COMPUTER SYSTEM

The components of a computer system is hardware and software.

Hardware is the physical parts of a computer. The parts that we can see and touch are named as hardware.

Software is the programs and the data that used by those programs. When we say software we mean the intangible part of a computer.

Hardware

It is composed of input/output devices, memory, central processing unit(CPU). Simply their basic roles are:

1) Input/Output Devices (I/O Devices)→ *allows a human being to interact with the computer*

When it is called input devices it can be understood as the tools which represents a source of information. Also output devices can be understood as the tools which information has been sent. But this is not the case for these. It is meant that those which help human to communicate with computers.

Some input devices are scanners, microphones, etc. Some output devices are speakers, plotters etc. There are also some devices, which is both input and output like a touch screen.

2) Memory→ *holds programs and data of those programs*

There are two types of memory: main memory and secondary memory.

a) Secondary memory → *stores software permanently*

Most common secondary memory devices are floppy disks and hard disk. Secondary memory devices are usually non volatile which means that the information stays even if the power supply has turned down.

b) Main memory→ *stores software when a program is running*

When a program is being executed a copy of that program is brought up from secondary memory to the main memory. CPU executes the instructions one by one after reading them from main memory.

Programs are large but main memory is not large enough to store as much programs as secondary memory can store. So it takes some portion of a program, which must be executed and stores that parts. To take a part of a program is named as "paging".

Main memory devices are volatile so information is lost when the power supply is off.

3) CPU (Central Processing Unit)→*executes the individual commands of a program*

It interacts with main memory to perform the instructions. After understanding what the instruction means, CPU executes them one by one.

It is made up of ALU (Arithmetic Logic Unit), CU (Control Unit) and R (Registers). ALU performs calculations and decisions. CU is the part, which interacts with the main memory directly. It coordinates the processing steps by determining the sequence of the instructions that will be executed and, controlling the transfer of data and instructions between main memory and the registers in the CPU. R are the internal storage of CPU. R are categorized into three groups. Instruction registers stores the instructions, which is being executed. Instruction pointers (program counters) hold the address of the next instruction,

which will be executed. We mean it points to the instruction to be executed. General purpose registers are used by the programmer.

How does the CPU works?
Fetch→Decode→Execute: The way CPU follows the fetch→decode→execute line.

Fetch➔The instruction is brought up from main memory and then put into the register.
Decode➔After having the instruction in register, the purpose of it is understood.
Execute➔With knowing, what the instruction means, it can be done, whatever is required. (It is also can be called as "perform".)

HOW TO STORE DATA & PROGRAMS?

They are stored in digital form in which information is broken down into discrete pieces and those pieces are represented as numbers. The numbers are not in decimal form, they are all in binary form. Information is stored in forms of bits. (bit =**bi**nary digi**t**) Every information is represented with 0's and 1's.

1 byte= 8 bits
1 KB=2^{10} bytes
1 MB=2^{20} bytes
1 GB=2^{30} bytes
1 TB=2^{40} bytes

NUMBER REPRESENTATION

Place Value: The position of each digit has a *Place Value* that indicates the amount it contributes to the overall value.

Base Value: The base value of a number system dictates how many digits we have to work with and indicates the place value of each digit in a number.

Decimal Number System:
In our everyday lives, we use the decimal number system to represent values, count, and perform arithmetic.
The base of Decimal Number System: 10 (0 through 9)
Ex: $123_{10} = 1*10^2 + 2*10^1 + 3*10^0$

Binary Number System:
Computers use the binary number system to store and manage information.
The base of Binary Number System: 2 (0 and 1)
Each 0 and 1 is called a *bit*, short for binary digit. A series of bits is called a *binary string*.

Binary is used for computer processing because the devices used to manage and store information are less expensive and more reliable if they only have to represent two possible values.

Ex: $111_2 = 1*2^2 + 1*2^1 + 1*2^0 = 7_{10}$

$0{,}11_2 = 1*2^{-1} + 1*2^{-2} = 0{,}75_{10}$

There are infinite numbers of number systems and they all follow the same basic rules.

Hexa-Decimal Number System:

For number systems higher than 10, we use alphabetic characters as single digits for values greater than 9.

The base of Hexa-Decimal Number System: 16 (0 through 9 represents the first 10 digits, and A represents the decimal value 10, B represents the decimal value 11, C represents the decimal value 12, D represents the decimal value 13, E represents the decimal value 14, F represents the decimal value 15)

Ex: $27 = X_{16}$

$27 = 16*1 + 11$

$X_{16} = 1B$

CONVERSIONS

Keep in mind that when we change number systems, we are simply changing the way we represent values, not the values themselves.

Decimal to Binary Conversion: Divide the original number by 2 (the base of binary number system). The remainder is the value that must be represented in the remaining digit positions. Continue this process, position by position, until the entire value is represented.

Ex: $6_{10} = X_2$

6 / 2 (base of binary number system) =3	6 – 2*3 = 0 (remainder)
3 / 2 = 1	3 – 2*1 = 1
1 / 2 =0	1- 2*0 = 1

$X_2 = 110$

Binary to Hexa-Decimal Conversion: Divide the number to parts by four from the right side. Sum the values of parts (by using their place value) separately and write their values in Hexa-Decimal system.

Ex: $0010\ 0101_2 = 37$

QUESTIONS

1) $13 = X_2$
2) $180_{10} = X_2$
3) $101111110110011_2 = X_{16}$
4) $100000011000110_2 = X_{16}$

ANSWERS

1) $X_2 = 1101$
2) $X_2 = 10110100$
3) $X_{16} = 5FB3$
4) $X_{16} = 40C6$