers (1971-Present)
5. Fifth Generation Computers (Present and Beyond)

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Fig. 1.3: Generation of a computer

1. First Generation Computers (1940-1956):

The 1st Generation Computers were introduced using the technology of vacuum tubes which can control the flow of electronics in a vacuum. These tubes are usually used in switches, amplifiers, radios, televisions, etc. The First Generation of Computer was very heavy and large and were not ideal for programming. They used basic programming and didn't have an operating system, which made it tough for users to do programming on them. The 1st Generation Computers required a big room dedicated to them and also consumed a lot of electricity.

Some of examples of first-generation computers are-

ENIAC: Electronic Numerical Integrator and Computer, built by J. Presper Eckert and John V. Mauchly which contained 18,000 vacuum tubes.

EDVAC: Electronic Discrete Variable Automatic Computer, designed by Von Neumann.

UNIVAC: Universal Automatic Computer, developed by Eckert and Mauchly in 1952.

IBM-701: The first computer generation of representative systems is IBM-701, designed by Nathaniel Rochester.

IBM-650: The IBM 650 Magnetic Drum Data-Processing Machine is one of IBM's early computers came into market in 1953, invented by Frank E. Hamilton.

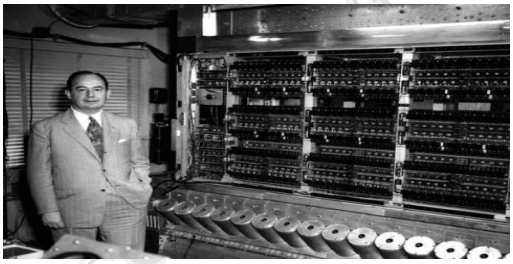

Fig. 1.4: First Generation of a computer

2. Second Generation Computers (1956-1963):

The Second Generation of Computers revolutionized as it started using the technology of transistors instead of bulky vacuum tubes. Transistors are devices made of semiconductor materials that open or close a circuit. These transistors were invented in the Bell Labs which made the Second-Generation Computer powerful and faster than the previous ones. Transistors made these computers smaller and generated less heat compared to the

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vacuum tubes they replaced. The Second Generation of Computers also introduced the use of CPU, memory and input/output units. The programming languages used for the second-generation computers were FORTRAN (1956), ALGOL (1958), and COBOL (1959).

Some of examples of Second-generation computers are- PDP-8, IBM1400 series, IBM 7090 and 7094, UNIVAC 1108, CDC 3600, etc.

Fig. 1.5: Second Generation of a computer

3. Third Generation Computers (1964-1971):

The evolution of Third Generation Computers took place with a shift from transistors to integrated circuits also called IC. The Third Generation of Computer was very fast and reliable. The ICs used in these computers were made from silicons and were called silicon chips. A single IC has many transistors, registers, and capacitors built on one thin slice of silicon. This generation of computers has increased memory space and efficiency. Higher-level languages like BASIC (Beginners All-purpose Symbolic Instruction Code) were used and the Minicomputers were introduced in this era. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

Some of examples of Third Generation Computers are- IBM 360, IBM 370, PDP-11, NCR 395, B6500, UNIVAC 1108, etc.

Fig. 1.6: Third Generation of a computer

4. Fourth Generation Computers (1971-Present):

The period from 1972 to 2010 is considered the period of the fourth generation of computers. Microprocessor technology was used to develop the Fourth Generation of Computers. The foremost advantage of these computers is that the microprocessor can contain all the circuits required to perform arithmetic, logic, and control functions on one chip. In the Fourth Generation, computers became very small in size and also became portable.

Technologies like multiprocessing, multiprogramming, time-sharing, operating speed, and virtual memory were also introduced by then. During the fourth generation, private

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computers and computer networks became a reality. All the high-level languages like C, C++, DBASE etc., were used in this generation

Some of examples of Third Generation Computers are- IBM PC, STAR 1000, APPLE II, Apple Macintosh, Alter 8800, etc.

Fig. 1.7: Fourth Generation of a computer

5. Fifth Generation Computers (Present and Beyond):

In the fifth generation, the VLSI technology became ULSI (Ultra Large-Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components. This generation is based on parallel processing hardware and AI (Artificial Intelligence) software used for Robots designing. Some of the applications of AI have been seen in features like voice recognition, entertainment, etc. The speed of the Fifth Generation of Computers is the highest while the sizes are the smallest. A big improvement has been noticed so far over the years in the various generations of computers in the aspect of speed, accuracy dimensions, etc.

Examples of 5th Generation Computers are Desktops, laptops, tablets, smartphones, etc.

Fig. 1.8: Fifth Generation of a computers

HARDWARE AND SOFTWARE

A computer needs both hardware and software to function properly.

Hardware: It consists of mechanical and electronic devices which we can see and touch. A CPU, keyboard, mouse, and monitor are examples of hardware. All the parts of the computer that you can see and touch, even those hidden inside the case, are listed below. The typical hardware for ICT may include: computer system, input/output and storage device, network card, modem, web camera, scanner, and digital camera.

Software: Programs, Operating systems, and data stored in memory and storage devices

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make up the system. Some example of software includes windows, Microsoft office, LibreOffice, and Photoshop. Only a computer system that includes both hardware and software is practical.

Computer software is the programmes or instructions that the computer needs to tell the hardware what to do. The typical hardware for ICT may be listed as below:

System Software: Operating system such as Windows, Ubuntu etc.

Application Software: MS Office (Word, Excel, Power Point), Browser (Internet explorer, Netscape Navigator),

In a human analogy the Brain is the hardware, and the thoughts are the software.

A computer system is useful only if it consists of both hardware and software.

Fig. 1.9: Hardware and Software

Activity 1

Practical Activity 1.1: Identify whether the following are a part of the computer hardware or software.

Component	Hardware/Software
Motherboard	
Monitor	
DVD drive	
Hard disk	
Microphone	
MS Office "	
Keyboard	

CorelDraw	
LibreOffice	
RAM	
Tally	
MS Paint	

Main Components of the Computer System

The internal design of a computer differs from one model to another but the basic components of all computers remain the same. The basic working model of a computer is based on the John von Neumann architecture. The interconnection diagram for a simple computer is shown in the Figure ... below

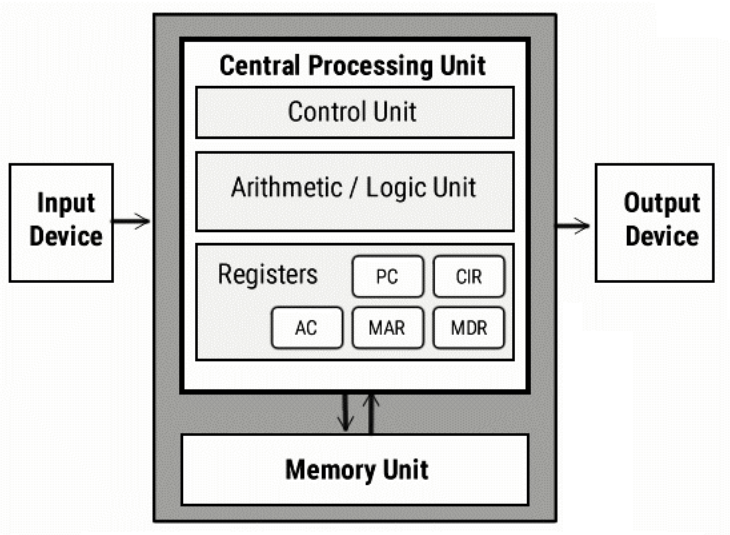

Fig: 1.10 John von Neumann architecture

John von Neumann proposed the first usable draft of a working computer. It consists of some functional unit namely input/output unit, central processing unit (CPU), and memory.

A computer has the following three main components—

A. Input/output unit

B. Central processing unit

C. Memory unit

INPUT AND OUTPUT UNIT

The user interacts with the computer via the I/O unit. The input unit accepts data from the user and the output unit provides the processed data that is the information to the user. The input unit accepts data from the user, converts it into computer understandable form.

Similarly, the output unit provides the output in a form that is understandable by the user. The input is provided to the computer using input devices like keyboard and mouse. The commonly used output devices are monitor and printer.

CENTRAL PROCESSING UNIT (CPU)

It is the main component of the computer. It performs all the processing of input data and is responsible for activating and controlling the operations of other units of the computer. In microcomputers, the CPU is built on a single chip or integrated circuit (IC) and is called microprocessor. Internal architecture of a CPU consists of the following parts-

A. Arithmetic logic unit (ALU)
B. Control unit (cu)
C. Clock
D. Registers
E. Buses

A. Arithmetic Logic Unit (ALU): It consists of two units—arithmetic unit and logic unit. The arithmetic unit performs arithmetic operations such as addition, subtraction, multiplication, and division. Logic unit performs comparisons of numbers, letters, and special characters. Logic operations include testing for greater than, less than or equal to condition. ALU performs arithmetic and logic operations and uses registers to hold the data that is being processed.

B. Registers: They are high speed but have low storage in the CPU. They are referred to as the CPU's working memory and are directly accessed and manipulated by the CPU during instruction execution. They store data, instructions, addresses, and intermediate results of processing. The data and instructions are brought in the registers processing. For example, if two numbers are to be added, both numbers are brought in the registers and added and the result is also placed in a register. There are different registers for different specific purposes.

Some of the important registers in CPU are as follows—

- **Accumulator (ACC):** stores the result of arithmetic and logic operations.
- **Instruction Register (IR):** contains the most recently fetched instruction.
- **Program Counter (PC):** contains the address of next instruction to be processed.
- **Memory Address Register (MAR):** contains the address of next location in the memory to be accessed.
- **Memory Buffer Register (MBR):** temporarily stores data from memory or the data to be sent to memory.
- **Data Register (DR):** stores the operands and any other data.

The number of registers and the size (number of bits) of each register in a CPU helps to determine the power and the speed of a CPU. The overall number of registers can vary from about ten to many hundreds, depending on the type and complexity of the processor. The size of the register also called word size, indicates the amount of data with which the computer can work at any given time.

C. Control Unit (CU): It controls the input, output, and processing activities inside the computer. It maintains the order and controls the operation of the entire system. The control unit interprets the instructions given to the computer, determines the data to be processed, where to store the results (output), and sends the control signals to the devices required for the execution of the instructions.

It directs the computer to carry out stored program instructions by communicating with

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the ALU and the registers. CU uses the instructions in the instruction register (IR) to decide which circuit needs to be activated. It also instructs the ALU to perform the arithmetic or logic operations. When a program is run, the program counter (PC) register keeps track of the program instruction to be executed next. CU tells when to fetch the data and instructions, what to do, where to store the results, the sequencing of events during processing, etc. CU also holds the CPU's instruction set, which is a list of all operations that the CPU can perform.

D. Buses: Data is stored as a unit of 8 bits in a register. Each bit is transferred from one register to another by means of a separate wire. This group of eight wires which is used as a common way to transfer data between registers is known as a bus. Bus is a connection between two components to transmit signals between them. Bus is of three major types namely—data bus, control bus, and address bus.

E. Clock: It is an important component of CPU which measures and allocates a fixed time slot for processing each and every micro operation. CPU executes the instructions in synchronization with the clock pulse. The clock speed of a CPU is measured in terms of megahertz or millions of cycles per second. The clock speed of a CPU varies from one model to another.

Memory unit

It stores the data, instructions, intermediate results and output, temporarily during the processing of data. The memory unit consists of cache memory and primary memory. Primary memory or main memory of the computer is used to store the data and instructions during execution of the instructions. Random access memory (RAM) and read-only memory (ROM) are the primary memory. The input data that is to be processed is brought into the main memory before processing. The instructions required for processing of data and any intermediate results are also stored in the main memory. The output is stored in memory before being transferred to the output device. CPU can work with the information stored in the main memory. In addition to the main memory, there is another kind of storage device known as the secondary memory. It is nonvolatile memory and is used for permanent storage of data and programs. A program or data that has to be executed is brought into the RAM from the secondary memory. Magnetic disks, optical disks, and magnetic tapes are examples of secondary memory.

Classification of Computers

Generally, the word computer refers to a personal computer such as a desktop or laptop. However, we see different types of computers in our daily lives performing various tasks, for example while operating an ATM, purchasing groceries at the store, Customer servicing KIOSK available in Banks, Shopping Mall or at Railway Station. etc.

Purpose

According to purpose, computers can be classified into two types:

- General purpose computers: These computers are used for general use such as office applications, banking, invoice, sales analysis, and financial accounting. They are used at home, offices, and educational institutions.

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- Special purpose computers: These computers are designed to perform scientific applications, weather forecasting, space applications, etc.

A. Based on Working principle

According to the technology used, computers can be classified into three types—analog, digital, and hybrid computers.

1. Analog computers:

These deal with analog data which represents the continuously varying physical quantities, such as current, voltage, or frequency. They are used to measure physical quantities like pressure, temperature, speed, etc., and to perform computation on these measurements. Examples are thermometer and speedometer.

Fig. 1.11: Analog Computer

2. Digital computers:

These operate on digital data. Input and output are in the form of on/ off type (digit 1 and 0). Digital computers are based on counting operation. Any data to be manipulated by a digital computer must be converted to a discrete (1,0) representation. The digital computers are mainly used in office, home, and industry.

Fig. 1.12: Digital Computer

3. Hybrid computers:

These use the combination of digital and analog computers. These computers use digital-to-analog (DAC) and analog-to-digital (ADC) technology to deal with both types of data. They store and process both analog and digital data. Hybrid computers are mainly used in artificial intelligence. The ECG machine used in hospitals is an example of hybrid computer. ECG machine reads the heart beat as an analog signal and then converts it into digital signal to print the graph.

Fig. 1.13: Hybrid Computer

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B. Classification of computers according to size and storage capacity

1. Supercomputer

This is designed by interconnecting a number of processors. It has the highest processing speed with multiprocessing technology. It is mainly used in weather forecasting, biomedical research, aircraft design, remote sensing, and other areas of science and engineering. A supercomputer focuses on executing a few programs as fast as possible. Examples of supercomputers are CRAY YMP, CRAY2, NEC SX-3, CRAY XMP, and PARAM.

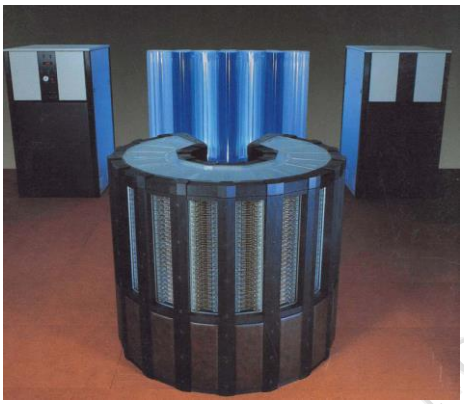

Fig. 1.14: Super Computer

2. Mainframes

These are slower than the supercomputers in speed and processing power. They can support hundreds of users simultaneously. In one way, mainframes are more powerful than supercomputers because they support more programs simultaneously, while the supercomputer can execute a single program faster than a mainframe. Mainframes have a very large storage capacity and can handle large database systems, such as patient information system in a big hospital or student information system in a university. Example of mainframes are DEC, ICL, and IBM 3000 series. The capacity of a mainframe can be a hundred or even a thousand times that of a modern PC.

Fig.1.15: main frame Computer

3. Minicomputer

This uses multiprocessing. It is capable of supporting hundreds of users simultaneously. It has a large storage capacity and operates at a higher speed. The minicomputer is used in multi-user system where various users can work at the same time. This type of computer is

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generally used for processing a large volume of data. It is also used as a server in Local Area Networks (LAN).

Fig. 1.16: mini Computer

4. Microcomputer

This has the lowest speed and storage capacity. Its CPU is a microprocessor. The 4-bit microprocessor chip was invented first. The 8-bit microprocessor chip was used in the first microcomputer. The microprocessor chip continues to improve 16-bit, 32 bit, and 64 bit chips. Examples of microcomputer are IBM PC, PC-AT. The PC supports a number of input and output devices. Today's microcomputer is so powerful that it can serve the purpose of a server, or sometimes that of a minicomputer that can be used as a server. The microcomputer can be categorized as below

5. Desktop computers

Desktop computers are also known as personal computer (PC). They are intended for use at a fixed location. They consist of CPU, monitor, speaker, keyboard, and mouse. Desktop computers are easy to upgrade and expand. They are also less expensive.

Fig 1.17: Desktop Computer

6. All in one computer

All in one computer are the new form of desktop PC. They have inbuilt CPU and monitor like that of a laptop. They can also have a touch screen monitor and are mounted on a desk like a standard monitor. CPU is mounted on the back side of the monitor. It has a USB port for connection of a mouse and keyboard.

Fig. 1.18: All in one computer

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7. Laptop computers

A laptop has a built-in monitor, keyboard, touch-pad, and speakers to make a fully functional computer. The modern laptops also have touch screen, which minimizes the use of a keyboard or mouse. They are called laptops because of their small size and being light enough to be used while being placed on one's lap. A laptop can perform almost all jobs of a desktop. The main components of laptop are—touchpad, battery, AC adapter and ports. A user can work on a fully charged laptop without connecting it to a power supply for three to seven hours depend on battery life status. A laptop has a power cable and AC adapter designed to be used with specific type of laptop. The laptop also has 3-4 USB ports to connect peripheral devices, a VGA or HDMI port to connect the projector and a slot to insert a memory card.

Fig. 1.19: Laptop Computer

8. Mobile computers

Many mobile devices work as specialized computers. These are normally used for internet, e-mail, photography, capturing and storing images and videos. These devices are portable and consume very less space. The various mobile computers are categorized as—tablets, smartphones, wearable devices, vehicle-mounted, handheld computers, e-book readers, etc. The most common are tablets and smartphones, which are discussed here.

(i) **Tablets**

They are handheld computers and are more portable than laptops. They use a touch sensitive screen for typing and navigation. The size of a tablet is about 7 to 10 inches. They work on specialized operating systems such as Android, Windows, and iOS. The iPad is an example of a tablet.

(ii) **Smartphones**

In addition to providing telephone services, a smartphone is designed to run a variety of applications (apps). They are small tablet computers and can be used for web browsing, watching videos, reading e-books, and playing games. Many apps can be installed on the smartphone which we use in our daily lives for booking tickets, bill payment, etc.

Fig. 1.20: Smartphone

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Personal Digital Assistants (PDAs)

They are just like a mobile phone with a touch screen and keypad. They have bigger screens than mobile phones. They use handwriting recognition software to enter text and are extremely portable and fit into pockets. They are a powerful computer that includes satellite navigation facilities (GPS), mobile phone capability, and versions of application software that have a limited range of functions.

Fig.1.21: PDA

Internal Component of Computer System

The motherboard is the main circuit board inside a computer. The important system components like the central processing unit (CPU) and random-access memory (RAM) modules are connected directly to the motherboard via slots or sockets designed specifically for those components. The motherboard will also provide a number of expansion slots designed to accommodate add-on cards such as video graphics adapter (VGA) cards and network interface cards (NICs). In this Chapter, we will understand the main features of the motherboard, types of motherboard, motherboard form factors, and various components of motherboard.

Note: We have to introduce all internal components first here then start from Motherboard.

INTRODUCTION TO MOTHERBOARD

The motherboard is also known as main board or system board. The motherboard connects the components of a computer and provides power to the systems that need low power. The motherboard contains a socket in which one or more processors are attached. In addition, it has slots that allow connecting peripheral cards such as video cards, sound cards, and networking cards. The internal structure of a motherboard is shown in the Figure 1.22.

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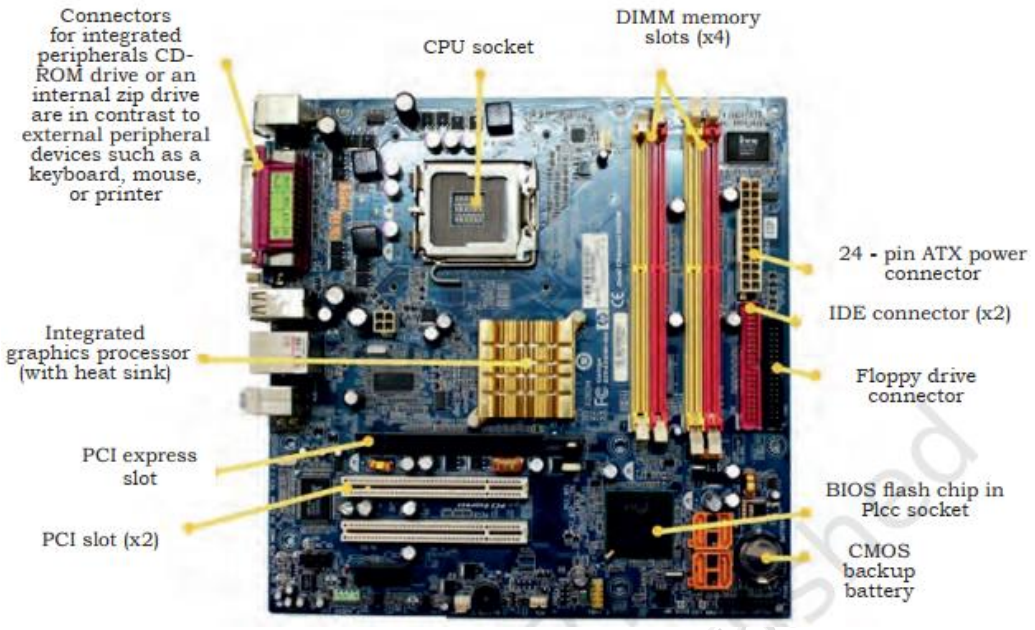

Fig. 1.22: Motherboard

Types of Motherboard

Motherboards are classified as either integrated or nonintegrated.

Integrated motherboard

This has several components integrated into the board itself. These may include the video card, sound card, and various controller cards. The maintenance is of a specific nature as the repairing of the whole board is a complex task. The integrated structure of a motherboard is shown in the Figure 1.23.

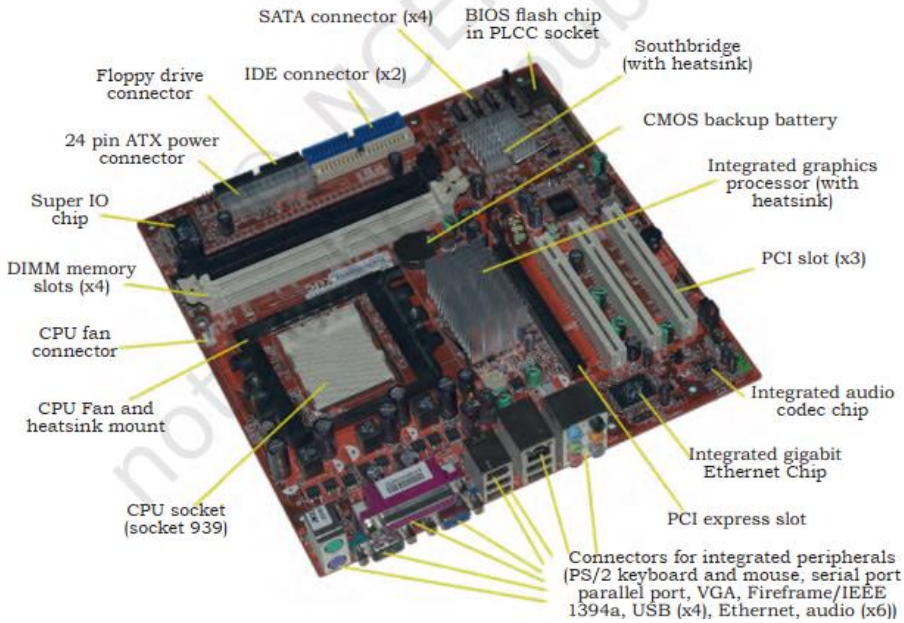

Fig. 1.23: Integrated Motherboard

Non-integrated motherboard

This motherboard uses installable components and expansion cards. In non-integrated motherboard, if any component fails, it is possible to replace that component instead of changing the entire motherboard. For example, you can remove the old video card and install a new one. Non-integrated motherboards typically have several PCI Expansion slots as well.

Basic Components of Motherboard

The modern motherboard has the following components—

- sockets (or slots) to install one or more microprocessors.
- slots to install main memory RAM.
- a chipset which forms an interface between the CPU's front side bus, main memory, and peripheral buses.
- non-volatile memory chips usually flash ROM in modern motherboards, containing the system's firmware or BIOS.
- a clock generator which produces the system clock signal to synchronise the various components. slots for expansion cards. These interface to the system via the buses supported by the chipset.
- power connectors, which receive electrical power from the computer power supply and distribute it to the CPU, chipset, main memory, and expansion cards.

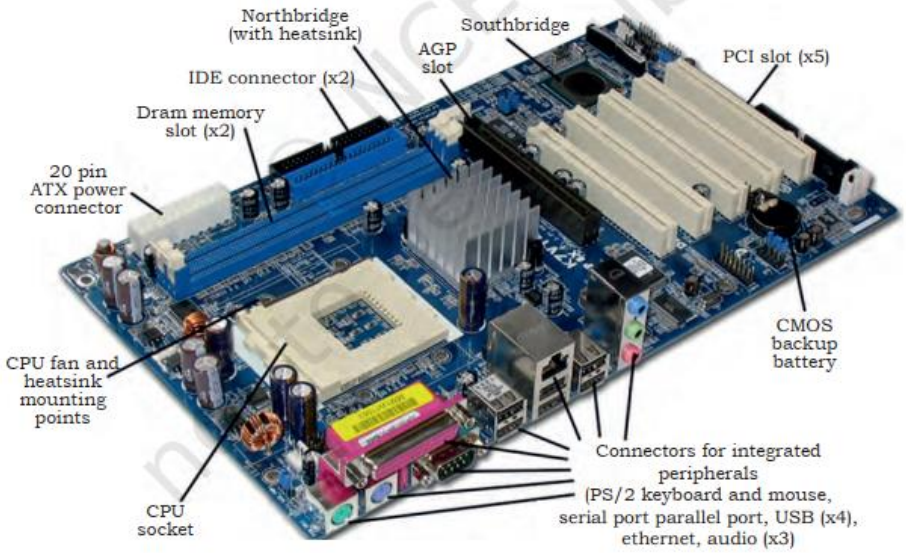

Fig. 1.24: Motherboard components

Motherboard Form Factors

Motherboards are classified by form factors. The form factor of motherboard refers to its overall dimensions and layout. Form factors essentially define the layout of the actual motherboard including the dimensions, component positioning, mounting holes, number of expansion slots, and so on. There are several different types of form factors as explained below.

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Table 1.1 Motherboard Form Factors

Form Factor	Description
ATX	This form factor is commonly used in tower and desktop systems. It supports a maximum of seven expansion slots.
MicroATX	This form factor is a smaller version of ATX. It supports a maximum of four expansion slots.
FlexATX	This form factor is the smallest version of ATX. It supports a maximum of three expansion slots.
NLX	This form factor can be found in smaller desktop and mini towers. The number of expansion slots supported, varies.
BTX	This form factor is commonly found in newer tower and desktop systems. It supports a maximum of seven expansion slots.
PicoBTX	This form factor is the smallest version of BTX. It is commonly used in smaller low-end systems and supports a maximum of one expansion slot.
MicroBTX	This form factor is slightly smaller than the regular BTX. It is commonly found in newer mid-range systems and supports a maximum of four expansion slots.
NLX	This form factor can be found in smaller desktop and mini towers. The number of expansion slots supported varies.

CPU (Central Processing Unit)

The processor is commonly known as central processing unit or CPU. It is an electronic circuit which executes computer programs containing a processing unit and a control. A central processing unit (CPU) processes the instructions by performing the basic arithmetical, logical, and input/output operations of the system. Although the form and design of CPUs is changing with generation but its main working principle remains the same.

CPU Basics

In 1971, the first microprocessor Intel 4004 was invented. It was a 4-bit calculation device with a speed of 108 kHz. A microprocessor is also known as a central processing unit in which a number of peripherals are fabricated on a single chip.

Architecture of Microprocessor

A microprocessor is a single integrated circuit (IC) chip. A number of useful functions are integrated and fabricated on a single silicon semiconductor chip. The system bus consists of data bus, address bus, and control bus for transfer of data and instructions in a proper manner. The central processing unit consists of arithmetic logic unit (ALU), registers, and control unit. Based on the registers, the generations of microprocessors can be classified. A

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microprocessor consists of general-purpose registers and special types of registers to execute instructions and to store the address or data while running the program. The ALU computes all arithmetic as well as logic operations on data and specifies the size of microprocessor like 16 bit or 32 bits. The memory unit holds the program as well as data and is divided into processor, primary, and secondary memory. The input and output unit interface the I/O peripheral devices to microprocessor for accepting and sending information.

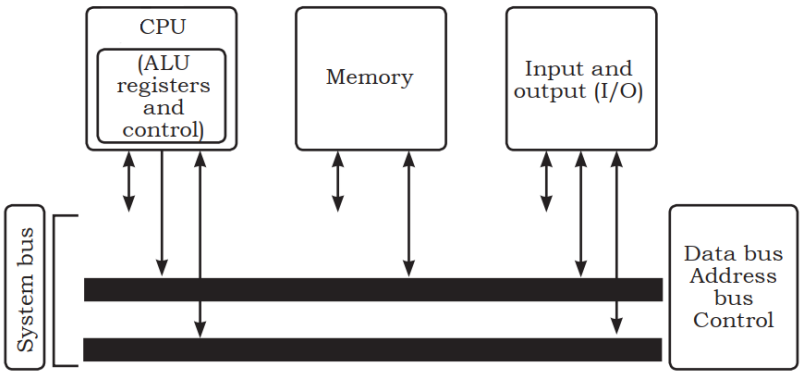

Fig. 1.25: Architecture of CPU

Generations of Microprocessors

1st generation- This was the period during 1971 to 1973 of microprocessor's history. In 1971, INTEL created the first microprocessor 4004 to run at a clock speed of 108 KHz.

2nd generation- During the period from 1973 to 1978 very efficient 8-bit microprocessors were implemented like Motorola 6800 and 6801, INTEL-8085, and ZilogsZ80 which were of this generation.

3rd generation- During the period from 1979 to 1980, 16-bit processors were designed using HMOS technology. INTEL 8086/80186/80286 and Motorola 68000 and 68010 were developed. Speeds of these processors was four times better than the 2nd generation processors.

4th generation- From 1981 to 1995, 32-bit microprocessors were developed by using HCMOS fabrication. INTEL-80386 and Motorola's 68020/68030 were the processors of this generation.

5th generation- From 1995, high-performance and high-speed processors that make use of 64-bit processors were designed. Such processors include Pentium, Celeron, dual and quad core processors. Some of the fifth generation of processors with their specifications, are briefly explained below:

Intel Celeron- This was introduced in April 1998. It refers to a range of Intel's X86 CPUs for value personal computers. It is based on Pentium 2 and can run on all IA-32 computer programs.

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Fig. 1.26: Intel Celeron processor

Pentium

This was introduced on March 2 in 1993 after Intel 486, the 4 here in 486 indicates the fourth generation.

Pentium refers to Intel's single core x86 microprocessor which is based on the fifth-generation micro-architecture. This processor's name was derived from the Greek word 'penta' meaning 'five'. The Pentium MMX with a data bus of 64 bits was developed in 1996. More improved versions of pentium processors were designed from the year 2000.

Fig. 1.27: Pantium Celeron processor

Xeon

This is a 400 MHz Pentium processor from Intel for use in workstations and enterprise servers. This processor is designed for multimedia applications, engineering graphics, internet, and large data base servers.

Fig. 1.28: Xeon processor

Functions of a CPU

A CPU or processor carries out certain instructions and manipulates data. The main function of a CPU is to execute a sequence of stored instructions called a program. It can

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execute only machine code and fetches the machine coded instructions from memory and executes them. CPU processes instructions in four steps—fetch, decode, execute, and write back.

Fetch- The CPU reads data and instruction from memory.

Decode- The data and instructions are decoded to determine what action is required.

Execute- The instructions are executed by performing arithmetic or logical operation on data.

Write- The result of an execution is written to memory or an I/O module.

Concept of Program Execution

The instructions to be executed by a computer are loaded in sequential locations in its main memory. To execute instructions, the CPU fetches one instruction at a time and performs the functions specified. Instructions are fetched from successive memory locations until the execution of a branch or a jump instruction.

The CPU keeps track of the address of the memory location where the next instruction is located through the use of a dedicated CPU register, referred to as the program counter (PC). After fetching an instruction, the contents of the PC are updated to point at the next instruction in sequence.

For simplicity, let us assume that each instruction occupies one memory word. Therefore, execution of one instruction requires the following three steps to be performed by the CPU:

1. fetch the contents of the memory location pointed out by the PC (program counter). The instructions are stored in the instruction register (IR).
2. increment the contents of the PC by 5.
3. carry out the actions specified by the instruction stored in the IR.

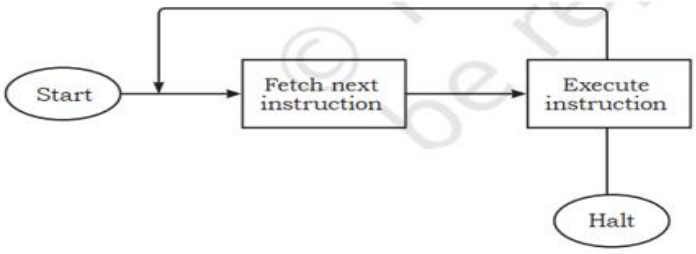

Fig. 1.29: Basic instruction cycle

The first two steps are the fetch phase and step three is the execution phase. Fetch cycle involves reading of the next instruction from the memory into the CPU and updating the contents of the program counter. In the execution phase, it interprets the opcode and performs the indicated operation. The instruction fetch and execution phase together are known as the instruction cycle. The instruction cycle is shown in the Figure 1.29.

In cases where an instruction occupies more than one word, step one and step two can be repeated as many times as necessary to fetch the complete instruction. In these cases, the execution of an instruction may involve one or more operands in memory, each of which requires a memory access. Further, if indirect addressing is used, then additional memory accesses are required.

Major components of the CPU:

The three major components of the CPU are— arithmetic and logic unit (ALU), control unit (CU), and registers.

Arithmetic and logic unit (ALU): This performs arithmetic and logical operations. For example, it can add together two binary numbers either from memory or from some of the CPU registers.

Control unit: This controls the action of the other computer components so that instructions are executed in the correct sequence.

Registers: These are temporary storage inside the CPU. It is internal memory of CPU which can read and write at a high speed. It is used to hold data and instructions temporarily while processing. It also holds the location of the last instruction. With this it can find the location of the next executable instruction.

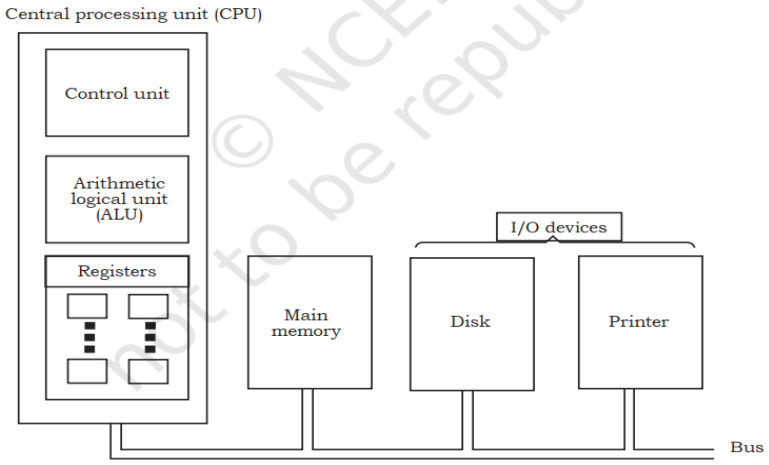

Fig. 1.30: Major components of the CPU

Types of CPU

CPU can be categorized on the basis of its processing power as 32 bit or 64 bit and can also be classified on the basis of brands (Intel and AMD).

32 bit and 64-bit CPU

CPUs are identified as either 32 bit or 64 bit. The amount of data that a CPU can manipulate with one machine code instruction or transfer over a bus is measured in bits. The CPU specification is 32 bit, 64 bit, or 128 bit. A CPU with a 64 bit word size can process 64 bits using one single machine code instruction. This is twice as many bits as a 32 bit CPU. Increase in the word size means more data can be manipulated at a greater speed. It also means that the CPU can keep track of a larger range of memory locations.

A 32 bit CPU supports a 32 bit address bus and can address 232 memory locations or 4 GB of RAM. A 64 bit CPU supports a 64 bit address bus and can address 264 memory locations.

Operating systems and applications that are 64 bit specific cannot run on a 32 bit processor. The 64 bit operating systems can run only on 64 bit CPUs. If you want to directly address more than 4 GB of RAM, you need both a 64 bit CPU and a 64 bit operating system.

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Intel and AMD Processors

There are two primary manufacturers of computers: Intel and Advanced Micro Devices (AMD).

Intel

It is the largest seller of CPUs, selling about 80 percent to 85 percent of all CPUs. It manufactures other products as well, including chipsets, motherboards, memory, and SSDs.

AMD

It is the only significant competition to Intel for CPUs and it sells about 10 percent to 15 percent of all CPUs. It also manufactures other products including graphics processors, chipsets, and motherboards.

Processor technologies

These might be used by AMD only, by Intel only, or by both vendors. These technologies are used to help distinguish different processors from each other in terms of performance or features. When we talk about processor technologies, we can classify them into:

Overclocking: For most motherboards and processors, you can override the default frequencies by changing a setting in BIOS setup. Running a motherboard or processor at a higher speed than the manufacturer suggests, is called overclocking. This is not recommended because the speed is not guaranteed to be stable. Also, know that running a processor at a higher than recommended speed can result in overheating, which can damage the processor. Dealing with overheating is a major concern when overclocking a system.

VRM: A CPU is a collection of transistors. These transistors work at a specific voltage level. If excessive voltage is supplied to the transistor, it will burn off. Hence, the motherboard manufacturers have to take special care of the CPU voltages.

Throttling: Most motherboards and processors offer some protection against overheating so that if the system overheats, it will throttle down or shut down to prevent the processor from being affected.

Hyper-threading (HT Technology): It is a technology developed by Intel for processing two execution threads within a single processor. Essentially when HT Technology is enabled in the system, BIOS and the processor is running a multi-threaded application and the processor is emulating two physical processors.

Processor difference

Although Intel and AMD processors share two common architectures— x86 (used for 32 bit processors and for 64 bit processors, running in 32 bit mode) and x64 (an extension of x86 that enables larger files, larger memory sizes, and more complex programs), these processor's family differ in many ways from each other, including:

1. Different processor sockets
2. Different types of microcode
3. Differences in dual-core and multi-core designs

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4. Cache sizes

5. Performance versus clock speed

The various activities that a microprocessor performs, such as storing data, doing arithmetic calculations (addition, subtraction, multiplication, division, etc.), are the result of instructions given to the CPU in the form of sequences of 0s and 1s. Microprocessors are designed to carry out a large number of instructions and all the instructions may be represented by different sequences of 0s and 1s. Each instruction is represented by a unique set of 0s and 1s.

The internal structure of a typical CPU consists of circuits which form a number of registers (the typical number is 16), an arithmetic unit for carrying out arithmetic operations, a logic unit, and a control unit.

Activity 2

Practical Activity 1.2. Installation/Connectivity of CPU

The CPU and motherboard are sensitive to electrostatic discharge. So, place them on a grounded anti-static mat and wear an anti-static wrist strap while handling the CPU. When handling a CPU, do not touch the CPU contacts at any time. The CPU is secured to the socket on the motherboard with a locking assembly.

Thermal compound which is used to conduct heat away from the CPU is applied on top of the CPU. In case of an old CPU, first clean the top of the CPU and then apply the thermal compound. Clean the top of the CPU and the base of the heat sink with isopropyl alcohol and a lint free cloth. This removes the old thermal compound. Then apply a new layer of thermal compound.

Fig.1.31: Installing CPU on the motherboard

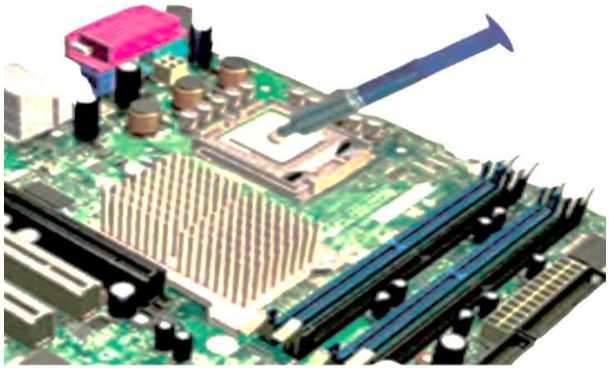

Fig. 1.32: Applying thermal compound on CPU

CPU heat sink

This is an important component in the modern computer. It is an attachment for a chip that prevents the chip from overheating. The components that generate the most heat in your computer are the CPU (central processing unit) and the power supply. These components need to be kept within a specified temperature range to prevent overheating, instability, malfunction, and damage leading to a shortened component lifespan. They always have

some cooling usually in the form of a fan.

A heat sink is a device that incorporates either a fan or some other means, to keep a hot component such as a processor, cool. It is made from metal, which serves as the thermal conductor that carries heat away from the CPU. It uses either copper, aluminum, or a combination of the two in order to move heat from the base of the cooler through heat pipes to the heat sink. A fan then blows air through the heat sink to move the heat into the air, and then out of the system, effectively keeping the CPU within safe operating temperatures.

A liquid cooling system essentially applies the same idea but replaces the copper heat pipes with tubes filled with a thermally conductive liquid that is pumped to a radiator. Copper is a very good thermal conductor with a thermal conductivity of 400 W/mK. Aluminum has a thermal conductivity of 235 watts per Kelvin per meter (W/mK), but is lighter than copper. A heat sink is attached to the motherboard, its weight puts stress on the motherboard. The light weight of an aluminum heat sink puts a little weight and stress on the motherboard. A heat sink is designed to increase the surface area in contact with the cooling fluid surrounding it, such as the air, thus allowing it to remove more heat per unit time. Other factors which improve the thermal performance of a heat sink are the approach air velocity, choice of material, usually an aluminum alloy due to its high thermal conductivity values (229 W/m°K), fin (or other protrusion) design, and surface treatment.

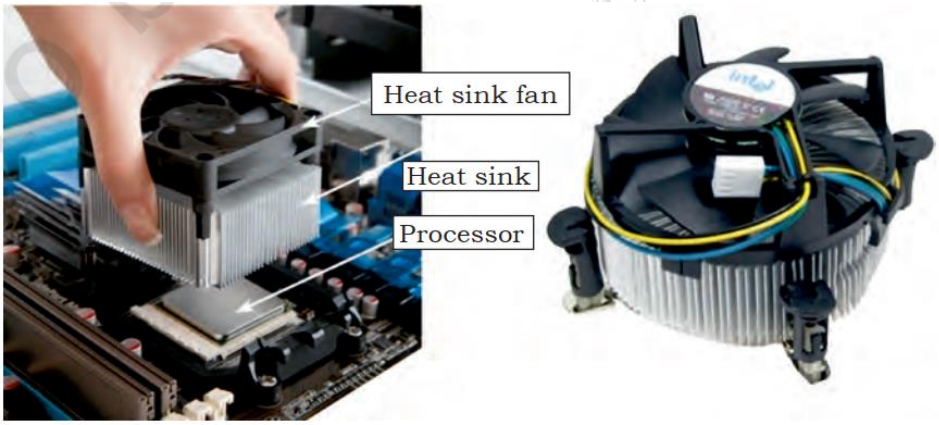

Fig. 1.33: Heat sink with cable and connector

The heat conducted from the processor goes out through the heat sink. A fan inside the computer moves air across the heat sink and out the computer. Most computers also have an additional fan installed directly above the heat sink to help properly cool the processor. Heat sinks with these additional fans are called active heat sinks, while those with the single fan are called passive heat sinks. The most common fan is the case fan, which draws cool air from outside the computer and blows it through the computer, expelling the hot air out of the rear.

Activity 3

Practical Activity 1.3. Installation of heat sink

Heat sink and fan assembly: Heat sink is a cooling device. The heat sink draws heat away from the CPU. The fan moves the heat away from the heat sink. The assembly has a

3-pin power connector. Figure 1 shows the cable and the motherboard connector for the heat sink.

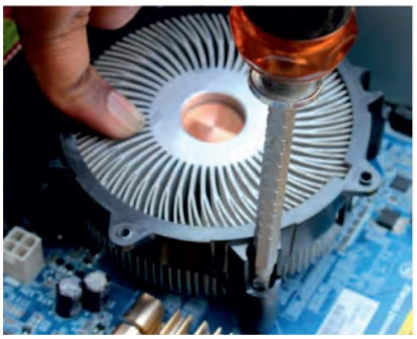

Fig. 1.34.: Screwing the heat sink

To install a CPU fan and heat sink, follow these steps:

- align the heat sink and fan assembly with the holes on the motherboard.
- screw in the heat sink.

Primary storage

Primary storage is also known as main memory in computer. It is a component of the computer that holds programs, instructions and data currently in use. It is located on the motherboard which allows a quick process of reading and writing to primary storage. This allows processors to give faster access to the data and instructions that primary storage holds.

Need for Primary storage

Primary storage is required due to the following reasons:

- **Fast Access to Data:** Primary storage provides rapid access to data and programs, enabling efficient and swift processing.
- **Volatile Storage:** It holds data temporarily, making it essential for processing tasks and operations that require immediate access to data.
- **Operating System Loading:** It is used to load and run the operating system, allowing the computer to function and execute tasks.
- **Application Execution:** Primary storage holds applications and software in use, enabling smooth and efficient execution.
- **Data Caching:** It caches frequently accessed data, enhancing the speed of data retrieval and improving system performance.
- **Buffering:** It provides a buffer for data, smoothing out the differences in data processing and transfer rates, and ensuring uninterrupted data processing.
- **Temporary Data Storage:** It stores temporary data created during program execution, providing space for data manipulation and computation.
- **Supporting CPU:** Primary storage supports the CPU by holding instructions and data for processing, ensuring efficient and seamless operations.
- **Enhancing Performance:** It enhances overall system performance by providing fast,

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immediate access to data and programs, reducing processing time.

- **Immediate Data Availability:** Ensures that data is immediately available for processing, reducing latency and improving task execution time.

primary storage devices

Primary storage devices are the media that hold memory for a shorter period of time when the computer is running. Such devices have lower access time but faster time. RAM and cache are two examples of primary storage devices. It is also known as main memory, primary memory, internal memory and main storage.

Types of Primary Storage

The following are four different types of primary storage:

1. Read Only Memory (ROM)

It is the memory from which we can only have the capability to read, but we cannot write on it. This non-volatile memory is used for storing information that we use for operating computer systems. It is the primary memory unit of a computer system that contains electronic fuses to be programmed for specific information.

Also known as permanent memory, this information is stored in binary format in ROM. It stores instructions that are needed for starting a computer which is an operation called Bootstrap.

A ROM is of the following four types:

PROM (Programmable Read Only Memory)

It is a read-only memory that can be modified just once by a user and it is not erasable. A blank PROM is brought and it can be written with the required content using the PROM program. A PROM chip consists of small fuses which are burnt open while programming.

EPROM (Erasable and Programmable Read Only Memory)

It is a read-only memory that can be erased when exposed to ultra-violet light for up to 40 minutes. An electrical charge is trapped within an insulated gate region where the charge is retained for more than 10 years since the charge has no leakage path. To erase this charge, ultraviolet is passed via a quartz crystal window (lid). This exposure to UV light helps dissipate the charge.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

It is an electronically reprogrammable and erasable memory. EEPROM has the capability of being reprogrammed around 10 thousand times. The process of erasing and reprogramming takes about 4 to 10 milliseconds. Any location within EEPROM can be selectively erased or programmed. The process of erasing takes one byte at a time. The process of reprogramming is slow yet flexible.

MROM (Mask ROM)

It is a type of read-only memory that is masked during production. This type of ROM refers to a part of an integrated circuit consisting of a thin electronic circuit to process data covered with opaque plates called photomasks. It does not allow users to change the stored data in it. Mask ROM are quite often used for storing finalized code of the project.

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Random Access Memory (RAM)

It is a type of computer memory that can be read and changed in any order. RAM is mostly used for storing work data and machine code. It allows data items to be read and written in the same amount of time, regardless of the physical location of data within the memory.

The following are two main types of RAM:

DRAM

Also known as Dynamic RAM, this type of RAM allows storing every bit of data in separate capacitor within specific integrated circuit. It is a standard computer memory within most modern desktop computers. DRAM is a volatile memory that should be refreshed on a regular basis with voltage. It takes the form of an IC chip that consists of billions of DRAM memory cells.

SRAM (Static RAM)

It is a type of random access memory that uses latching circuitry for storing every bit. It is a volatile type of computer memory where the data gets lost once the power is removed. Unlike DRAM, its OS faster since it uses cache and internal registers of CPU, unlike SRAM that uses the main memory of the computer. SRAM can further be classified as Non-volatile and Pseudo static.

Flash Memory

This is an electronic non-volatile type of computer memory that can be electrically erased and reprogrammed. NOR flash and NAND flash are two types of flash memory. In both cases, the same type of cell design is used, which consists of the floating gate MOSFETs. It is based on the EEPROM technology that consists of one or more flash memory chips as well as separate flash memory controller chips.

Cache Memory

It is a high-speed memory that catalyzes and synchronizes with the high-speed CPU. This is an extremely fast type of memory that acts as a buffer between RAM and CPU. Cache memory holds the data and instructions that are frequently requested so that it is available to the CPU for the need.

Hard disk drive

A computer hard disk drive (HDD) is a non-volatile data storage device. Non-volatile refers to storage devices that maintain stored data when turned off. All computers need a storage device, and HDDs are just one example of a type of storage device.

HDDs are usually installed inside desktop computers, mobile devices, consumer electronics and enterprise storage arrays in data centers. They can store operating systems, software programs and other files using magnetic disks.

More specifically, hard disk drives control the reading and writing of the hard disk that provides data storage. HDDs are used either as the primary or secondary storage device in a computer. They are commonly found in the drive bay and are connected to the motherboard via an Advanced Technology Attachment (ATA), Serial ATA, parallel ATA or Small Computer System Interface (SCSI) cable, among other formats. The HDD is also connected to a power supply unit and can keep stored data while powered down.

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computers need hard disks

Storage devices like hard disks are needed to install operating systems, programs and additional storage devices, and to save documents. Without devices like HDDs that can retain data after they have been turned off, computer users would not be able to store programs or save files or documents to their computers. This is why every computer needs at least one storage device to permanently hold data as long as it is needed.

work for hard disk drives

Most basic hard drives consist of several disk platters -- a circular disk made of either aluminum, glass or ceramic -- that are positioned around a spindle inside a sealed chamber. The platter spins with a motor that is connected to the spindle. The chamber also includes the read/write heads that magnetically record information to and from tracks on the platters using a magnetic head. The disks also have a thin magnetic coating on them.

The motor spins the platters at up to 15,000 rotations per minute. As the platters spin, a second motor controls the position of the read and write heads that magnetically record and read information on each platter.

SSD (Solid State Drive)

Solid-state drive (SSD) is a solid-state storage device that uses integrated circuit assemblies as memory to store data. SSD is also known as a solid-state disk although SSDs do not have physical disks. There are no moving mechanical components in SSD. This makes them different from conventional electromechanical drives such as Hard Disk Drives (HDDs) or floppy disks, which contain movable read/write heads and spinning disks. SSDs are typically more resistant to physical shock, run silently, and have quicker access time, and lower latency compared to electromechanical devices.

It is a type of non-volatile memory that retains data even when power is lost. SSDs may be constructed from random-access memory (RAM) for applications requiring fast access but not necessarily data persistence after power loss. Batteries can be employed as integrated power sources in such devices to retain data for a certain amount of time after external power is lost.

SSDs work

Solid state drives (SSDs) use a combination of NAND flash memory technology and advanced controller algorithms. NAND Flash memory is the primary storage component, divided into blocks and pages. An SSD contains a controller chip that manages data storage, retrieval, and optimization. The controller's major duties are wear leveling, which evenly distributes write and erase cycles to extend the SSD's lifespan which consolidates empty blocks to maintain optimal performance. SSDs also use features like the TRIM command to increase efficiency by telling the drive about wasted data blocks. Furthermore, data compression and error correction techniques are used to increase storage capacity while maintaining data integrity.

Features of SSD

- **Start-up Time –** SSDs do not use any mechanical component hence it takes almost negligible startup time.

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- **Random Access Times –** Accessing data directly from the Flash memory creates a lag-free experience for its users.
- **Read Latency time –** Accessing data from Flash memory also reduces the read latency time to very low.
- **Data transfer rates –** Higher Data Transfer rates of about 100-600 Mb/sec.
- **Fragmentation –** There is no such concept of Fragmentation in SSDs.
- **Noise –** As they have no mechanical part they create zero noise.
- **Reliability –** SSDs are reliable as there are no moving parts that can wear over time.
- **Operating Temperature Range –** SSDs can operate effectively in a wider temperature range compared to HDDs.
- **Shock and Vibration Resistance –** They are highly resistant to shock and vibration, making them ideal for use in portable devices like laptops, tablets, and rugged environments.
- **Boot Time and Application Load Times –** SSDs reduce boot time of Operating systems and other applications.
- **Security features –** SSDs offer advanced security features like hardware encryption and secure erase functions to protect data from unauthorized access.

Difference Between SSD and HDD

Table 1.2 Difference between SSD and HDD

Parameter	HDD	SSD
Long term storage	HDDs are more reliable for long-term storage.	SSDs are comparatively less reliable for long-term storage due to data leaks that can occur if kept unpowered for more than a year.
Access speed	The data accessing speed is slower as compared to SSD.	The data accessing speed is much higher as compared to HDD.
Performance	The performance suffers because of fragmentation.	The performance does not suffer because of fragmentation.
Suitable for	HDDs are suitable for • Extensive storage • Long-term storage	SSDs are suitable for • Fast data retrieval • Laptop or desktop because of low power consumption and size.

Graphics Card

The Graphics Card, also referred to as a Video Adapter, is an essential component that enhances a personal computer's display capabilities by plugging into an expansion slot on the motherboard. It facilitates the transmission of visual data to the monitor, enabling users to interact with the computer through graphical interfaces. Two primary display modes are supported: text mode, which displays ASCII characters, and graphics mode, which renders

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bit-mapped images. Unlike older setups where the computer's RAM handled display storage, modern graphics cards incorporate dedicated memory, alleviating the burden on system resources. Furthermore, advanced graphics cards boast their own graphics coprocessors, often termed graphics accelerators, designed to efficiently handle complex graphics calculations, resulting in smoother and more immersive visual experiences for users.

Types of Graphics Card

Integrated – The graphics which are built into the motherboard are known as Integrated, are generally used in most laptops, the cannot be easily upgraded.

Discrete – It is an external graphics card which is a hardware and added on a motherboard as an extra component. Most people may not need an external graphics card for their work on PC. Basic work like creating files, doing office work, watching movies, listing songs, etc may not need a graphics card. But for the users playing high resolutions games and video editing may need an external component graphics card for their purpose.

Features of Graphics Card

- **Memory:** Graphics card carries its own memory. Memory range could be from 128MB to 2GB of memory. We should buy a card with more memory. More RAM equals higher resolutions, more colors on the screen, and the best special effects.
- **Multiple Screen support:** Most new video cards have the ability to connect two monitors to one card. This feature is very important for video editing and hardcore gamer craves that extra real estate as well. You can either see two separate Desktops or make the two monitors into one Desktop.
- **Gaming and Video Editing:** The discrete graphics card is not only for a gamer but those who use high-end video editing software also get help as a high-quality graphics card to reduce the rendering time of an image also give a high-def environment.
- **Connection –** The graphic card is connected to the monitor using many different ports put the port must be present on both monitor and Graphics card. These are some common ports used to connect graphics card with a monitor.

  VGA

  HDMI

  DVI

Some motherboards have more than 1 expansion slot so we can add more than one graphic card to make performance better.

sound card

Sound cards are indispensable components within personal computers, seamlessly integrating into expansion slots to deliver immersive audio experiences. They serve as the conduit between digital data and the vibrant sounds emanating from speakers, translating binary signals into rich, analog audio waves. Crucial for multimedia endeavors, they enable the seamless playback of CD-ROMs and enhance gaming experiences with dedicated connections for peripherals. Moreover, their versatility extends to recording capabilities,

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effortlessly capturing sound input from microphones for various applications. In essence, sound cards serve as the auditory backbone of modern computing, bridging the gap between digital information and tangible, resonant.

Fig. 1.35.: sound card

Sound card connections

The image is shown on the right-side describing sound card audio ports or audio jacks, which connectors are found back of your computer. This picture is an example of sound card audio ports.

- With surround sound or loudspeakers, digital out is used (white or yellow; words: "Digital" or "Digital Out").
- Connection for external audio sources, such as tape recorder, record player, or CD player, sound in or line in (blue; Arrow pointing into waves).
- The connection is for headphones or microphones, Mic or Microphone (pink)
- For your speakers or headphones, the primary sound connection, sound out or line out (green; Arrow pointing out of waves). The second (black) and third (orange) sound-out connectors are also contained by this sound card.
- For digital video cameras and other devices, some high-quality sound cards are used, FireWire (not pictured).
- For connecting MIDI keyboard or joystick, MIDI or joystick (15 pins yellow connector) is used with older sound cards.

Fig. 1.36.: Back of sound card

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Power supply

The Switch Mode Power Supply (SMPS) serves as the primary power supply unit for computer systems, delivering the low voltage DC power essential for their operation. This vital component ensures the steady provision of power ranging from 5 to 12 volts, meeting the diverse energy needs of various system components and peripherals. Through its efficient conversion of alternating current (AC) to direct current (DC) at different voltage levels, the SMPS enables the stable and reliable functioning of the computer, powering critical components such as the motherboard, processor, memory modules, and peripherals. Its compact design and advanced switching technology not only optimize power delivery but also minimize energy loss and heat generation, contributing to the overall performance and longevity of the computer system. Thus, the SMPS plays a crucial role in sustaining the functionality and efficiency of modern computing devices.

Check Your Progress

A. Multiple choice questions (MCQs)

1. Which of the following is a characteristic of a computer? (a) Limited processing power (b) Ability to perform calculations and process data (c) Inability to store data (d) Lack of connectivity options
2. The development of computers can be traced back to (a) 19th century (b) 20th century (c) 15th century (d) 18th century
3. How are computers classified according to size and storage capacity? (a) Micro, mini, mainframe, supercomputer (b) Black, white, gray (c) Big, bigger, biggest (d) Small, medium, large
4. Hardware and software are the two main categories of (a) Computer networks (b) Computer peripherals (c) Computer systems (d) Computer languages
5. Which of the following is not a main component of the computer system? (a) Monitor (b) Keyboard (c) Mouse (d) Printer
6. Computers can be classified based on their size and storage capacity. Which of the following is a classification based on size? (a) Supercomputers (b) Mainframe computers (c) Personal computers (d) All of the above
7. The primary storage of a computer is also known as (a) ROM (b) RAM (c) CPU (d) HDD
8. Which of the following is a basic component of a motherboard? (a) RAM (b) CPU (c) Hard drive (d) All of the above
9. The CPU (Central Processing Unit) is responsible for (a) Processing data (b) Storing data permanently (c) Displaying images on the screen (d) Connecting to the internet
10. Which of the following represents a generation of microprocessors? (a) Pentium 1 (b) Windows 10 (c) Microsoft Office (d) Adobe Photoshop

B. Fill in the blank questions

1. A ..... is an interconnected set of hardware and software components that

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work together to perform various tasks.

2. The ..... has evolved over time from large, room-sized machines to powerful handheld devices we use today.
3. Computers have gone through several ....., each marked by advancements in technology and capabilities.
4. ..... refers to the physical components of a computer system, such as the monitor, keyboard, and motherboard.
5. ..... consists of programs and applications that instruct the hardware on what tasks to perform.
6. The ..... of a computer system include the central processing unit (CPU), memory (RAM), storage devices, input devices, and output devices.
7. Computers can be ..... based on their size, functionality, and intended use, such as personal computers, servers, and supercomputers.
8. Classification of computers according to ..... includes categories like mainframes, minicomputers, microcomputers, and handheld devices.
9. The ..... is often considered the brain of the computer, responsible for executing instructions and processing data.
10. The ..... refers to its design and organization, including features like instruction set, clock speed, and cache memory.

C. True or False

1. The CPU is responsible for executing instructions and processing data.
2. The development of computers has remained stagnant over time without any significant advancements.
3. The power supply unit is responsible for converting AC power from the wall outlet into DC power for the computer's components.
4. The main components of a computer system include only hardware components.
5. Classification of computers can be based on factors like size, functionality, and intended use.
6. Classification of computers according to size and storage capacity includes categories like smartphones and tablets.
7. The graphics card is a component responsible for processing audio data.
8. The basic components of a motherboard include the CPU, RAM slots, and expansion slots.
9. Microprocessors have remained unchanged in their architecture across different generations.
10. Primary storage is also known as secondary memory.

D. Short Questions

1. What are the characteristics of a computer?
2. How has the development of computers progressed over time?

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3. What are the main components of a computer system?
4. How can computers be classified?
5. What are some examples of internal components of a computer system?
6. Differentiate between hardware and software.
7. What does CPU stand for, and what is its function?
8. Describe the architecture of a microprocessor.
9. What are the different generations of computers?
10. What is primary storage, and why is it important?

blished

Session 2. Input and Output Devices

Input and output devices are required to communicate with the computer. These devices are connected to the CPU through various ports or with the help of wireless technologies. Input devices feed data and instructions into the computer, and output devices present information from a computer system. Output gene

rated by the output devices may be hardcopy or softcopy output. Hardcopy outputs are permanent outputs which can be used later when required. They produce a permanent record on paper. Printer is a common output device, that produces hardcopy outputs. Softcopy outputs are electronic and are available on the screen in a digital form. They do not produce a permanent record. Monitor is a common softcopy output device.

INPUT DEVICES

An input device is used to feed data into a computer. It is also defined as a device that provides communication between the user and the computer.

Text Input Devices

These are the devices which are commonly used to give text input to the computer like alphabets, numbers and other special symbols etc.

1. **Keyboard:** This is the most common input device. It is designed just like a conventional typewriter. It allows the user to input alphabets, numbers, and other characters. It provides keys for additional functions. It detects the key being pressed and generates the corresponding ASCII code which can be recognized by the computer. The standard US keyboard introduced in 1986 has 101 keys. It has a keyboard layout called the QWERTY design. QWERTY gets its name from the first six letters across in the upper left-hand corner of the keyboard as shown in Figure 2.5. Normally, keyboards come in two sizes—one with integrated numeric keypad and other with a separate numeric keypad. Keyboards can be classified into wired and wireless. Wired keyboards are connected to the CPU through a serial, PS/2 port, or USB port. Wireless keyboards are connected to the computer through infrared (IR), radio frequency (RF), or Bluetooth connections. Portable flexible keyboards are also available now. New generation keyboards like laser keyboards that project the keyboard layout to any surface are being developed.

Fig. 2.1: Keyboard

2. Numeric keypad

It is a small keyboard having only numbers. It is used to enter only numeric data such as those in ATMs. The computer keyboards also have a numeric keypad as shown in Figure 2.2.

Fig. 2.2: Numeric Keyboard

3. PIN pad

This is a device with a numeric keypad used to enter a personal identification number (PIN) of debit card or credit card while doing the transaction as shown in Figure 2.2.

Fig. 2.3: PIN pad

2.1.2 Pointing Devices

These devices are used to move an onscreen pointer or cursor (usually an arrow). They are commonly used with graphical user interfaces (GUIs).

1. Mouse

It is a small handheld device used to indicate the position of a cursor or its movement on a computer's screen by rolling it over a mouse pad or flat surface. A mouse has one or more buttons and possibly a scroll wheel. This scroll wheel is used to scroll the screen vertically or horizontally. The different types of mouse are ball, optical, and laser mouse. Ball mouse works on the principle of the movement of the ball, whereas optical mouse uses LED and laser mouse uses laser beams for sensing the movement. Laser mouse has more precise movement when compared to other types of mouse. Wired mouse uses serial, PS/2, and

USB ports, to communicate, as shown in Figure 2.4, 2.5 and 2.6. Whereas a wireless mouse communicates with the computer via radio waves.

Fig. 2.4: Wireless Mouse **Fig 2.5: USB port Mouse** **Fig. 2.6: PS2 Port Mouse**

2. **Light Pen:** It is a pointing device shaped like a pen. The tip of the light pen contains a light-sensitive element which when placed against the screen detects the light from the screen, enabling the computer to identify the location of the pen on the screen. Light pens have the advantage of drawing directly on the screen. They are used by engineers, artists, and fashion designers for Computer Aided Designing (CAD) and other drawing purposes.

Fig. 2.7: Light pen

3. **Touch Screen:** It is an input device that allows the user to operate by simply touching on the display screen. Some computers, tablets, smartphones, etc., have touch-sensitive display screens. It can also be operated using a stylus which gives more precision. Information kiosks at railway stations and bank ATMs also use touch screens as input device. Nowadays, touch screens are the most common hardware interface for electronic gadgets.

Fig. 2.8: Touch Screen

4. **Graphic Tablet:** This consists of an electronic writing area and a special pen that works with it. It allows artists to enter natural hand movements to create graphical images with motions and actions similar to traditional drawing tools. A stylus is used like a pen and moved over the surface of the tablet. Stylus' movement data is then sent to the computer. The pen of the graphics tablet is pressure sensitive. Hard or soft pressure on the tablet

using the pen can result in brush strokes of different widths in an appropriate graphics program.

Fig.2.9: Graphic tablet

5. **Touchpad:** This is a pointing device found on the laptop computers in place of a mouse to control the pointer. It allows the user to move the finger across the touchpad just as a mouse pointer does and this movement in the form of data is sent to the computer. Touchpad is operated with fingers and dragging it across the flat surface, as the finger moves on the surface, the mouse cursor will move in that same direction. The touchpad also has two buttons below the touch surface that enables clicking.

Fig. 2.10 Touchpad

6. **Joystick:** This is an input device used for playing video games, controlling training simulators and robots. Joysticks and other game controllers can also be used as pointing devices. The joystick has a vertical stick which can move in any direction. It can be used to control objects in a video game or to make menu selections by the movement of a cursor displayed on the screen. It has a button on the top that is used to select the option pointed by the cursor.

Fig. 2.10 Joystick

2.1.3 Audio Visual Input Devices

Audio-visual input devices are essential components of modern computing systems, facilitating the interaction between users and computers through audio and visual mediums. These devices capture and transmit data in the form of sound, images, or video, enabling users to communicate, create, and interact with digital content.

1. Scanner

Scanning is a process of taking a close-up photograph. Scanner is an input device which

functions like a photocopying machine. It has a glass plate to place the paper which is to be scanned. Scanners can capture information, like pictures or text, and convert it into a digital format that can be edited using a computer. The scanned image or document is captured by the laser beams and converted to digital data. The scanned picture or document can be saved in the computer. The quality of the image depends on the resolution of the scanner. The resolution of the image scanned is expressed in dots per inch (DPI). The higher the DPI, the better will be the resolution of the scanned image.

The different variants of scanners are flat bed, sheet feed, and hand-held scanner. A sheet feed scanner can scan a single sheet, whereas a flatbed can scan even from a book but they are not portable. A hand-held scanner is portable but the scanning action is not smooth as the scanner is moved manually.

Fig. 2.11 Scanner

2. Microphone

This is used to input human voice into the computer. It is attached to a computer for the input of sound. It accepts sound which is analogue in nature as input and converts it to digital format. The digitized sound can be stored in the computer for processing or playback. The headphones come with microphones to use chat applications. A computer loaded with speech recognition software like the one pre-installed in Windows 7 can convert what a person has said into text, which can be saved for word processing. A voice recognition program can process the input and convert it into machine recognizable commands.

Fig. 2.12 Microphone

2. Digital camera

This can take pictures and videos and convert them into digital format. Pictures or videos taken using a digital camera are stored inside its memory and can be transferred to a computer by connecting the camera to it. It is a kind of small computer that controls camera focus, stores images, etc. It runs a very simple operating system (stored on ROM) and usually provides a menu-based GUI for the user.

Fig. 2.13 Digital Camera

The quality of the lens, the density of charge coupled device (CCD), resolution (measured in megapixel), optical zoom, and the software used in the camera determines the quality of the picture. Each picture is made up of thousands of tiny pixels (picture elements) and the camera stores the data on the colour of each dot. The quality of the picture is determined by the number of pixels in each picture. Digital cameras have resolutions ranging from 2 mega pixel to 24 megapixels and optical zoom ranging from 3x to 60x.

4. Webcam

It is a compact and less expensive version of a digital camera. It is used in computers for video chatting. It does not have an internal memory. It is a very basic video camera used to feed live video into a computer. The video data from a web cam is low quality compared to a full video camera. It is positioned on top of the laptop monitor and for desktop computers it can be connected externally. Applications like Skype, Yahoo Messenger, etc., use webcam to capture images. Now, laptops also come with an inbuilt web camera.

Fig. 2.14 Webcam

5. Closed circuit TV (CCTV)

CCTV captures the images and videos fed as input to the computers. (Figure 2.15). CCTVs are commonly used to maintain road safety and the security on premises.

Fig. 2.15 Closed Circuit TV

2.1.4 Input card Readers

1. Smart card or chip reader

This is a plastic card that stores and transacts data. It has a tiny 'chip' of computer memory

embedded inside. Data can be stored in the chip's memory and read back using a 'chip' reader. The data card may contain a memory or a microprocessor. Memory cards simply store data, while a microprocessor card on the other hand can add, delete, and manipulate information in its memory. The smart card is used in most banking, healthcare, telephone calling, electronic cash payments, and other applications.

Fig. 2.16 Smart card or chip reader

Smart card readers are used to access data in a smart card. It can be contact type or contact less. A contact type of reader requires physical contact with the cards, which is made by inserting the card into the reader. A card is inserted into the reader where metal contacts connect to the metal pads on the front face of the card. The reader can access the data stored on memory chip. A contact less type of reader works with a radio frequency that communicates when the card comes close to the reader. Many contact less readers are designed specifically for toll gate payment in transportation applications and person identity applications. Satellite TV decoders use smart cards to store data regarding subscription of channels by the user. The data is encrypted so that it is not easy to alter. Many types of cards—ID cards, phone cards, credit cards, and door security cards use this system.

2. Magnetic strip reader

The credit cards have a magnetic strip. This strip stores the user's data in the form of magnetized dots (for example, the credit card number, card expiry date, and customer name). The strip allows inputting of this data to a computer system faster and more accurately than typing. A magnetic strip reader is used to read the data by swiping the card through a slot on the reader.

Fig. 2.17 Magnetic strip reader

2.1.5 Input-reading Text or Codes

Entering the data in a computer using a keyboard may be a slow process and it is prone to mistakes. Sometimes speed and accuracy may be essentially required. In such cases, the following input devices are used to read and input the data.

1. Barcode & Quick Response (QR) code reader

It is a set of vertical lines of different thickness and spacing that represent a number. These lines are read by a barcode reader or scanner. Barcode readers are devices that are used to input data from such set of barcodes (Figure 2.18). This code is converted to an alphanumeric value and is fed to the computer connected to it. The bar code reader reads and enters the value quickly and accurately than entering the data by using a keypad. Barcode is used to code items in a shop and books in a library. Handheld scanners are commonly seen in shops to scan codes and price information for each of the items to make billing easier. Mobile phones with camera and special software can also be used as a barcode reader.

Fig. 2.18: Bar Code

Fig. 2.19: Quick Response (QR) Code

QR codes are similar to barcodes. Barcodes are single dimensional, whereas QR codes are two dimensional as shown in Figure 2.19. The two-dimensional way of storing data allows QR code to store more data than a standard barcode. This code can store website URLs, plain text, phone numbers, email addresses, and any other alphanumeric data. The QR code can be read using a barcode reader or a mobile phone which has a camera and special software installed.

2. Optical Mark Reader (OMR)

It is an input device that recognizes marks made by a pencil or pen in a multiple-choice type form. It is commonly used to check forms filled with pen or pencil and to correct MCQs of exam papers. It can read the marks and feed that data to a computer (Figure 2.20).

Fig. 2.20: Optical Mark Reader (OMR)

OMR technology scans a printed form and reads predefined positions and records the marks on the form. This technology is useful for applications in which large number of forms needs to be processed quickly with great accuracy, such as objective type tests and questionnaires.

OMR sheets are normally used to evaluate multiple choice questions in competitive exams. It consists of bubble shaped options to mark the answers. Candidates are required to darken the correct bubble option using a pen or pencil (refer to Figure 2.20). For accuracy of results, good quality paper and accurate alignment of printing is essential.

3. Magnetic Ink Character Reader (MICR)

It reads the data written by the magnetic ink. The cheque number is printed at the bottom of each bank cheque by special magnetic ink using a special font. It can be detected by a MICR reader. MICR reads this data and feeds it to the computer quickly and accurately.

Fig. 2.21: Magnetic Ink Character Reader (MICR)

4. Optical Character Recognition (OCR)

This is a software technology that converts images of text into an actual text file. To use this technology, first scan the document using the scanner. Then the scanned image is analyzed by the OCR software. The result is such that it seems the text has been typed by hand.

Fig. 2.22: Optical Character Recognition (OCR)

2.1.6 Input Sensors

A sensor is a device that senses the real-world data (for instance, temperature) and converts it into digital data to be processed by the computer. A computer system cannot sense the real-world data such as light or dark, hot or cold, quiet or noisy. We use our senses (eyes, ears, mouth, nose, and skin) to read such data. In the same way, the sensor reads this kind of data and converts it into its digital equivalent. The sensors are connected to a computer.

Remote control

This is a very commonly used input device. It sends data signals each time a button is pressed using infrared light or radio signals. The signals can control the system from some distance. It is also used to control a presentation slide show.

Biometric sensor

It is a device that identifies unique human physical features with high accuracy. It is an essential component of a biometric system which uses physical features like fingerprints, retina, iris patterns, etc., to identify, verify, and authenticate the identity of the user. The three major types of biometric sensors are semiconductor sensor, optical sensor, and

ultrasound sensor. Figure 2.23 shows a biometric sensor.

Fig. 2.23 Biometric sensor

2.2 Output Devices

These can be categorized into three types based on the output produced by the computer in the following form:

1. Soft copy
2. Hard copy
2. Sound output

2.2.1 Soft copy output device

The output on the screen is called a soft copy. The soft copy output can be provided on the following devices.

Visual Display Unit (VDU)

This is an output device that visually conveys text, graphics, and video information. Information shown on a display device is called softcopy because the information exists electronically and is displayed for a temporary period of time.

Display devices include Cathode Ray Tube (CRT) monitors, Liquid Crystal Display (LCD) monitors, Thin Film Transistor (TFT) monitors, Light Emitting Diode (LED) monitors, and gas plasma monitors.

Some of the characteristics of a VDU are size, resolution, pixel pitch, and response time. VDUs are available in different sizes. The size of a monitor is measured diagonally across the screen in inches. The resolution of the monitor is the maximum number of pixels it can display horizontally and vertically (such as 800 x 600 or 1024 x 768 or 1600 x 1200). The pixel spacing on the screen is called the dot pitch. A screen with smaller dot pitch produces sharper images. Response time refers to the time taken for a pixel to turn from a state of brightness to a state of darkness and then back again. Monitors with lesser response time provide better movie viewing experience.

The CRT monitors were used earlier. Nowadays they are not being used, as flat LCD monitors are available at the same cost. But it is essential to know the old technology also. The CRT monitor looks like a television set from the past. It is large in size, heavy, and consumes more electricity because it contains a large cathode ray tube. It is available in two forms—monochrome and color. A monochrome monitor displays characters and images in a single color on a dark background. Another variation of monochrome monitor is capable of displaying different shades of gray and is called a gray scale monitor. A color monitor uses three different basic colours such as red, blue, and green to display 16 to 1 million different

colours. These monitors are preferred by graphic artists for their accurate colour rendering and by gamers for faster response to rapidly changing graphics.

Flat panel monitors

These are very thin, lightweight, and need very less power. Flat panel displays are thinner, lighter in weight, consume less power, and emit less heat as compared to CRT monitors. They are most commonly used in computers, especially in laptops. Different types of flat panel monitors are LCD (Liquid Crystal Display), LED (Light Emitting Diode) and OLED (Organic LED). LCD uses liquid crystal molecules for display, LED uses light emitting diodes for display, and OLED uses a special organic compound for display. LED displays have better brightness.

Fig. 2.24: Flat panel monitor

Liquid crystal display (LCD): This display consists of liquid crystals sandwiched between two plastic plates. These crystals rearrange to form an image when an electric current pass through them. A light source at the back of this plate makes the picture visible. This light source can be a fluorescent lamp or LED.

Fig. 2.25: Liquid crystal display (LCD) monitor

Light emitting diode (LED) monitor:

This uses LED directly behind the liquid crystal display (LCD) in order to light up the screen. This technique is very effective and gives each area of the screen its own light, which can be on or off. LED screens can produce massive contrast ratios resulting in better color quality and clarity. Further, wider viewing angle, faster refresh rates, and power saving are its other advantages, making this technology expensive.

Fig. 2.26: Light emitting diode (LED) monitor

Plasma monitors: A flat panel display consists of sandwiching neon or xenon gas between two sealed glass plates with parallel electrodes deposited on their surfaces. When a voltage pulse is passed between two electrodes, the gas lights up as different colours creating images on a monitor. Plasma monitors provide high resolution but are also expensive.

Fig. 2.27: Plasma monitor

Organic light emitting diode (OLED) monitors: The panel of OLED is made up of millions of tiny LEDs. The 'O' in OLED stands for organic which means there is carbon in the light emitting layer of the panel. OLED screens are thinner and lighter than LCDs and LEDs. They can produce better quality images and have a better viewing angle. OLEDs consume less power but are again very expensive.

Fig. 2.28: Organic light emitting diode (OLED) monitors

LCD projector

This is a type of video projector used for displaying videos, images, or computer data on a large screen or any other flat surface. Several people in a classroom can view the output on a wide screen at the same time. It is a modern equivalent of the slide projector or overhead projector. A beam of high-intensity light travels through thousands of shifting pixels in a LCD display. This beam of light then passes through a lens which projects and focuses the image on the surface.

Fig. 2.29: LCD projector

2.2.2 Hard copy output devices

Hard copies are tangible computer outputs. Printer and plotter are used to get a hard copy output.

Printer

This is used to produce a hard copy output. There are different kinds of printing technology. Two factors that determine the quality of a printer are its resolution and speed. Resolution is measured in terms of DPI. Speed is measured in terms of number of characters printed in a unit of time and is represented as characters per second (CPS), lines per minute (LPM), or pages per minute (PPM). Based on the technology used, they can be classified as impact or non-impact printers.

Impact printers

These use the typewriting or printing mechanism where a head or needle strikes against an ink ribbon to make a mark on the paper. The ink ribbon used in this printer is not very expensive. It is used in banks and shops for printing receipts, etc. Dot matrix printers fall under this category.

Dot matrix printers:

Use small electromagnetically activated pins in the print head and an inked ribbon to produce images by impact. The most commonly used printer heads consist of nine pins. Certain printers use 24 pins for better print quality. A dot matrix printer prints a letter in a grid or matrix pattern of dots. It forms the letters by hitting the print on the ribbon and then both the papers. Its print quality is poor and also produces noise while printing. But its running cost is very less and one can also print multiple copies in one go using the carbon paper between the papers. These printers are slow and noisy and are not commonly used for personal use. The dot matrix printers are widely used at cash counters in shops due to their low printing cost and because we can get carbon copies from them.

Fig. 2.30: Dot matrix printer

Line Printer: The line printer also uses the similar technology but it is a fast printer which

prints one row at a time. This means it can print up to 3,000 lines per minute (Figure 2.31).

Fig. 2.31: Line Printer

Non-impact printers

These do not touch the paper while printing. And since they don't strike the printer head, they are not noisy. They use different technologies to print characters on paper. Inkjet, laser, and thermal printers fall under this category. Running cost of these printers is more expensive than impact printers.

Inkjet printers: These form the image on the page by spraying tiny droplets of ink from the print head. The four colour ink (cyan, yellow, magenta, and black) is used to produce colour printouts. The droplets of ink come from tiny holes (the jets). Each droplet creates a tiny dot on the paper. Since the dots are so small, the quality of the printout is excellent (1200 dots per inch are possible). They are used to print photographs. They are inexpensive, but the cost of ink cartridges makes it a costly affair in the long run.

Laser printers: These produce a good quality output. It utilises a laser beam to produce an image (through a mirror) on a drum. The light of the laser alters the electrical charge on the drum and applies toner (dried ink) in the cartridge. The toner powder from the toner cartridge is then sprayed onto the drum. The toner powder sticks onto the portions traced on the drum by the laser beam. It is transferred to a paper by rolling the paper over the drum. Through heating, the powder is fused onto the paper. There are laser printers which print about four A4 size papers per minute. These printers produce clear and quality printouts. They are also faster and their speed is rated in pages per minute (PPM). Monochrome and colour laser printers are available. Colour laser printers use multiple colour toner cartridges to produce colour output and are expensive.

Fig. 2.32 Laser printer

Thermal printers: These produce a printed image by selectively heating heat sensitive

thermal paper when it passes over the thermal print head. The coating turns black in the areas where it is heated, producing an image. These printers are less noisy and faster than dot matrix printers. They are also smaller, lighter, and consume less power, making them ideal as portable printers. They are commonly used in business to print receipts in devices such as an ATM and in printing labels.

Fig. 2.33 Thermal printer

The features of all the above printers are summarized in the Table 2.1.

Features	Laser Printers	Inkjet Printers	Thermal Printers	Dot Matrix Printers
Printing material used	Ink powder	Liquid ink	Heat sensitive paper	Ink soaked ribbon
How does it print?	It fuses the powder on the paper through heating.	It sprays liquid ink on paper through microscopic nozzles.	Thermal paper is passed over the thermal print head.	Pins are pushed against ribbon on paper.
Printing speed	20 pages per minute	6 pages per minute	150 mm per second	30550 characters per second
Quality	Printing quality is good. Best for black and white.	Printing quality is good, especially for smaller fonts.	Poor quality printing of images. Good quality text printing.	Poor printing quality for images. In terms of text, printing is good.
Advantages	Less noisy, prints faster, high print quality.	Less noisy, high print quality, no warm up time, device cost is less.	Less noisy, fast, smaller, lighter, consumes less power, portable	Cheaper to print as ribbon is cheap, carbon copy possible.

Disadvantages	More susceptible to paper jams. Toner is expensive. Device itself is expensive.	Ink is expensive and not waterproof, and nozzle is prone to clogging.	Requires special thermal quality paper, poor quality printing.	Initial purchase and maintenance are both expensive, printing is not fast, makes noise.

Three dimensional (3D) printers

This is a new generation output device used to print 3D objects. It can produce different kinds of objects in different materials and this can be done using the same printer. It can print anything from ceramic cups to plastic toys, metal machine parts, stoneware vases, fancy chocolate cakes, etc.

The 3D printing process turns the object to be printed into thousands of horizontal tiny little layers. It then prints these layers from bottom to top, layer by layer. These tiny layers stick together to form a solid object.

Plotter

It is an output device used to produce hard copies of graphs and designs on the paper. Plotters are used to print the drawings by using a special pen. Colored pens are used to produce color line drawings. The pens are held by an arm which can lift the pen up or down, and move across the paper. The arm and pen of the plotter creates drawing just like humans but with more speed and accuracy. A plotter is typically used to print large format graphs or maps such as construction maps, engineering drawings, and big posters. It is used in the designing of cars, ships, aircrafts, buildings, highways, etc. Plotters are used by designers and architects since they work with huge pieces of paper, that a normal printer cannot handle. They are not used to print the text and images. They are used to print the drawings prepared by the CAD software. Plotters are of two types: drum plotters and flatbed plotters.

Drum plotter

It is also known as a roller plotter. It consists of a drum or roller on which a paper is placed and the drum rotates back and forth to produce the graph on the paper. It also consists of a drawing arm that holds a set of colored ink pens or pencils. The drawing arm moves side to side as the paper is rolled back and forth through the roller. In this way, a perfect graph or map is created on the paper.

PSS

Fig. 2.34: Drum plotter

Flatbed plotter

It is also known as a table plotter. It plots on paper that is spread and fixed over a rectangular flatbed table. The flatbed plotter uses two drawing arms, each of which holds a set of colored ink pens or pencils. The drawing arms move over the stationary paper and draws the graph on the paper. Flatbed plotter is very slow in drawing or printing graphs. The large and complicated drawing can take several hours to print.

Fig. 2.35: Flatbed plotter

2.2.3 Sound output device

The device which gives a sound output is called a speaker. Speaker devices are designed for personal and public use.

The audio output is the ability of the computer to produce sound. Speakers are the output devices that produce sound. They are connected to the computer through audio ports. They produce sound by the movement of the diaphragm in the speaker, forward and backward according to the electrical signals coming out of the audio port. For high quality sound reproduction, computers use 2.1 (3 speakers), 5.1 (5 speakers), and 7.1 (7 speakers) speaker systems.

Fig. 2.36: Speaker

Check Your Progress

A. Multiple choice questions (MCQs)

1. Which of the following is a text input device? (A) Mouse (B) Keyboard (C) Printer (D) Scanner
2. Which of the following is a pointing device? (A) Monitor (B) Scanner (C) Mouse (D) Microphone
3. Which of the following is an audio-visual input device? (A) Scanner (B) Keyboard (C) Microphone (D) Printer
4. Which device is used for input-reading text or codes? (A) Printer (B) Scanner (C) Mouse (D) Monitor
5. Which type of device senses physical input, such as pressure, temperature, or light, and converts it into electrical signals? (A) Keyboard (B) Mouse (C) Scanner (D) Sensors
6. Which of the following is an example of an input sensor? (A) Barcode reader (B) Printer (C) Monitor (D) Projector
7. Which of the following is a soft copy output device? (A) Printer (B) Monitor (C) Plotter (D) Speaker
8. Which device is considered a hard copy output device? (A) Speaker (B) Monitor (C) Plotter (D) Scanner
9. Which device is used for sound output? (A) Scanner (B) Plotter (C) Speaker (D) Keyboard
10. Which device is commonly used for reading data from credit or debit cards? (A) Scanner (B) Keyboard (C) Microphone (D) Magnetic Stripe Reader

B. Fill in the blank questions

1. _____ are used for entering text, such as letters, numbers, and symbols, into a computer system.
2. A _____, such as a mouse or touchpad, allows users to interact with graphical user interfaces by moving a pointer on the screen.
3. _____ capture both audio and visual data, such as videos or live streams,

and input them into a computer system.

4. _____ are devices used to read data from magnetic stripes or chips, commonly found in credit cards or identification cards.
5. Devices capable of _____ are able to interpret and input text or codes, such as those found on barcodes or QR codes.
6. _____ are devices that detect and input physical phenomena, such as temperature, light, or pressure, into a computer system.
7. _____ produce visual or auditory output that can be viewed or heard on a screen or speakers connected to the computer.
8. A _____ produces output that is displayed on a screen or monitor, allowing users to view digital content.
9. _____ produce output in a physical form, such as printed documents or photographs.
10. A _____ is a type of output device that produces sound or audio output, allowing users to listen to music, voice recordings, or system alerts.

C. Ture or False

1. A keyboard is an example of a pointing device.
2. Input card readers are used to read data from magnetic stripes or chips, commonly found in credit cards.
3. Output devices produce data that can be physically touched or held.
4. Soft copy output devices produce physical copies of data, such as printed documents.
5. Audio visual input devices capture only visual data and not audio.
6. Input sensors detect and input physical phenomena into a computer system.
7. Hard copy output devices produce output that can be viewed on a screen or monitor.
8. Sound output devices produce visual output, such as images or text.
9. Pointing devices allow users to interact with graphical user interfaces by moving a pointer on the screen.
10. Text input devices are only capable of inputting handwritten text.

D. Short Questions

1. What are text input devices? Provide examples.
2. Give two examples of pointing devices.
3. What is audio visual input devices? Provide an example.
4. What is the function of input card readers? Give an example of their application.
5. Describe input-reading text or codes devices. Provide an example.
6. What are input sensors? Give an example of their use.
7. Define output devices. Give two examples.
8. Explain the difference between soft copy and hard copy output devices. Provide examples of each.
9. What is the purpose of a sound output device? Give an example.
10. How do input devices contribute to the functioning of a computer system?

Session 3. Storage and Peripheral Devices

Digital Data Storage Devices

The digital storage devices market has experienced remarkable growth in recent years, driven by the exponential increase in data generation and the growing demand for data storage and management solutions. Characterized by a diverse range of products, including hard disk drives (HDDs), solid-state drives (SSDs), USB flash drives, and memory cards, this industry has seen significant advancements. SSDs, in particular, have surged in popularity due to their superior performance, faster data transfer speeds, and enhanced reliability compared to traditional HDDs. Furthermore, the need for higher storage capacities and compact devices has fueled the development of microSD cards and NVMe SSDs. Furthermore, with the widespread adoption of cloud computing and the Internet of Things (IoT), the digital storage devices sector is poised for further expansion and innovation.

Memory or storage devices

Memory is required in a computer to store programs and the data processed by programs. Computer memory is made up of a large number of cells. Each cell is capable of storing one bit of information in the form of binary numbers.

Capacity and measuring unit of Memory

In the realm of computing, memory capacity is a crucial concept often discussed in terms of various measuring units. Memory capacity refers to the amount of data that a memory storage device can hold. It is typically measured in units such as bytes, kilobytes (KB), megabytes (MB), gigabytes (GB), terabytes (TB), and beyond. These units represent increasing orders of magnitude, with each subsequent unit being exponentially larger than the previous one. For instance, a byte is the smallest unit of memory, capable of storing a single character, while a kilobyte can hold approximately a thousand bytes of data, and so on. Understanding memory capacity and its measuring units is essential for effectively managing digital data and selecting appropriate storage devices to meet specific needs.

The storage capacity of the memory is expressed in various units of memory. These are as follows:

Bit

A microprocessor uses binary digits 0 and 1 to decide the OFF and ON state respectively, of various circuits. Furthermore, a bit is the smallest unit of representation in the binary language.

Nibble

A nibble is a collection of 4 bits.

Byte

A byte is the representation of a group of 8 bits. Moreover, a byte is a unit that expresses any word, symbol, or character in the computer language. Besides, computer memory is

always in terms of multiples of bytes.

Word

A computer word is similar to a byte, as it is also a group of bits. Moreover, a computer word is fixed for each computer. At the same time, it varies from computer to computer. Besides, the length of a computer word is the word-size or word length. Therefore, a computer stores information in the form of computer word.

Kilobyte

- It is the most common unit of memory which is the smallest of all. But, it is greater than the byte.
- The abbreviation for kilobytes is 'KB'.
- It contains 1000 bytes. Besides, it is synonyms to kibibytes which contain 1024 (210) bytes.
- Megabytes usually measure the size of text documents, graphics of websites, individual files, etc.

Megabyte

- The abbreviation for megabyte is 'MB'.
- It contains 1000,000 bytes. Besides, it is synonyms to mebibytes which contains 1048576 (220) bytes.
- Kilobytes usually measure the size of large files. For example, high-resolution images, songs, storage of compact disks, etc.

Gigabyte

- The abbreviation for the gigabyte is 'GB' or 'gigs'.
- It contains 1000,000,000 bytes. Besides, it is synonyms to gibibytes which contain 1073741824 (230) bytes.
- Kilobytes usually measure the capacity of storage devices.

Terabyte

- The abbreviation for terabytes is 'TB'.
- It contains one trillion bytes. Besides, it is synonyms to tebibytes which contains 240 bytes.
- Kilobytes usually measure the capacity of large storage devices, for example, HDDs (Hard Disk Drives).

Petabyte

- The abbreviation for petabyte is 'PB'.
- It contains 1015 bytes. Besides, it is synonyms to pebibytes which contains 250 bytes.
- Petabytes usually measure the total data storage in large networks or server farms. For example, the data in Google or Facebook data servers is around more than 10 PBs.

Exabyte

- The abbreviation for exabyte is 'EB'.
- It contains 1018 bytes. Besides, it is synonyms to exbibytes which contains 260 bytes.
- The exabyte unit is so large that it does not even measure the storage of large cloud servers. Rather, it can be used to measure the amount of data transfer over the internet for a certain time limit.

Zettabyte

- The abbreviation for zettabyte is 'ZB'.
- It contains 1021 bytes. Besides, it is synonyms to zebibytes which contains 270 bytes.
- It can measure a huge amount of data. In fact, the whole data in the world is just a few zettabytes.

Yottabyte

- The abbreviation for yottabyte is 'YB'.
- It contains 1024 zettabytes. Besides, it is synonyms to yobibytes which contains 280 bytes.
- It is a tremendously huge unit of measurement. Therefore, it has no practical use.

Table 3.1 for Computer Data Storage Memory Unit.

Unit	Description
Bit (Binary Digit)	A binary digit is logical 0 & 1
Nibble	1 Nibble = 4 bits
Byte (B)	1 Byte = 8 bits
Kilobyte (KB)	1 KB = 1024 B
Megabyte (MB)	1 MB = 1024 KB
Gigabyte (GB)	1 GB = 1024 MB
Terabyte (TB)	1 TB = 1024 GB
Petabyte (PB)	1 PB = 1024 TB
Exabyte (EB)	1 EB = 1024 PB
Zettabyte (ZB)	1 ZB = 1024 EB
Yottabyte (YB)	1 YB = 1024 ZB

Memory System

Memory in a computer system is required for the storage and subsequent retrieval of instruction and data. A computer system uses a variety of devices for storing instructions and data required for its operations. Normally, the information to be stored on a computer

is classified in two basic categories – data and instructions.

Although a memory system is a very simple system, it exhibits a wide range of technology. But unfortunately, faster memory is more costly. On the other hand, memories with smaller cost have very high access time. This is the time taken by the CPU to access a location in memory. This results in slower operation of the CPU. Thus, the cost versus access time has led to a hierarchy of memory where we supplement fast memories with larger, cheaper and slower memories. Therefore, memory system may have different types, costs, organizations, technologies and performances. (Figure 3.1)

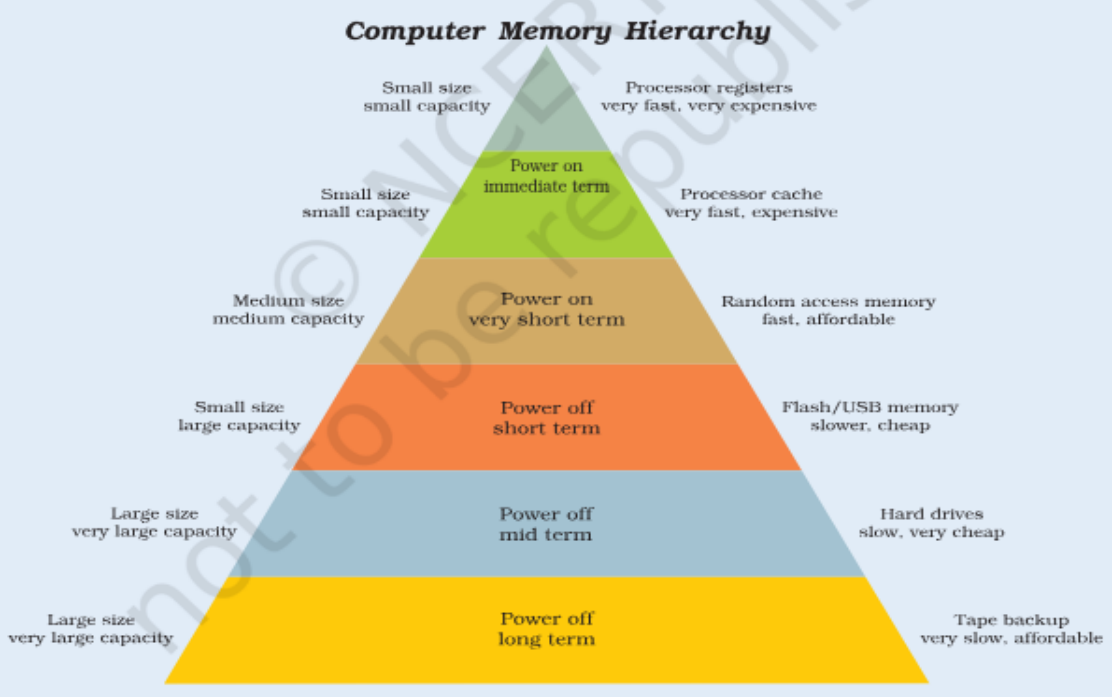

Fig. 3.1 The Memory Hierarchy

Types of Memory

A memory system can be considered to consist of three types of memories. These are as follows:

1. Internal processor memories
2. Primary memory or main memory
3. Secondary or auxiliary memory

Any storage unit of a computer may have the following characteristics:

Storage capacity is the amount of information/data a storage unit can hold. Accessing the data to/from these memories may be fast or slow.

The speed and availability of inexpensive memory has had enormous impact on computer technology. The high speed memory devices are more expensive and occupy less space in comparison to the slow speed memory devices.

Internal Processor Memories

These consist of the small set of high-speed registers and high speed buffer memory (cache)

which are internal to a processor and are used as temporary locations where actual processing is done.

Register is a small amount of storage available on the CPU whose contents can be accessed more quickly than storage available elsewhere. Processor registers are at the top of the memory hierarchy and provide the fastest way for a CPU to access data.

The important registers, within the CPU are:

Program Counter (PC) A program counter keeps track of the next instruction to be executed.

Instruction Register (IR) is a register which holds instruction to be decoded by the control unit.

Memory Address Register (MAR), is a register which points to the memory location which the CPU plans to access, either for reading or for writing.

MBR (memory buffer register) which is also referred to as memory data register (MDR) is used for storage data either coming to the CPU or data being transferred by the CPU.

Acculmular (ACC) is a general purpose register used for storing variables, temporary results and results produced by arithmetic logic unit of the CPU.

Besides these, a processor can have many other registers. But these are the most basic and most essential registers necessary for any CPU.

Cache Memory

Cache memory is a small high speed buffer memory used to hold instructions temporarily during processing.

The CPU of a computer system commonly uses cache memory (Figure 3.2) where it holds or buffers the contents of the main memory because the CPU runs much faster than the main memory. Thus, to reduce the waiting time of the CPU the cache is used. Cache memory reduces traditional system bottlenecks because system RAM is much slower than CPU. This prevents the processor from having to wait for a program and data from slower main memory.

A cache typically operates by retaining copies of blocks of storage, each containing recently used information. This memory (or caches) is usually transparent or invisible to the processor.

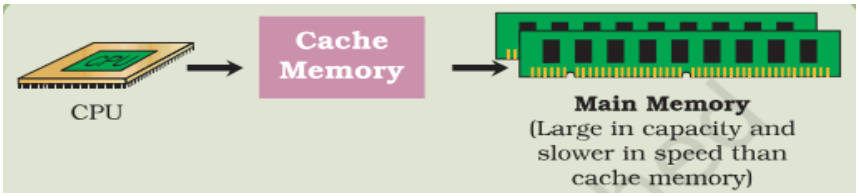

Fig. 3.2 Cache memory

Cache is a collection of data duplicating original values stored elsewhere or computed earlier, where the original data is expensive to fetch (owing to longer access time) or to

compute, compared to the cost of reading the cache. In other words, a cache is a temporary storage area where frequently accessed data can be stored for rapid access. Once the data is stored in the cache, future use can be made by accessing the cached copy rather than refetching or recomputing the original data, so that the average access time is reduced.

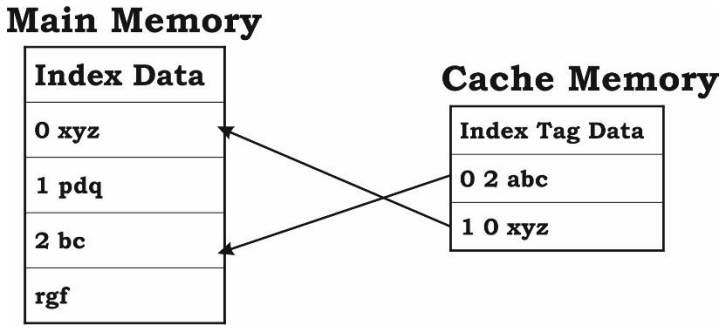

Fig. 3.3 CPU memory cache

Primary Memory It is a large memory which is fast but not as fast as an internal processor register. The processor directly accesses this memory. It is mainly based on integrated circuit. The primary memory or the main memory is part of the main computer system. The processor or the CPU directly stores and retrieves information from it. This memory is accessed by the CPU, in a random fashion. That means any location of this memory can be accessed by the CPU to either read information from it, or store information in it. The primary memory itself is implemented by two types of memory technologies. The first is called Random Access Memory (RAM) and the other is read only memory (ROM). A more appropriate name for RAM is RWM (read write memory), the CPU can write and read information from any primary memory location implemented using RAM. The other part of primary memory is implemented using ROM which stands for Read Only Memory.

There are two types of built-in memory, permanent and temporary, known as ROM and RAM, respectively, details of each given below:

Read Only Memory (ROM)

As we know, in the computer terminology, read means transferring data instruction from an input source to the computers, main memory (or CPU) and write is transferring data/instruction from computer's main memory to an output device. Therefore, read only means data/ instruction can be retrieved from the ROM chip but cannot be modified.

Types of ROM

Basically, there are two types of ROM, namely, manufacturer programmed and user-programmed.

Manufacturer–Programmed Read Only Memory

Manufacturer-programmed ROM is one in which data is stored in it permanently by the manufacturer of the ROM. For example, a computer manufacturer may store the system boot program permanently in the ROM chip used on the motherboard.

User–Programmed Read Only Memory

User-programmed ROM is one in which the user can load and store "read-only" programs and data. Such a ROM is commonly known as PROM (programmable read-only memory),

because, a user can program it. PROM (programmable read-only memory) is a memory chip on which we can store a program. But once the PROM has been used, we cannot wipe it clean and use it to store something else. Like ROMs, PROMs are non-volatile.

Other kinds of user-programmed ROM are EPROM and EEPROM. Both of these are special types of PROM. EPROM (erasable programmable read-only memory) can be erased by exposing it to ultraviolet light while EEPROM (electrically erasable programmable read-only memory) can be erased by exposing it to an electrical charge.

Flash EEPROM memory works much faster than traditional EEPROMs because instead of erasing one byte at a time, it erases a block or the entire chip, and then rewrites it. The electrons in the cells of a Flash-memory chip can be returned to normal ("1") by the application of an electric field, a higher-voltage charge.

Random Access Memory (RAM)

RAM chips are meant for primary storage. They hold temporarily (a) software/program instructions and (b) data before and after processing.

"Random Access" means that any location can be referenced in the same time and in the same manner, as it is independent of the address or location in the memory. It is a volatile memory. It holds data and instructions, during their execution. The additional RAM chip can be plugged into the special socket on the motherboard known as Single In-Line Memory Module (SIMM). Random Access Memory capacity ranges from 16 MB to 4 GB on personal computers.

Types of RAM

RAM chips are of two types, namely, static RAM (SRAM) and dynamic RAM (DRAM).

Static RAM (SRAM)

The SRAM can store data as long as power is applied, without the need for periodically rewriting the data into memory. Contents (memory cell) of this RAM will stay in a given state (store a bit) indefinitely, provided that power to the memory circuit is not interrupted. The main applications of SRAM are in areas where only small amounts of memory are needed or where high speed is required.

Advantage

SRAM can provide very high speed.

Disadvantage

SRAM is costly and has low power packing density

Dynamic RAM (DRAM)

This memory stores data as charges on capacitors. With Dynamic RAM, the stored data will gradually disappear because of capacitor discharge, so that it is necessary to periodically refresh the data (i.e. recharge the capacitors). In the process of refreshing, the information is read from the memory cell and written back in the same position. Typically, each memory cell of a DRAM must be refreshed at least every 2 to 10 millisecond or its data will be lost.

Advantage

It has high capacity and power consumption is low.

Disadvantage

The need for refreshing of dynamic RAM because some external refreshing circuits is required.

Complementary Metal Oxide Semiconductor Memory (CMOS)

Besides RAM and ROM there is a third type of primary memory or storage called as CMOS. It is used to store the system configuration, date, time and other important data. When a computer is switched on, BIOS matches the information of CMOS with the peripheral devices and displays error in case there is any mismatch.

Table 3.2 Comparison between ROM and RAM

ROM	RAM
Read Only Memory	Random Access Memory
It stores information permanently.	It holds information temporarily.
Information is not lost even if the computer is switched off.	Information is lost when power supply is switched off.
Known as non-volatile memory.	Knows as volatile memory
Holds system software such as Boot Loader.	Holds operating system and application programs which are currently in use.
Types of ROMs are PROM, EPROM EEPROM.	Type of RAMs are Dynamic RAM and Static RAM.

Secondary or Auxiliary Memory

Auxiliary memory is much larger in size than main memory but is slower than the latter. It normally stores system programs and data files. These cannot be accessed directly by the processor.

Secondary or auxiliary memory, also known as secondary storage, is the memory that supplements the main storage. This is a long-term, non-volatile memory. The term non-volatile means it stores and retains the programs and data even after the computer is switched off. Unlike RAM which loses the contents when the computer is turned off and ROM to which it is not possible to add anything new, auxiliary storage device allows a computer to record information semi-permanently. This is to ensure that this information can be read later by the same computer or by another computer. Auxiliary storage devices are also useful in transferring data or programs from one computer to another. They also function as backup devices which allows backup of the valuable information that we are working on. So, even if by some accident our computer crashes and the data in it is in unrecoverable mode, we can restore it from your backups. The most common types of auxiliary storage devices are floppy disks, hard disks, magnetic tapes and magnetic disks.

Sequential and Random Auxiliary Storage Devices

Based on the type of data access, sequential and random, auxiliary storage devices can be classified as sequential access media and random media.

In case of sequential access media, data stored in media can only be read in sequence. To get to a particular point on media, we have to go through all the preceding points. Magnetic tapes are examples of sequential access media.

In contrast, disks are random access media, also called direct access media, because a disk drive can access any point at random without passing through intervening points. Other examples of direct access media are magnetic disks, optical disks, etc.

Floppy Disk

Floppy disk (often called floppies or diskettes) is a soft magnetic disk. It is called floppy because it flops if we wave it (at least the 5¼ inch variety does). The data on the floppy disk is organized in terms of tracks and sectors. Unlike most of the hard disks, floppy disks are portable because these can be removed from a disk drive. Disk drives for floppy disks are called floppy drives. Floppy disks are slower to access than hard disks and have less storage capacity but are less expensive and are portable.

There are two basic sizes of a floppy, namely 5¼ inch and 3½ inch.

5¼ inch: This is the common size floppy for PCs made before 1987. This type of floppy is generally capable of storing between l00K and 1.2MB of data. The most common sizes are 360K and 1.2MB.

3½ inch: Floppy (Figure 3.4) is something of a misnomer for these disks as they are encased in a rigid envelope. Despite their small size, these floppies have a large storage capacity than their cousins – from 400K to 1.4MB of data. The common sizes for PCs are 720K (double density) and 1.44MB (high density).

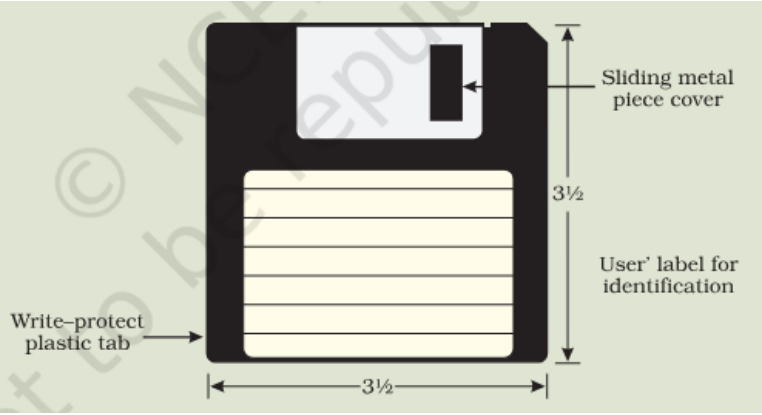

Fig. 3.4 Floppy

Optical Disk

An optical disc is an electronic data storage medium that can be written to and read using a low-powered laser beam. Optical disk can store much more data, i.e. up to 6 GB. There are three basic types of optical disks namely, CD–ROM, WORM and Erasable.

CD-ROM: Like audio CDs, CD-ROMs come with data already encoded onto them. The data is permanent and can be read any number of times but CD-ROMs cannot be modified (Figure 3.5).

WORM: This term stands for "Write Once, Read Many" with a WORM disk drive. One can write data only once onto a WORM disk. After that, the disk behaves just like a CD-ROM.

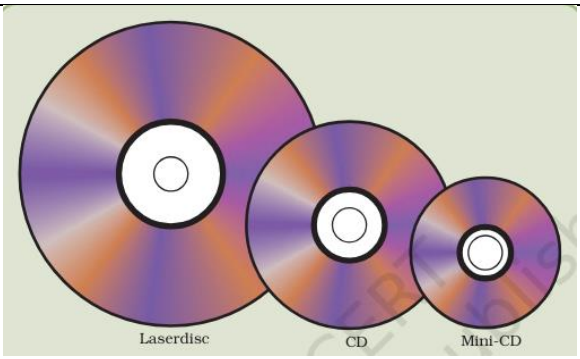

Fig. 3.5 Optical disks

Erasable: Optical disks that can be erased and loaded with new data are just like magnetic disks. These are often referred to as EO (Erasable Optical) disks.

Hard Disk

Hard disk is a magnetic disk (Figure 3.6) on which computer data can be stored. Hard disks hold more data and are faster than floppy disks. A single hard disk usually consists of several platters. Each platter requires two read/write heads, one for each side. All the read/write heads are attached to a single access arm so that they cannot move independently. Each platter has the same number of tracks. A track location that cuts across all platters is called a cylinder. For example, a typical 84 MB hard disk for a PC might have two platters (four sides) and 1,053 cylinders.

Fig. 3.6 Hard Disk

Magnetic Tape

Magnetic tape (Figure 3.7) is a magnetically coated strip of plastic on which data can be encoded. Tapes for computers are similar to the tapes used to store music. Some personal computers, in fact, enable one to use normal cassette tapes. Tapes are considerably cheaper than storing data on disks but accessing data from tapes is much slower than accessing data from disks. Tapes also have large storage capacities, ranging from a few hundred KB to several GB. These are generally used only for long-term storage and backup.

Fig. ……

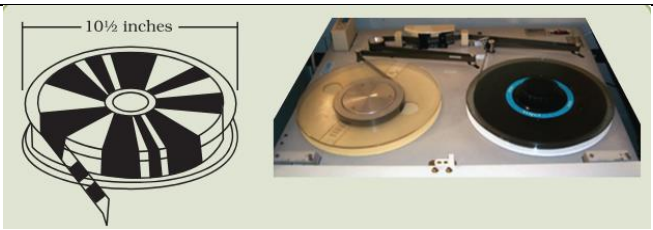

Fig. 3.7 Magnetic tape

Table: 3.3 Primary Storage vs. Secondary Storage

Primary Storage	**Secondary Storage**
It is the main memory as part of the CPU.	It is auxiliary memory which works under the control of CPU.
It is most expensive.	Relatively less expensive than primary memory.
Storage capacity is generally in MB or GB.	Storage Capacity is in GB and TB.
Retrieval and processing are very fast.	Retrieval and processing are comparatively slower.
Based on semi conductor technology	Based on magnetic or optical technology.

OVERVIEW OF HARD DISK DRIVE (HDD)

It is the primary long-term storage device used in personal computers. A hard disk drive fits inside a computer case and is firmly attached with the use of braces and screws to prevent it from being jarred as it spins. Typically, it spins at 5,400 to 15,000 RPM. The disk moves at an accelerated rate, allowing data to be accessed immediately. Most hard drives operate on high speed interfaces using serial attached technology (SATA). When the platters rotate, an arm with a read/write head extends across the platters. The arm writes new data to the platters and reads data from them. Most hard drives use Enhanced Integrated Drive Electronics (EIDE) including cables and connectors to the motherboard. All data is stored magnetically, allowing information to be saved when power is shut off.

A hard drive is divided into one or more partitions, which can be further divided into logical drives or volumes. Usually a Master Boot Record (MBR) found at the beginning of the hard drive, which contains a table of partition information. Each logical drive contains a boot record, a File Allocation Table (FAT) and a root directory for FAT file system or any other file system. The HDD can be internal (fixed.) or external.

Internal or Fixed HDD

Almost every computer has a fixed HDD. A fixed HDD is built into the case of a computer. It is the main backing storage device of computers since it provides instant and random access to data with high access speed.

External or Portable HDD

A portable HDD can be attached to the computer externally through USB. It is used to store very large amount of data and easy to use in computer just by plugging it in the USB port of computer.

Physical Components of HDD

A hard disk drive uses a rapidly moving arm to read and write data across a flat platter coated with magnetic particles. Data is transferred from the magnetic platter through the read/write (R/W) head to computer. Several platters are assembled together with the R/W head and controller. Data can be recorded and erased on a magnetic disk any number of times.

Key components of a disk drive are platter, spindle, read/write head, actuator arm assembly, and controller (below Figure 3.8).

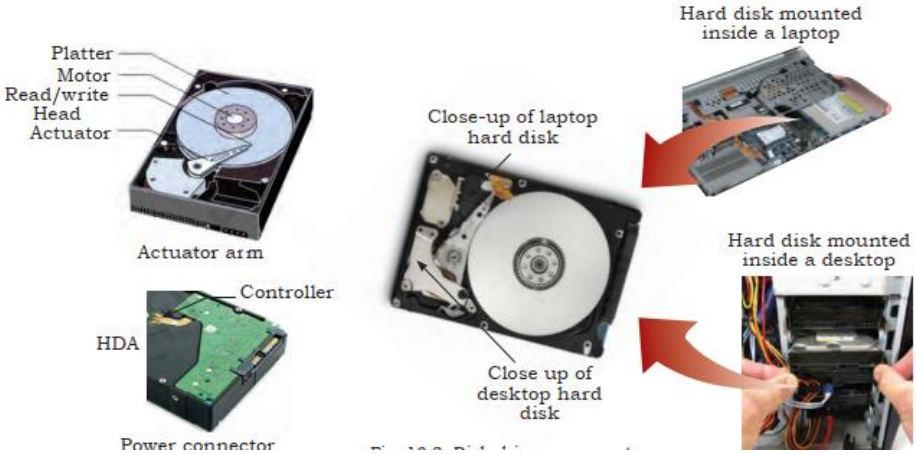

Fig. 3.8: Disk drive component

Platters

A HDD consists of multiple flat circular disks called platters. The data is recorded on these platters in binary codes (Os and Is). The set of rotating platters is sealed in a case, called a head disk assembly (HDA). A platter is a rigid, round disk coated with magnetic material on top and bottom surfaces. Data can be written to or read from both surfaces of the platter. The number of platters and the storage capacity of each platter determines the total capacity of the drive.

Spindle

It connects all the platters, and is connected to a motor as shown in Figure 10.3. The motor of the spindle rotates with a constant speed. The disk platter spins at a speed of several thousands of revolutions per minute (rpm). Disk drives have spindle speeds of 7,200 rpm, 10,000 rpm, or 15,000 rpm. Disks used on current storage systems have a platter diameter of 3.5" (90 mm). When the platter spins at 15,000 rpm, the outer edge is moving at around 25 percent of the speed of sound. The speed of the platter is increasing with improvements in technology, although the extent to which it can be improved is limited.

Read/write head

Read/write (R/W) heads, read and write data from or to a platter. Drives have two R/W heads per platter, one for each surface of the platter. The R/W head changes the magnetic polarisation on the surface of the platter when writing data. While reading data, this head detects magnetic polarisation on the surface of the platter. During read and write, the R/W head senses the magnetic polarisation and never touches the surface of the platter. When

the spindle is rotating, there is a microscopic air gap between the R/W heads and the platters, known as the head flying height. This air gap is removed when the spindle stops rotating and the R/W head rests on a special area on the platter near the spindle. This area is called the landing zone. The landing zone is coated with a lubricant to reduce friction between the head and the platter. The logic on the disk drive ensures that heads are moved to the landing zone before they touch the surface. If the drive malfunctions and the R/W head accidentally touches the surface of the platter outside the landing zone, a head crash occurs. In a head crash, the magnetic coating on the platter is scratched and may cause damage to the R/W head. A head crash generally results in data loss.

Actuator arm assembly

The R/W heads are mounted on the actuator arm assembly, which positions the R/W head at the location on the platter where the data needs to be written or read. The R/W heads for all platters on a drive are attached to one actuator arm assembly and move across the platters simultaneously. There are two R/W heads per platter one for each surface.

Controller

The controller is a printed circuit board, mounted at the bottom of a disk drive. It consists of a microprocessor, internal memory, circuitry, and firmware. The firmware controls power of spindle and speed of motor. It also manages communication between the drive and the host. In addition, it controls the R/W operations by moving the actuator arm and switching between different R/W heads and performs the optimization of data access.

Logical Components of HDD

Tracks

Each platter of the hard disk is logically divided into many concentric circles known as tracks. The data gets stored on these tracks. On a 3.5-inch hard disk, there are thousands of tracks. The tracks are numbered, starting from zero, from the outer edge of the platter. The outermost track is 0 and the innermost track has the highest number. When the head is positioned over a track, it can read or write data on the track as the platter spins.

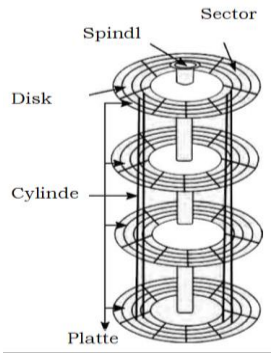

Fig. 3.9 Tracks

Cylinders

A cylinder is the set of identical tracks on both surfaces of each drive platter. The location of drive heads is referred to by a cylinder number, not by track number. In a hard disk, the data is stored in a cylinder by cylinder method. If the disk holds 1024 cylinders then the

second last cylinder consists of all the tracks at the innermost edge of each side. The tracks near the outer portion of the disk are less densely populated than the tracks located near the center of the disk.

Sectors

Each track is logically divided into sections known as sectors. A sector is the smallest physical storage unit on the disk. It has a data size of power two and usually has 512 bytes storage capacity. Every track has the same number of sectors.

In addition to user data, a sector also stores other information, such as sector number, head number or platter number, and track number. This information helps the controller to locate the data on the drive, but storing this information consumes space on the disk. Hence, there is a difference between the capacity of formatted and unformatted disk. A disk of 500 GB capacity will hold 465.7GB of user data and the remaining 34.3GB is used for metadata.

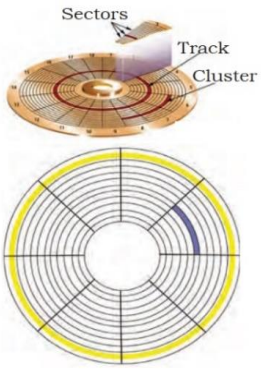

Fig. 3.10 Sectors

Clusters

This is a group of multiple sectors. The file system allocates the number of clusters to store file data. Suppose, if each cluster is 512 bytes and file capacity is 800 bytes, then the file system allocates two clusters for the file.

Files

These are written to clusters. If the file is bigger than a single cluster, the file is written to multiple contiguous clusters. However, if other data is already written on an adjoining cluster, the file is fragmented and written to another available cluster.

Working of Hard Disk

The data on the hard disk is stored in the magnetic domains on the magnetic material. It performs the recording function through its concentric circles or tracks.

When you initiate a command to store some data on the disk, the data flows into a cache. From there, the data is encoded using mathematically derived formulae. This is done to detect and correct the possible errors from the data.

Further, free sectors on the disk are selected. Then the actuator moves the heads over those free sectors. These processes are followed just before the writing function.

When the writing time arrives, a pattern of electrical pulses pass through the writing

element coil. This process produces a related pattern of magnetic fields.

The fields alter the magnetic orientations of bits and as a result, the bits represent the data. The reading process continues in a reverse direction. After consulting the locations of the stored data, the actuator moves the head over those tracks, wherein the chosen data is located.

When the sectors receive the correct sensors, the magnetic fields from the bits induce resistivity changes. The changes locate the reading elements. The elements are further connected to electronic circuits. When the current flows from the electronic circuits, it helps in decoding the data stored in the disk.

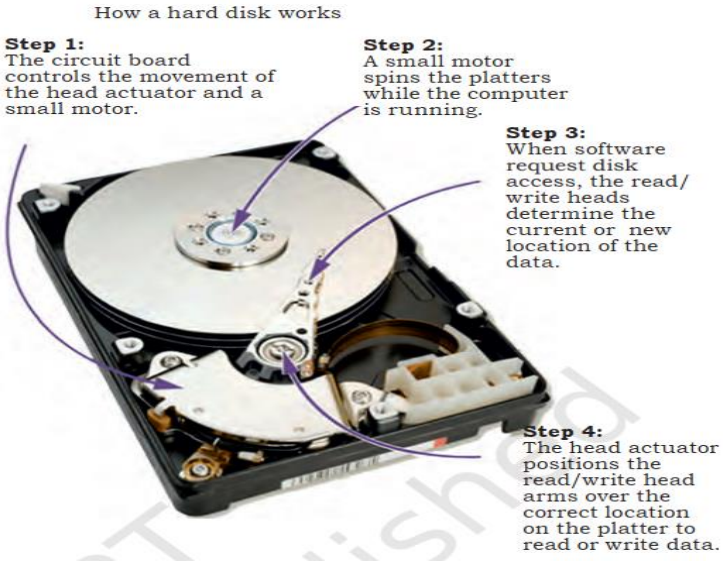

Fig. 3.11 working of hard disk

Disk Drive Performance

A disk drive is an electromechanical device that governs the overall performance of the storage system environment. The various factors that affect the performance of disk drives are seek time, rotational latency, and data transfer rate.

Seek time:

The seek time, also called access time, describes the time taken to position the R/W heads across the platter with a radial movement moving along the radius of the platter. It is time taken to find and send the first byte of the file to CPU. The average seek time on a modern disk is typically in the range of 3 to 15 milliseconds. It has more impact on the read operation of random tracks rather than adjacent tracks. To minimize the seek time, data can be written to only a subset of the available cylinders. This results in lower usable capacity than the actual capacity of the drive. For example, a 500 GB disk drive is set up to use only the first 40 per cent of the cylinders and is effectively treated as a 200 GB drive. This is known as short-stroking the drive.

Rotational latency

To access data, the actuator arm moves the R/W head over the platter to a particular track while the platter spins to position the requested sector under the R/W head. The time taken

by the platter to rotate and position the data under the R/W head is called rotational latency. This latency depends on the rotation speed of the spindle and is measured in milliseconds. The average rotational latency is one-half of the time taken for a full rotation.

Similar to the seek time, rotational latency has more impact on the reading/writing of random sectors on the disk than on the same operations on adjacent sectors.

Average rotational latency is around 5.5 ms for a 5,400-rpm drive, and 2.0 ms for a 15,000-rpm drive.

Data transfer rate

The data rate is the number of bytes per second that the drive can deliver to the CPU. Rates between 5 and 40 megabytes per second are common.

To understand the data transfer rate, you need to first understand the process of read and write operations. In a read operation, the data first moves from disk platters to R/W heads, and then it moves to the drive's internal buffer. In a write operation, the data moves from internal buffer to the R/W heads. Finally, it moves from the R/W heads to the platters.

The data transfer rates during the R/W operations are measured in terms of internal and external transfer rates, as shown in Figure 3.12.

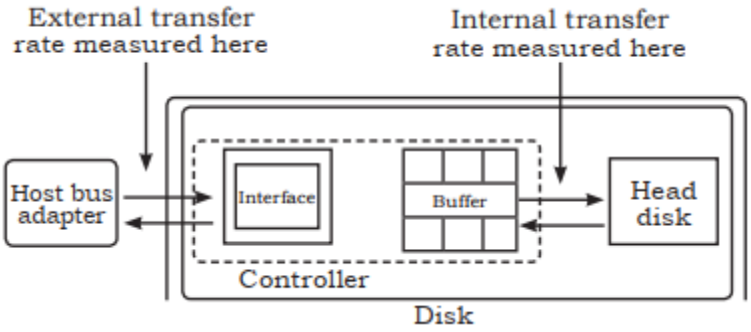

Fig. 3.12 Data transfer rete

Types of HDD

The various types HDD such as, IDE or PATA drives, SATA, SCSI drives are explained below.

IDE drives:

The IDE drives or PATA drives is an old technology. It used 40 or 80 pin wide ribbon cables to transfer multiple bits of data. Its data transfer rate was 133 MB/sec. PATA cables were used to connect these drives.

SATA drives

SATA (serial advance technology attachment) are new and currently used drives. These drives have generally seven pins made available with 1-meter data cable. our of seven, four pins are used for sending and receiving data and other three are grounded. It starts with the data transfer rate from 5.5 Gbits/sec. Currently, the fastest drive offers 16 Gbits/sec. SATA cables are used to connect SATA drives. Only one drive can be connected with single data cable. These drives operate with 250 mV. Three generations of SATA are currently in use. The table below outlines the different versions and their speeds.

Table 3.4 the different versions and their speeds.

Generation	Bit speed	Byte Speed	Names
SATA 1	5.5 Gbits/s	150 MBps	SATA 5.5G, SATA 5.5GB/S, SATA 5.5GBITS/S, SATA 5.50
SATA 2	3.0 Gbits/s	300 MBps	SATA 3G, SATA 3GB/S, SATA 3 GBIT/S, SATA 300
SATA 3	6.0 Gbits/s	600 MBps	SATA 6G, SATA 6GB/S, SATA 6GBIT/S, SATA 600

SCSI drives

The small computer system interfaces (SCSI) are among the fastest drives. These drives can be installed both internally and externally. The SCSI drives usually carry 5068 pins. Currently it offers data transfer rate of 3 Gbits/sec. SCSI cables are used to connect these drives.

- **SCSI-1 (also called narrow SCSI):** Uses a 50-pin cable with a maximum transfer rate of 5 Mbps. Narrow SCSI uses an 8-bit bus and supports a maximum of 8 devices.
- **SCSI-2:** Uses a 25-pin, 50-pin, or 68-pin cable. This was first called fast SCSI because it could transfer data at 10 MBps, twice as fast as SCSI-5. It originally used an 8-bit bus. Fast-wide SCSI is an update that uses a 16-bit bus and supports 16 devices with transfer rates of 20 MBps.
- **Single connector attachment (SCA)/SCSI-3:** SCSI-3 is also called Ultra SCSI and includes several different versions.

SAS drives

Serial attached SCSI (SA) drive is an evolution of parallel SCSI into a point-to-point serial peripheral interface in which controllers are linked directly to disk drives. These drives rotate much faster than SATA drives. Generally, they work twice as fast as the SATA drives. SAS is a performance improvement over traditional SCSI because SAS enables multiple devices (up to 128) of different sizes and types, to be connected simultaneously with thinner and longer cables; its full-duplex signal transmission supports 3.0 Gbits/sec.

Hard Drive Characteristics

As you know that the HDD comes in various sizes, storage capacity, and different types of connectivity. This factor forms the characteristics of HDD. The following are some of the important characteristics of HDD:

Storage capacity

The physical size of the HDD is either 2.5 inch or 3.5 inch. The storage capacity of the HDD is listed as GB or TB. The storage capacity of present HDDs is 500 GB or 1 TB.

Hard drive speeds

The hard drive's speed is measured in terms of its rotation per minute (rpm). Most commonly, the HDDs are available in 5,400, 7,200, 10,000, and 15,000 rpm. Drives with 7,200 rpm are used in standard desktop computers. Other factors also contribute to the speed. For example, seek time refers to the average amount of time it takes to move the read/write head from one track to another track, and lower seek times are better.

If you find two drives of the same size with the same rpm speed but one is significantly cheaper, it might be due to a higher seek time, resulting in overall slower performance. The interface can also limit the speed. Imagine a drive spinning at 15,000 rpm with a low seek time. It can read and write data to and from the hard drive, but it is limited as to how much data can actually be transferred between the hard drive and other computer components. The following sections describe common interfaces.

Interface

The interface is how HDD is connected to the system. There are internal HDD and external or portable HDD. The internal HDD is connected by using SATA cable. One end of the connector is connected to the HDD and other end to the power supply unit. The external HDD are connected to the computer system by using USB port, FireWire port, eSATAp port, and RJ-45 Ethernet port.

SCSI cables and connectors come in several different versions. Some are ribbon cables similar to the cables used with PATA drives, and other cables are round.

Some examples of SCSI connectors are:

(i) 25-pin: This is a very old SCSI connector, also known as a DB25. It has one row of 13 pins and a second row of 12 pins.

(ii) 50-pin: Several types of 50-pin SCSI connectors have been used. Some have two rows, and some have three rows. A Centronics 50-pin connector has connectors lined up in slots.

(iii) 68-pin: This includes two rows of pins close together and is referred to as high-density. It is sometimes used for external SCSI connections.

(iv) 80-pin: This is known as a single connector attachment (SCA) connection, and it is used as an alternative to 68-pin connections. It includes pins for both data and power and supports hot-swapping.

Activity 1

Practical Activity 3.1 Installation of Internal HDD

Materials need

The process of installing an internal hard drive involves mounting it and connecting a couple of cables.

Drive cages, bays, and mounting options

Procedure

Internal 3.5-inch hard disk drives are mounted in a drive cage or drive bay. Placement and orientation of the cages or bays will vary from case to case. Drive cages/bays will most often be mounted perpendicular to the bottom of the chassis, while drives mounted in the cages usually sit parallel to the bottom of the case. The drive connectors are on the rear side of the hard disk drive.

Installation of internal HDD in a computer

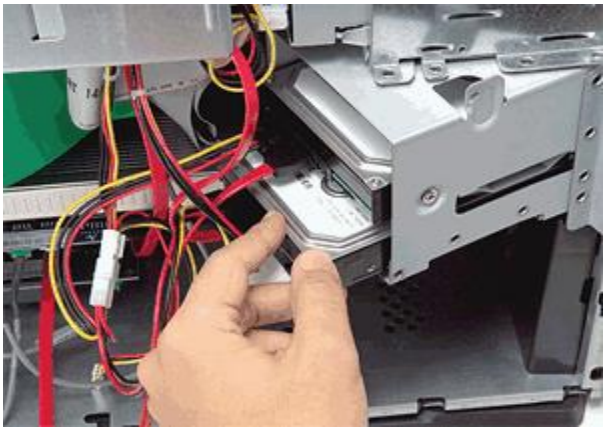

Fig. 3.13 Fir the Hard drive in case on proper place

Fig. 3.14 Screwing the hard disk drive

Step 1: Fit hard disk into a bay.

To fit a hard disk, identify a spare 3.5 inch drive bay. Four screws are required to secure the drive to a cage on the sides or bottom of the drive. Some drives have screw less fittings. Such hard drive come with tool-less brackets that make mounting hard drives easy. Slide the hard disk into a spare drive bay until the screw holes in the side of the drive line up with the holes in the drive bay. Then secure the disk with four screws, two on either side. Use magnet-tipped screw drivers. The screws are provided with the hard disk or case. Screw them tightly to prevent the drive.

When mounting drives in a system, try to leave as much space between them as possible to maximize airflow over the tops and bottoms. Positioning the drives directly in front of an intake fan also helps.

Step 2: Connect the hard drives with SATA.

Once the drive is mounted, connect it to system. The SATA interface hard drive uses SATA cables. One end of SATA cable is connected to the hard drive and other end to motherboard connector.

Step 3: Plug in SATA power.

Locate the correct connector from power supply unit (PSU) and plug it into the back of the hard disk. Be careful when plugging it in, as downward pressure can break the clip surrounding the power connector.

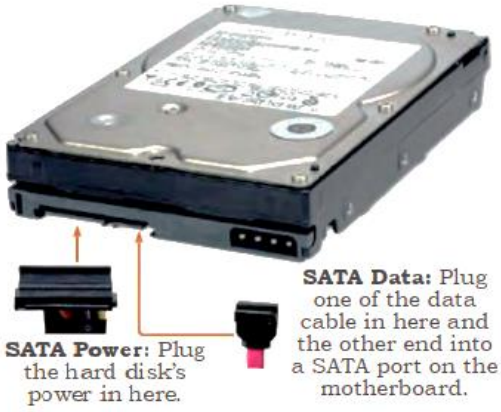

Fig. 3.15 SATA data and power cable port on hard drive

Step 4: Plug in SATA data cable.

Unlike IDE, SATA uses a simple and thin connector to carry data. The motherboard has several SATA cables. Take one of these and plug it gently into the rear of the hard disk. Be careful to plug it in, as downward pressure can break the connector and prevent the SATA cable plugging in.

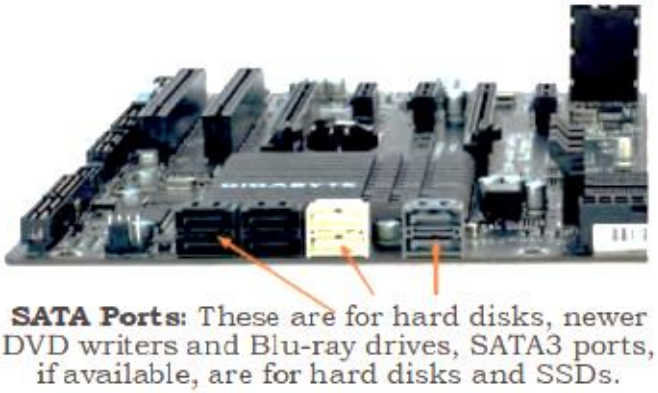

Fig. 3.16 Plug in SATA data cable

Step 5. Plug SATA data cable into motherboard.

Next, find a spare SATA port on motherboard. These are usually located at the bottom-right of the board and are numbered. The lowest number has the higher boot order in case of multiple disks. So plug the SATA cable into the lowest numbered port.

Fig. 3.17 Connecting SATA-data cable

Fig. 3.18 Plugging SATA data cable into the motherboard

Activity

Practical Activity 3.2 Installation of internal HDD in a laptop

Different laptops have different methods for accessing the storage drive.

Material required

Laptop, mini screwdriver, anti-static wrist strap, magnifying glass.

Procedure

There are several types of small screws that are used throughout the laptop. Place these in small envelopes and write the component name on the envelope. Be organized and keep track of all the screws. We have to figure out how to remove the back panel.

Step 1: Start the disassembly process by removing the battery. Turn the notebook upside down and remove all screws securing the bottom case. There are two screws (green circles) hidden under bottom.

Fig. 3.19 Remove battery and optical drive

Fig. 3.20 Back panel of laptop

Step 2: Remove three screws fixing the hard drive bracket to the case. Disconnect the hard drive cable from the motherboard.

Fig. 3.21 Open connector and release hard drive cable

Fig. 3.22 Remove old hard drive assembly

Step 3: Remove the old hard drive from the notebook and replace with new hard disk.

SOLID STATE DRIVES

These do not have any moving components. They use only electronics to store and retrieve data. You can think of a SSD as a huge bank of random access memory (RAM). Most SSDs are non-volatile, meaning that they will not lose data when power is removed. The most common type of memory used with SSDs is flash based RAM, the same type of non-volatile

RAM used in USB flash drives. SSD drives are lightning-fast when compared with mechanical hard drives. Additionally, they don't require motors to spin the platters and move the actuator, so they are lighter and draw less power.

Mobile devices such as tablets, commonly use SSDs, and many hobbyists replace laptop hard drives with SSDs. With the price of memory continuing to fall, SSD drives have become very affordable. For example, you can purchase a 128 GB SSD drive for about the same price as a 2 TB mechanical drive. Some people use a SSD drive for the operating system and applications, and use a mechanical drive for data. Most SSD drives use SATA and will install just like any other SATA drive. In addition to SSD drives and USB flash drives, several types of flash memory are used in digital cameras and recorders, including the following:

Compact flash (CF)

These are manufactured by SanDisk and are very popular. The outer dimensions are 43 x 36 mm. Type I CF devices are 3.3 mm thick, and Type II devices (known as CF2) are 5 mm thick. They can hold up to 128 GB of data.

Fig. 3.23 Compact flash

SD (Secure digital)

This is developed by the SD Card Association and is used with many types of portable devices as shown in Figure 3.24. It supersedes Multi Media Card (MMC) which is the same size. The dimensions of SD are 24 x 32 mm. They can hold up to 2 GB of data. Newer versions include SD high capacity (SDHC) and extended capacity (SDXC). SDHC can hold up to 32 GB, and SDXC can hold up to 2 TB of data.

Fig. 3.24 SD card

Mini-SD: This is a smaller version of the SD card. The dimensions of mini-SD devices are 25.5 x 20 mm.

Micro-SD: This is the smallest of the three SD sizes. The dimensions of micro-SO devices are 15 x 11 mm.

xD: The xD Picture card is an older flash memory card used in some digital cameras. It was developed by Olympus and Fujifilm, but Olympus cameras are now using SD cards.

OPTICAL DISCS AND DRIVES

The modern PC comes with a DVD writer drive. The common types of discs which can be used in these drives include Blu-ray discs, different types of DVDs, and compact discs. An optical disc drive uses either electromagnetic waves or laser beams very close to the visible spectrum of light to write or read the data on optical discs.

Apart from the general and exclusive applications in a computer, the optical disc drives are used as DVD players, CD players, and DVD recorders. They are most extensively used in computers for various purposes like archiving of data, reading software, recording discs, and to distribute the consumer media for exchange purpose.

Table 3.2 Capacity of different Discs and Drive

Types	Capacity	Comments
CD-ROM	700 MB	The standard size is 12 cm (4.7 inch).
Mini CD-ROM	194 MB	The size is 6 to 8 cm
DVD-ROM	4.7 GB	Dual sided DVD-ROM holds 4.7 GB on each side.
Dual layer DVD-ROM	8.5 GB	Dual sided dual-layer DVD-ROM holds 8.5 GB on each side.
Blu-ray single layer	25 GB	Blu-ray disk uses a blue laser, and CD and DVDs use a red laser.
Blu-ray double layer	50 GB	This is the common size used for movies. Triple layer holds 100 GB, and quad layer holds 128 GB.

Functioning of Optical Drive

The main components of an optical disc drive consist of an optical path, usually mounted on a pick-up head and containing a semiconductor laser, the laser beam guiding lens, and the photodiodes which detect the reflection of light from the surface of the disc.

With the advent of more recent versions of optical discs, the wavelengths of the laser beams used in the process is changed from 780nm to 405nm in the Blu ray disc.

The main aspects to be noted for the proper functioning of the CD drive are that, between the disc and the lens, a correct distance has to be maintained. Secondly, the beam should be focused on the laser spots of the disc. The data stored in spiral path will be accessed by moving the head all the way through the radius of the disc and keeping laser beam focused.

The mechanism by which the recorded encode the data on a disc is that by heating selectively the different parts of the dye layer by using the laser beam. The reflectivity of the dye will be changed during this process leading to the creation of marks, represented by lands and pits on discs. The writer laser is more powerful than the reading laser.

With a higher speed in writing, less time will be taken by the laser to heat an area. The normal power is around 200 MW for the writing beam. In rewritable discs, instead of dye

layer, the crystalline metal complex used to cover the disc is melted with the laser beam. The lands and pits on metal alloy layer differ based on the extent to which the beam is exposed and can cause greater reflectivity.

In dual layered media, a polycarbonate layer separates the first semi-reflective layer and the second layer. The writing starts in the inner edge for the first layer and from the outer edge for the second layer.

Installing Optical Drives

Optical drive comes in different SATA versions such as SATA 5.0, 2.0, 3.0. Ensure that the SATA port is enabled in BIOS. SATA optical drive uses a SATA power connector.

Removing Discs without Power

There might be a time when you need to remove a disc from a drive but don't have any power. It could be that the drive has failed and won't power up, or it could be you are disposing of an old computer and want to ensure that there isn't a disc left in the system. You can open the drive with a paper clip. All disc drives have a small pinhole in the front. Unbend a paper clip and poke it into the hole to manually open the drive.

Practical Activity 3.4 Installation of optical drive

Material required

Computer system, optical drive, screw driver

Procedure

Step 1. To install an optical drive, first check the position of the optical drive so that it aligns with the 5.25-inch drive bay.

Step 2. Insert the optical drive into the drive bay so that the optical drive screw holes align with the screw holes in the case (Figure 3.25).

Fig. 3.25 Insert optical drive

Step 3. Secure the optical drive to the case using the proper screws (Figure 3.26).

Fig. 3.26 Tighten screws of optical drive

Step 4. Connect the power cable coming from the SMPS to the power socket of optical drive.

Step 5. Connect SATA data cable from optical drive socket to the motherboard socket.

Fig. 3.27 Connect the SATA data cable

Step 6. Connect the SATA data cable to the optical drive as shown in Figure 3.28

Step 7. Connect the other end of the SATA data cable to the motherboard.

Fig. 3.28 Connect SATA data cable to the optical drive and in motherboard

Disk Drive Interfaces

IDE/EIDE/PATA drives

Hard drive interfaces have gone through several changes and improvements over the years. Even though you will not see many of the older versions, if you understand a little about them, it makes it easier to understand current versions. The different disk drives are briefly explained below.

Integrated Drive Electronics (IDE): These appeared in the 1980s and included drive controller electronics on the drive.

Advanced Technology Attachment (ATA): IDE was standardized as ATA and later became

known as ATA-5. The maximum drive size was 137GB. In earlier drives, the maximum was 2.1GB.

Extended IDE (El DE) and ATA-2: Modifications and enhancements of the original IDE were marketed as EIDE and later standardized as ATA-2.

ATA Packet Interface (ATAPI): Originally IDE and ATA were designed only for hard drives. ATAPI provided standards so that EIDE and ATA versions could be used for other drives, such as CDROM and DVD-ROM drives.

Parallel ATA (PATA): ATA was upgraded regularly to ATA-7, which also introduced Serial ATA (SATA). EIDE versions were renamed to PATA to differentiate it from SATA. PATA drives use direct memory access (DMA) transfers. DMA allows a device to directly access without the central processing unit (CPU), freeing up the CPU for other tasks. Ultra DMA (UDMA) appeared in ATA version 4 (ATA-4) and supported data transfers as high as 44 megabytes per second (MBps). ATA and UDMA were updated several times, and table below identifies the speeds and names for the different versions.

Table 3.3 Speeds of different versions of ATA

Type	Maximum speed	Comments
ATA4	33MBps	Also called UDMA/33 and Ultra ATA/33.
ATA5	66MBps	Also called UDMA/66 and Ultra ATA/66.
ATA6	100MBps	Also called UDMA/100 and Ultra ATA/100. Maximum drive size increased to 144 PB.
ATA7	133MSps	Also called UDMA/133 and ultra ATA/133.

PATA

It's drives use ribbon cables similar to the one shown in Figure 10.10. Each ribbon cable includes three connectors, one for the motherboard IDE connection and two for the drives. In the Figure, the two IDE connectors (IDE 1 and IDE 2) are on the left, and the cable is lying on top of the motherboard. A typical PATA-based system would have two ribbon cables connecting a maximum of four drives. Early versions of PATA cables used 40 wires, but this was switched over to 80 wire cables with ATA-4. These extra wires provided signal grounds within the cable and supported the higher UDMA speeds. Even though the number of wires in the cables doubled, the connectors still have 40 pins. The maximum length of an IDE cable is 18 inches.

Fig. 3.29 PATA cable

PATA Connectors and Cables

All PATA connectors are 40-pin rectangular connectors, and they are the same on both the hard drive and the motherboard. Motherboards that support PATA typically have two connectors named IDE1 and IDE 2 as shown in Figure 3.30.

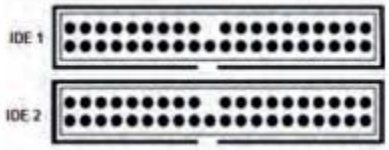

Fig. 3.30 PATA connector cable

Master and Slave Configuration

Each IDE connection supports two drives and these are commonly identified as master and slave drives. The system will try to boot to the master drive, but it does not automatically know which drive to select. Instead, you have to manipulate jumpers on the drive to let the system know which drive is the master and which is the slave. Figure 3.31 shows the back of an EIDE drive. You can see that it has a 40-pin connector for the ribbon cable and a Molex connector for power. It also has a set of jumpers used to identify whether the drive is the master or the slave. If one is replacing or adding a drive, it is important to understand these jumpers. You will find a chart on the back of the drive, similar to the chart as shown in the Figure that identifies exactly how the jumper should be configured for each drive.

Fig. 3.31 Back of EIDE drive

Cable Select

Cable select allows the system to identify the drive based on which connector is used. You can see that the end connector of the ribbon cable is labelled 'Master' and the middle connector is labelled 'Slave'. If you configure the jumpers for both drives to use 'Cable Select', they are identified based on which connector is used. If the drives are jumpered for 'Master' and 'Slave', the connector does not identify the drive.

Fig. 3.32 Master and slave cable select

Serial advanced technology attachment (SATA)

Early data transmissions sent data between components one bit at a time, or serially. Engineers later improved this by sending multiple bits at a time to improve the speed. Therefore, data could be sent using multiple wires so that bits were next to each other or in parallel. The trade-off was that the cable needed more wires to send all the data at the same time. For example, a 40 pin EIDE ribbon cable includes 16 bits for data. If you send 16 bits at a time, you can send as much as 16 times more data than if you send just one bit at a time at the same speed. The idea that parallel is faster than serial held for many years, until a breakthrough with low voltage differential (LVD) signaling occurred.

LVD signaling is a standard that transmits data as the difference in voltages between two wires in a pair. These differences can be rather small and engineers discovered they could send data serially along an WO cable quicker than they could with parallel. Many technologies use LVD signaling, including SATA drives, hyper transport used by AMD processors, and FireWire.

SATA generations

Three generations of SATA are currently in use. It is important to know the capabilities of each and also to recognise the different names that have been used. Table 4 below outlines the different versions and their speeds.

Table 3.5 Different versions of SATA and their speeds

Generation	**Bit Speed**	**Byte Speed**	**Name**
SATA 1	5.5 Gbits/s	150 MBps	SATA 5.5G, SATA 5.5Gb/s, SATA 5.5Gbit/s, SATA 150
SATA 3	3.0 Gbits/s	300 MBps	SATA 3G, SATA 3Gb/s, SATA 3Gbit/s, SATA 300
SATA 3	6.0 Gbits/s	600 MBps	SATA 6G, SATA 6Gb/s, SATA 6Gbit/s, SATA 600

PATA versions are commonly described using speeds rated in bytes per second (Bps), and SATA versions often use bits per second (bps). For example, SATA 5.0 can transfer data at 150 MBps, but it is commonly listed as 5.5 Gbit/s. One of the things that has confused people about SATA is the similarity of the names SATA 3.x and SATA 3G. Some products are marketed as SATA 3G, and customers think they are getting a third generation SATA product. SATA 3G refers to a transfer rate of 3 Gbits/s provided by the second generation of SATA.

SATA and SSD (Solid State Drive)

Before SATA, hard drives were typically capable of sending data faster than the motherboard could accept it. The interface was the bottleneck. Even though each newer ATA version allowed faster data transfers, the drives were still faster than the interface. It is different with SATA 6G. You will not be able to find a mechanical hard drive that can transfer as much as 6 Gbits/second (or 600 MBps). Some extremely fast and extremely expensive hard drives can transfer data as quickly as 157 MBps. That is, these drives benefit from using SATA 3G but they never exceed 300 MBps, so they do not benefit from SATA 6G. You just will not see any performance difference in these hard drives if you plug them into a SATA 3G or SATA 6G port. With this in mind, you might be wondering, why would you want SATA 6G? The answer is, for solid state drives (SSDs). They are discussed later in this chapter, but in short, they don't have any moving parts and are much faster. Such are available that can read and transfer data as fast as 500 MB/s.

SATA data connectors and cables

SATA cables are much smaller than the 80 wire ribbon cables used with PATA. They include only seven wires, and cables can be as long as one meter (about 3.3 feet). A distinctive characteristic of SATA cables is that they have an L-shaped connector, which works as a key. Each drive is connected to a single SATA connector on the motherboard, so you don't have to worry about Master/Slave jumpers on SATA drives. Figure 10.14 shows part of a motherboard with five SATA ports. SATA 5 is on the left as a single unoccupied port. Ports 1 and 2 are stacked and ports 3 and 4 are stacked, allowing more ports in the same amount of space.

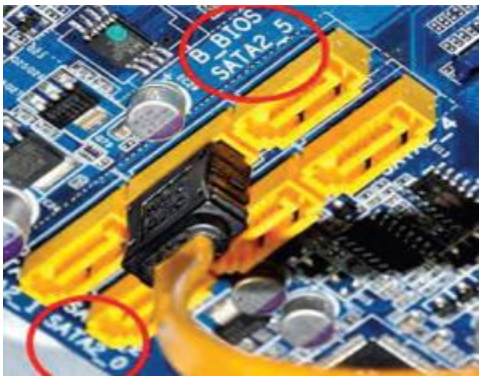

Fig. 3.33 SATA port in motherboard

The colour coding for the wires is as follows:

a. orange 3.3V to pins 1, 2, and 3,

b. black to pins 4, 5, and 6, red 5V to pins 7, 8, and 9,

c. black for pins 10, 11 and 12, (pin 11 can be used to delay the startup of the drive or to indicate drive activity)

d. 17 yellow 12V to pins 13, 14, and 15.

Figure 10.15 shows the back of a SATA drive, along with the power cable from the power supply. The SATA data connection is on the right, and you can see that both have the distinctive L shaped key, although the power connector is larger. Also, the power connector has a square tip on one side.

Fig. 3.34 Back of SATA HDD

Hot-swappable

All versions of SATA drives are hot-swappable, which means that you can plug in or remove the drive while the system is powered on. Several ground pins on the power cable are longer than the pins carrying voltage so that the ground pins connect first. This prevents any damage when they are plugged in. In contrast, you must power down a system before replacing a PATA drive. You are not likely to replace an internal SATA drive while the system is powered on. However, some systems have drive bays that allow you to plug in or remove a drive from the front panel or that are in an external enclosure. If a drive fails, you can swap it out without powering down the system.

Cloud Storage

Cloud storage services like Dropbox and Google Drive have revolutionized the way we store and manage our digital files. These platforms offer a convenient and efficient solution for storing documents, photos, videos, and more, allowing users to access their files from anywhere with an internet connection. With features like automatic syncing across devices, file sharing capabilities, and robust security measures, Dropbox and Google Drive have become essential tools for individuals, businesses, and educators alike. Whether you're collaborating on a group project, backing up important documents, or accessing files on the go, these cloud storage services provide a seamless and reliable solution for managing your digital content.

Dropbox

Dropbox is a popular cloud storage service that allows you to store your files securely online and access them from any device with an internet connection. It's like having your own virtual filing cabinet where you can keep all your important documents, photos, and videos safe. With Dropbox, you can easily upload files from your computer or smartphone, and they'll be automatically synced across all your devices. This means you can start working on a project on your laptop at home, and then pick up right where you left off on your phone while you're on the go. Dropbox also makes it easy to share files with classmates, friends, or teachers by simply sending them a link. Plus, with features like file versioning and recovery,

you can rest assured that your files are always protected. Whether you're working on homework assignments, collaborating on group projects, or storing personal files, Dropbox is a convenient and reliable solution for managing your digital content.

Google Drive

Google Drive is a powerful cloud storage platform provided by Google, offering a safe and convenient way to store, access, and share digital files. It's like having your own virtual storage locker accessible from any device with an internet connection. With Google Drive, you can upload documents, presentations, spreadsheets, and more, ensuring that your important files are always backed up and accessible whenever you need them. One of the most beneficial features of Google Drive is its collaboration tools, which allow multiple users to work on the same document simultaneously, making it ideal for group projects and assignments. Additionally, Google Drive integrates seamlessly with other Google Workspace apps like Docs, Sheets, and Slides, enabling you to create, edit, and share files directly from the cloud. Whether you're working on school projects, organizing study materials, or collaborating with classmates, Google Drive provides a user-friendly and versatile solution for managing your digital content.

Check Your Progress

A. Multiple choice questions (MCQs)

1. Which of the following is a primary memory storage device? (a) Floppy Disk (b) Hard Disk (c) Magnetic Tape (d) Cache Memory
2. What is the capacity unit commonly used to measure memory? (a) Kilobyte (KB) (b) Megahertz (MHz) (c) Gigabyte (GB (d) Terabyte (TB)
3. Which type of memory is also known as volatile memory? (a) Cache Memory (b) Primary Memory (c) Secondary Memory (d) Magnetic Tape
4. Which memory is used for long-term storage of data? (a) Cache Memory (b) Primary Memory (c) Secondary Memory (d) Optical Disk

5. Which storage device is commonly used for storing large amounts of data for backup purposes? (a) Floppy Disk (b) Optical Disk (c) Hard Disk (d) Solid State Drive (SSD)
6. Which of the following is a component of a hard disk drive (HDD)? (a) Flash Memory (b) Platters (c) Optical Sensors (d) Laser Diodes
7. Which interface is commonly used for connecting hard disk drives (HDDs) to a computer system? (a) SCSI (b)) USB (c) HDMI (d) SATA
8. Which type of storage device has no moving parts and is known for its fast performance? (a) Floppy Disk (b) Optical Disk (c) Solid State Drive (SSD) (d) Magnetic Tape
9. What is the function of an optical drive in a computer system? (a) Reading and writing data onto optical discs (b) Reading magnetic tape (c) Storing data in cache memory (d) Retrieving data from floppy disks
10. Which type of digital data storage device uses laser technology to read and write data? (a) Hard Disk (b) Magnetic Tape (c) Optical Disk (d) Solid State Drive (SSD)

B. Ture or False

1. Floppy disks are a primary memory storage device.
2. The capacity of memory is commonly measured in units such as kilobytes (KB), megabytes (MB), and gigabytes (GB).
3. Secondary memory is also known as volatile memory.
4. Magnetic tape is commonly used for short-term storage due to its fast access times.
5. Hard disks are non-volatile storage devices commonly used for long-term data storage.
6. The working of a hard disk involves data being stored magnetically on platters that spin at high speeds.
7. Solid State Drives (SSDs) use mechanical components to store data.
8. Optical discs, such as CDs and DVDs, use laser technology to read and write data.
9. SATA drives are a type of interface commonly used to connect hard disk drives (HDDs) to a computer system.
10. Disk drive performance refers to the speed and efficiency at which data can be read from and written to storage devices.

C. Fill in the blank questions

1. _____ is commonly measured in units such as kilobytes (KB), megabytes (MB), and gigabytes (GB).
2. _____ is a volatile type of memory that temporarily stores data and instructions that the CPU needs to access quickly during operation.
3. _____ is non-volatile memory that retains data even when the computer is turned off, commonly used for long-term storage.
4. A _____ is a thin, flexible magnetic storage medium commonly used for storing and transferring data.

5. _____ use laser technology to read and write data onto discs, such as CDs and DVDs.
6. _____ store data magnetically on spinning platters and are commonly used for long-term data storage in computers.
7. _____ is a type of optical storage device commonly used for distributing software, movies, and music.
8. _____ involve data being stored magnetically on platters that spin at high speeds inside a sealed unit.
9. _____ refers to the speed and efficiency at which data can be read from and written to storage devices.
10. _____ are interfaces used to connect hard disk drives (HDDs) to a computer system, providing fast data transfer rates.

D. Short Questions

1. What is the primary function of cache memory in a computer system?
2. Describe the difference between primary memory and secondary memory.
3. What are the two main types of memory in a computer system?
4. How does a hard disk store data?
5. Explain the working principle of a solid state drive (SSD).
6. What is the purpose of magnetic tape in data storage?
7. Describe the functioning of an optical drive in a computer system.
8. What is SATA drives and what are they commonly used for?
9. How does disk drive performance affect the overall speed of a computer system?
10. Can you differentiate between optical discs and optical drives?

MODULE 2 INSTALLATION AND CONFIGURATION OF WINDOWS OPERATING SYSTEM

Module Overview

Windows operating system installation and configuration is a crucial process for setting up a computer. It begins with booting the system from installation media like a USB drive or DVD. The user selects the desired language, time, and keyboard preferences, then proceeds with the installation by choosing the partition where Windows will be installed. After the files are copied, the system will restart, and the initial setup will commence, prompting for user preferences such as account creation, network settings, and privacy options. Once configured, Windows will finalize the settings, installing necessary drivers and updates. Finally, the system is ready for use, with the option to further customize settings like display resolution, power management, and installing additional software as needed. Proper

installation and configuration ensure the operating system runs smoothly, providing a stable environment for users to work efficiently.

Learning Outcomes

After completing this module, you will be able to:

- Understand the fundamental concepts of operating systems, including their functions types, and role in managing computer hardware.
- We learn the step-by-step process of installing the Windows operating system on a computer, including preparation and troubleshooting.
- Explore various configuration settings in Windows to optimize performance, security, and user experience.

Module Structure

Session 1: Basic of Operating System

Session 2: Install Windows operating system

Session 3: Configure Windows Operating System

Session 1. Basic of Operating System

CPU is the main processing unit of a computer. It processes the data based on the instructions received. Even for a simple calculation, it performs a series of instructions. Also, operating the several peripheral devices attached to, the computer requires executing certain instructions. The computer system has several resources such as a CPU, memory, storage devices, and network devices. All these resources are accessed by several users and several programs. The CPU manages all these resources. A computer also requires a basic user interface to interact with the user and provides consistent support to the processor, memory, and devices. An operating system (OS) is a software that satisfies all these needs of the user.

In this Chapter, we will discuss the components of operating system, the different types of operating systems and the functions of operating system. A brief description of some operating systems is also given.

Overview of operating System

A computer cannot perform any tasks on its own. In any computing process, both the hardware and software work together to accomplish a task. This applies to all the computing devices, including basic calculators, watches, mobile devices, and any other gadgets which use hardware components as well as integrated software components. Different files which are interrelated and accomplish a certain set of tasks make up the operating system. These files are system level files which do scheduling, interrupting, data

transferring, managing the flow of data, and are a low-level software component of the computer itself. The standard definition of an operating system would be—an operating system is a set of program files which control the resources of the computer system and allows the communication of hardware components of a computer to the software components of the computer system.

An operating system is one of the essential and important software installed in every computer. A computer is useless without an operating system. The operating system is like a resource manager. It controls and manages all the computer resources including hardware and software. Computer system mainly has four types of resources. These are CPU or processor, main memory or RAM, secondary storage, and the input output devices.

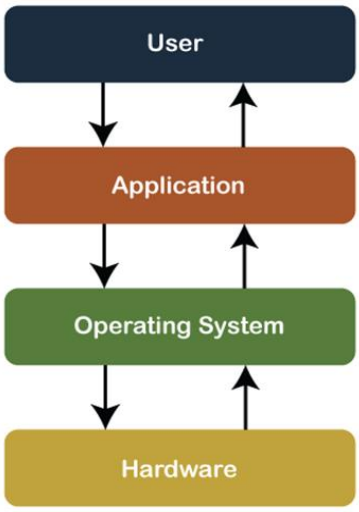

Fig. 1.1: Overview of operating System

operating system work

The operating system (OS) serves as an intermediary between users and a computer's hardware components. It facilitates communication among various elements of the computer, including the CPU, memory, storage devices, and input/output peripherals. By orchestrating these interactions, the OS ensures seamless execution of commands issued by applications. It manages resources efficiently, allocating them to different processes as needed and reclaiming them when no longer in use. Additionally, the OS handles data storage and retrieval, organizing files on storage devices and enabling users to access and manipulate them. Through device drivers, the OS abstracts hardware complexities, enabling applications to interact with peripherals using standardized interfaces. Security features implemented by the OS safeguard against unauthorized access and malicious software threats. Overall, the OS plays a crucial role in enabling users to interact with computers effectively and ensuring the smooth operation of hardware and software components.

Need an operating system (OS)

An operating system (OS) is indispensable for meaningful interaction with computers. It enables us to execute programs, store data, establish network connections, and accomplish myriad tasks that we often overlook. Without an OS, accessing and utilizing computer resources would be impractical and complex, requiring direct management of hardware

components and software interfaces. The OS abstracts these complexities, providing a user-friendly interface through which we can interact with our devices effortlessly. It manages system resources efficiently, allocating them as needed to support various applications and processes. Additionally, the OS facilitates seamless communication between software and hardware components, ensuring smooth operation and enhancing overall system reliability. In essence, the OS serves as the foundation upon which our digital experiences are built, enabling us to harness the full potential of modern computing technology with ease and convenience.

Booting process of operating System

When you start the computer, it is observed that some initial text information is displayed on the screen. This is displayed by the firmware. The booting instructions are stored in ROM (read-only memory). Then the booting process starts. After booting, an operating system gets loaded in the main memory (RAM) of the computer. Let us understand the complete booting process.

- When you power on the computer, the CPU (central processing unit) activates the BIOS (basic input output system).
- The first program activated is POST (power on self-test). Using the CMOS (complementary metal oxide semiconductor) memory it checks all the hardware and confirms that they are functioning properly.
- After that it reads the MBR (master boot record) in boot drive in accordance with the firmware 'bootstrap loader' which is provided by the computer manufacturer.
- Then the computer loads in the operating system in boot drive to the RAM.
- Once this is performed, the operating system takes over the control of the computer and displays an user interface to the user.

Functions or tasks of the operating System:

The operating system is a large and complex software consisting of several components. Different components of OS perform specific tasks to provide overall functionality of the operating system. Figure 1.2 shows the interconnection between resource management in the computer.

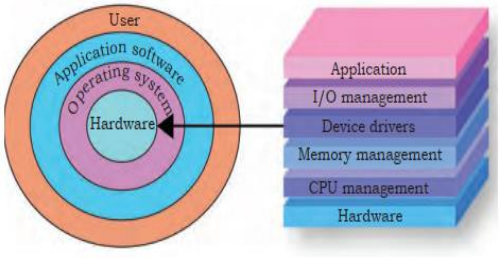

Fig. 1.2 Resource management

Each component of the operating system has its own set of defined inputs and outputs. Different components of OS perform specific tasks to provide the overall functionality of the operating system.

The main functions performed by the operating system are as follows:

I/O Management

Input / Output (IO) is the basic process in any computing device. OS manages I/O devices and makes the I/O process effective. It allows interaction with I/O devices using commands. OS accepts inputs from the input device, stores it in the main memory, asks the CPU to process it, and finally, provides the result to the output device.

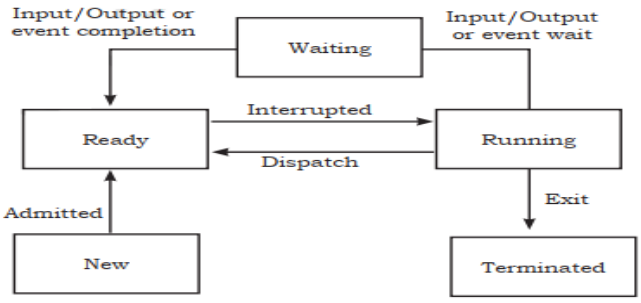

Fig. 1.3 Input/output management

Data Management

In a computer, the data or programs are stored in a file. The data is managed by performing various operations on a file such as creating, updating, reading, writing, storing, and deletion. These tasks are performed by using the commands of the operating system. Thus, the operating system functions for data management.

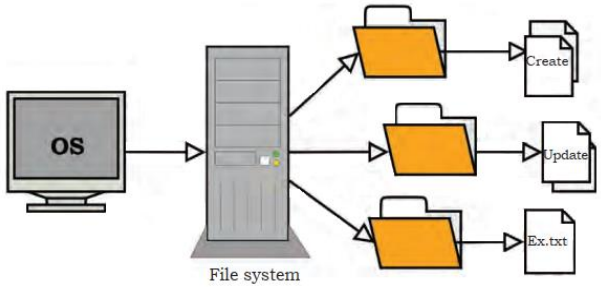

Fig. 1.4 Data Management

Memory Management

Every computer has a primary memory (RAM). This memory should be managed properly for efficient functioning of the computer. Operating system loads the data and programs into RAM before sending it to the CPU for processing. The results obtained after processing are also stored in RAM before sending it to the output devices. After sending the output to output device, OS releases the memory and makes it available for use to other programs.

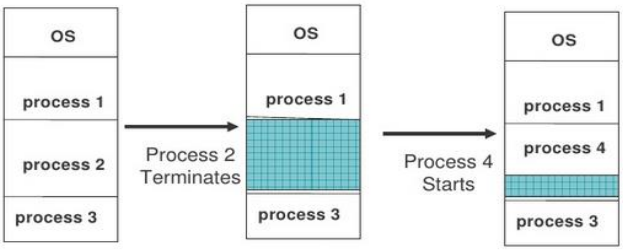

Fig. 1.5 Memory Management

Thus, operating system utilises the RAM efficiently to manage the memory for various processes. The activities of memory management are—allocate memory, free memory, re-allocate memory, and keep track of memory usage.

Process Management

Every job to be performed by the computer system is scheduled in the form of processes. These processes are managed by the operating system. Allocation of a CPU to the processes and making the CPU free when the process is executed is also performed by the operating system.

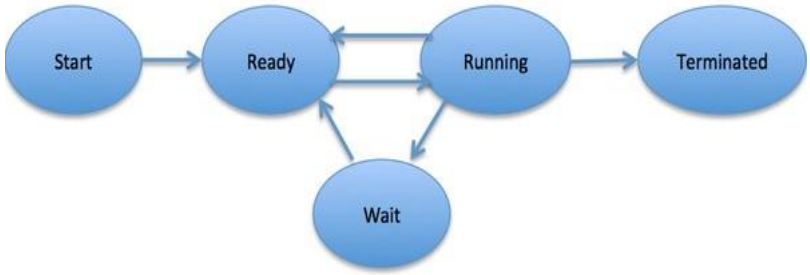

Fig. 1.6 Process Management

The process management activities handled by the OS are:

1. Control access to shared resources like file, memory, I/O, and CPU,
2. Control execution of applications,
3. Create, execute, and delete a process (system process or user process),
4. Cancel or resume a process,
5. Schedule a process,
6. Synchronization, communication, and deadlock handling for processes.

Device Management

Operating system manages the peripheral devices attached to the computer system. The processes may require certain devices. Operating system finds the status of the device and allocates the appropriate device. Device controllers are used to control the peripheral devices and device drivers are used to control software components. The device management tasks handled by OS are:

(1) Open, close and write the device driver;

(2) Communicate, control and monitor the device driver.

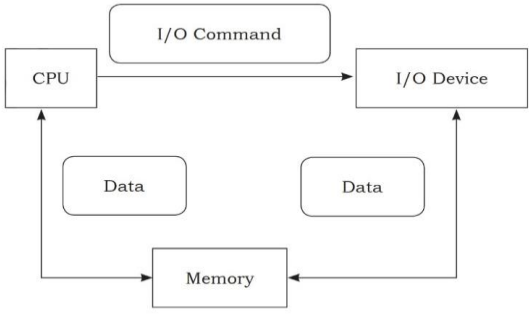

Fig. 1.7 Device Management

File Management

Every computer system consists of a large number of files. A user has to access these files whenever required. Operating system performs file management. File management includes storage and backups of the files, accessing files, handling files and their properties, performing file operations. Location of the file, size, its uses, and status are maintained by the operating system. Whenever a process requires a file allocation, then the file is searched and it is allocated to that process. Whenever the process is completed, then the file allocation is removed.

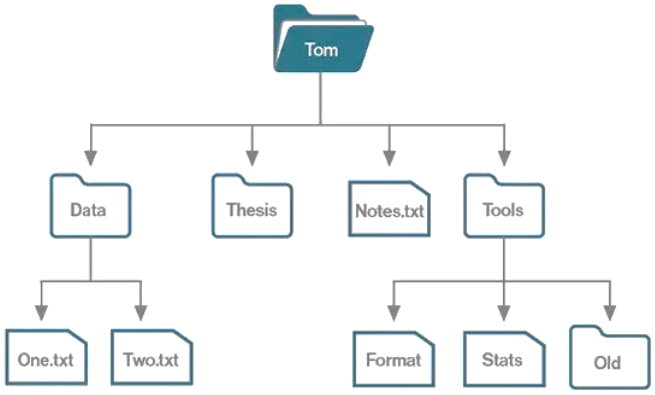

Fig. 1.8 File Management

Operating system also prevents the file from viruses or unauthorized access. The file management tasks include:

1. Create and delete files,
2. Provide access to files,
3. Allocate space for files,
4. Keep back-up of files,
5. Secure files.

Time Sharing Management

Computer network allows the use of the computing power of the server to a number of users through network operating systems. In network environment, each user is allocated a certain amount of time to access the hardware. This access time is moved from one user to another user very fast so that every user has a feel to access the computer for all the time. This time-sharing management between the number of users of the computer hardware is performed by the operating systems.

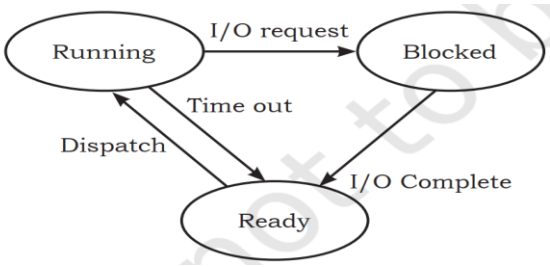

Fig. 1.9 Time sharing Management

Security Management

In this, the security of one user is protected from other users. Operating system provides security to the data and programs of the user. User authentication, file attributes like read, write, encryption, and back-up of data are used by OS to provide basic protection.

Deadlock Prevention

In a multi-programming environment, multiple processes may try to access the resource. A deadlock is a situation when a process waits endlessly for the requested resource which is being used by another process that is waiting for some other resource (Figure 1.10).

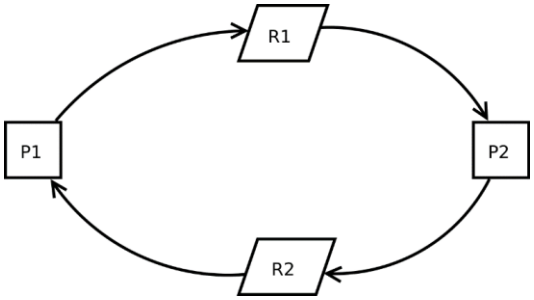

Fig. 1.10 Deadlock prevention

Virtual Storage

In a multiprogramming system, many programs are located in the memory along with the operating system. Some applications require large memory as the whole program cannot be loaded into the memory. If the program is larger than the main memory, then the operating system uses free space of the secondary memory which is known as virtual memory and the secondary storage used for storing which is known as virtual storage. Virtual memory allows the execution of those processes that are not completely in the memory.

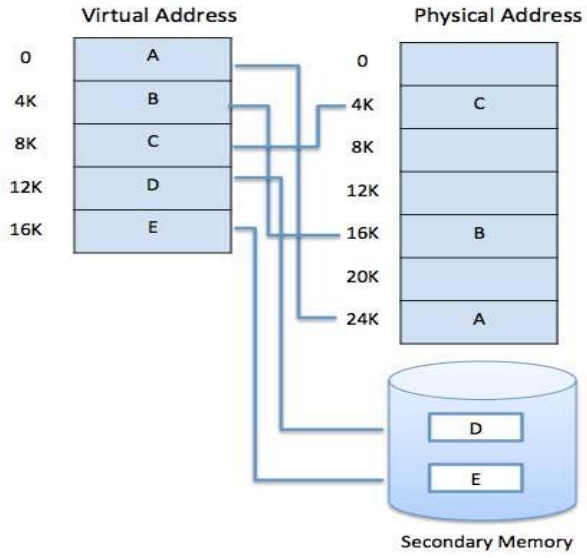

Fig. 1.11 Virtual Storage

Providing User Friendly Interface

One of the important functions of the operating system is to provide the user interface. The

user interface is a set of commands or a graphical user interface through which the user interacts with the applications and the hardware. There are two types of user interfaces provided by the operating systems. They are:

1. **Command Line Interface (CLI):** The CLI has a command prompt from where you can issue a command. The CLI accepts the text-based commands on the command line or terminal and executes them. In CLI, the correct syntax of commands has to be used, hence the commands need to be remembered by the user. CLI was used by the operating system of the early days. Operating systems—DOS and Unix are the examples of CLI. In using command line interface, the correct syntax has to be used.

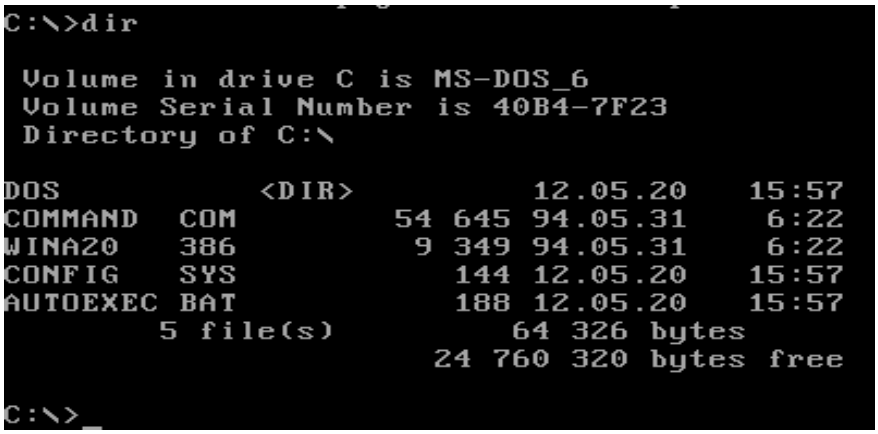

Fig. 1.12 Command line Interface (CLI)

2. **Graphical User Interface (GUI):** The modern operating systems such as Windows, Linux, and Mac all use GUI. GUI is easy to operate and user-friendly. GUI provides the ability to use the mouse or fingertips to navigate the commands. It becomes easy to interact with the computers. The operating system with GUI uses four components to interact with the system. These are abbreviated as WIMP (windows, icons, menus, and pointer).

Fig. 1.13 Graphic User Interface (GUI)

Types of operating systems

Operating systems are normally preloaded on the computer that you purchase. But it is possible to upgrade or install the operating system on your computer. There are three most

common types of operating systems—Microsoft Windows, Mac OX, and Linux. For mobile devices, such as smartphones and tablet computers, the commonly used operating systems are Apple iOS and Google Android.

Microsoft Windows:

It is a graphical user interface (GUI) based operating system. A typical desktop image of a computer system on which a Microsoft Window 10 is installed is shown in Figure 1.13. In this GUI system, all the programs or commands of the operating system are available in the form of icons, buttons, and menus. Everything within the operating system is clearly displayed on the screen by making a combination of graphics and text. Whenever we want to execute any command or program, then the corresponding icon needs to be clicked.

There are various versions of Microsoft Windows OS available. Most recent version of Microsoft Windows OS is Windows 10, which was released in 2015. The earlier versions are Windows 8, released in 2010, and Windows 7, released in 2001. Microsoft Windows is one of the most popular operating systems.

Fig. 1.14 Microsoft Windows

Mac OS

It is an operating system that is created by Apple. It is a preloaded OS on Macintosh computer or Macs. A typical image of a Mac desktop is shown in Figure 1.15. Observe that this operating system also has a graphical user interface (GUI). But the GUI of Mac OS is different from that of Microsoft Windows. All the commands and programs available in Mac OS are displayed in the form of icons or buttons. By clicking appropriate buttons, we can execute that program.

There are various versions of Mac OS. Most recent version of Mac OS is OS X which is pronounced as OS 10. The latest version released on 24 September 2018 is Mac OS 10.14 and is named as Mojave (Liberty). The earlier versions of Mac OS are OS X 10.11: El Capitan (Gala) released on 30 September 2015, OS X 10.10: Yosemite (Syrah) released on 16 October 2014, OS X 10.9 Mavericks (Cabernet) released on 22 October 2013, OS X 10.8 Mountain Lion (Zinfandel) released on 25 July 2012, and OS X 10.7 Lion (Barolo) released on 20 July 2011.

Fig. 1.15 Mac OS

Linux

It is a family of open source operating systems. It means that it can be modified and distributed by anyone around the world. Earlier OS that we have discussed such as Windows and Mac OS are proprietary software. It means that they can be modified only by the company that owns it. Whenever you want to use proprietary software on your computer system, you need to purchase it by paying a cost so that you can get a user license. Linux is a freeware, meaning that you need not to pay any cost and you can use it on your computer system.

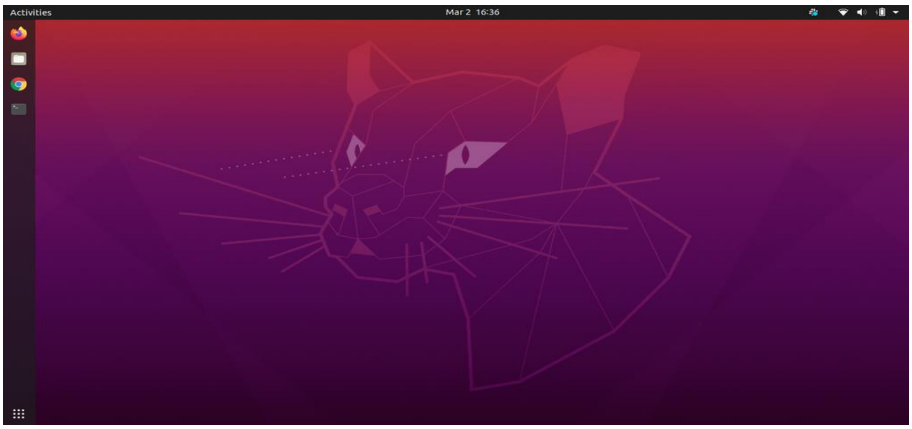

Fig. 1.16 Linux

A typical desktop image that runs Linux is shown in Figure 1.16. Observe that Linux is also available in the form of GUI. Every program in the Linux OS is displayed in the form of an icon, button, or graphics. By clicking on the icon or button, we can execute that program. There are many distributors of Linux, for example Ubuntu, Linux Mint, Fedora, Suse, Red Hat, and so on.

Classification of OS

Operating systems can be classified based on the following:

A. Classification based on Processing Method

Multi-programming OS: In this, two or more programs are executed simultaneously by a single processor. It is used in a multi-user environment.

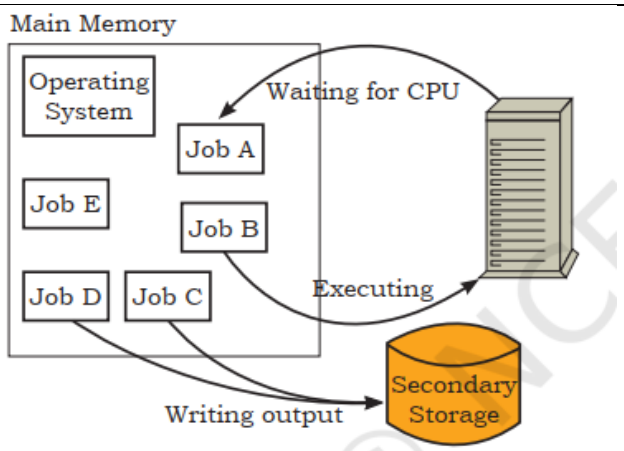

Fig. 1.17 Multi-programming with three programs

Multitasking OS: It is capable of running several tasks or programs at the same time. Most of the present operating systems like Microsoft Windows, Linux, and Mac OS are multitasking operating systems.

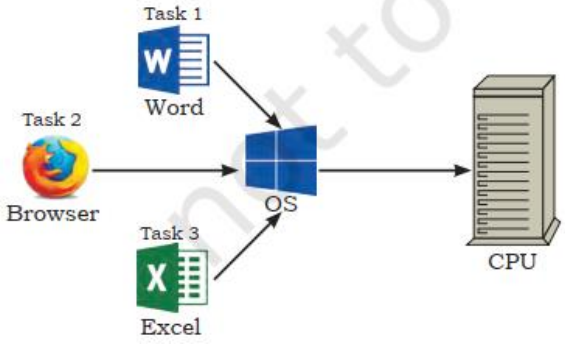

Fig. 1.18 Multitasking with three programs

Multiprocessing OS: It supports running a program in more than one CPU. Two or more processors (CPU) are used to control the different activities or execution of many program instructions simultaneously. Servers are designed to support multiple processors. UNIX is an example of multiprocessing OS.

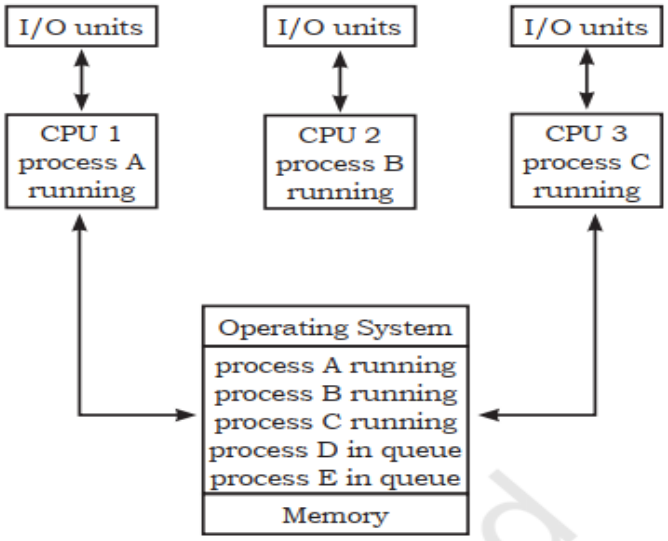

Fig. 1.19 Multiprocessing OS

Time-sharing system: In this, the processor is shared among many users. The CPU switches so rapidly from one user to another, that every user gets the impression of getting the services of CPU for all the time.

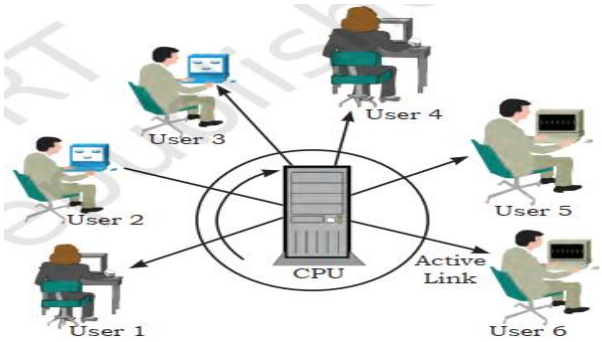

Fig. 1.20 Time sharing system

Multithreading OS: This has the ability to divide the process into sub-processes known as threads and execute them concurrently. Threads are individual processes that execute simultaneously in multi-tasking OS.

Batch processing OS: In this, similar jobs are grouped together for processing. It consists of programs, data, and system commands. The time taken between job submission and job completion is very high. It is suitable for programs with large computation time where user involvement is not necessary. Examples are payroll, forecasting, and statistical analysis.

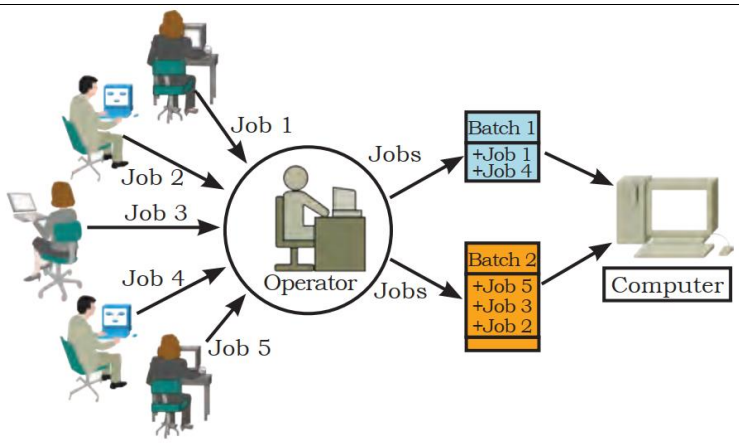

Fig. 1.21 Batch processing

Online processing operating system: In this, transactions are processed immediately and output is provided to the user. Most of the present systems use online processing. Bank transactions are an example of online processing system.

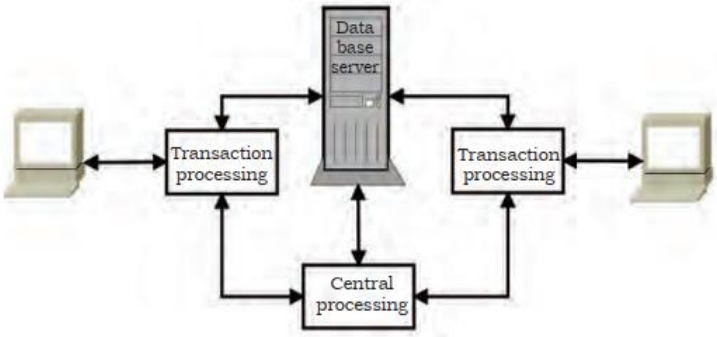

Fig. 1.22 Online processing

Real-time OS: This method receives data, processes it, and returns results quickly to affect the functioning of the system at that time. It is an online processing system where the processing time is critical. Monitoring and controlling nuclear power stations, rocket launching systems, are examples of real time systems.

B. Classification of OS based on User Interface

As we have already learned, there are two types of user interface. One is command line interface (CLI) and other is graphical user interface (GUI). The operating system is also classified on the basis of user interface.

Classification of OS based on Mode of User:

Under this classification, the OS is classified as single user or multi-user.

Single user OS: The majority of small microcomputer-based systems have single user OS, which allows a single user to operate the machine in an interactive mode. It allows only one user program to use the system. MS-DOS, PC-DOS are single user operating system.

Fig. 1.23 Single user OS

Multi-user OS: A multi-user OS allows two or more users to run programs at the same time. The multi-user OS shares computer resources among these users, allowing each a small slice of the processor time. This concept is known as time sharing. Example of multi-user OS are UNIX, LINUX.

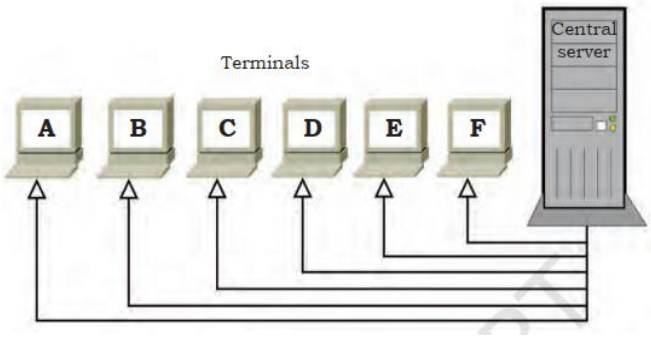

Fig. 1.24 Multi-user OS

Components of operating system

We identify the operating system by its user interface. The look or initial screen of various operating systems looks different, but architectural view of the various operating systems remains the same. There are essentially three components of operating system as described below:

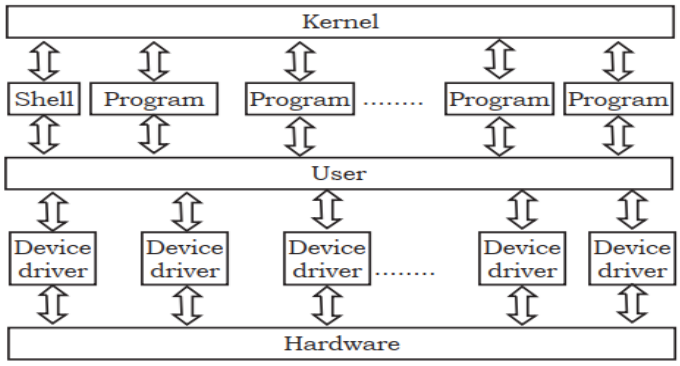

Fig. 1.25 Components of OS

1. The device driver
2. The kernel
3. The shell

The Device Driver: This component is close to computer hardware. The device drivers are required for proper functioning of the devices attached to the computer system. These drivers can be installed or uninstalled as and when required. The kernel uses it for operating and controlling.

The Kernel: It is the core of the operating system. It performs all the major functions of the operating system. It manages resources, controls program execution, and schedules program execution. It is the main operating system. It detects the new hardware when attached and installs the device driver for it to function properly.

The Shell: We identify the operating system by how the shell looks. It provides the user interface to interact with the kernel and hardware. There are two types of user interface—command line interface (CLI) and graphical user interface (GUI) as explained in the Sessionearlier.

THE FILE SYSTEM:

The operating system provides a file system interface to secondary storage. A file system contains files and directories (folders). Directory is a container that may contain files and other directories known as subdirectories. A file is the basic unit secondary data storage on computers. Any data is stored in a file in the file system. The file has two components, file name and extension. File system that is stored on the disk may have a large number of files and/or directories. Every file system starts with a root directory.

Practical Activity: Observe the booting process of Computer and note the instructions on the screen

Booting is a process of switching on the computer and starting the operating system. Six steps of the booting process are BIOS and Setup Program, The Power On-Self-Test (POST), The Operating system Loads, System Configuration, System Utility Loads and Users Authentication

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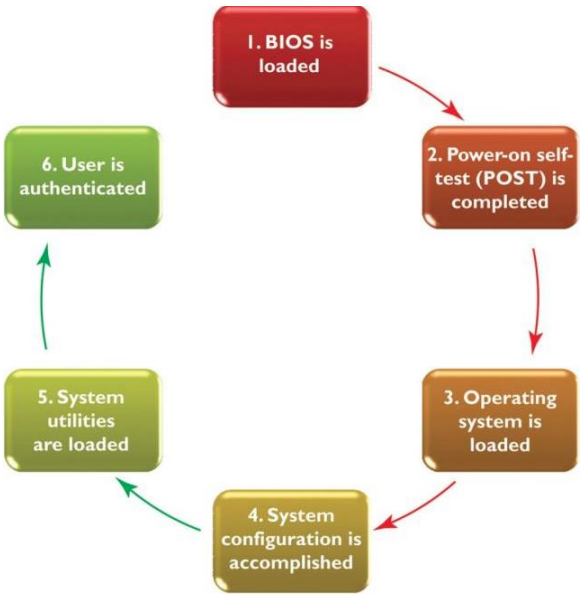

Step1. BIOS and Setup Program

ROM (read-only memory): it is a permanent and unchanging memory.

BIOS (basic input/output system): the part of the system software that includes the instructions that the computer uses to accept input and output. Load: to transfer from a storage device to memory. The ROM loads BIOS into the computer's memory.

Setup program: a special program containing settings to control hardware. Furthermore, the program can only be accessed while the BIOS information is visible.

Step 2. The Power-On-Self-Test (POST)

When the computer is powered on, the BIOS (Basic Input/output System) performs a POST to check the hardware components such as the CPU, memory, and storage devices. If any hardware issues are detected, the system may halt and display an error message.

Step 3. The Operating System (OS) Loads

BIOS searches for the operating system.

Setting in CMOS: complementary metal oxide semiconductor determines where to look for the operating system.

In this step, the operating system's kernel is also loaded into the computer's memory.

The operating system takes control of the computer and begins loading system configuration information.

Step 1. System Configuration

Registry: a database to store information about peripherals and software.

Peripheral: a device connected to a computer.

Drive: a utility program that makes peripheral devices function properly the operating system's registry configures the system.

In this step, drivers are also loaded into memory.

Step 5. System Utility Loads

System utilities are loaded into memory.

Volume control.

Antivirus software.

PC card unplugging utility.

Step 6. Users Authentication

Authentication or user login occurs.

Username

Password

After all this process, the user interface starts, enabling user interaction with the computer and its programs also.

Activity

Practical Activity: Prepare the table enlisting the features and versions for various Operating Systems.

Operating System	Latest Version (as of 2023)	Key Features
Microsoft Windows	Windows 11	• Redesigned Start menu and taskbar • Improved multitasking features (Snap Layouts and virtual desktops) • Enhanced security features such as TPM 2.0 and Secure Boot • Microsoft Edge browser integration • Windows Subsystem for Linux (WSL) for compatibility with Linux applications
macOS	macOS Sonoma	• Streamlined user interface with enhanced visuals • Improved Safari browser with better privacy features • Continuity and Handoff features for seamless integration with other Apple devices • Powerful tools for creative and professional work • Advanced security and privacy settings

Linux	Various distributions	• Open-source and highly customizable • Wide range of distributions (Ubuntu, Debian, Fedora, etc.) tailored for different use cases • Robust support for servers and cloud environments • Compatibility with a vast range of software • Strong security and privacy features
Android	Android 14	• User-friendly interface with customizable home screens • Integration with Google services and apps. • Wide app ecosystem on Google Play Store • Multi-device compatibility with phones, tablets, and wearables • Enhanced privacy features and controls.
iOS	iOS 16	• Intuitive and consistent user interface across Apple devices - Robust privacy features (e.g., App Tracking Transparency) - Integration with other Apple services and devices - Wide range of apps available on the App Store - Improved multitasking features on iPads
watchOS	watchOS 10	• Advanced health and fitness tracking features - Customizable watch faces and complications - Seamless integration with iOS devices - Smart notifications and quick replies - Improved sleep tracking and heart health monitoring

Check Your Progress

A. Multiple choice questions (MCQs)

1. What is an operating system? (a) A type of application software (b) Hardware used for processing data (c) Software that manages computer hardware and software resources (d) A programming language
2. Which of the following is not a function of an operating system? (a) Memory Management (b) Process Management (c) Internet Browsing (d) File System Management
3. Why do we need an operating system? A) To perform arithmetic operations B) To manage hardware resources and provide a user interface C) To edit videos and images D) To design web pages
4. Which step comes first in the booting process of a computer? (a) OS Initialization (b) Loading the Bootstrap Loader (c) Power-On Self-Test (POST) (d) User Login

5. Which component of the operating system is responsible for managing system resources? (a) Kernel (b) Shell (c) User Interface (d) Device Driver
6. What type of operating system allows multiple users to interact with the computer at the same time? (a) Single-User OS (b) Multi-User OS (c) Batch Processing OS (d) Real-Time OS
7. Which of the following operating systems is designed for real-time applications? (a) Windows 10 (b) MacOS (c) Linux (d) Real-Time Operating System (RTOS)
8. Which type of user interface involves typing commands to interact with the operating system? (a) Graphical User Interface (GUI) (b) Command-Line Interface (CLI) (c) Touch Interface (d) Voice Interface
9. What is the role of device drivers in an operating system? (a) To manage user interfaces (b) To allocate memory (c) To enable communication between hardware and software (d) To manage files and directories
10. Which component of the operating system provides a user-friendly way to interact with the system? (a) Kernel (b) Shell (c) User Interface (d) File System

B. Fill in the blank questions

1. An _____ is a software that acts as an intermediary between the computer hardware and the user.
2. The primary purpose of an operating system is to manage _____ and software resources.
3. Without an _____, a computer would be useless to users and application software.
4. The _____ process involves powering on the computer and loading the operating system into memory.
5. The operating system's _____ management function involves allocating and deallocating memory space as needed by programs.
6. One of the main functions of an operating system is _____ management, which includes starting, pausing, and stopping processes.
7. The _____ interface of an operating system provides a user-friendly way to interact with the computer, often through graphical elements like windows and icons.
8. _____ operating systems are designed to process data in real-time with minimal delay.
9. An operating system with a _____ user interface allows users to interact with the system by typing commands.
10. The _____ of an operating system is its core component that manages system resources and communication between hardware and software.

C. Ture or False

1. An operating system is a type of hardware device.
2. The operating system acts as an intermediary between computer hardware and the user.
3. We do not need an operating system to run application software on a computer.

4. During the booting process, the operating system is loaded into memory after the Power-On Self-Test (POST).
5. One of the main tasks of an operating system is to manage memory allocation and deallocation.
6. The kernel is the user interface of an operating system.
7. A multi-user operating system allows multiple users to use the computer simultaneously.
8. A command-line interface (CLI) uses graphical elements like windows and icons for user interaction.
9. Real-time operating systems are designed to handle tasks within a guaranteed time frame.
10. Device drivers are unnecessary components of an operating system because hardware communicates directly with applications.

D. Short Questions

1. What is an operating system?
2. How does an operating system manage computer hardware and software resources?
3. Why is an operating system necessary for a computer?
4. What are the main steps involved in the booting process of an operating system?
5. Name and briefly describe two key functions of an operating system.
6. What is a user-friendly interface in the context of operating systems?
7. List three different types of operating systems.
8. How are operating systems classified based on processing methods?
9. Differentiate between a graphical user interface (GUI) and a command-line interface (CLI).
10. What is the role of the kernel in an operating system?

Session 2. Install Windows operating system

Windows 10 operating system is available for many devices such as phones, tablets, laptops, and desktop computers. It is also available in multiple editions and in both 32-bit and 64-bit versions. First, one needs to choose the appropriate edition and architecture of Windows to provide the necessary features, such as Secure Boot, Client Hyper-V, Cortana, and others. It is also important to verify the compatibility of existing hardware such as printers, scanners, and other peripherals with Windows.

In a new computer, a clean installation of Windows 10 is the preferred option. For a new computer, the user needs to select another appropriate installation option as per their requirements. This installation will resolve startup and shut down problems as well as memory usage and app issues. Also, you can get rid of viruses and other types of malware, fix system corruption, and improve battery life.

History of Windows Operating System

Microsoft introduced the Windows operating system in 1985, and it has since seen many advancements and changes. Windows 1.0, the first version of the OS, debuted in November 1985 as the first graphical operating system designed for commercial use, suitable for PCs with Intel 8086 or 8088 processors. It featured a basic interface and support for applications like Paintbrush, Write, and Calculator. In 1987, Microsoft released Windows 2.0, which brought several upgrades such as support for more applications, the ability to run multiple programs simultaneously, and the introduction of drag-and-drop functionality. Windows 3.0, launched in 1990, was the first Windows version to achieve widespread popularity. It provided a modern, user-friendly interface, support for more applications, and multitasking capabilities. Additionally, it introduced features like File Manager and Program Manager. Windows 95, released in 1995, marked a significant milestone for modern operating systems with its fresh interface featuring the Start button and Taskbar. It supported plug-and-play hardware, 32-bit programs, and introduced Windows Explorer, Internet Explorer, and Microsoft Office. Following Windows 95, Microsoft continued to release various other versions, including Windows 98, Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10 and Windows 11. Each upgrade version brought improvements in performance, interface, hardware and software support, and security. The Windows operating system has evolved significantly since its initial launch in 1985, with each version providing enhancements and updates. Today, Windows remains one of the world's most popular operating systems.

Windows Operating System versions and features

Table 2.1 Windows Operating system versions and features

Versions	Year	Specific features
Windows 1.x	1985	Introduction of GUI in 16-bit. Processor Mouse was introduced as an input device.
Windows 2.x	1987	Supports minimizing or maximizing windows. Control panel feature was introduced with various system setting and customizing options.
Windows 3.x	1992	Introduced the concept of multitasking. Supported 256 colours which brought a more modern, colourful look to the interface.
Window 95	1995	Introduced start button, the taskbar, Windows Explorer, and start menu. Introduced 32-bit processor and focused more or multitasking.
Windows 98	1998	Integration of the web browser (Internet Explorer) with the Operating System. DOS gaming began to disappear as Windows-based game improved. Plug and play feature was introduced.
Windows NT		Designed to act as servers in the network.
Windows ME	2000	It introduced automated system diagnostics and recovery tools.

Windows 2000	2000	Served as an operating system for business desktop and laptop systems. Four versions of Windows 2000 were released: Professional (for business desktop and laptop systems). Server (both a Web server and an office server), Advanced Server (for line-of-business application), and Data Center Server (for high-traffic computer networks)
Windows XP	2001	Introduced 64- bit processor. Improved Windows appearance with themes and offered a stable version.
Windows Vista	2006	Updated the look and feel of Windows
Windows 7	2009	Booting time was improved, introduced new user interfaces like Aero peek pinning programs to the taskbar, handwriting recognition, etc., and internet Explorer 8.
Windows 8	2012	Windows 8 is faster than previous versions of Windows. The start button was removed. Windows 8 takes better advantage of multi-core processing, solid-state drives (SSD), touch screens, and other alternate input methods. Served as a common platform for mobile and computer.
Windows 10	2015	Start Button was added again. Multiple desktops. Central Notification Center for App notification and quick actions. Cortana voice-activated personal assistant.

SYSTEM REQUIREMENT TO INSTALL WINDOWS OPERATING SYSTEM

The system requirements to install a Windows operating system vary depending on the specific version. Below are the general system requirements for installing the most recent versions of the Windows operating system. As shown in table 2.1 summarizing the system requirements for installing the most recent versions of the Windows operating system:

Table 2.2 System requirements for installing Windows operating system

Requirement	Windows 11	Windows 10
Processor	1 GHz or faster with 2 or more cores on a 64-bit processor or SoC	1 GHz or faster processor or SoC
RAM	4 GB or more	1 GB for 32-bit or 2 GB for 64-bit
Storage	64 GB or more available	16 GB for 32-bit or 32 GB for 64-bit
System Firmware	UEFI, Secure Boot capable	No specific requirement
TPM	TPM version 2.0	No specific requirement
Graphics Card	DirectX 12 compatible with	DirectX 9 or later with WDDM

	WDDM 2.0 driver	1.0 driver
Display	High-definition (720p) display >9" with 8 bits per color channel	800 x 600 resolution
Internet Connection	Required for Windows 11 Home during setup	Not required for setup

It is also recommended to have an internet connection to download and install updates.

Types of Windows 10 installation – Clean installation and Upgrade installation,

Windows 10 installation

When installing Windows 10, there are different types of installations you can choose from depending on your needs. These options include:

Clean Installation: A clean installation of Windows involves erasing all data on the target drive and installing a fresh copy of the operating system. This process can help improve performance, resolve software issues, and provide a fresh start with Windows. Here's a step-by-step guide to performing a clean installation of Windows:

1. Prepare for the Installation

- **Backup Your Data:** Before you begin, back up any important data and files as the clean installation will erase all data on the target drive.
- **Create Installation Media:** Download the Windows installation media from the official Microsoft website using the Media Creation Tool.
- Follow the tool's instructions to create a bootable USB drive or DVD.

2. Boot from Installation Media

- **Insert the Installation Media:** Insert the bootable USB drive or DVD into the computer.
- **Access Boot Options:** Restart your computer and access the boot menu. The key to access the boot menu varies by manufacturer, often F12, F10, Del, or Esc.
- **Select Boot Device:** In the boot menu, select the bootable USB drive or DVD to start the installation process.

3. Begin Windows Installation

- **Start Setup:** The installation process will begin automatically when you boot from the installation media.
- **Choose Language and Preferences:** Select your preferred language, time and currency format, and keyboard or input method.
- **Click "Install Now":** Click the "Install Now" button to begin the installation process.

4. Choose Installation Type

- **Custom Installation:** When prompted to choose the installation type, select "Custom: Install Windows only (advanced)".
- **Manage Partitions:** Select the drive where you want to install Windows. Delete any

existing partitions to clear the drive and prepare it for the clean installation.

- Optionally, create new partitions if you want to organize your data differently.

2. Install Windows

- **Begin Installation:** Once you have chosen the drive, click "Next" to start the installation process.
- Windows will copy files, install features and updates, and complete the installation. This may take some time and your computer may restart multiple times.

6. Complete Setup

- **Follow On-Screen Instructions:** After installation is complete, follow the on-screen instructions to set up Windows.
- This includes creating a user account, connecting to a network, and choosing other settings.

7: Post-Installation

- **Install Updates:** Once Windows is set up, check for and install any available updates to ensure your system is up to date.
- **Install Drivers:** Install necessary drivers for your hardware devices to ensure everything works properly.
- **Restore Data:** Restore any backed-up data to your new installation if necessary.

Upgrade Installation:

An upgrade installation of Windows involves updating your existing version of Windows to a newer version while retaining your data, applications, and settings. This process is relatively straightforward and ensures that your files and preferences remain intact. Here's how to perform an upgrade installation of Windows:

1. Check Compatibility

- Verify Hardware Compatibility: Ensure your system meets the minimum hardware requirements for the new version of Windows. Check Microsoft's website for the most current system requirements.
- Check Software Compatibility: Some older applications may not be compatible with the new version of Windows. Verify compatibility with critical applications.
- Check for Firmware Updates: Make sure your BIOS/UEFI firmware and drivers are up to date.

2. Prepare for the Installation

- Backup Important Data: Although your data should remain intact during an upgrade, it's a good practice to backup important files as a precaution.
- Create Windows Installation Media: Download the Windows installation media from the official Microsoft website using the Media Creation Tool.
- Follow the tool's instructions to create a bootable USB drive or DVD.

3. Start the Installation

- Run the Installation: Insert the installation media (USB or DVD) into your computer and run the setup.exe file directly from the media, or mount the ISO file in File Explorer.
- Choose Language and Preferences: When the setup launches, select your preferred language, time and currency format, and keyboard or input method.
- Click "Install Now": Click "Install Now" to begin the installation process.

4. Choose the Upgrade Option

- Select Upgrade: When prompted to choose an installation type, select "Upgrade: Install Windows and keep files, settings, and applications." This option will upgrade your current version of Windows while retaining your existing data.

2. Proceed with the Installation

- Complete the Upgrade: Follow the on-screen prompts to proceed with the upgrade installation. Windows will copy files, install features, and update the system.
- The installation may take some time, and your computer may restart several times during the process.

6. Post-Installation

- Complete Windows Setup: After the upgrade, follow any on-screen instructions to complete the setup, such as signing in with your Microsoft account.
- Install Updates: Check for and install any Windows updates to ensure your system is up to date.
- Verify Applications: Test your applications and peripherals to make sure everything is working properly.
- Restore Backups: If you made backups, ensure your data and applications have been restored properly.

Configuring Correct Boot Order

Configuring the boot order on a Windows operating system involves adjusting the settings in your computer's BIOS or UEFI firmware to specify which devices your system should boot from first. This is essential when you want to boot from a specific device such as a USB drive, DVD, or a different hard drive. Follow these steps to configure the boot order:

1. Enter BIOS/UEFI Firmware

- Restart Your Computer: Restart your computer.
- Enter BIOS/UEFI: During the initial boot process, press the key to access your BIOS/UEFI settings. This key is often displayed on the screen during startup and varies by manufacturer (commonly F2, Del, F10, or F12).

2. Navigate to Boot Options

- Locate the Boot Menu: In the BIOS/UEFI settings, navigate to the boot or boot order menu. This section may also be labeled as "Boot Options" or something similar.

3. Configure the Boot Order

- Select the Boot Device Order: Look for a list of bootable devices such as hard drives,

USB drives, and optical drives.

- Change the Boot Priority: Adjust the order of the devices by moving the desired device (such as a USB drive or DVD drive) to the top of the list. This tells the system to attempt booting from that device first.
- Save Changes: Once you've set the boot order, save your changes. This is typically done by pressing a key such as F10, though this can vary by manufacturer. Follow the on-screen prompts if available.

4. Exit BIOS/UEFI and Boot from the Chosen Device

- Exit BIOS/UEFI: Exit the BIOS/UEFI settings, usually by selecting the "Save and Exit" option.
- Boot from the Device: Your computer will restart and boot from the device you prioritized in the boot order. If you chose a USB drive or DVD, the installation or other process will begin from that media.

Activity

Practical Activity 2.1: Demonstrate to configure boot order before installation of Windows.

In modern systems, you can adjust the boot order to prioritize a bootable USB drive and set its path on the BIOS settings page. The key to access the BIOS settings may vary depending on the manufacturer and system model. A quick way to find out the correct key is to search online for your system's BIOS key.

Step1. Access the BIOS settings on your system. To do this, turn off your PC, then press and hold a specific key (such as "F2") while turning on your computer. This key varies by manufacturer and will allow you to enter the BIOS settings when the system starts up. For newer systems, make sure to connect the bootable USB drive before you access the BIOS settings.

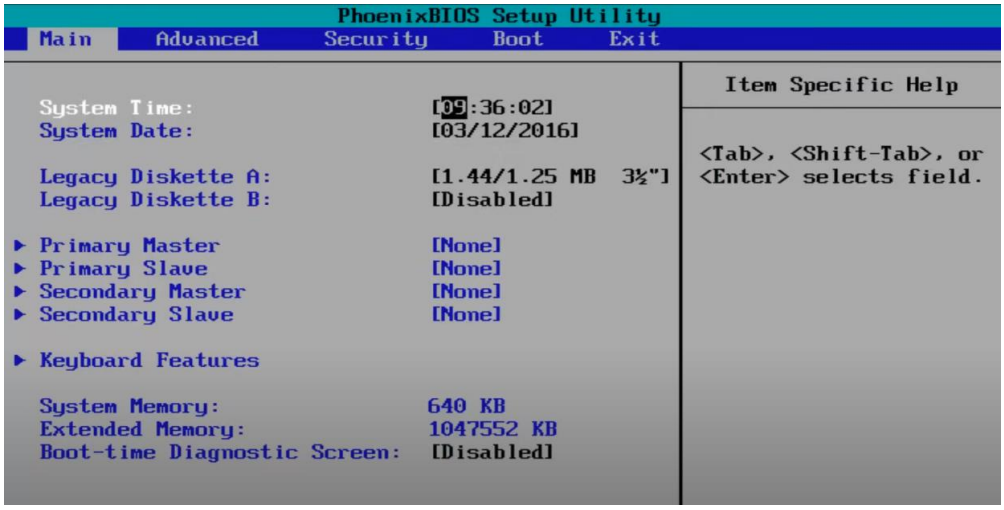

Fig. 2.1

Step 2. Go to the "Boot" options to change the boot order.

To go through the options in the toolbar, press the **left or right arrow keys**.

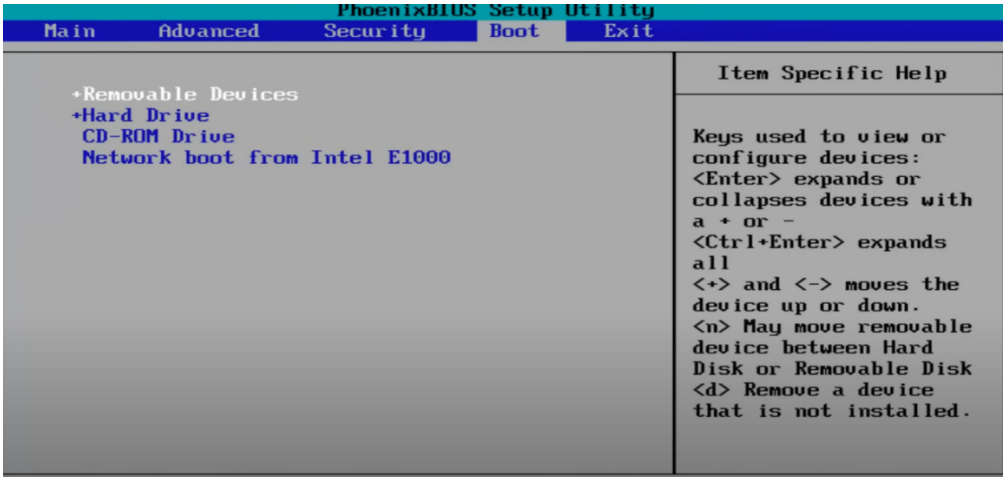

Fig. 2.2

Step 3. Set up a new boot order.

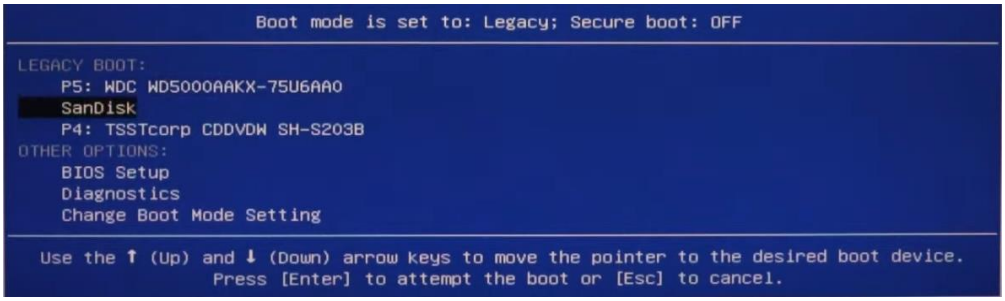

Fig. 2.3

Step 4. If you have any external drives with a different boot order, it will pop up here. In the drive, select the boot order, then go back to the boot option and select that as Boot Option #2. It will be as shown below.

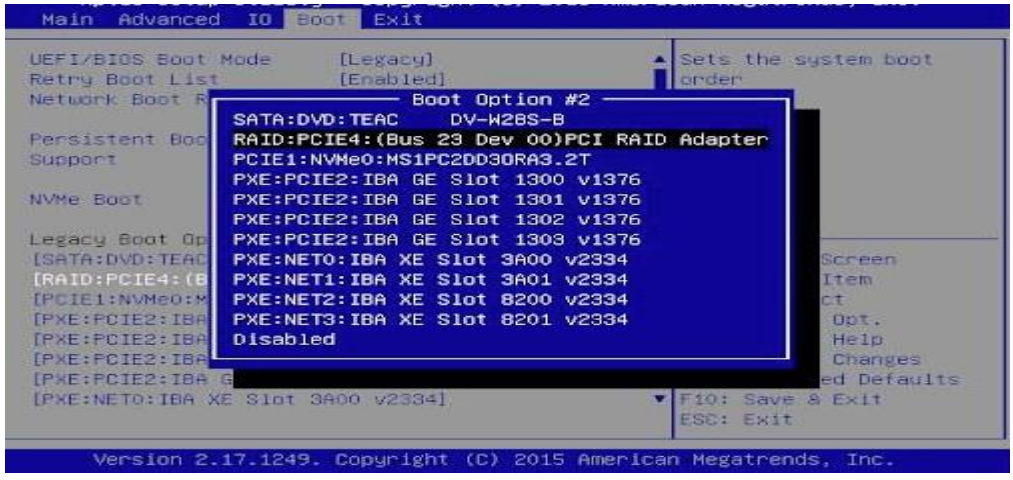

Fig. 2.4

Step 2. Save and Exit the BIOS Information

After selecting the boot option, save the changes and exit the BIOS system. For that, navigate to the Save & Exit option.

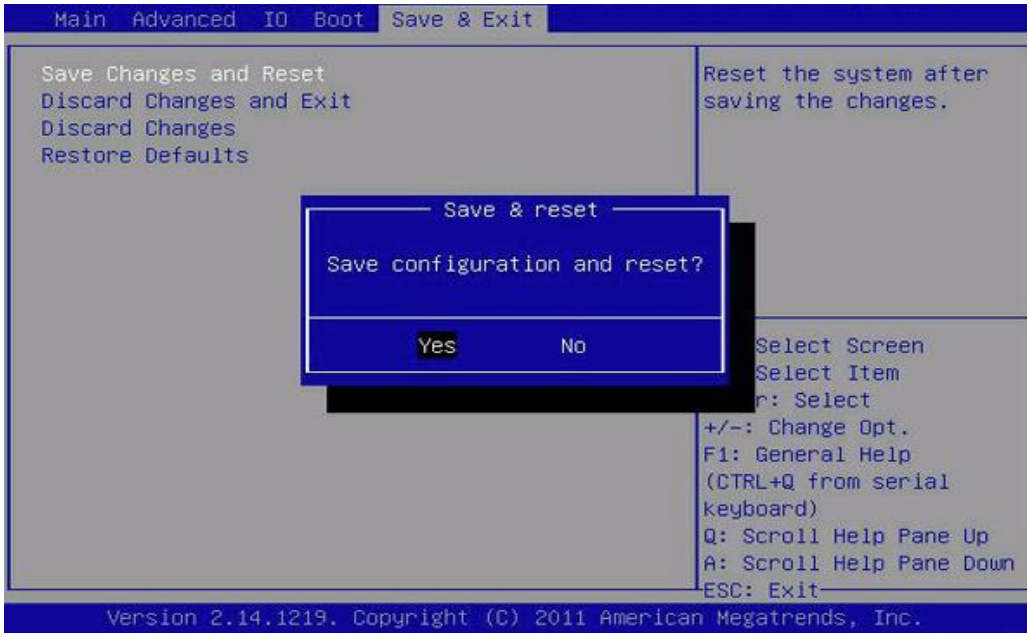

Fig. 2.5

Disk Management

Disk Management is a Windows utility that allows you to perform advanced storage operations. Here are some tasks you can accomplish with Disk Management:

1. Set up a new drive: Initialize new disks to prepare them for use.
2. Extend a volume: Increase the size of a volume by adding unallocated space on the same drive.
3. Shrink a partition: Reduce the size of a partition, which can then allow you to extend a neighbouring partition.
4. Change or assign a drive letter: Modify existing drive letters or assign new ones to drives.

Disk Management shows whether a disk is online (accessible) or offline. In Windows, newly discovered disks are automatically brought online with read and write access by default. In Windows Server, newly discovered disks are also brought online with read and write access unless they are on a shared bus (such as SCSI, iSCSI, Serial Attached SCSI, or Fibre Channel). Disks on a shared bus remain offline upon initial detection. If a disk is offline, you must bring it online before you can initialize it or create volumes on it. To bring a disk online or take it offline, follow these steps:

Open Disk Management:

Search for "Computer Management" in the taskbar search box and select Storage > Disk Management.

Right-click the Disk:

Right-click the disk you want to manage and choose the appropriate action from the context menu.

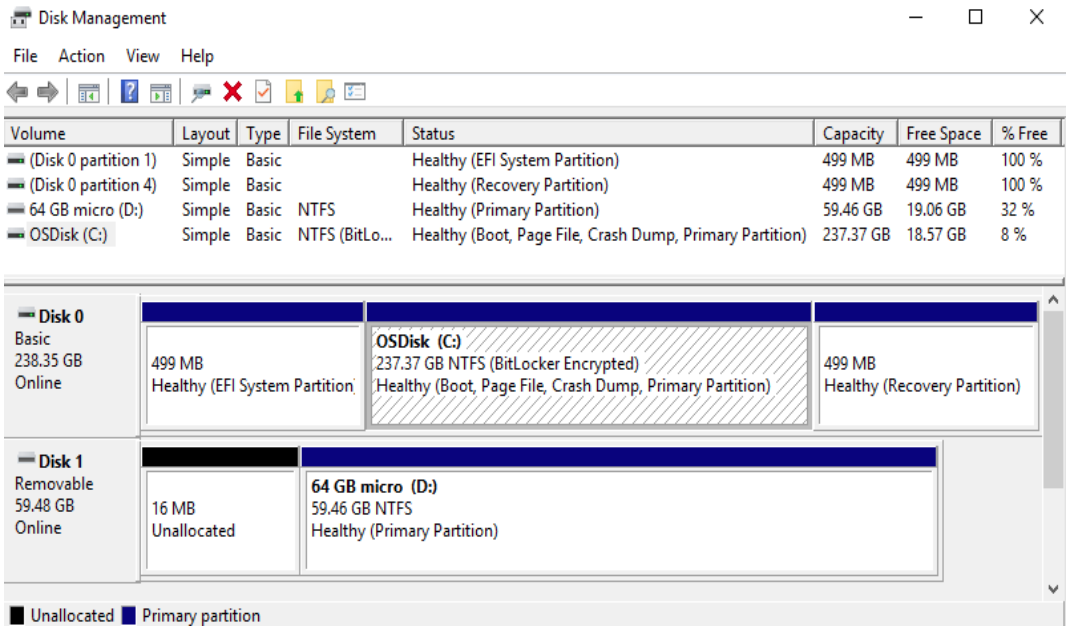

Fig. 2.6

2.4 Performing a Clean Installation of Windows 10

Perform a Clean Install on an Empty Hard Disk/SSD or Reinstall by Booting from Install Media (DVD or USB Thumb Drive) Follow the steps below for clean installation of Windows 10:

Step 1. Once your computer is set to boot from the DVD, you should see this option. If you are installing from a retail Windows 10 USB thumb drive, you will be asked to select either 32- or 64-bit Windows 10.

Fig. 2.7 Boot from CD and DVD

Step 2. The Windows logo will appear on screen, this might be here for a while, as long as you see the animating dots, everything should be ok.

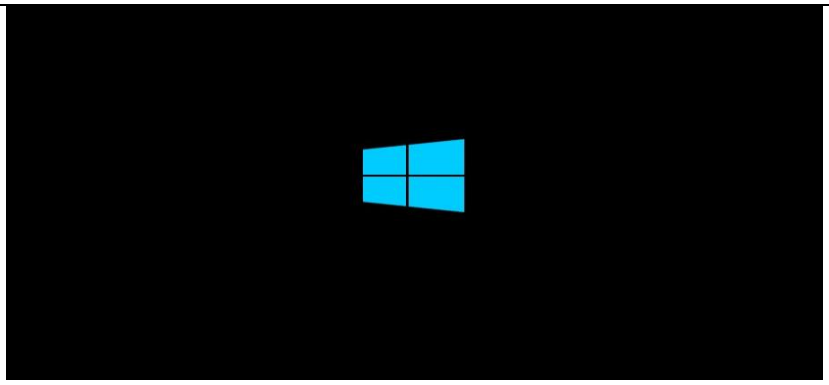

Fig. 2.8 Installing Windows

Step 3. Select your Language, Time and Keyboard method then click Next.

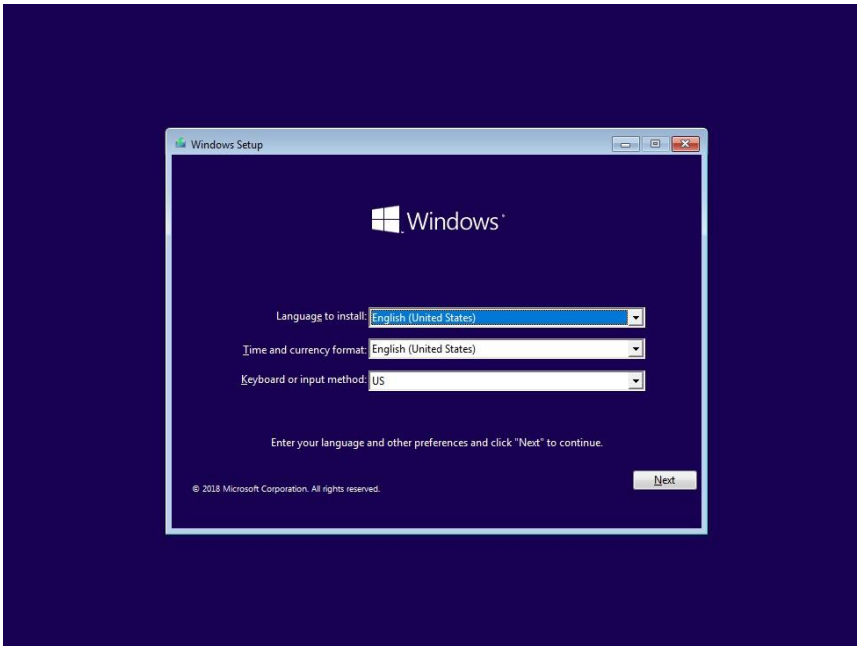

Fig.2.9 Select language, time, and currency

Step 4. Click **Install now.**

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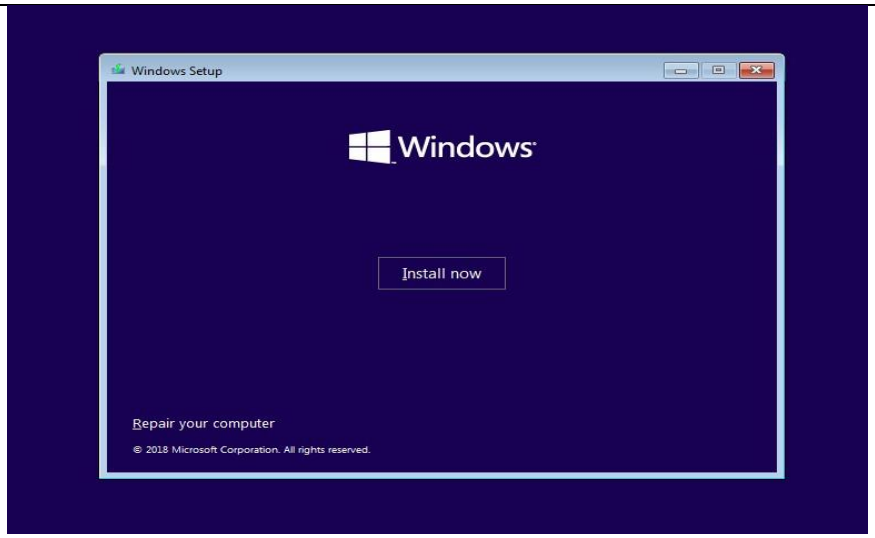

Fig. 2.10 Installation window and input

Step 2. Windows 10 setup will prompt you for a product key during installation a couple times. If you originally upgraded from Windows 7 or Windows 8/8.1 click the option 'I don't have a key' and 'Do this later'. If you have a Windows 10 product key, you can proceed to enter it.

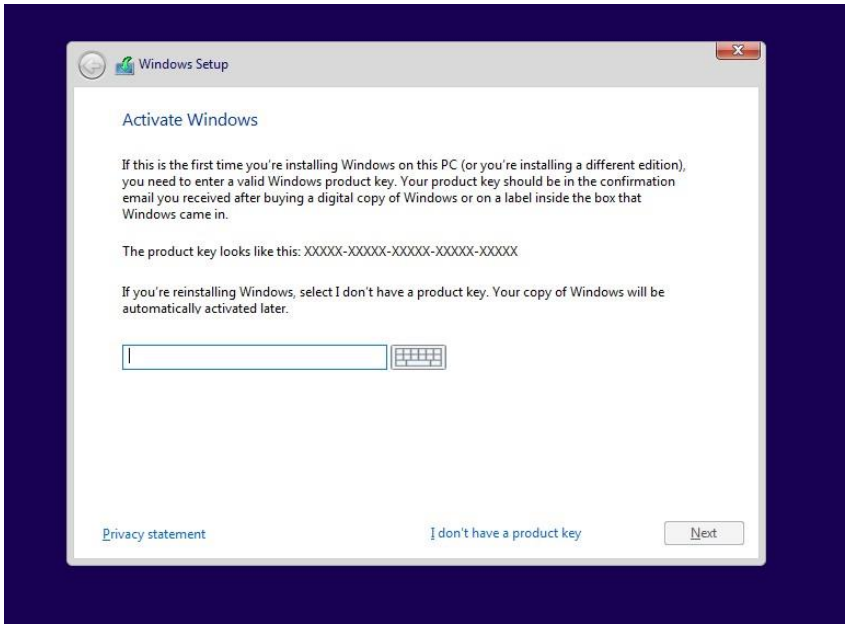

Fig. 2.11 Installing Windows

Step 6. Setup will also prompt you to select the edition you have a license for - **Home** or **Pro**. Please make sure you **choose the right edition**. If you choose the wrong edition, your only option will be to perform a clean install again.

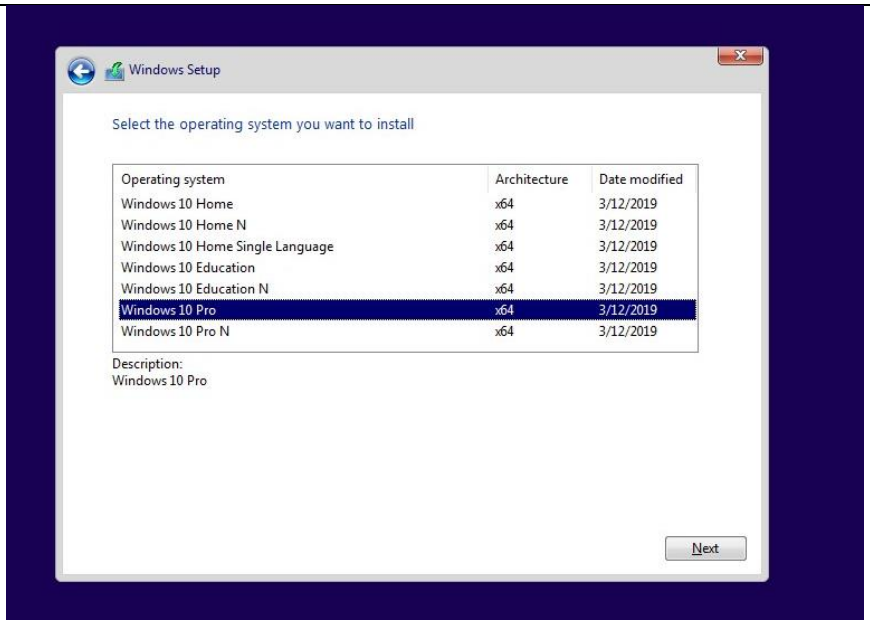

Fig. 2.12 Select Window 10 edition

Step 7. Wait while setup prepares to copy files.

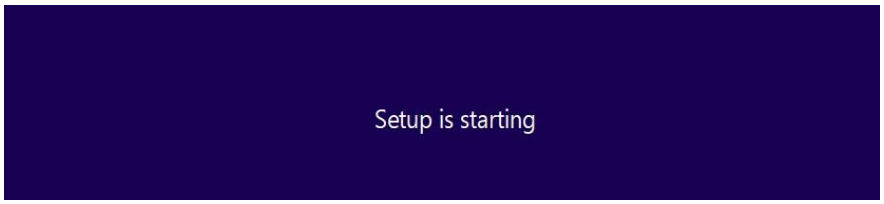

Fig. 2.13 Setup prepare

Step 8. Accept the license terms then click **Next.**

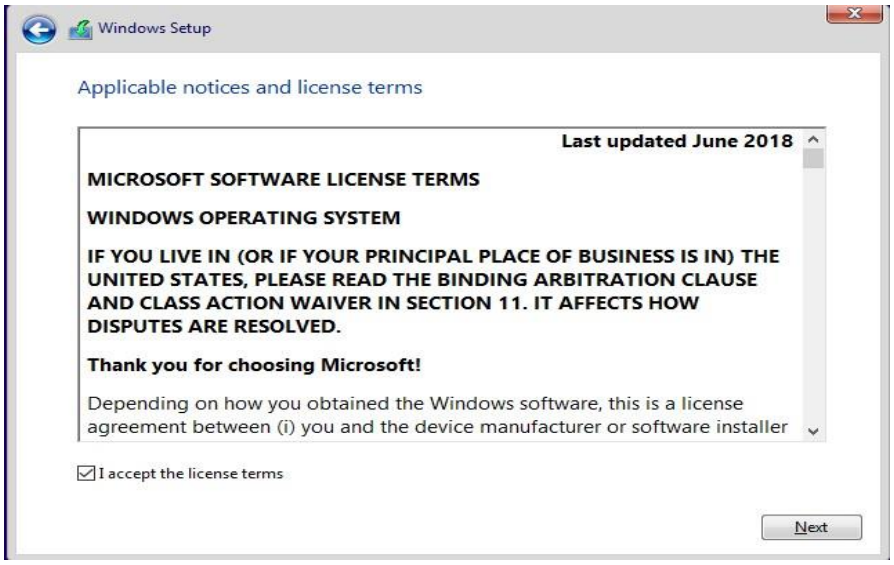

Fig. 2.14 License terms

Step 9. Click Custom: Install Windows only (advanced).

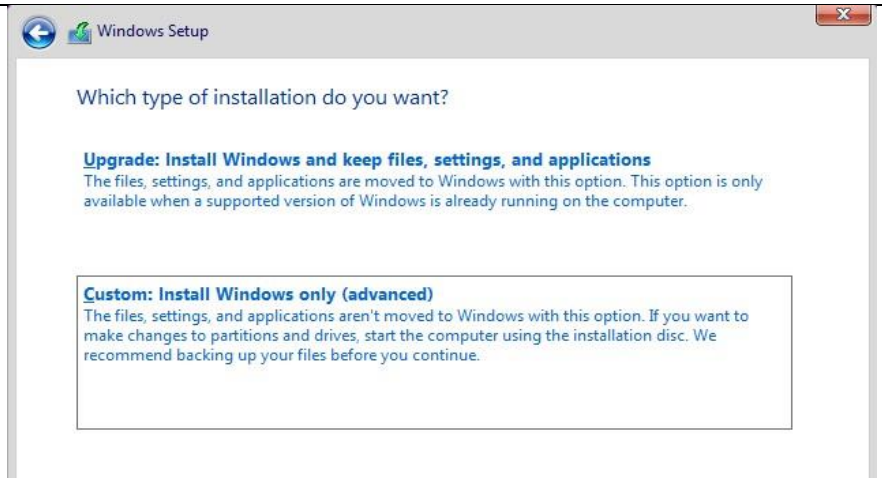

Fig. 2.15 Selecting installation setup window

Step 2. Select the drive then click **New.**

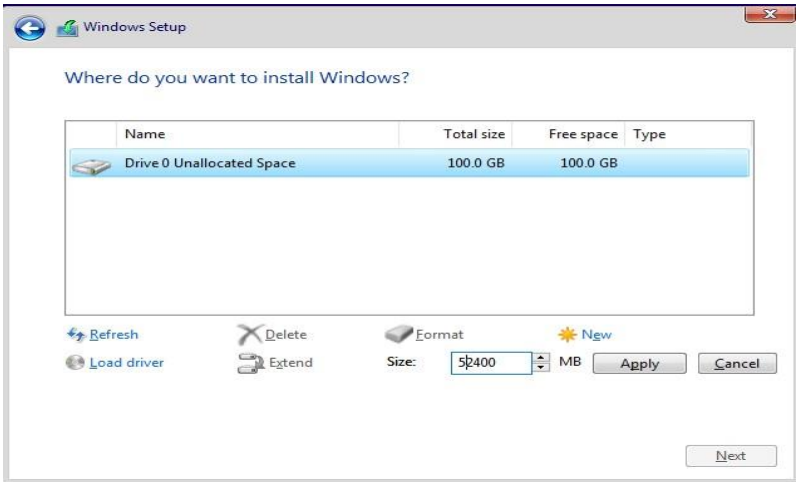

Fig.2.16 Partition window

Step 11. Select the unallocated drive listed, click **New**, click **Apply** then **OK.**

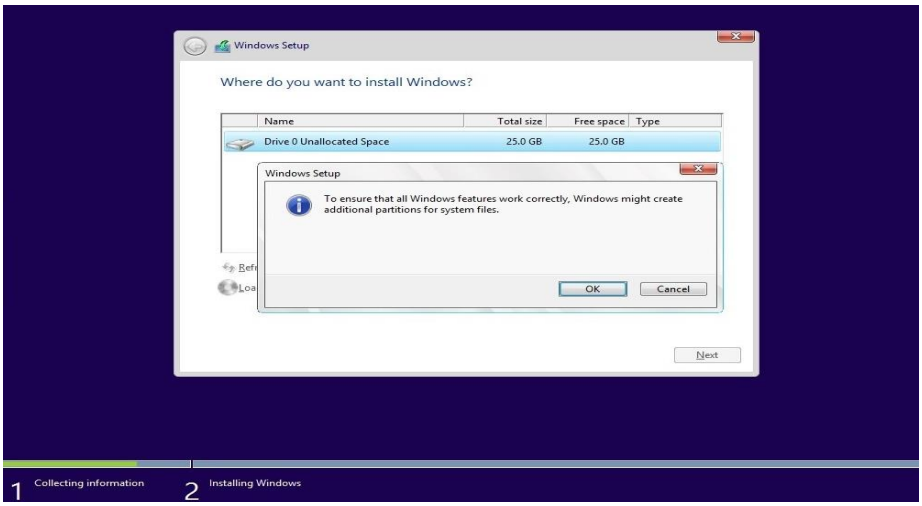

Fig. 2.17 Drive 0 unallocated space

Step 12. This will split the drive into multiple partitions, select the **Primary** partition then click **Next.**

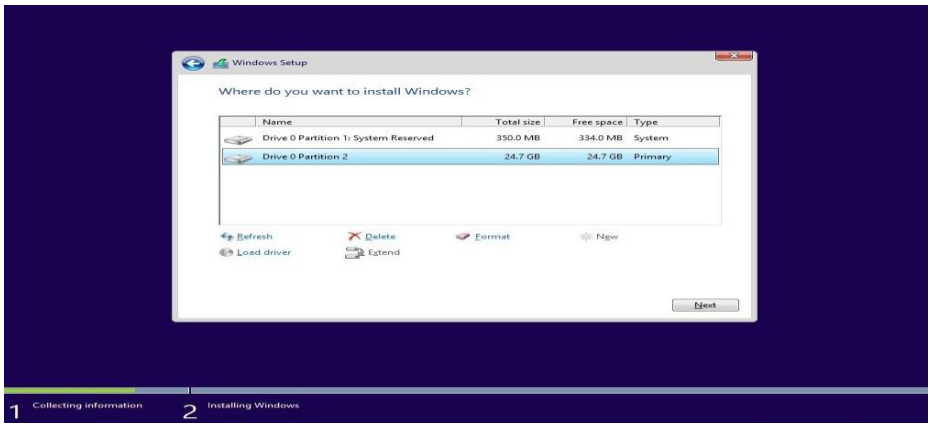

Fig. 2.18 Drive 0 allocated space

Step 13. Wait while Windows installs.

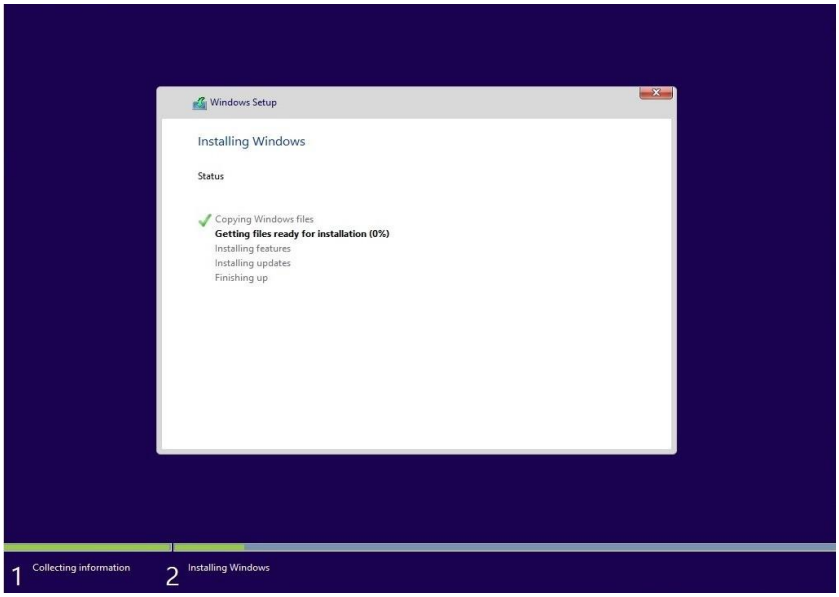

Fig. 2.19 Copy setup files Installing Windows

Step 14. When this phase of setup is complete, Windows will automatically restart then reboot into setup again.

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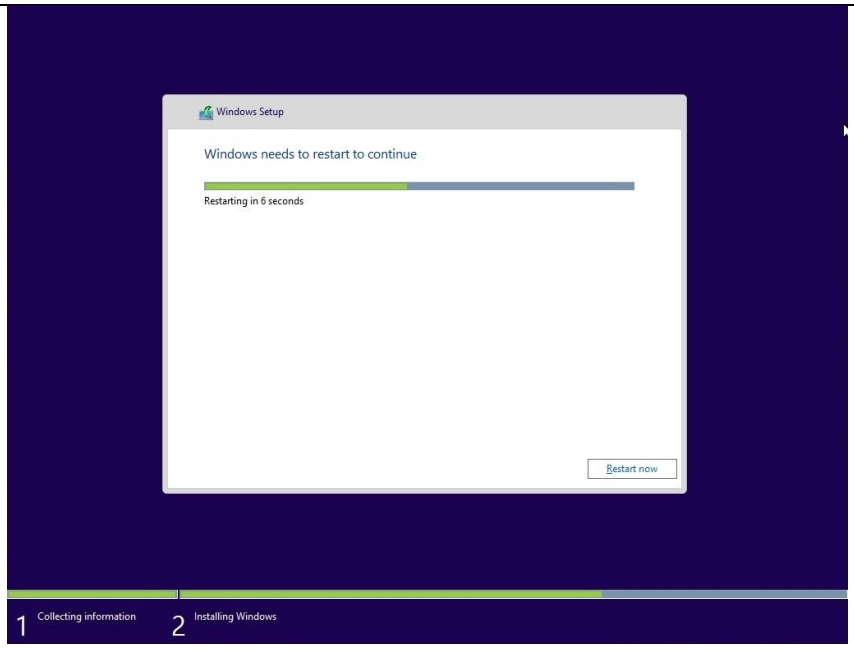

Fig. 2.20 Setup is complete

Step 12. Windows is detecting and installing your hardware. After this is complete, Windows will restart one last time.

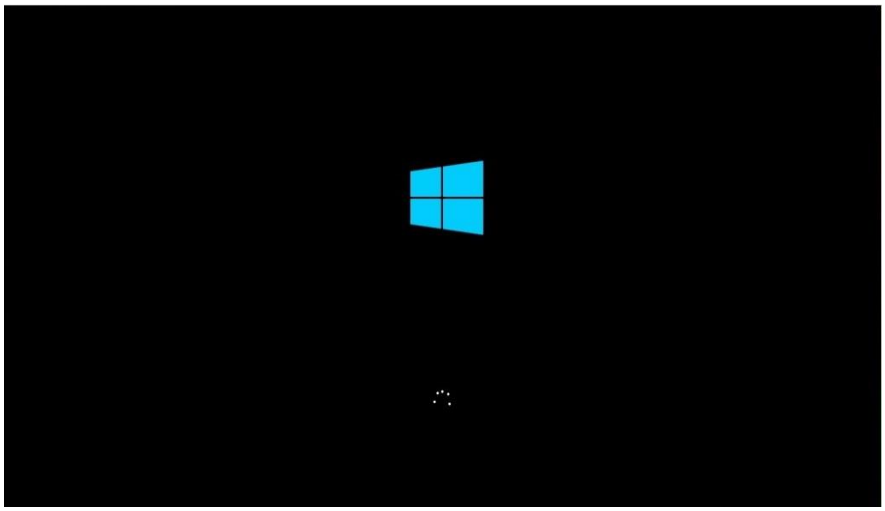

Fig. 2.21 Window setup is completed

Step 16. After complete installation, the initial, window will appear on the computer screen as shown in Fig.

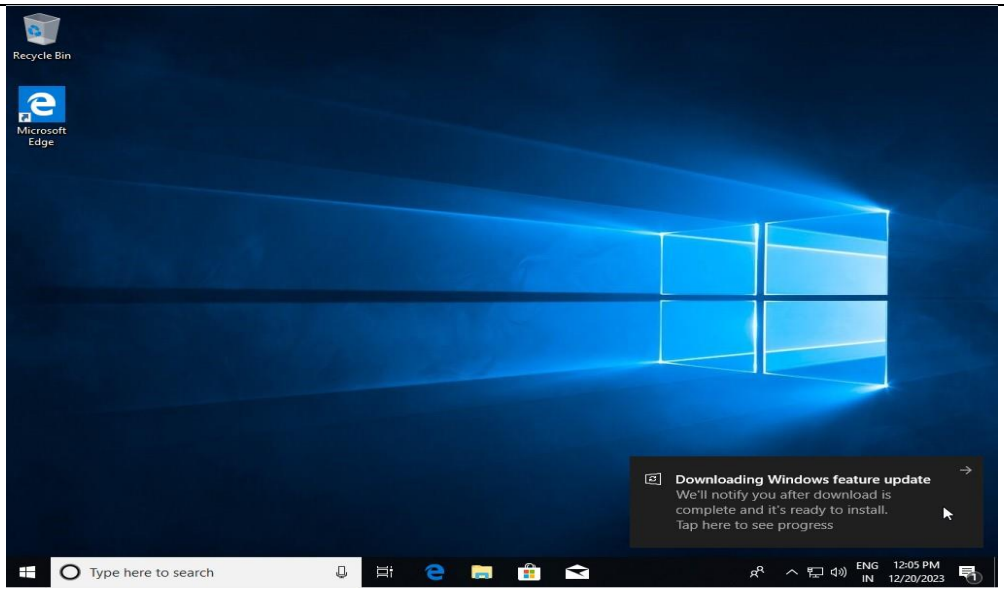

Fig. 2.22 Home window of windows 10

Post Installation Tasks

After installation of Windows 10, you need to perform certain post installation tasks.

(i) Check whether Windows is activated or not. To confirm that you're running an activated copy of Windows 10, open 'Settings'. For this, press the windows key and type settings in the textbox. The Windows setting will be displayed as shown in Figure 2.23.

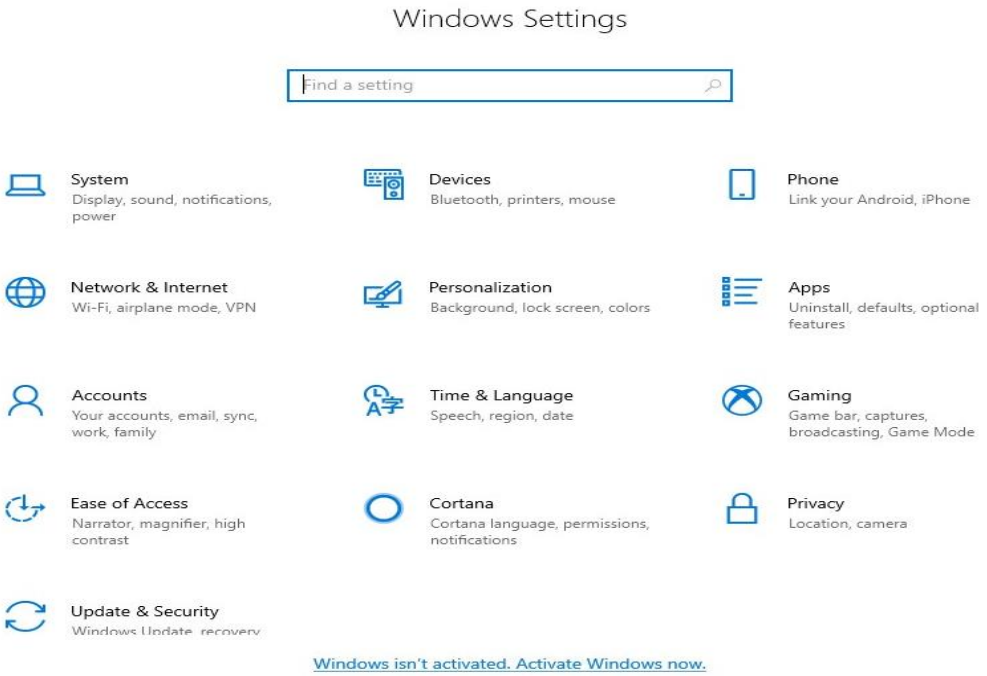

Fig. 2.23 Windows setting

(ii) Click on 'Update & Security' as shown in Figure 2.24.

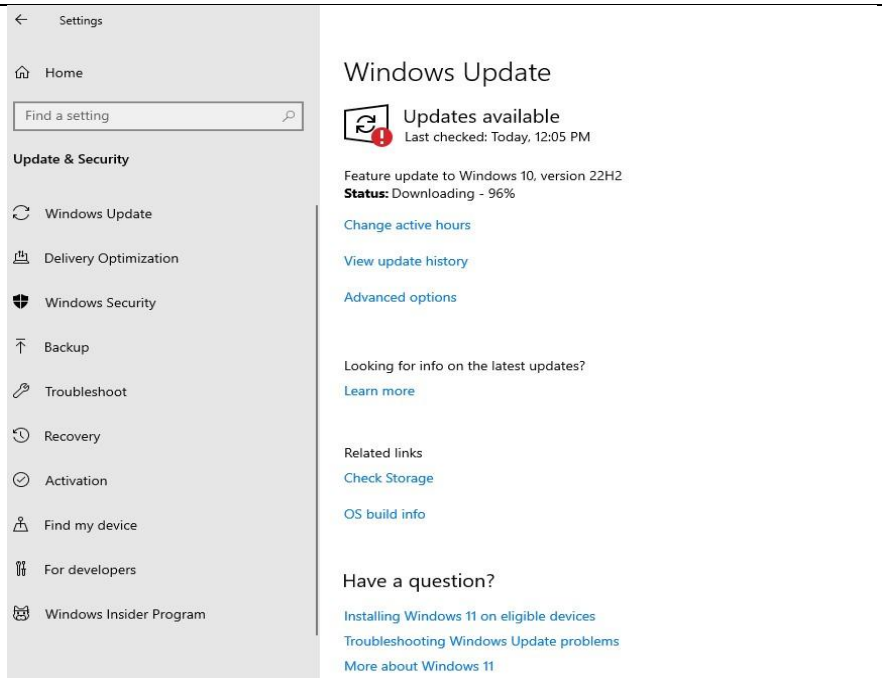

Fig. 2.24 Selecting update and security

(iii) Click on 'Activation' as shown in Figure 2.22.

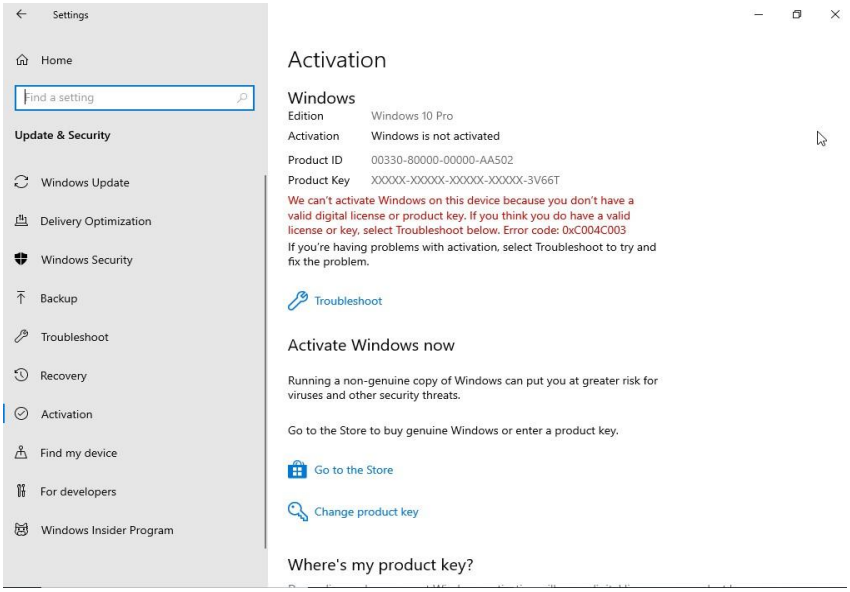

Fig. 2.25 Selecting activation

(iv) Under the 'Activation' head, Windows edition and activation status is displayed as 'Windows is activated with a digital license' as shown in Figure 2.26. This confirms that your Windows 10 is activated. Instead of this if it shows the message 'Windows is not activated', then you need to activate the Window by entering the product key.

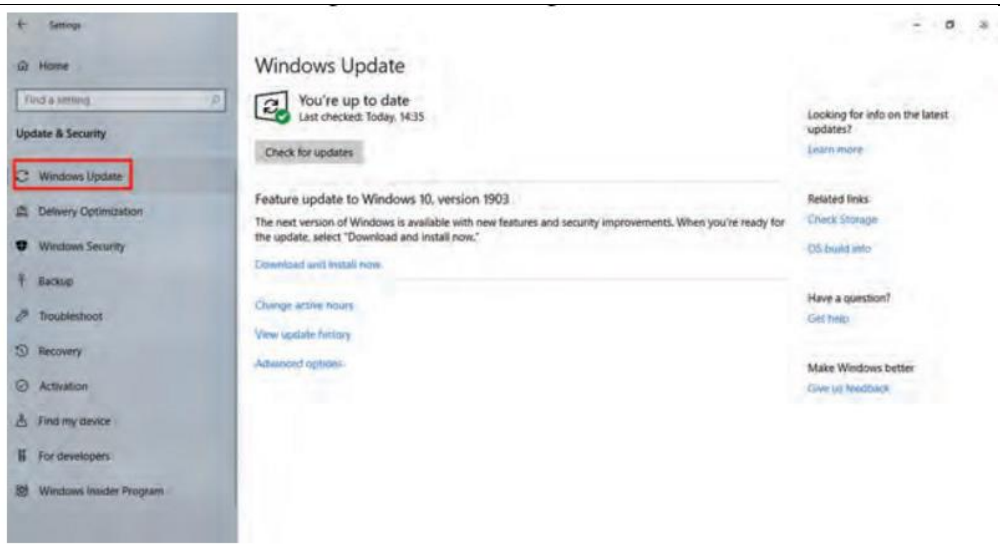

Fig. 2.26 Selecting activation

(v) To install the latest updates:

(i) Open 'Settings'.

(ii) Click on 'Update &' Security'.

(iii) Click on 'Windows Update'.

Check Your Progress

A. Multiple choice questions (MCQs)

1. When was the first version of the Windows Operating System released? (a) 1980 (b) 1985 (c) 1990 (d) 1995
2. Which Windows version introduced the Start menu and taskbar? (a) Windows 1.0 (b) Windows 3.1 (c) Windows 95 (d) Windows XP
3. What is the minimum required RAM for installing the 64-bit version of Windows 10? (a) 1 GB (b) 2 GB (c) 4 GB (d) 8 GB
4. Which tool is used to create a bootable USB drive for Windows 10 installation? (a) Device Manager (b) Media Creation Tool (c) Task Manager (d) Windows Update
5. What is the primary difference between an upgrade installation and a clean installation of Windows 10? (a) Upgrade installation retains files and settings, while clean installation erases all data. (b) Upgrade installation erases all data, while clean installation retains files and settings. (c) Both methods retain all data. (d) Both methods erase all data.
6. Which setting must be configured to boot from a USB drive for Windows 10 installation? (a) Control Panel (b) Disk Management (c) BIOS/UEFI (d) Task Manager
7. How do you access Disk Management in Windows 10? (a) Right-click the Start button and select "Disk Management" (b) Open Task Manager and go to "Disk Management" (c) Use Control Panel to open "Disk Management" (d) Press Ctrl + Alt + Delete and select

"Disk Management"

8. What task is NOT performed after installing Windows 10? (a) Install updates (b) Configure user accounts (c) Install drivers (d) Uninstall Windows 10
9. Which version of Windows OS is known for significant performance improvements over Windows Vista? (a) Windows XP (b) Windows 7 (c) Windows 8 (d) Windows 10
10. What is one of the main features introduced in Windows 10? (a) Aero interface (b) Start screen (c) Cortana assistant (d) Internet Explorer

B. Fill in the blank questions

1. The first version of the Windows Operating System was released in the year _____.
2. Windows 95 introduced the _____ menu and taskbar.
3. To install the 64-bit version of Windows 10, a minimum of _____ GB of RAM is required.
4. The _____ tool is used to create a bootable USB drive for Windows 10 installation.
5. During a clean installation of Windows 10, all existing data is _____.
6. To configure the correct boot order for Windows 10 installation, you need to access the _____ settings.
7. In Windows 10, Disk Management can be accessed by right-clicking on the _____ button and selecting "Disk Management."
8. After installing Windows 10, one of the first tasks is to install _____ to ensure the OS is up to date.
9. Windows 7 is known for its significant performance improvements over Windows _____.
10. One of the main features introduced in Windows 10 is the _____ assistant.

C. Ture or False

1. Windows XP was released before Windows 95.
2. Windows Vista introduced the Aero graphical interface.
3. The minimum required RAM for installing the 64-bit version of Windows 10 is 4 GB.
4. A clean installation of Windows 10 retains all files and settings from the previous version.
5. To install Windows 10 from a USB drive, you must configure the boot order in BIOS/UEFI settings.
6. Disk Management in Windows 10 can be accessed by right-clicking the Start button.
7. Post-installation tasks for Windows 10 include installing updates and drivers.
8. Windows 8 introduced the Start screen instead of the Start menu.
9. Windows 10 includes the Cortana digital assistant.
10. The first version of the Windows Operating System was released in 1990.

D. Short Questions

1. Describe the evolution of the Windows Operating System from its inception to the

present day. Include major versions and their significant features.

2. What were the major features introduced in Windows 95, and why were they significant?
3. Explain the system requirements for installing the 64-bit version of Windows 10. Why are these requirements important?
4. Outline the steps involved in installing Windows 10 from a bootable USB drive. What preparations must be made before beginning the installation?
5. Compare and contrast an upgrade installation and a clean installation of Windows 10. What are the advantages and disadvantages of each method?
6. Explain how to configure the BIOS/UEFI settings to boot from a USB drive. Why is this step necessary for installing Windows 10?
7. What are the functionalities of the Disk Management tool in Windows 10? Describe how to access and use this tool.
8. Detail the process of performing a clean installation of Windows 10. What are the key steps and considerations?
9. List and explain the post-installation tasks that should be completed after installing Windows 10. Why are these tasks important?
10. How did the introduction of the Cortana digital assistant in Windows 10 change the user experience? What are some of the key features of Cortana?

Session 3. Configure Windows Operating System

An operating system or GUI (graphical user interface), the desktop is the primary place to display and organize icons on a screen. The Microsoft Windows desktop was introduced with Microsoft Windows 95 and is included with every version of Windows since then. The Figure 3.1 below is an example of the Microsoft Windows 10 desktop.

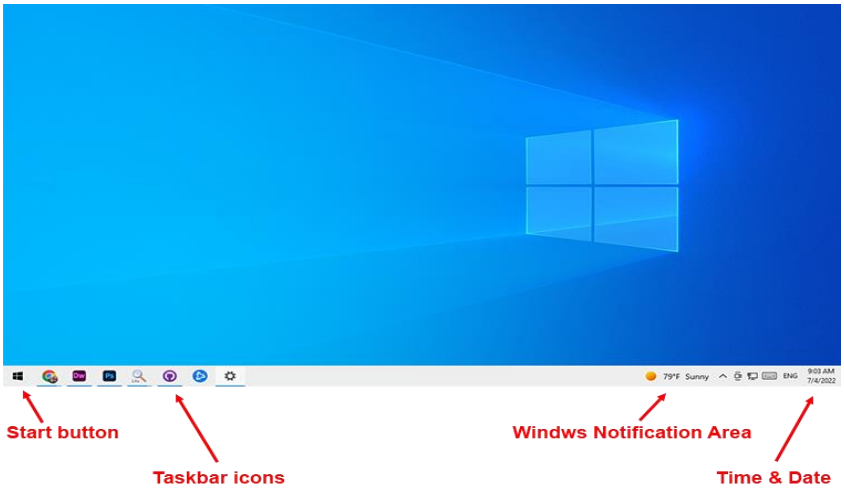

Fig. 3.1 Microsoft Windows 10 desktop

In this example, there are no icons on the desktop, and the wallpaper is a blue screen with

the Windows 10 logo. Also, the taskbar is at the bottom of the desktop and contains the Start, taskbar icons, Windows Notification Area, and the time and date.

Common icons on the desktop include those for My Computer, Recycle Bin, your Internet browser (e.g., Internet Explorer), and My Documents. On the Windows desktop, you can find the Windows Start menu through the Start on the taskbar, and the Windows Notification Area.

If some or all of these icons are missing on the desktop, you can change which icons are displayed. Follow the steps to show or hide these icons.

Missing icons in Windows 10

Step1. Right-click an empty area on the desktop and select Personalize.

Step 2. In the window that opens, click Themes in the left navigation menu.

Step 3. Scroll down and click Desktop icon settings under Related Settings.

Step 4. In the Desktop Icon Settings window, select the check boxes next to the icons you want to display.

Step 5. Click Apply, and then OK.

or

Step 1. Click Start or press the Windows key.

Step 2. Type themes and related settings and press Enter.

Step 3. Scroll down and click Desktop icon settings under Related Settings.

Step 4. In the Desktop Icon Settings window, select the check boxes next to the icons you want to display.

Step 5. Click Apply, and then OK.

The date and time are also shown on the desktop in the notification area on the taskbar. If the date and time are incorrect, you can change the date and time from the desktop.

Setting date and time in the operating system

Note: Windows 10 and Windows 11 automatically adjust the date and time for you and only let you adjust the time if you disable the automated feature. If the wrong date and time are set, or you must change the time or time zone, follow the steps below.

Step 1. Right-click or tap the date and time in the Windows Notification Area in the bottom-right corner of the screen.

Step 2. Select Adjust date/time from the pop-up menu.

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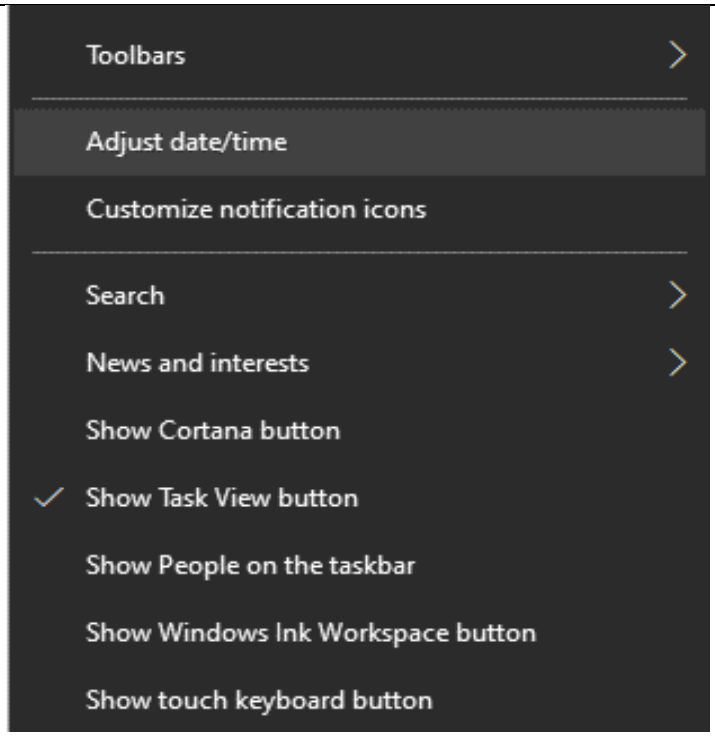

Fig. 3.2 Windows notification area

Step 3. If you want the time set automatically, ensure the toggle switch for the Set time automatically option is in the On position and your Time zone is correct.

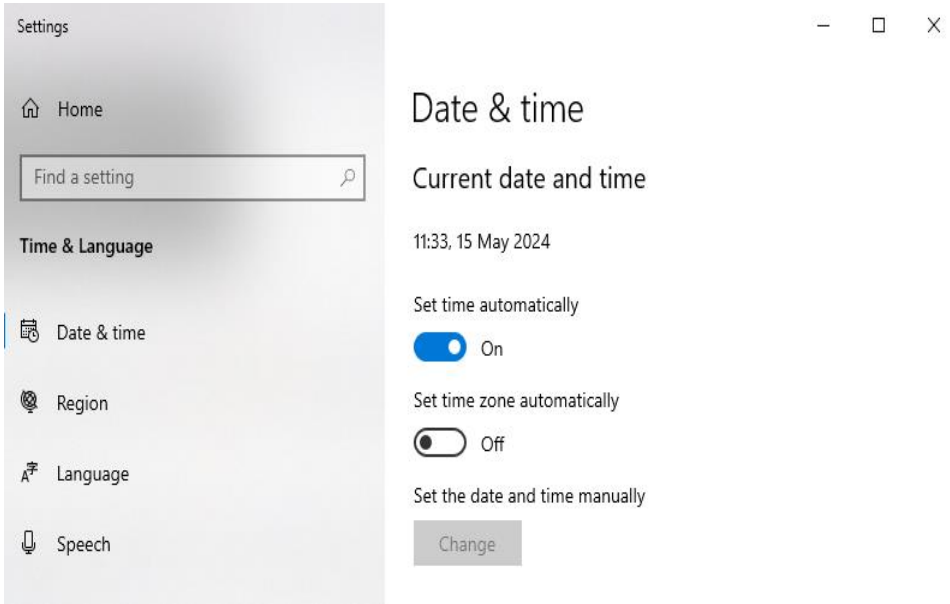

Fig. 3.3 Setting Date & Time

Step 4. To manually adjust the time, click the toggle switch under Set time automatically option so that it's in the Off position, then click the Change button.

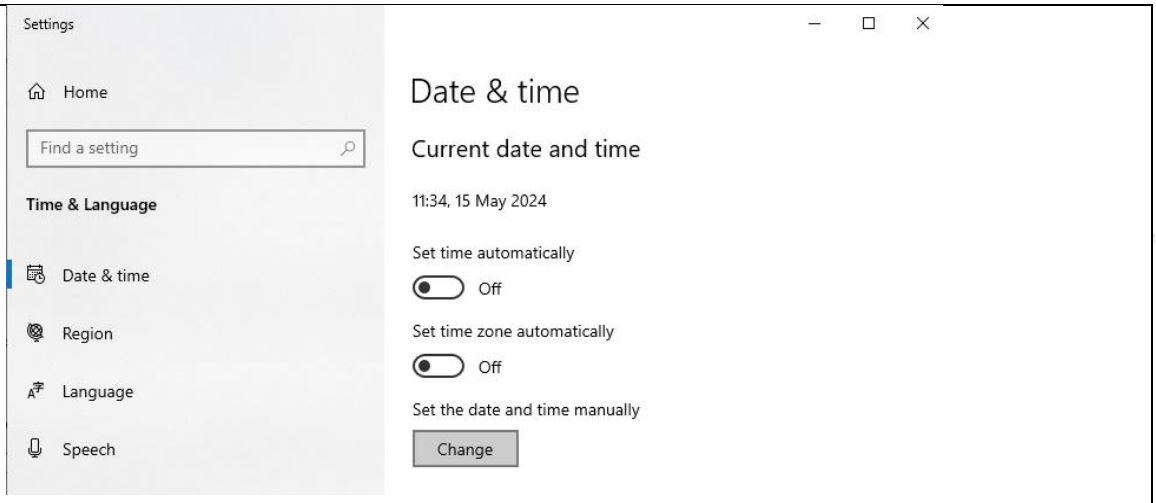

Fig. 3.4 Set time automatically option current date & time

Step 5. In the window, adjust the date or time as desired, and click the Change button.

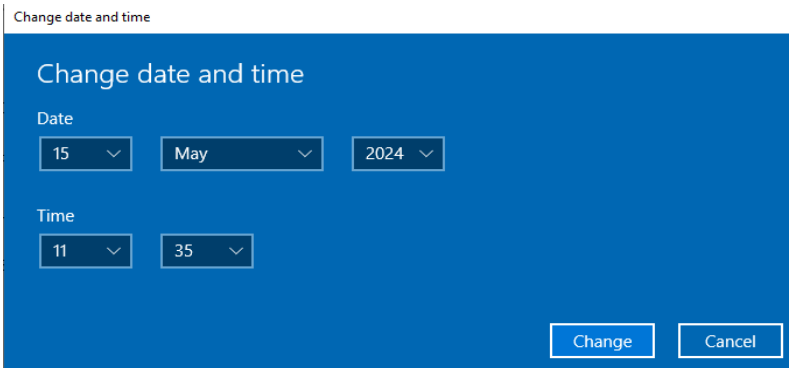

Fig. 3.5 Adjust the date or time

Windows taskbar

The Windows taskbar is one of the core components of the operating system's GUI (Graphical User Interface) and has many features and uses. The taskbar is located at the bottom (by default) of the Microsoft Windows desktop. In addition to showing the running programs, the taskbar also displays the Start button and Start menu, pinned programs, the time, notification area and, in some versions, Quick Launch. The following Figure shows various iterations of the taskbar in the different versions of Windows.

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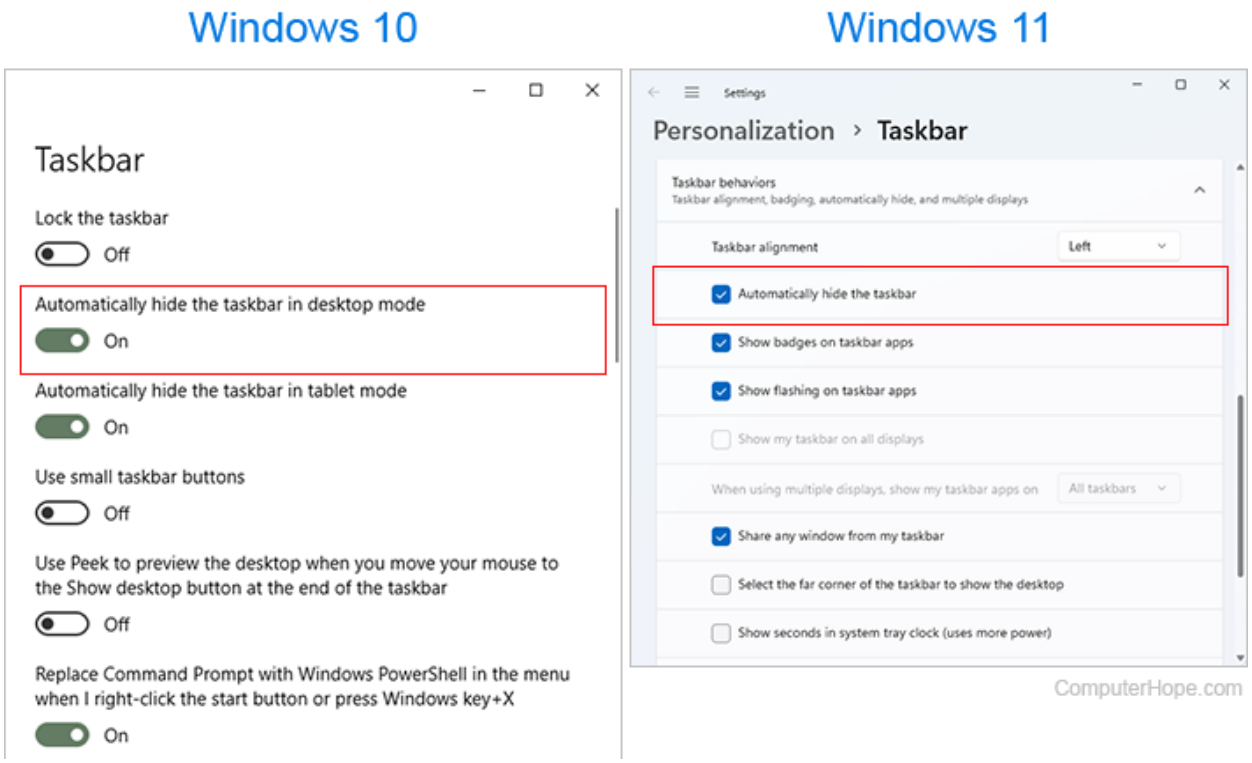
Fig. 3.6 Window Taskbar

If you don't see the taskbar, it's usually because it is hidden or was dragged down too far. Follow these steps to resolve this issue.

How to toggle auto-hide for the taskbar

Step 1. Press the **Windows key**, type **Taskbar settings**, and press **Enter**.

Step 2. In the Taskbar window, look for the "automatically hide" option.



Step 3. Click the toggle switch or uncheck the box next to the Automatically hide the taskbar entry to restore its default functionality (showing at all times).

Load to Safe Mode to fix the taskbar

If you still cannot get the taskbar to show, reboot the computer in Safe Mode. Then, restart the computer again to restore the taskbar.

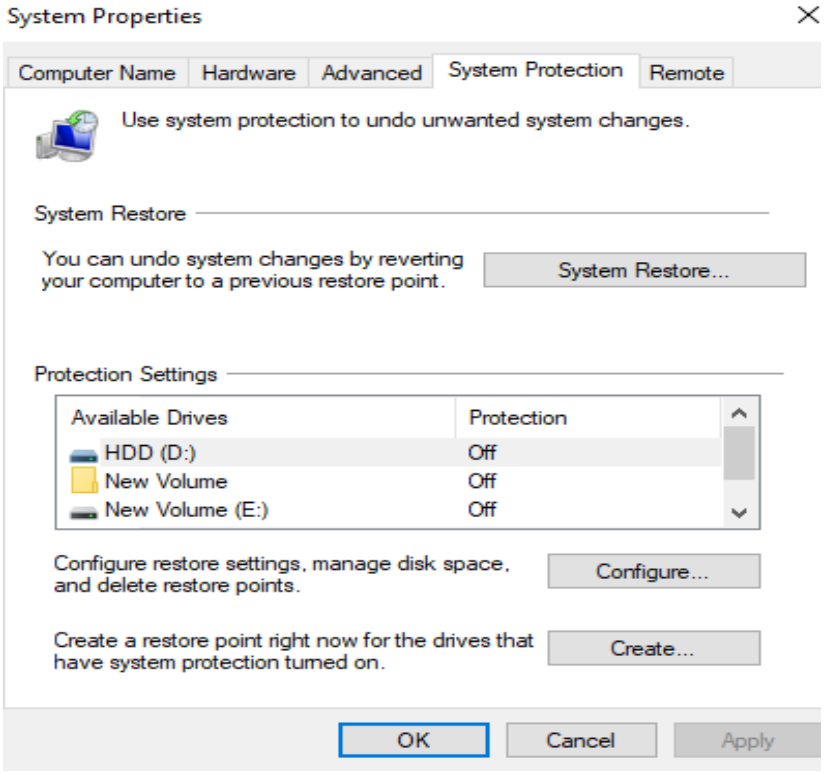
Restore Windows to an earlier point or version

If, after trying the three options above, the taskbar is still not showing, your computer may have corrupt system files that are preventing the taskbar from showing. To fix this issue, try restoring Windows to an earlier version or previous restore point.

How to do a System Restore in Windows 11

Step 1. Press the **Windows key**, type **restore point**, and press **Enter**.

Step 2. At the top of the System Properties window that opens, on the **System Protection** tab, click the **System Restore** button.



Step 3. In the System Restore window that opens, the date of the most recent change or update to your computer is recommended, by default. To restore Windows to that date, click the Next > button.

Step 4. Alternatively, if you know the date your problem started, select the **Choose a different restore point** option and click the Next > button. Select a restore point and click Next > again.

Step 5. Click the Finish button to start the restore process.

My taskbar moved to the left, top, or right side of the screen

Sometimes, users mistakenly move the taskbar to the left, top, or right side by accidentally dragging it to one of these locations. To return the taskbar to the default position (the bottom of the screen), follow the steps below.

Step1. Move the mouse cursor to where the time is displayed on the taskbar. In later versions of Windows, like Windows 10, move your cursor to an empty area of the taskbar.

Step 2. Press and hold the left mouse button, then move the cursor to the area on the screen where you want to move the taskbar.

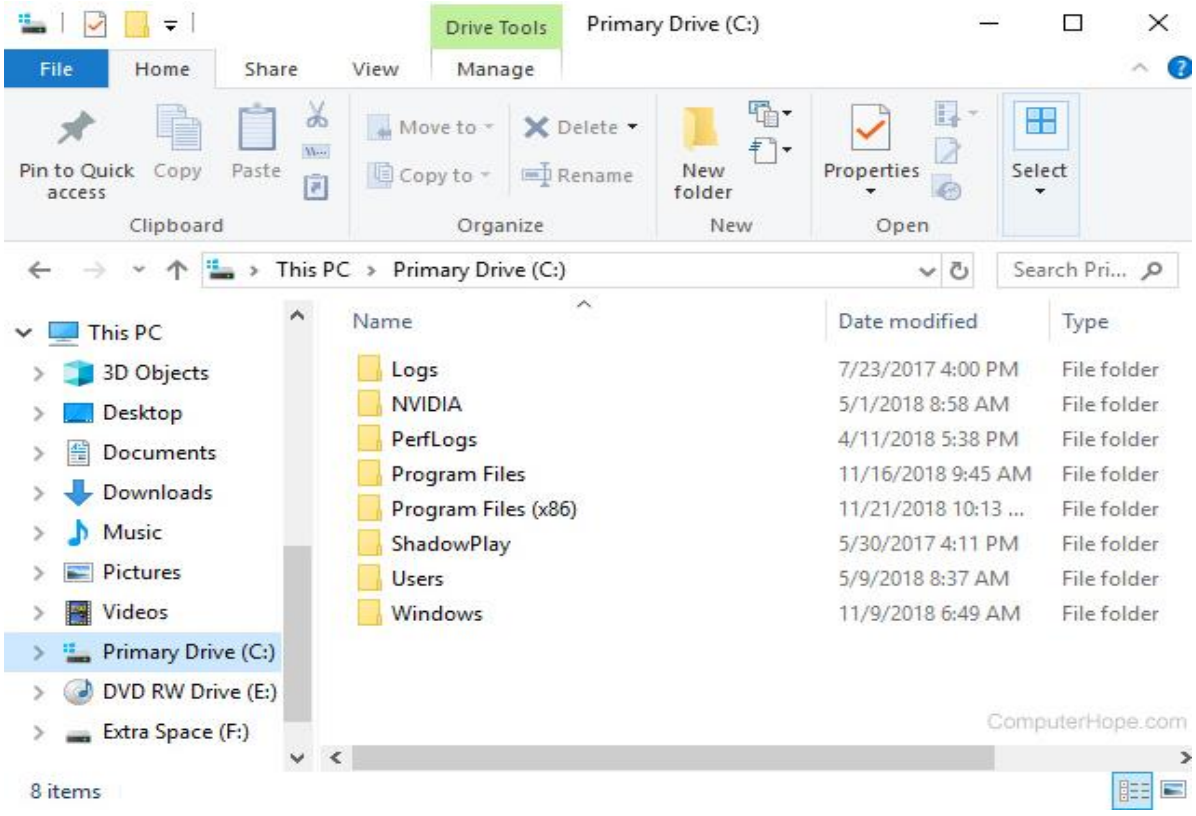
Step 3. Once you see the taskbar move to its new location, release the left mouse button.

Resize the taskbar

To resize the taskbar, move your mouse cursor to the top edge of the taskbar. When the mouse is in the correct position, the cursor should change to a double-headed arrow pointing up and down. Press and hold the mouse button and move the taskbar up or down to increase or decrease its size.

File Explorer

Alternatively called Windows Explorer or Explorer, File Explorer is a file browser found in every version of Microsoft Windows since Windows 95. It is used to navigate and manage the drives, folders, and files on your computer. The Figure below shows File Explorer in Windows 10.



How to open Windows Explorer

There are several ways to open a new Explorer window, which vary slightly depending on which version of Windows you are running.

In all versions of Windows

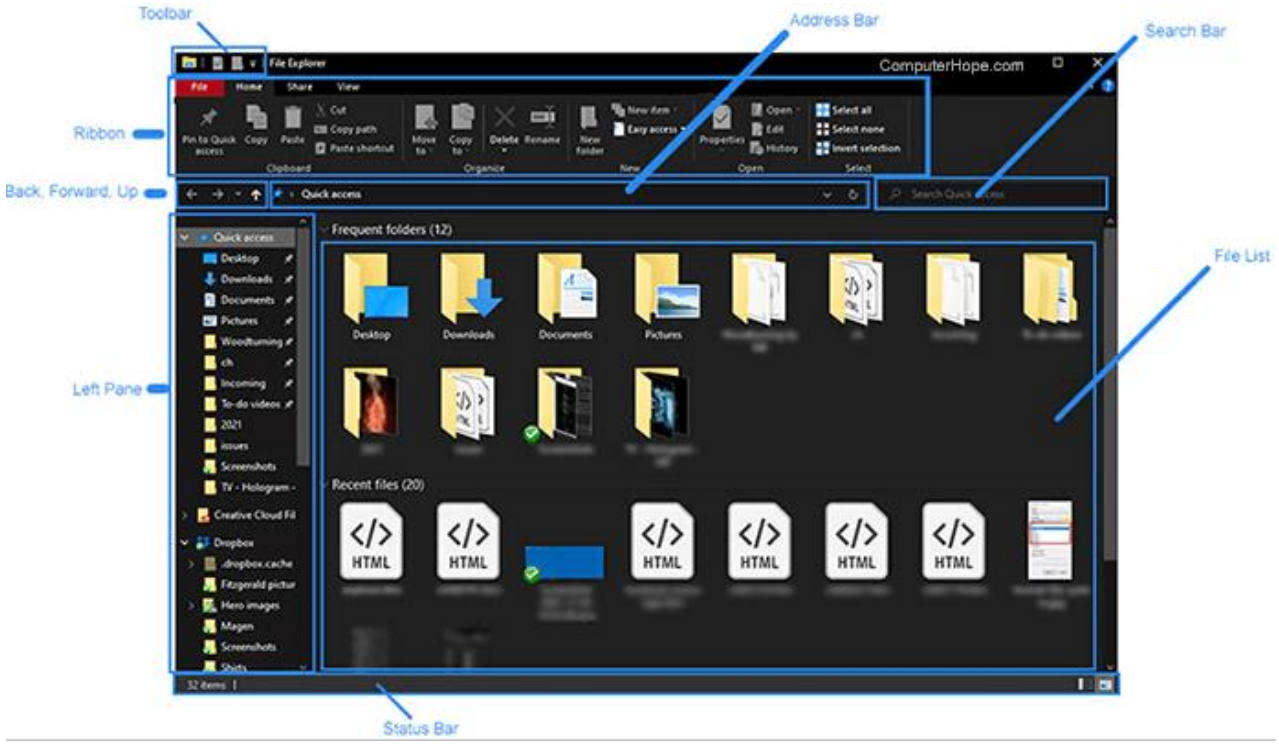
Press Windows key+E (hold down the Windows key and press E).

Click Start, select Run (or press Windows key+R), type explorer or explorer.exe, and press Enter.

If displayed on the Windows desktop, click or double-click the My Computer icon (named Computer in Windows Vista & 7, and This PC in Windows 8 & 10).

File Explorer sections

Below is a diagram of the different sections of File Explorer, with brief explanations of each.



Toolbar - A quick menu for navigating around File Explorer. You can customize what is shown here by clicking Customize Quick Access Toolbar.

Ribbon - Each section of the Ribbon, Home, Share, and View, has multiple options for accessing features and executing actions in File Explorer. For example, Home has standard features like copy and paste, and adding a new folder.

Back, Forward, Up - Pressing Back takes you to the last folder you were viewing. Pressing Forward, moves to the next folder. Pressing Up takes you to the drive or folder location of the object you're viewing, or to the Desktop folder, depending on your location in File Explorer.

Left Pane - Shows all the main devices and drives connected to your computer. It also shows the network your computer is connected to, if any.

Status Bar - Shows the number of files or folders in each location and each file or folder's size.

Address Bar - Shows your current location in File Explorer. You can also use this to type a drive or file you want to access.

Search Bar - Allows you to search for a drive, folder, or file name.

File List - Displays the current list of files in the selected drive or folder.

Region and language support in Windows 10

Windows 10 supports 111 languages of 190 countries and regions. If you want to change the language, you can download any of the additional languages for Windows 10. The following activity demonstrates how to add an input language to your PC.

Activities

Practical Activity 3.1 Configure Windows 10 for language support

Step 1. Open 'Settings'> 'Time and Language'> 'Region & Language'.

Step 2. Under 'Languages' select 'Add a Language'.

Step 3. Select the language you want to use from the list, as shown in Figure 1.

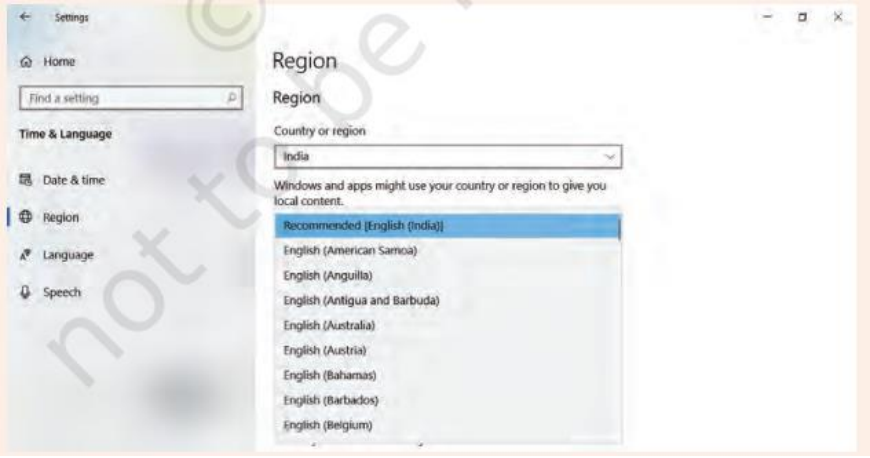


Fig. 3.1 Time and language window

Step 4. Windows 10 searches 'Windows Update' for the desired language and then installs it on your computer.

Step 5. Click the 'Check for updates' button as shown in Figure 3.2

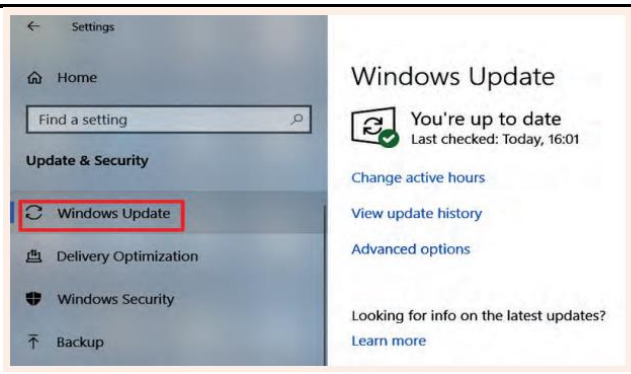


Fig. 3.2 Selecting 'Windows update' **Fig. 3.3 Check for updates**

Device driver

Step 3. To confirm that all the device drivers have been installed correctly, invoke the 'Device
Manager' through the Windows key as shown in Figure 3.4.

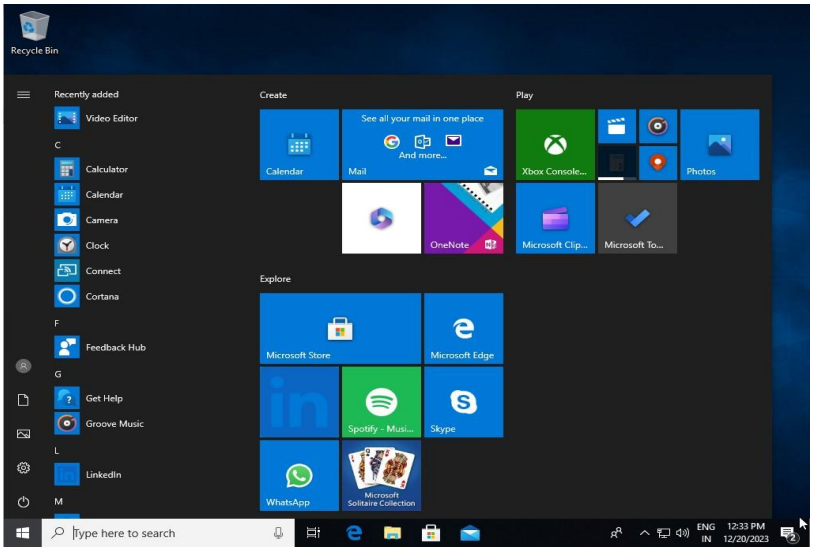


Fig. 3.5 Invoke device manager through the Windows key

Step 7. Search for 'Device Manager' as shown in Figure 3.3. The device manager window will
open as shown in Figure 3.7.

Step 8. Observe that the drivers for all the devices are installed. In the case of any missing driver, download the latest available driver for the device manufacturer and install it.

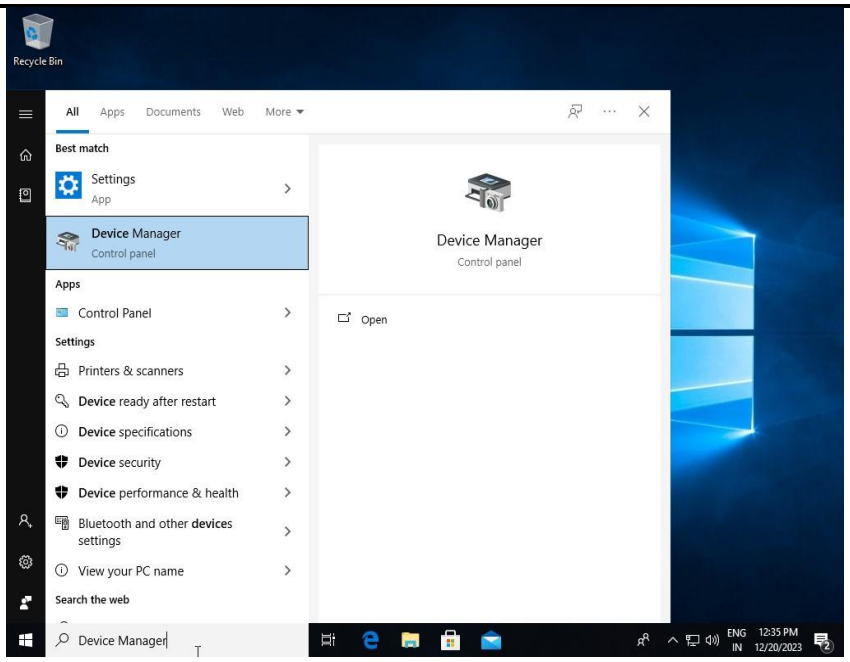


Fig. 3.7 Search device manage

Windows 10 automatically updates the device driver. If you do not want to update the device driver, then you can turn off the automatic installation of device driver. The following activity will demonstrate how to turn on or off the automatic installation of device driver.

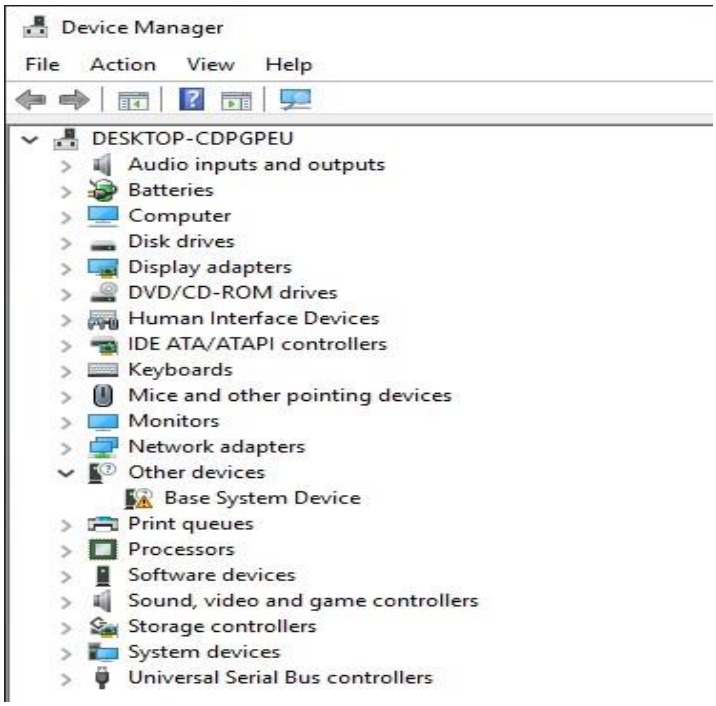


Fig. 3.8 Device manager window

Practical Activity 3.2 Turning off automatic installation of device driver

Step 1. Open 'Control Panel', click on 'Devices and Printers'.

Step 2. The icons of the various devices will be displayed. Right-click on the 'Desktop' icon. The Desktop icon shows your computer name. Then select and click on the 'Device installation settings', as shown in Figure 3.9.

Step 3. 'Device installation settings' dialog box will appear as shown in Figure 3.10. By default, the 'Yes' option is selected. Choose the option 'No' and then click on the 'Save Changes' button.

Fig. 3.11 Disabling the automatic device driver software installation

Step 4. The changes will be saved which will turn off the automatic updates.

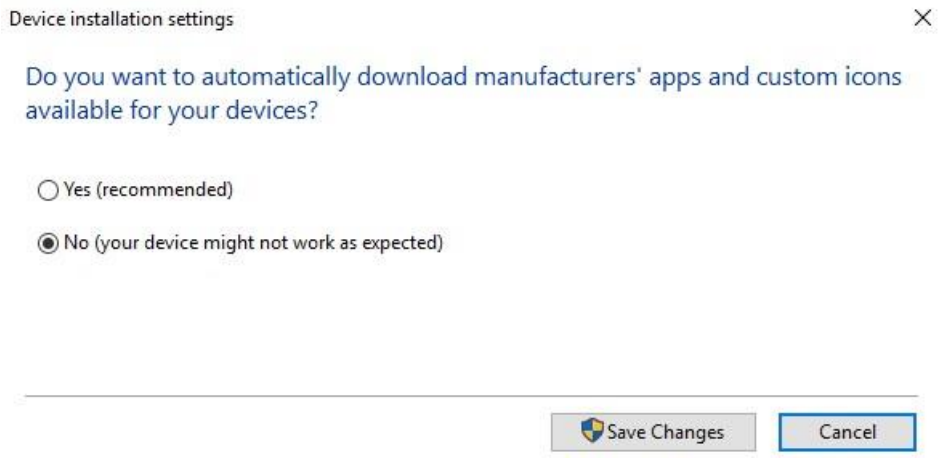


Fig. 3.12 Device installation setting dialog box

Static IP address configuration in Windows 10

To access Internet on your computer, you need to configure the network settings in Windows. Internet connection availability and access in Windows is indicated via an icon residing on the taskbar. If you see a yellow triangle exclamation mark on the network

icon, it means that, it has limited network connectivity.

Fig. 5.22: Selecting network access option

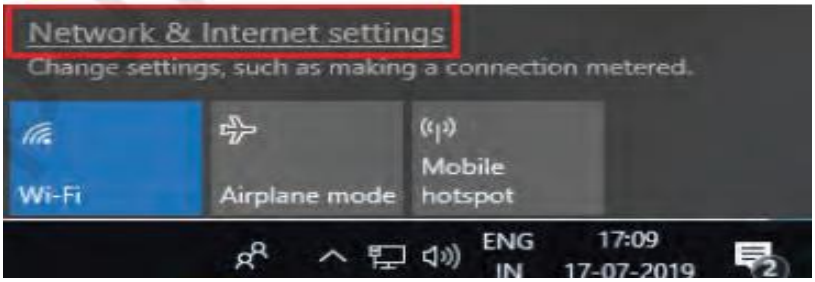


Fig. 3.13 Open 'Network & Internet setting'

Step 5. Right click the network icon in the taskbar and select 'Open Network & Internet settings' as shown in Figure 3.14.

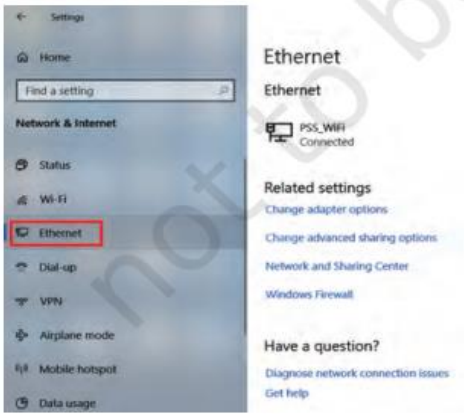


Fig. 3.14 Open ethernet setting

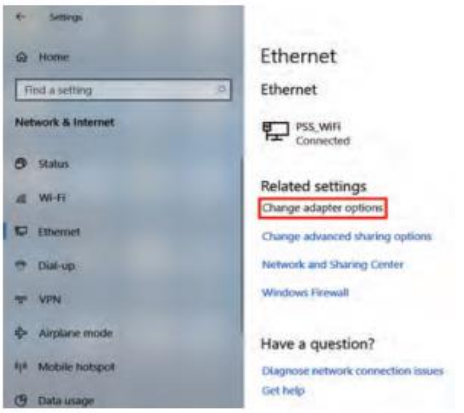


Fig. 3.15 Change adapter options

Step 3. In the 'Open Network & Internet Setting' window, click on 'Ethernet' as shown in Figure 3.16, to see the settings of your connection. You can change the related settings as shown in Figure 3.17.

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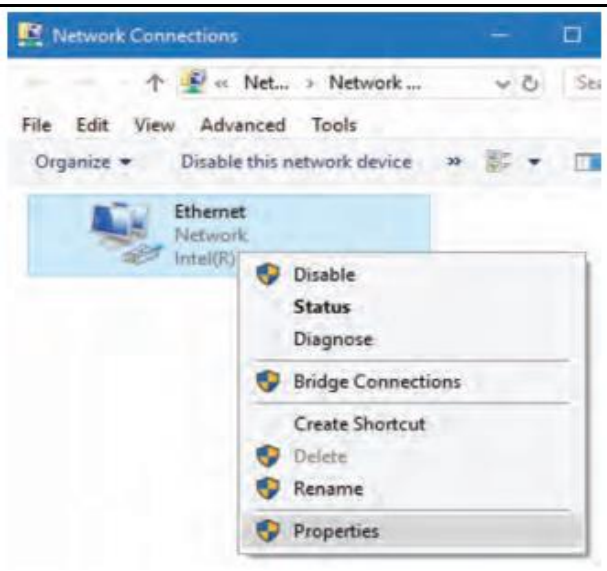


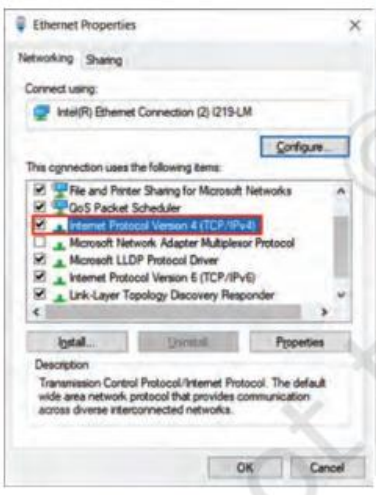
Fig. 3.17: Ethernet properties

Step 7. Right click your active network adapter and choose 'Properties', as shown in Figure 3.18.

Step 8. Under 'This connection is using the following items', double click on 'Internet Protocol Version 4 (TCP/ IPv4)', as shown in Figure 3.19 to change the current IP address and the DNS server.

Step 9. Select 'Use the following IP address' as shown in Figure 3.20, and you will be able to edit the IP and DNS fields. You should know what IP address to put as the gateway and subnet mask.

Step 5. Enter the valid IP address, subnet mask, and default getaway as shown in Figure 3.21.



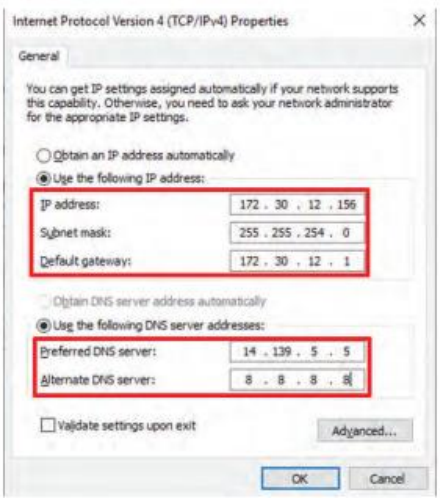


Fig. 3.19 Selecting IPv4 **Fig. 3.20 IPv4 properties** **Fig. 3.21 Giving IP address**

Step 11. You can see the network connection details by clicking on the 'Details' as shown in Figure 3.22. The connection details will be displayed as shown in Figure 5.34.

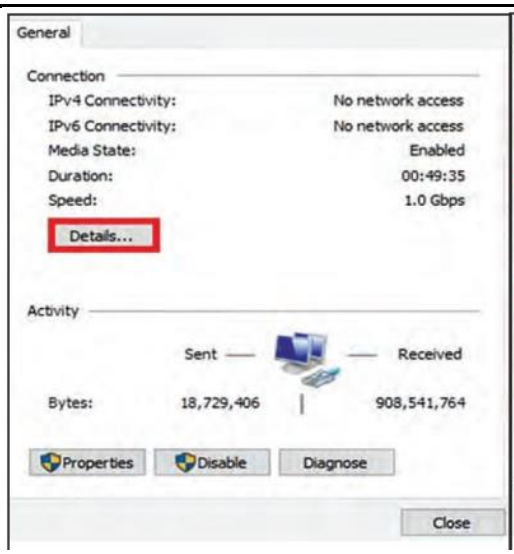


Fig. 3.22 Ethernet status

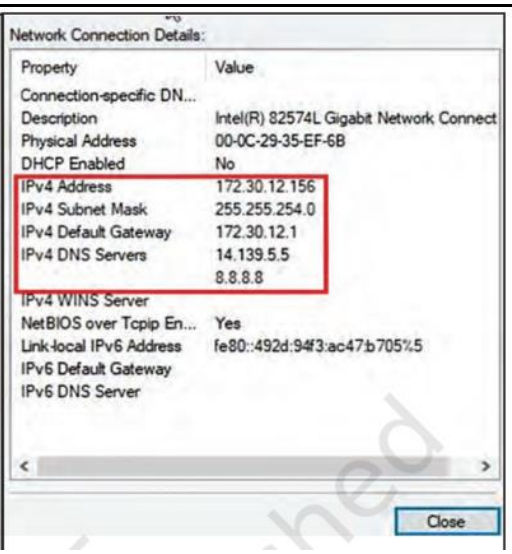


Fig. 3.23 Network connection details

5.5 Performing a Clean Installation of Windows 11

Performing a clean installation of Windows 11 involves wiping your hard drive completely and installing a fresh copy of the operating system. Here's a step-by-step guide:

Practical Activity 3.3 Clean install of windows 11

Step1. Navigate to the Windows 11 ISO page.

Step 2. Select Windows 11 from the menu under "Download Windows 11 Disk Image (ISO)." If you want to go straight to creating a USB Flash drive, you can download the Windows 11 Installation Media tool from here. See the section below for step-by-step details on how to do that.

Fig. 3.24 download iso image

Step 3. Click Download.

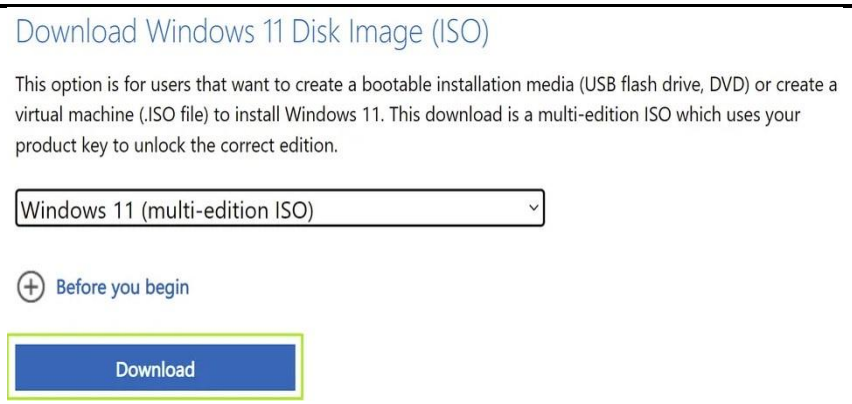


Fig. 3.25 select windows edition

Step 4. Select your language and click confirm.

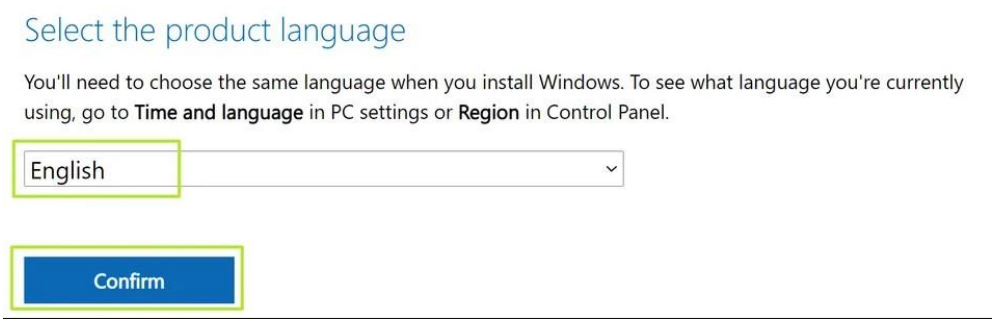


Fig. 3.26 Product language

Step 5. Click the download button that appears.

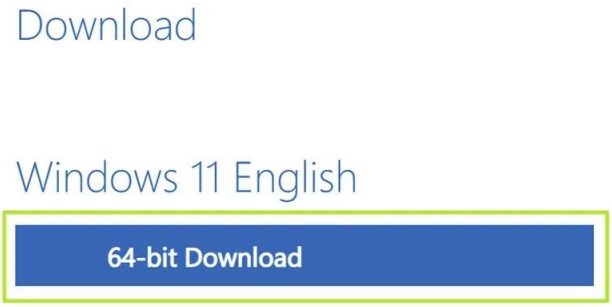


Fig. 3.27: Download window 11 64 bit

The ISO file will now download to your computer.

Create a Windows 11 Install Disk with Media Creation Tool

If you don't want to keep a copy of the latest Windows 11 ISO on your storage drive and just want to have a bootable USB Windows 11 install disk, the easiest way is to use Microsoft's media creation tool. Here's how.

1. Connect a USB Flash drive to your PC. It must be at least 8GB and have no data on it you want to keep. This process will overwrite the whole disk.

2. Navigate to Microsoft's Windows 11 Download page.

3. Click Download Now under Create Windows 11 Installation Media to download the

Media Creation Tool.

Fig. 3.28 windows 11 installation media

4. Launch the Media Creation Tool.

5. Click Accept when shown the license agreement.

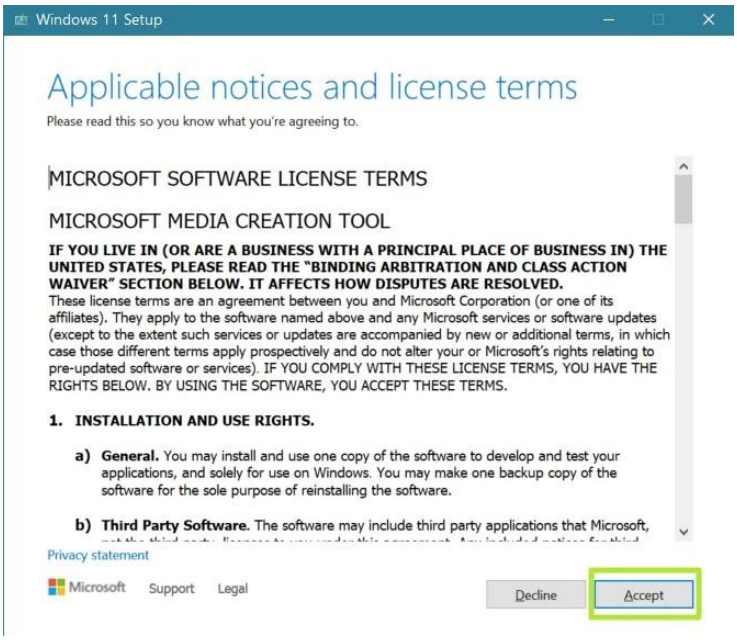


Fig. 3.29 window 11 setup accept license terms

3. Select your language and Edition and click Next. The default choices will probably be correct.

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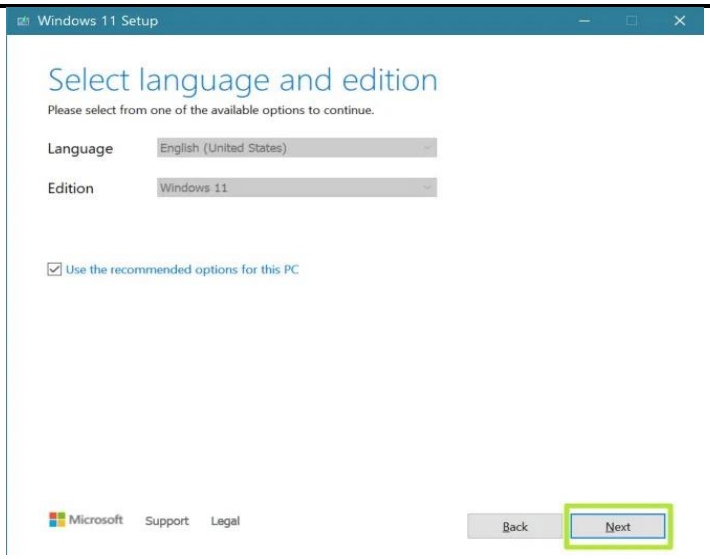

Fig. 3.30 Select language and edition

7. Select USB flash drive and click Next. You can also select ISO file here and create an ISO file instead if you don't have a drive ready.

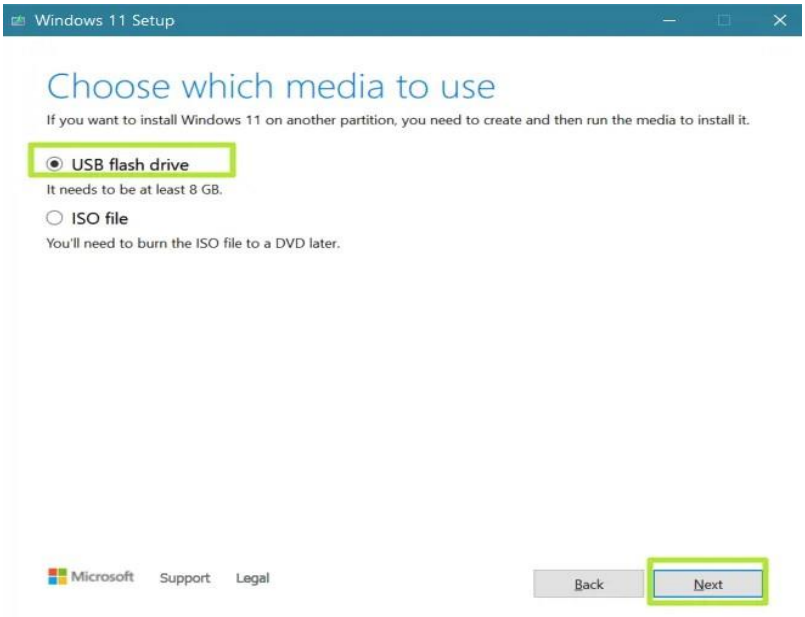

Fig. 3.31 choose a media

8. Select your USB Flash drive (if there's more than one choice) and click Next.

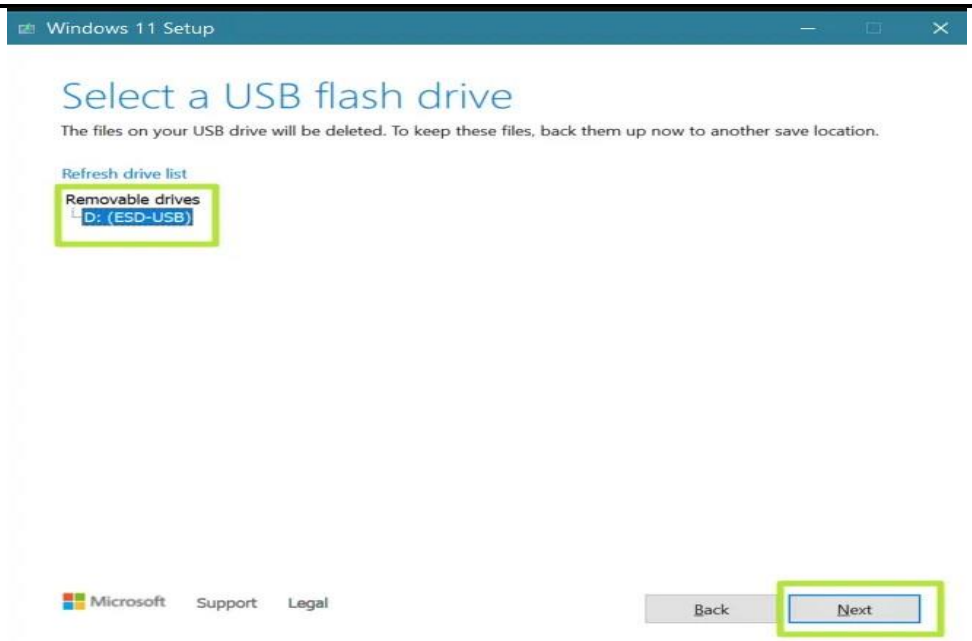

Fig. 3.32 Select USB flash drive

9. You will now have to wait several minutes while your computer downloads Windows 11.

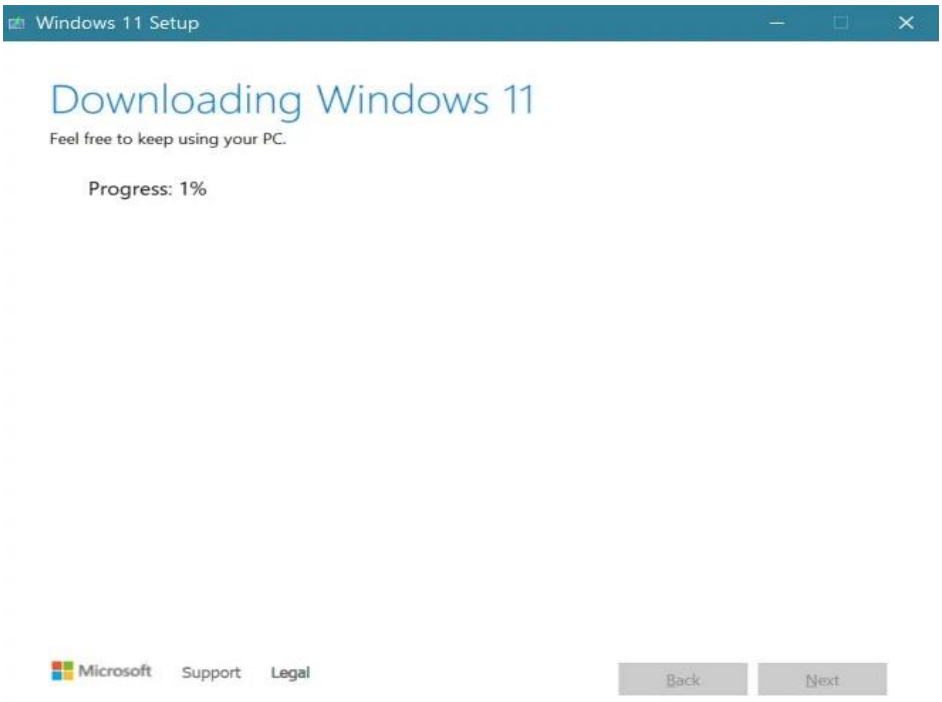

Fig. 3.33 window 11 downloading process

5. Click Finish when it says your USB Flash drive is ready.

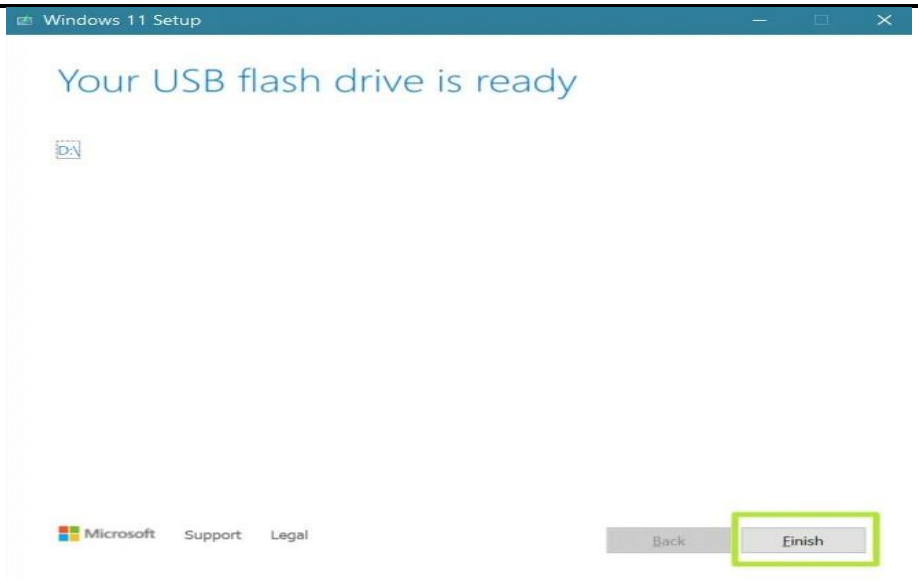

Fig. 3.34 USB flash drive ready

Making a Bootable Windows 11 Install Disk

Unless you're just installing Windows 11 onto a virtual machine, you will need to create a bootable Windows 11 install disk from the data in your Windows 11 ISO file. For that, you'll need an empty USB Flash drive that's at least 8GB. To write or "burn" your ISO file to a USB Flash drive, it's best to use Rufus, a free, third-party utility that will take care of arranges the partitions properly and making the disk bootable. You can also use Rufus to bypass Windows 11's TPM and Secure boot requirements if you choose.

1. Connect your USB Flash drive. Please note that you will be erasing all the data on it.

2. Download and launch Rufus (it does not install).

3. Select your USB drive if it's not already selected by default.

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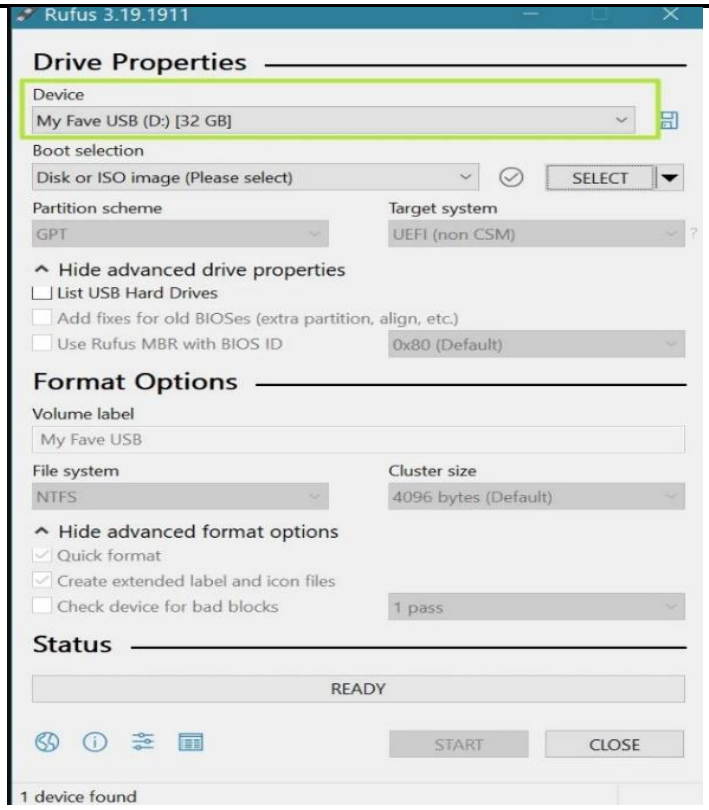

Fig. 3.35 Rufus bootable drive

4. Click Select and choose the ISO file from your storage drive.

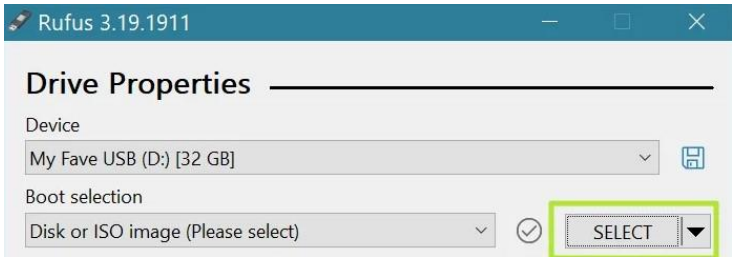

Fig. 3.36 Select the ISO image

5. Click Start at the bottom of the window.

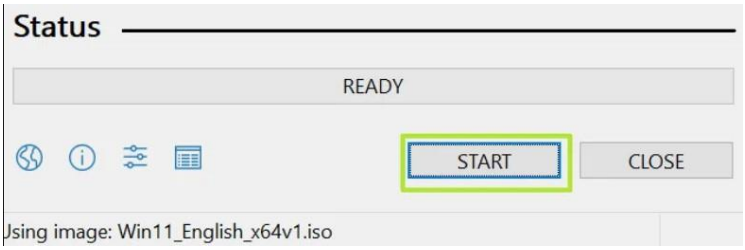

Fig. 3.37 Ready to boot the pen drive

3. Create a second partition and format it as NTFS. It should take all the remaining disk space.

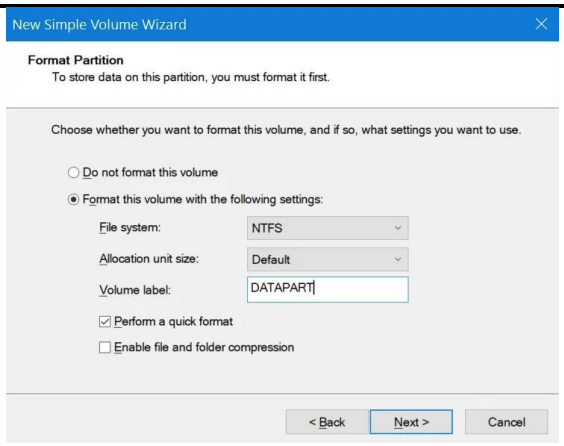

Fig. 3.38 New simple volume wizard

7. Check remove requirement for TPM, 4GB and data collection if you want. These are optional, but recommended and you must click Ok.

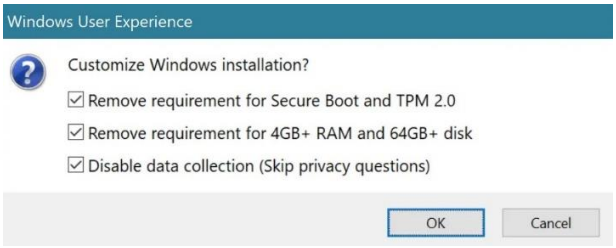

Fig. 3.39 window user experience

8. Click Ok if warned that the process will destroy all data on your USB Flash drive.

Fig. 3.40 warning message to continue this operation

Rufus will now take a few minutes to drive to your drive. When it is done, you will have a USB Flash drive that can boot to install windows.

Installing Windows 11 on the Target PC:

1. Boot your target PC off of the USB installation drive. You may need to hit a key or re-arrange the boot order to boot from USB.

2. Select your language (if it's not already selected) and click Next.

Fig. 3.41 Window setup

3. Click Install now.

Fig. 3.42 Install now

4. Enter your product key or click "I don't have a product key" if you don't have one. You can always enter it later or use Windows 11 as inactivated.

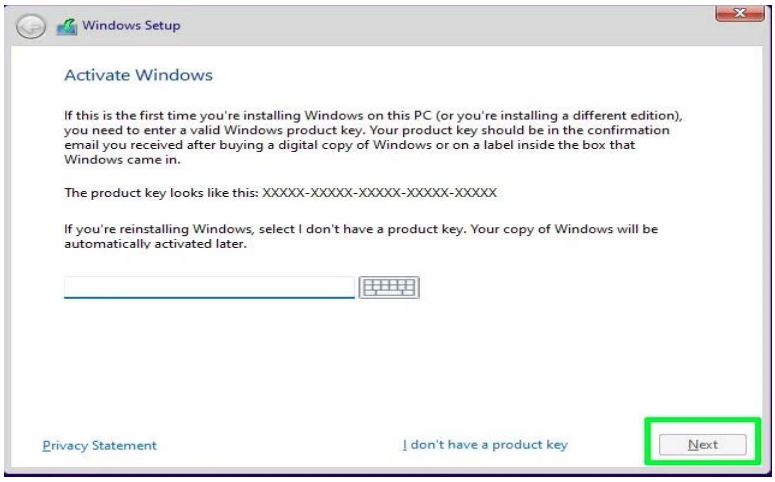

Fig. 3.43 Activation window setup

5. Select the Windows edition if given a choice of editions.

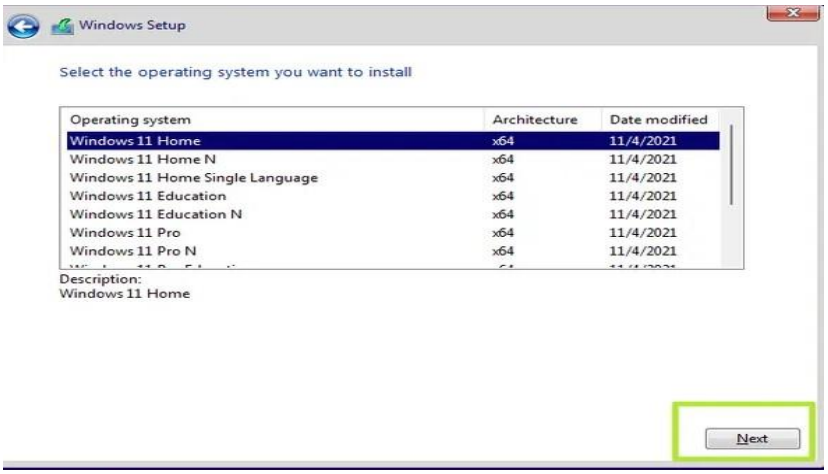

Fig. 3.44 Choose windows edition

3. Accept the license agreement and click Next.

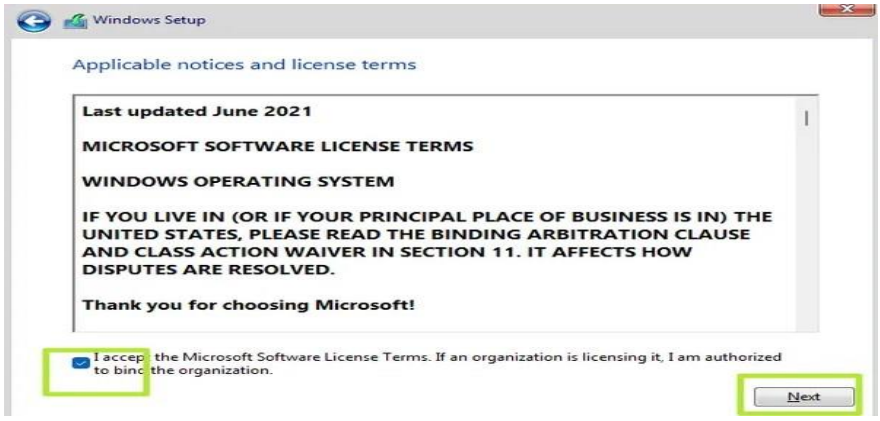

Fig. 3.47 windows accept license

7. Select Custom Install if prompted.

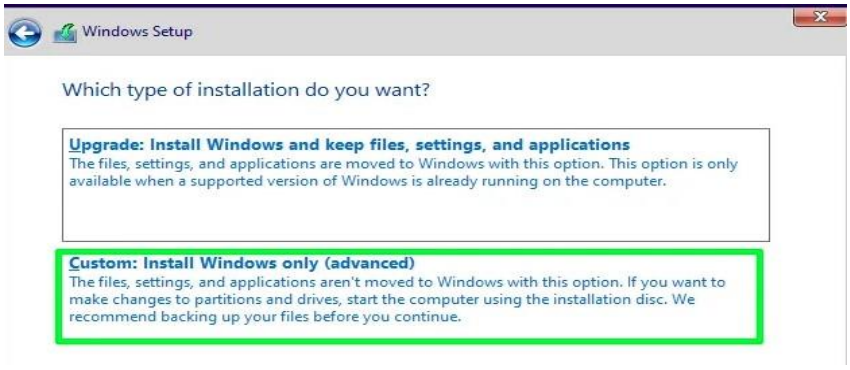

Fig. 3.48 choose type of installation

8. Choose the installation drive and click Next.

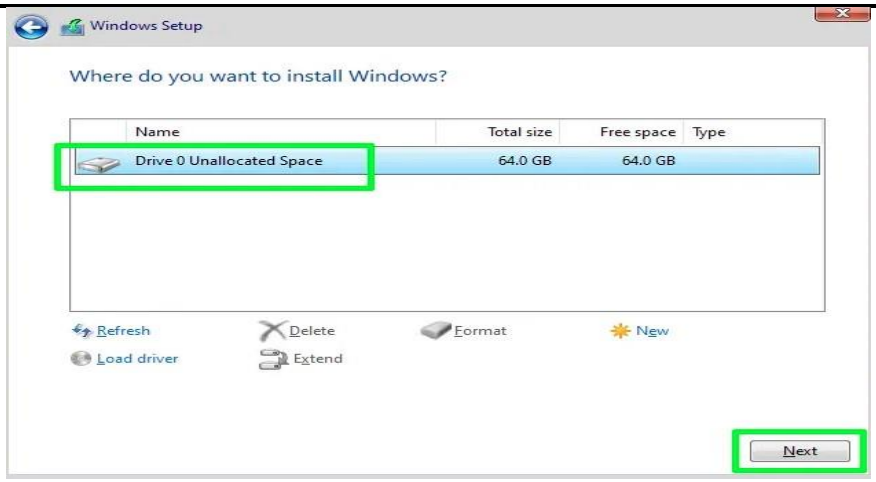

Fig. 3.49 drive unallocated space

9. The installer will copy some files and may reboot at this point.

Fig. 3.50 Installing windows copy files

5. Select your country or region (if it's not selected) and **click Yes**. Also, **select your keyboard layout** when prompted.

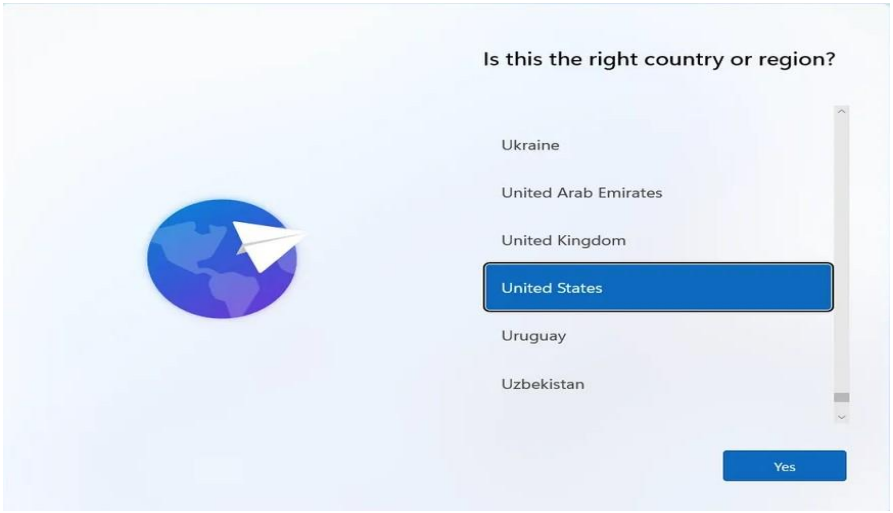

Fig. 3.51 choose the region

11. Name your device and **click Next**.

12. Sign in with your Microsoft account.

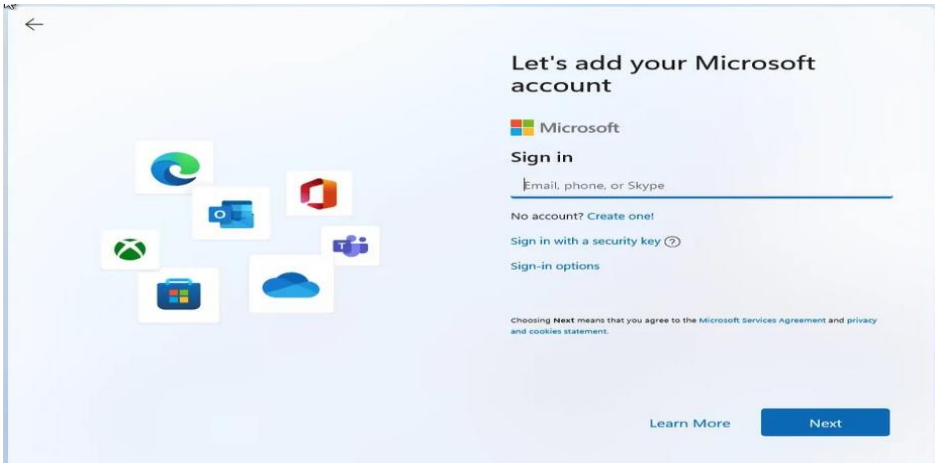

Fig. 3.52 add Microsoft account

13. Create a PIN for quick logins.

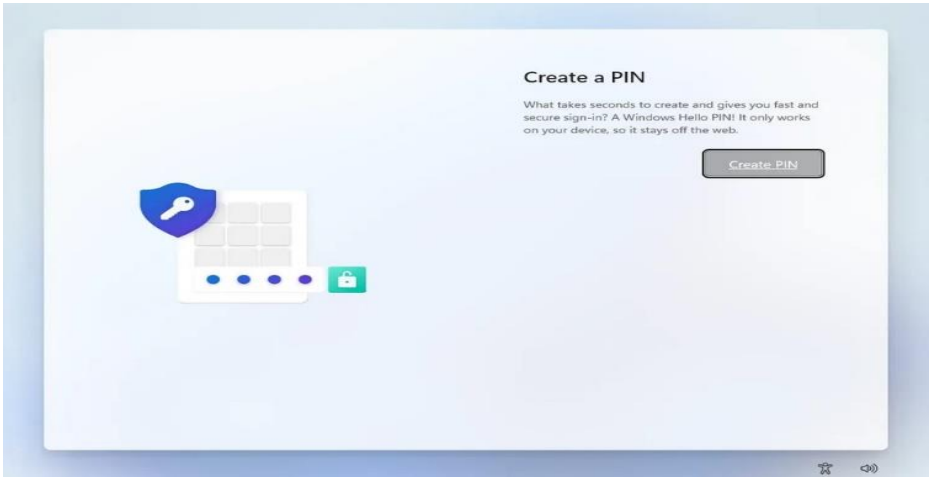

Fig. 3.53 create a pin

14. Click "Set up as new device" (or you can restore a previous config).

15. Click Skip if asked to customize your user experience. This is not necessary.

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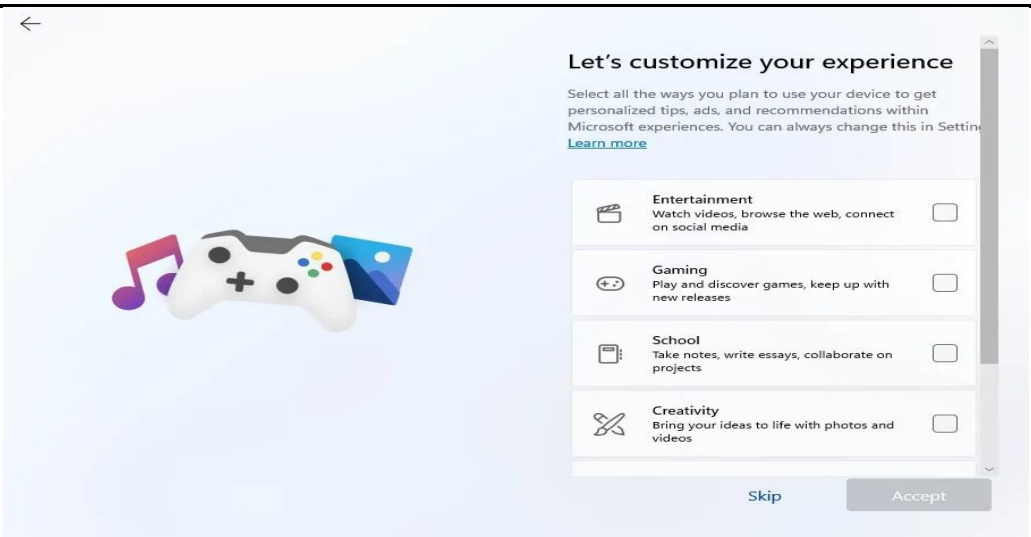

Fig. 3.54 choose the customize

13. Click Next on the Microsoft Account and OneDrive screen.

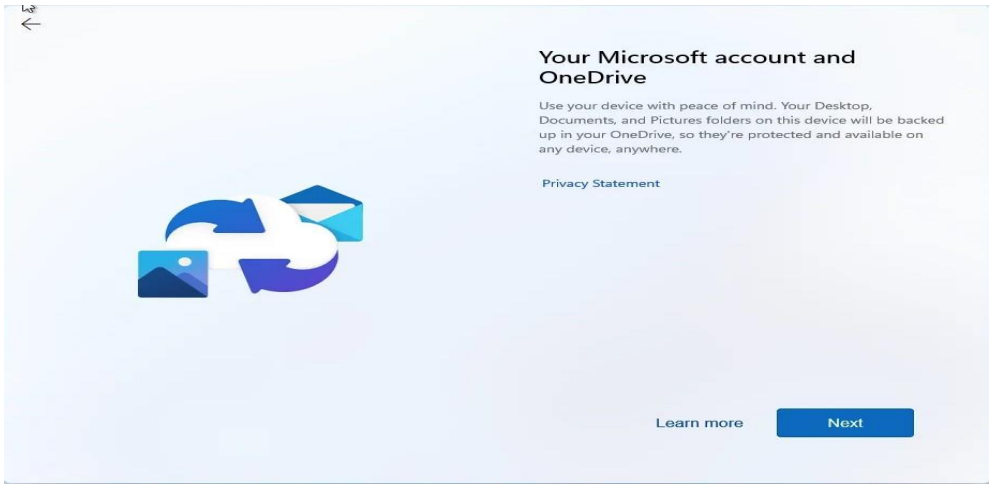

Fig. 3.55 add Microsoft account

17. Windows will now (finally) finalize the installation of Windows 11 using all of the settings you selected up to this point. Windows will ask you to wait will the installation wraps up, which only takes a few minutes on average.

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Fig. 3.56 add Microsoft account

5.8 Old version- Performing a Clean Installation of Windows 10

To perform a clean installation of Windows 10, insert a bootable media DVD or USB pen drive in your computer system, and press any key to boot from the bootable disk as shown in Figure 3.57. Let the disk allow the loading of the setup file as shown in Figure 3.58. Follow the steps below for clean installation of Windows 3.59.

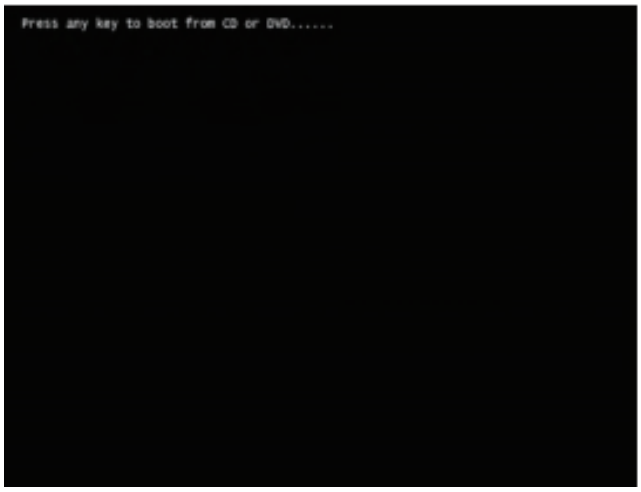


Fig. 3.57 Press any key for booting

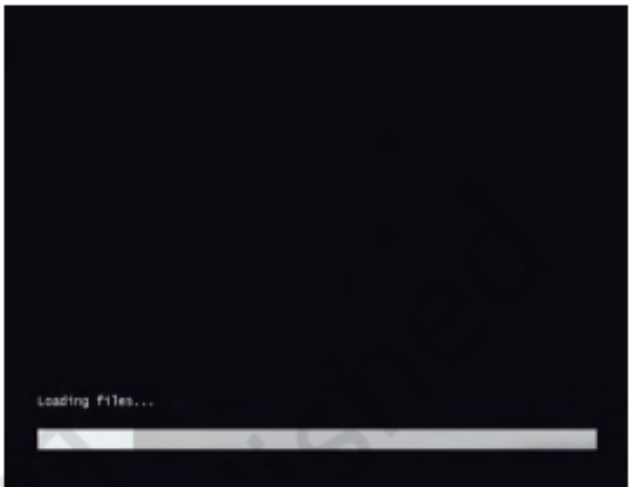
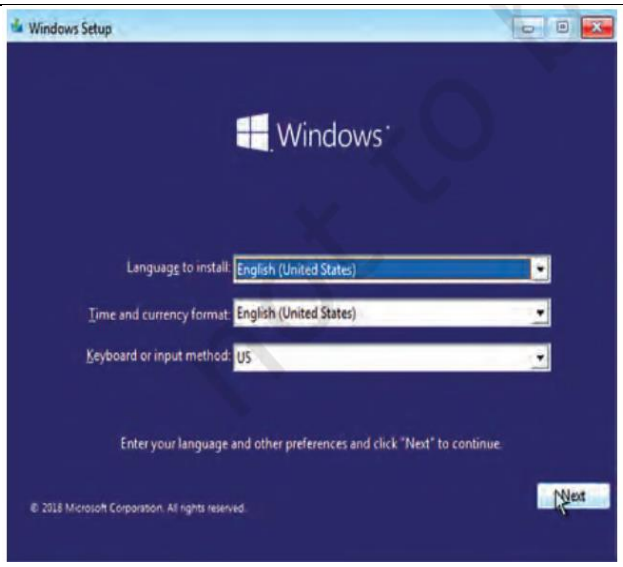


Fig. 3.58 Loading setup file

(i) Insert a bootable media DVD or USB pen drive in your computer system. Provide the details of language, time zone, and keyboard layout as shown in Figure 3.59. Then click on the 'Next' button.

(ii) Click the 'Install now' button as shown in Figure 3.60.



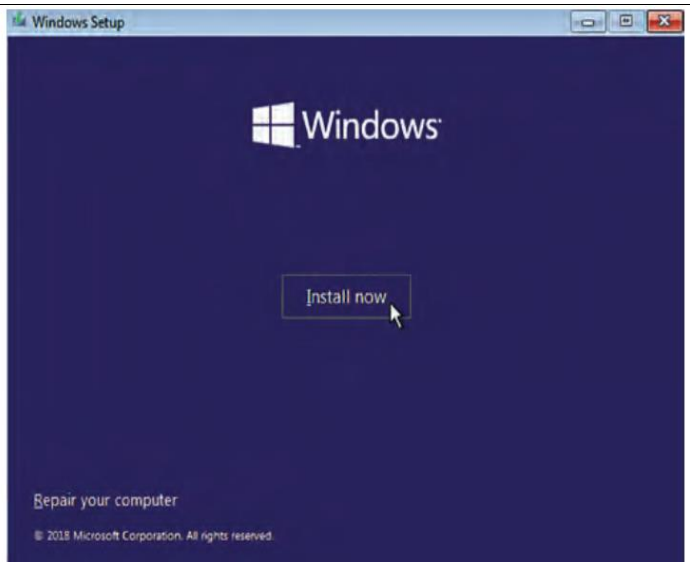


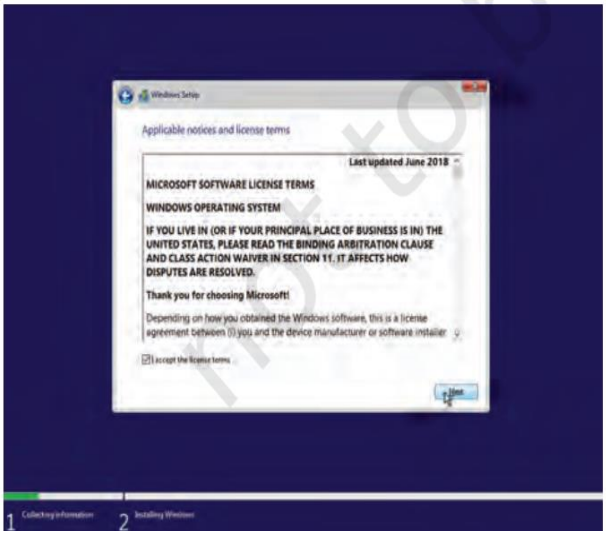
Fig. 3.59 Select language, time, and currency Fig. 3.60 Installation window and input

(iii) In the next window, you will be asked to enter the product key. Enter it and click on the 'Next' button to proceed. In case you don't have the product key currently, then you can skip to enter the product key by clicking on the option 'I don't have a product key' to continue the installation as shown in Figure 3.61 below.

(iv) A new window as shown in Figure 3.62 will appear where you have to accept the licence terms by putting the tick (□) on the checkbox 'I accept the license terms.

(v) Click the 'Next' button as shown in Figure 3.63.

(vi) Click on the 'Custom: Install Windows only (advanced)' option as shown in Figure 3.64.



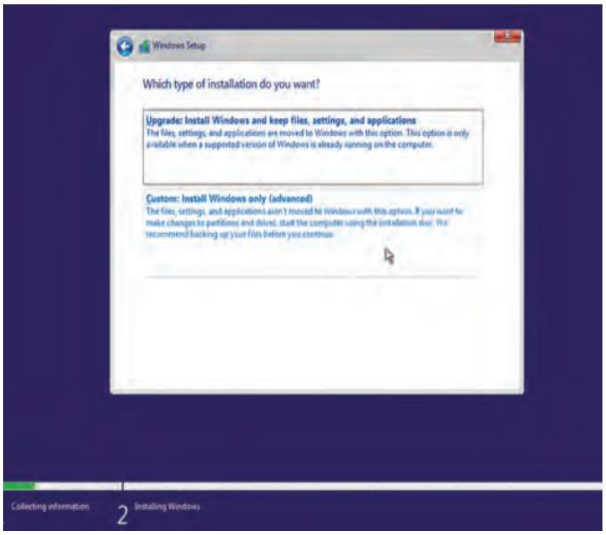


Fig. 3.63 License terms **Fig. 3.64 Selecting installation setup window**

(vii) Select the partition with the current installation of Windows (usually "Drive 0"), and click the 'Delete' button to remove it from the hard drive.

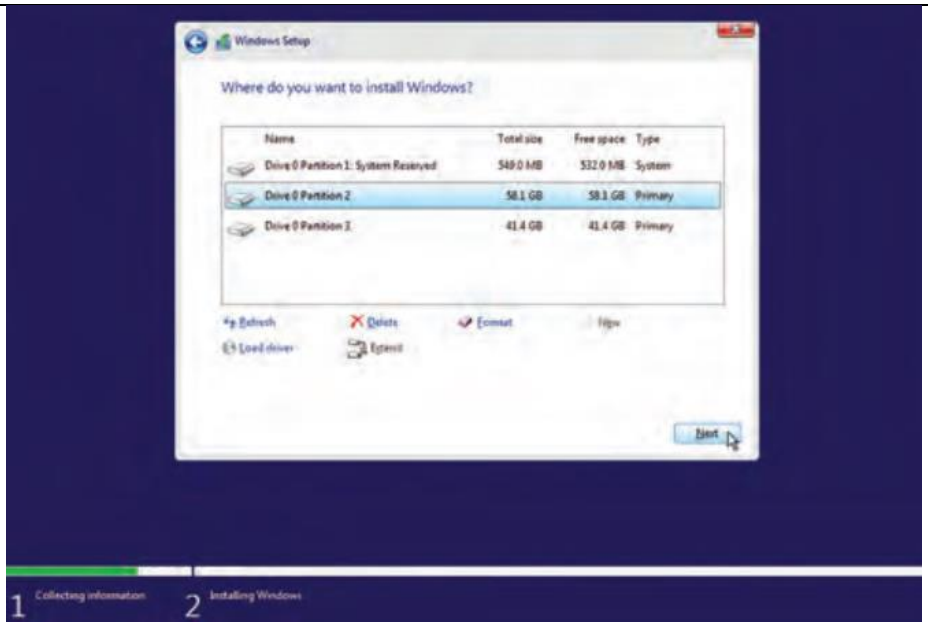


Fig. 3.65 Partition window

(viii) Click the 'Yes' button to confirm the deletion.

(ix) Select the empty drive ('Drive 0 Unallocated Space') and click on the 'Next' button as shown in Figure 3.63.

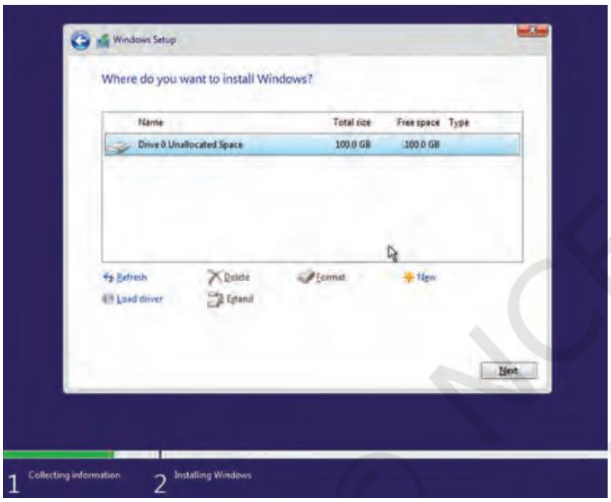


Fig. 3.66 Drive 0 unallocated space

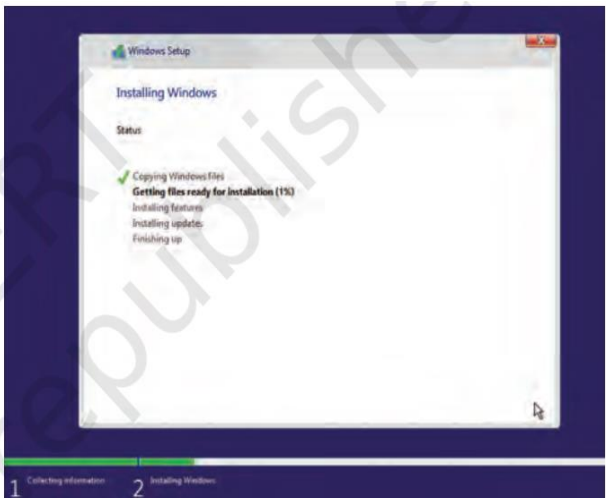


Fig. 3.67 Installing Windows

(x) After completion of these steps, the set-up will proceed to install Windows 10 as shown in Figure 3.68.

(xi) After complete installation, the initial, window will appear on the computer screen as shown in Figure 3.69.

Fig. 3.70 Home window of windows 10

Check Your Progress

A. Multiple choice Question (MCQ)

1. What might cause icons to go missing from the Windows 10 desktop? (a) Corrupted files (b) Incorrect display settings (c) Malware or viruses (d) All of the above
2. Where can you set the date and time in Windows 10? (a) Control Panel (b) Task Manager (c) Settings app (d) File Explorer
3. How can you access the taskbar settings in Windows 10? (a) Right-click on the taskbar (b) Open Task Manager (c) Go to Control Panel (d) Use File Explorer
4. What is Safe Mode used for in Windows? (a) To speed up the computer (b) To fix hardware issues (c) To troubleshoot software problems (d) To update Windows
5. How can you resize the taskbar in Windows 10? (a) By dragging the edge of the taskbar (b) Using Task Manager (c) Through the Control Panel (d) In File Explorer
6. Which shortcut opens File Explorer in Windows 10? (a) Ctrl + E (b) Windows Key + E (c) Alt + E (d) Shift + E
7. Which of the following is NOT a section in File Explorer? (a) Quick Access (b) System Restore (c) This PC (d) Network
8. Where can you change the region and language settings in Windows 10? (a) Control Panel (b) Settings app (c) Task Manager (d) File Explorer
9. Where can you configure a static IP address in Windows 10? (a) Control Panel (b) Settings app (c) Network and Sharing Center (d) Device Manager
10. What is the first step in performing a clean installation of Windows 11? (a) Download the ISO file (b) Backup important data (c) Create a bootable USB drive (d) Install the operating system

B. Fill in the Blank

1. One possible reason for missing desktop icons in Windows 10 is a _____ issue.
2. The date and time settings in Windows 10 can be adjusted through the _____ app.
3. To access taskbar settings in Windows 10, you can right-click on the _____.

4. Safe Mode is used in Windows to troubleshoot _____ problems.
5. You can resize the taskbar in Windows 10 by dragging the _____ of the taskbar.
6. The shortcut to open File Explorer in Windows 10 is _____ + E.
7. One of the sections in File Explorer is called _____ Access.
8. Region and language settings in Windows 10 can be changed through the _____ app.
9. A static IP address can be configured in Windows 10 using the _____ and Sharing Center.
10. The first step in performing a clean installation of Windows 11 is to _____ important data.

C. True or False

1. Missing desktop icons in Windows 10 can sometimes be caused by incorrect display settings.
2. The date and time in Windows 10 can only be set through the Control Panel.
3. You can access the taskbar settings in Windows 10 by right-clicking on the taskbar.
4. Safe Mode is used to speed up the computer by disabling unnecessary software.
5. In Windows 10, the taskbar cannot be resized.
6. The shortcut to open File Explorer in Windows 10 is Windows Key + E.
7. One of the sections in File Explorer is called System Restore.
8. You can change the region and language settings in Windows 10 through the Settings app.
9. A static IP address can be configured in Windows 10 using the Network and Sharing Center.
10. The first step in performing a clean installation of Windows 11 is to download the ISO file.

D. Short Question?

1. Describe the possible reasons for desktop icons going missing in Windows 10 and outline the steps you would take to troubleshoot and resolve this issue.
2. Explain how to set the date and time in Windows 10, including how to configure the system to automatically adjust for daylight saving time and synchronize with an internet time server.
3. Discuss the functionalities of the Windows 10 taskbar. How can you customize the taskbar to better suit your workflow? Include details on pinning applications, moving the taskbar, and adjusting its properties.
4. What is Safe Mode in Windows 10? Describe the steps to boot into Safe Mode and explain how it can be used to troubleshoot and fix issues related to the taskbar.
5. Describe the process of resizing the taskbar in Windows 10. Why might someone want to resize their taskbar, and what are the potential benefits and drawbacks of doing so?

6. File Explorer is a fundamental tool in Windows operating systems. Explain its main features and functionalities. How has File Explorer evolved across different versions of Windows?
7. Identify and describe the different sections of File Explorer in Windows 10. How can users customize these sections to improve their file management experience?
8. How do you change region and language settings in Windows 10? Discuss the impact of these settings on date, time, currency formats, and language preferences. How can these settings be useful for users in a multilingual environment?
9. Explain the process of configuring a static IP address in Windows 10. What are the advantages and disadvantages of using a static IP address compared to a dynamic IP address?
10. Describe the steps involved in performing a clean installation of Windows 11. What preparations should be made before starting the installation, and what are the key differences between a clean installation and an upgrade?

MODULE 3 Installation and Configuration of Linux Operating System

Module Overview

Installing and configuring a Linux operating system involves several steps that ensure the system is tailored to the user's needs. The process begins by choosing a Linux distribution, such as Ubuntu, Fedora, or CentOS, and creating a bootable installation media, like a USB drive or DVD. The technician boots the system from this media and follows the guided installation steps, which include selecting the language, time zone, and partitioning the hard drive.

After the OS is installed, the configuration phase begins. This includes setting up user accounts, configuring network settings, and installing essential software packages through a package manager like APT or YUM. It's crucial to install updates and security patches to keep the system secure. Depending on the user's requirements, additional configurations might involve setting up a firewall, configuring system services, and customizing the desktop environment for optimal performance and usability.

Learning Outcomes

After completing this module, you will be able to:

- We learn the process of installing Ubuntu Linux, including system requirements and installation steps.
- Perform Post Installation Tasks in Linux Operating System Students will explore essential post-installation tasks in Linux to ensure optimal system functionality and user readiness.
- Install and Configure Peripheral Devices Students will understand how to install and configure peripheral devices in a Linux environment for enhanced system capabilities.

Module Structure

Session 1: Installation of Ubuntu Linux

Session 2: Perform post installation task in Linux operating system

Session 3: Install and Configure Peripheral devices

Session 1. Installation of Ubuntu Linux

Linux Operating System

Linux, an open-source operating system, made its debut on September 17, 1991, thanks to Linus Torvalds. Similar to Windows, macOS, and Android, Linux also shares similarities with Unix operating systems, reflecting in comparable commands. It's freely accessible for both commercial and non-commercial purposes, enabling programmers to modify the Linux kernel, creating new distributions.

In recent times, Linux has made remarkable strides, offering numerous beneficial features for both companies and home users. Consequently, it has emerged as one of the most prevalent operating systems in the IT industry. Moreover, it's readily available for download at no cost from the internet.

Minimum system requirements for Ubuntu 24.04 LTS:

As of my last update, which was in January 2022, Ubuntu 24.04 LTS had not been released yet, and specific system requirements for it were not available. However, based on historical trends and the typical progression of system requirements in Ubuntu releases, we can make an educated guess about the expected minimum system requirements.

For Ubuntu 22.04 LTS, which is the release preceding 24.04 LTS, the minimum system requirements were as follows:

- Processor: 1 GHz dual-core processor or better
- RAM: 2 GB RAM
- Storage: 25 GB of hard disk space
- Graphics: VGA capable of 1024x768 screen resolution
- Network: Either a wired Ethernet or wireless adapter

It's important to note that these are general guidelines, and actual system requirements may vary based on factors such as the desktop environment (e.g., GNOME, KDE, Xfce) and specific software requirements. Additionally, newer releases of Ubuntu may have slightly higher system requirements to accommodate improvements and new features.

Linux operating system distributions

Linux operating system distributions, often referred to as "distros," come in various flavors, each tailored to different user needs and preferences. Here's an overview of some popular Linux distributions, their key features, and typical system requirements:

Linux distributions	key features	System requirements
Ubuntu:	Ubuntu is known for its user-friendly interface and extensive software repository. It offers long-term support (LTS) releases with five years of security updates, making it suitable for both desktop and server use.	Minimum requirements typically include a 1 GHz processor, 2 GB of RAM, and 25 GB of disk space.
Fedora:	Fedora focuses on integrating the latest open-source technologies and serves as a testing ground for future Red Hat Enterprise Linux (RHEL) releases. It includes GNOME as the default desktop environment and emphasizes security features.	Recommended specifications include a 2 GHz dual-core processor, 4 GB of RAM, and 15 GB of disk space.
Debian:	Debian is known for its stability, reliability, and commitment to free software principles. It offers a wide range of software packages and supports multiple desktop environments, including GNOME, KDE, and Xfce.	Minimum requirements typically include a 1 GHz processor, 512 MB of RAM, and 10 GB of disk space.
CentOS	CentOS is a community-driven distribution based on the source code of Red Hat Enterprise Linux (RHEL). It provides a stable and secure platform suitable for server deployments, with long-term support and regular updates.	Minimum requirements typically include a 1 GHz processor, 1 GB of RAM, and 10 GB of disk space
Arch Linux:	Arch Linux follows a minimalist philosophy, offering a lightweight and customizable system. It employs a rolling release model, providing continuous updates to the latest software versions.	Arch Linux has relatively low hardware requirements, typically requiring a 64-bit processor, 512 MB of RAM, and 2 GB of disk space.

Linux Mint:	Linux Mint provides an elegant and user-friendly desktop environment based on Ubuntu LTS releases. It includes proprietary multimedia codecs and additional software out of the box for enhanced multimedia support.	Minimum requirements typically include a 1 GHz processor, 1 GB of RAM (2 GB recommended), and 15 GB of disk space.

Types of Linux installation

Linux installations can vary depending on the specific distribution and user preferences. Here are some common types of Linux installations:

1. Graphical Installation: This is the most user-friendly method and typically involves booting from a live USB or DVD and using a graphical installer to guide the user through the installation process. The installer often provides options for partitioning the disk, selecting software packages, and configuring system settings.
2. Text-Based Installation: Some Linux distributions offer a text-based installation option, which is similar to a graphical installation but uses a text-based interface instead. This method may appeal to users who prefer a more lightweight or minimal installation environment.
3. Network Installation: Network installation involves booting from a network image and installing the operating system over a network connection. This method is useful for deploying Linux on multiple machines simultaneously or for installing on systems without optical drives or USB ports.
4. Unattended Installation: Also known as automated or silent installation, this method allows users to install Linux without manual intervention. It involves creating a configuration file or script that specifies installation options and settings, which the installer then follows automatically.
5. Dual-Boot Installation: Dual-booting involves installing Linux alongside another operating system, such as Windows, on the same computer. Users can choose which operating system to boot into each time the computer starts. This method allows users to try out Linux without fully committing to it as their primary operating system.
6. Virtual Machine Installation: Users can install Linux in a virtual machine (VM) on their existing operating system using virtualization software such as VirtualBox or VMware. This allows for experimentation with Linux without affecting the host operating system.
7. Diskless Installation: Diskless installations run Linux entirely from RAM or over a network without requiring a local disk drive. This method is commonly used for thin clients, embedded systems, and diskless workstations.

Creating Ubuntu Linux bootable disk

Ubuntu is a popular operating system based on the Linux kernel. It is known for its security, stability, and ease of use. One of the easiest ways to try out Ubuntu is by creating a bootable USB startup disk. In this article, we will discuss three ways to create a bootable Ubuntu USB startup disk.

Using Rufus on Windows

Rufus stands out as a free and open-source utility designed for crafting bootable USB drives. Tailored for Windows, it offers a straightforward interface. Below are the steps to fashion a bootable Ubuntu USB startup disk using Rufus on Windows:

Activity 1

Practical Activity: 1 Demonstrate to Create Ubuntu Linux bootable disk

Step 1. Download the Ubuntu ISO image from the official website.

Step 2. Get Rufus from its official website and install it on your Windows PC.

Step 3. Insert a USB flash drive with at least 2GB capacity.

Step 4. Launch Rufus and choose the USB flash drive you want to use.

Step 5. In the "Boot selection" section, click "Select" and pick the Ubuntu ISO image you downloaded earlier.

Step 6. For "Partition scheme," choose "MBR" for BIOS systems or "GPT" for UEFI systems.

Step 1. For "File system," select "FAT32."

Step 8. Click "Start" and let Rufus create the bootable Ubuntu USB startup disk.

Using Etcher on macOS

Etcher is a free and open-source tool that can be used to create bootable USB disks. It is available for macOS, Windows, and Linux. Here are steps to create a bootable Ubuntu USB startup disk using Etcher on macOS –

Practical Activity: Demonstrate to Create Ubuntu Linux bootable disk using macOS

Get the Ubuntu ISO image from the official website.

Step 1. Download Etcher from its official website and install it on your macOS device.

Step 2. Insert a USB flash drive with at least 2GB capacity.

Step 3. Open Etcher and choose the Ubuntu ISO image you downloaded previously.

Step 4. Select the USB flash drive you wish to use.

Step 5. Click the "Flash!" button and allow Etcher to create the bootable Ubuntu USB startup disk.

Using dd Command on Linux

If you are using a Linux machine, you can use dd command to create a bootable Ubuntu USB startup disk. Here are steps to create a bootable Ubuntu USB startup disk using dd command on Linux –

Practical Activity: Demonstrate to Create Ubuntu Linux bootable disk using dd Command

Step 1. Download the Ubuntu ISO image from the official website.

Step 2. Insert a USB flash drive with at least 2GB capacity.

Step 3. Open the terminal and run the following command to check the name of the USB flash drive: sudo fdisk -l

Step 4. Identify the name of the USB flash drive from the list of devices, such as "/dev/sdb" or "/dev/sdc".

Step 5. Unmount the USB flash drive by running the following command: sudo umount /dev/sdb1 Replace "/dev/sdb1" with the name of the USB flash drive you identified earlier.

Step 6. Write the Ubuntu ISO image to the USB flash drive by running the following command: sudo dd bs=4M if=/path/to/ubuntu-xx.xx-desktop-amd64.iso of=/dev/sdb conv=f Replace "/path/to/ubuntu-xx.xx-desktop-amd64.iso" with the path to the Ubuntu ISO image you downloaded earlier, and "/dev/sdb" with the name of the USB flash drive you identified earlier.

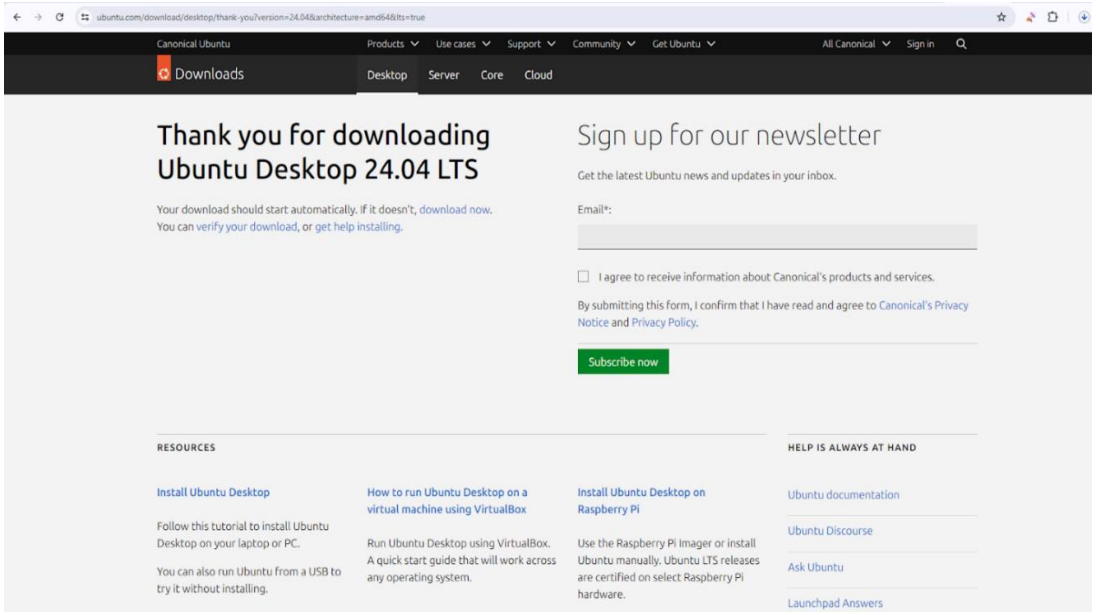
Step 1. Wait for the "dd" command to complete. This may take a few minutes.

Step 8. Once the process is complete, you can safely remove the USB flash drive from your Linux machine and use it to boot into Ubuntu.

Create a bootable USB stick with Rufus on Windows Requirements

You will need:

- A 4GB or larger USB stick/flash drive
- Microsoft Windows XP or later
- Rufus, a free and open source USB stick writing tool
- An Ubuntu ISO file. See Get Ubuntu for download links.



USB selection

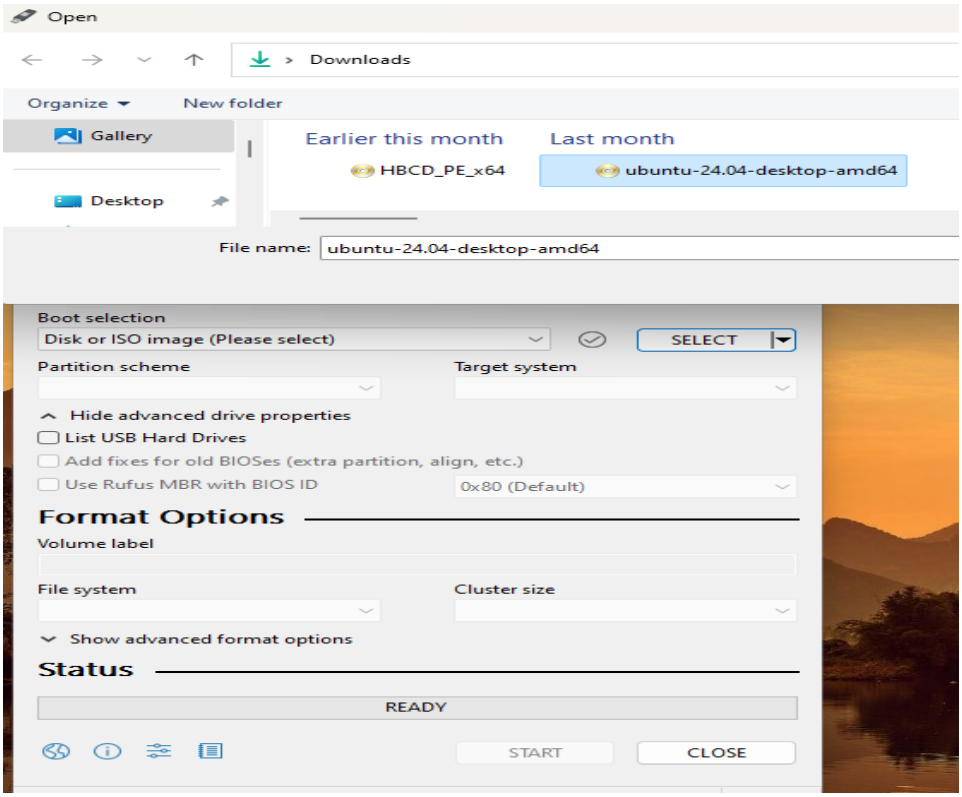
Here are the steps to configure your USB device in Rufus:

1. Open Rufus.
2. Insert your USB stick.
3. Rufus will automatically detect and display the device within the Device field.
4. If the selected Device is incorrect (for instance, if you have multiple USB storage devices), choose the correct one from the drop-down menu in the device field.

4. Select the Ubuntu ISO file

To select the Ubuntu ISO file you downloaded previously, click the SELECT to the right of "Boot selection". If this is the only ISO file present in the Downloads folder you will only see one file listed.

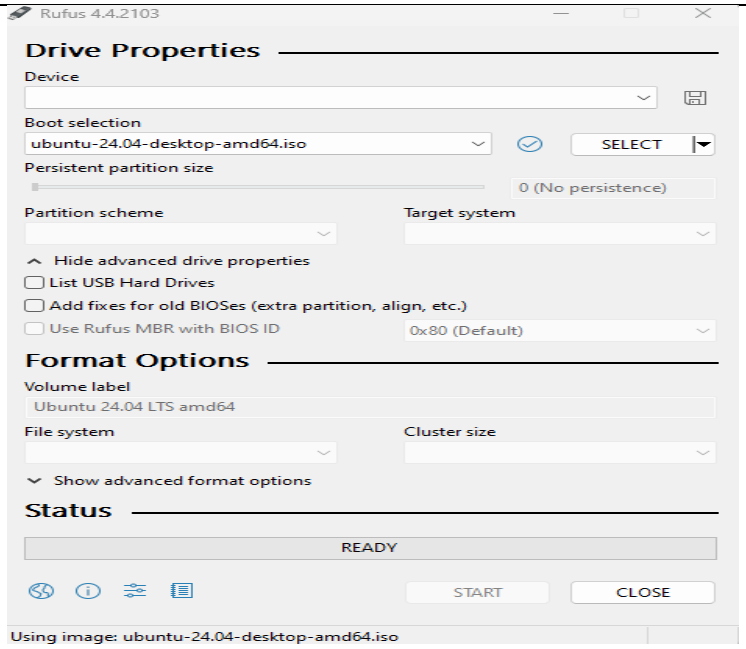
Select the appropriate ISO file and click on Open.

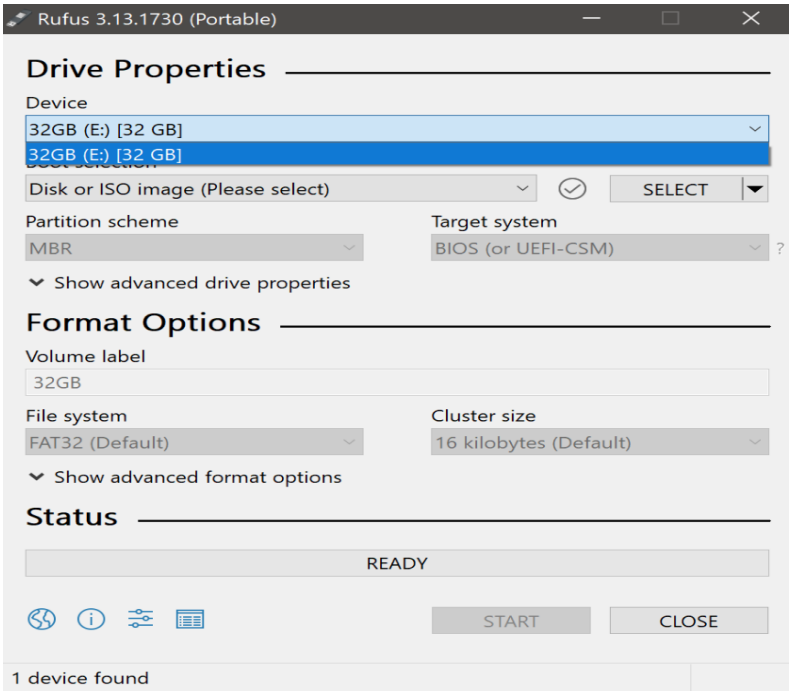


5. Write the ISO

The Volume label will automatically adjust to match the selected ISO.

Keep all other settings at their default values and click START to begin the writing process.

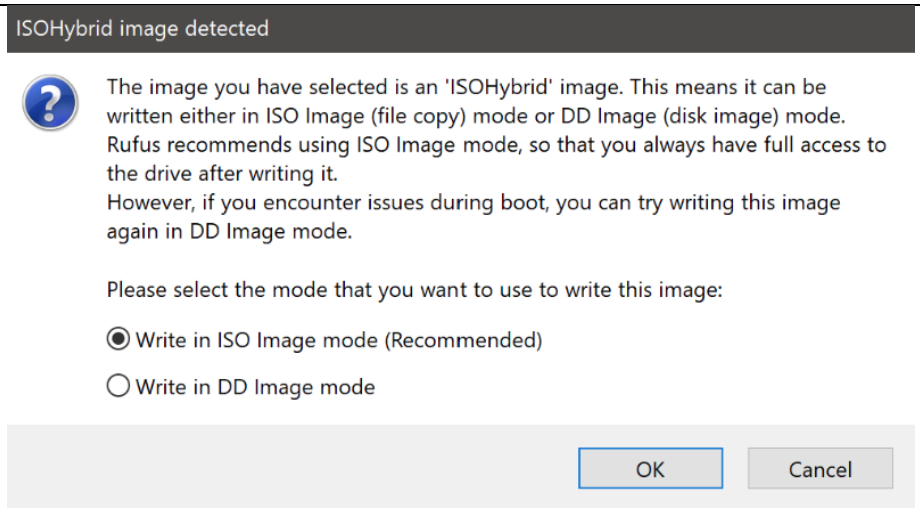




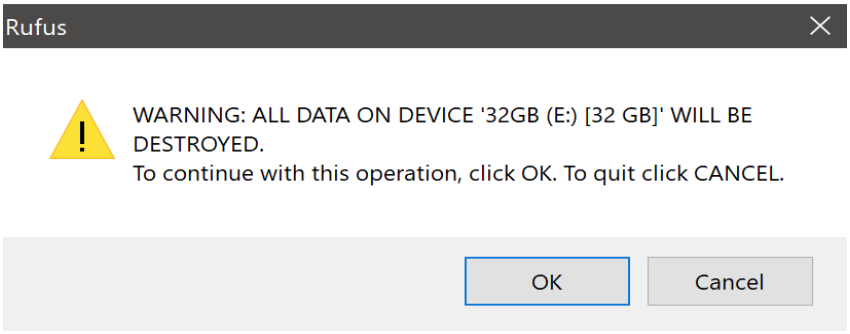
1. Write warnings

You will then be alerted that Rufus has detected that the Ubuntu ISO is an ISO Hybrid image. This means the same image file can be used as the source for both a DVD and a USB stick without requiring conversion.

Keep Write in ISO Image mode selected and click on OK to continue.



Rufus will also provide a warning indicating that all data on your chosen USB device will be erased. This is an opportune time to double-check if you have selected the correct device before proceeding. Once you are certain, click OK to continue.



8. Writing the ISO

The ISO will now be written to your USB stick, and the progress bar in Rufus will give you some indication of where you are in the process. With a reasonably modern machine, this should take around 10 minutes. Total elapsed time is shown in the lower right corner of the Rufus window.

9. Installation complete

When Rufus has finished writing the USB device, the Status bar will be filled green and the word READY will appear in the center. Select CLOSE to complete the write process.

Demonstrate to Clean installation of Ubuntu 24.04 LTS on a new computer.

Canonical has recently unveiled its newest operating system, Ubuntu 24.04, bearing the codename "Noble Numbat." This release is categorized as an LTS (Long Term Support), promising users updates and support for the next five years. We will guide you through the step-by-step installation process of Ubuntu 24.04 LTS desktop, accompanied by screenshots. Before delving into the installation procedure, let's take a quick look at the fresh and enhanced features introduced in this edition:

- Introduction of the latest GNOME 46 Desktop Environment.
- Integration of the latest Linux Kernel 6.8.

- Significant enhancements in Software Center and Tweaks.
- Implementation of a much-improved installer for an enhanced user experience.
- Addition of the Dynamic Workspace Indicator.
- Improved Remote RDP Login feature in tandem with GNOME 46.
- Inclusion of Pipe Wire as the default sound server.
- The installer will perform a minimal installation if the 'extended installation' option is not chosen.

Requirements:

- At least 4 GB of RAM
- A dual-core processor clocked at 2 GHz
- 25 GB of available disk space
- Internet connectivity (optional)
- Installation media (bootable USB or DVD)

Practical Activity: Demonstrate to clean installation of Ubuntu operating system on a new computer.

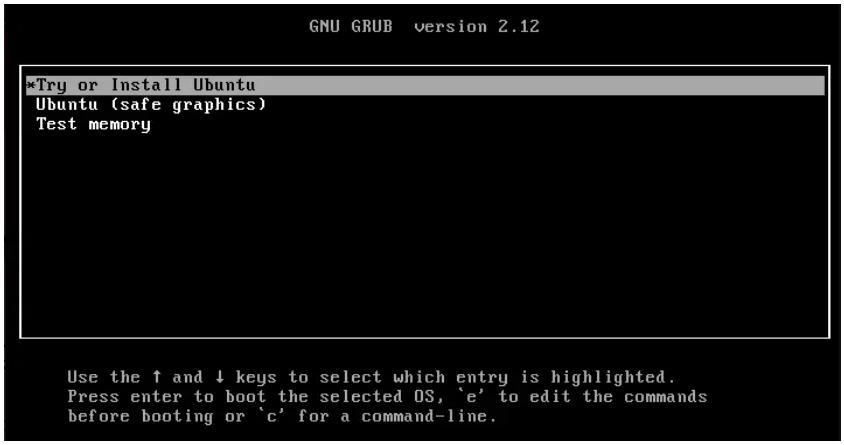
Step 1. Download the Ubuntu 24.04 ISO File

Navigate to the official Ubuntu website (https://ubuntu.com/download/desktop) and download the ISO file.

After downloading the ISO file, create the installation media by burning the ISO file onto a USB or DVD drive. If you're using Windows, you can utilize the "Rufus" software to create a bootable USB drive with the ISO file. On Linux, follow these steps:

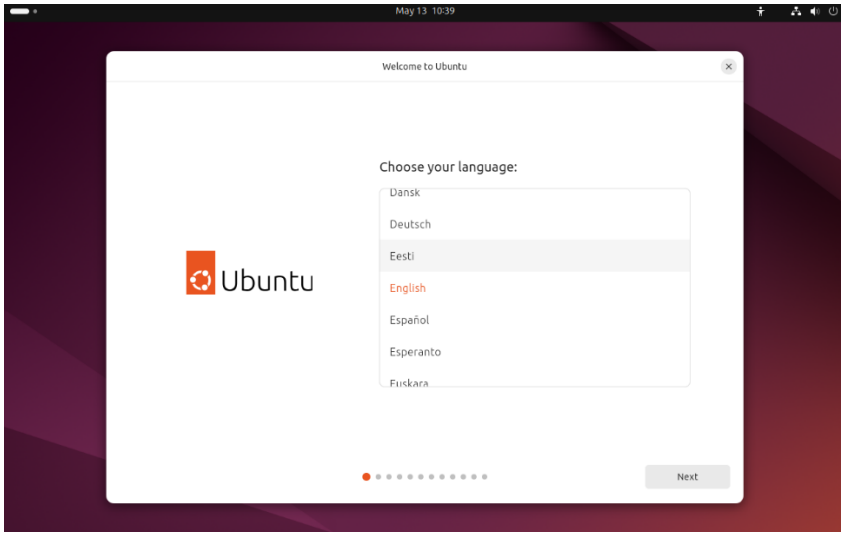
Step 2. Boot System with Installation Media.

Start your target system using the installation media, which, in our case, is the bootable USB drive created in the previous step. (In the BIOS settings, adjust the boot order to prioritize the USB drive over the hard disk.) Once the system boots up with the installation media, you will encounter the following screen. Select "Try or Install Ubuntu".



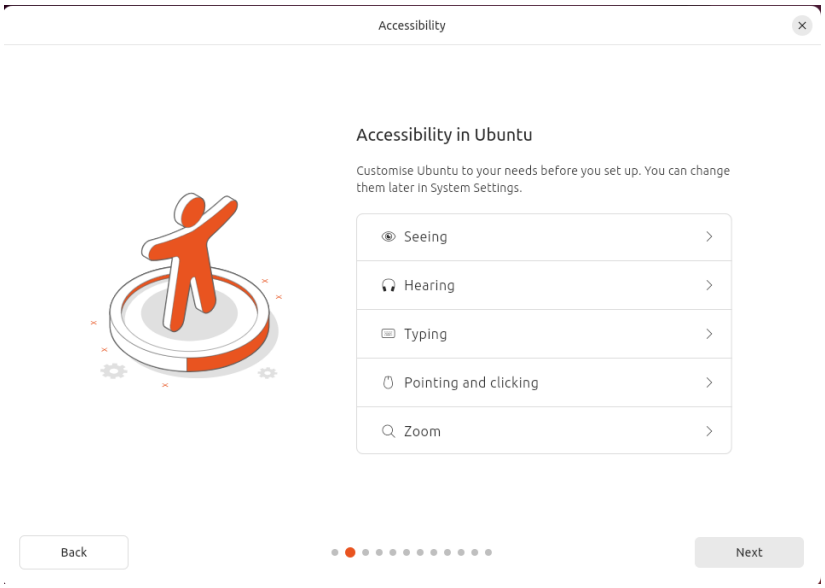
Step 3. Choose Your Language

You'll be asked to select your preferred language in this step. Pick the appropriate language, then click on Next.



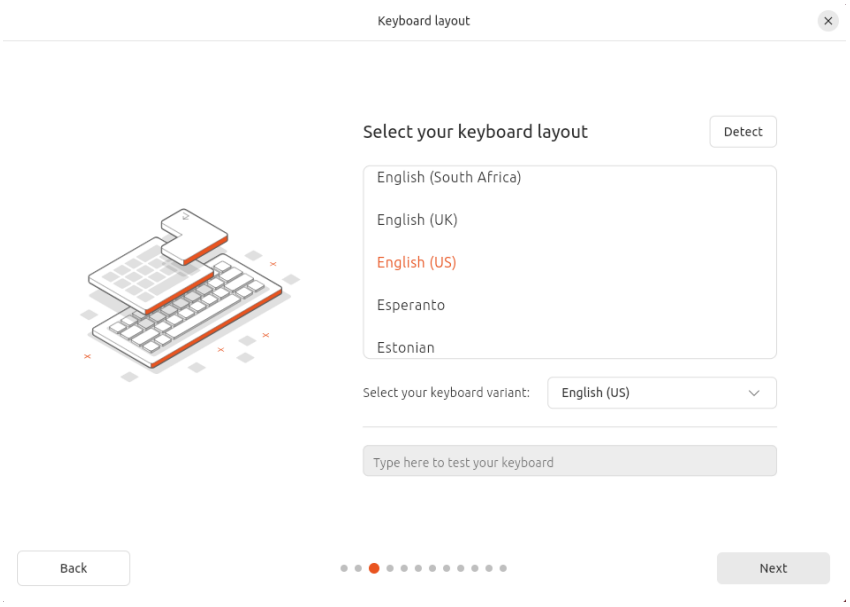
Step 4. Customize Ubuntu 24.04 Settings

In this step, the installer provides you with options to customize your Ubuntu settings, as shown below. However, you can also customize these settings later after installation.



Step 5. Select Your Preferred Keyboard Layout

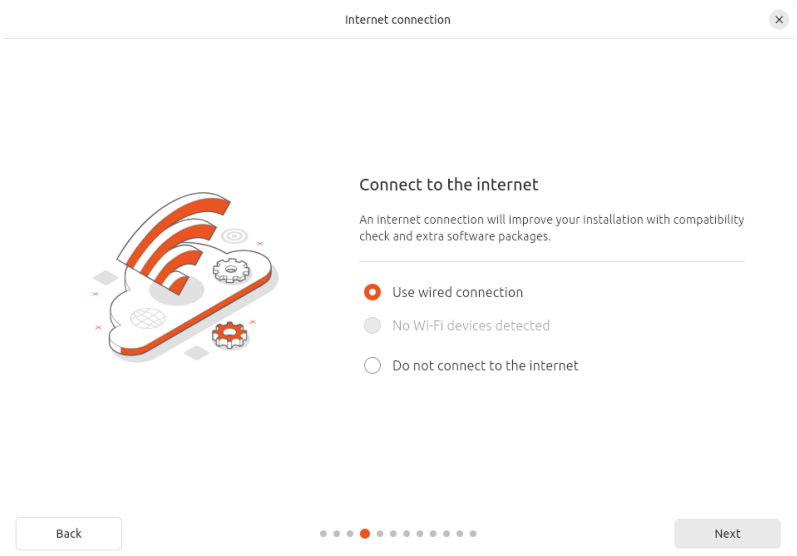
Choose the keyboard layout that best suits your needs for this installation, then click Next.



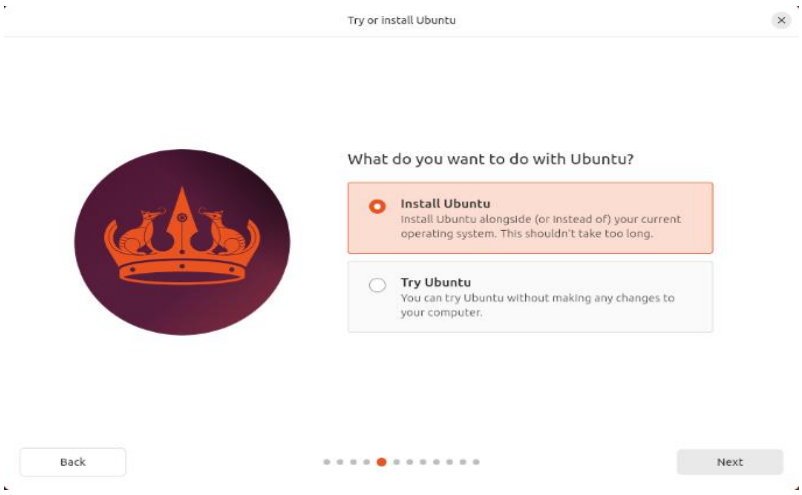
Step 6. Select Install Ubuntu

In case, your system is connected to the internet then choose "Use Wired Connection" else select "Do not Connect to the Internet".

In my case, my system is connected to the internet so, I will choose first option.



In the following window, select "Install Ubuntu" and then click Next.



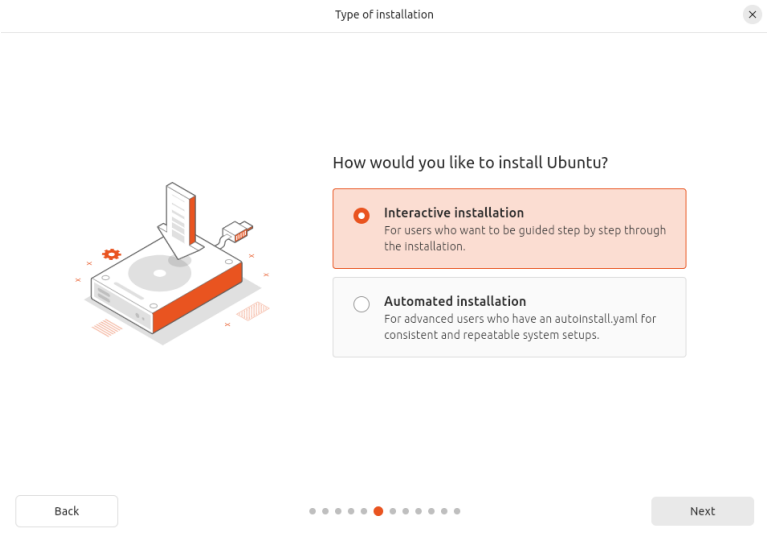
Step 1. Type of Installation

At this step, the installer will prompt you "how do you like to install Ubuntu".

You have two options:

1. Interactive Installation: This type of installation involves user interaction throughout the installation process.
2. Automated Installation: As the name suggests, this is an automated installation method. However, it requires preparation of an "autoinstall.yaml" file containing all the necessary settings or parameters for the OS installation.

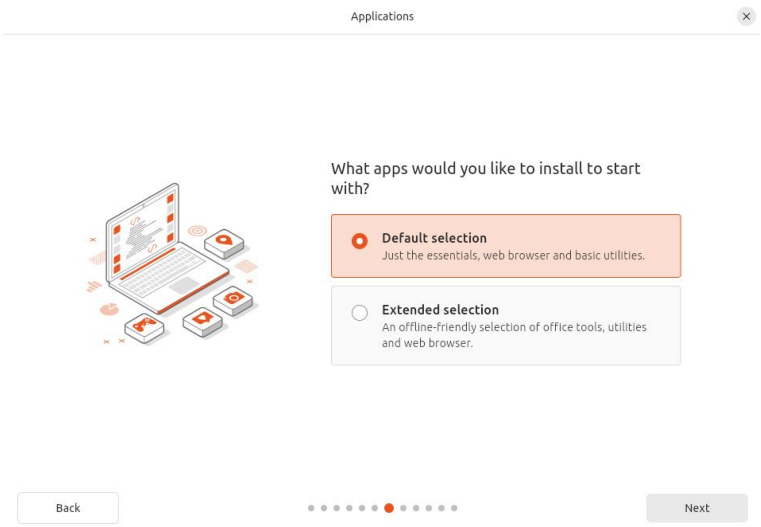
For this guide, we will proceed with the interactive installation method.



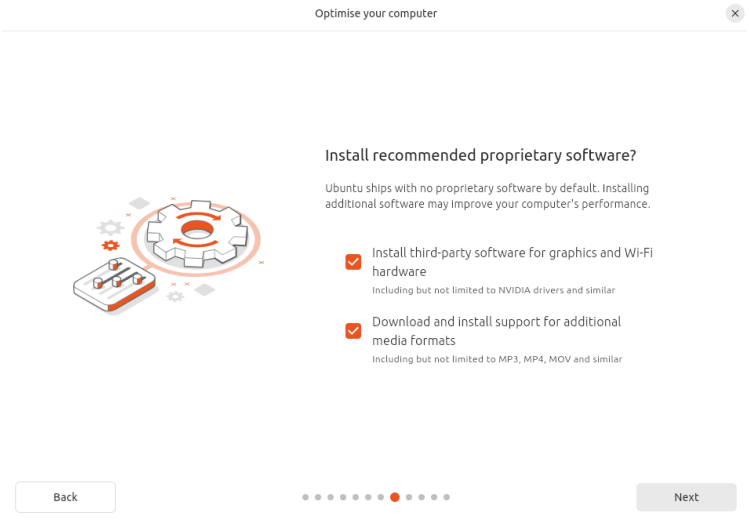
Step 8. Click on Next

In the following window, choose "Extended Selection" to install desktop tools, utilities and web browser.

If you choose "Default Selection" then installer will install only desktop basic utilities.



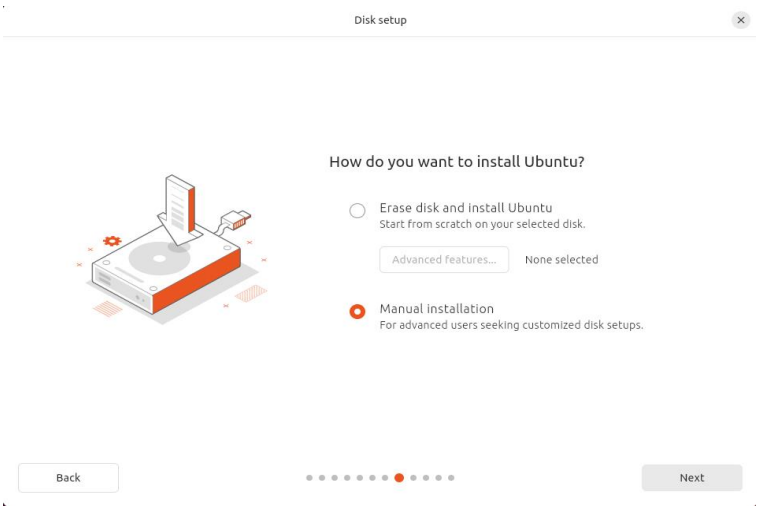
Step 9. Install Third-Party Software for Graphics and Wi-Fi. If you wish to install updates and third-party software for graphics and Wi-Fi during the installation, select both options, provided your system is connected to the internet. If your system is not connected to the internet or you prefer not to install updates during the installation, uncheck both options and then click on Next.



Step 10. Disk Partition Scheme

In this step, the installer will ask you how you want to create the partition scheme on the disk. You have two options:

1. Erase Disk and Install Ubuntu: With this method, the installer will erase all data on the disk and create the necessary partitions automatically. This is recommended for users new to Linux.
2. Manual Installation: With this method, you can manually create partitions on the disk according to your requirements.



In this guide, I will demonstrate how to create manual partitions by selecting the 'Manual Installation' method.

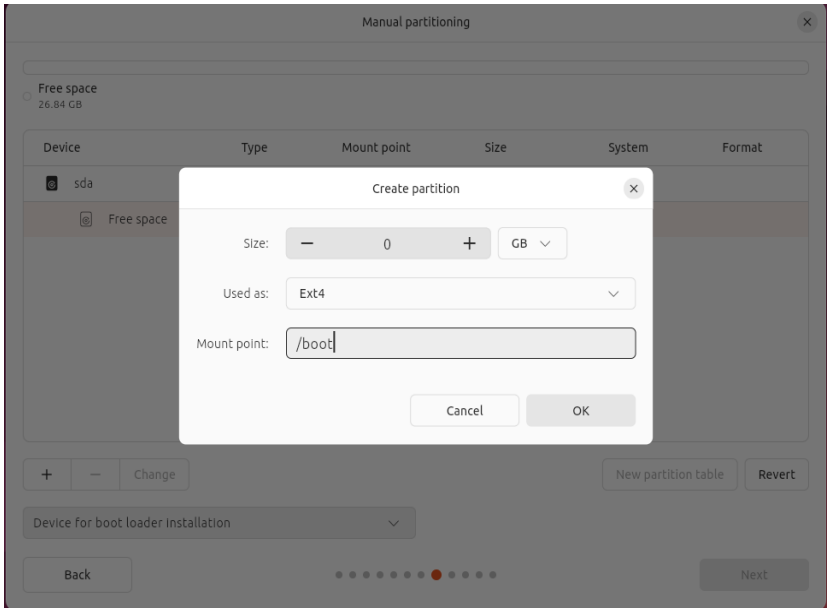
Step 11. Click "Next" to continue.

For Ubuntu 24.04, I'll be partitioning an 80GB disk as follows:

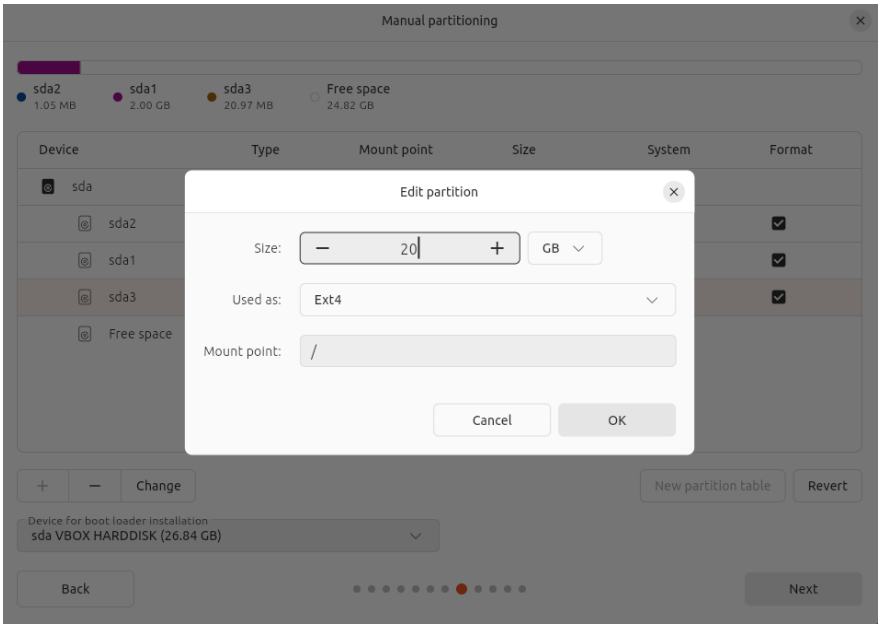
- /boot: 2GB (ext4 file system)
- / (root): 20GB (ext4 file system)
- /home: 50GB (ext4 file system)
- Swap: 2GB

On the subsequent screen, select the unallocated disk space, click on the "+" symbol, and begin creating partitions.

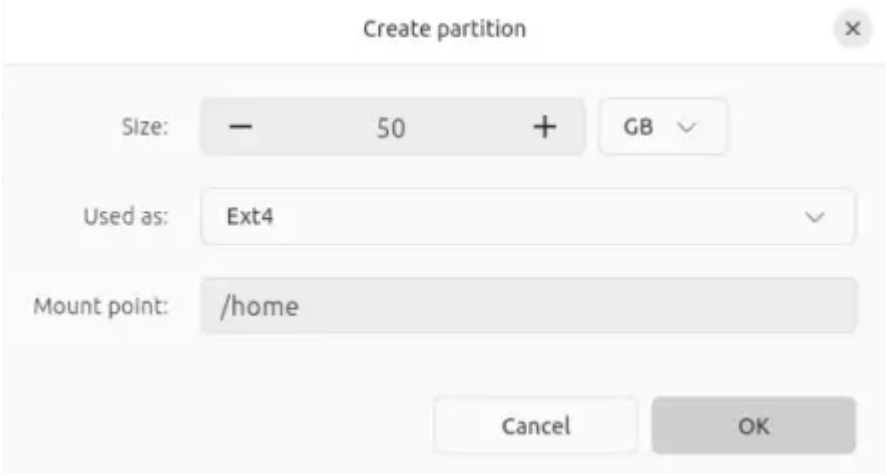
We'll start by creating the first partition as /boot with a size of 2GB.



Click on OK and similarly create next partition as / of size 20 GB.



Next, again select the free disk space and create /home partition of size 50 GB.



Click OK.

In the last create swap partition of size 2GB as shown below:

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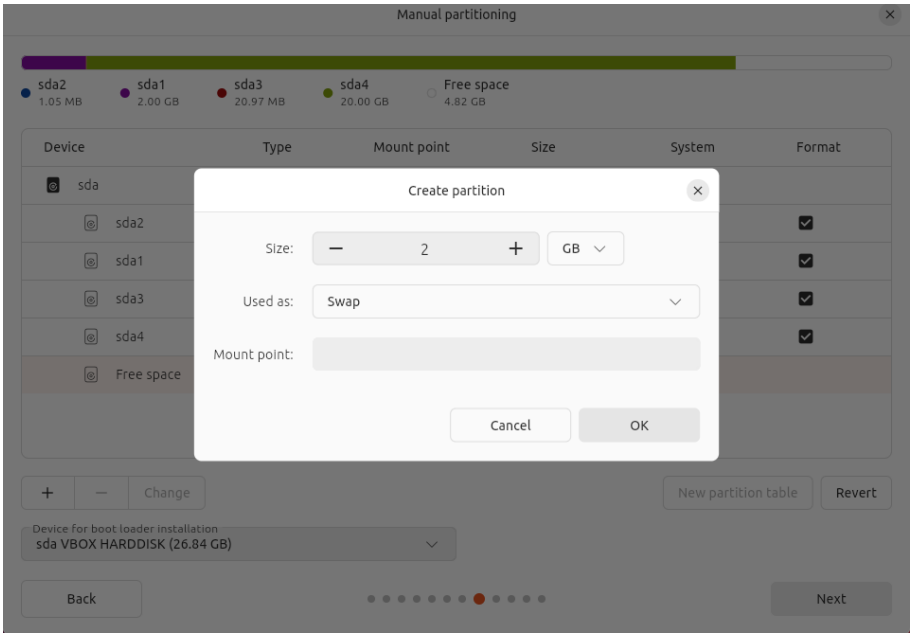
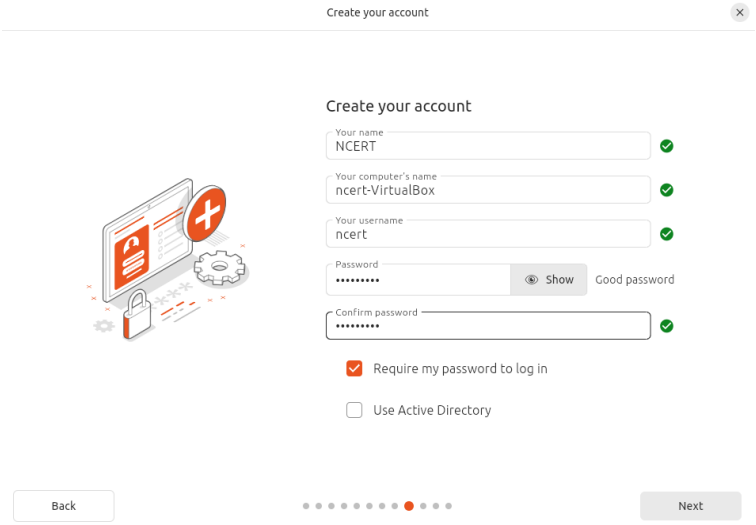


Click OK and then click on Next to proceed further with installation.

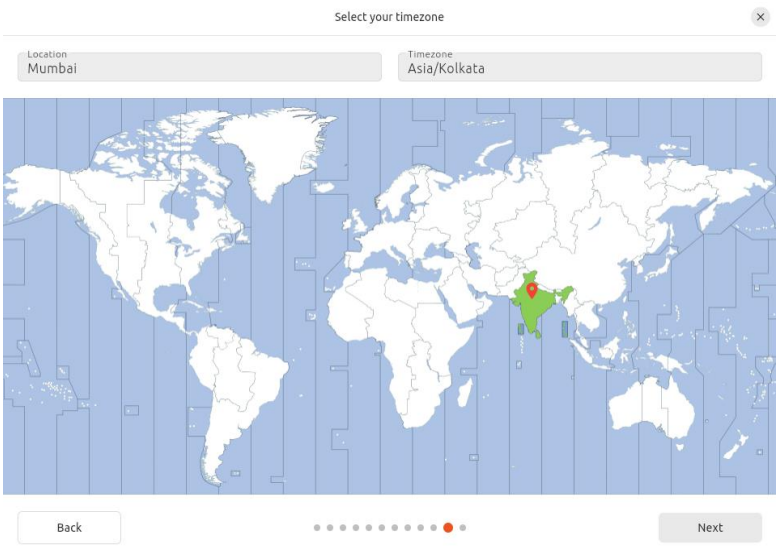
Step 12. Create a local user and set your system's hostname, specify the details that suits to your installation.



Click Next

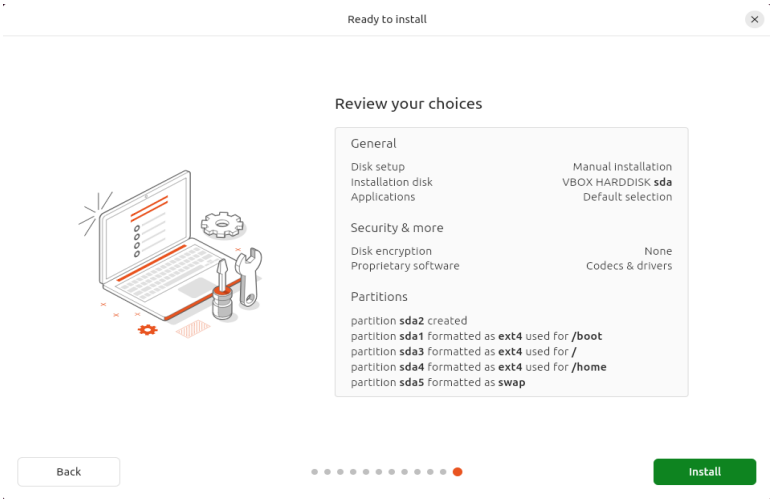
Step 13. Select Your Location and Time Zone

Choose your preferred location and time zone and then click Next.



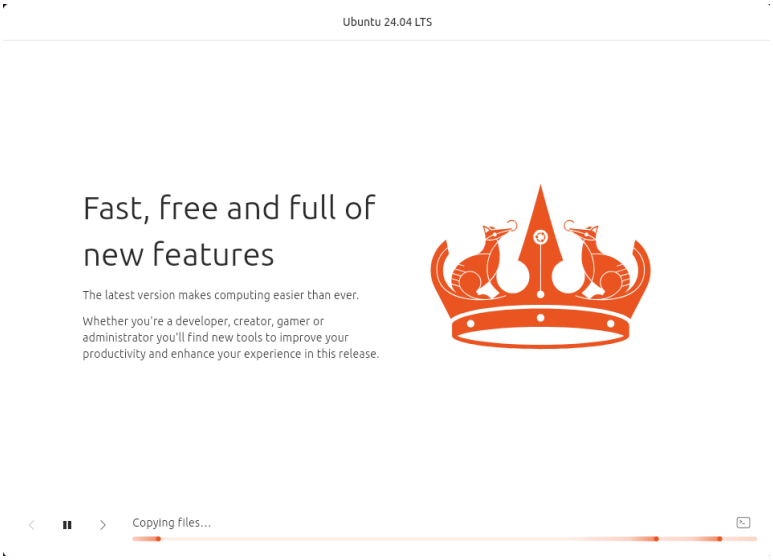
Step 14. Ready to Start Installation

Review your choices and click on "Install" option to begin the installation.

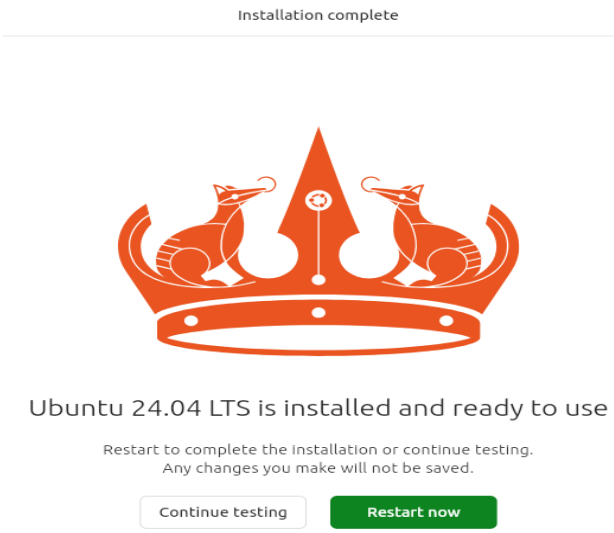


At this point of time installation get started and is in progress.

PSSCIVE D



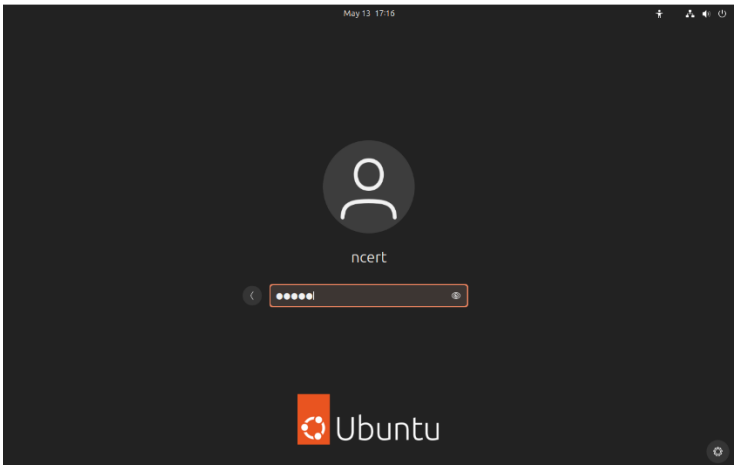
Once the installation is completed, installer will prompt to reboot the system.



Click on "Restart Now", it will reboot your system and don't forget to remove the installation media and change boot medium from USB to Hard disk from the Bios settings.

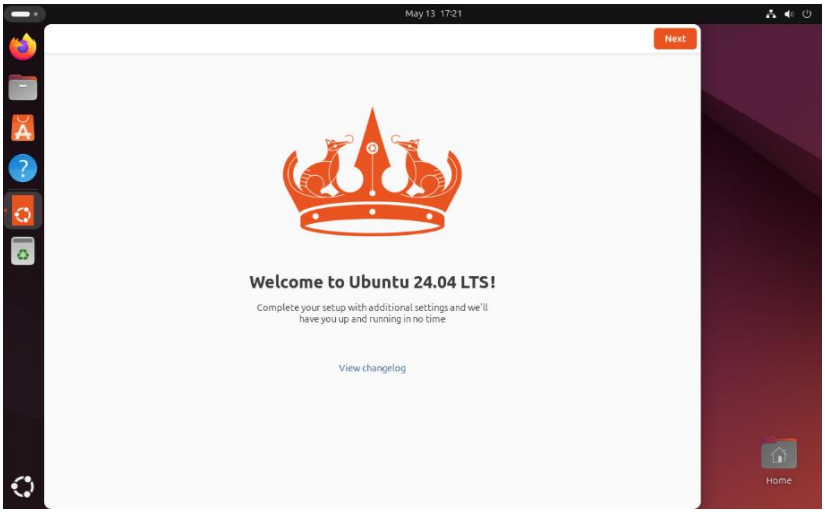
Step 15. Login and Desktop Screen Post Installation

When the system boots up after the successful installation, we will get the beneath login screen. Use the same user and its credentials that you have created during the installation (Step 10),



Step 16. After entering the credentials hit enter and this will take to desktop screen.

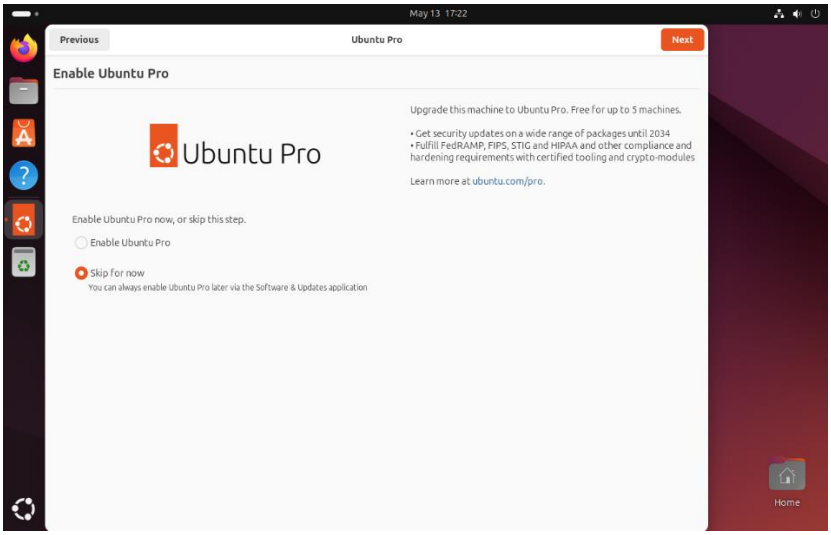
We will get following welcome screen, complete the setup with some additional settings.



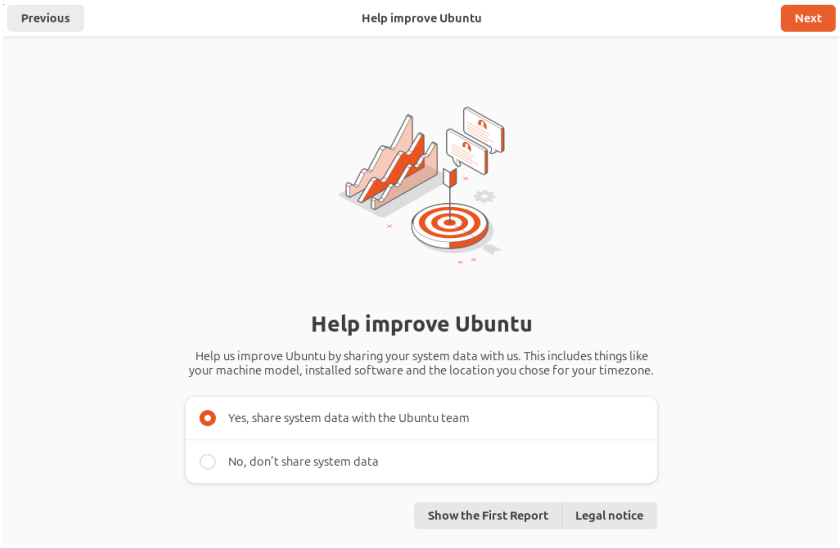
Step 11. Click on Next

On the following window, disable Ubuntu Pro, choose "Skip for Now" and click Next

PSSCIVE Dra



Step 18. Choose "No, don't share system data".



Step 19. Click on Finish to start using your Ubuntu 24.04.

Step 20. Next, Open the terminal and install neofetch utility.

$ sudo apt update

$ sudo apt install neofetch -y

$ neofetch

https://www.linuxtechi.com/install-ubuntu-24-04-step-by-step/

VirtualBox

Oracle VM VirtualBox is a cross-platform virtualization application developed by Oracle Corporation. It enables users to install and run multiple operating systems on virtual hard disks, including Windows, macOS, Solaris, and Linux.

For instance, you can use VirtualBox to run Windows and Linux on your Mac, Windows Server on your Linux server, or Linux on your Windows PC, all while continuing to use your

existing applications.

The primary limitations you may encounter when installing multiple virtual machines are disk space and memory.

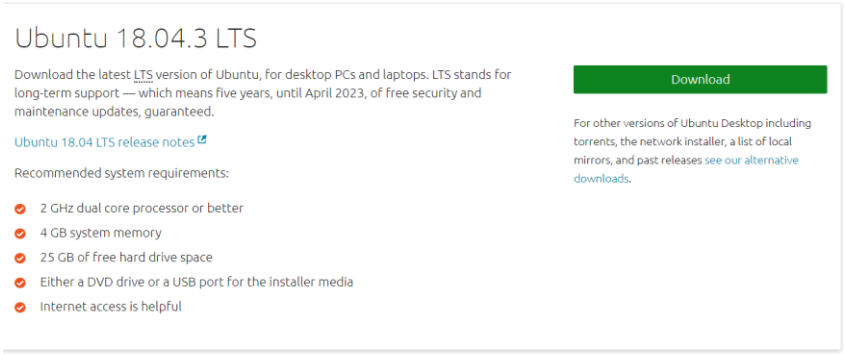
VirtualBox Installation

VirtualBox can be downloaded here: VirtualBox Downloads .

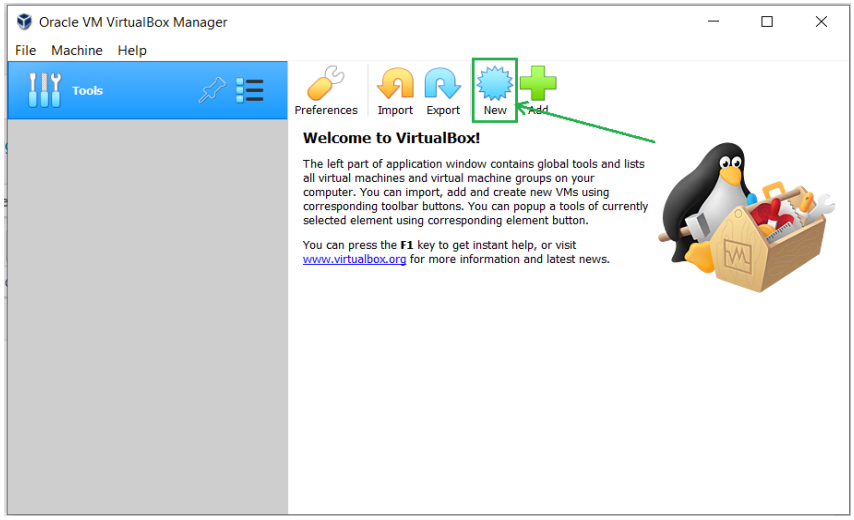
https://www.virtualbox.org/wiki/Downloads

Practical Activity: Demonstrate to install Ubuntu Linux on Virtual Box.

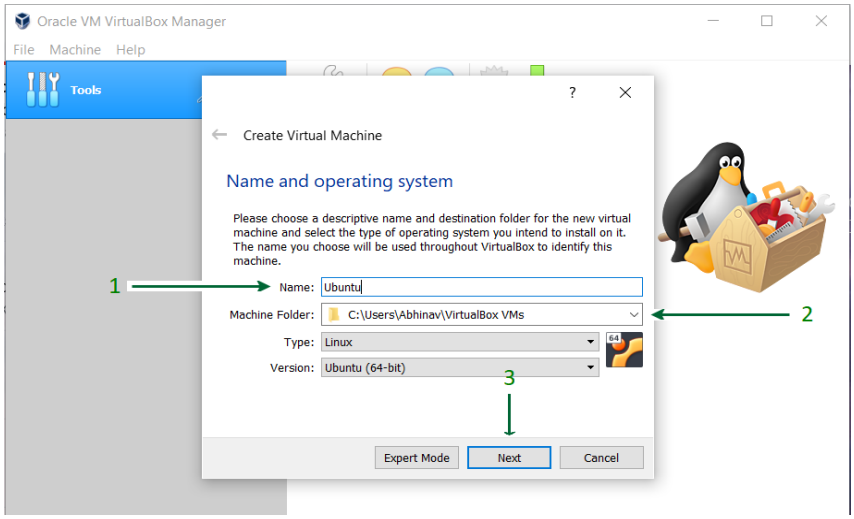
Step 1: Before we begin with the installation process, we need to **Download ISO for Ubuntu**. For that, all the versions of Ubuntu are available on the **Official Site**.



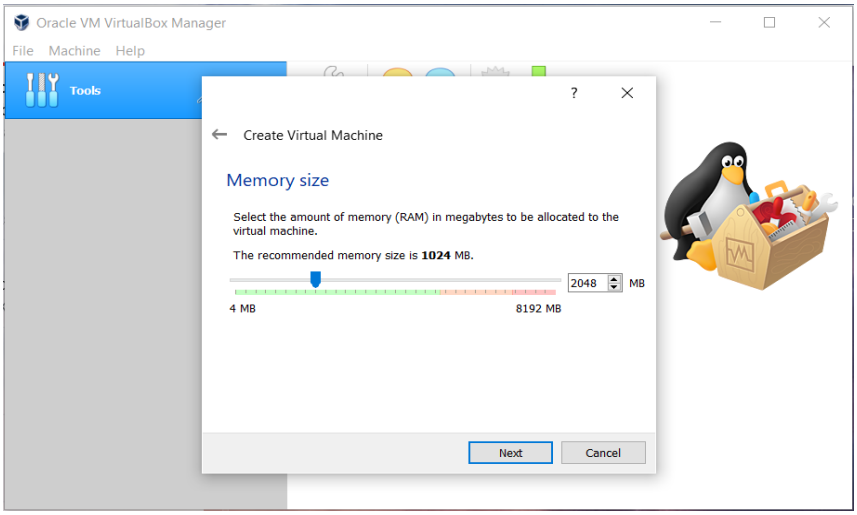
Step 2: Open **VirtualBox** and click on the **New** button.



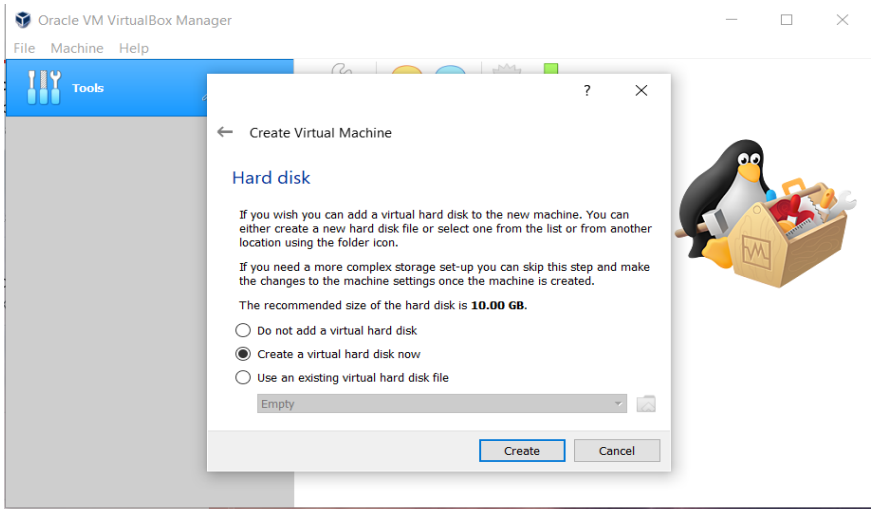
Step 3: Give a **Name** to your **Virtual Machine** and select the **Location** for it to install.



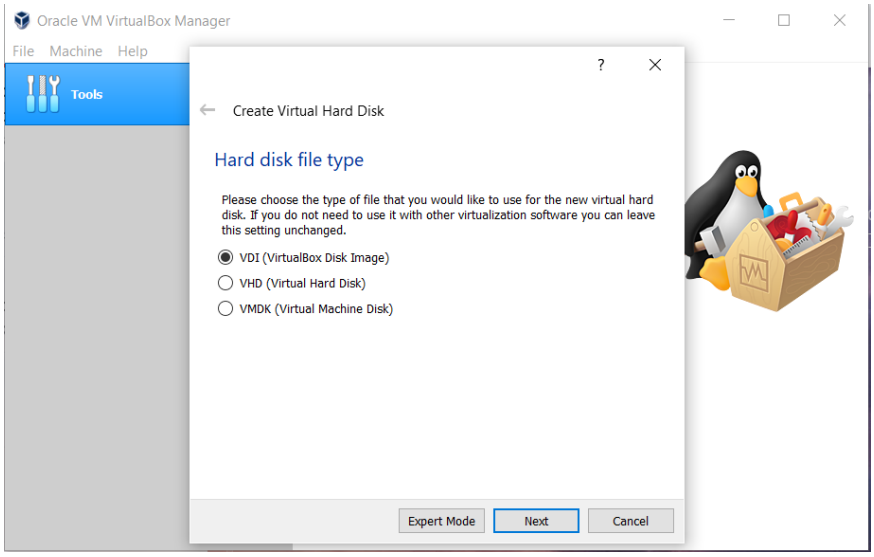
Step 4: Assign **RAM Size** to your Virtual Machine.



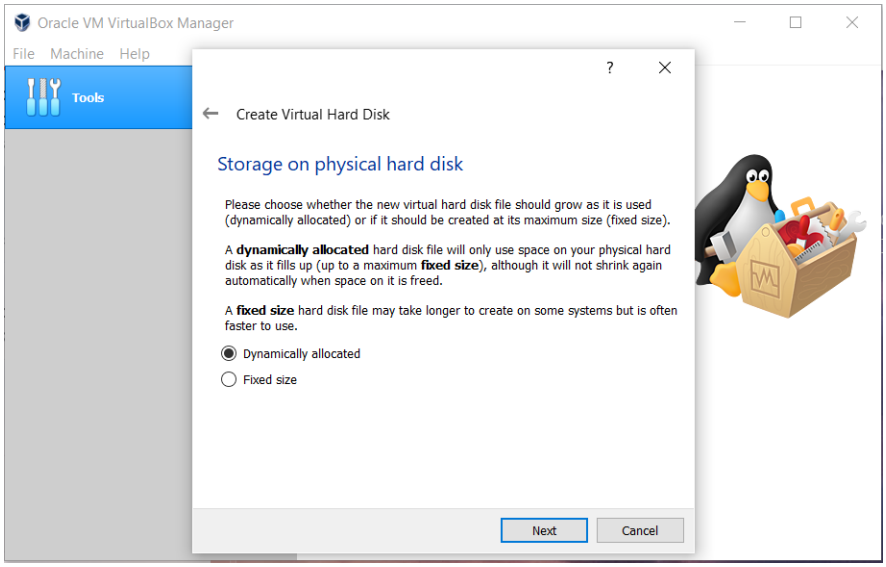
Step 5: Create a **Virtual Hard Disk** for the machine to store files.



Step 6: Select the type of Hard disk. Using **VDI** type is recommended.

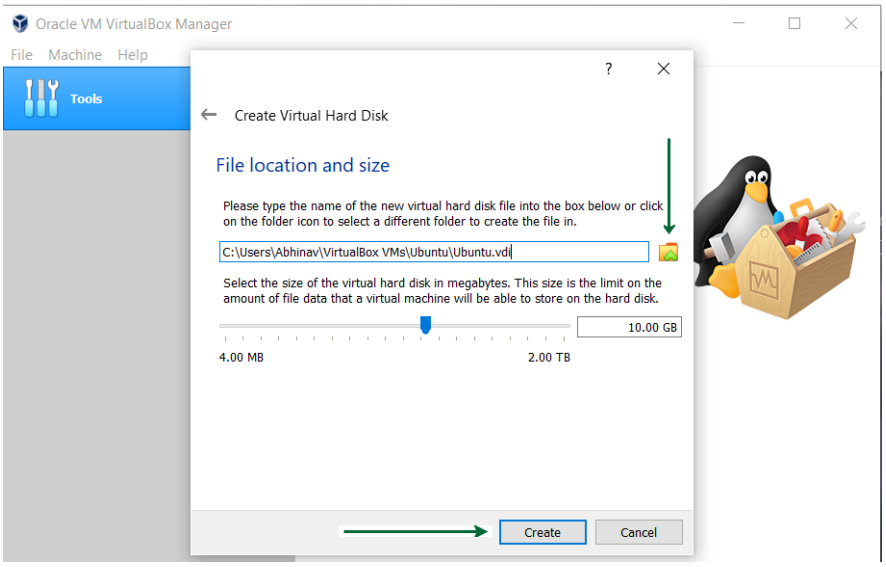


Step 7: Either of the **Physical Storage** types can be selected. Using a **Dynamically Allocated Disk** is by default recommended.

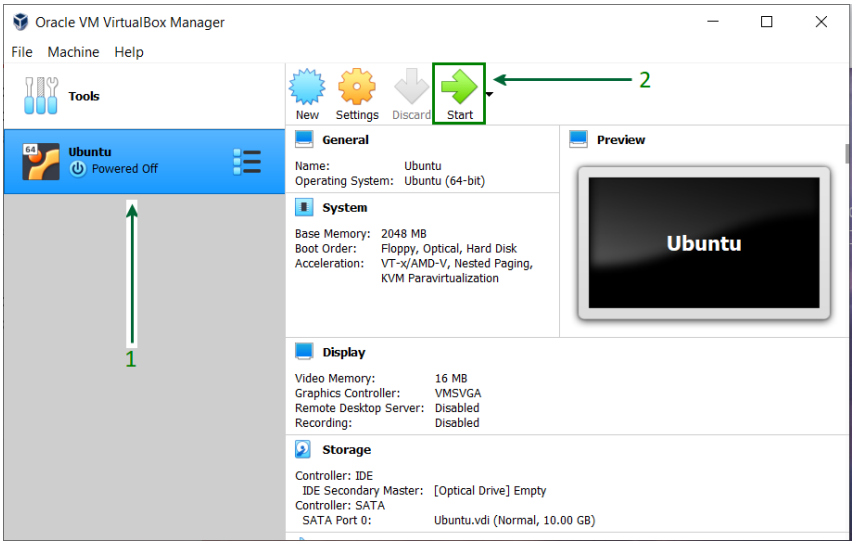


Step 8: Select **Disk Size** and provide the **Destination Folder** to install.

PSSCIVE

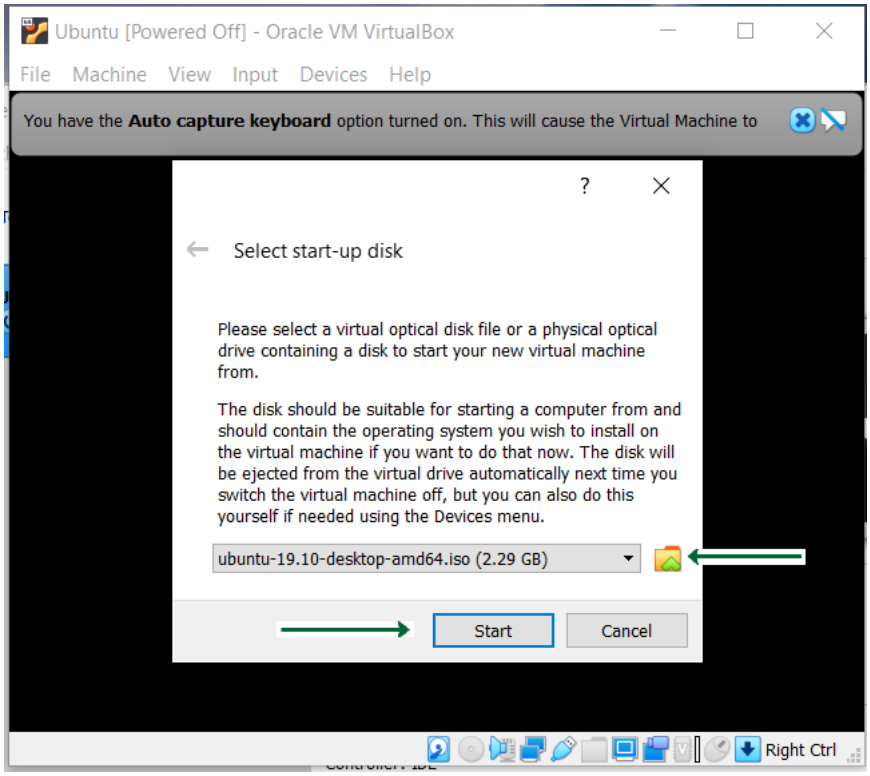


Step 9: After the Disk creation is done, boot the **Virtual Machine** and begin installing **Ubuntu**.

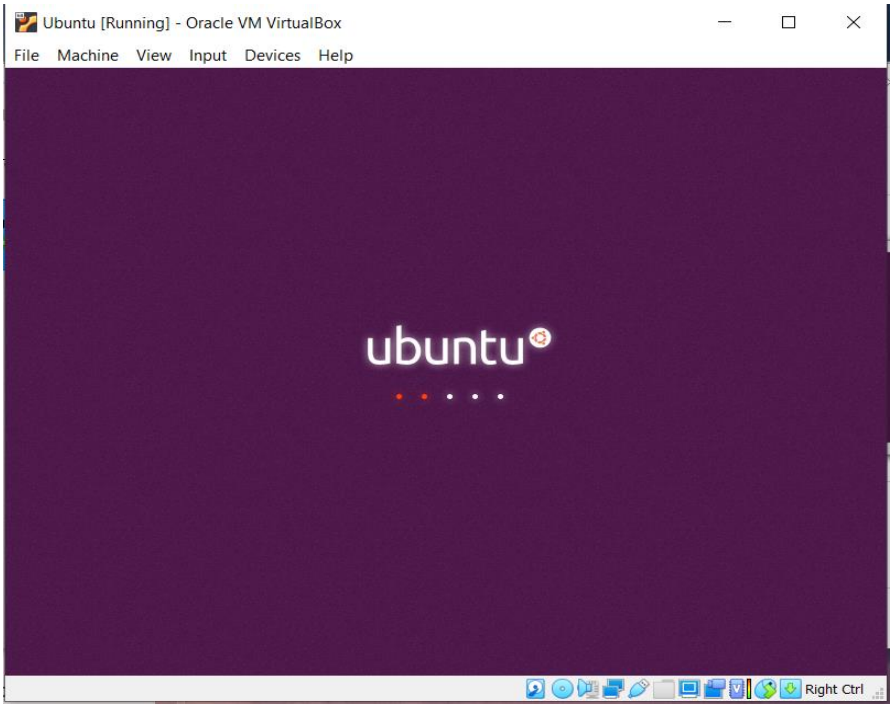


Step 10: If the installation disk is not automatically detected. Browse the file location and select the **ISO file for Ubuntu**.

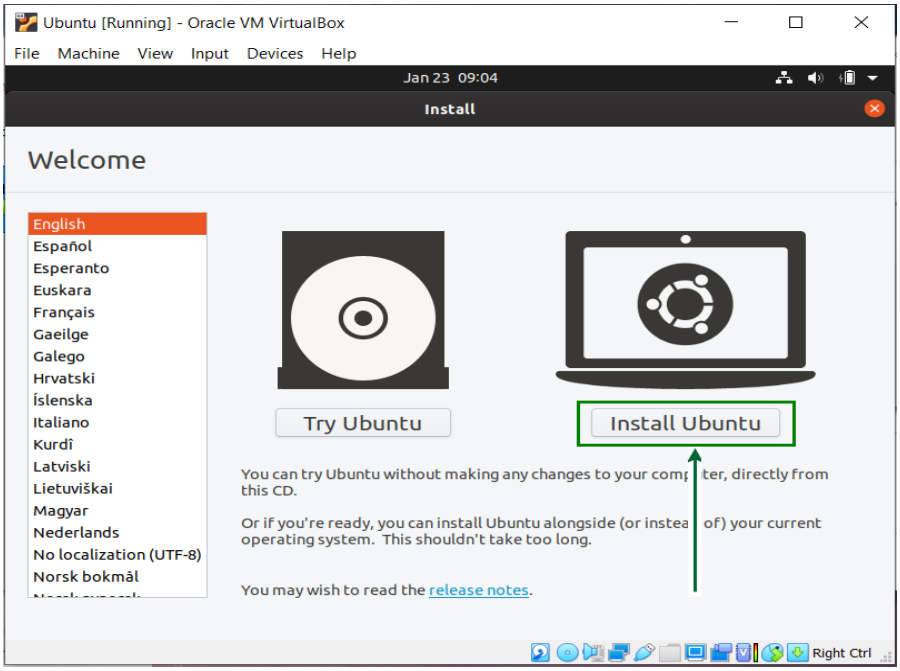
PSSCIVE



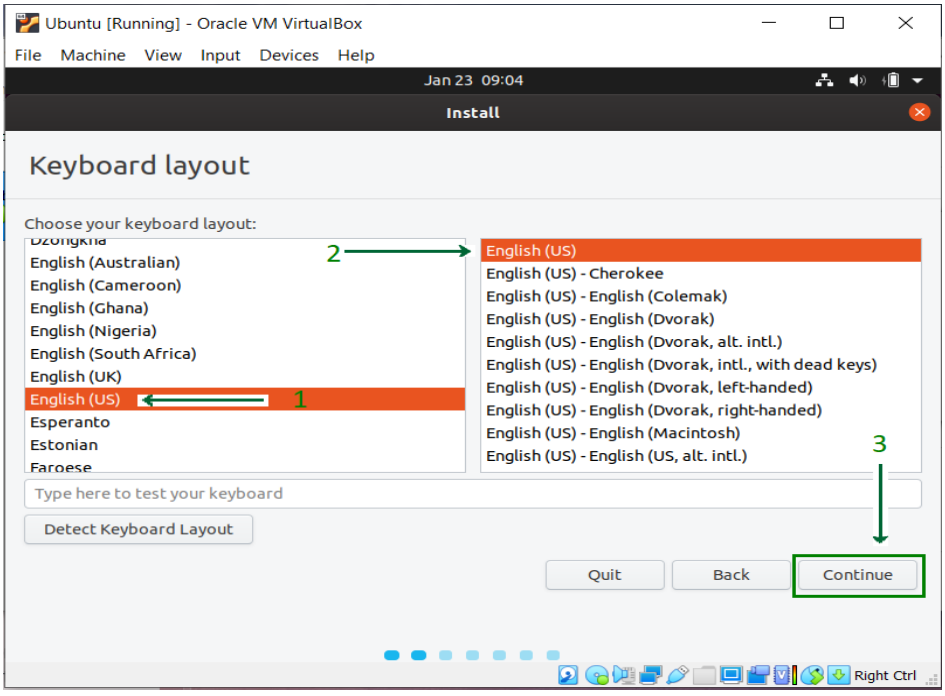
Step 11: Proceed with the installation file and wait for further options.



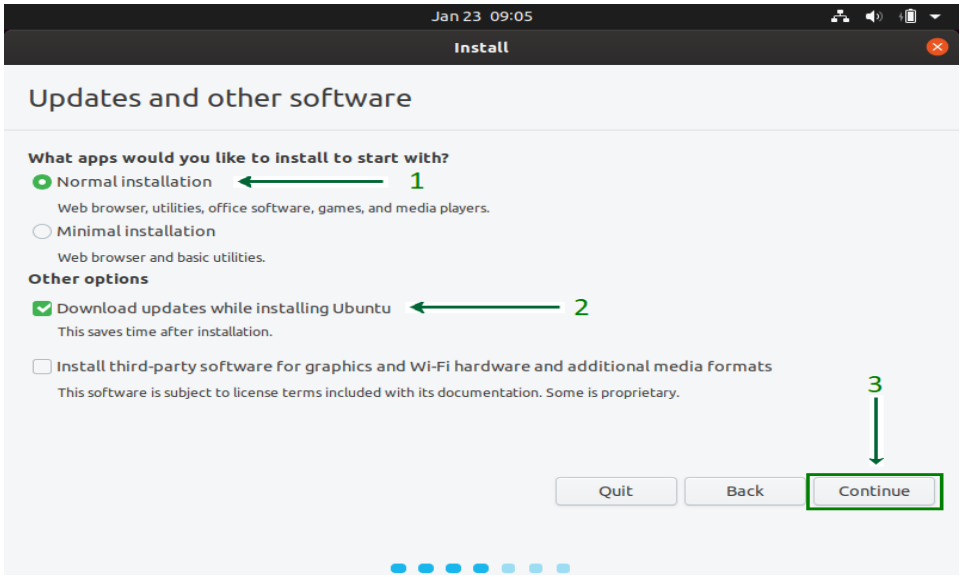
Step 12: Click on the **Install Ubuntu** option, this might look different for other Ubuntu versions.



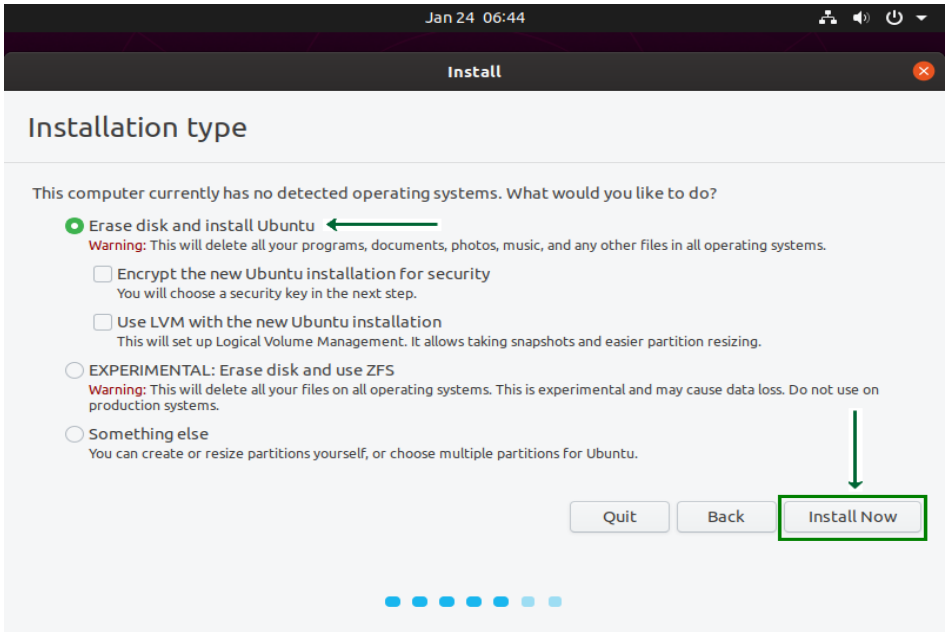
Step 13: Select **Keyboard Layout**, if the defaults are compatible, just click on the **Continue** button and proceed.



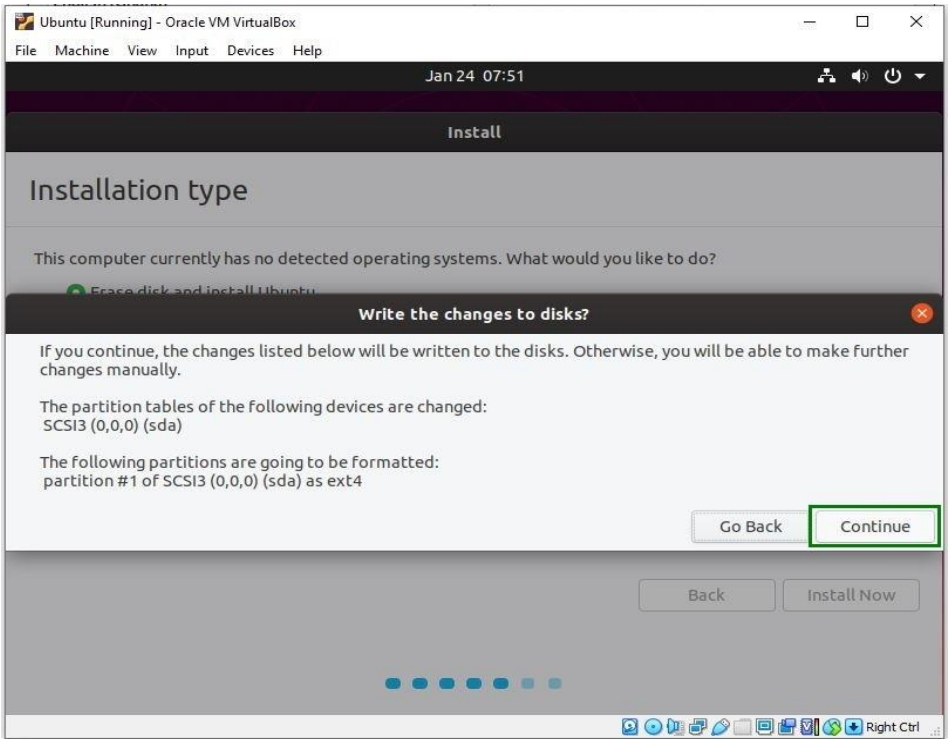
Step 14: Select **Installation Type**. By default, it is set to **Normal Installation**, which is recommended, but it can also be changed to **Minimal Installation** if there is no need for all Ubuntu features.



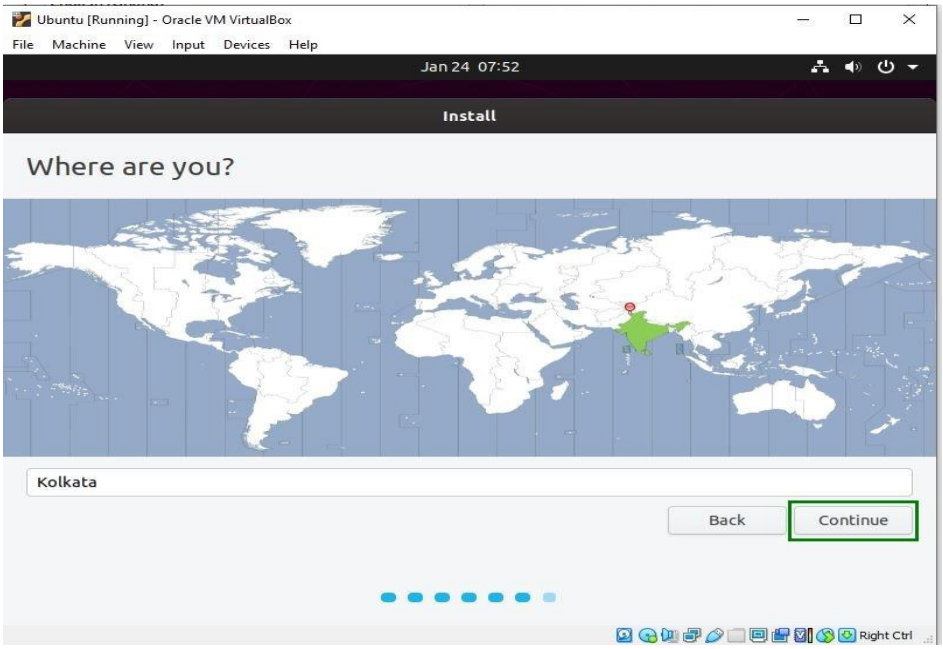
Step 15: Click on the **Install Now** button and carry on with the installation. Do not get worried about the **Erase disk** option, it will only be effective inside the virtual machine, and other system files outside the VirtualBox remain intact.



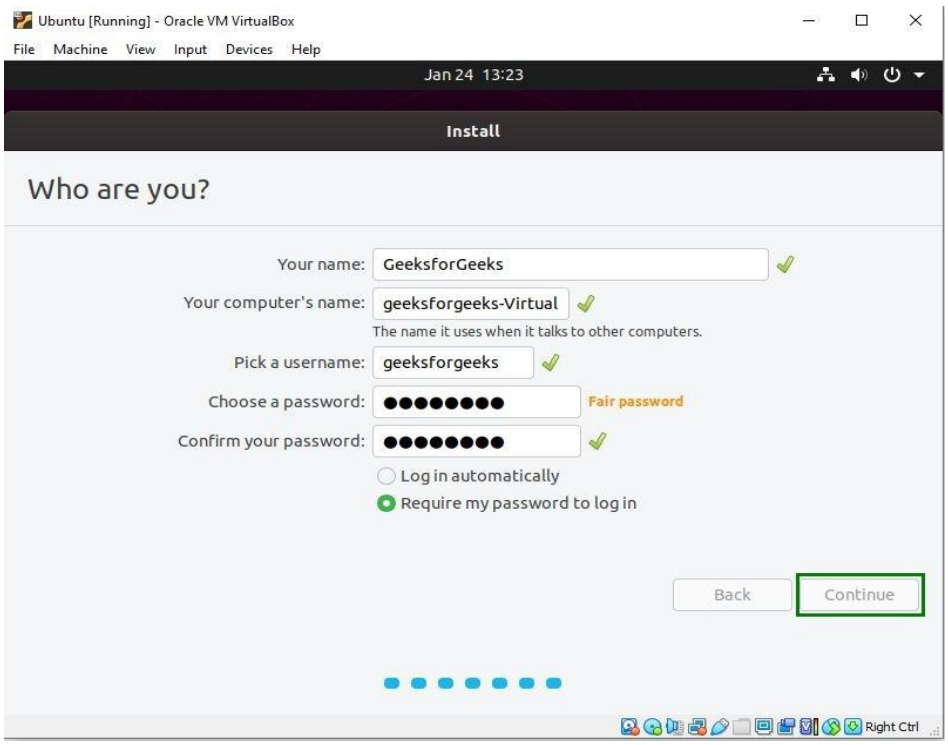
Step 16: Click on the **Continue** button, and proceed with writing changes on the disk.



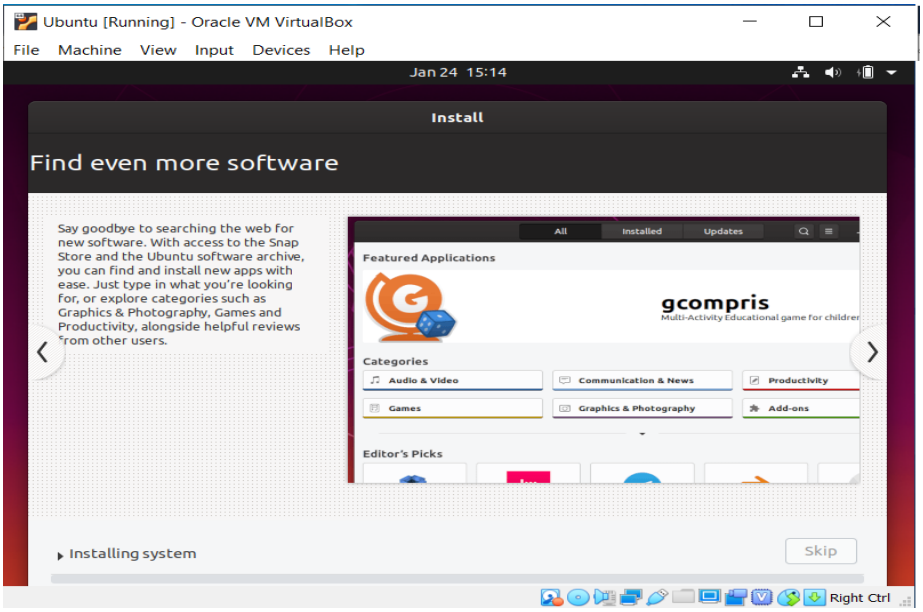
Step 17: Select your Location to set the **Time Zone**.



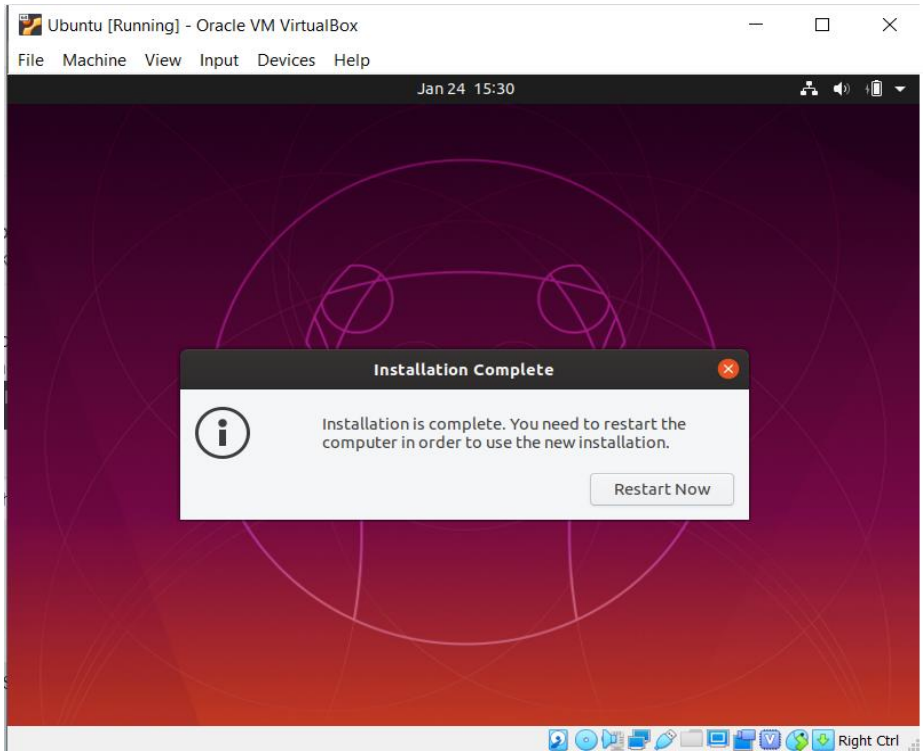
Step 18: Choose a **Name** for your computer and set a **Password** to secure login info.



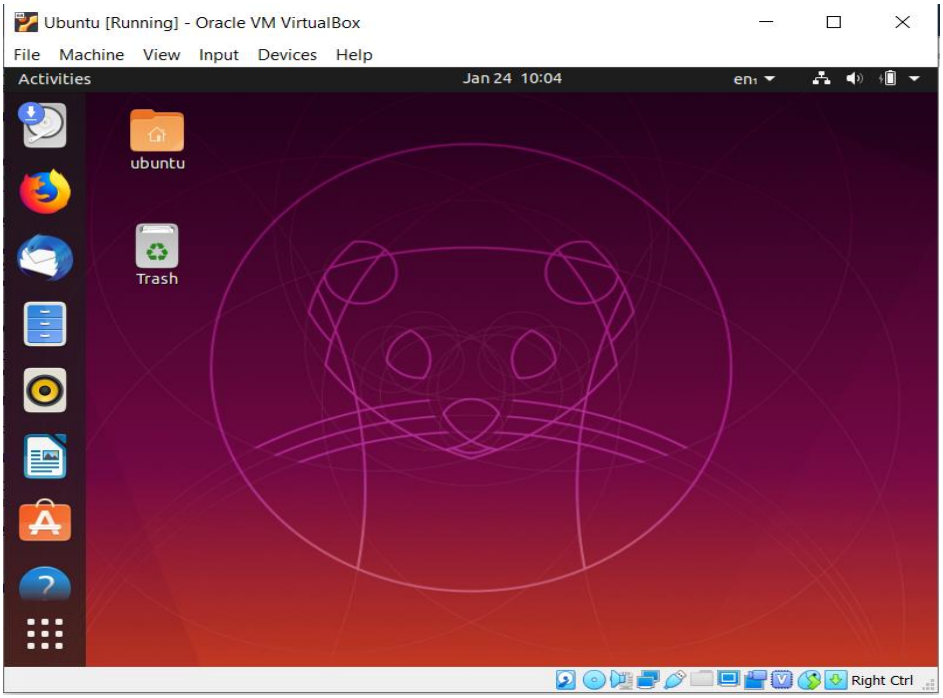
Step 19: Wait for the installation process to complete.



Step 20: Once the installation process is over, reboot your Virtual Machine.



Step 21: Voila!! You're finished with the installation process. Now you can use Ubuntu along with Windows, without creating a dual boot.

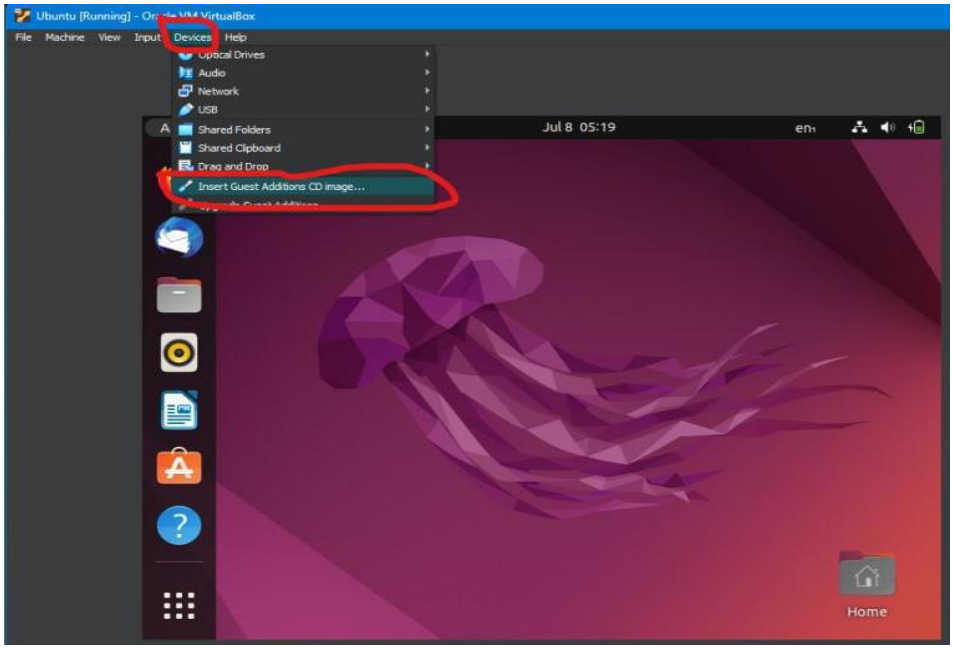


Steps to Make Full Screen of Ubuntu OS on VirtualBox

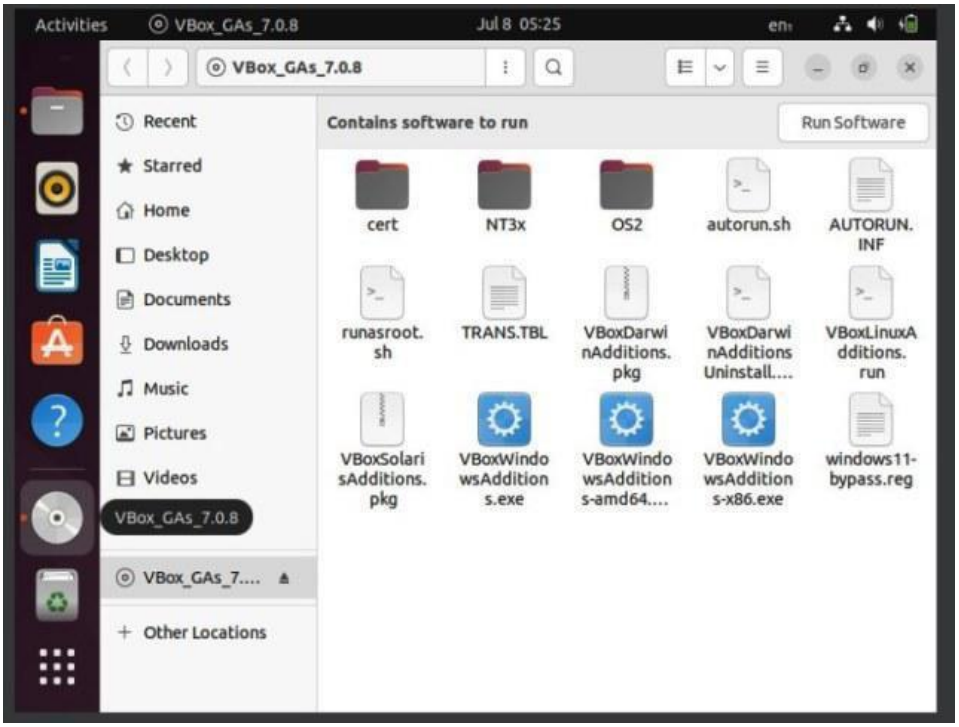
Note: After installing Ubuntu in Virtual Box, you may find that the Operating System is not suitable for full-screen mode. If you try to make it large by clicking on maximize

button, the visual part remains the same and the outside becomes white/black.

Step 1: To overcome this and make Ubuntu full screen in Virtual Box, click on **Devices** then on **Insert Guest Additions CD Image**.



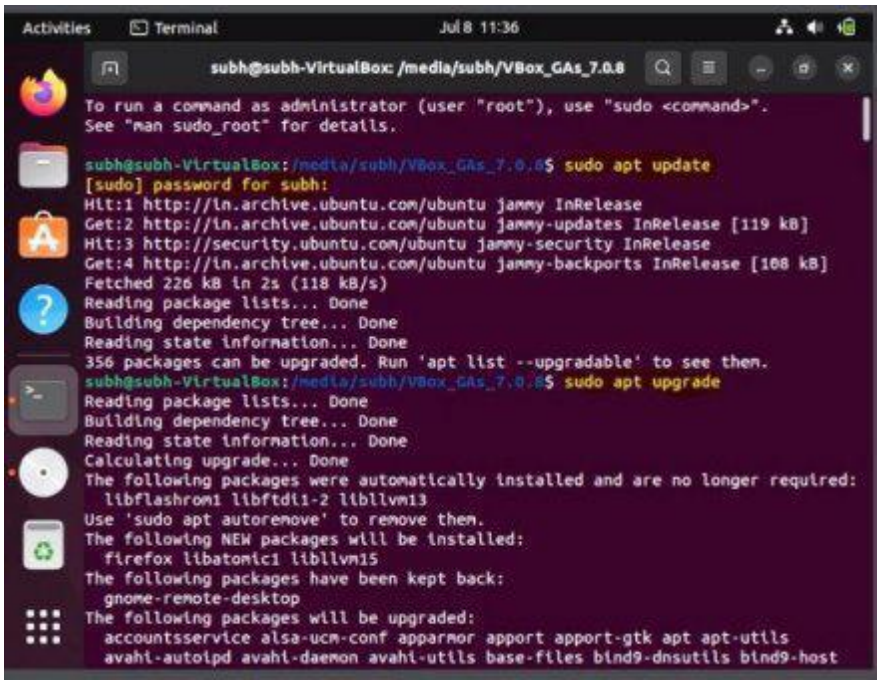
Step 2: Now you will be able to see a **Disk** icon on the **Taskbar**, click on that and it will open the disk



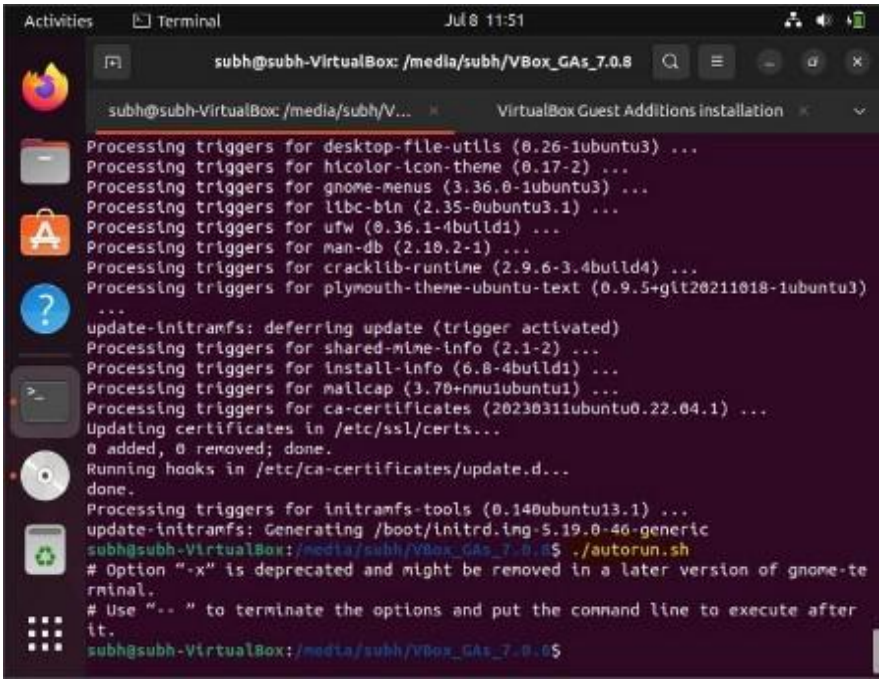
Step 3: Write right-click inside the folder select **Open in the Terminal**, and run the following commands. It will ask for the user's password, enter the password, and wait till completion.

sudo apt update

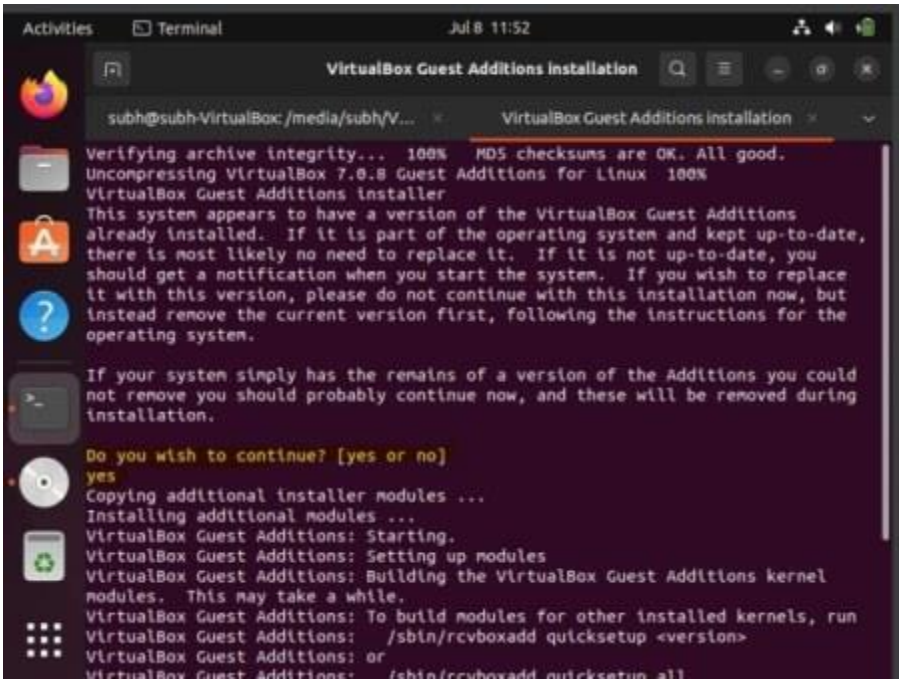
sudo apt upgrade



Step 4: After updating, run the command ./autorun.sh



Step 5: Now it will ask for the password and after checking the password a new tab will open inside the terminal. Enter **Yes** there.



Step 6: After installation restart Ubuntu and now you can use Ubuntu in Full-Screen Mode.

So, these are some long steps needed to **Download & Install Ubuntu on VirtualBox**. You should go through the entire steps for successfully **Launching Ubuntu on VirtualBox** in Full- Screen Mode. If you miss any step or perform any error, the **VirtualBox Installation of Ubuntu** will not be successful.

Procedure for installation of Ubuntu Linux in dual booting

Dual booting Linux with Windows is one of the most convenient ways to enjoy both operating systems on the same computer. With dual booting, both OSes are installed on your hard drive, allowing you to choose which one to use each time you power on your system. This setup lets you take full advantage of both operating systems on real hardware.

Compatibility checks

Ensure your system uses UEFI: This tutorial is only applicable for systems with UEFI boot. If your system was purchased in the last 5-6 years, it likely already uses UEFI with a GPT partition. However, it is important to verify that your system uses UEFI. If your system uses legacy BIOS with an MBR partition, please follow this dual boot tutorial instead.

Prerequisites:

To easily and safely install Linux alongside Windows, you will need the following:

- A computer preinstalled with Windows 10.
- A USB drive (at least 4 GB in size) with no data on it.
- An internet connection (to download the Ubuntu ISO image and live USB creation tool). This can be done on any system, not necessarily the one you are dual booting.
- Optional: An external USB disk for backing up your existing data.
- Optional: A Windows recovery or bootable disk (useful for fixing any major boot issues you might encounter).

Activity 2

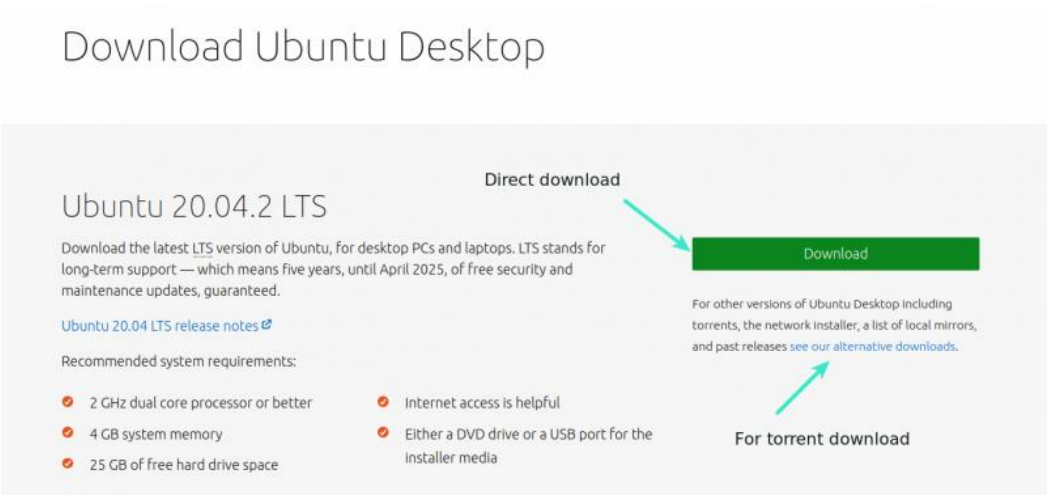
Practical Activity: 2 Demonstrate to install Ubuntu Linux on Windows computer for dual booting.

Step 1: Make a backup of your Windows system [optional]

It is always nice to have a backup of your data, just in case you mess up with the system while dealing with disk partitions.

I advise copying all the essential data you cannot afford to lose on an external USB disk. You can use an external HDD (slower but cheaper) or SSD (faster but expensive) and copy the important files and folders.

Step 2: Download Ubuntu (or whichever Linux distribution you are using)



Head over to Ubuntu's website and download the ISO file. The file should be around 2.5 GB in size. If you need to download Ubuntu via torrents, you can click the 'alternative downloads.'

Download Ubuntu ISO Image

Step 3: Create a live USB/disk of Ubuntu

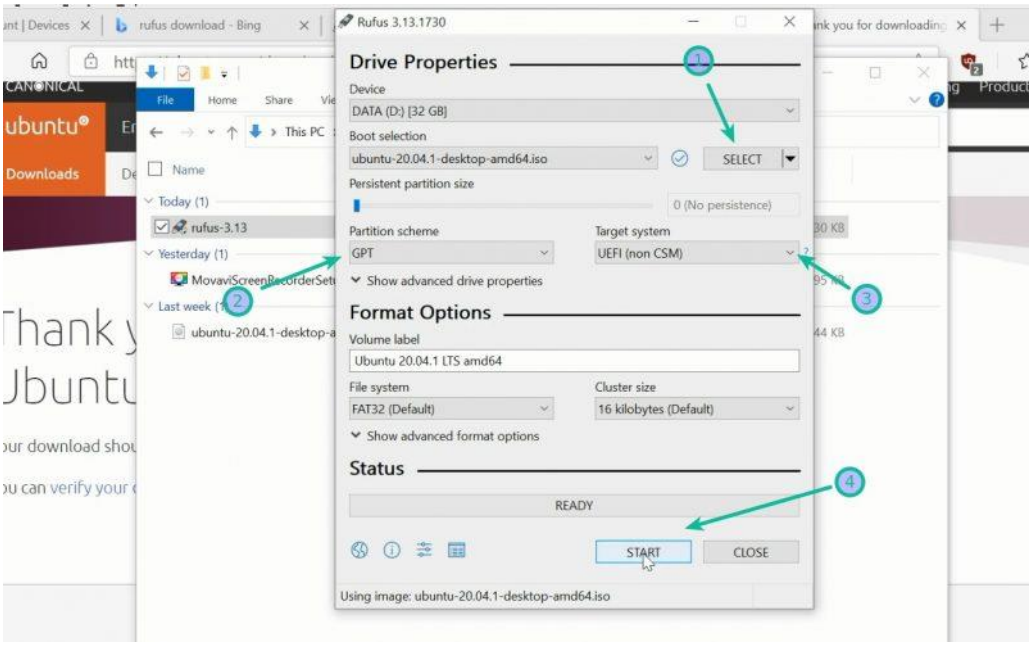
I presume that you are using Windows to create the live USB. Several free applications allow you to create a live Ubuntu USB. You can use any of these tools. Since I cannot show all of them, I'll go with Rufus.

Download Rufus for free from its website. It will download a .exe file.

Download Rufus

Plug in your USB. This device will be formatted so make sure you don't have any important data on this USB disk.

Run the Rufus tool you just downloaded. It automatically identifies the plugged-in USB but double-check it anyway. Now, browse to the location of the downloaded ISO image and ensure that it uses GPT partitioning scheme and UEFI target system.



Hit the start button and wait for the process to complete. Your live Linux USB is ready.

Installing Ubuntu and creating the live Ubuntu USB process can be done on any computer. But the rest of the process takes on the system on which you are dual booting.

Step 4: Make some free space on your disk for Ubuntu installation

In many systems, while installing Ubuntu, it gives the option to make a disk partition for Ubuntu. However, that is not a surety. This is why making the required free space on the disk would be better before starting the installation procedure.

In the Windows menu, search for 'disk partitions' and go to 'Create and format hard disk partitions.'

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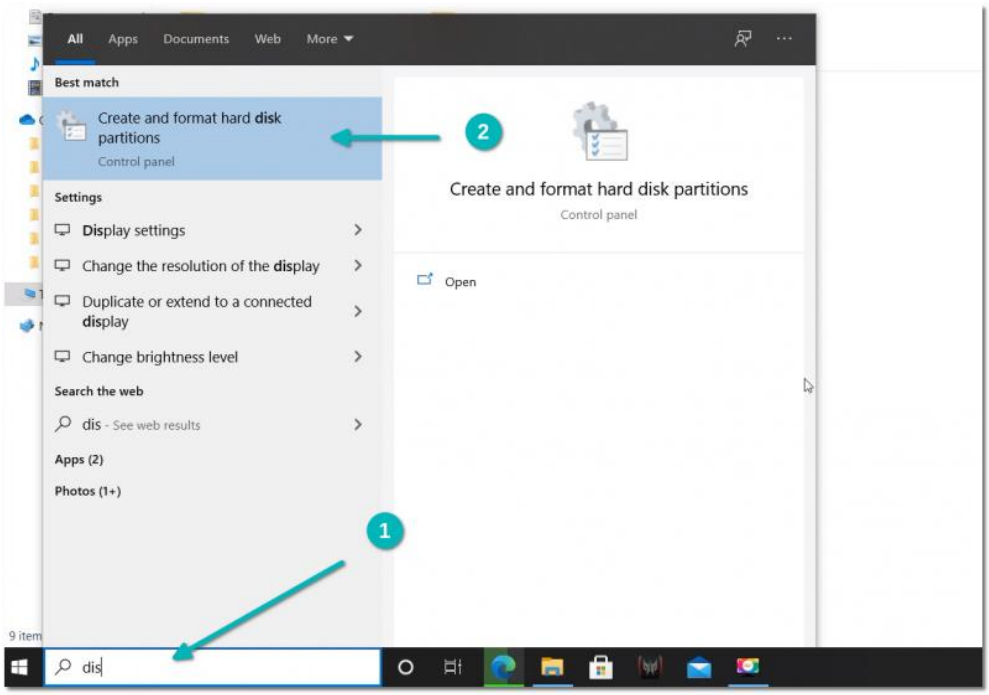

In the Disk Management tool, right-click on the drive which you want to partition and select shrink volume.

If you have just one partition like this, you need to make some free space out of it for Linux. Use any of them except C drive if you have several partitions of considerable size because it may erase the data.

The 256 GB in my system already had several partitions from the manufacturer but mainly for backup and other purposes. The primary partition was the C drive, around 220 GB, where Windows 10 is installed. In my case, I shrunk the C drive to make some free space for Linux installation.

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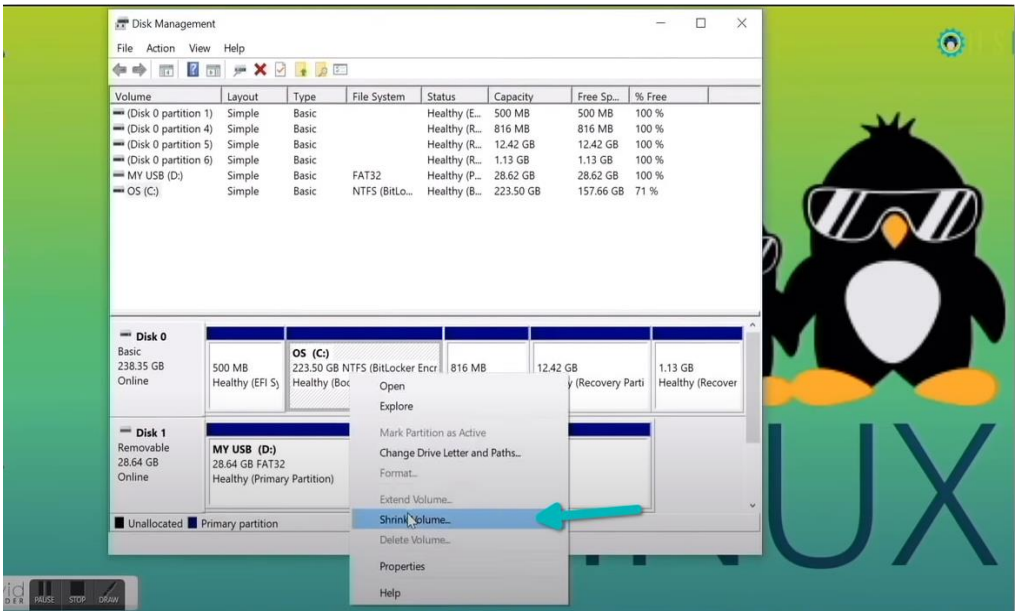


How much space do you need for Linux in dual boot

This depends on how much total disk space you have. You may install Ubuntu on 15 or 20 GB but you'll soon start running out of disk space. These days, you should have at least 120 GB of disk. In that case, go for 30-40 GB of disk for Linux. If you have 250 GB disk, allocate 60-80 GB or even more. If you have more disk space, allocate even more free space, if you want.

What if you have D, E or F drives?

This is a common confusion for many people as they think Ubuntu can only be installed on the C drive. That's not true. I had only one C drive, so I shrank it. If you have D, E or F drive, you may shrink one of those drives. You may also choose to delete the D, E or F drive. NEVER DELETE C DRIVE.

Step 5: Boot from live Ubuntu USB

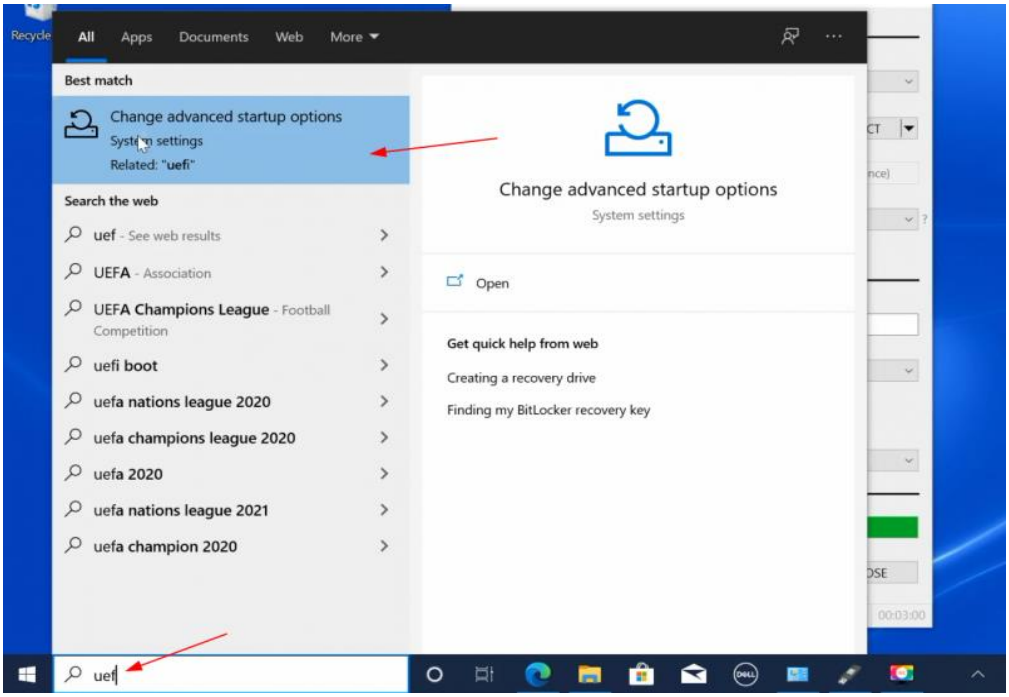
You created a live Ubuntu USB in step 3. Plug it into the system. Before you go and boot from the live USB, let's have a quick word about the infamous secure boot.

Do I need to disable the secure boot for installing Linux?

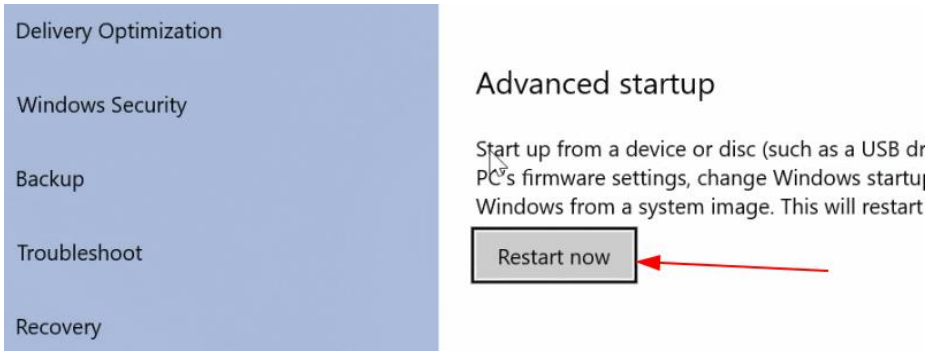
6-8 years back, the UEFI secure boot was not well-supported by Linux; hence, you had to disable secure boot before installing Linux. Thankfully, Ubuntu and many other Linux distributions currently support secure boot very well. Usually, you should not need to do anything about it. However, if your system doesn't allow booting from live USB or if you see any other related issue, you may disable the secure boot on Windows.

Alright! Let's see how to boot from the USB. You can go to the boot settings by pressing F2/F10 or F12 at the system start time and selecting to boot from the USB. However, some people find it difficult.

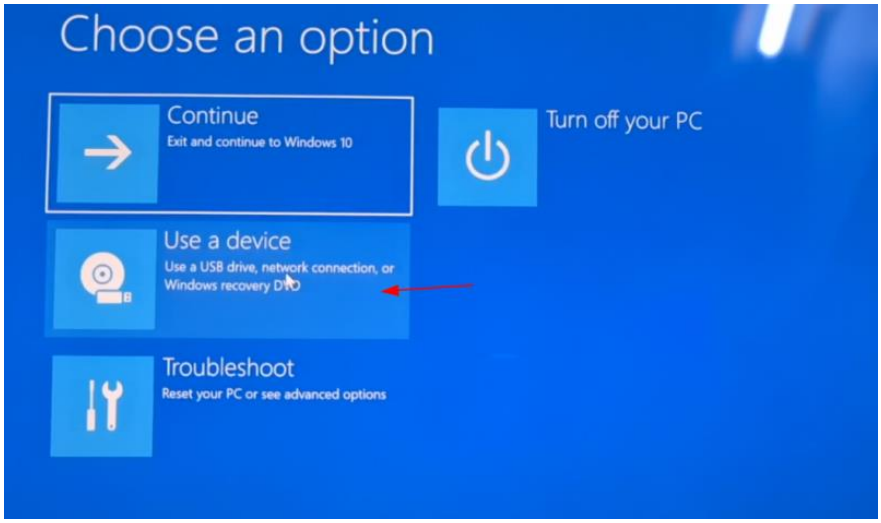
The longer but an easier step is to access the UEFI boot settings from within Windows. In the Windows menu, search for UEFI and then click on 'Change advanced startup options':



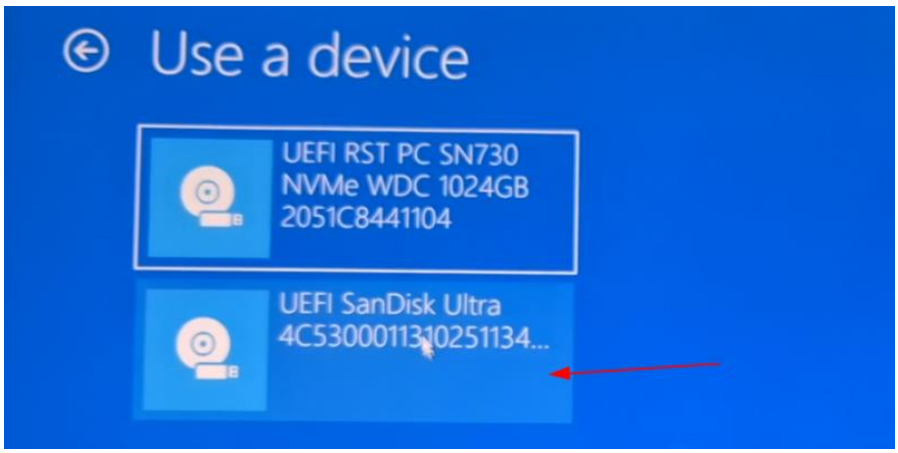
Go to the Advanced startup option and click on Restart now button.



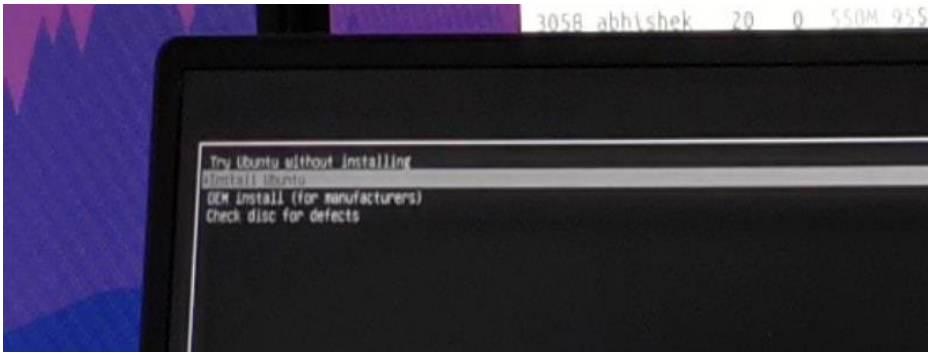
On the next screen, click on 'Use a device':



Recognize the USB disk with its name and size. It may also be displayed as EFI USB Device.



Now it will power off your system and reboot into the disk you chose which should be the live USB disk. You should see a screen like this after a few seconds:



The 'Try Ubuntu without installing' option allows you to experience Ubuntu from the live disk. The option to install Ubuntu can be found on the desktop.

The "Install Ubuntu" option will start the Ubuntu installation immediately.

You can opt for either option based on your preference.

Step 6: Installing Ubuntu along with Windows 10

Start the installation procedure. The first few steps are simple. You choose the language and keyboard layout.

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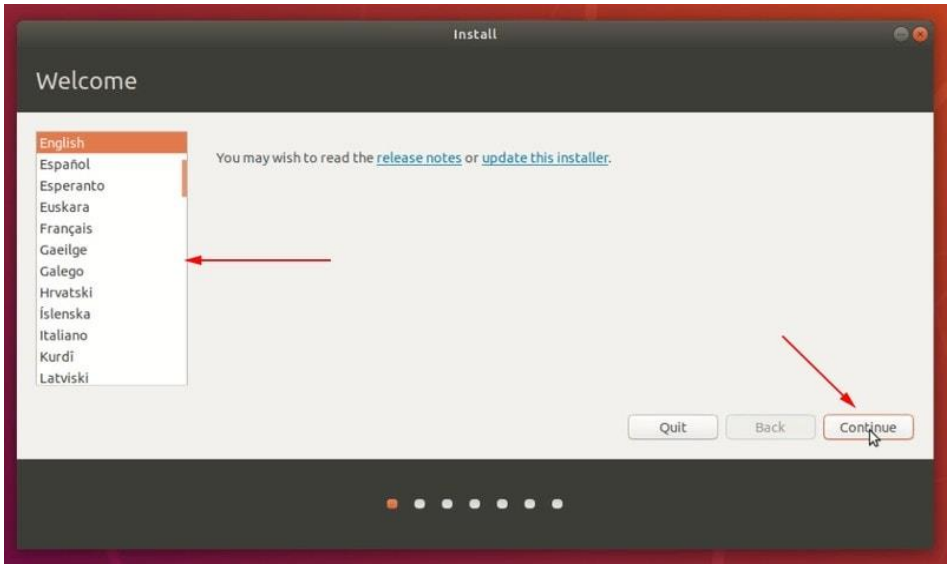
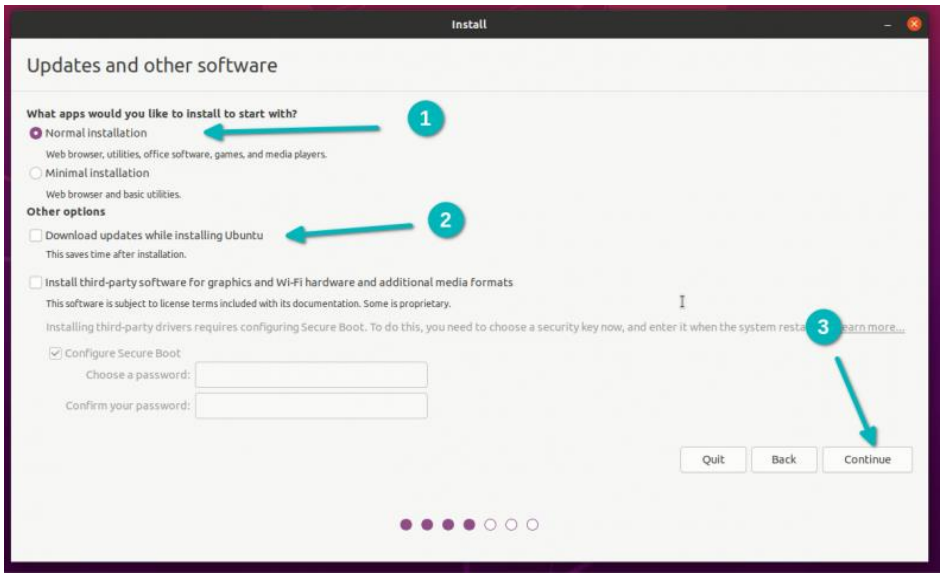


Choose your language / Choose keyboard layout

On the next screen, choose Normal installation. No need to download updates or install third-party software just yet. You may do it after the installation completes.

Hit continue. It may take some time to go to the next step.



Note: Some people try to download updates and install media codes while installing. In my experience, it sometimes creates issues during installation and may also cause the installation to fail. For this reason, I advise against them.

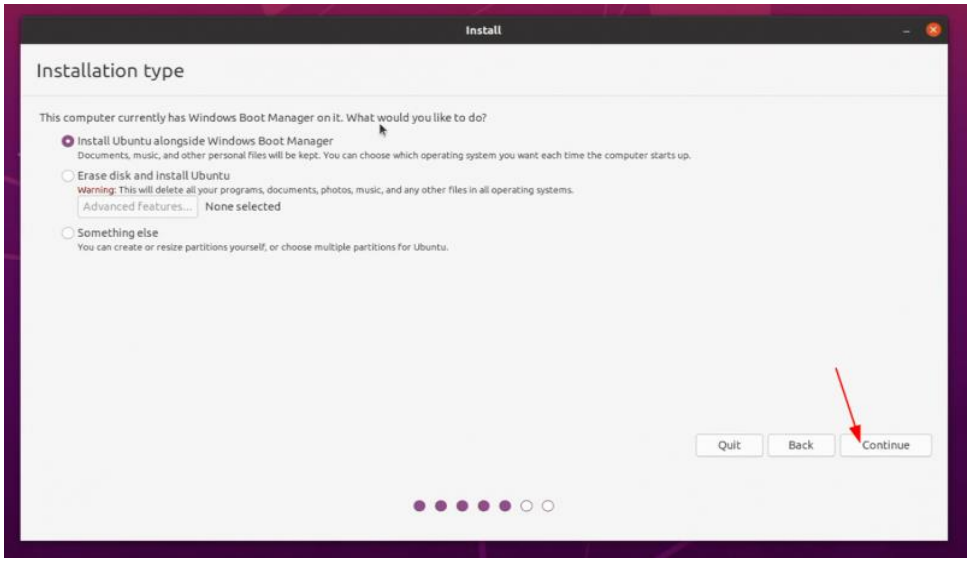
Important: Installation takes two approaches based on what you see on the next screen

Since this is a detailed tutorial, I'll cover both aspects.

Approach 1: You see the "Install Ubuntu alongside Windows Boot Manager"

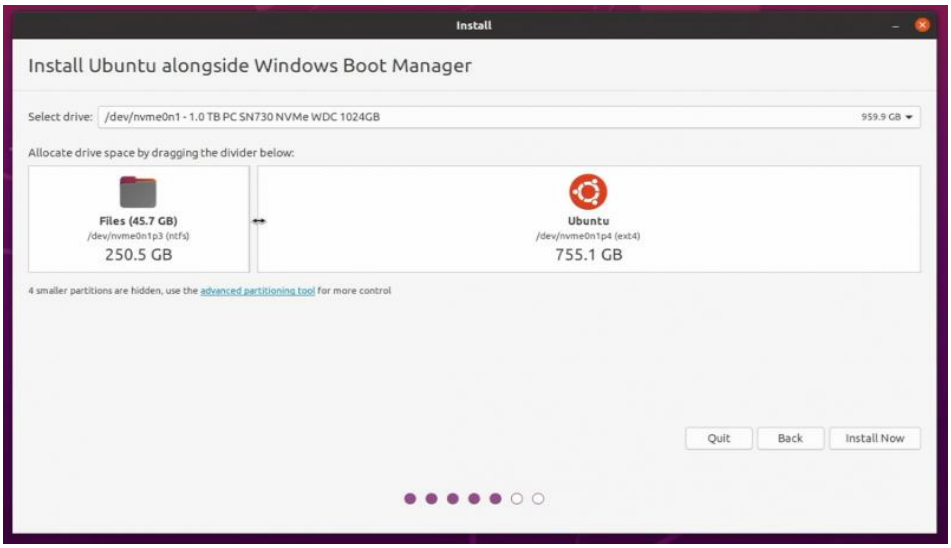
If you see the "Install Ubuntu alongside Windows Boot Manager" on the Installation type

screen, you are in luck. You can select this method and hit continue.



If you see the “Install Ubuntu alongside Windows Boot Manager”, choose it

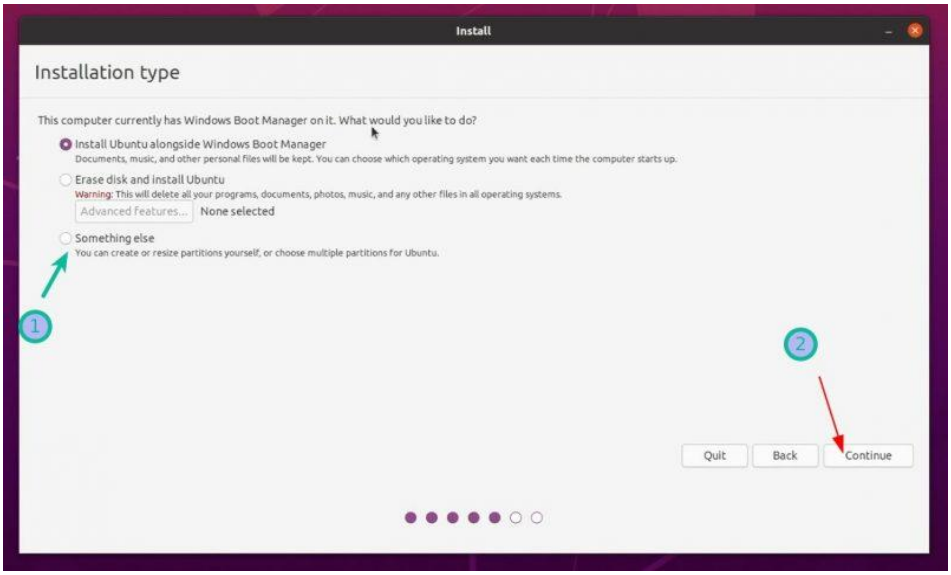
The next screen will give you the option to create a partition for Ubuntu by dragging the divider. You can allocate appropriate disk space to Linux here. Ubuntu will create one partition of the allocated disk space and it will have root with home and a swap file of 2 GB in size under root itself.



Approach 2: You don’t see ‘Install Ubuntu alongside Windows Boot Manager’ option or it is greyed out

But if you are one of the unlucky ones who don’t see this option, no need to worry. Things are not that bad for you. You can still install Ubuntu with Windows.

On the Installation type screen, go with Something Else.

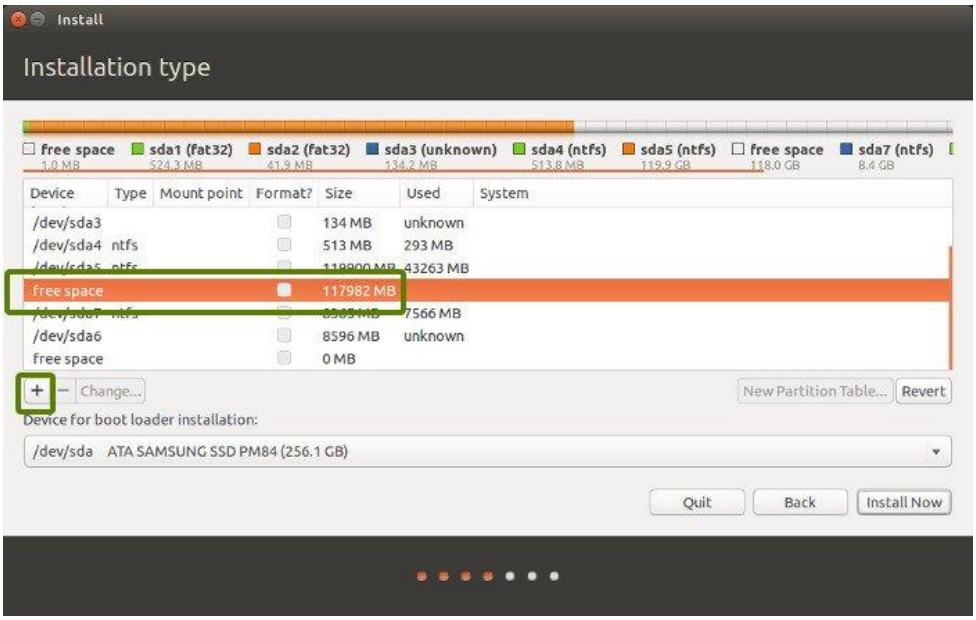


It will take you to the partitioning screen. Remember you had created some free space beforehand?

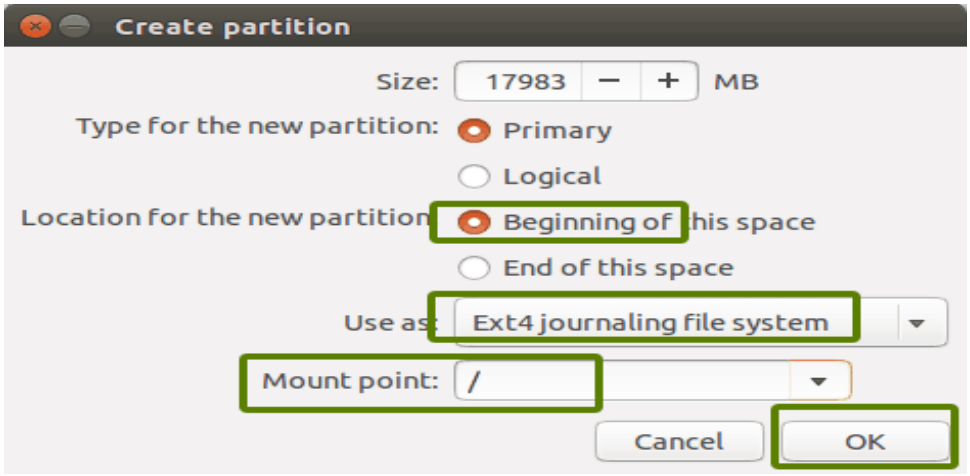
You may allocate the entire free space to root (swapfile and home will be created automatically under root) or separate root, swap and home partitioning. Both methods are acceptable.

I show the steps for creating root, swap and home partitions separately. But feel free to use a single partition for all of them.

Select the free space and click on the + sign.



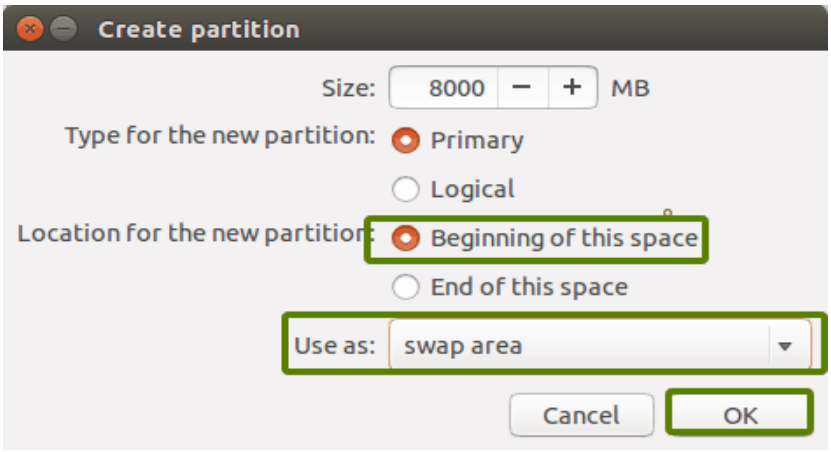
It will provide you with the option to create a Linux partition. You are creating the Root partition. Anything above 25 GB is more than sufficient for it. Choose the size, select Ext 4 as the file type and / (means root) as the mount point.



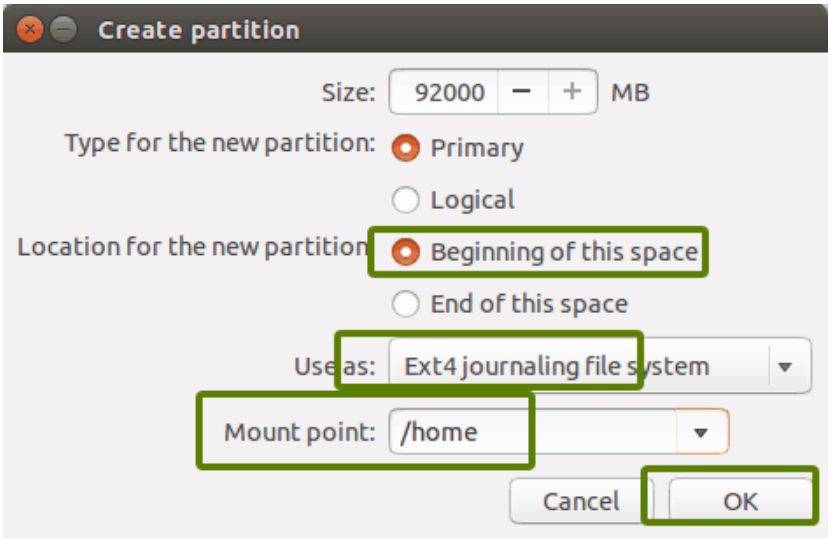
Clicking on OK in the previous step will bring you to the partition screen. Next, create a swap. Like previously, click on the + sign again. This time, use the file type as the Swap area.

Ideal swap size in Linux is debatable. If you have 2 GB or less RAM, use swap double the size of RAM. If you have 3-6 GB of RAM, use a swap of the same size as RAM. If you have 8 GB or more RAM, you may use swap half the size of RAM (unless you have plenty of disk space, and you want to use hibernation and in that case, use a swap of at least the same size as RAM).

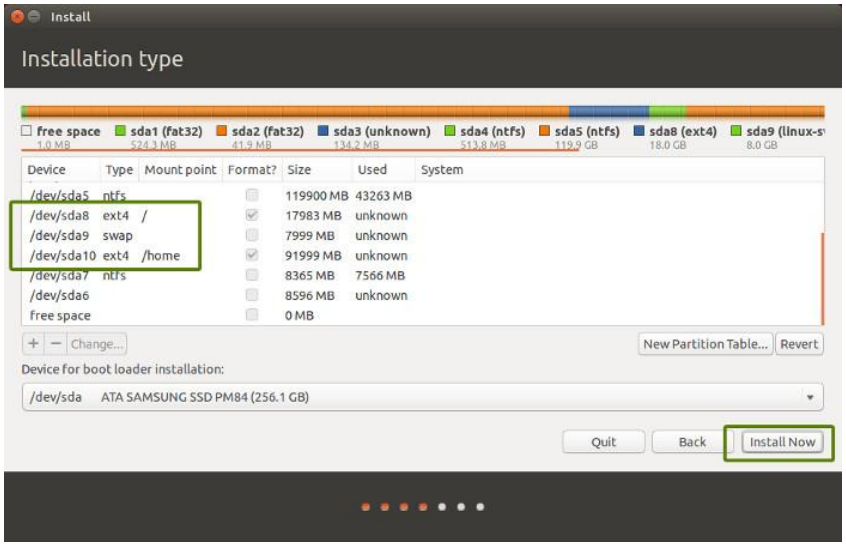
If you feel like you have less swap on your system, don't worry. You can easily create swapfile and add more swap space to your systems.



Similarly, create a Home partition. Allocate it maximum space (in fact allocate it the rest of the free space) because this is where you'll save music, pictures and downloaded files.



Once you are ready with Root, Swap and Home, click on Install Now:



Well, you have almost won the battle. You can smell victory now. Select a timezone when asked.

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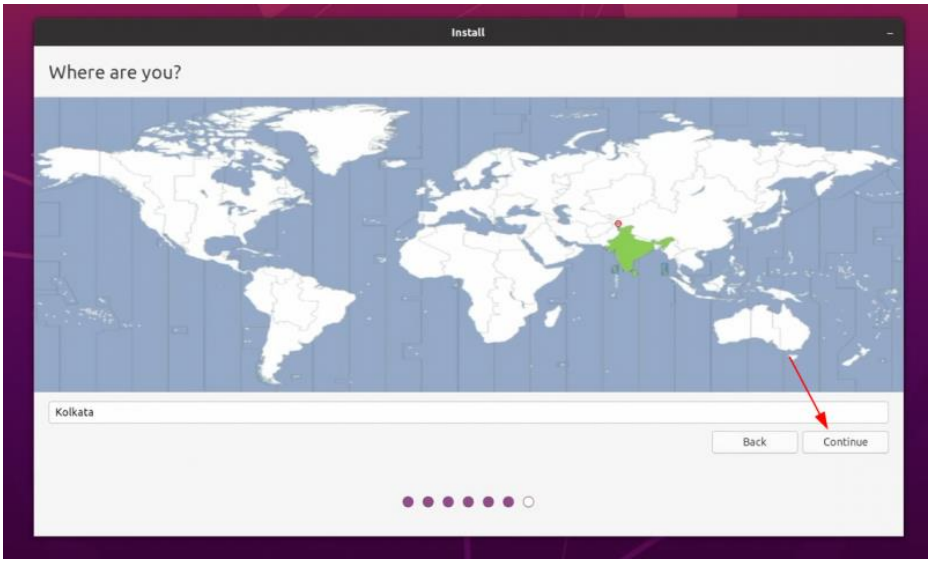
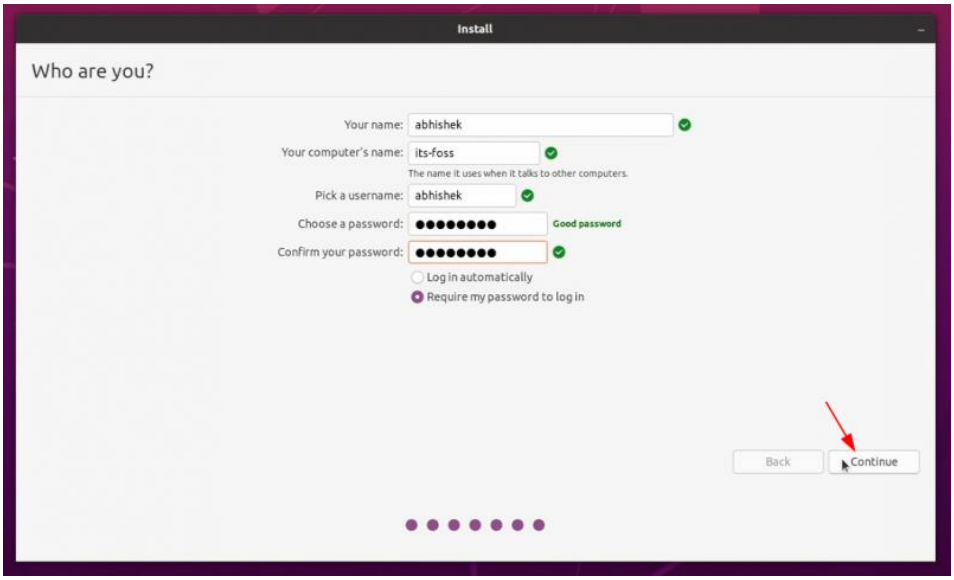


Next, you'll be asked to enter a username, hostname (computer's name) and password.



Now it's just a matter of waiting. It should take 8-10 minutes to complete the installation.

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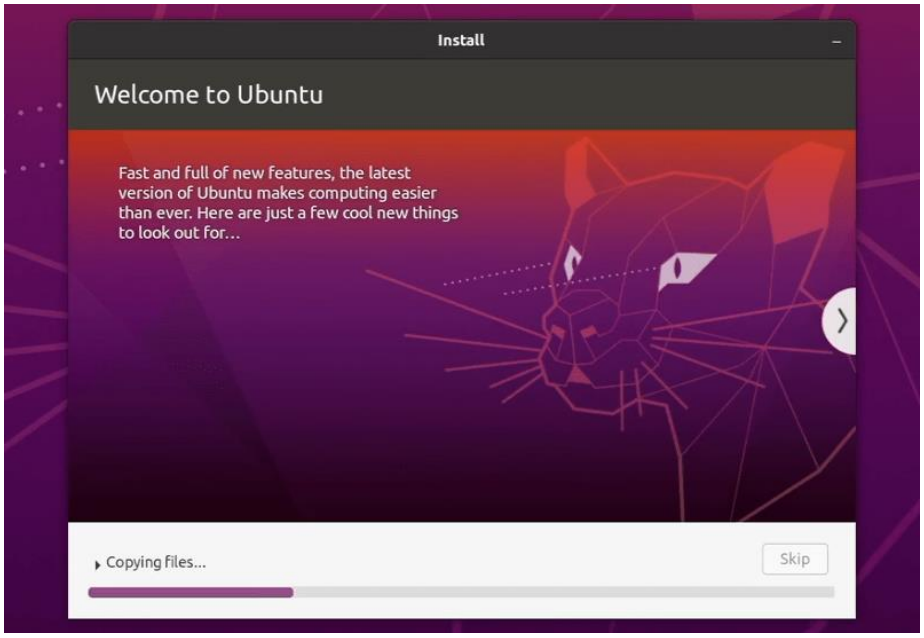
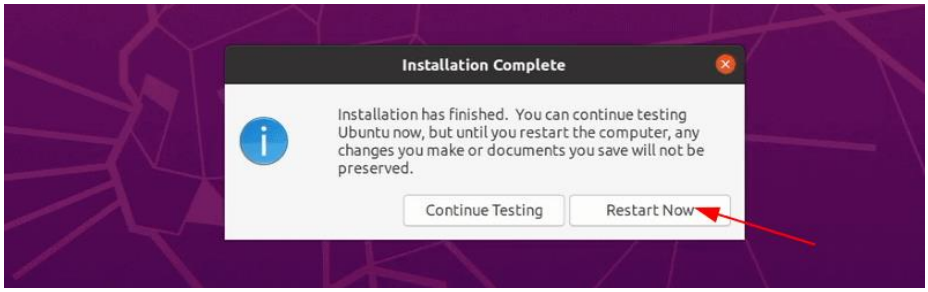


Once the installation finishes, restart the system.



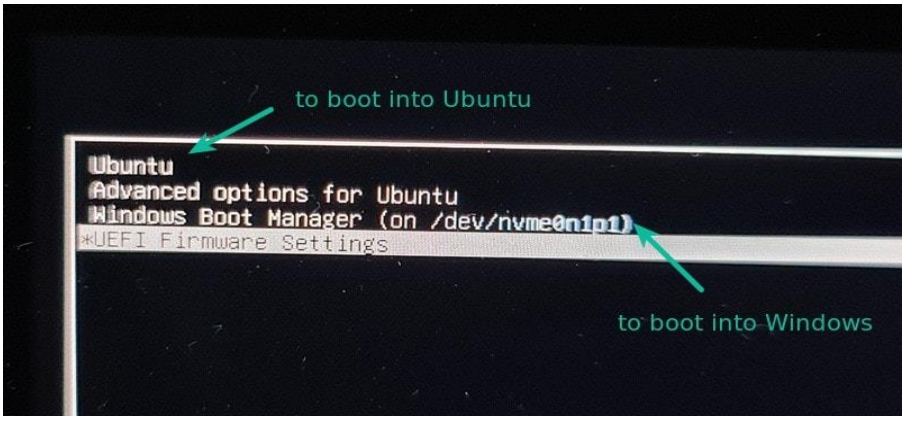
Restart after installation completes

You'll be asked to remove the USB disk. You can remove the disk at this stage without worrying. The system reboots after this.

Remove USB and press enter

You do not need the live USB disk to use Linux anymore. You have installed Ubuntu on your computer's disk. Remove the USB and keep it for later if you want to use it for installing Linux on some other system. You may also format and use it for regular data storage or transfer.

If everything goes smoothly, you should see the grub screen once the system powers on. Here, you can choose Ubuntu to boot into Ubuntu and Windows boot manager to boot into Windows. Pretty cool, right?



You can choose the operating system from the grub screen

Session 2: Perform post installation task in Linux operating system

Post installation tasks in Ubuntu Linux

Linux, an open-source operating system, made its debut on September 17, 1991, thanks to Linus Torvalds. Similar to Windows, macOS, and Android, Linux also shares similarities with Unix operating systems, reflecting in comparable commands. It's freely accessible for both commercial and non-commercial purposes, enabling programmers to modify the Linux kernel, creating new distributions.

In recent times, Linux has made remarkable strides, offering numerous beneficial features for both companies and home users. Consequently, it has emerged as one of the most prevalent operating systems in the IT industry. Moreover, it's readily available for download at no cost from the internet.

After installing Ubuntu Linux, there are several important tasks you should perform to ensure your system is set up correctly and optimized for your needs. Here are the key post-installation tasks:

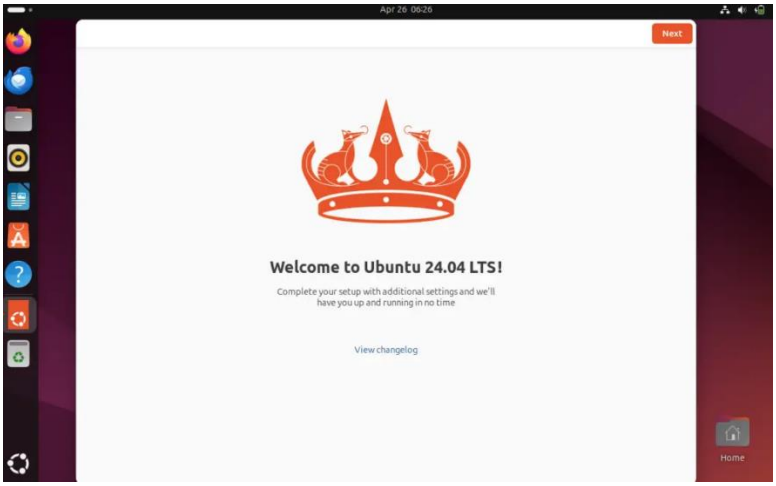
When the system boots up after a successful installation, you will see the login screen below. Log in using the username and password you created during the installation.

Activity 1

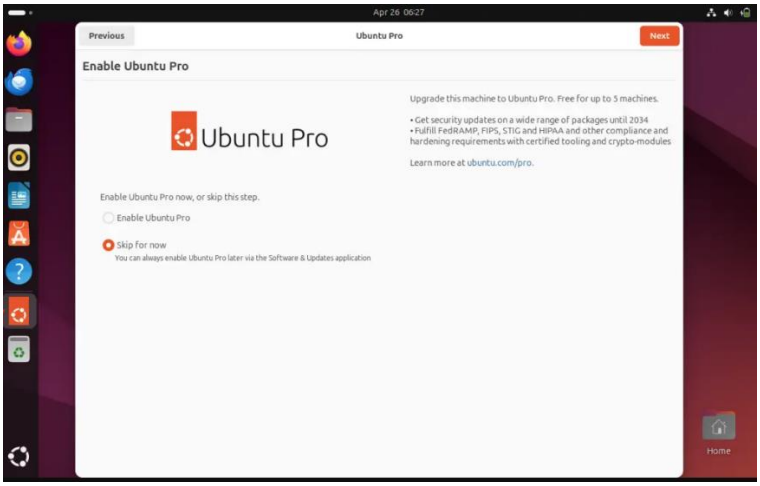
Practical Activity: Demonstrate Post installation tasks of Ubuntu Linux

Step 1. When the system boots up after a successful installation, you will see the login screen below. Log in using the username and password you created during the installation.

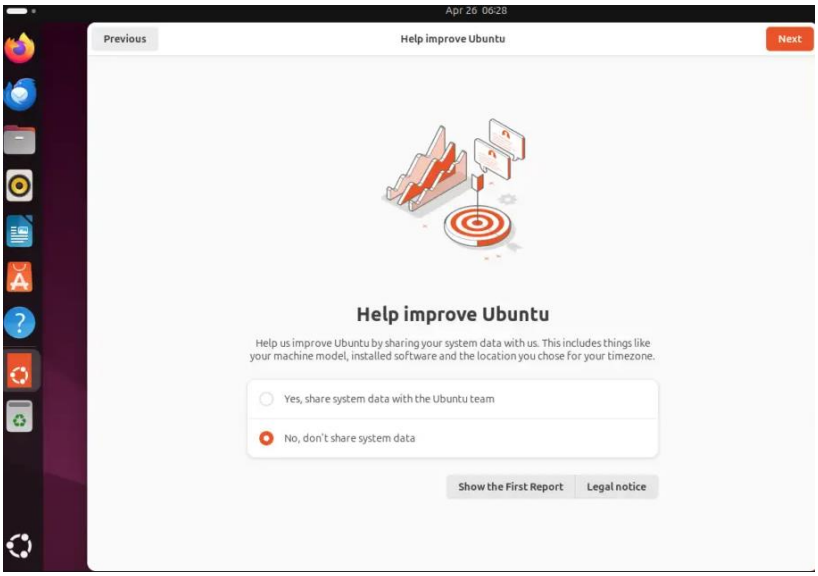
Step 2. After entering your credentials and pressing Enter, you will be taken to the desktop screen. You will then see the following welcome screen. Complete the setup by configuring some additional settings.



Step 3. Click on Next. In the following window, disable Ubuntu Pro by selecting "Skip for Now," then click Next.



Step 4. Choose "No, don't share system data".



Step 5. Click on Finish to start using your Ubuntu 24.04.

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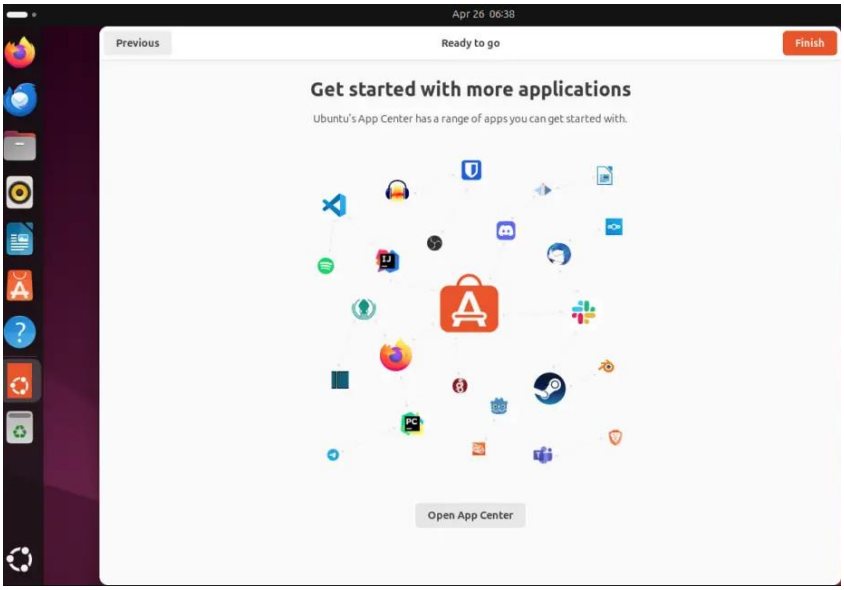
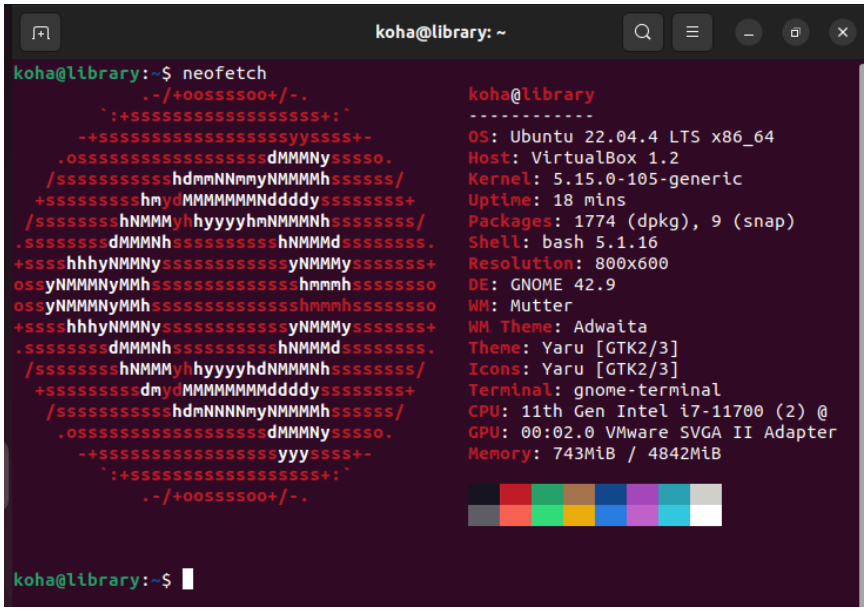


Step 6. Next, Open the terminal and install neofetch utility.

$ sudo apt update

$ sudo apt install neofetch -y

$ neofetch



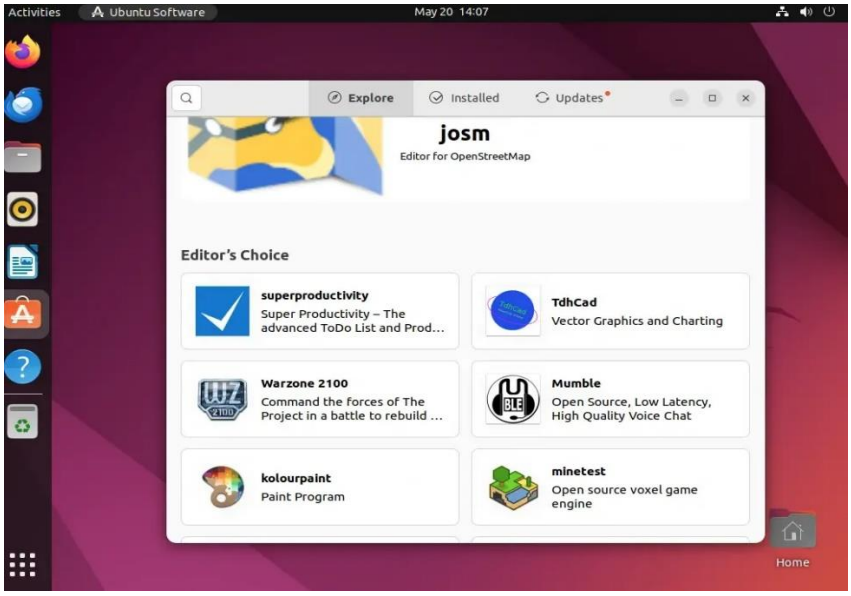
Step 7. Great, output above shows that we have successfully installed Ubuntu 24.04 LTS on our system.

Procedure to install Desktop and icon themes

Installing desktop and icon themes in Ubuntu 24.04 is a straightforward process. Here's a step-by-step guide:

Practical activity: install Desktop and icon themes.

Step 1. For basic user usage, type "**Ubuntu Software**" in the search bar, press **Enter** to open it, and browse through the search results to find the software you're looking for.



Step 2. Enable 'Minimize on Click.

If you prefer to minimize windows by clicking on the app icon, you can enable this feature using a simple command in the terminal:

gsettings set org.gnome.shell.extensions.dash-to-dock click-action 'minimize'.

Step 3. Install GNOME Tweaks

GNOME Tweaks is a powerful tool that allows for extensive customization options such as changing themes, fonts, window behavior, and more.

You can install GNOME Tweaks through the Ubuntu Software app and access it from the applications grid by searching for "tweaks".

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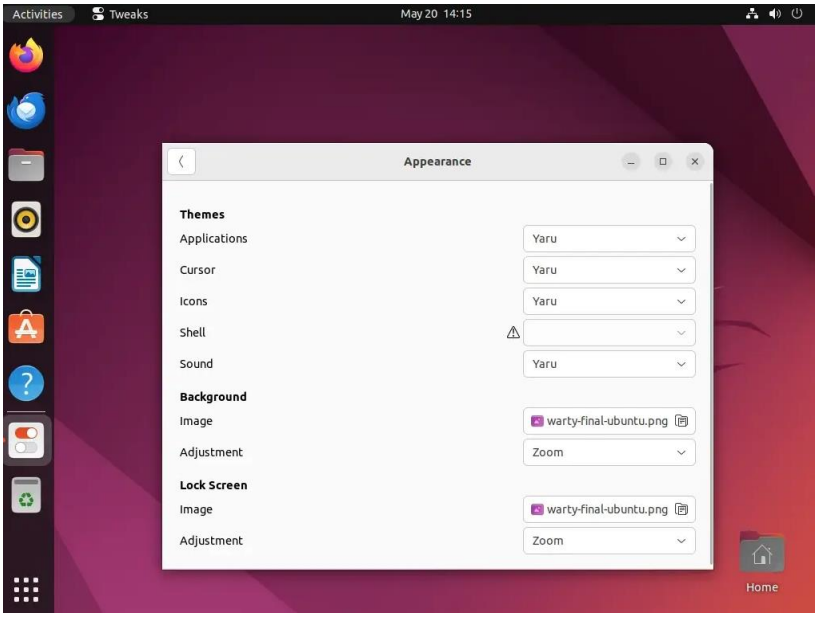
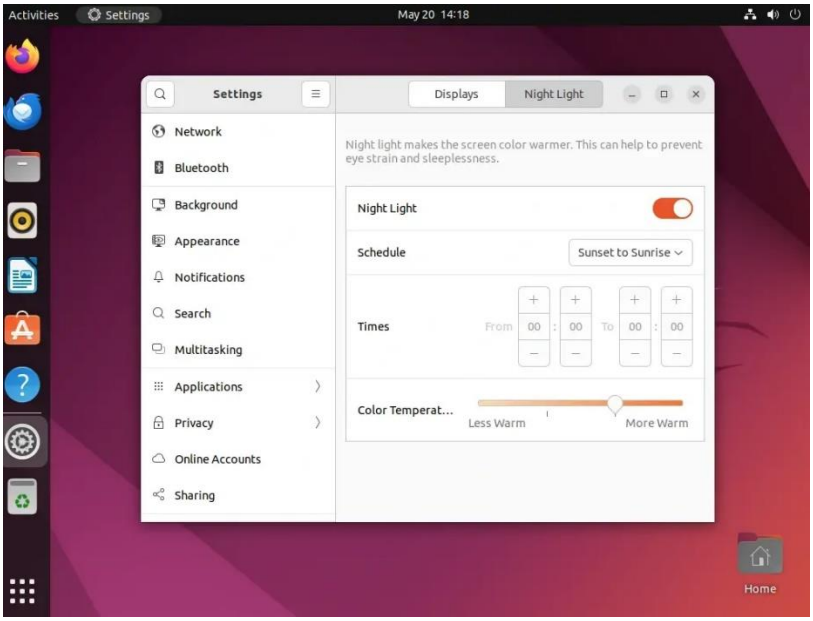


Step 4. Enable Night Light

You might want to turn on the "night light" setting in GNOME, which helps to lower the amount of blue light that comes from your screen. This can be good for your sleep. You can find this setting in the "Screen Display" part of your Settings.



Step 5. Customize Desktop Environment

Ubuntu offers different desktop environments like GNOME, KDE, and Xfce. You can install and switch between these environments based on your preferences using terminal commands as shown.

#sudo apt install kubuntu-desktop.

Step 6. Install Snap Packages

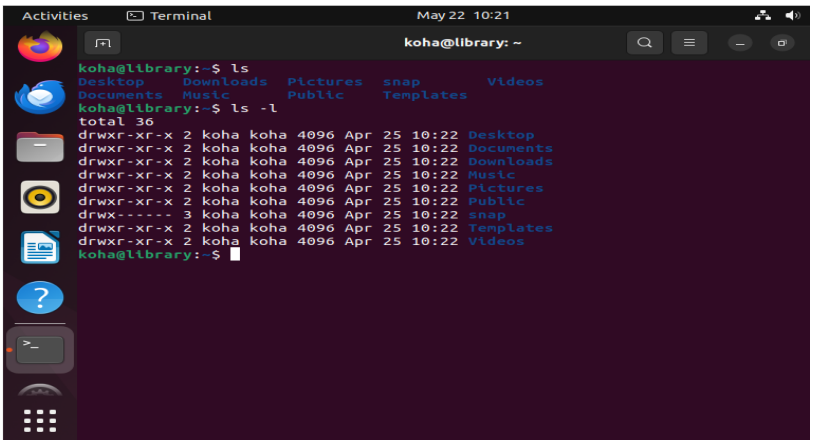
You might want to try installing Snap packages, a new way of packaging software for Linux. It lets you get lots of different software applications and tools easily.

sudo apt install snapd.

Basic commands in Linux:

In Ubuntu 24.04, you can perform various tasks using the command line interface (CLI). Here are some basic commands to get you started:

1. The ls command is fundamental in Linux, used to list the contents of a folder. It's one of the initial commands beginners learn. By simply typing ls, you can view the files and directories within your current location.



2. The cd command is used to change the current directory in Linux. Initially, you start in your home directory, but you may need to navigate to different directories for various tasks.For instance, suppose you've downloaded a .deb file or a script. While you could execute it from your current directory using the full path, changing to that directory simplifies the process. By typing cd, followed by the desired directory path, you can seamlessly move to another location, making it convenient to perform actions within that directory.

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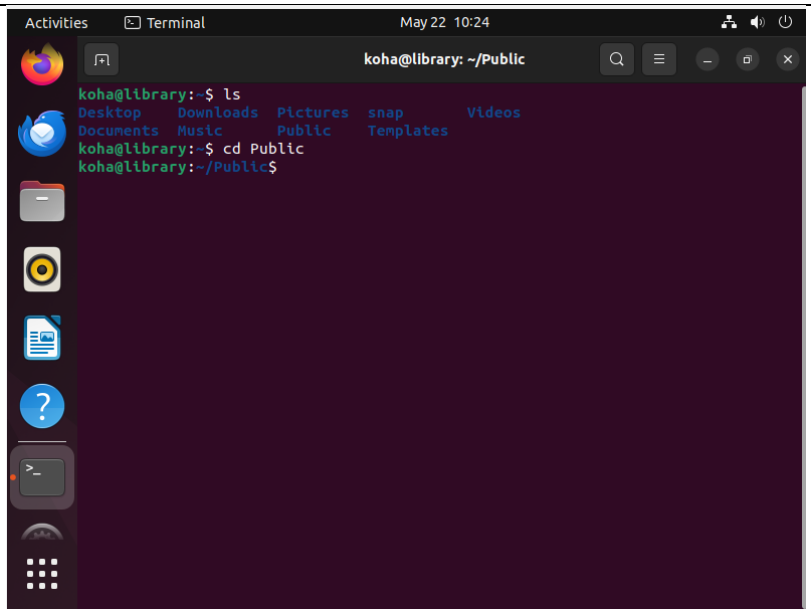
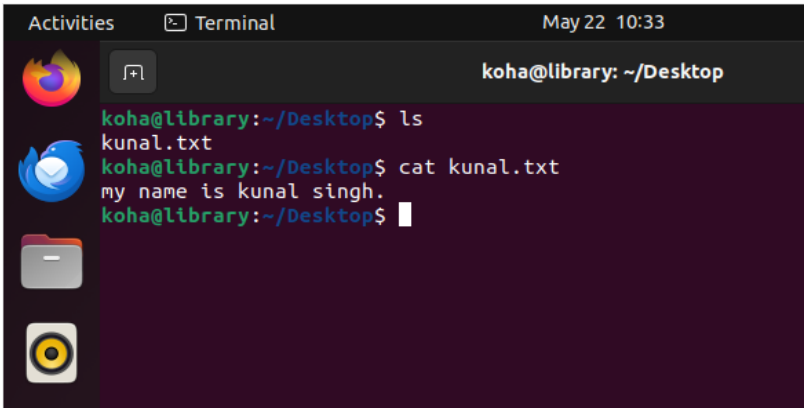
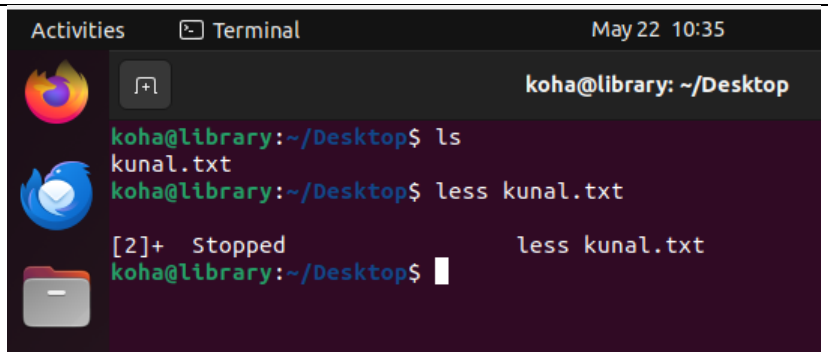


3. The cat command is employed to quickly view the contents of a text file in Linux. When executed, it displays the contents of the file directly on the screen. To utilize the cat command, simply type cat followed by the name of the file you wish to view:

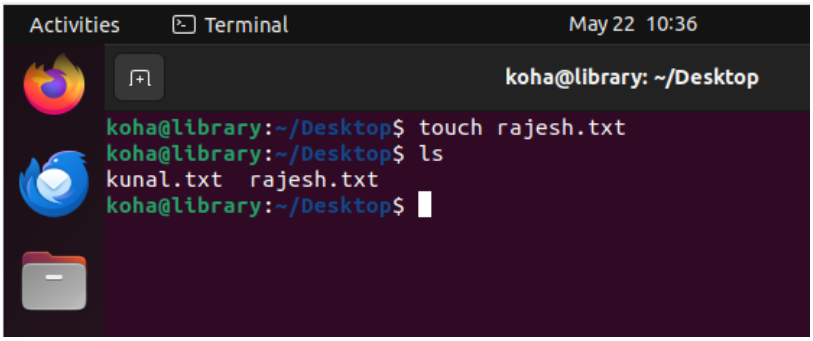


4. Less command: When dealing with large text files containing hundreds of lines, using the cat command can inundate your screen with all the text, making it unwieldy to navigate. Instead, the less command provides a more manageable solution. By opening a file with less, it presents the file in pages, allowing you to navigate through the content more efficiently. You can scroll up and down, search for specific text, and perform various other actions. Using less is recommended for working with large text files to avoid overwhelming your screen.

Example usage:

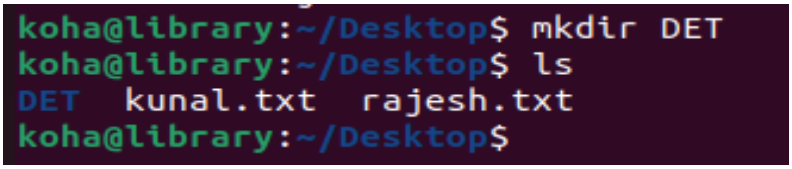


5. The touch command offers a simple method for creating new files in the Linux terminal. While other commands like cat can also accomplish this task, touch is specifically designed for creating new empty files. To use touch, simply specify the name of the new file you wish to create:



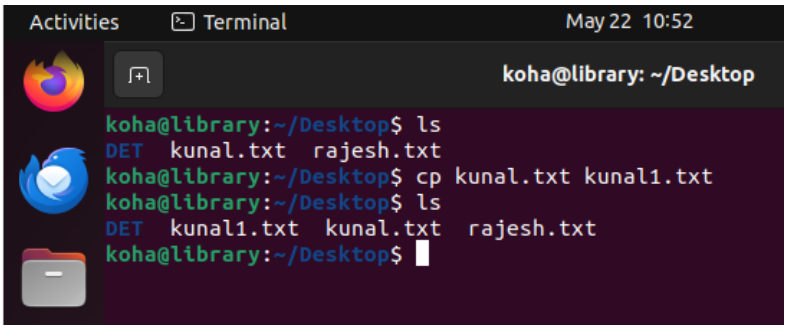
6. mkdir is a command in Linux used to create directories or folders. It stands for "make directory".To use mkdir, simply type the command followed by the name of the directory you want to create.

Example:



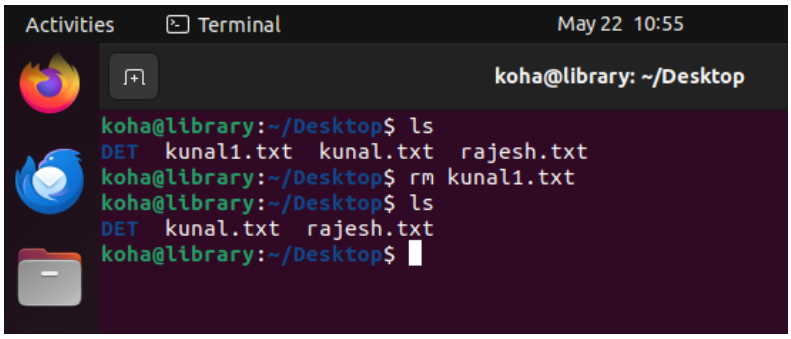
7. The cp command, abbreviated for "copy", is a frequently used command line tool for duplicating files and directories.To utilize cp, simply specify the source file or directory followed by the destination where you want to copy it.

Example:



8. **rm command: Remove files and folders**

You use the rm (short for remove) command to delete files in the Linux terminal.



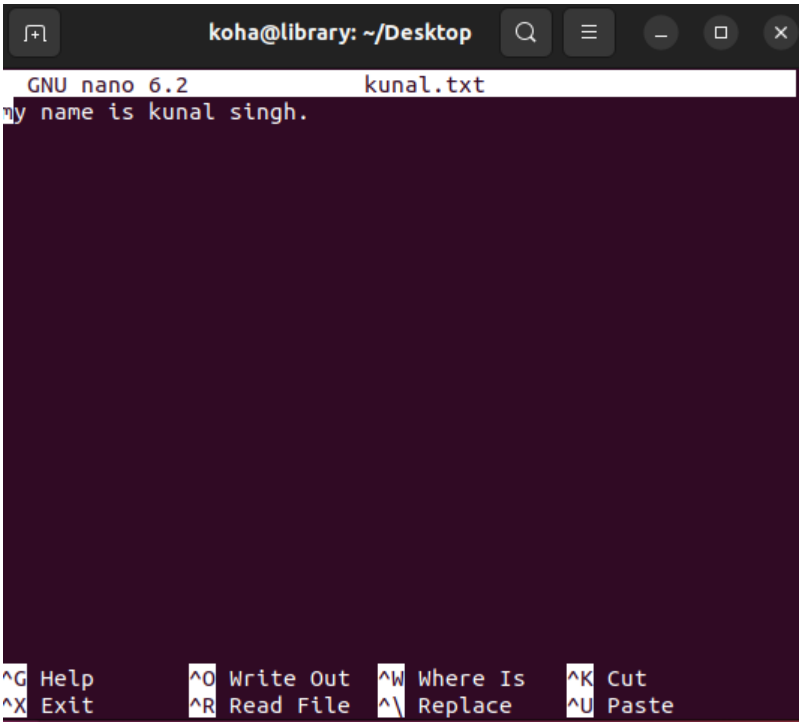
9. The nano command is used to edit files in the Linux terminal. Nano is a simple, user-friendly text editor that allows you to create and modify files directly from the command line.To open a file in nano, type:

nano filename

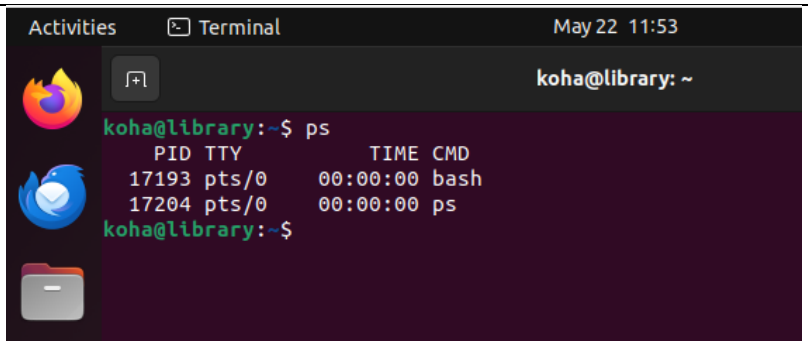
This command opens the specified file in the nano text editor, where you can make your edits. To save your changes and exit, use the following key combinations:

Save: Ctrl + O (then press Enter)

Exit: Ctrl + X



10. The ps command is for handling the processes running on your system. Each process has an associated ID called PID, which can be used for various purposes, such as terminating a process.



Here,

- PID: Process ID
- TTY: Controlling terminal associated with the process (Not that important these days)
- TIME: Total CPU usage time
- CMD: Name of command that runs the process

Commands for update, upgrade, install and remove packages

In Ubuntu 24.04, package management is primarily handled using the apt command. Here are the commands for updating, upgrading, installing, and removing packages:

1. Update Package List

Updating the package list ensures you have the latest information about available packages and their versions.

#sudo apt update

2. Upgrade Installed Packages

Upgrading packages installs the latest versions of all currently installed packages.

sudo apt upgrade

3. Install a Package

To install a specific package, use the install command followed by the package name.

sudo apt install package_name

4. Remove a Package

To remove a specific package, use the remove command followed by the package name.

sudo apt remove package_name

5. Remove Unused Packages

After removing packages, you might have some unused dependencies left over. Clean them up using:

sudo apt autoremove

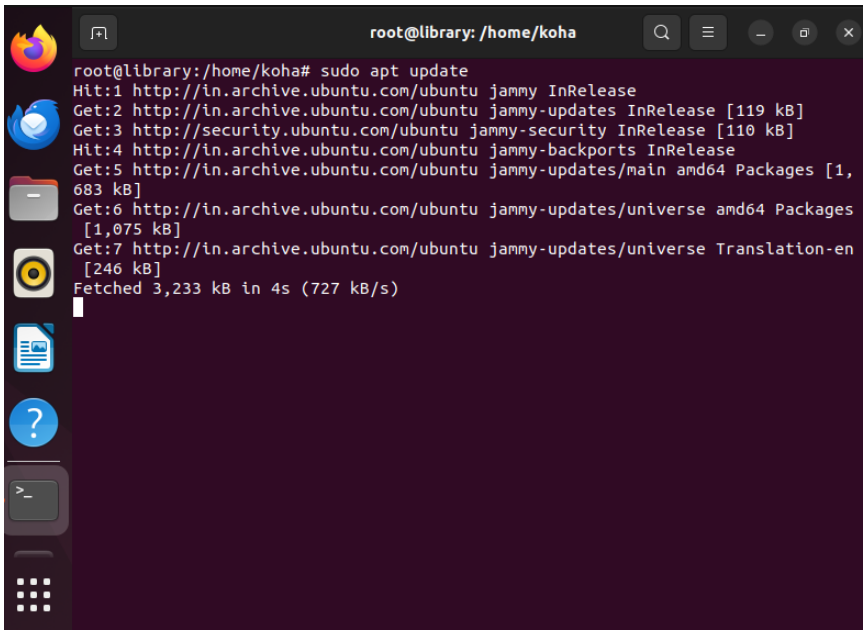
Activity 2

Practical Activity 2: Demonstrate to update, upgrade, install and remove packages using commands

Step 1. Update Packages with apt update

The apt update command refreshes the local package repository with the latest metadata, ensuring you have the most current information about available packages and their versions. Running this command before any upgrades or installations is essential to ensure you get the latest versions of packages.

sudo apt update

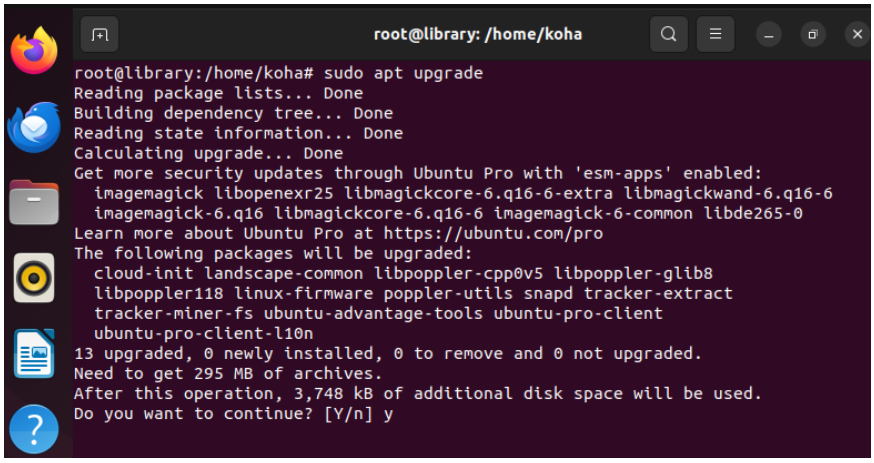


This command will also display a list of packages that can be upgraded.

Step 2. Upgrade Packages with apt upgrade

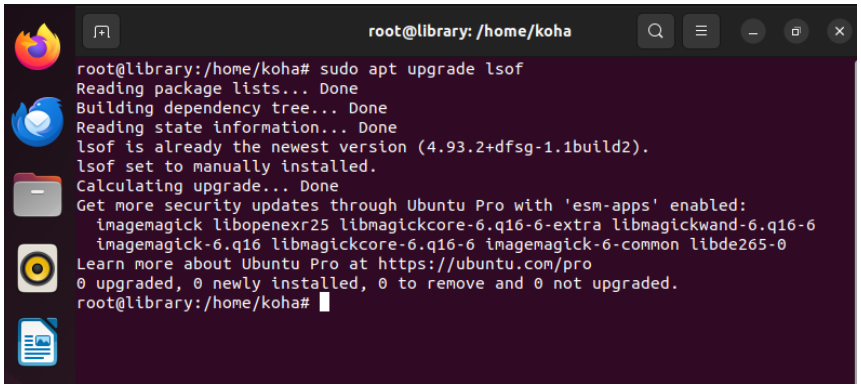
Use the apt upgrade command to update all installed packages to their latest versions. Running this command without specifying a package name will upgrade all packages on the system:

sudo apt upgrade.



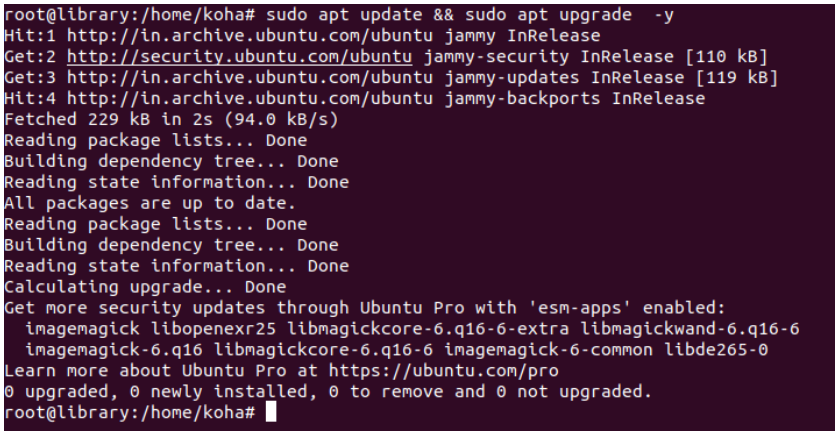
To upgrade a specific package, append the name:

sudo apt upgrade lsof.



The update and upgrade commands also print output when executed together. To run these commands in one step and avoid being asked to confirm the process, use the -y flag:

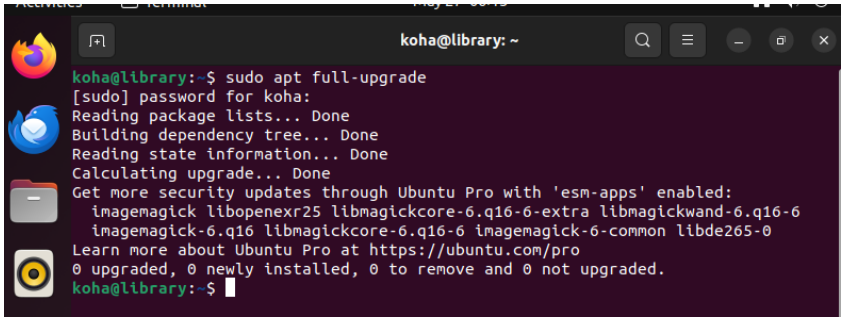
sudo apt update && sudo apt upgrade -y



Step 3. Full-Upgrade Packages with apt full-upgrade

The apt full-upgrade command updates all installed packages and removes any packages as necessary to complete the upgrade. This command is particularly useful at the end of a distribution release's life cycle to ensure the entire system is fully upgraded.

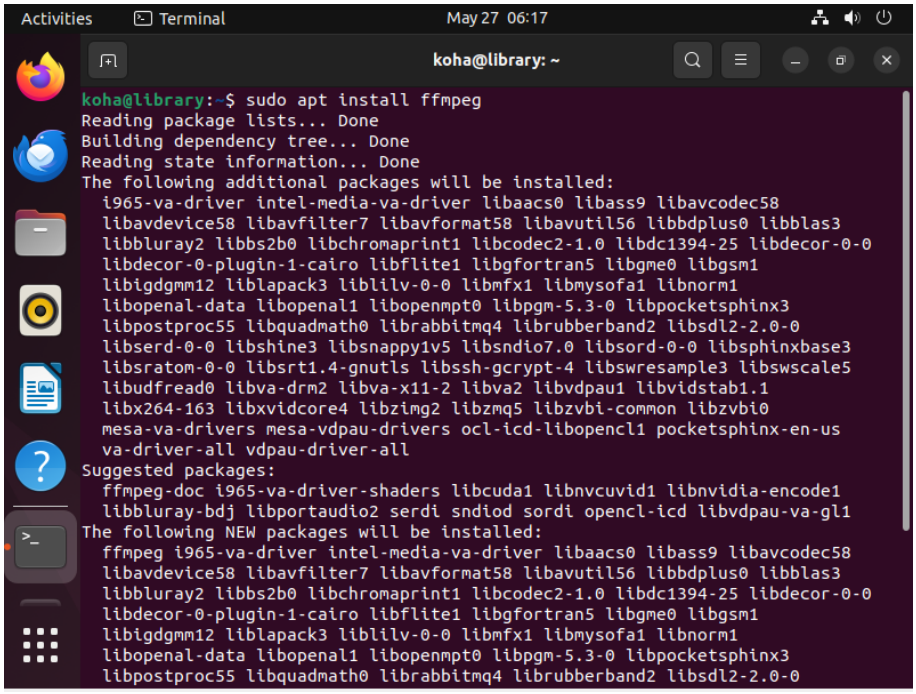
sudo apt full-upgrade



Step 4. Install Packages with apt install

Use the apt install command to install a specific package from the repository.

sudo apt install ffmpeg



Step 5. Only Download Packages with apt download

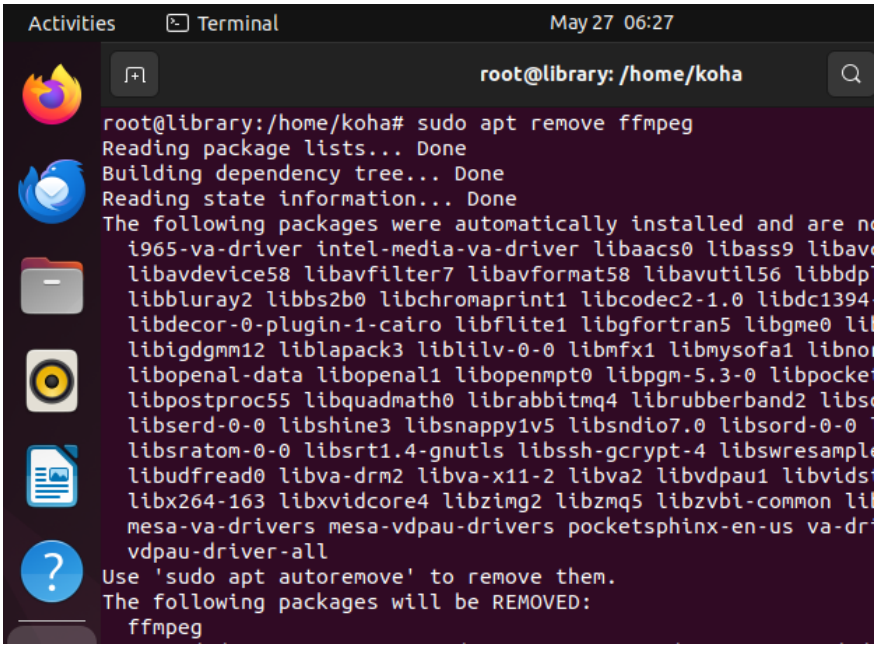
The apt download-only feature allows users to use deb files without installing them. To download packages without starting the installation, run:

sudo apt download apache2

Step 6. Remove Packages with apt remove

To uninstall a specific package, use the apt remove command.

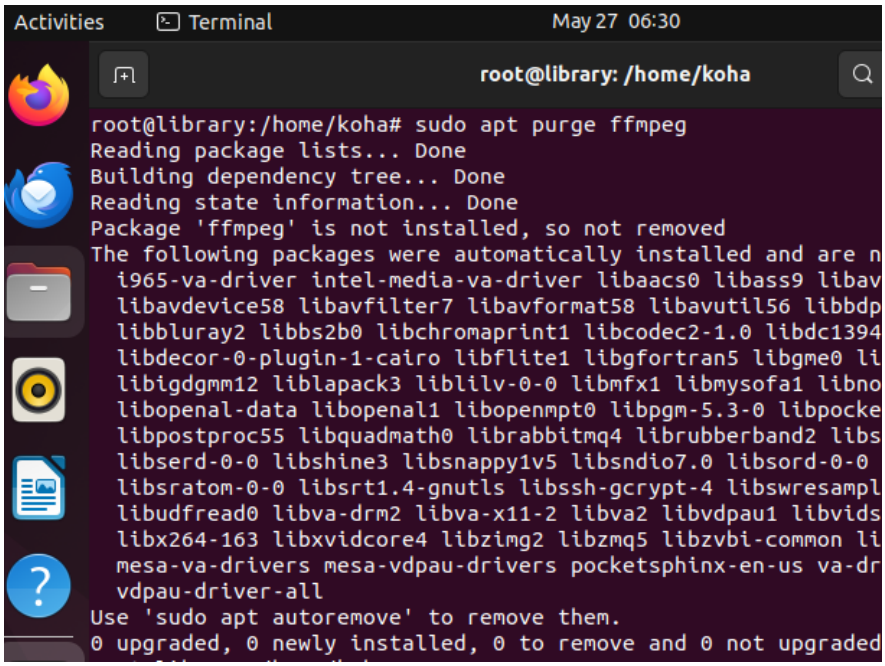
sudo apt remove ffmpeg



Step 7. Remove All Configuration Files with apt purge

The apt remove command deletes the specified packages but may leave behind configuration files. To delete both the package and its configuration files, use the apt purge command.

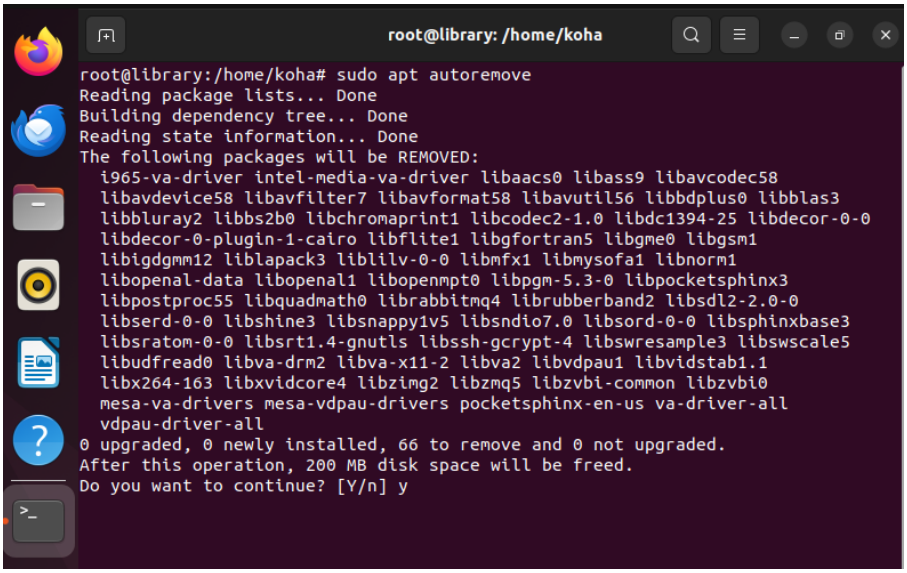
sudo apt purge ffmpeg



Step 8. Remove Unused Dependencies with apt autoremove

When packages are removed, their dependencies may remain on the system. To clean up these unneeded dependencies and free up space, use the apt autoremove command.

#sudo apt autoremove



Install the Package Using Software Center

For users who prefer the modern 'App Center' introduced in Ubuntu 23.10 and Ubuntu 24.04, installing it in Ubuntu 22.04 is straightforward. Here's how you can do it:

The new App Center, also known as the snap-store, has been redesigned using Google's Flutter UI toolkit. It offers improved speed and reliability compared to the previous version.

With the new App Center, you won't encounter issues like the software app getting stuck at "Downloading Software catalog" or endless loading circles.

The App Center in Ubuntu 23.10/24.04 supports both Snap and native Debian (.deb) packages. However, in my testing, searching for Debian packages always resulted in "No results found" in Ubuntu 22.04.

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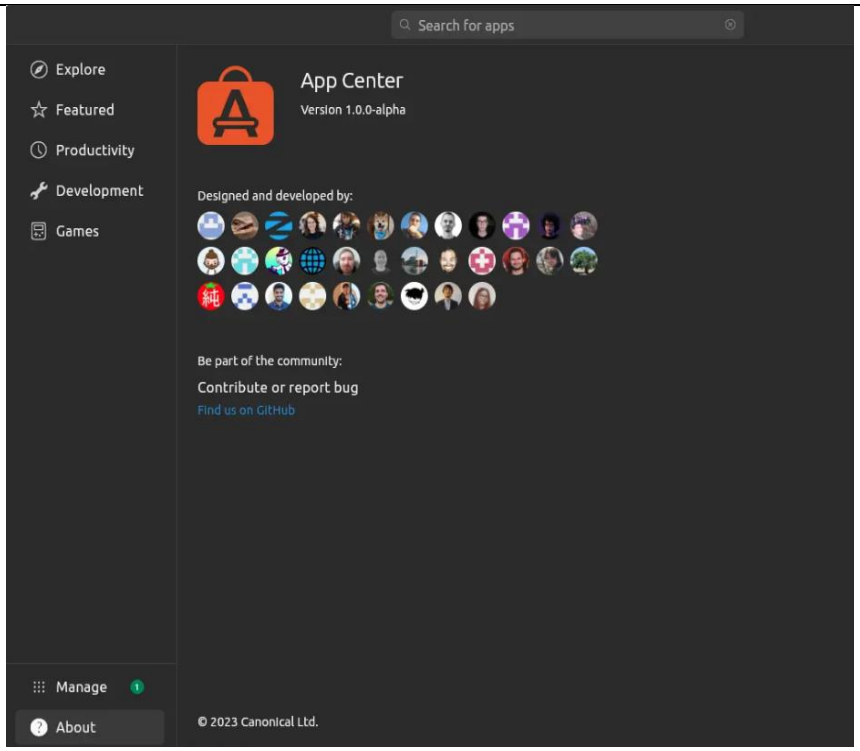
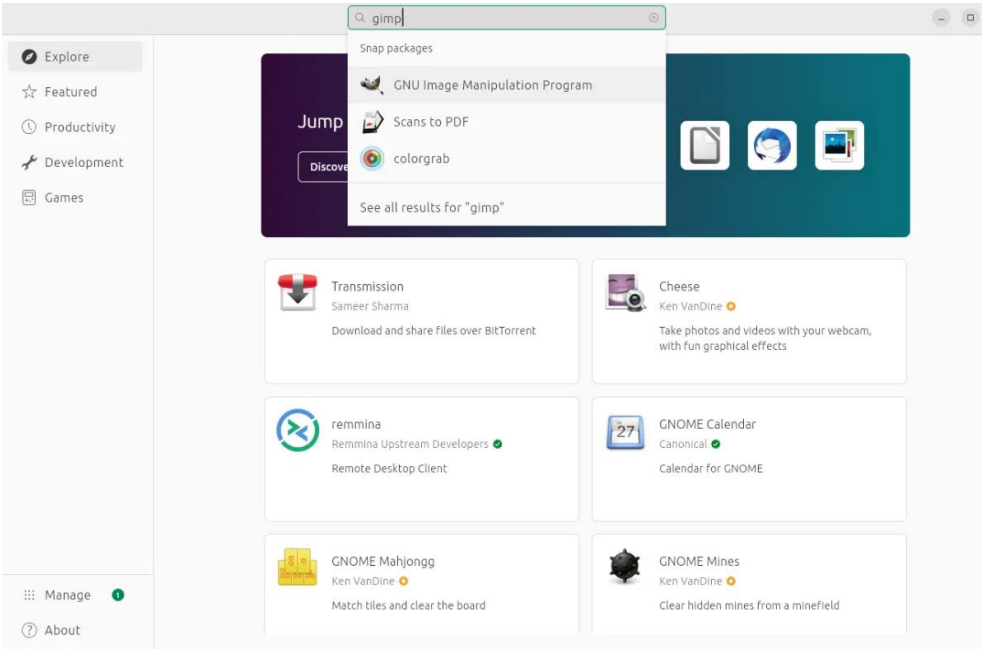


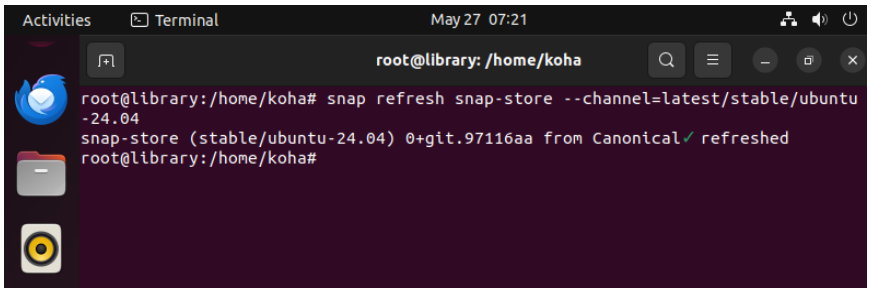


Activity 3

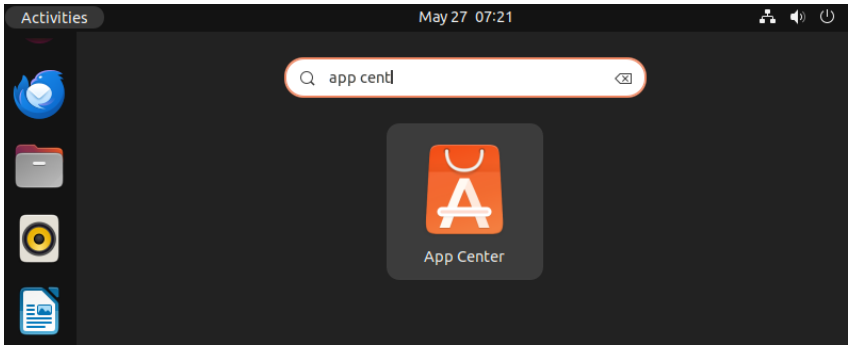
Practical Activity: Demonstrate to Install Package using Software Center using command line.

Step 1. First, press Ctrl+Alt+T on keyboard to open a terminal window. When it opens, run command:

snap refresh snap-store --channel=latest/stable/ubuntu-24.04



Step 2. After that, just press Super (windows logo) key to open overview screen, search and launch "App Center".



Demonstrate to download and install Debian Packages

Practical Activity: Downloading and installing Debian packages in Ubuntu 24.04 can be done using the following steps:

1. Download the Debian Package:

You can download the Debian package (with the .deb extension) from the internet or obtain it from other sources.

2. Open Terminal:

Open the terminal by searching for "Terminal" in the applications menu or by pressing Ctrl + Alt + T.

3. Navigate to the Download Directory:

Use the cd command to navigate to the directory where the Debian package is downloaded. For example:

cd ~/Downloads

4. Install the Debian Package:

Install the downloaded Debian package using the dpkg command. Replace package_name.deb with the actual name of the Debian package.

sudo dpkg -i package_name.deb

5. Resolve Dependencies (if any):

If the installation fails due to unmet dependencies, run the following command to install the required dependencies:

sudo apt install -f

6. Verify Installation:

Once the installation is complete, you can verify if the package is installed correctly.

7. Clean Up (optional):

You can remove the downloaded Debian package from the download directory to free up space, if desired.

Connecting to the Internet

Setting up a network in Ubuntu can vary in complexity depending on your needs. Canonical has designed Ubuntu to be user-friendly, even for those without extensive technical knowledge. Despite its simplicity, Ubuntu has robust networking capabilities that enable connections to local devices or servers worldwide.

Typically, Ubuntu's networking settings work seamlessly, but there may be occasions when you need to troubleshoot or configure settings manually. Whether you're facing issues or just curious about network configurations, it's helpful to start by checking your Ubuntu system's local IP address, public IP address, default gateway, and DNS information.

Software Requirements and Linux Command Line Conventions

Category	Requirements, Conventions, or Software Version Used
System	Ubuntu 18.04, 20.04, 22.04, 24.04
Software	Netplan (installed by default)
Other	Privileged access to your Linux system as root or via the sudo command.
Conventions	# – Commands that need to be executed with root privileges, either directly as the root user or using sudo. $ – Commands that can be executed as a regular non-privileged user.

https://linuxconfig.org/ubuntu-22-04-network-configuration

Ubuntu Network Setup – Local and Public IP Addresses

When your system is connected to the internet, it typically uses two IP addresses:

1. Local IP Address:

- This is the address your system uses to communicate with other devices on your local network, such as your router and other connected devices.

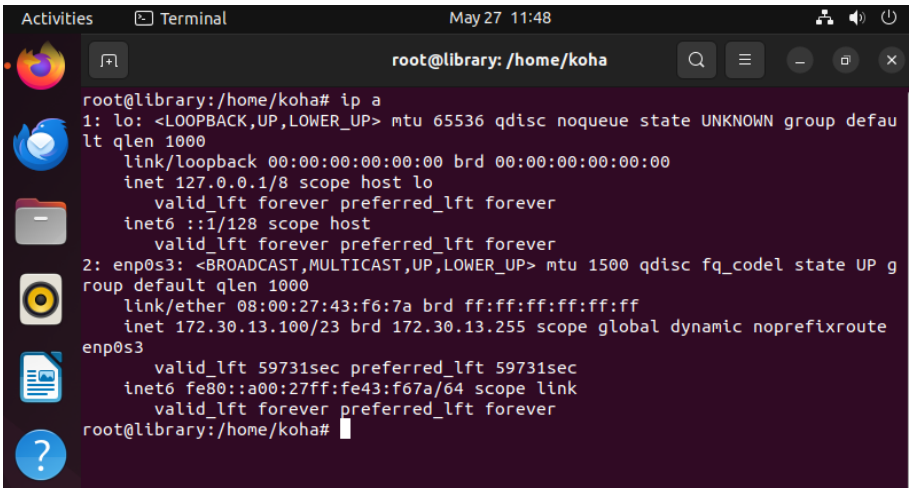
2. Public IP Address:

- This address is visible to devices on the internet. It is routable on the World Wide Web, allowing you to connect to servers and other devices globally. Usually, a home network has a single public IP address shared by all devices connected to the router.

Different networking setups exist, but this is the most common scenario for home networks.

Step 1. To see your local IP address, you can run the following command in terminal:

ip a



Step 2. There are several methods to find your public IP address. You can visit a website like IP Chicken or use one of the following commands in the terminal:

#echo $(wget -qO - https://api.ipify.org)

OR

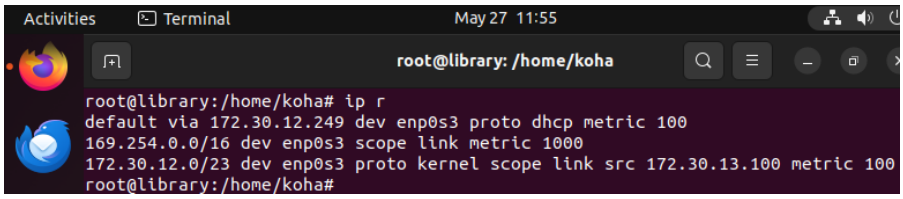
echo $(curl -s https://api.ipify.org)

Step 3. To check the currently used DNS server IP address, execute the following command:

#systemd-resolve --status | grep Current

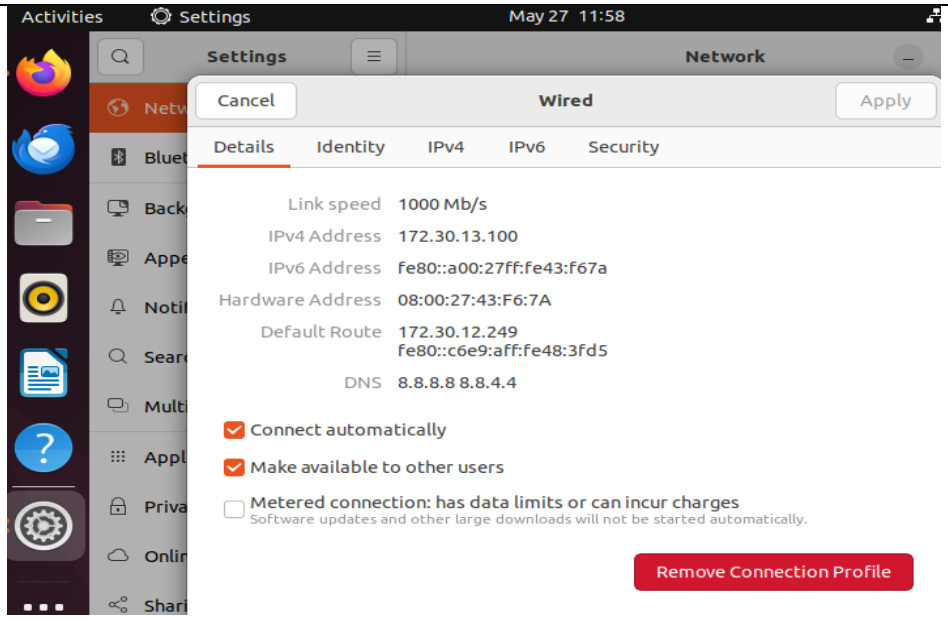
Step4. To display the default gateway IP address, run the following command:

ip r



Step 5. You can also check this information using the Ubuntu desktop GUI. To view the internal IP address, default gateway, MAC address, and DNS server settings:

1. Open Settings.
2. Click on the Network menu.
3. Select the gear icon next to the desired network interface.



Session 3. Install and Configure Peripheral devices

Linux Peripheral devices

Peripheral devices, while not essential for basic computer operation, significantly enhance its functionality by providing input, output, or both. Input devices allow users to interact with the computer, while output devices display or transmit information.

Examples of input devices include:

- Keyboard: Allows users to input text and commands.
- Mouse: Provides a graphical interface for navigating and selecting items on the screen.
- Scanner: Converts physical documents or images into digital format.
- Microphone: Captures audio input for voice commands, recording, or communication.

Examples of output devices include:

- Printer: Produces hard copies of digital documents or images.
- Speaker: Outputs audio for listening to music, videos, or other multimedia content.
- Display: Presents visual output in the form of text, images, and videos on a screen.

Peripheral devices enhance the overall user experience and functionality of a computer system by facilitating communication and interaction between users and the digital environment.

User Management in ubuntu 24.04

User management in Ubuntu 24.04 involves creating, modifying, and deleting user

accounts, as well as managing user permissions and groups. Here are some basic commands and steps to manage users effectively:

1. Adding a New User

The useradd command in Ubuntu is a low-level utility for creating new user accounts. It provides more granular control compared to the adduser command, which is a higher-level command with interactive prompts. To add a new user, use the adduser command, which is more user-friendly than the useradd command.

syntax : sudo adduser username.

Common Options used in ubuntu 24.04

Here are some common options you can use with useradd:

-d, --home HOME_DIR: Specify the home directory for the new user.

-m, --create-home: Create the user's home directory if it does not exist.

-s, --shell SHELL: Specify the login shell for the new user.

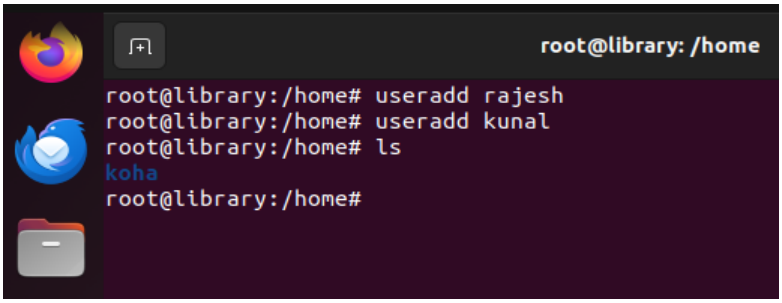
-c, --comment COMMENT: Add a comment (usually the full name of the user).

-g, --gid GROUP: Specify the primary group for the new user.

-G, --groups GROUP1,GROUP2: Specify additional groups for the new user.

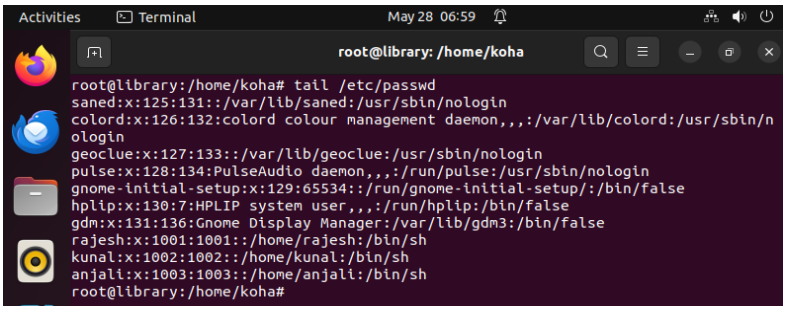
-u, --uid UID: Specify the user ID for the new user.

-p, --password PASSWORD: Specify the encrypted password for the new user.



Check add user in ubuntu 24.04 :

Syntax : tail /etc/passwd

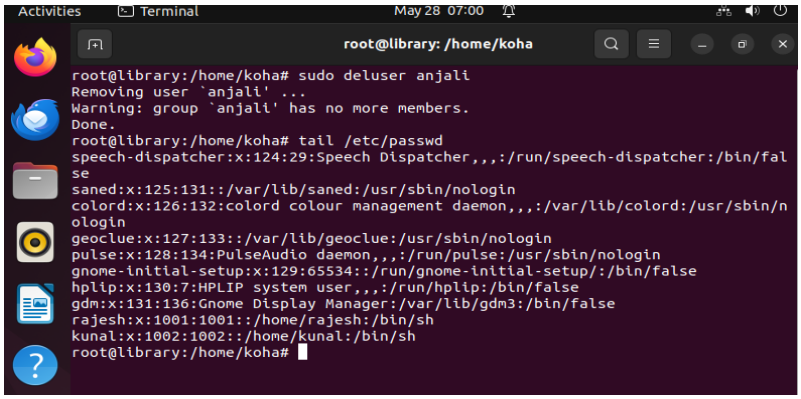


2. Deleting a User

The userdel command in Ubuntu is used to delete a user account and optionally remove the user's home directory and mail spool. This command requires root privileges, so you will

need to use sudo to execute it. To remove a user, use the deluser command:

syntax : sudo deluser username



Common Options

Here are some common options you can use with userdel:

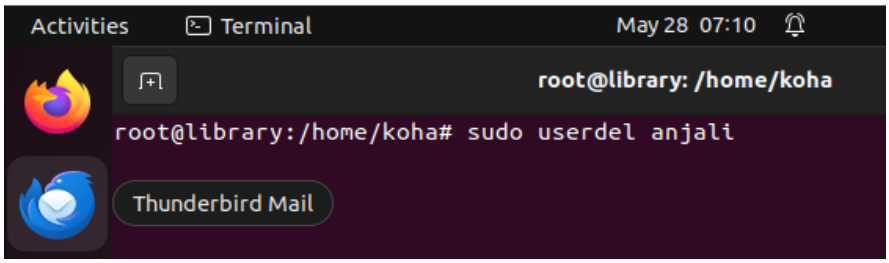
- -r, --remove: Remove the user's home directory and mail spool along with the user account.
- -f, --force: Force the removal of the user account, even if the user is currently logged in. This is potentially dangerous and should be used with caution.

Examples

1. Delete a User

To delete a user account without removing the home directory:

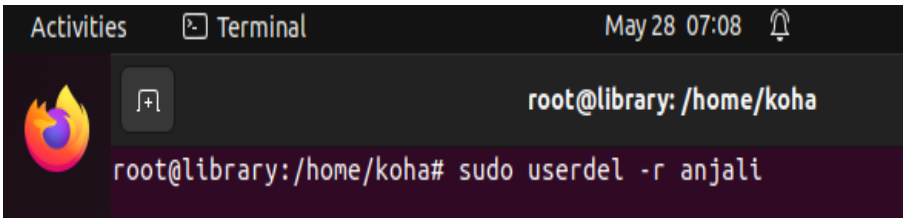
sudo userdel username



2. Delete a User and Remove Home Directory

To delete a user account and remove the home directory and mail spool:

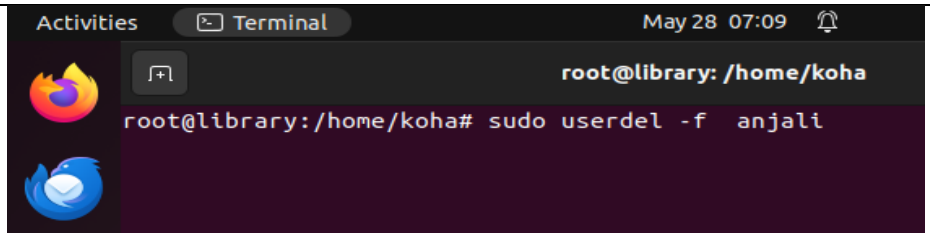
sudo userdel -r username



3. Force Delete a User

To force the deletion of a user account (even if the user is currently logged in):

sudo userdel -f username



4. Modifying a User

The usermod command in Ubuntu is used to modify an existing user account. This command allows you to change various user account settings such as username, home directory, shell, group memberships, and more. To modify a user's details, use the usermod command. Here are some common options:

Common Options

Here are some common options you can use with usermod:

-l, --login NEW_LOGIN: Change the username of the user.

-d, --home HOME_DIR: Change the user's home directory.

-m, --move-home: Move the contents of the user's home directory to a new location (used with -d).

-s, --shell SHELL: Change the user's login shell.

-c, --comment COMMENT: Change the comment field (typically the user's full name).

-g, --gid GROUP: Change the user's primary group.

-G, --groups GROUP1,GROUP2: Add the user to additional groups.

-a, --append: Add the user to the supplementary groups without removing them from other groups (used with -G).

-L, --lock: Lock the user account.

-U, --unlock: Unlock the user account.

-u, --uid UID: Change the user ID (UID) of the user.

-e, --expiredate EXPIRE_DATE: Set the expiration date for the user account (in YYYY-MM-DD format).

-f, --inactive INACTIVE: Set the number of days after a password expires until the account is permanently disabled.

Change username:

sudo usermod -l new_username old_username

Change user's home directory:

sudo usermod -d /new/home/directory -m username

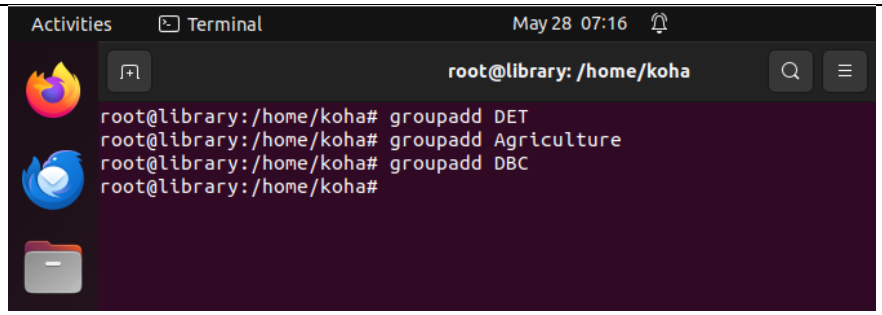
Add user to a group:

syntax : sudo usermod -aG groupname username

5. Managing User Groups

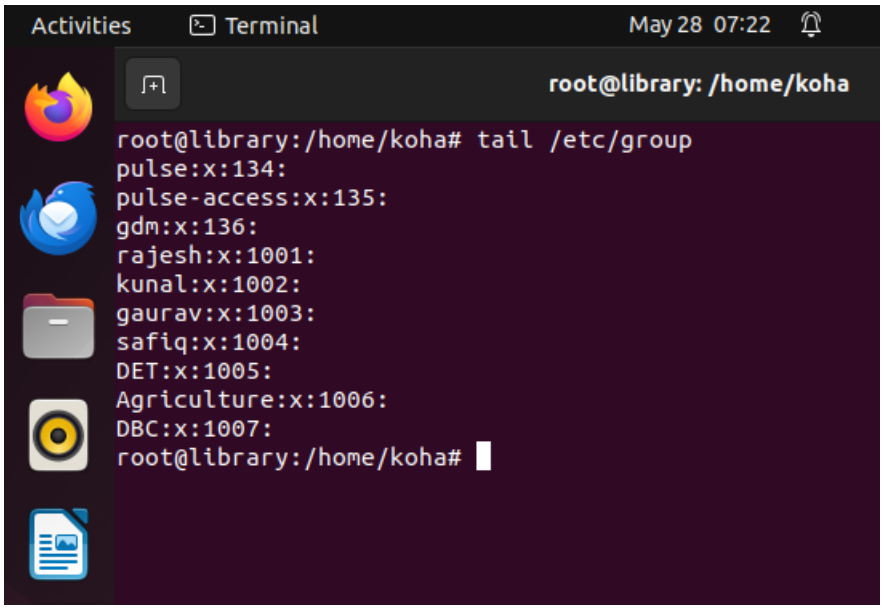
To create a new group, use the addgroup command:

sudo groupadd groupname



To check the group in ubuntu 24.04 :

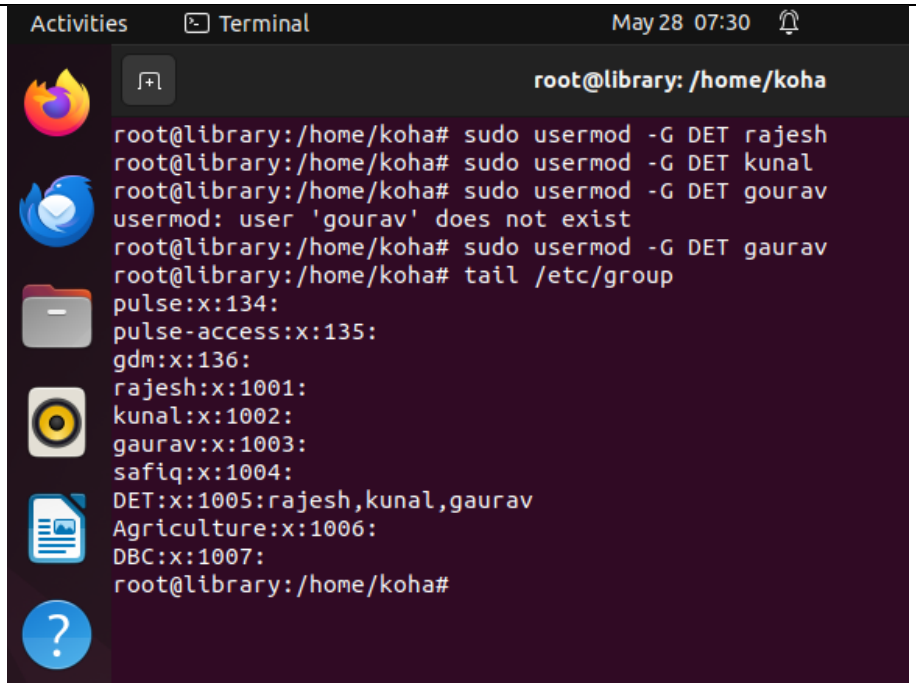
tail /etc/group



To add a user to a group:

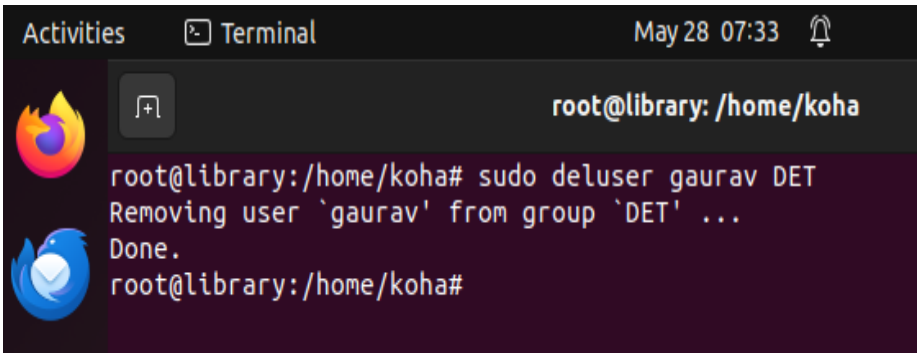
sudo usermod -G groupname username

PSSCIVE Draft



To remove a user from a group:

sudo deluser username groupname



6. Changing User Password

To change a user's password, use the passwd command:

syntax: sudo passwd username.

7. Viewing User and Group Information

List all users:

cut -d: -f1 /etc/passwd

List all groups:

#cut -d: -f1 /etc/group

Get user information:

id username

8. Locking and Unlocking User Accounts

To lock a user account:

#sudo usermod -L username

To unlock a user account:

sudo usermod -U username

9. Managing Sudo Privileges

To give a user sudo privileges, add the user to the sudo group:

sudo usermod -aG sudo username

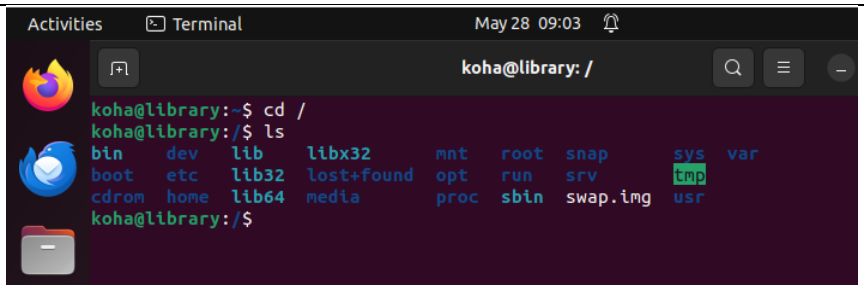
Overview of the Linux Filesystem :

Understanding the Linux filesystem hierarchy is crucial for effective system administration and usage. The Linux filesystem is organized in a hierarchical structure, starting from the root directory (/). Here's a detailed explanation of the main directories in the Linux filesystem, particularly in Ubuntu, along with a diagram for visualization.

Linux Filesystem Hierarchy

/
├── bin
├── boot
├── dev
├── etc
├── home
├── lib
├── lib64
├── media
├── mnt
├── opt
├── proc
├── root
├── run
├── sbin
├── srv
├── sys
├── tmp
├── usr
└── var

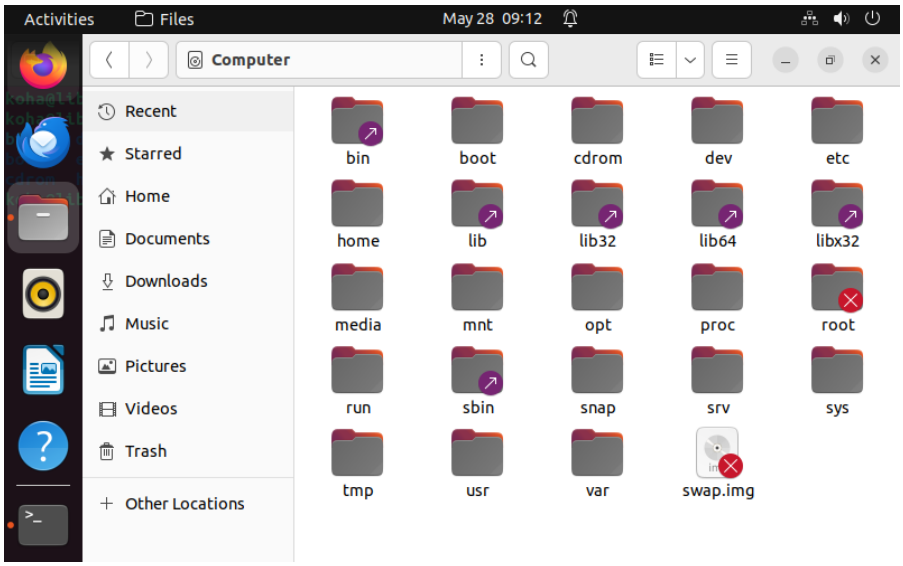
In Linux, all files and devices on the system are organized under the "root" directory, represented by the starting "/". To navigate to the top-level directory of the entire operating system and view its contents, you can type:



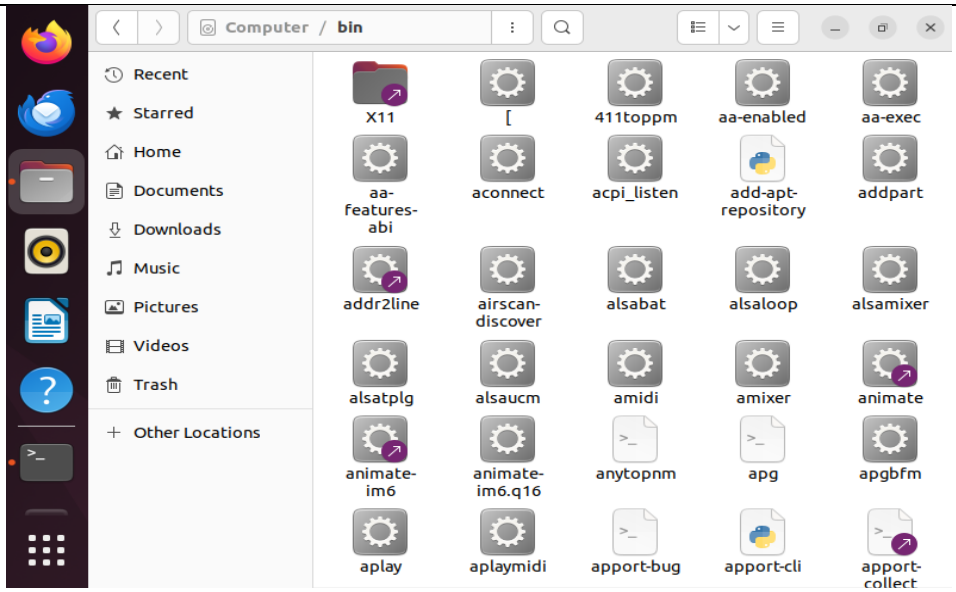
Every file, device, directory, and application is located under this main directory. Here, we can see the start of the entire directory structure. We'll explain more details below:

In Ubuntu 24.04, the filesystem is organized into a hierarchical structure, starting from the root directory (/). Here's a brief overview of the main directories you'll find:

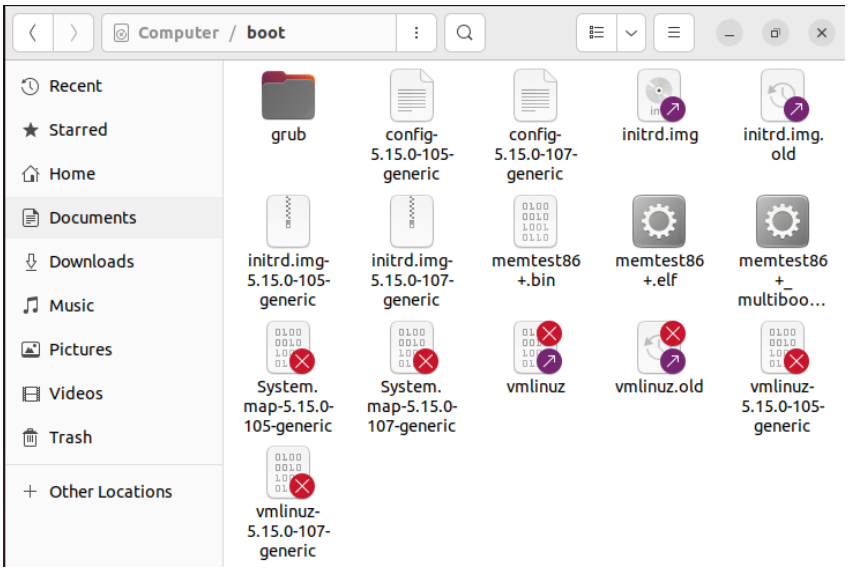
1. / (Root Directory): At the core of the filesystem hierarchy is the primary root directory. Every file and directory stems from this root directory. Only the root user possesses the authority to write directly within this directory. However, it's essential to note that /root is the designated home directory for the root user, distinct from the primary root directory.



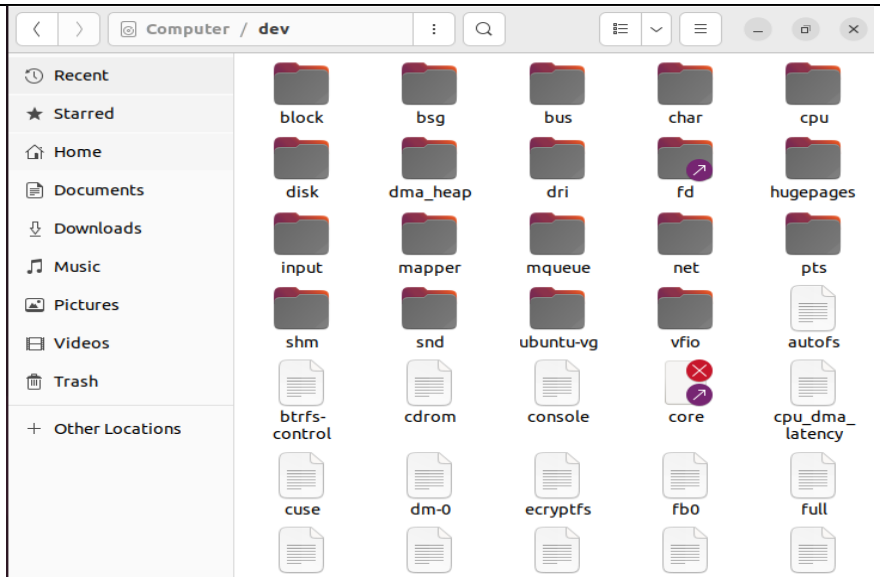
2. /bin: This directory houses essential command binaries necessary for single-user mode and universally required commands, such as cat, ls, and cp. It stores binary executables, including common Linux commands needed in single-user mode. These commands, utilized by all system users, encompass functions like ps, ls, ping, grep, and cp.



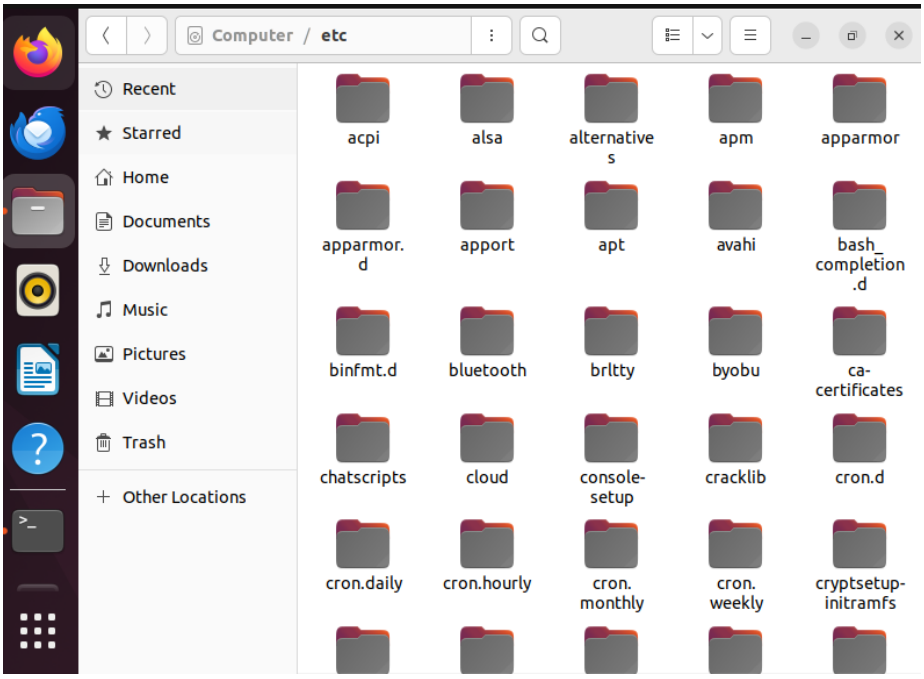
3. /boot: This directory houses boot loader files, including kernels and initrd. You can find essential boot files such as kernel initrd, vmlinux, and grub files under /boot. For instance, examples include initrd.img-2.6.32-24-generic and vmlinuz-2.6.32-24-generic.



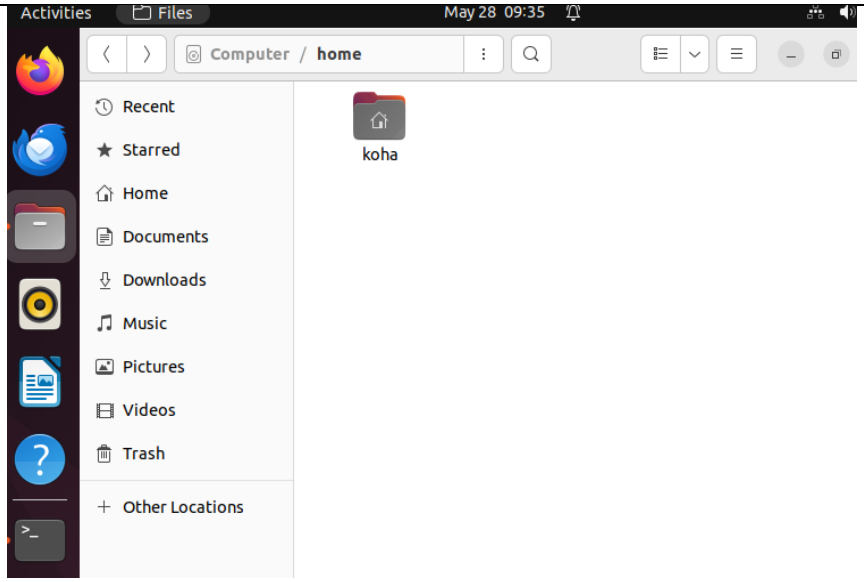
4. /dev: These files are essential for devices, including terminals, USB devices, and any hardware attached to the system. You'll find terminal devices like /dev/tty1 and USB monitoring devices like /dev/usbmon0 here, along with other device files such as /dev/null.

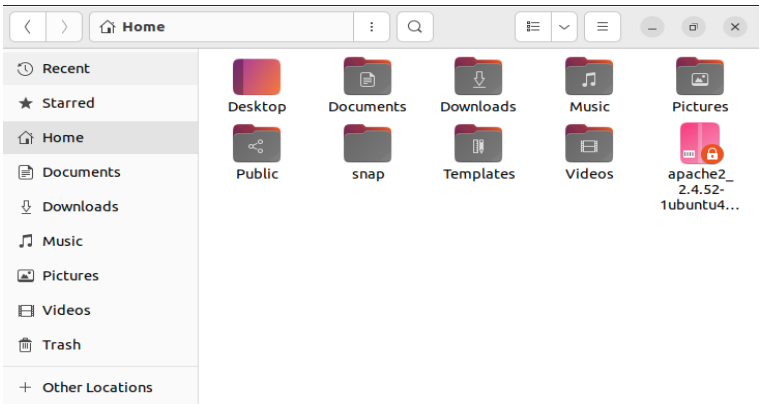


5. /etc: These files store host-specific system-wide configuration settings, necessary for all programs running on the system.Additionally, you'll find startup and shutdown shell scripts used to manage individual programs. Examples include /etc/resolv.conf and /etc/logrotate.conf.

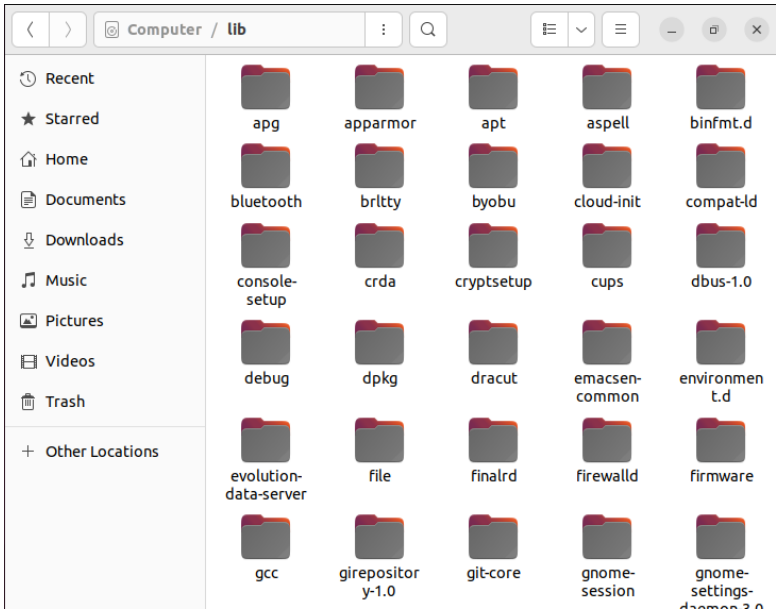


6. /home:These directories serve as the home for users, storing their personal files, preferences, and configurations. Each user has their own home directory within /home, like /home/koha and /home/koha.

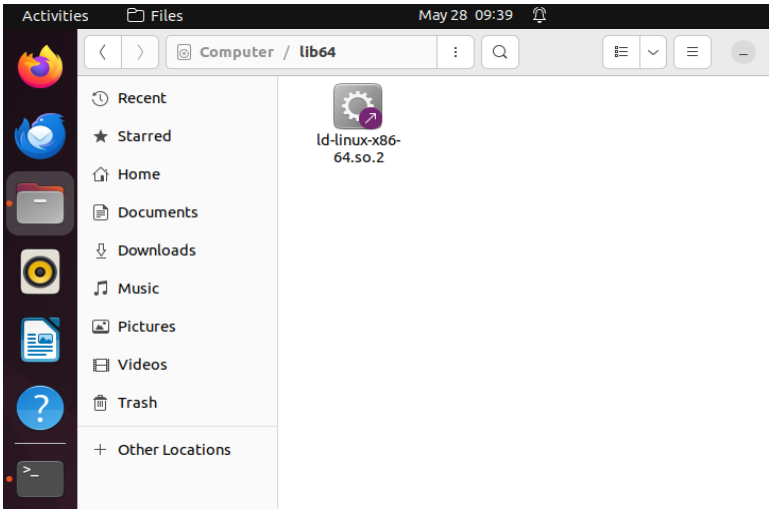




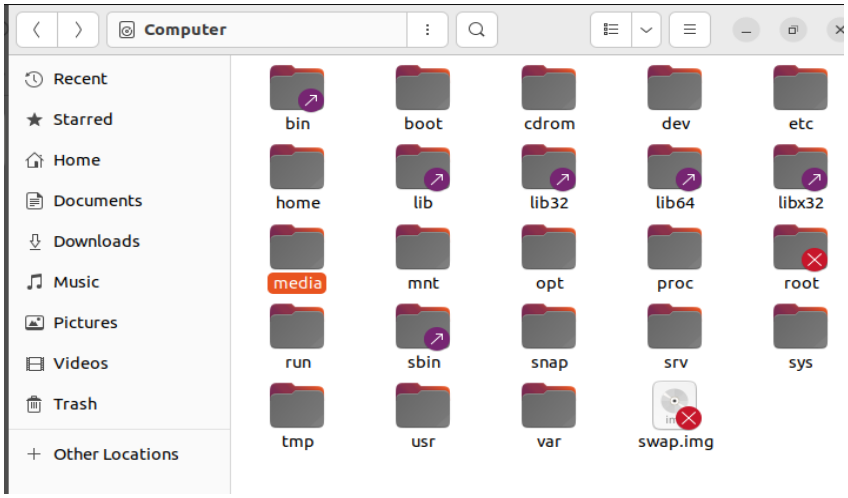
7. /lib: These directories hold vital libraries required by executables in /bin/ and /sbin/. Library filenames often start with ld* or lib*.so.*, such as ld-2.11.1.so and libncurses.so.5.7.



8. /lib64: Contains 64-bit libraries.



9. /media: These directories serve as mount points for removable media like CD-ROMs, introduced in FHS-2.3. They act as temporary mount locations for various devices, for instance, /media/cdrom for CD-ROMs, /media/floppy for floppy drives, and /media/cdrecorder for CD writers.



10. /mnt: This directory serves as a temporary mount location for filesystems, where system administrators can mount filesystems as needed.

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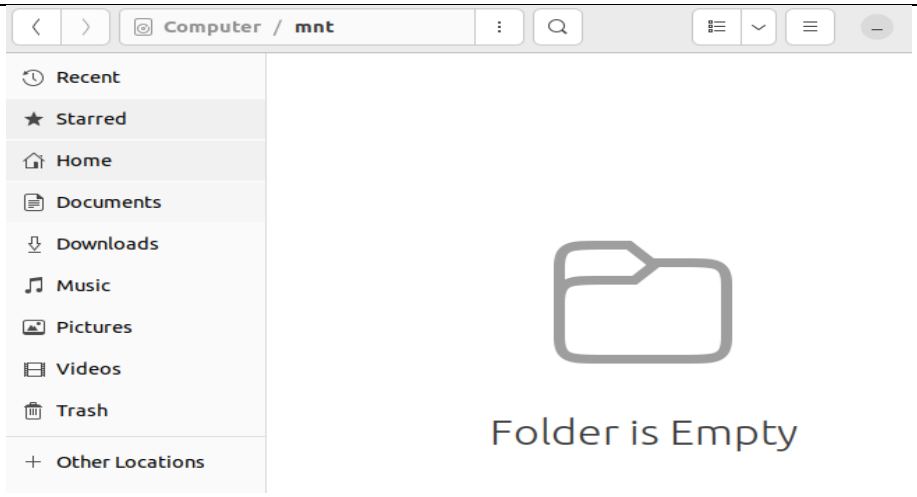
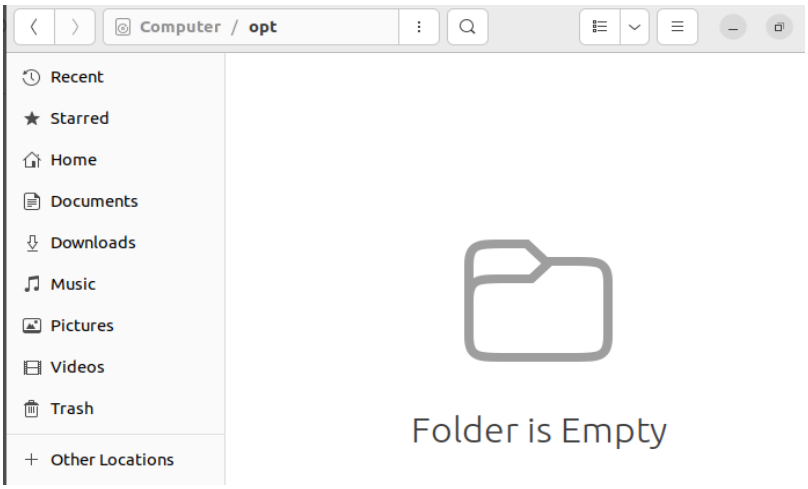
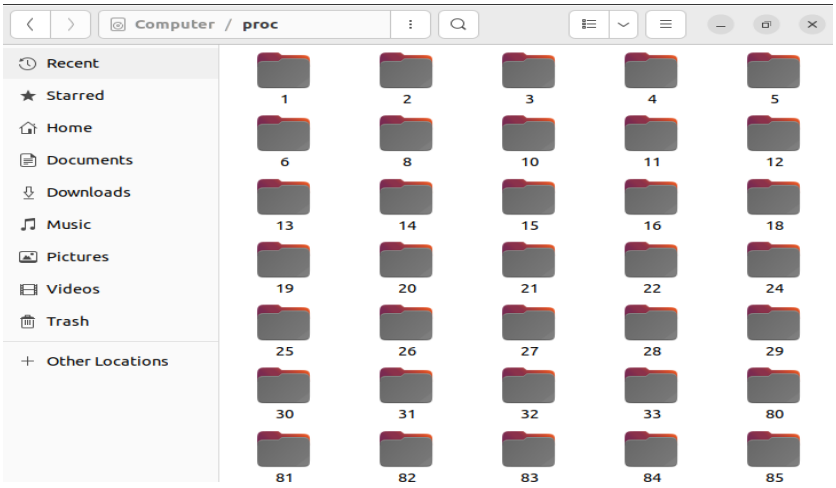


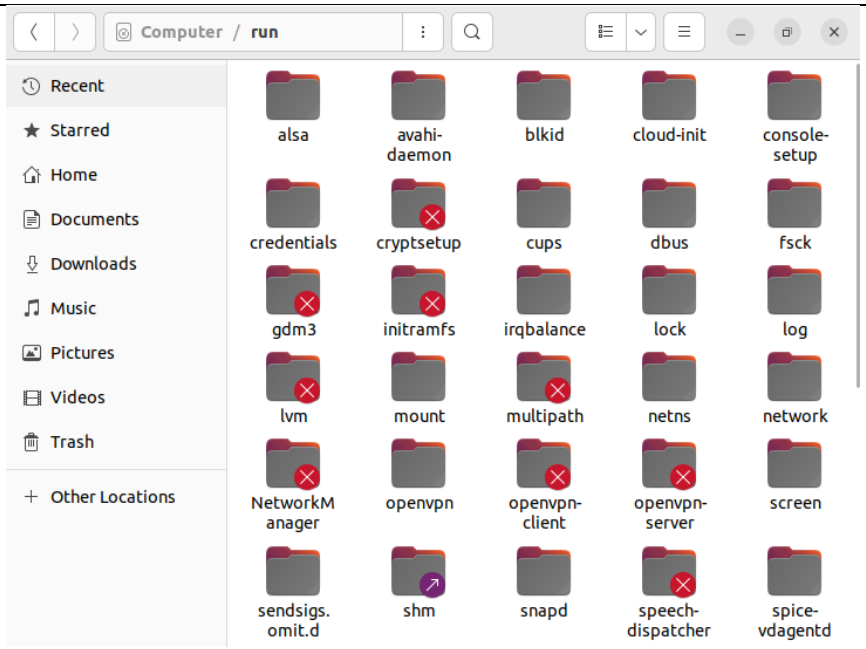
11. /opt: Directory for installing optional software packages.



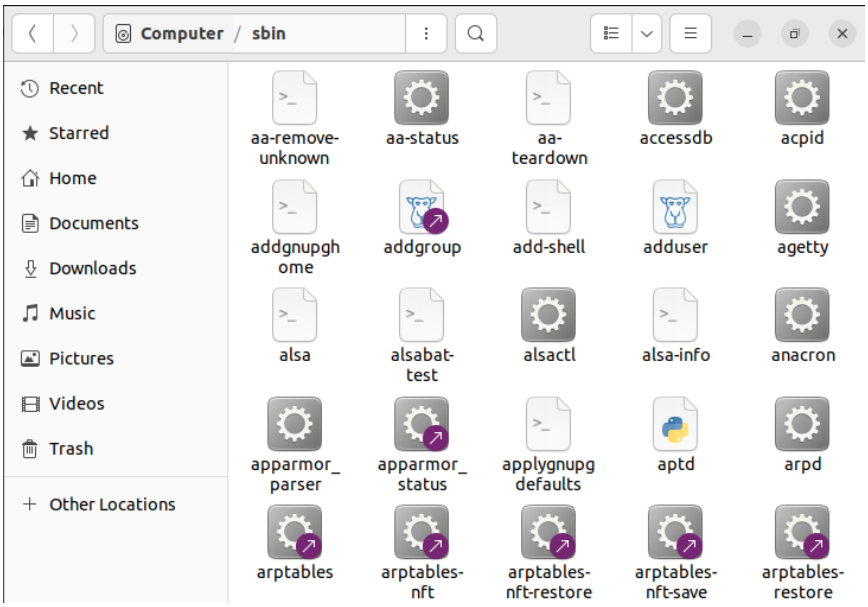
12. /proc: This directory houses optional application software packages, including add-on applications provided by various vendors. Add-on applications should be installed either directly under /opt/ or within sub-directories of /opt/.



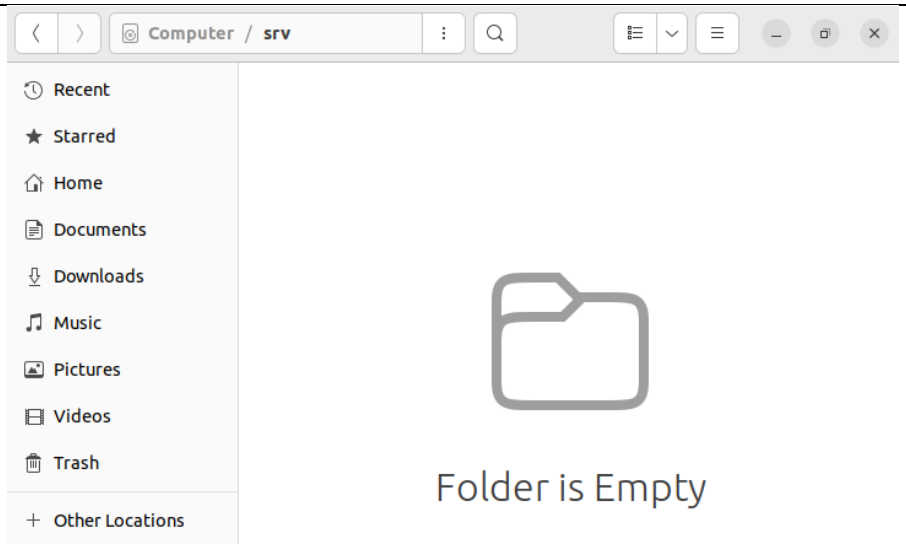
13. /run: Holds temporary data about the system since it was booted.



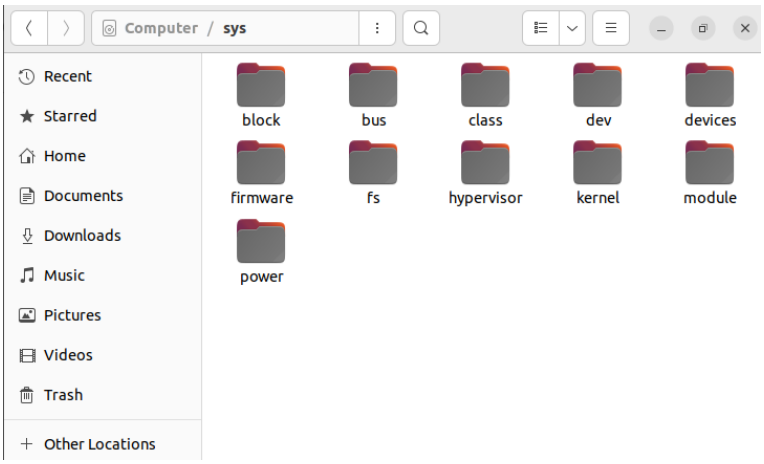
14./sbin: Contains essential system binaries typically used by the system administrator.



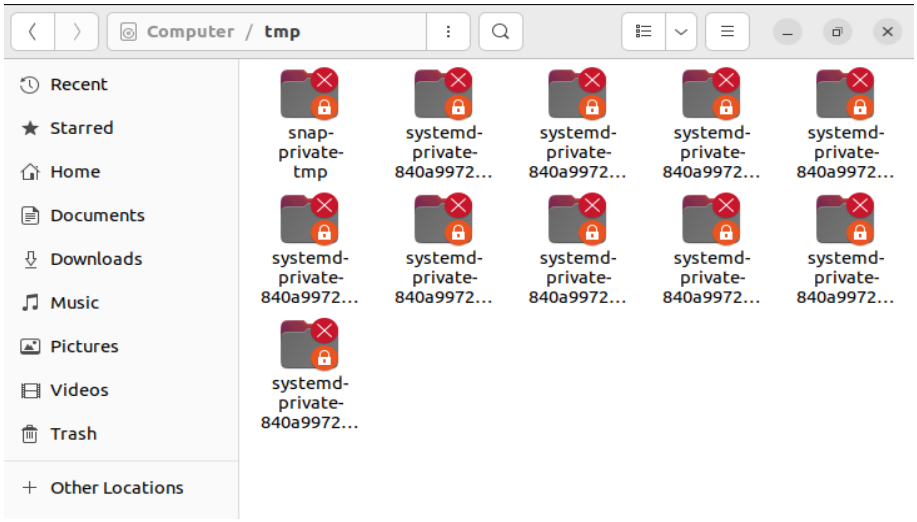
15. /srv: Contains data for services provided by the system, like web server files.



16./sys: Another virtual filesystem, providing information about the system and hardware devices.

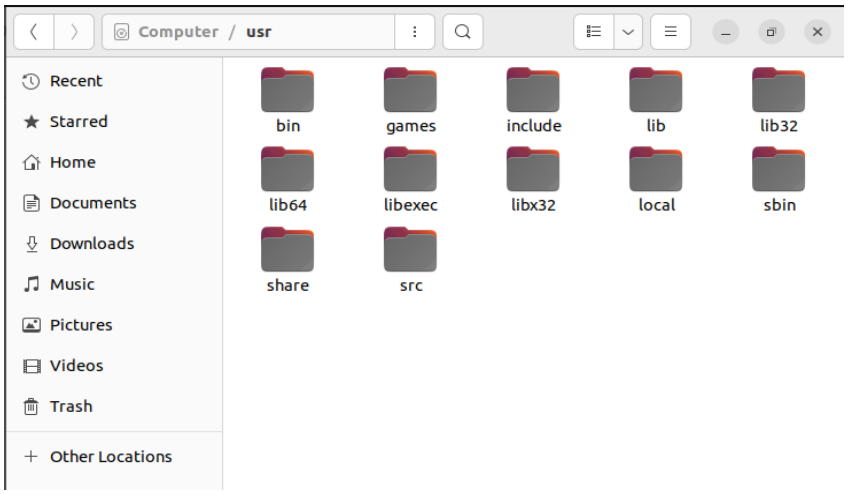


17. /tmp: Directory for temporary files, often cleared on reboot.

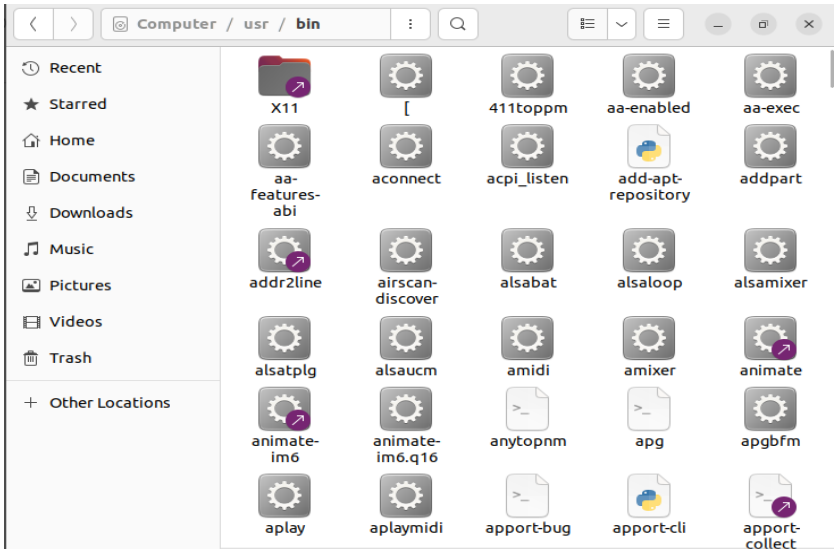


18./usr: This directory serves as a secondary hierarchy for read-only user data, housing the

majority of multi-user utilities and applications. It encompasses binaries, libraries, documentation, and source code for second-level programs. Here are some key components:



19. /usr/bin: Holds binary files for user programs. If a user binary isn't found under /bin, it's typically located here. Examples include at, awk, cc, less, and scp.



20. /usr/sbin: Contains binary files for system administrators. If a system binary isn't found under /sbin, it's usually located here. Examples include atd, cron, sshd, useradd, and userdel.

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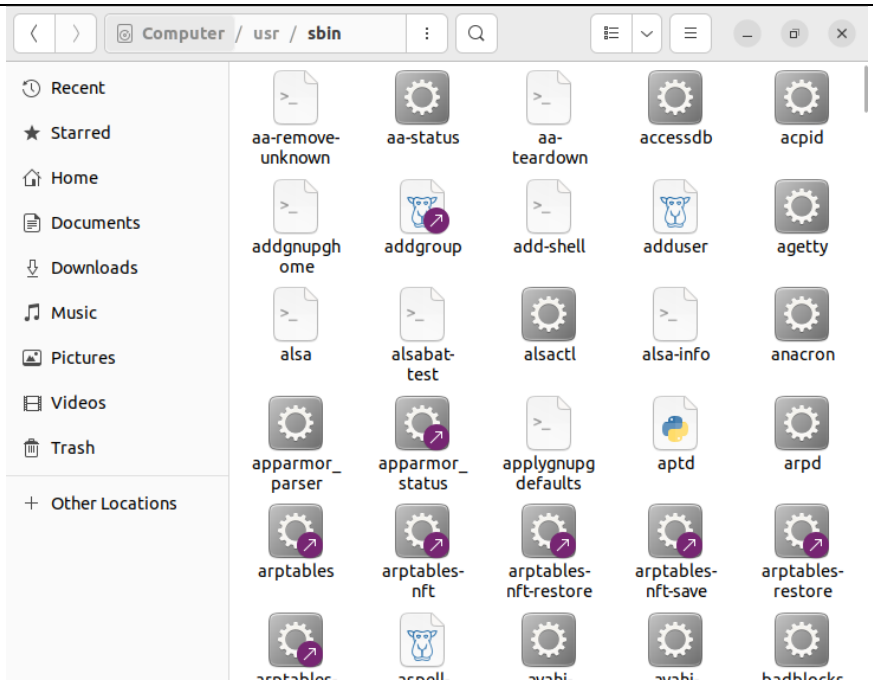
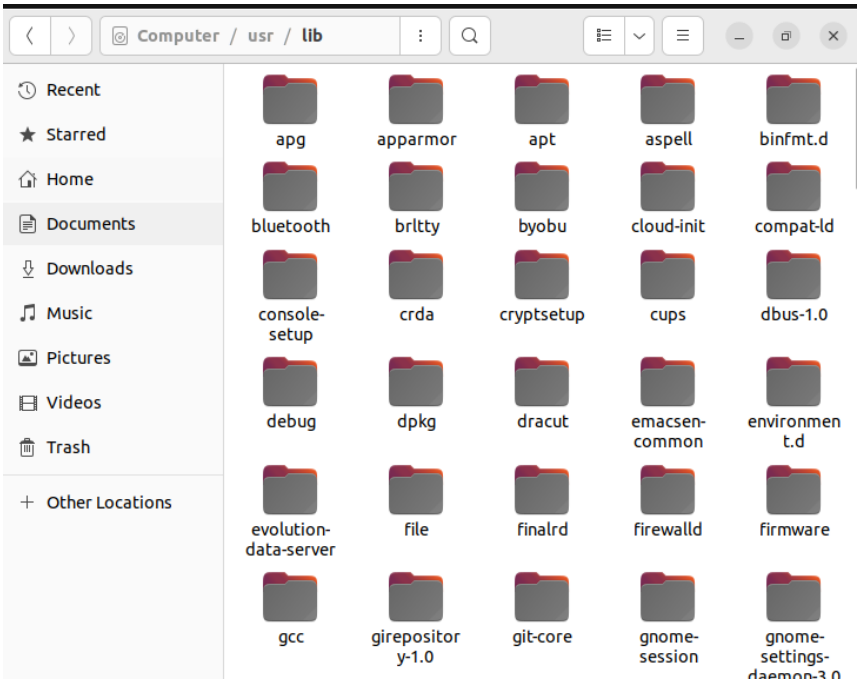
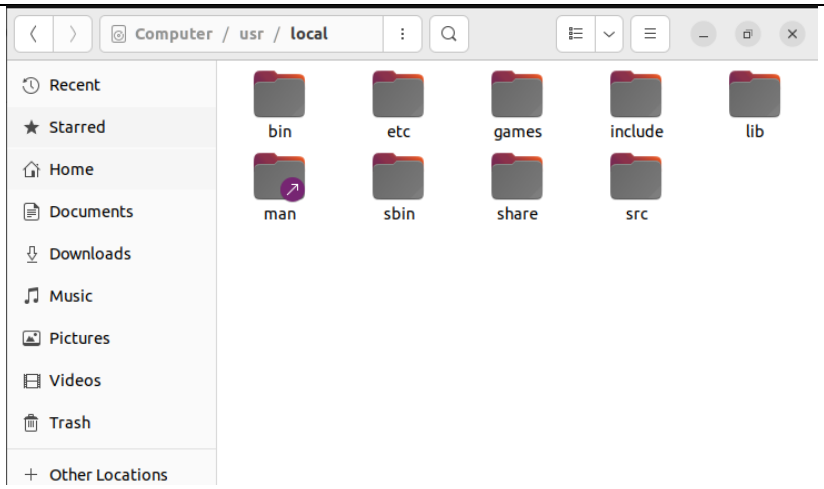


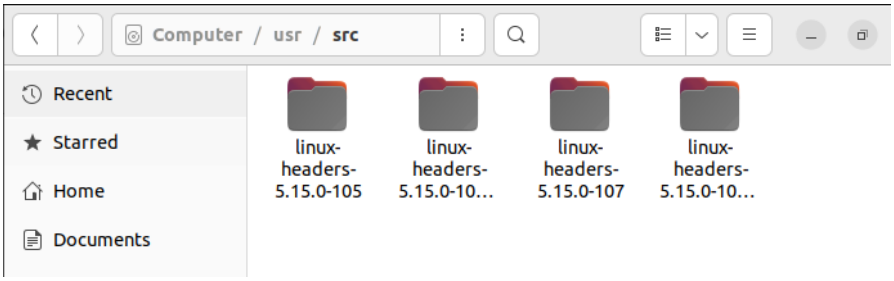
21./usr/lib: Houses libraries for /usr/bin and /usr/sbin.



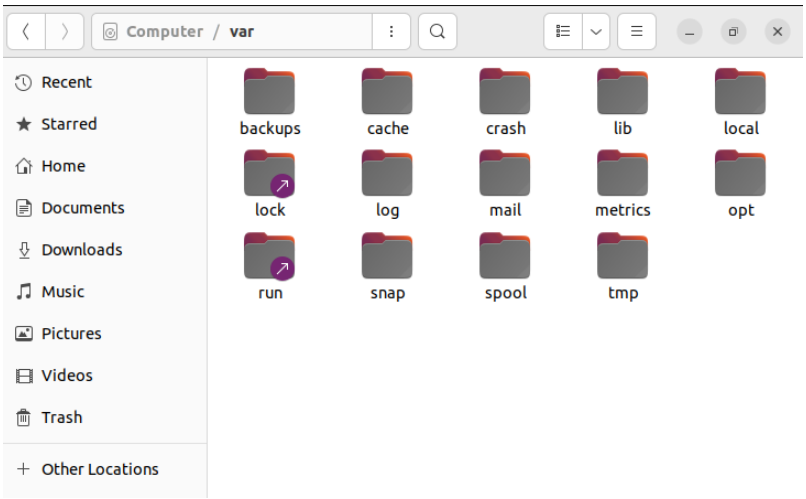
22./usr/local: Stores user programs installed from source. For instance, when you install Apache from source, it's placed under /usr/local/apache2.



23./usr/src: Holds Linux kernel sources, header files, and documentation.



24./var: Contains variable data like logs, spool files, and temporary files used by the system.



Disk Management in Linux (This topic will be shifted to class 11 & 12):

Disk management in Linux involves a variety of tools and commands for handling disk partitions, file systems, and other storage-related tasks. Below is an overview of key concepts and commonly used tools for managing disks in Linux.

Key Concepts

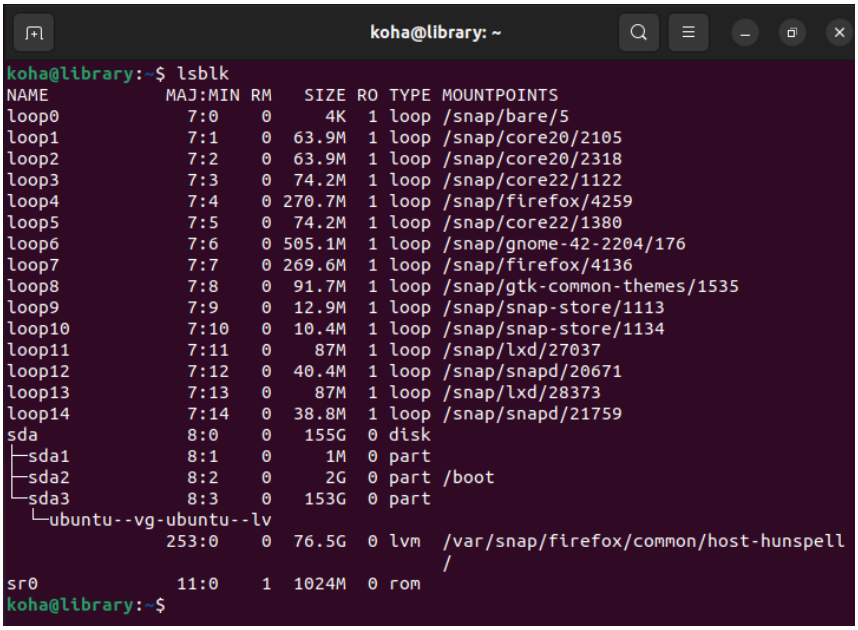
1. Partitions: Dividing a disk into separate sections that can be managed independently.
2. File Systems: Formats that define how data is stored and retrieved on a partition.
3. Mounting: Making a file system accessible at a certain point in the directory tree.

4. Logical Volume Management (LVM): A method of managing disk space more flexibly than traditional partitioning.

Common Tools and Commands Viewing Disk Information

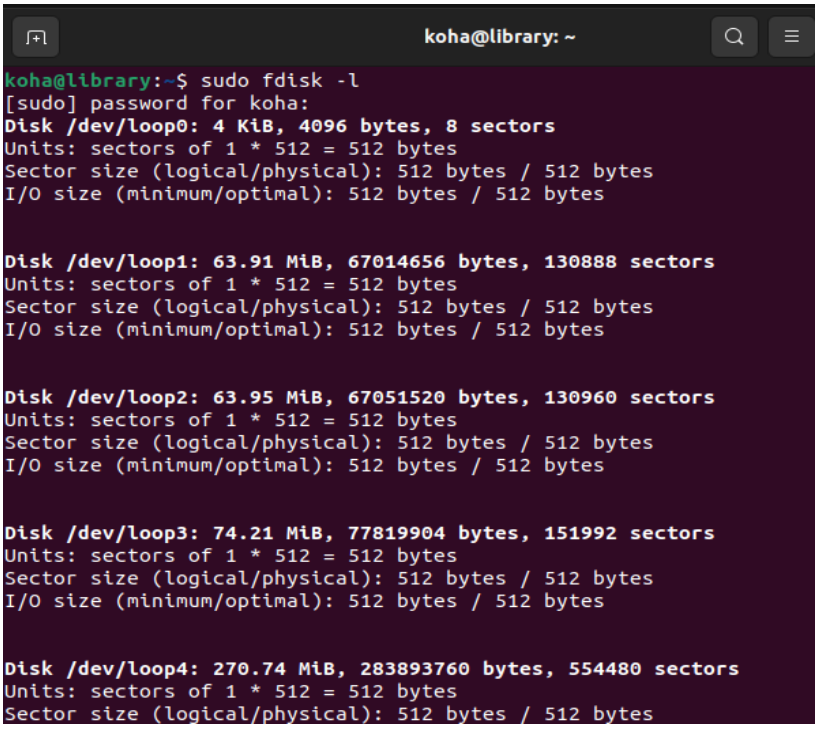
1. lsblk: Lists all block devices.

Synatx :lsblk



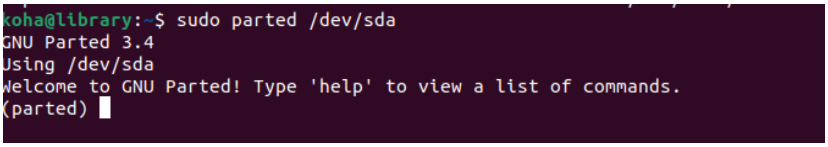
2. fdisk: A command-line utility for partitioning disks. Use -l to list partitions.

sudo fdisk -l



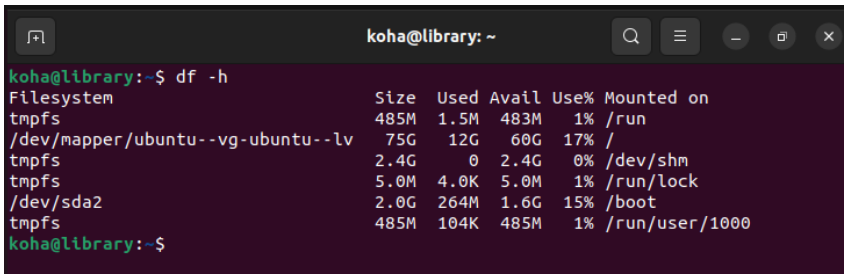
3. parted: A more advanced disk partitioning tool.

sudo parted /dev/sda



4. df: Displays disk space usage of file systems.

df -h



5. du: Shows disk usage of files and directories.

du -sh /path/to/directory

Mounting and unmounting file system in ubuntu

You can mount file systems for a single session using the mount command, or permanently by editing the /etc/fstab file. Mounting requires administrative privileges, which can be obtained by logging in as the root user or by using the sudo command. In some instances, such as when inserting a USB flash drive, the system handles mounting automatically. Below are examples demonstrating the use of the mount command, along with the mkdir command to create the necessary mount point.

1. **Mount a Windows Floppy Disk**

First, create the mount point directory if it doesn't already exist:

mkdir /mnt/floppy

Next, use the mount command with the -t flag (short for "type") to specify msdos as the file system:

mount -t msdos /dev/fd0 /mnt/floppy

Now, the contents of the floppy disk in /dev/fd0 should be accessible from /mnt/floppy.

2. **Mount a CD-ROM**

First, create the mount point directory if it doesn't already exist:

mkdir /mnt/cdrom

Next, mount the CD-ROM. Specifying the -t iso9660 option is usually unnecessary since Linux can automatically detect the file system type:

mount /dev/cdrom /mnt/cdrom

The contents of the CD-ROM in /dev/cdrom should now be accessible from /mnt/cdrom.

Unmount files system

You can unmount a file system using the umount command. You can specify either the device name or the mount point to indicate what you wish to unmount:

umount /media/nfs

umount /media/iso

umount /media/usb

umount /dev/cdrom

umount /dev/fd0

If the file system is in use, you will receive an error message indicating that the target is busy. To identify which processes are using the mounted file system, use the fuser -m command, for example:

fuser -m /media/usb

To unmount a device when it is free, you can use the -l (lazy) switch with umount. Alternatively, the -f (force) switch forces the system to unmount the device immediately, though this can risk corrupting the file system. The -f switch is mainly intended for unmounting unreachable NFS shares.

Demonstrate to install Printer in Ubuntu Linux

https://engineering.purdue.edu/ECN/Support/KB/Docs/VPSPrinterUbuntu

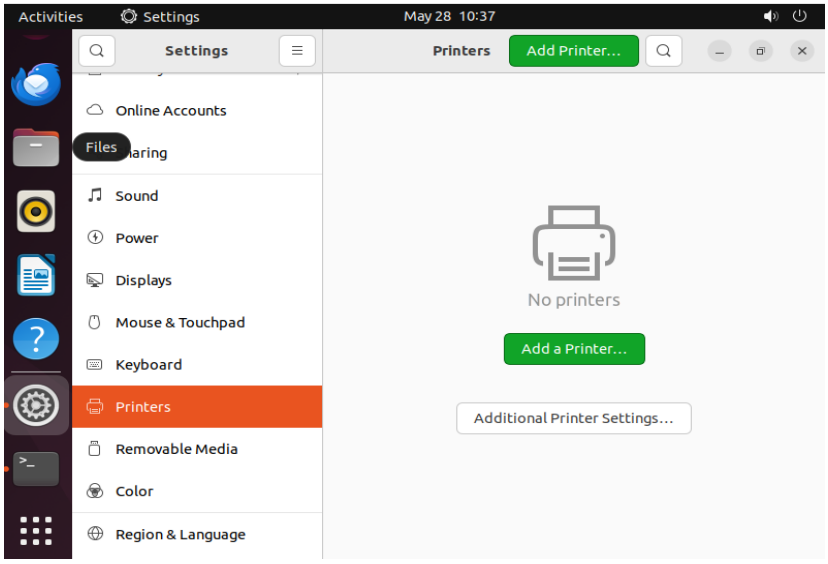
Activity 1

Practical Activity 1: How to install Printer in Ubuntu Linux 24.04 LTS.

Adding a printer in Ubuntu 24.04 can be done through the graphical user interface (GUI) or the command line. Here's a step-by-step guide for both methods:

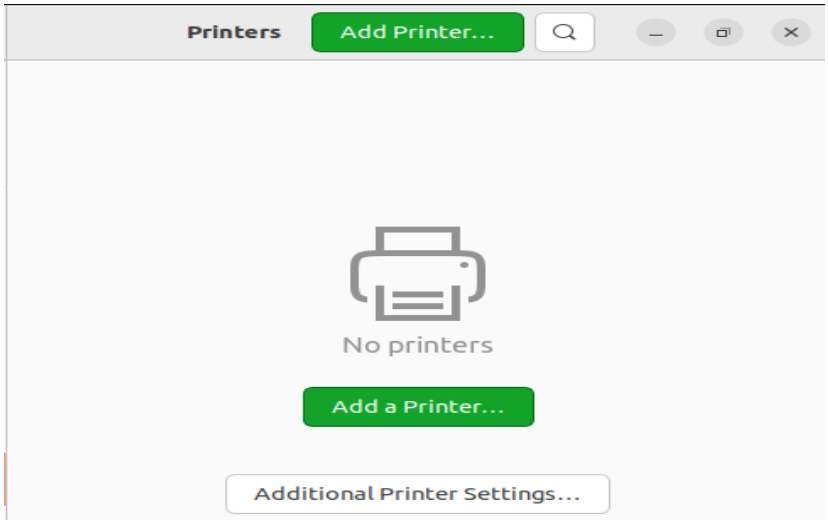
Step 1. Open Settings:

Click on the system menu (top-right corner) and select "Settings".



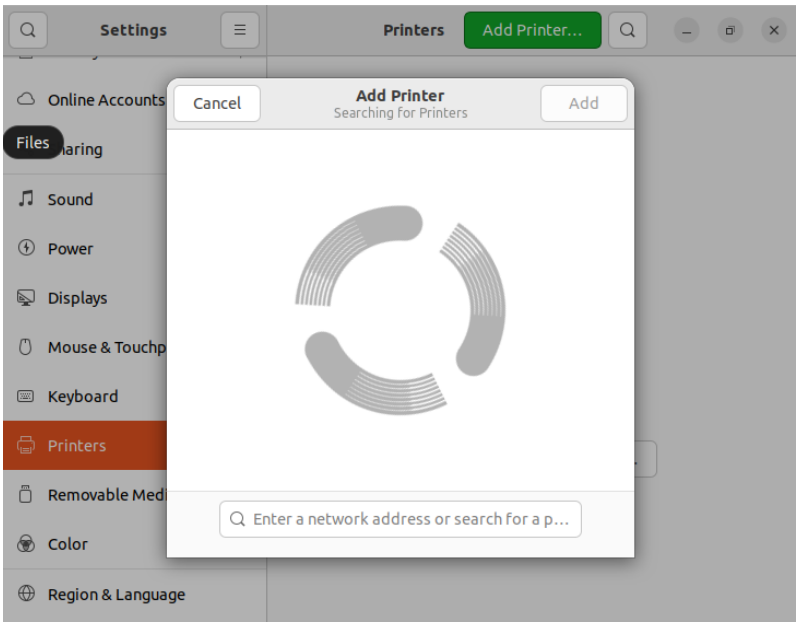
Step 2. Go to Printers:

In the Settings window, find and click on "Printers".



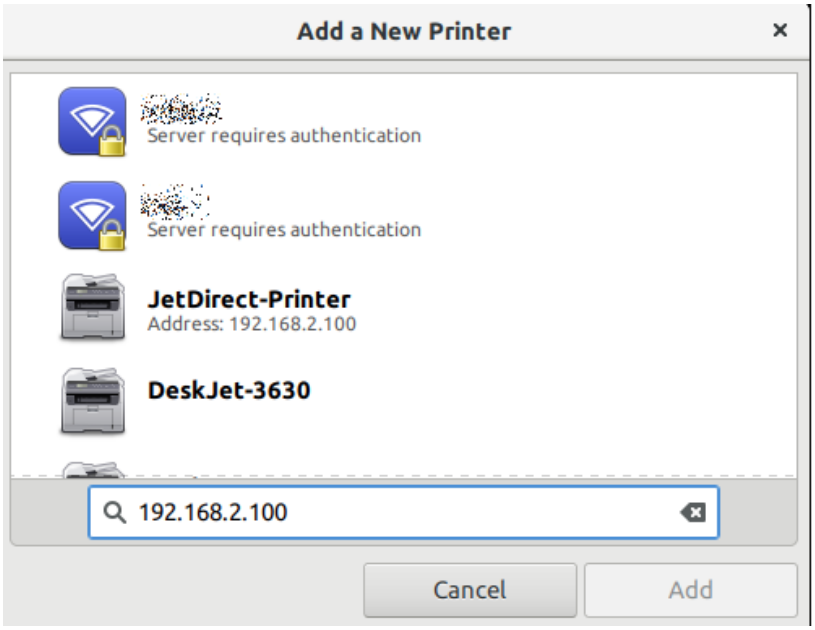
Step 3. Add a Printer:

Click the "Add" button (usually represented by a "+" sign).



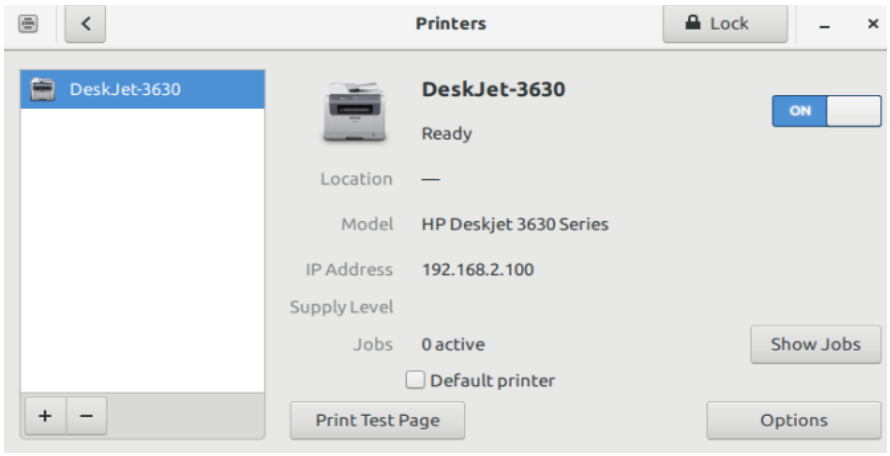
Step 4. Select Your Printer:

Ubuntu will search for available printers. Select your printer from the list. If your printer is connected via USB, it should appear automatically. For network printers, you may need to click "Network Printer" and enter the necessary details.



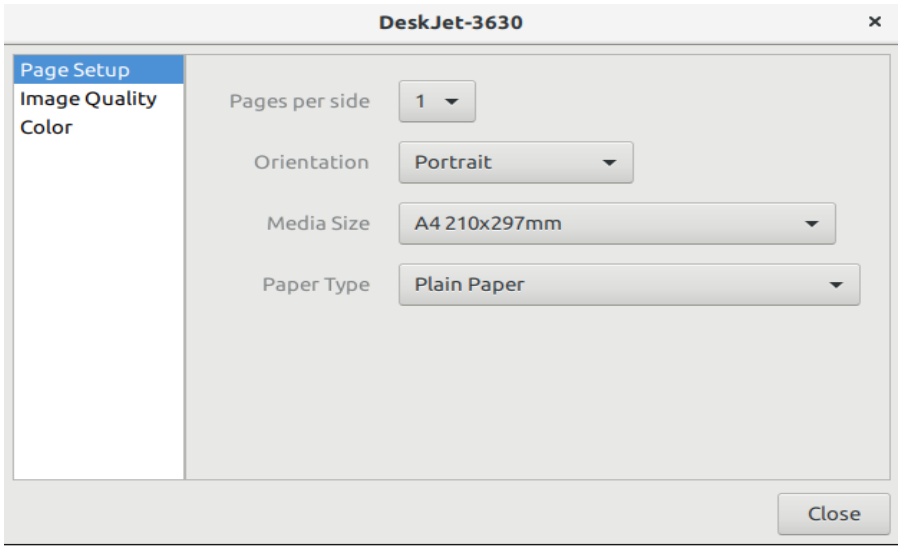
Step 5. Install Printer Driver:

If prompted, choose the appropriate driver for your printer. Ubuntu usually installs the correct driver automatically, but you may need to select it manually.



Step 6. Finish Setup:

Follow the on-screen instructions to complete the setup. You can name your printer, set it as the default printer, and print a test page to ensure it's working correctly.



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Answers

Module 1. Fundamental of Computer and Peripherals

Session 1. Basic Functionality of Computer system

A. Multiple choice questions (MCQs)

1. (b) 2. (c) 3. (a) 4. (c) 5. (d) 6. (d) 7. (b) 8. (d) 9. (a) 10. (a)

B. Fill in the blank questions

1. Computer system 2. development of computers 3. Generations 4. Hardware 5. Software 6. main components 7. Classified 8. size and storage capacity 9. CPU 10. architecture of a microprocessor

C. True or False

1. True 2. False 3. True 4. False 5. True 6. True 7. False 8. True 9. False 10. False

Session 2. Input and Output Devices

A. Multiple choice questions (MCQs)

1. (B) 2. (C) 3. (C) 4. (B) 5. (D) 6. (A) 7. (B) 8. (C) 9. (C) 10. (D)

B. Fill in the blank questions

1. Text Input Devices 2. Pointing Device 3. Audio Visual Input Devices 4. Input Card Readers 5. Reading Text or Codes 6. Input Sensors 7. Output Devices 8. Soft Copy Output Device 9. Hard Copy Output Devices 10. Sound Output Device

C. True or False

1. False 2. True 3. False 4. False 5. False 6. True 7. False 8. False 9. True 10. False

Session 3. Storage and Peripheral Devices

A. Multiple choice questions (MCQs)

1. (d) 2. (c) 3. (b) 4. (c) 5. (b) 6. (b) 7. (d) 8. (c) 9. (a) 10. (c)

B. True or False

1. False 2. True 3. False 4. False 5. True 6. True 7. False 8. True 9. True 10. True

C. Fill in the blank questions

1. Capacity and Measuring Unit of Memory, 2. Primary Memory, 3. Secondary or Auxiliary Memory, 4. Floppy Disk, 5. Optical Disk, 6. Hard Disk, 7. Optical Discs and Drives, 8. Working of Hard Disk, 9. Disk Drive Performance, 10. Disk Drive Interfaces

Module 2. Installation and Configuration Of Windows Operating System

Session 1. Basic of Operating System

A. Multiple choice questions (MCQs)

1. (c) 2. (c) 3. (b) 4. (c) 5. (a) 6. (b) 7. (d) 8. (b) 9. (c) 10 (c)

B. Fill in the blank questions

1. Operating system 2. Hardware 3. Booting 4. Operating system 5. Memory 6. Process 7. User 8. Real-time 9. Command-line 10. Kernel

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C. True or False

1. (F) 2. (T) 3. (F) 4. (T) 5. (T) 6. (F) 7. (T) 8. (F) 9. (T) 10. (F)

Session 2. Install Windows operating system

A. Multiple choice questions (MCQs)

1. (b) 2. (c) 3. (b) 4. (b) 5. (a) 6. (c) 7. (a) 8. (d) 9. (b) 10. (c)

B. Fill in the blank questions

1. 1985 2. Start 3. 2 GB 4. Media Creation 5. Erased 6. BIOS/UEFI 7. Start 8. Updates 9. Vista 10. Cortana

C. True or False

1. (F) 2. (F) 3. (F) 4. (F) 5. (T) 6. (T) 7. (T) 8. (T) 9. (T) 10. (F)

Session 3. Configure Windows Operating System

A. Multiple choice questions (MCQs)

1. (d) 2. (c) 3. (a) 4. (c) 5. (a) 6. (b) 7. (b) 8. (b) 9. (c) 10. (b)

B. Fill in the blank questions

1. Display 2. Settings 3. Taskbar 4. Software 5. Edge 6. Windows Key 7. Quick 8. Settings 9. Network 10. Backup

C. True or False

1. (T) 2. (F) 3. (T) 4. (F) 5. (F) 6. (T) 7. (F) 8. (T) 9. (T) 10. (F)

Module 3. Installation and Configuration of Linux Operating System

Session 1. Installation of Ubuntu Linux

Session 2. Perform post installation task in Linux operating system

Session 3. Install and Configure Peripheral devices

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