A. Binary – to – Hexadecimal conversion:

4-bit groups, starting at the right-most bit.

***Example*(17)**: **$(1100101001010111)_2$ =======$(CA57)_{16}$**

1100	**1010**	**0101**	**0111**
C	**A**	**5**	**7**

B. Hexadecimal – to – Binary Conversion:

***Example (18)*: $(10A4)_{16}$=========$(1000010100100)_2$**

1	**0**	**A**	**4**
0001	**0000**	**1010**	**0100**

C.*Hexadecimal – to –Decimal Conversion:*By two method

*** First method:**

***Example (19)*:** $(A85)_{16}$====$(2693)_{10}$

1- Convert to binary number.

2- Convert from binary number to decimal number.

A 8 5

1010 1000 0101 =

$2^{11}*1+2^{10}*0+2^9*1+2^8*0+2^7*1+2^6*0+2^5*0+2^4*0+2^3*0+2^2*1+2^1*0+2^0*1=$

$2^{11}+2^9+2^7+2^2+2^0=2048+512+128+4+1=2693=$ $(2693)_{10}$

*** Second method:**

***Example(20)*: (**$E5)_{16}$ ========$(229)_{10}$

$(E5)_{16}=16^1*E+16^0*5$

$16*14+1*5 =224+5=229=$ $(229)_{10}$

D.*Decimal – to – Hexadecimal Conversion:*

Convert the decimal number 650 to hexadecimal by repeated division by 16.

***Example(21)* :**

$(650)_{10}$=====$(28A)_{16}$

650 | 16	**mod LSB**
40 | 16 →	A
2 | 16 →	8
0 →	2

↑ ⟹ $(28A)_{16}$

MSB

Microcomputer Architecture

The word ***computer*** comes from the word ***(compute)*** the word compute means to ***(calculate)*** or to ***(count)***, computer is an electronic device that manipulates information or ***(data).*** It has ability to store, retrieval, and process data.

Advantages of computer system: -

1- Store and retrieve large quantities of data.
2-The speed is faster than in any other form of data processing.
3-A single computer can perform a wide variety of activities as directed by a set of instructions (program).
4-Once data and instructions are fed into the computer, processing is continuous with a minimum of human intervention.
5-Data and programs may be stored inside the computer indefinite and be retrieved quickly.
6- Accuracy is greater than any other system.

***A* computer system has three main components**: a **Central Processing Unit** (CPU) or processor, a **Memory Unit** and **Input/output Units (**devices). In any microcomputer system, the component which actually processes data is entirely contained on a single chip called M**icroprocessor** (MPU). This MPU can be programmed using assembly language.
The main **internal hardware** features of a computer are the **processor**, **memory** and **registers** (registers are special processor components for holding address and data).

The **external hardware** features are the computer Input/Output devices such as keyboard, monitor…

Software consists of the operating system (O.S) and various programs and data files stored on disk.

Personal Computer (PC) Components:-

The main component of the PC is **System Board** (or motherboard). It contains the processor, main memory, connectors, and expansion slots for optional cards. The slots and connectors provide access to such components as ROM, RAM, hard disk, CD-ROM drive, additional memory, video unit, keyboard, mouse, parallel and serial device, sound adapter and cache memory (the processor use high speed cache memory to decrease its need to access the slower main memory). A bus with wires attached to the system board connects the components. It transfers data between the processor, memory and external devices.

A. The processor

The CPU or processor acts as the controller of all actions or services provided by the system. The operations of a CPU can be reduced to three basic steps:
وحدة المعالجة المركزية أو معالج تعمل وحدة تحكم من جميع الإجراءات أو الخدمات المقدمة من قبل النظام. ويمكن تخفيض عمليات وحدة المعالجة المركزية إلى ثلاث خطوات أساسية

fetch, **decode**, and **execute**. Each step includes intermediate steps, some of which are:

1- Fetch the next instruction:
- Place it in a holding area called a queue.
- Decode the instruction.

2- Decode the instruction
- Perform address translation.
- Fetch operand from memory.

3- Execute the instruction.
- Perform the required calculation.
- Store results in memory or register.
- Set status flag attached to the CPU.

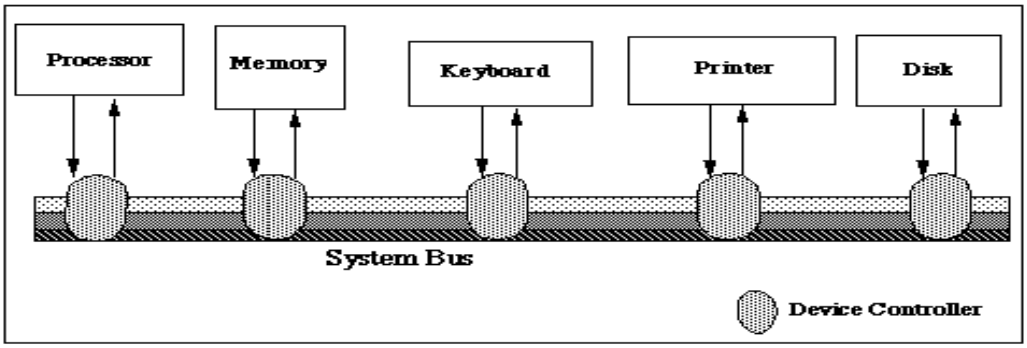
System Bus:-

The components of the computer system must communicate with each other and with the outside world. Although it may be possible to connect each component to the CPU separately as a practical matter this would require too many physical connects. To keep the number of connections manageable, the processor is connected to memory and all peripherals using a bus.

A Bus is a bunch of wires, and electrical path on the printed IC to which everything in the system is connected.

There are three types of Bus:

1-



Address Bus (AB): the width of AB determines the amount of physical memory addressable by the processor.

2- Data Bus (DB): the width of DB indicates the size of the data transferred between the processor and memory or I/O device.

3- Control Bus (CB): consists of a set of control signals, typical control signals includes memory read, memory write, I/O read, I/O write, interrupt acknowledge, bus request.
These control signals indicates the type of action taking place on the system bus.

Figure (1) The system bus:
the processor communicates with all devices via the system bus

The CPU is divided into two general parts. **Arithmetic Logic Unit** (ALU) and **Control Unit** (CU).
- The **ALU** carry Arithmetic, logical, and shifting operations.
- The **CU** fetches data and instruction, and decodes addresses for the ALU.

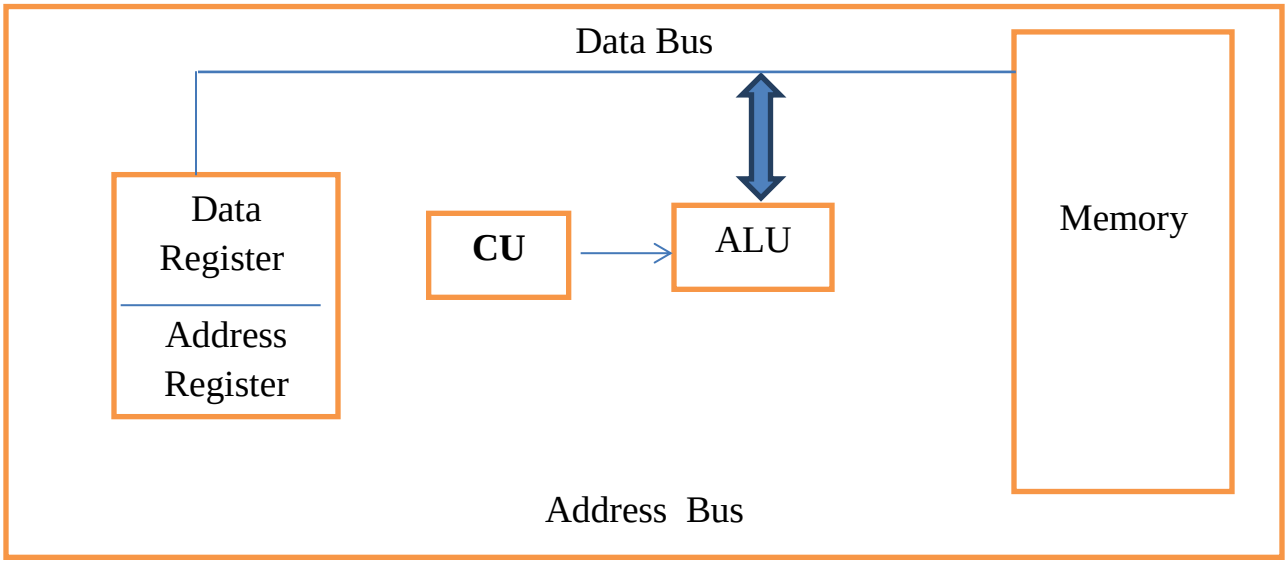


***Figure* (2): A Block Diagram of the Simple CPU**

Register:-Registers are devices capable of storing information, receiving data from other areas within the computer and transferring information as directed by the control unit, it is used for temporary storage of data or instruction and the most important register are :

- **Program counter** (PC): hold address of the next instruction

-**Instruction register** (IR): Hold instruction while it is decoded and Executed

- **Address register** (AR): holds the address of memory location.

-**PSW** (Processor Status Word): collection of bits called Flags or Condition Codes. They typical used to indicate a Zero result, a Negative result, a Carry, an Overflow and so on.

-**SP** (Stack Pointer): Stack may consist of a set of internal registers or a portion of main memory. It is used for temporarily storing important information while subroutines are being executed. The top of the stack is the last information put onto the stack.

The instruction is brought in from the memory and placed in the IR. The Control Unit then decodes the instruction direct its execution. At the same time the CU sets the PC/IP to the address of the next instruction.

B- Memory (Main Memory)

The memory of a computer system consist of tiny electronic switches, with each switch set in one of two states: open or close.

It is however more convenient to think of these states **as 0 and 1**.Thus each switch can represent a binary digit or bit, as it is known, the memory unit consists of millions of such bits, bits are organized into groups of eight bits called **byte**. Memory can be viewed as consisting of an ordered sequence of bytes. Each byte in this memory can be identified by its sequence number

starting with 0, as shown in Figure 3. This is referred to as memory address of the byte. Such memory is called **byte addressable memory.** The memory address space of a system is determined by the address bus width of the CPU used in the system.

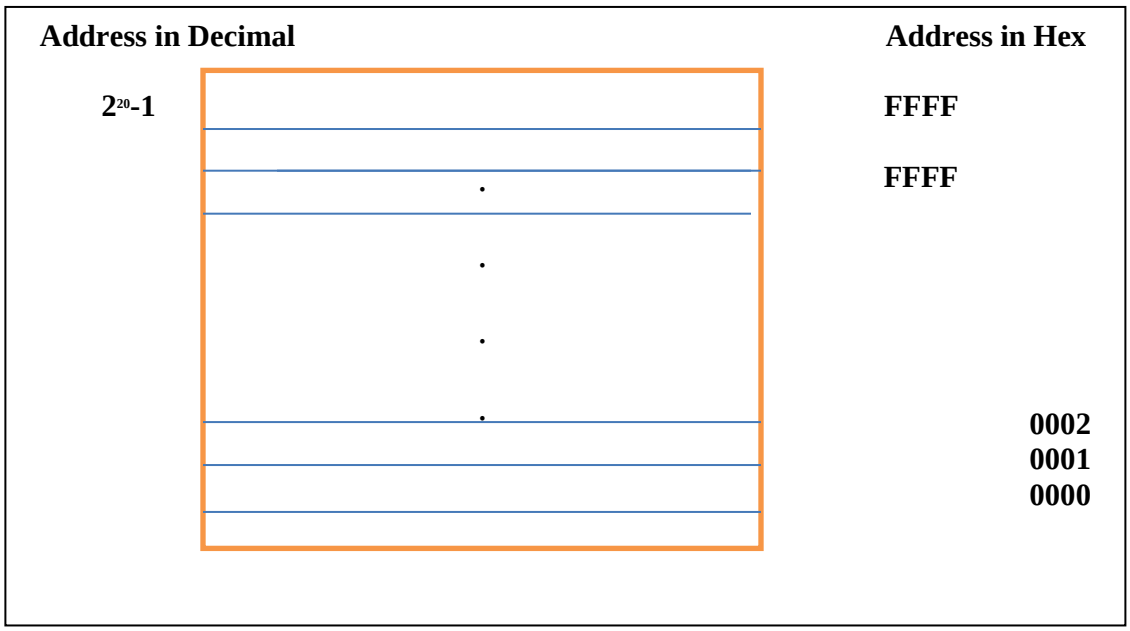


Figure 3: Logical view of the system memory