TOPIC 2: COMPUTER HARDWARE

Unit Two: Processing Devices

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Unit Two: Processing Devices

- **Unit Summary:-**

Devices inside the system Unit:

a) The system Unit

- Definitions, Components and parts.

b) The Motherboard

- Definitions, Components and parts.

c) The Central Processing Unit CPU

- Definitions, Components and parts.

d) Memory (internal/primary storage)

- RAM and ROM, Memory Cache, CMOS,
- Units of Measuring Computer Memory
- Computer Data representation & numbering systems

a) Processing devices

- Processing devices are the computer electronic components and chips housed in the system unit.

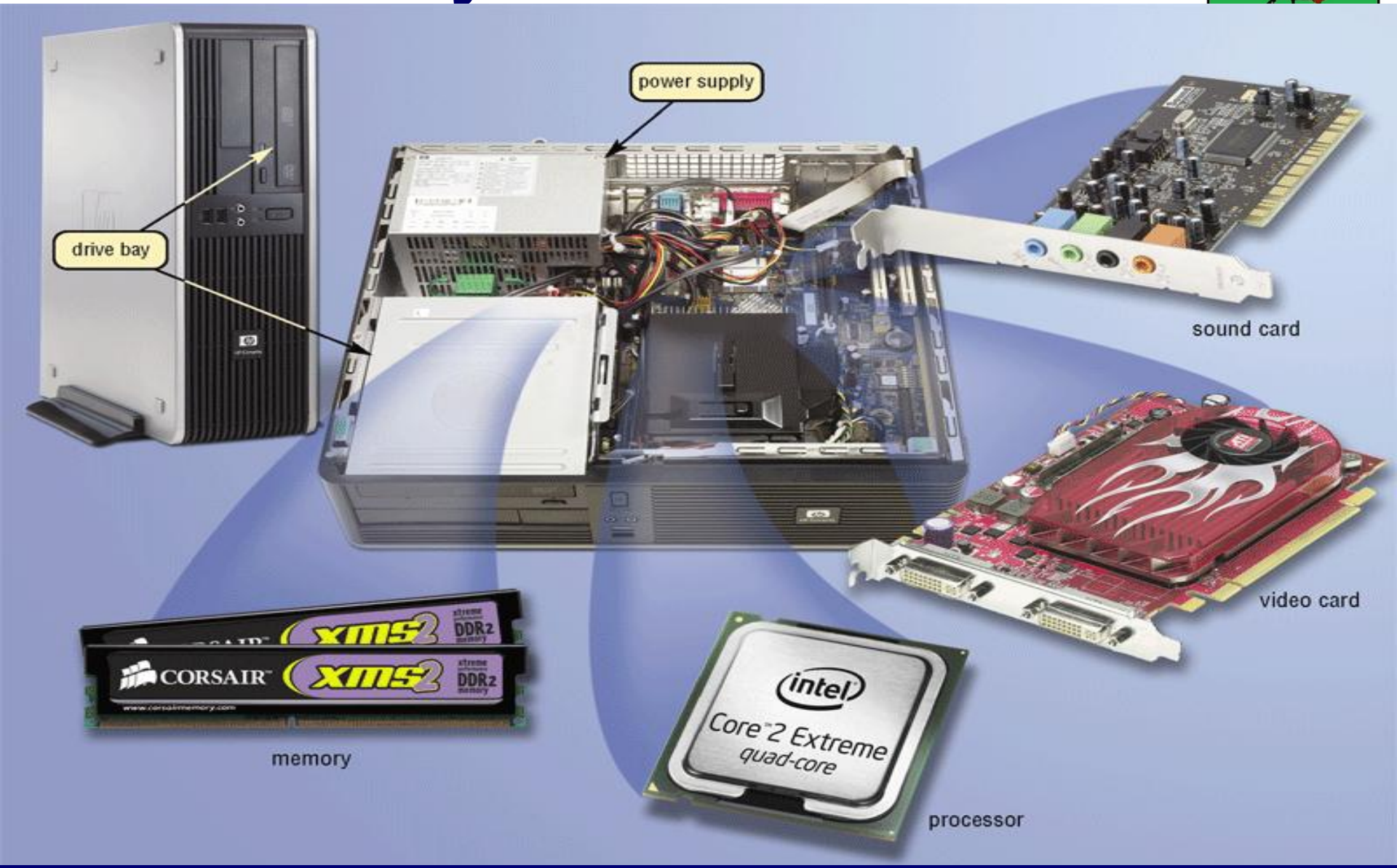
The system unit

- The *system unit is a box-like case that houses the motherboard, the disks and drive bays, the power supply and cooling systems.*
- The components in the system unit are connected to the *motherboard.*
- A drive bay is a rectangular opening inside the system unit that typically holds disk drives.

a) The system unit

All sizes of computers have a system unit

The system unit

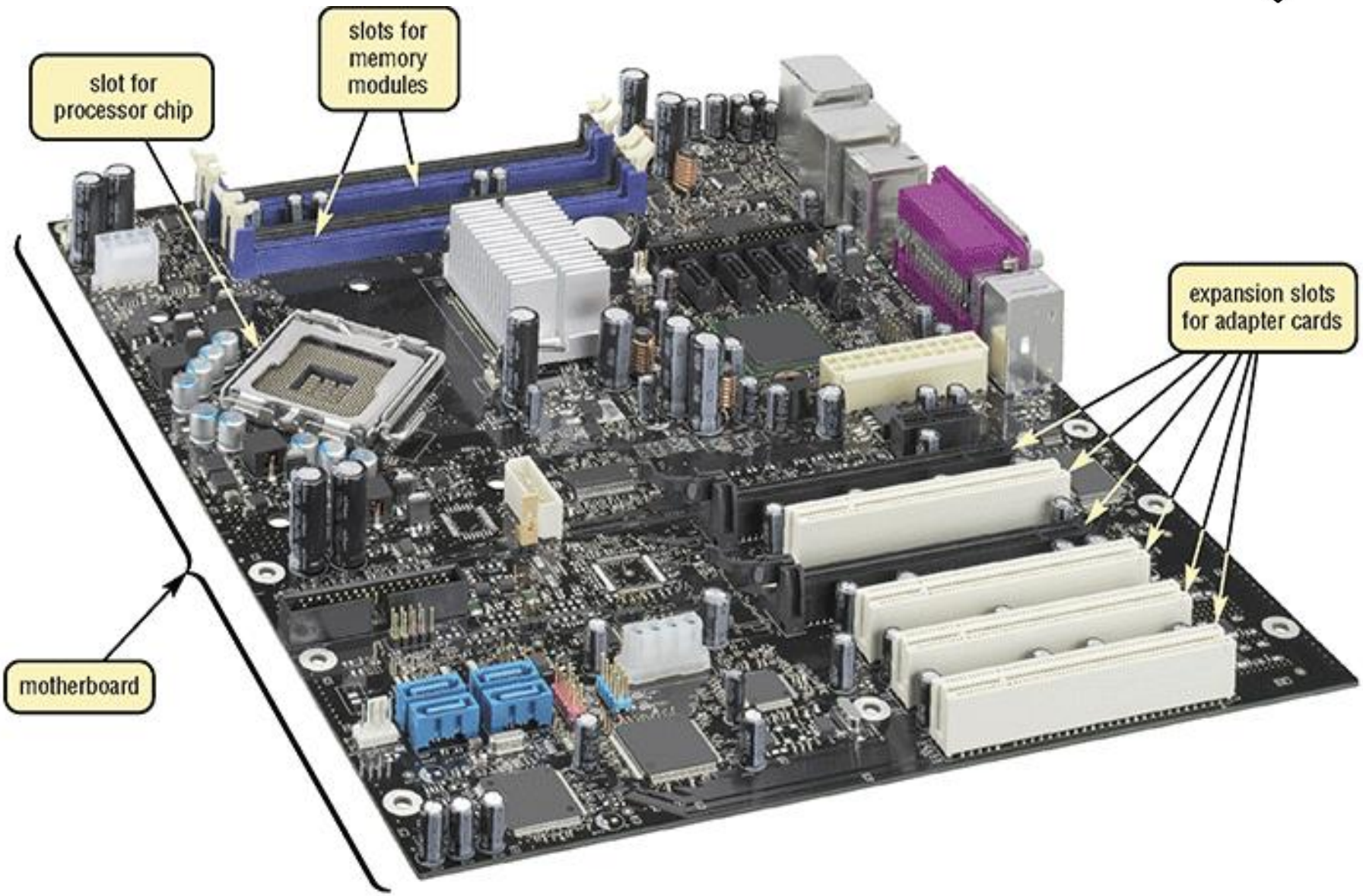


A system unit contains numerous electronic components

b) The motherboard

- The motherboard is a single circuit board, that provides the path through which the processor communicates with internal and peripheral devices.
- The motherboard is also called the *system board*
- The components attached to the motherboard include the processor chip (the CPU), memory chips, support electronic circuitry, buses, and Expansion Slots for Adapter Cards.

Basic parts of a motherboard



Expansion slots and Adapter cards

- An *expansion slot* *is a socket on the motherboard that* can hold an adapter card.
- An *adapter card, also called* expansion card, is a circuit board that increases the capabilities of the system or provides connections to peripherals.
- Some motherboards include all necessary capabilities and do not require adapter cards.
- Adapter cards are used for many supplemental capabilities, such as more memory, higher-quality sound devices, a modem, extra ports, or graphics capabilities.

An adapter card being inserted into an expansion slot

Commonly used adapter cards and their functions

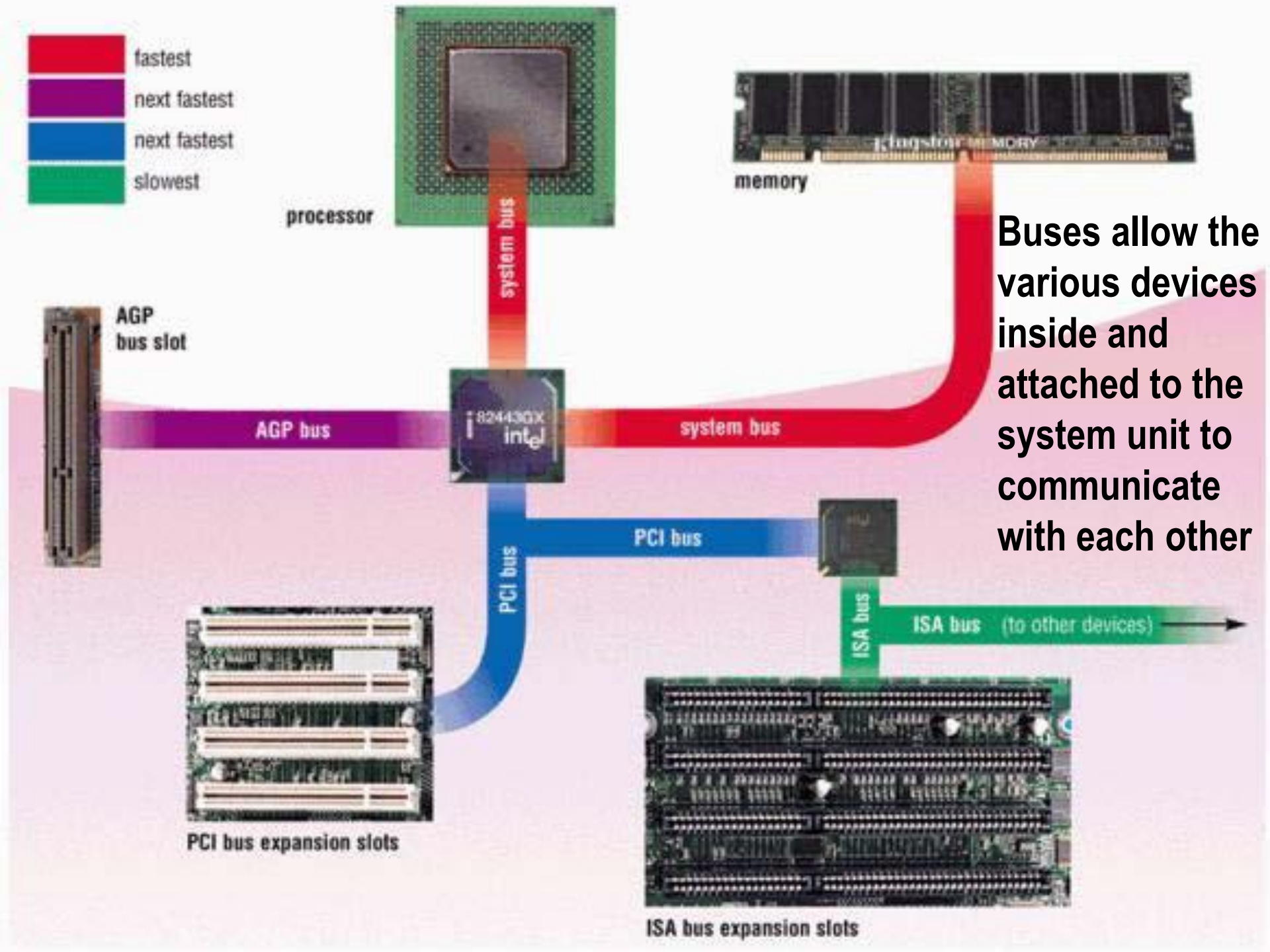
Adapter Card	Purpose
Sound card	Connects speakers or a microphone
MIDI card(musical instrument digital interface)	Connects musical instruments
Network interface card (NIC)	Connects other computers
Video card	Connects a monitor
USB card	Connects USB devices
TV tuner card	Allows viewing of television channels
Video capture card	Connects a video camera
Modem card	Converts telephone or cable analog signals to digital and vice versa
FireWire card	Connects FireWire devices

Plug and Play (PnP)

- In the past, installing a card was not easy and required you to set switches and other elements on the motherboard.
- Today, many computers support *Plug and Play.*
- *PnP refers to the computer's* capability to automatically configure adapter cards and other peripherals as you install them when the computer is still running.

Buses

- The **bus** is a common electrical path, *that enables data flow between the various system components.*
- A *bus, allows the various devices inside and* attached to the system unit to communicate with each other.
- All buses consist of two parts:
- *The data bus which transfers* actual data bits and
- The address bus which transfers information about where the data should go in memory.

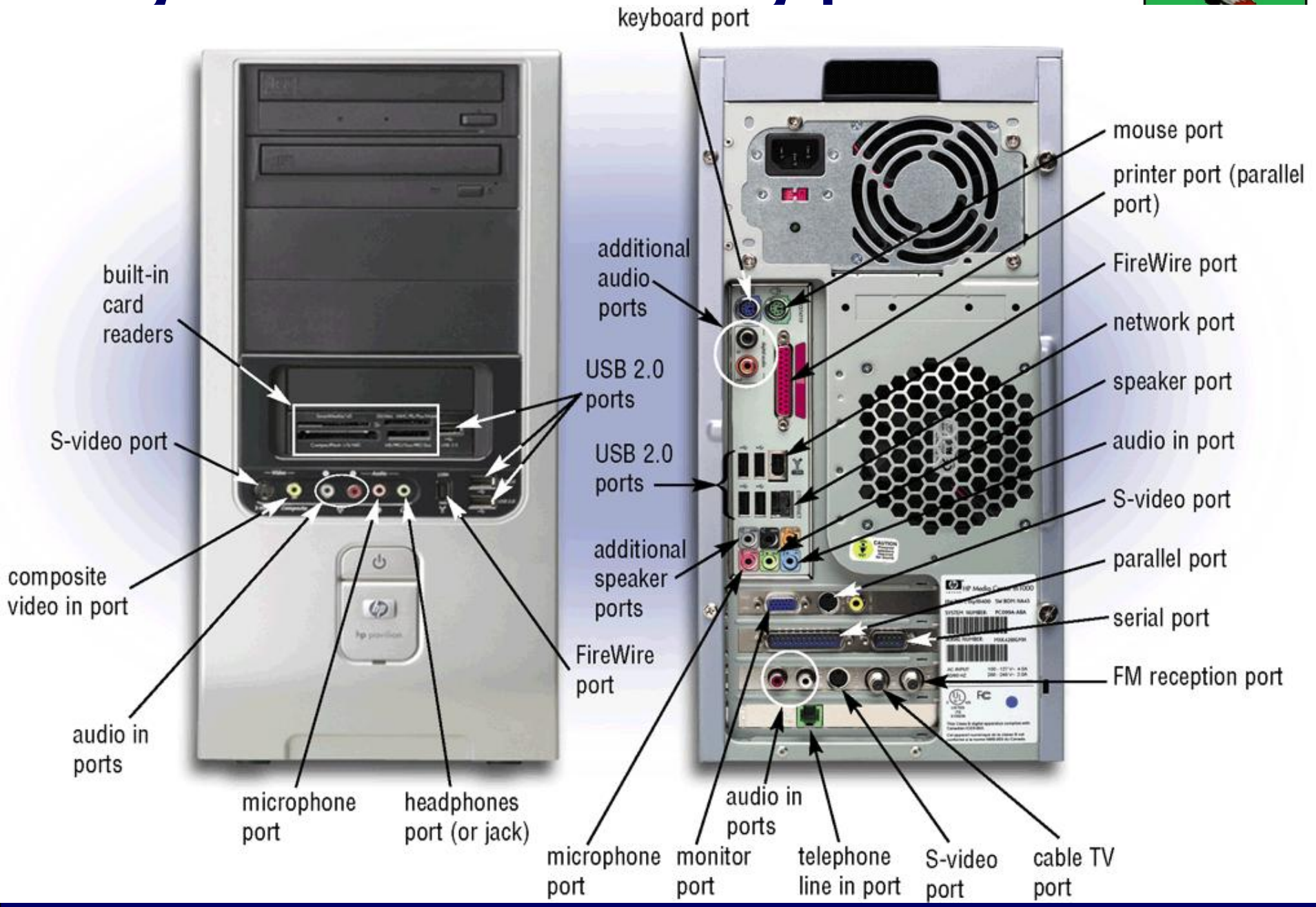


Buses allow the various devices inside and attached to the system unit to communicate with each other

Ports

- A *port is the point at which a peripheral attaches to the* system unit.
- Through a port, the peripheral can send data to or receive information from the computer.
- A peripheral device, such as a keyboard, monitor, printer, mouse, digital camera, and microphone, often attaches by a cable to a port on the system unit.

A system unit has many ports



Examples of different types of ports on a system unit

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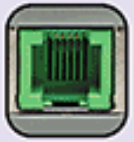
Type	Picture	Type	Picture
Audio in		Monitor	
Cable TV		Mouse	
Center Surround Sound/Subwoofer		Network	
Composite video in		Printer	
Digital Video Interface (DVI)		Rear Surround Sound	
eSATA port		Serial	

FireWire		Side Surround Sound	
FM reception		S/PDIF	
HDMI port		Speaker	
Headphones		S-video	
Keyboard		Telephone line in	
Microphone		USB	

Common ports

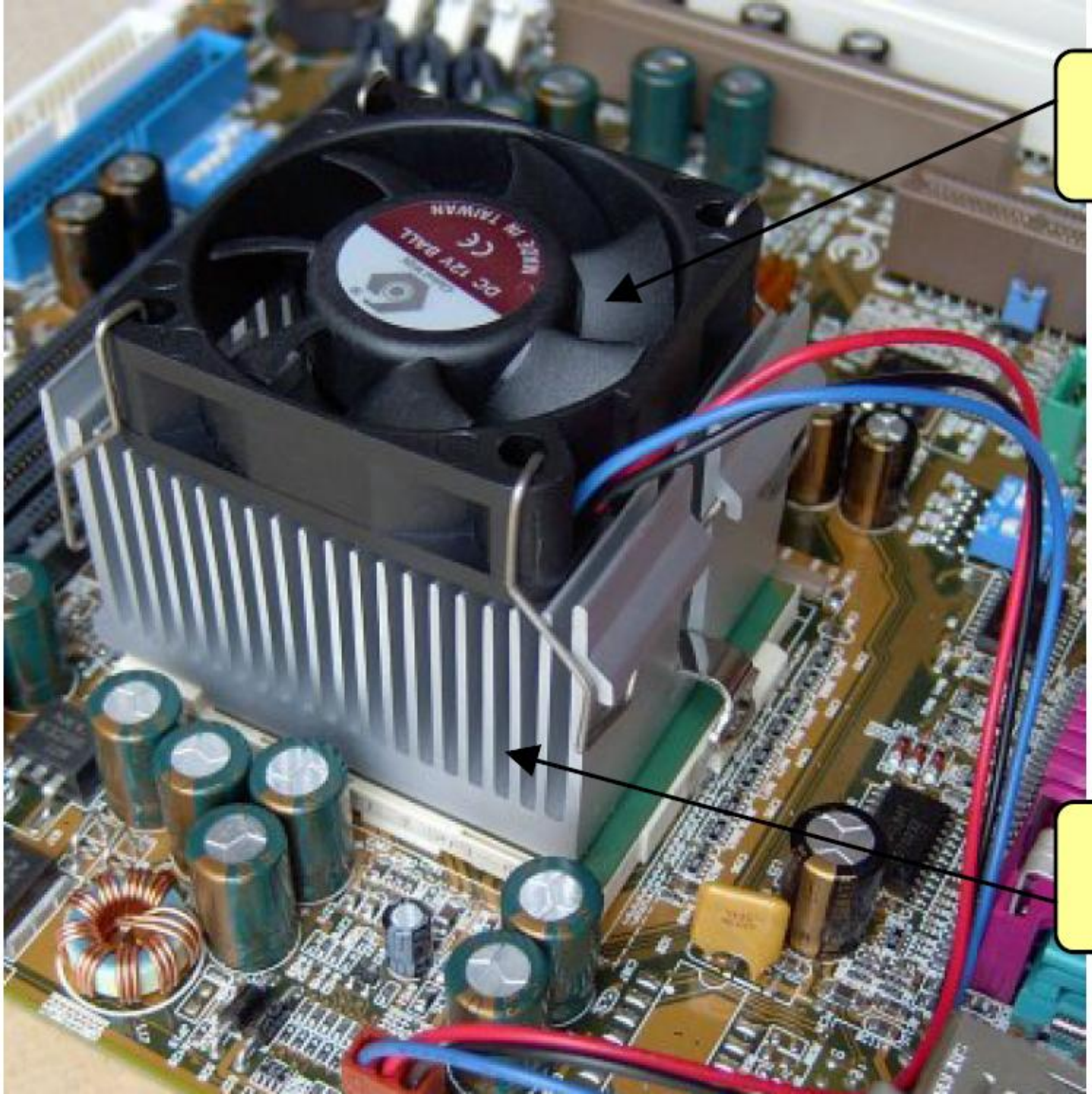
- **A serial port is a type of interface that connects a device to the system unit by transmitting data one bit at a time.** It is used to connect devices that do not required fast data transmission rates, such as a mouse or keyboard.
- **Parallel ports** allow the parallel transmission of data;
- that is, several bits are transmitted simultaneously. These ports provide the interface for such devices as high-speed printers.
- ***USB (Universal Serial Bus) ports are used in high-speed device interfaces.***
- **Bluetooth ports use radio waves to transmit data between two devices, without using cables.**

Connectors

- A *connector joins a cable to a port.*
- *A connector at one* end of a cable attaches to a port on the system unit, and a connector at the other end of the cable attaches to a port on the peripheral.
- Most connectors are available in one of two genders: male and female.
- Male connectors have one or more exposed pins.
- Female connectors have matching holes to accept the pins on a male connector.

Power Supply and Cooling Technology

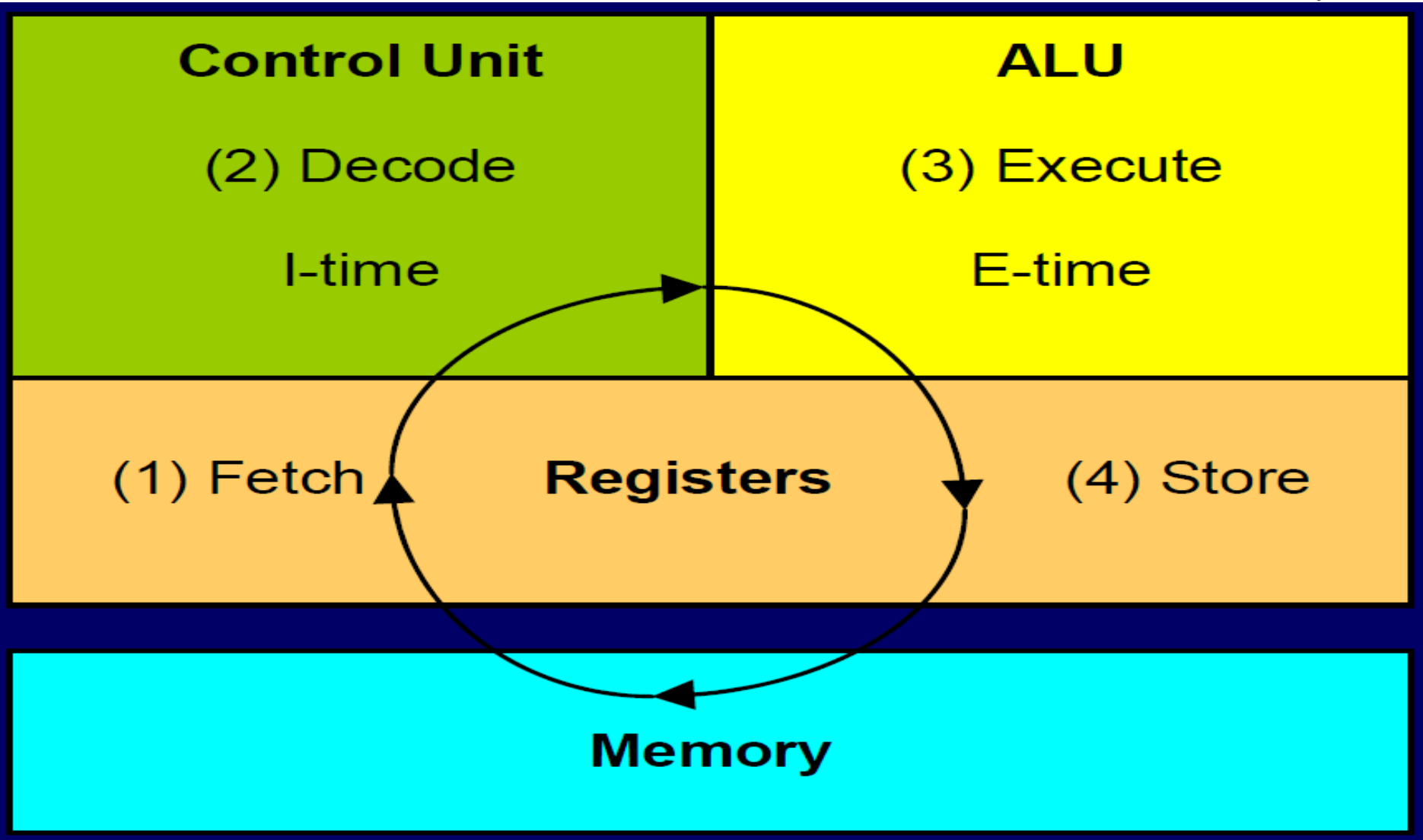
- The power supply is the component of the system unit that converts the wall outlet AC power of 110 to 240 volts into DC power of 0.5 to 12 volts
- Built into the power supply is a fan that keeps the power supply cool.
- Processor chips generate heat, which could cause the chip to burn up.
- A heat sink is a small ceramic or metal component with fins on its surface that absorbs and disperses heat produced by electrical components such as a processor.


Heat sink fan
Heat sink

c) The CPU

- The *central processing unit (CPU), is a chip that* interprets, carries out the basic instructions and manages most of a computer's operations.
- It is at times referred to as the ‘brain’ of the computer.
- It has two basic sections: the control unit (CU) and the arithmetic/logic unit (ALU), which work together to perform the processing operations.
- *Other CPU components are the Registers and the System Clock.*

Components of a CPU.



The control unit (CU)

- The *control unit is the component of the processor that directs and* coordinates most of the operations in the computer.
- It interprets each instruction issued by programs and then initiates the appropriate action to carry out the instruction.
- For every instruction, the control unit repeats a set of four basic steps called the machine cycle steps:

The machine cycle steps

- **Step 1: Fetching the instruction.** The instruction to be executed is obtained from memory.
- **Step 2: Decoding the instruction.** The instruction is translated into commands the computer understand and sent to the ALU.
- **Step 3: Executing the instruction.** The commands are carried out.
- **Step 4: Storing results.** The results are stored in registers or memory.

Arithmetic/logic unit (ALU),

- **The ALU performs the arithmetic, comparison, and logical operations in a computer.**
- **It performs the execution step of a machine cycle.**
- ***Arithmetic operations include addition,* subtraction, multiplication, and division.**
- ***Logical operations work* with conditions and logical operators such as AND, OR, and NOT.**
- **For example, if you wanted to search a student database for Candidates of Computer studies, you would search for any students classified under 'Computer studies AND listed under Candidates.**

An example of a machine cycle

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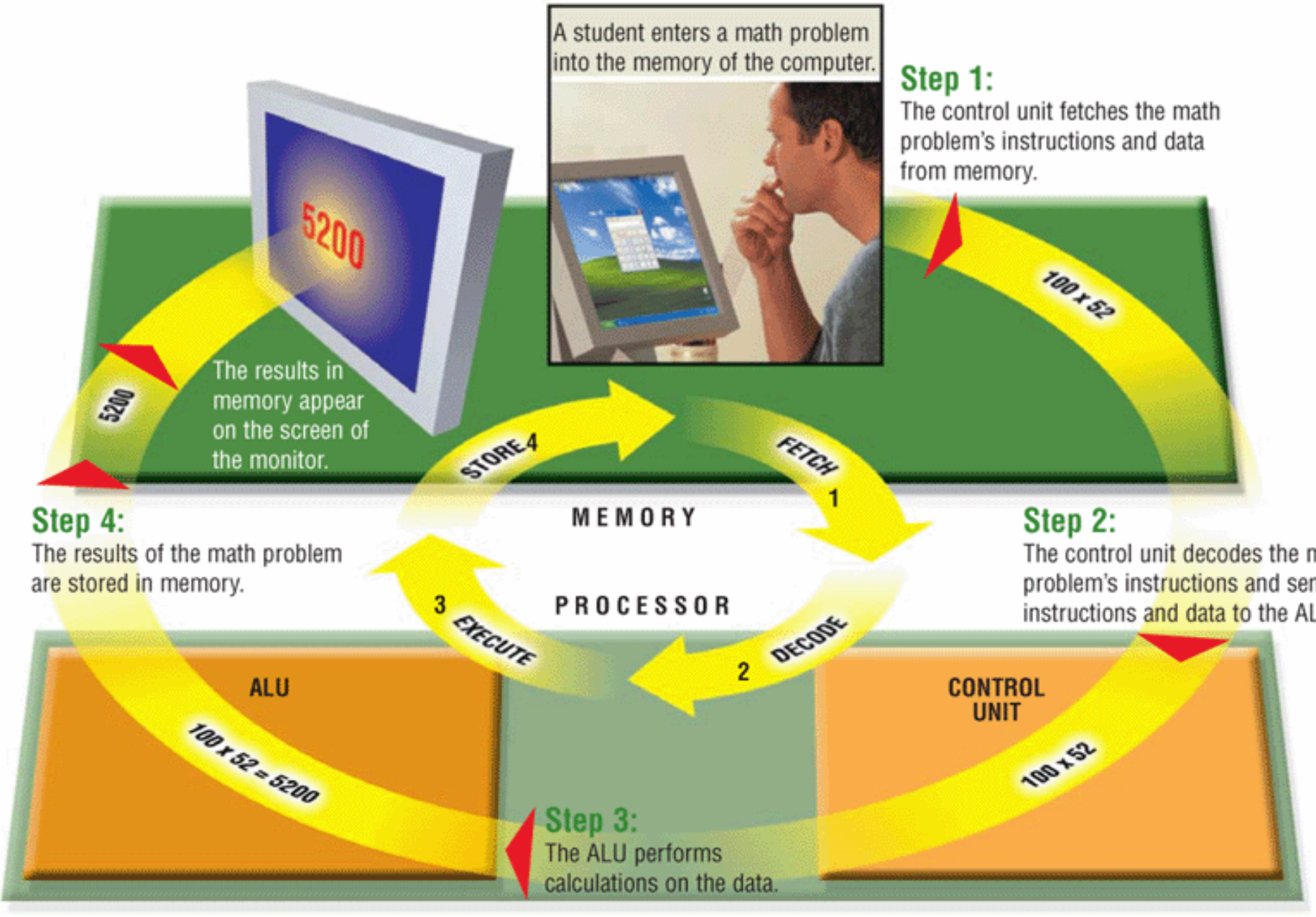


Registers

- Registers are high-speed working storage areas *that temporarily hold instructions and data.*
- Registers work under the direction of the control unit to accept, hold, and transfer instruction or data and comparisons at high speed.
- Registers are not part of Memory or Secondary Storage: Registers hold data *immediately related to the operation being executed. Memory is used to store data that will be used in the near future.* Secondary storage holds data that may be needed *later (in future)*

Types of registers

- **Instruction register,** which contains the instruction being executed;
- **Address register,** which keeps track of where a given instruction or piece of data is stored in memory;
- **Storage register,** which temporarily holds data taken from or about to be sent to memory;
- **The Accumulator,** which collects the result of computations;
- **General-purpose register,** which is used for several functions, as assigned by the CU

The *system clock*

- **The *system clock is a small chip that is used* by the CPU to synchronize the timing of all computer operations.**
- **The system clock generates electronic pulse or ticks at a fixed rate, which set the operating pace of components in the system unit.**
- **Each tick is called a *clock cycle, which affects* machine cycle time.**
- **The faster the clock, the more instructions the CPU can execute per second.**

Clock speed.

- This refers to the speed at which a processor executes instructions
- Clock speed is measured in hertz.
- *A hertz is one cycle or tick per second. A Megahertz (MHz) equates to one million ticks of the system clock per second.*
- Processor's speed is sometimes measured according to the number of MIPS (millions of instructions per second) it can process.

d) Memory (internal/primary storage)

- While performing a processing operation, a processor needs a place to temporarily store instructions to be executed and the data to be used with those instructions.
- The CPU cannot process data on an input device or disk directly; the data must first be available in memory.

- A computer's memory in the system unit is located physically close to the CPU to decrease access time.
- It provides the CPU with a working storage area for program instructions, data and information.
- Memory is also known as primary storage or internal storage.
- Memory usually consists of one or more chips on the motherboard.

Examples of primary memory

1) RAM – Random Access Memory.
2) Cache memory (used by the CPU to store data before processing it).
3) Registers (basically used for calculations)

Types of memory:

- The system unit contains two types of memory: volatile and nonvolatile.
- The contents of *volatile memory are lost when* the computer power is turned off.
- *The contents* of nonvolatile memory are not lost when power is turned off.
- RAM is the most common type of volatile memory.
- Examples of nonvolatile memory include ROM, flash memory, and CMOS.
- Below, we discuss these types of memory.

Random Access Memory (RAM)

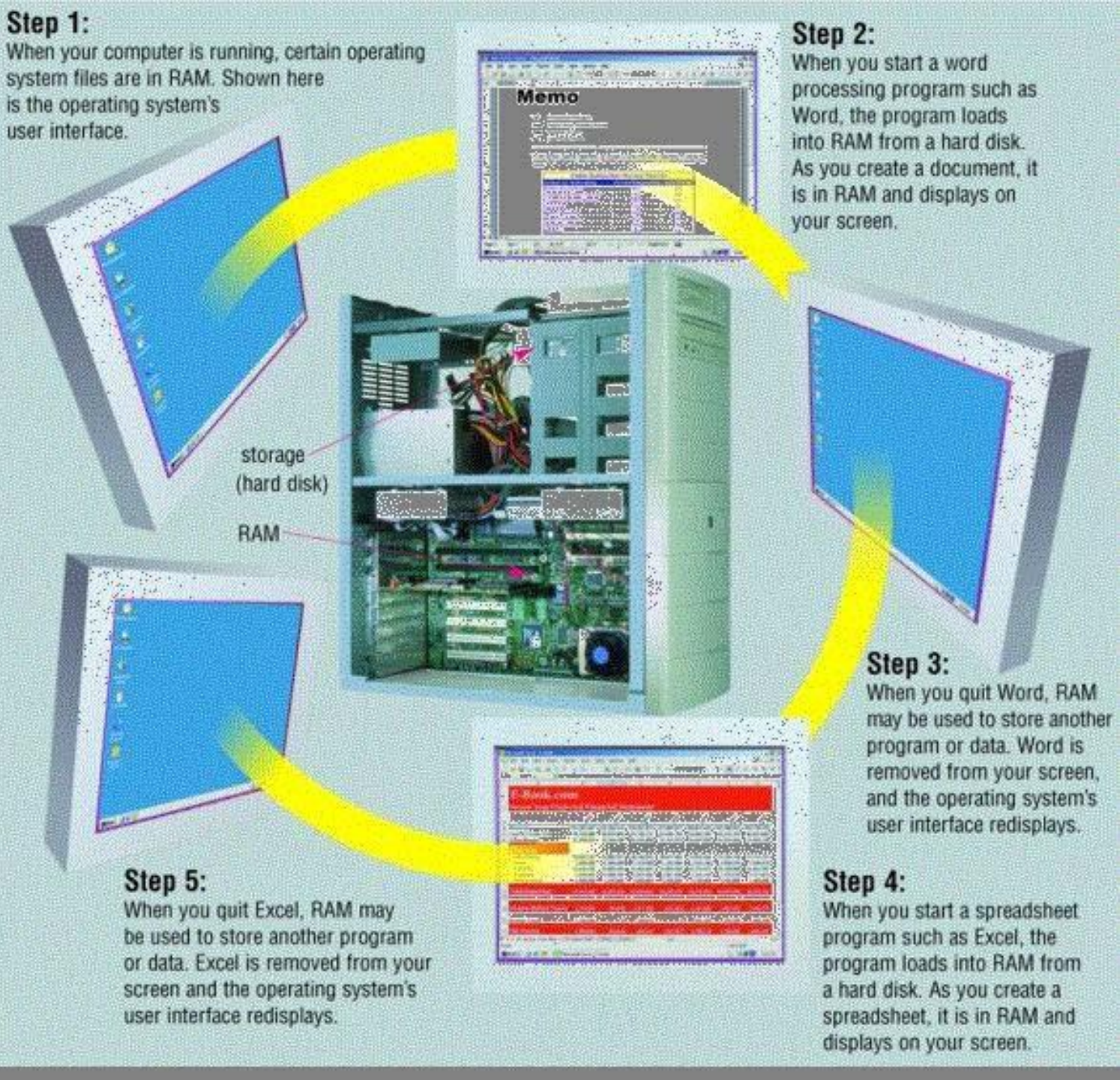
- *Random Access Memory (RAM) is the memory chips that are mounted directly on the motherboard or mounted on peripheral* cards that plug into the motherboard.
- When the computer is powered on, certain files of the operating system are loaded from a storage device such as a hard disk into RAM.
- These files remain in RAM as long as the computer is running
- During the running time, the contents of RAM may change as the program is executed.

RAM chip being inserted into a mother board

The amount of RAM

- The amount of RAM a computer requires often depends on the types of applications you plan to use on the computer.
- This because the more RAM a computer has, the faster the computer will respond.
- RAM in computers purchased today ranges from 128MB, 512MB, 1GB to 64GB.

How program instructions transfer in and out of RAM



Types of RAM

- Dynamic RAM (DRAM) must be refreshed (or recharged) constantly by the CPU.
- Static RAM (SRAM) is faster and more reliable than any form of DRAM. The term static refers to the fact that it does not have to be re-energized as often as DRAM.
- Magneto resistive RAM (MRAM), stores data using magnetic charges instead of electrical charges.
- MRAM has greater storage capacity, consumes less power, and has faster access times.
- Virtual RAM (VRAM): Modern operating systems can use spare storage space on the hard disk as if it is working memory and this is referred to as Virtual memory or Virtual RAM

Read-only memory (ROM)

- *Read-only memory (ROM) refers to memory chips used for storing data and instructions permanently.*
- *That is, the items stored in ROM* **chips cannot be modified hence the name read-only.**
- **ROM is usually nonvolatile i.e its content can not be lost even if the power is (switched off) or removed.**
- **ROM chips that contain permanently written data, instructions, or information are called *firmware.***
- *There fore, Firmware can be read and used, but cannot be changed by user.*

TYPES OF ROM

There are basically three types of ROM, namely;-

- PROM
- EPROM
- EEPROM

1. PROM – Programmable Read Only Memory is a blank ROM chip that can be written to but only once. It is just like a CD-R.

2. **EPROM** – Erasable Programmable Read Only Memory is just like PROM except that it can be erased by using a special ultraviolet light to make it rewritable.
3. **EEPROM** – Electrically Erasable Programmable Read Only Memory is a type of PROM whose contents can be erased electrically to make it rewritable.

- **NB:** EEPROM can be programmed up to 10,000 times. It is also sometimes called flash BIOS which allows users to upgrade their BIOS.

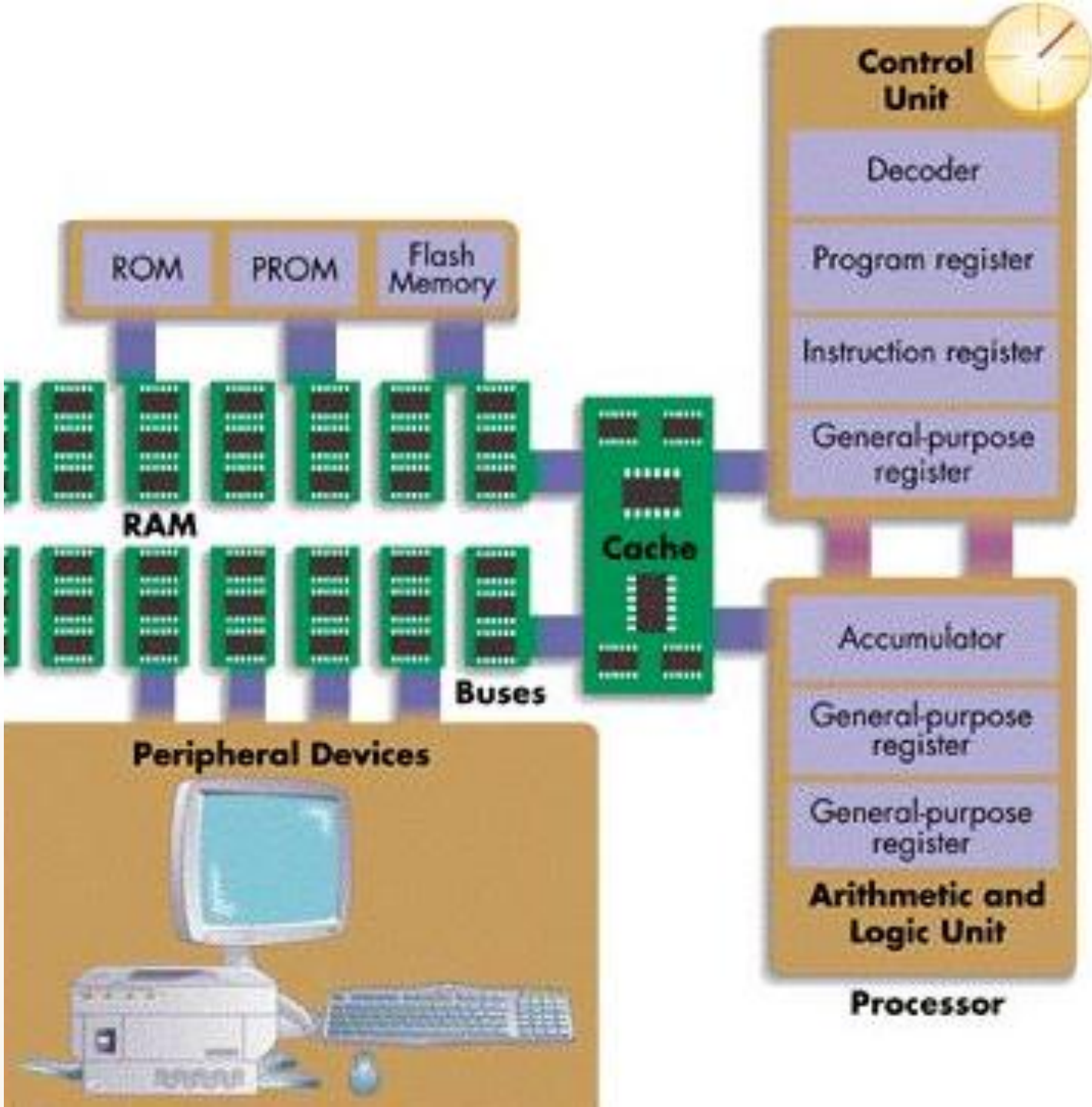
Differences Between RAM and ROM

RAM	ROM
1. Volatile, temporally	1.Non Volatile, permanent
2. Contents lost when power goes off	2. Contents remain when power goes off
3. Read and Write	3. Read Only
4. Can be increased	4. Can't be Increased
5. Not installed at Factory	5. Installed at Factory

Memory cache

- A cache is a relatively small block of very fast memory designed for the specific purpose of speeding up the internal transfer of data and software instructions.
- Cache uses internal storage technologies that are much faster than conventional RAM.
- Cache speeds up processing time because it stores frequently used instructions and data.

The processor first checks cache, then RAM for needed data and instructions



Flash memory

- Flash memory is a chip also that keeps its contents when the power is shut off.
- Flash memory can be erased electronically and reprogrammed.
- Most computers use flash memory to hold their startup instructions because it allows the computer easily to update its contents.

CMOS

- Complementary Metal-Oxide Semiconductor (CMOS) technology provides high speeds and consumes little power.
- CMOS technology uses battery power to retain information even when the power to the computer is off.
- Battery-backed CMOS memory chips, for example, can keep the calendar, date, and time current even when the computer is off.

TOPIC 3:
COMPUTER SOFTWARE

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Unit Objectives

- By the end of the topic we should be able to:
- Define and describe the types/ classifications of software, their definitions with examples.
- Describe the characteristics of computer software

Introduction

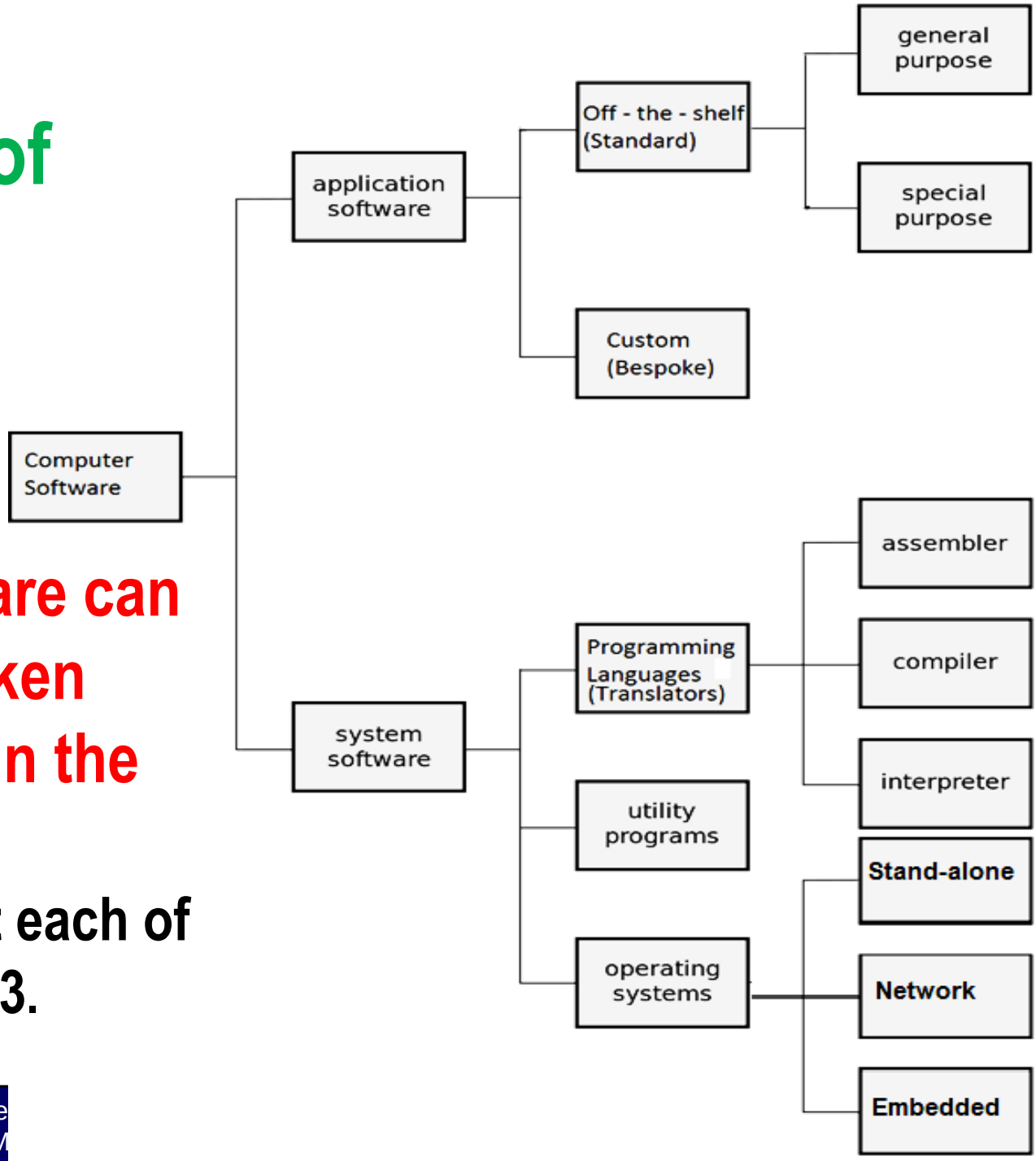
- The usefulness of computer hardware depends alot on available software and the ability of users to evaluate, monitor, and control that software.
- Previously we looked at (The Computer System),and we met the term 'computer software' as one of the components:

- Computer software refers to the set of electronic instructions and procedures that controls the operations of the computer.

- There are two major types of software: system software and application software.
- Each performs a different function.
- System software is a type of software that manages and coordinates all the programs and devices on the computer. e.g. the Operating system
- While Application software is a type of software that solve the exact needs of the user. For example, Word-processors, Paint, Calculator and, Games.

(illustration):system and application software

Types and Classifications of Computer Software



- **Computer software can be generally broken down as shown in the chart below:**
- **NB we shall look at each of these in unit 2 and 3.**

- It should be noted that some people interchangeably use the words: software, program and an application to mean the same, but this is not true.

Factors to consider before obtaining a software program

1. **user-friendliness — the software must be easy to use by users.**
2. **adaptability —the software must be easy to adjust to an ever-changing world.**
3. **reusability — the software must be easily reused to build other software systems.**

4. efficiency — the software must make good use of its resources (e.g memory, disk, CPU, network)
5. portability — the software can be to easily moved to other operating systems.
6. security — the software must protect the information it is responsible for.

Characteristics of a good computer software

- It provides the required functionality.
- It is reliable, dependable and predictable.
- It can be "easily" maintained and updated.
- It has a "life-time" (measured in years).
- It provides an appropriate user interface.
- It is accompanied by complete documentation to guide the user.
- It can be easily customized/configured.

TOPIC 3: COMPUTER SOFTWARE

Unit Two: System Software

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Unit Introduction

- System software is a set of programs that controls or maintains all the operations of the computer and its devices, such as the CPU and peripheral devices.

- System software serves as the interface between the user, the application software, and the computer's hardware.

- **System Software Includes:**
  - **The Operating system.**
  - **Utility Programs and**
  - **Programming Languages**

OPERATING SYSTEMS

- An operating system (OS) is system software that manages computer hardware and software resources and provides common services for computer programs.
- The operating system works as a middleman between the user and the computer, as well as between application software programs and the hardware devices.

Device Drivers

- To communicate with the hardware devices, the operating system relies on device drivers.
- A device driver is a computer program that controls a particular type of device that is attached to a computer.
- Each device on a computer, such as the keyboard, mouse, monitor, printer, card reader/writer, and scanner, has its own device driver.

1. USER
The user instructs the operating system to start an application program.

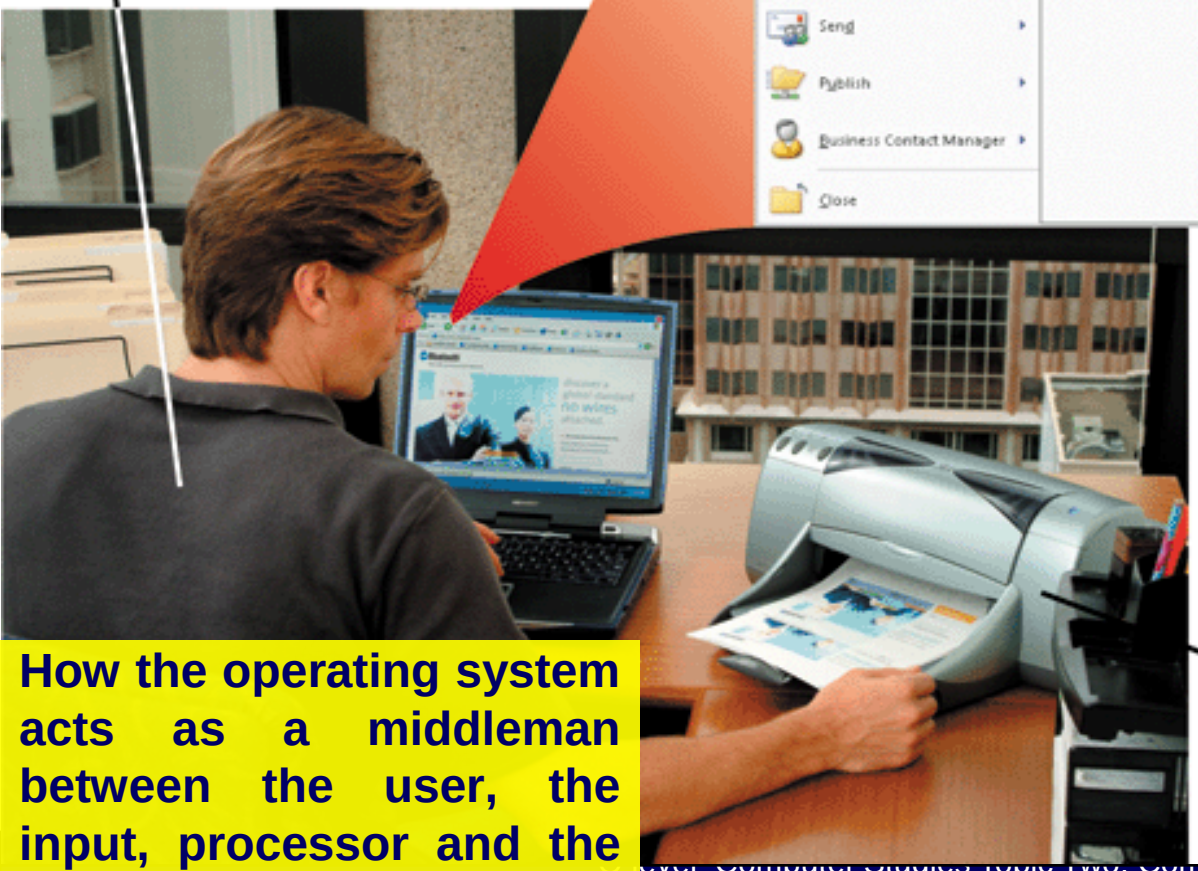
2. OPERATING SYSTEM
The operating system starts the requested program.

3. USER
The user instructs the application program to print the current document.

4. APPLICATION PROGRAM
The application program hands the document over to the operating system for printing.

5. OPERATING SYSTEM
The operating system sends the document to the printer.

6. PRINTER
The printer prints the document.



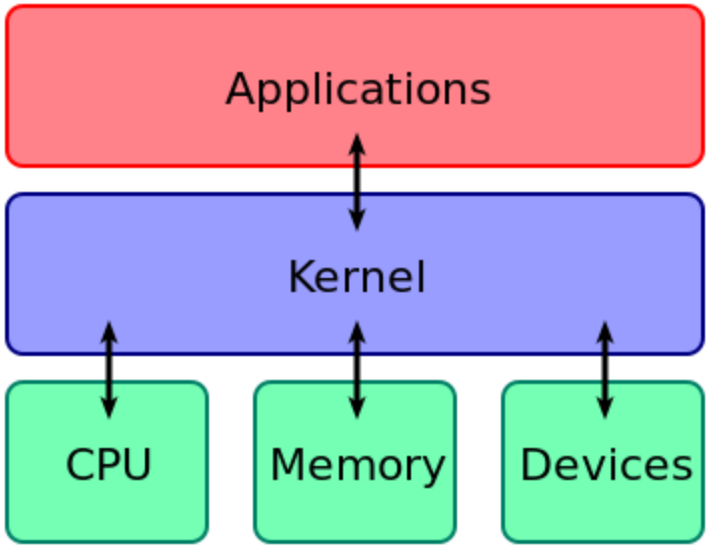
How the operating system acts as a middleman between the user, the input, processor and the output devices

Where does the OS reside?

- On an ordinary computer, the operating system does permanently reside on the hard disk. It is then loaded into memory on boot by the bootloader.
- On handheld computers and many mobile devices such as smart phones, the operating system resides on a ROM chip.

The Kernel of the OS

- The kernel is a computer program that constitutes the central core of the operating system of a computer.
- It has complete control over everything that occurs in the system.



- Each time the computer is switched on, the kernel and other frequently used instructions in the operating system are copied from the hard disk to the computer's RAM

The term 'Software Platform'

- A software platform is a software environment that is used to write applications and run them.
- It includes software tools such as

✓ GUI builders,
✓ Compilers
✓ class libraries
✓ utilities (for developing the applications)
✓ A runtime engine (for executing the applications)

Functions of an Operating System

Most operating systems provide similar functions that are outlined as follows :

a) Starting a computer, (Booting the computer)
b) Providing a user interface,
c) Managing programs,
d) Configuring devices, (Device drivers are often needed). Plug and Play devices are recognized automatically.
e) Monitoring performance
f) Providing file management.
g) Administering security.
h) Managing resources.
i) Coordinating tasks, and Spooling.
j) Managing memory,
k) Establishing an Internet connection

Functions of an Operating System

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Start the computer

Provide a user interface

Manage programs

Manage memory

Operating System Functions

Provide file management and other utilities

Establish an Internet connection

Control a network

Administer security

Monitor performance

Coordinate tasks and configure devices

CATEGORIES / TYPES OF OPERATING SYSTEMS

- There are basically 3 categories of operating systems;-
  - Stand -alone Operating System
  - Network Operating System
  - Embedded Operating System.

TOPIC 3: COMPUTER SOFTWARE

Unit Three: Application Software

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Unit Objectives

- To be able to identify and describe the different types of application software (with examples).
  - Focus on types of application software will be on Off-shelf, Custom-tailored, Shareware, Freeware and Open-source application software.
- Describe the characteristics of application software.
- To be able to explain the uses of application software.

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APPLICATION SOFTWARE

- **Application software are programs designed to perform specific tasks for end-users.**
- **This unit presents an overview of the major types of application software, that end-users depend on as they work with computers, and as they access computer networks.**
- **Today, there are millions of commercial software products that cover a variety of tasks such as:**
  - **making personal and business activities more efficient,**
  - **assisting with graphics and multimedia projects**
  - **supporting household activities,**
  - **Improving education,**
  - **facilitating communications, etc.**

CLASSIFICATIONS OF APPLICATION SOFTWARE

The common Classifications of application software include:

- Off-the-shelf (standard) software,
- Custom (bespoke) software,
- Shareware, Freeware,
- Open-source, Public-domain software,
- Web-based software, copyrighted software,
- Special Purpose and General purpose.

Off-the-shelf software

- This refers to packaged software that is designed to meet the needs of a wide variety of end users.
- Off the shelf software is mass-produced, commercially sold software, and copyrighted.
- Microsoft Office suit and Adobe Photoshop are examples of Off the shelf software.

Custom (bespoke) software

- Custom software is tailor-made software, which is developed at a user's request to perform specific functions.
- Sometimes, when a company cannot find packaged soft-ware that meets its unique requirements, it pays computer programmers to write custom software that is specifically tailored to meet the needs of the company.
- Custom software usually costs more than packaged software.

Comparison of the characteristics Standard and Custom Software

STANDARD SOFTWARE IS…	CUSTOM SOFTWARE IS…
1. Easy to use, because it is known by many people.	1. Unique, and requires extensive training before use.
2. Cheaper because it is massively produced and packaged for commercial purposes.	2. Expensive because it requires hiring a programmer.
3. Easy to acquire because it is already made.	3. Difficult to acquire due to the time needed for programming it.
4. More reliable because it is tried and well tested by many users.	4. May contain programming errors since it is not tested adequately.
5. Containing online help to guide users in case of any problems in use.	5. Usually lacking online help services.
6. Can not be modified or changed to meet unique user requirements.	6. Meets all user requirements and can be edited if need arises.

Copyrighted software

- Copyrighted software is a type of software that is designed with restrictions regarding use, modification, and redistribution.
- You have to pay for copyrighted software and must not copy it without permission from the manufacturer.
- Copying copyrighted software without paying for it is clearly unethical and illegal.

Shareware

- Shareware is copyrighted software that is distributed at no cost for a trial period.
- To use a shareware program beyond that period, you send payment to the program developer.
- In some cases, a scaled-down version of the software is distributed free, and payment entitles the user to the fully functional product.

Freeware

- Freeware is copyrighted software provided at no cost by an individual or a company that retains all rights to the software.
- Therefore, other programmers cannot include freeware in applications they intend to sell.

Open-source

- Open source software is a software provided without restrictions regarding use, modification, and redistribution.
- This software has no restrictions from the copyright holder.
- Open source software usually can be downloaded from the Web at no cost.

Public-domain software

- **Public-domain software** is a software that has been donated for public use and has no copyright restrictions.
- **Anyone can copy or distribute public-domain software to others at no cost.**

Web-based software

- Web-based software refers to programs hosted by a Web site.
- Users access and interact with Web-based software from any computer or device that is connected to the Internet.
- Many Web sites allow free access to their programs while some charge a fee.
- Examples of Web-based software include e-mail, Website builders, online games, travel and mapping software ,e.t.c.

Special Purpose (Specialized) Software

This refers to computer programs developed and dedicated to accomplish particular jobs only. Programs that run on special purpose computers like ATMs are special purpose softwares.

Other Examples of specialized software include:

- Business Transaction and Sales Management software.
- Science and Engineering software etc..

General purpose software

- This refers to a Wide variety of application programs that perform many common tasks.
- Varieties of General purpose application programs include Word processing programs, Spreadsheet programs, web browsers, Graphics programs, etc.

SOFTWARE SUITES

- A software suit is a collection of individual application soft-ware programs sold as a single package.
- When you install the suite, you install the entire collection of applications at once instead of installing each application individually.

- **The best examples of software suites are;**

➢ **Microsoft office – which typically include software applications like**

- word processing
- Spreadsheet
- Database
- Presentation graphics

➢ **Adobe photoshop**

POPULAR SOFTWARE SUITES

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SUITE NAME	Word Processor	Spreadsheet	Presentation Program	Database Management Software
Lotus Smart Suite	Lotus Word Pro	Lotus 1-2-3	Lotus Freelance Graphics	Lotus Approach
Microsoft Office	Microsoft Word	Microsoft Excel	Microsoft PowerPoint	Microsoft Access
KOffice	KWord	KSpread	KPresenter	Kexi
OpenOffice.org	OpenOffice.org Writer	OpenOffice.org Calc	OpenOffice.org Impress	OpenOffice.org Base
WordPerfect Office	WordPerfect	Quattro Pro	Corel Presentations	Corel Paradox

Celframe Office	Celframe Write	Celframe Spreadsheet	Celframe Power Presentation	Celframe Data Access
Ability Office	Ability Write	Ability Spreadsheet	Ability Presentation	Ability Database
Kingsoft Office	Kingsoft Writer	Kingsoft Spreadsheets	Kingsoft Presentation	(None)
Apple iWork	Apple Pages	Apple Numbers	Apple Keynote	(None)

Advantages of using software suites

- Costs significantly cheaper than buying each of the application package separately.
- Easy to learn and use because applications within a suite usually use a similar interface and share common features such as clip art and toolbars.
- Easy to install because all the various applications can be installed at once.

Learning Aids and Support Tools for Application Software

- To assist in the learning process, many programs provide off line Help, Web-based Help, wizards, and templates.
- Off line Help is the electronic equivalent of a user manual. It usually is integrated in a program. In most programs, the F1 key or a button on the screen starts the Help feature.
- Web-based Help provides updates and more comprehensive resources to respond to technical issues about software.

- A **wizard** is computer program that guides a user through a procedure of completing a task. The wizard asks the user questions and then automatically performs actions based on the responses.
- For example, spreadsheet software includes wizards for creating charts and building functions.
- A **template** is a document that contains the layout and formatting necessary for a specific document type.
- For example Word processors contain templates for, cover sheets, flyers, letters, resumes/CVs, etc..

END OF TOPIC THREE: COMPUTER SOFTWARE

NEXT TOPIC:
TOPIC FOUR: WORD PROCESSING