

# مِبادئ علوم الحاسوب Principles of Computer

ح 101، حسب

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أستاذ مشارك

قسم علوم الحاسوب

محاضرة 1#

# **Course Objectives:**

The course designed to achieve the following objectives:

- Introduce the student with main concepts of computer, how it has been developed and its applications.
- Introduce the student with the concepts of algorithms, and to think logically for solving mathematical and other problems.
- Introduce the student with main concepts of computer, programming languages and how it can be used in solving some of the real world (daily life) problems.

# المحتوى المقرر Course Content

The course designed to cover the following topics (content):

# Course Content

1- مقدمة

2- نظام الحاسوب Computer System

1.2 عتاد الحاسوب computer Hardware

2.2 برمجيات الحاسوب Computer Software

3- شبكات الحاسوب computer Networks

4- نظام الأعداد Number System

5- الخوارزميات Algorithms

6- مفاهيم البرمجة ولغة C++ Programming Concepts and C++ Language

## المراجع : References

- - HOW COMPUTER WORK by RON WHITE
- - [http://www.karbosguide .com](http://www.karbosguide.com)
- عالم الكمبيوتر، مصطفى زايد
- مدخل الحاسب الآلي ونظم المعلومات، أسامة محمد محي الدين

# Course Evaluation

**Course will be evaluated based on the following:**

- **Course works:**
  - Assignments & Quizzes (15 – 20)%
  - Midterm Exam (15 – 20)%
- **Final Exam (60 – 70)%**

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- **Total 100%**

# الساعات المكتبية Office hours

الثلاثاء 1-3 (مقترن)

# introduction

تعريف الحاسوب

تاريخ الحاسوب

أجيال الحاسوب

صفات الحاسوب

محدودية الحاسوب

أنواع الحاسوبات

تطبيقات الحاسوب

# A World of Computers

## What is computer literacy?

- is defined as the **knowledge** and **ability** to use computers and related technology efficiently, with a **range of skills** covering levels from elementary use to programming and advanced problem solving.



# Computer Definition

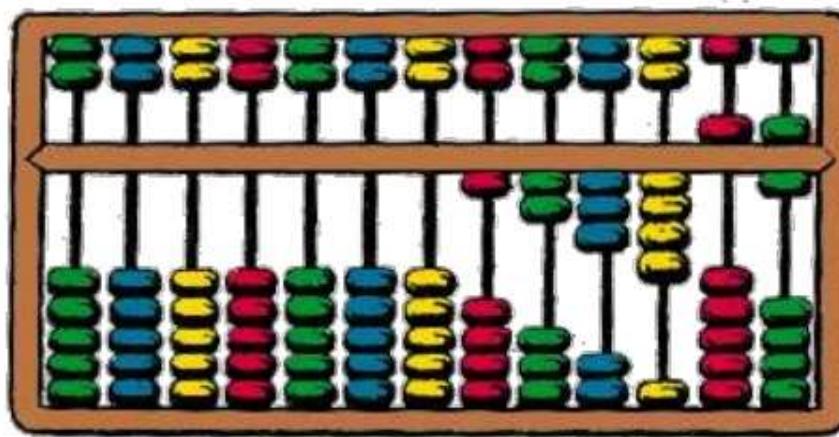
تعريف الحاسوب

- Computer is an electronic device that can accept input data, process data, store data and produce output according to set of instructions /program.

# تاریخ الحاسوب Computer History...

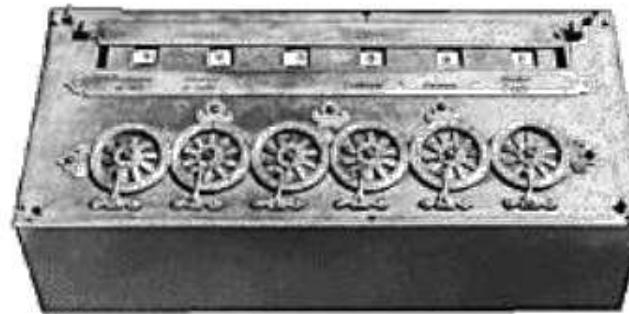
## Counting aids:

- The history of computers starts out about 2000 years ago in **Babylonia** (Mesopotamia), at the birth of the **abacus**, a simple calculator,a wooden rack holding two horizontal wires with beads strung on them.



# تاریخ الحاسوب ... Computer History...

- In 1642 French scientist and philosopher Blaise Pascal invented the first practical mechanical calculator, the Pascaline to help his tax-collector father do his sums. .



# تاریخ الحاسوب ... Computer History...

- In 1671, German mathematician and philosopher Gottfried Wilhelm Leibniz came up with a similar but more advanced machine.
- The Leibniz machine could do much more than Pascal's: as well as adding and subtracting, it could multiply, divide, and work out square roots.
- Another pioneering feature was the first memory store or "register."

# تاریخ الحاسوب ... Computer History...

## Programmable calculator (Engines of calculation):

- Charles Babbage is considered to be the father of modern digital computers.
- He designed “Difference Engine” in 1822.
- He designed a fully automatic analytical engine in 1842 for performing basic arithmetic functions.
- His efforts established a number of principles that are fundamental to the design of any digital computer.

# تاریخ الحاسوب ... Computer History...

- The Z1, originally created by Germany's **Konrad Zuse** in his parents' living room in 1936 to 1938 and is considered to be the first electro-mechanical binary programmable (modern) computer and really the first functional computer.
- In 1946 John Mauchly and J. Presper Eckert invented the world's first fully electronic, general-purpose, digital computer --Electronic Numerical Integrator And Calculator (ENIAC)

# تاریخ الحاسوب ... Computer History...

- By 1974, Intel had launched a popular microprocessor known as the 8080 and computer hobbyists were soon building home computers around it.
- The first was the MITS Altair 8800, built by Ed Roberts.
- From this time processor based modern computers evolved largely.

# Computer Generations

## 1<sup>st</sup> Generation (1940-1956)

## الجيل الأول

The first generation of computers used the technology of vacuum tubes for circuitry. The features of these computers are:

- Very big, very heavy (about 30 tons)
- Very expensive to be manufactured
- Using a great deal of electricity, therefore generating a lot of heat, cause of failure
- Very hard to program (machine language)
- Solve one problem at a time
- Input based on punched cards and paper tape
- Output displayed on printout

The **ENIAC** (Electrical Numerical Integrator And Computer) is an instance of computer first-generation, ENIAC field of application includes:

- Weather prediction
- Atomic-energy calculations
- Random-number studies
- Other scientific uses



# ENIAC Computer

The second generation computers used the technology of transistors instead of vacuum tubes. The features of these computers are:

- smaller, less heavier
- cheaper to be manufactured
- Using less electricity, and then more reliable
- Generating a great deal of heat, which was often the cause of computer damage
- Using assembly language instead of machine language
- Starting development of high level language (COBOL)
- Input based on punched cards and paper tape
- Output displayed on printout
- developed for the atomic energy industry.

## 3<sup>rd</sup> Generation (1964-1971)

This generation of computers used the technology of integrated circuit, where transistors were minimized and placed on silicon chips . The features of these computers are:

- Very fast
- Smaller and more cheaper to be manufactured
- Users interact through keyboards and monitors instead of punched cards and printouts
- Executed many different applications at one time
- Using the disks for data store
- Development of other high level languages

The fourth generation of computers used the technology of large (wide) integrated circuit, where thousands of integrated circuits were built onto a single silicon chips, it is known as a microprocessor.

-Computers move into many areas of life as more and more everyday products began to use microprocessors (PCs)

The technology of this generation which, computers based on is the use of artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today.

# Characteristics of Computer صفات الحاسوب

- 1. Speed:** The speed of a computer in processing information is increasing from time to time and computers can calculate at very high speed.
- 2. Accuracy:** The accuracy of a computer system is very high provided that the data and the program given to it are accurate.
  - Error in computer data processing is mostly human factor. The program may be wrongly coded or the data may be wrongly entered.

## Characteristics of computer...

3. **Storage:** Computers can store large amount of data using their memory unit
4. **Versatility:** Computers can be programmed and applied for different purposes. People can use computers for different applications.
5. **Diligence:** The computer does the same thing repeatedly without saying “I am tired or I am bored”.

# Limitations of Computer

محدودية الحاسوب

## ➤ No I.Q:

- A computer is a machine that has no intelligence to perform any task.
- Each instruction has to be given to computer.
- A computer cannot take any decision on its own.

## ➤ Dependency

- It functions as per a user's instruction, so it is fully dependent on human being

## ➤ Environment

- The operating environment of computer should be dust free and suitable.

## ➤ No Feeling

- Computers have no feelings or emotions.
- It cannot make judgment based on feeling, taste, experience, and knowledge unlike a human being.

# أنواع الحاسوب

# Types of Computers

## Criteria's:

- Based on the operational principle(hardware structure and the way physical quantities are represented in a computer)
- Based on their processing power, cost and size

## Types of Computers...

- Based on the operational principle, computers can be classified into three categories:
  1. Analog computer
  2. Digital computer
  3. Hybrid computer

# الحسابات القياسية

## Analog Computers

- Analog computers are used to process analog data.
- Analog data is of continuous nature and which is not discrete or separate such as temperature, pressure, speed weight, voltage, depth etc.
- Utilize mechanical or electrical energy to operate.
- Analog computers are the first computers being developed and provided the basis for the development of the modern digital computers.

## Analog Computers...

- Analog computers are widely used for certain specialized engineering and scientific applications, for calculation and measurement of analog quantities.
- These computers are ideal in situations where data can be accepted directly from measuring instrument without having to convert it into numbers or codes.  
Examples: The Speedometer of a car measures speed, the change of temperature is measured by a Thermometer, etc.

# Digital Computers

الحسابات الرقمية

- They use digital circuits and are designed to operate on two states, namely bits 0 and 1. They are analogous to states ON and OFF.
- Data on these computers is represented as a series of 0s and 1s.
- Digital computers are suitable for complex computation and have higher processing speeds.
- They are programmable.

# Digital Computers...

- Digital computers are either special purpose computers or general purpose ones.
- Special purpose computers, as their name suggests, are designed for specific types of data processing while general purpose computers are meant for general use.
- Most of the computers available today are digital computers.
- The most common examples of digital computers are accounting machines and calculators.
- Analog computers lack digital memory where as digital computers store information.

# Digital Computers...

Examples:

- IBM PC
- Apple Macintosh
- Digital calculators
- Digital watches etc

# Hybrid Computers

- These computers are a combination of both digital and analog computers.
- In this type of computers, the digital segments perform process control by conversion of analog signals to digital ones.
- Hybrid computers for example are used for scientific calculations, in defense and radar systems.

## Hybrid Computers...

- For example a petrol pump contains a processor that converts fuel flow measurements into quantity and price values.
- In hospital Intensive Care Unit (ICU), an analog device is used which measures patient's blood pressure and temperature etc, which are then converted and displayed in the form of digits.
- Radar systems are another example.

# Types of Computers...

- Based on their processing power (speed), cost and size computers can be classified into 4 types:
  - a) Micro computers
  - b) Minicomputers
  - c) Mainframe computers
  - d) Super computers

# الحاسبات الدقيقة/الشخصية

# 1. Micro/Personal computers

Desktop



Laptop/notebook



PALMTOP

PDA (PERSONAL DIGITAL ASSISTANT)

(The smallest classification of computers)

# Are iPads computers? How about iPods?



# الحاسبات الصغيرة

## 2. Minicomputer

- Minicomputers are also called mid-range systems or workstations.
- They contain one or more microprocessors.
- Mini computers can be used to handle the processing for many users simultaneously who are connected via terminals.
- Used in different software application development.
- **Examples:**
  - ✓ IBM AS/400
  - ✓ IBM SYSTEM 360
  - ✓ HP 3000
  - ✓ PRIME 9755



## 3. Mainframe computers

- Mainframes are data processing system employed mainly in large organizations for various applications, including bulk data processing, process control, industry and consumer statistics, and financial transaction processing.
- Mainframes typically cost several hundred thousand dollars.
- They are used in situations where a company wants the processing power and information storage in a centralized location.



## Mainframe computers...

- A mainframe computer may contain several microprocessors.
- A single mainframe computer can be used by hundreds of people at once.
- A mainframe computer system is usually composed of several computers in addition to the mainframe, or host processor.

Examples:

- IBM S/390
- Amdahl 580
- Control Data Cyber 176

## 4. Super computers

- are the largest, fastest, most powerful, and most expensive computers made.
- are used for extremely calculation-intensive tasks such simulating nuclear bomb detonations, aerodynamic flows, and global weather patterns.
- Use multiple processors
- cost several million dollars



# **Super computers...**

## **Features:**

- The aerospace, automotive, chemical, electronics and petroleum industries use supercomputers extensively.
- Supercomputers are used in weather forecasting.
- The ultra supercomputer will simulate nuclear explosions (eliminating the need to explode any bombs).
- Supercomputers can perform at up to 128 gigaflops, and use bus widths of 32 or 64 bits. This capability makes supercomputers suitable for processor-intensive applications, such as graphics.

# **Super computers...**

## **EXAMPLE:**

- ✓ Cray-1
- ✓ Cray-2
- ✓ Control Data Cyber 205
- ✓ ETA

# Applications of Computer

# تطبيقات الحاسوب

➤ The various applications of computers in today's arena include:

- ✓ Home
- ✓ Health Care
- ✓ Business
- ✓ Banking
- ✓ Insurance
- ✓ Education
- ✓ Marketing
- ✓ Engineering Design
- ✓ Military
- ✓ Communication
- ✓ Government

## In HealthCare

- To keep the record of patients and medicines.
- Used in scanning and diagnosing different diseases.
- ECG, Ultrasounds and CT Scans etc., are also done by computerized machines.

## In HealthCare...

- Some major fields of health care in which computers are used are:
  - **Diagnostic System** - Computers are used to collect data and identify cause of illness.
  - **Lab-diagnostic System** - All tests can be done and reports are prepared by computer.
  - **Patient Monitoring System** - These are used to check patient's signs for abnormality such as in Cardiac Arrest, ECG etc.
  - **Pharmacy Information System** - Computer checks Drug-Labels, Expiry dates, harmful drug's side effects etc.
  - **Surgery** : Nowadays, computers are also used in performing surgery.

*Computer*

*System*

نظام الحاسوب

# Computer System

Computer system consists of two parts:

1. Computer Hardware
  - A generic name for the various devices that make up a computer system
2. Computer Software
  - Set of instructions that direct the computer hardware to perform a particular task

Computer

Hardware

عتاد الحاسوب

## Hardware

三

العدد

- Any visible part of a computer which can be seen and touched is known as hardware.
  - Hardware components are involved in the data processing cycle as an input, output or as both.
  - On data processing cycle, there are hardware devices used to enter data which are known as **input devices** and other hardware devices used to display the information are known as **output devices** but there are also devices used as both input and output devices.
  - Moreover others are involved in the processing cycle such as CPU, RAM, ROM.

# Hardware Components مكونات العتاد

1. **Input Unit** – feeds data & instruction to the computer system
2. **Output Unit** – displays / prints the results of the processing
3. **CPU** – is the brain of the computer that carries out the processing of the data as per the instructions
4. **Memory** – stores data and programs within and/or outside the computer system
5. **Power supply** – used to convert AC into DC and provide appropriate power for each of internal components of a PC.

# Input Devices

وحدات الادخال

- **Input** is all information put into a computer.
- Input can be supplied from a variety of sources:
  - A person
  - A storage device on computer
  - Another computer
  - A peripheral device
  - Another piece of equipment, such as a musical instrument or thermometer

# Input Devices...

- Input devices gather and translate data into a form the computer understands.
- Primary input devices:
  - **Keyboard** - Most common input device; used to type in commands and data.
  - **Mouse or trackball:** enhances user's ability to input commands, manipulate text, images.

# Input Devices...

- **Scanners:** are peripheral input devices which allow users to import:
  - Text
  - Graphics
  - Images
- Specialized software aids in translating information into a format the computer can understand and manipulate.

# Input Devices...

- **Digital Cameras:** are peripheral input devices that allow users to create pictures and/or movies in a digital format.
  - Some require specialized software to import images into the computer.
  - Some record digital images directly to a disk that can be read by the computer.

# Some input devices

- Mouse
- Keyboard
- Scanner
- Touch pad
- Light pen
- Joysticks
- Microphones
- Digital Cameras
- Touch Screen
- Bar Code Reader
- Trackball
- CD-ROM



# وحدات الإخراج

# Output Devices

- Used to display processed information to the user either in **softcopy** or **hardcopy**
- Soft copy** – output displayed on a computer screen. It is the primary output medium.
  - E.g. Monitor, speaker, LCD projector
- Hard copy** – output produced on paper or micro film.
  - E.g. Printers, plotters, ...

# Output Devices...

- **Monitors:** are the most commonly used output device.
- Most monitors use a **bitmap** display.
  - Allows user to resize the display.
  - Divides the screen into a matrix of tiny square “dots” called **pixels**.
  - The more “dots” a screen can display, the higher the **resolution** of the monitor.

# Output Devices...

- Monitors are connected to a computer system via a port integrated on the **video adapter** or **graphics card**.
- Graphics cards convert digital data output from software to analog data for display on monitors.

# Output Devices...

## Printer

- Most widely used output devices to prepare printed paper documents
- There are **Impact** and **Non-impact printers**
- **Impact printers**
  - Form characters by striking an inked ribbon with hammers against paper
    - E.g. **Dot matrix printers & ink printers**



Ink-jet printer



Dot matrix printer

# Output Devices...

- **Non-impact printers:**
  - Form characters without physical contact between a printer and paper
    - E.g. Laser jet printers

## Plotters

- capable of drawing complex shapes with multiple colors

# Output Devices...

- VDU
- Flat screen monitors
- Printer
- Plotters
- Speakers
- Headphone
- Projectors

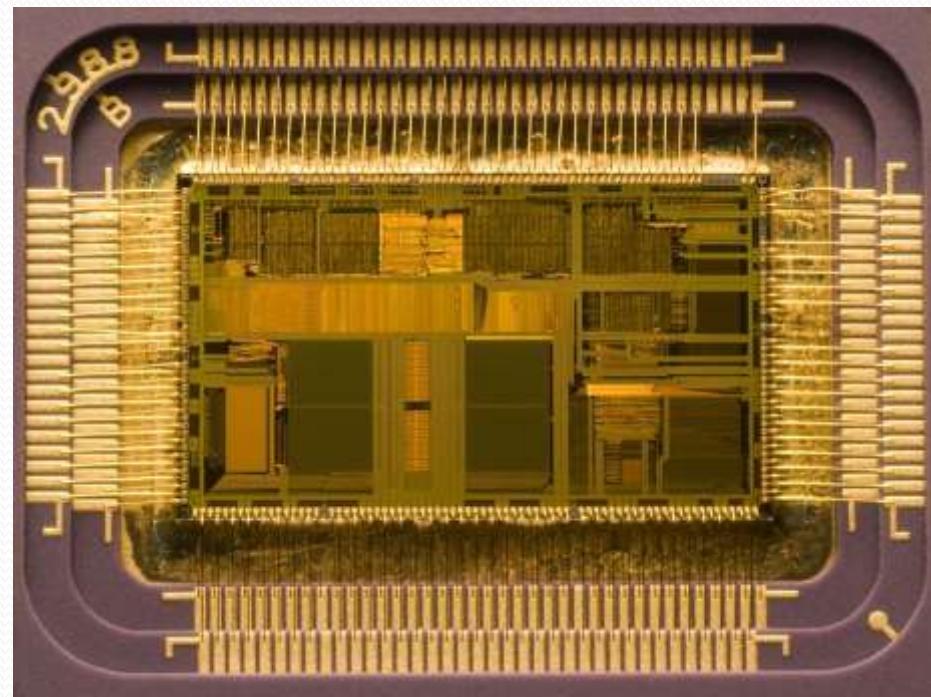


# Central Processing Unit

وحدة المعالجة المركزية

- CPU or microprocessor is often described as the brain of a computer.
- CPU is an integrated circuit or “chip” which processes instructions and data.
- It is the place where data processing takes place
- The system's memory also plays a crucial role in processing data.
- Both the CPU and memory are attached to the system's motherboard, which connects all the computer's devices together, enabling them to communicate.

# A typical processor can be shown as



# CPU Speed

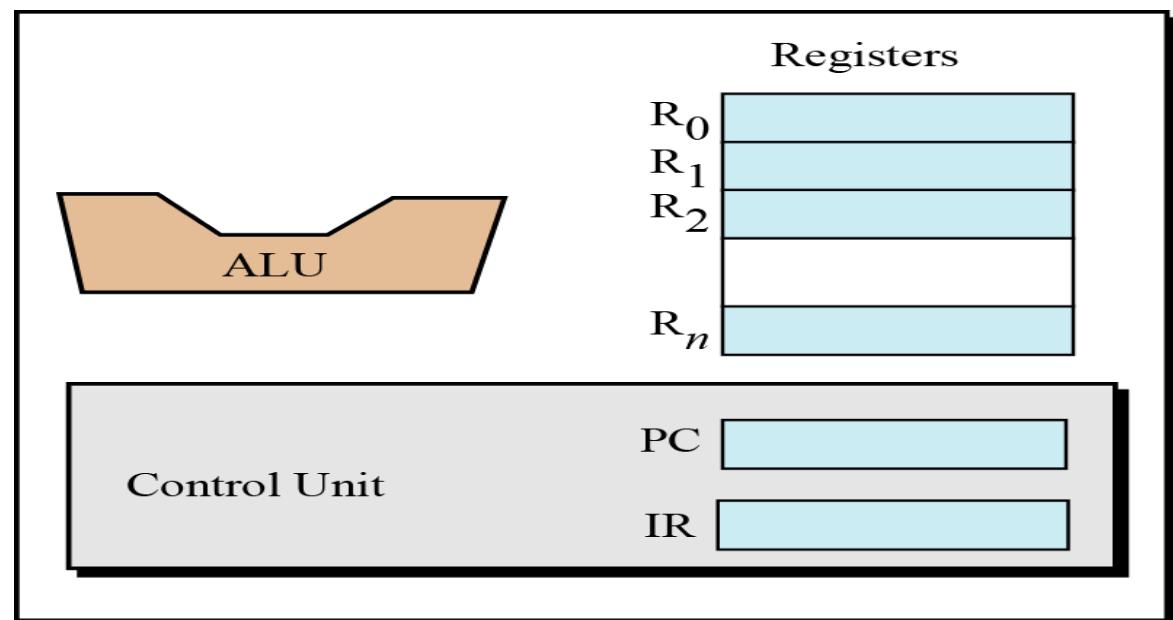
- CPU speed is measured by the number of completed **instruction cycles** per second
  - Currently, CPU speeds range from 600 megahertz (MHz or million cycles per second) to 4 gigahertz (GHz or billion cycles per second).
- Always check new software's requirements for CPU type and speed before purchasing.

# Main parts of CPU

- Arithmetic and Logical Unit (ALU)

- The control unit

- Registers



Central Processing Unit (CPU)

# The Control Unit

وحدة التحكم

- Controls the entire operation of the computer.
- Directs the flow of data through the CPU, and to and from other devices.
- The control unit stores the CPU's microcode, which contains the instructions for all the tasks the CPU can perform.

# The Arithmetic Logic Unit

## وحدة الرياضيات والمنطق

- The actual manipulation of data takes place in the ALU.
- Performs the arithmetic operations and the logical comparisons
- Controls the speed of calculations;
  - Larger & powerful computers speed are measured in:
    - ✓ Pico seconds
    - ✓ Nano seconds, etc.

# Registers

المُسْجَلَات

- A special storage location within CPU which temporarily hold data and program instructions while they are being processed.
- Small amount of very fast memory built in CPU
- Registers are normally measured in the number of bits, 8, 32, 64. It means it can store 8, 32 and 64 bits of data respectively.
- Both the **ALU** and **control units** are connected to registers, such that to execute an instruction the control units retrieves data from main memory and places it into a register and after processing the results are stored in register.

# Bus

- Refers to an electronic highway through which information are transmitted between the various components
- A bus(transmission path) is a path between the components of a computer. Data and instructions travel along these paths.
- Different types of bus
  - Data bus
  - Address bus
  - Control bus

# Bus...

- The bus width determines how many bits can be transmitted between the CPU and other devices.
- A 64 bits wide bus carries 8 characters at a time
- The wider the data bus the more data it can carry at one time

# Computer Memory

## ذاكرة الحاسوب

- Computer memory refers to devices that are used to store data or programs (sequence of instructions) on temporary or permanent basis.
- You can store data on your hard disk, that used to store data permanently, while data which is being processed is stored in RAM (Random Access Memory)

# How computer memory is measured?

- **Bit:** 1 or 0 level of storage
- **Byte:** A byte consists of eight bits.
- **Kilobyte:** A kilobyte (KB) consists of 1024 bytes.
- **Megabyte:** A megabyte (MB) consists of 1024 kilobytes, approximately 1,000,000 bytes.
- **Gigabyte:** A gigabyte (GB) consists of 1024 megabytes, approximately 1,000,000,000 bytes.
- **Terabyte:** A terabyte (TB) consists of approximately 1,000,000,000,000 bytes.

# Types of Computer Memory

- Computer memory or storage devices are classified into two broad categories:
  - i. Primary memory / storage
    - ✓ Internal storage
    - ✓ RAM and ROM and Cache
  - ii. Secondary memory / storage
    - ✓ External storage
    - ✓ CD / DVD, Hard disk, floppy disk, magnetic tape

# **Primary Memory**

Two types of primary memory:

- Main memory (RAM):
  - ✓ The main working area of the computer
  - ✓ The CPU can utilize only those instructions and data that are stored in main memory
- ROM:
  - ✓ Stores small programs permanently

# RAM

# ذاكرة الوصول العشوائي

- Stands for Random Access Memory
- “Waiting room” for computer’s CPU.
- Working place of computer used to store data temporarily.
- Holds instructions for processing data, processed data, and raw data.
- The amount of RAM in a PC has a direct impact on the system's speed.

# RAM...

- The more RAM a PC has, the more program instructions and data can be held in memory, which is faster than storage on disk.
- Ram is measured by:
  - Capacity (in Megabytes or Gigabytes)
  - Speed (in Nanoseconds)

# RAM...

- All software applications will have RAM specifications listed on their packaging.
- Many applications list both a **minimum** and a **recommended** amount of RAM necessary to run the software.
- Be cautious about buying software for a system based on minimum requirement.

# ROM

# ذاكرة القراءة فقط

- **R**ead **O**nly **M**emory (ROM) as the name suggests is a special type of memory chip which holds software which can be read but not written to.
- A good example is the ROM-BIOS chip, which contains read-only software.
- Often network cards and video cards also contain ROM chips.

The main program stored on the ROM called  
**"Basic Input Output System (BIOS)".**

**The BIOS perform the following tasks:**

- Computer automatic detection.
- Startup (booting up) the system, upload & operate the operating system.
- Basic input and output operations.
- Enable changing system setup.

# Comparison

<b>RAM</b>	<b>ROM</b>
<ul style="list-style-type: none"><li>• Volatile</li><li>• Working area of computer (stores data and program code needed by the CPU)</li><li>• Allows both read and write</li></ul>	<ul style="list-style-type: none"><li>• Non-volatile</li><li>• Permanently stores programs</li><li>• Allows read only</li></ul>

# **Cache Memory**

# **الذاكرة المخبأة**

**It is the storage device that is fixed inside the CPU and act as a mediator between the CPU and the RAM to increase the execution speed.**

**CPU call all data and instructions need to be processed and store it temporary in the Cache Memory.**

# Secondary Storage Devices

## وحدات التخزين الثانوية

- Storage devices designed to retain data and instruction in a more permanent form.
- Non-volatile storage media.
- **Capacity** and **speed** are important considerations when selecting a new storage device for a PC.
- Currently used ones:
  - hard disks,
  - floppy disk,
  - optical disk (CD)
  - Versatile disk (DVD)
  - Flash disk

# Storage Technology

تقانة التخزين

- **Magnetic storage devices** store data by magnetizing particles on a disk or tape.
- **Optical storage devices** store data as light and dark spots on the disk surface.

# Magnetic storage devices

## وحدات التخزين المغناطيسية

### Hard Disks:

- Capacity is measured in gigabytes(GB) or Terabytes(TB).
- Typically permanently installed.
- Used to store operating system, application software, utilities and data.

### Exercise:

What is Hard Disk Drive?

# Magnetic storage devices..

## Internal Hard Disks:

- Store all your files and folders permanently.
- **Speed:** Very fast. The speed of a hard disk is often quoted as “average access time” speed, measured in milliseconds. The smaller this number, the faster the disk is.
- **Capacity:** Enormous, Measured in Gigabytes Terabytes.
- **Cost:** cheapest way of storing data.

# Magnetic storage devices...

## External Hard Disks:

- Another type of hard disk is an external hard disk that is placed outside the computer.
- This is helpful for computers that have no space inside the cabinet for installing extra hard drive.
- A big advantage of this type of drive is that backup of data is easier.
- **Speed:** Normally slower than internal disks, but more expensive than internal disks.
- **Capacity:** Same as internal disks.
- **Cost:** More expensive than internal disks.

# Magnetic storage devices...

## Floppy Disks:

- Capacity is 1.44 to 2.0 megabytes (MB or millions of bytes).
  - Storage device with the smallest capacity
  - Most portable storage media

## Exercise

What is Floppy Disk Drive?

# **Magnetic storage devices...**

## **Magnetic Disk /Tape:**

- Generally used for system backups, becoming less common.

**Exercise:**

**What about Flash Disk?**

# Optical storage devices

## وحدات التخزين الضوئية

### CD-ROM Drives:

- Typically installed on all new computer systems.
- Used to read data from CD and write data to a CD by a laser.

### CD:

- ✓ Used to store data and programs.
- ✓ Capacity is 600 to 750 MB .
- ✓ Most mass-produced commercial software is packaged on a CD.

# **Optical storage devices...**

## **DVD drives:**

- Used to read data from the DVD and write data to the DVD by laser.
- Can also read CDs, now more common as a standard device on new computer systems.

## **DVD:**

- ✓ Store large amount of data.
- ✓ Capacity is 4.7GB.

# **Exercise**

- **List and discuss the common types of CD?**
- **List and discuss the common types of DVD?**

**To be submitted next class**

# Mother Board

اللوحة الأم/الأساسية

It is very important hardware parts.

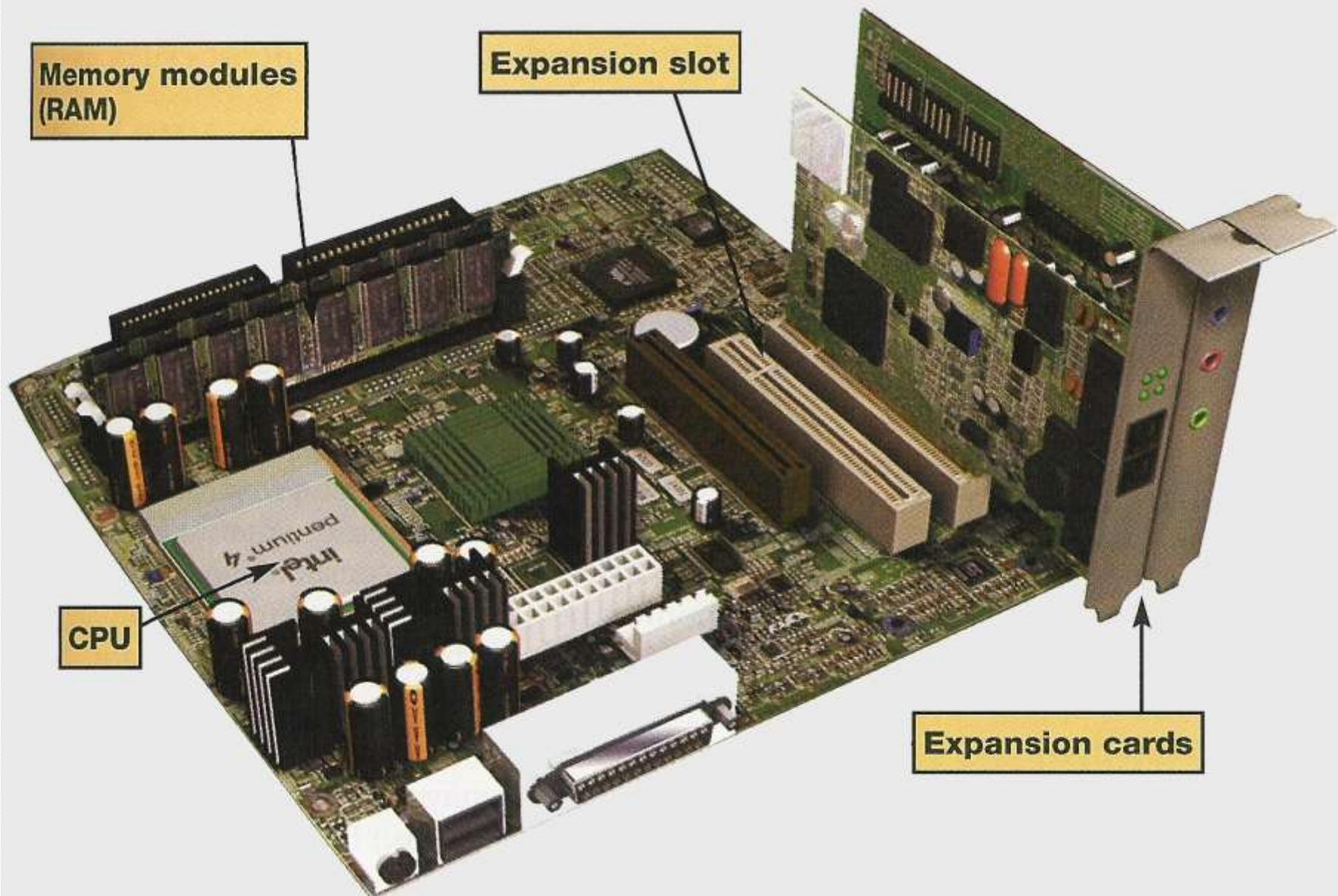
In order for All computer components

to work properly they should be

connected to the mother board. It also

known as the main board.

# Computer Main board (Motherboard)



# **Other Cards (Hardware)**

A computer card is an expansion device that provides an existing computer with certain added capabilities. What these capabilities are depends of course on the computer card. Always card are fixed to the main board

**Types of Cards:** Different type of cards, such as

- Sound Card
- TV Card
- Network Card
- Modem Card