University of Batna 2
Institute of safety and security
1st year LMD

Chapter 1: Introduction to computer science

What is a computer?

- A computer is an electronic device for storing and processing data, typically in binary form, according to instructions given to it in a variable program [Oxford languages].
- an electronic machine that is used for storing, organizing, and finding words, numbers, and pictures, for doing calculations, and for controlling other machines. [Cambridge dictionary]

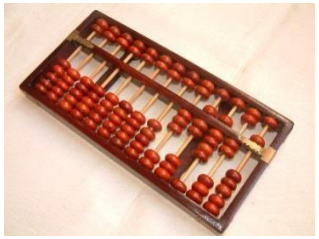
What is computer science?

- Computer science is the science that deals with the theory and methods of processing information in digital computers, the design of computer hardware and software, and the applications of computers.[Dictionary.com]

A Brief History of Computing

- **The Early Period: Up to 1940**
- 3,000 years ago: Mathematics, logic, and numerical computation
  - Important contributions made by the Greeks, Egyptians, Babylonians, Indians, Chinese, and Persians
- 1614: Logarithms
  - Invented by John Napier to simplify difficult mathematical computations
- Around 1622: First slide rule created

A Brief History of Computing



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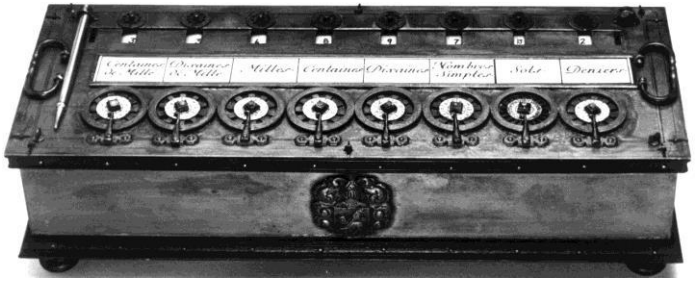
A Brief History of Computing

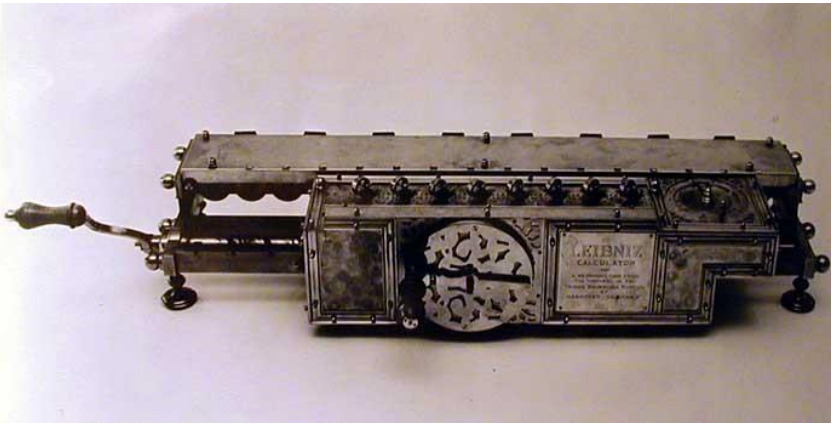
- **The Early Period: Up to 1940**
- 1672: The Pascaline
  - Designed and built by Blaise Pascal
  - One of the first mechanical calculators
  - Could do addition and subtraction



The Pascaline: One of the Earliest Mechanical Calculators

A Brief History of Computing

- **The Early Period: Up to 1940**
- 1674: Leibnitz's Wheel
  - Constructed by Gottfried Leibnitz
  - Mechanical calculator
  - Could do addition, subtraction, multiplication, and division



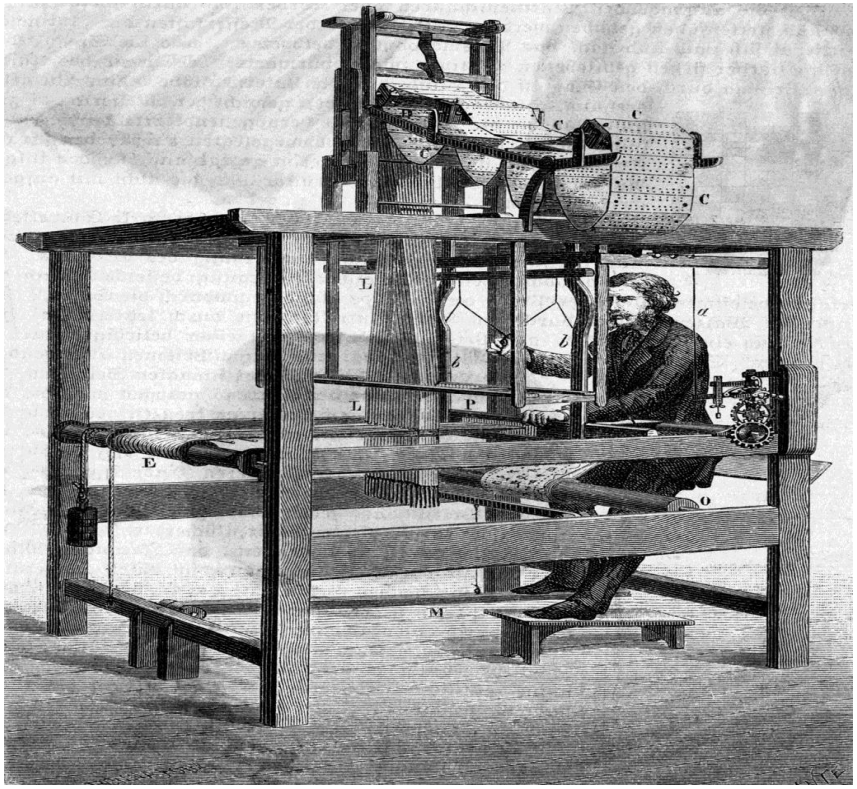
The Leibnitz's Wheel

A Brief History of Computing

- **The Early Period: Up to 1940**
- 1801: The Jacquard loom
  - Developed by Joseph Jacquard
  - Automated loom
  - Used punched cards to create desired pattern
- 1823: The Difference Engine
  - Developed by Charles Babbage
  - Did addition, subtraction, multiplication, and division to 6 significant digits
  - Solved polynomial equations and other complex mathematical problems

A Brief History of Computing

- **The Early Period: Up to 1940**



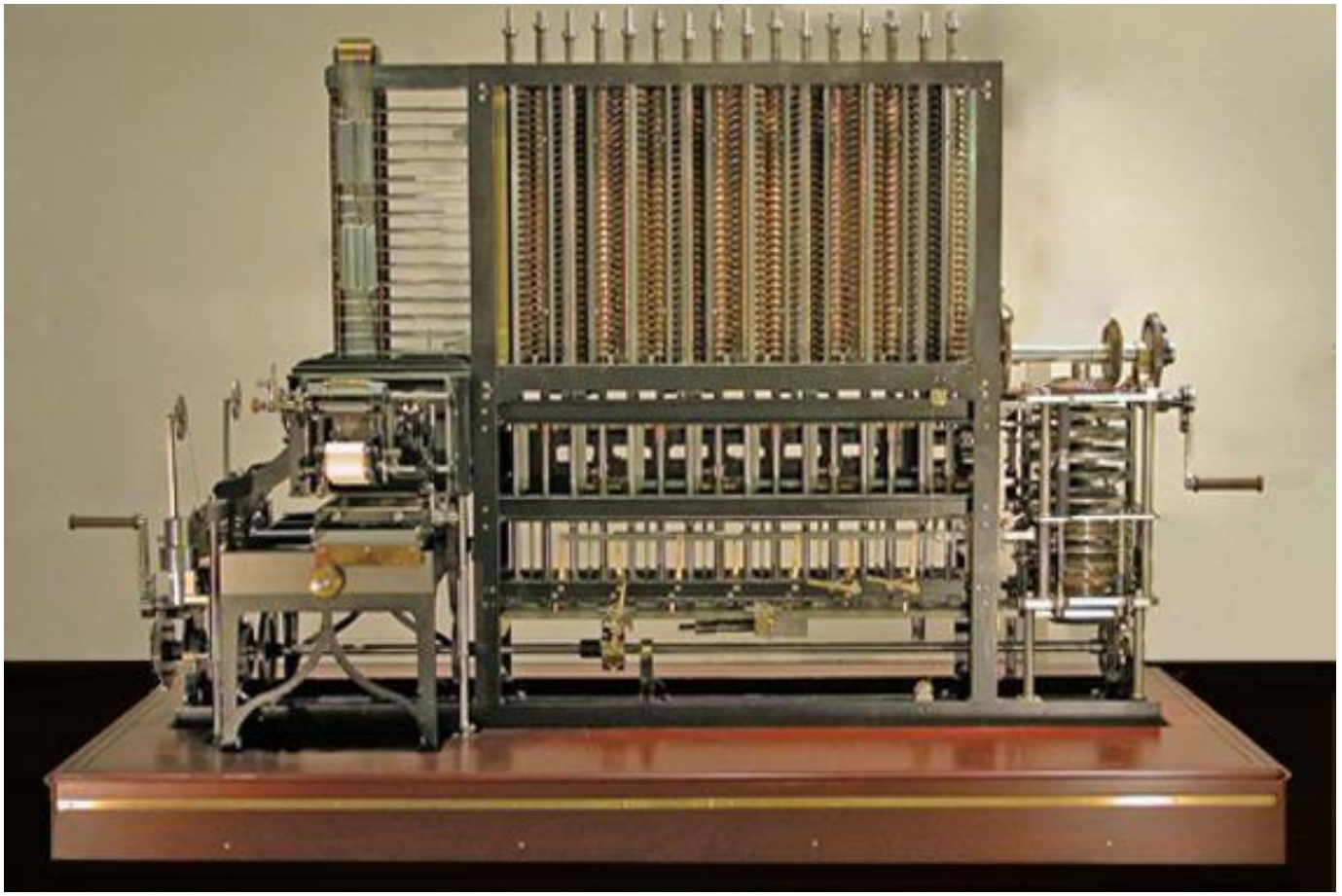
Drawing of the Jacquard Loom

A Brief History of Computing

- **The Early Period: Up to 1940**
- 1830s: The Analytic Engine
  - Designed by Charles Babbage
  - More powerful and general-purpose computational machine
  - Components were functionally similar to the four major components of today's computers
    - Mill (modern terminology: arithmetic/logic unit)
    - Store (modern terminology: memory)
    - Operator (modern terminology: processor)
    - Output (modern terminology: input/output)

A Brief History of Computing

- The Early Period: Up to 1940



A Brief History of Computing

- **The Early Period: Up to 1940**
- 1890: U.S. census carried out with programmable card processing machines
  - Built by Herman Hollerith
  - These machines could automatically read, tally, and sort data entered on punched cards

A Brief History of Computing

- **The Early Period: Up to 1940**

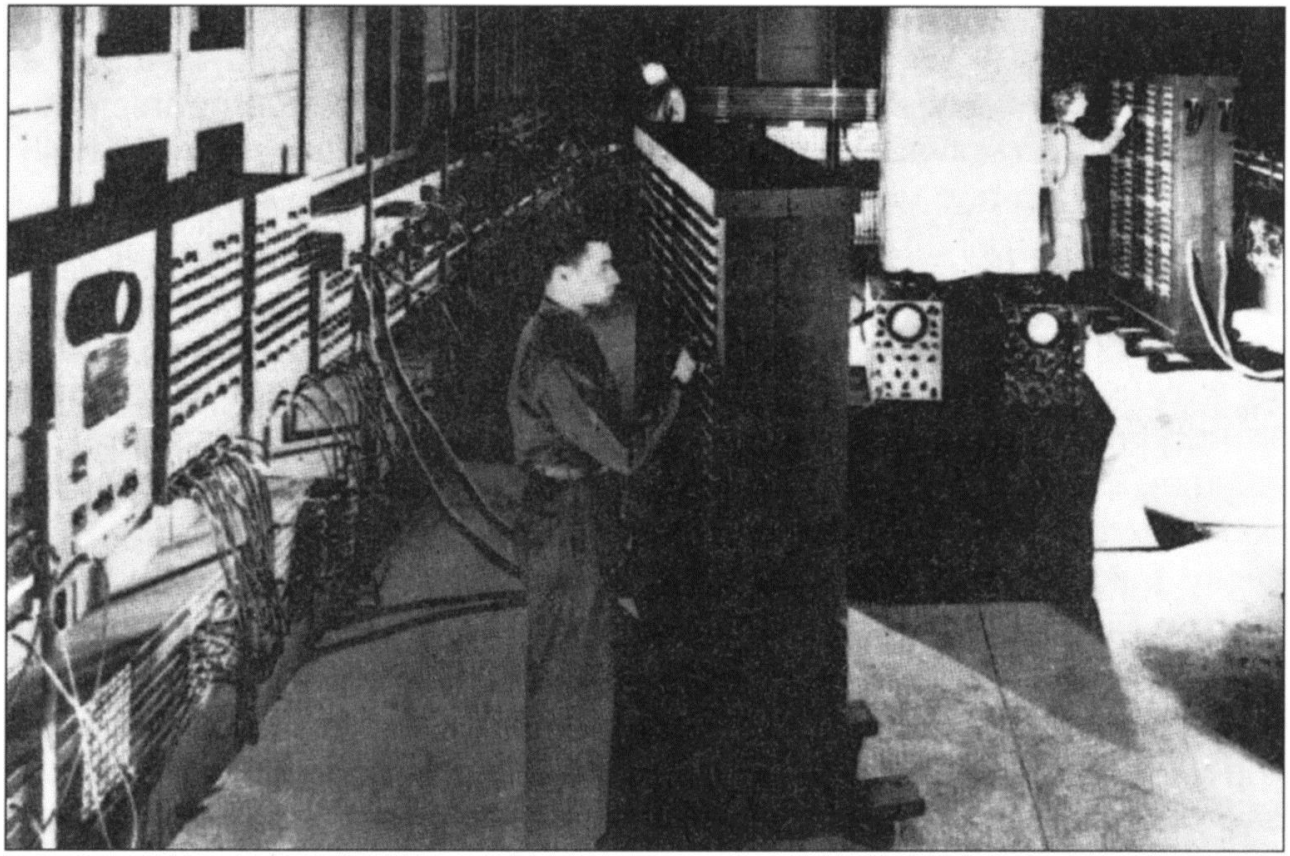
- First Programmer
- Ada Augusta Byron, Countess of Lovelace

A Brief History of Computing

- **The Birth of Computers: 1940-1950**
- Development of electronic, general-purpose computers
  - Did not begin until after 1940
  - Was fueled in large part by needs of World War II
- Early computers
  - Mark I
  - ENIAC
  - ABC system
  - Colossus
  - Z1

A Brief History of Computing

- **The Birth of Computers: 1940-1950**



Photograph of the ENIAC Computer

A Brief History of Computing

- **The Birth of Computers: 1940-1950**

Programming the ENIAC

A Brief History of Computing

- **The Birth of Computers: 1940-1950**
- Stored program computer model
  - Proposed by John Von Neumann in 1946
  - Stored binary algorithm in the computer's memory along with the data
  - Is known as the Von Neumann architecture
  - Modern computers remain, fundamentally, Von Neumann machines
  - First stored program computers
    - EDVAC
    - EDSAC

A Brief History of Computing

- **The Modern Era: 1950 to the Present**
- First generation of computing (1950-1959)
  - Vacuum tubes used to store data and programs
  - Each computer was multiple rooms in size
  - Computers were not very reliable

A Brief History of Computing

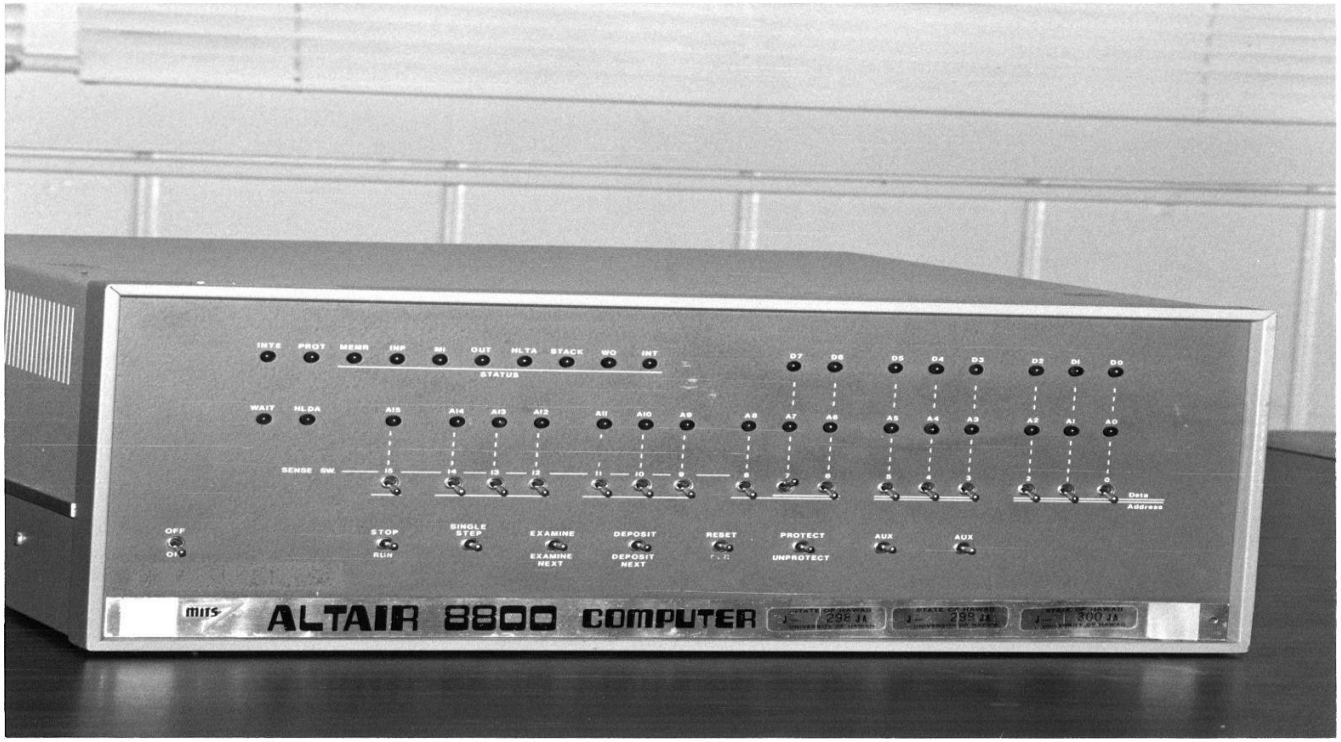
- **The Modern Era: 1950 to the Present**
- Third generation of computing (1965-1975)
  - Integrated circuits rather than individual electronic components were used
  - Further reduction in size and cost of computers
    - Computers became desk-sized
    - First minicomputer developed
  - Software industry formed

A Brief History of Computing

- **The Modern Era: 1950 to the Present**
- Fourth generation of computing (1975-1985)
  - Reduced to the size of a typewriter
  - First microcomputer developed
  - Desktop and personal computers common
  - Appearance of
    - Computer networks
    - Electronic mail
    - User-friendly systems (graphical user interfaces)
    - Embedded systems

A Brief History of Computing

- **The Modern Era: 1950 to the Present**



The Altair 8800, the World's First Microcomputer

A Brief History of Computing

- **The Modern Era: 1950 to the Present**
- Fifth generation of computing (1985-?)
  - Recent developments
    - Massively parallel processors
    - Handheld devices and other types of personal digital assistants (PDAs)
    - High-resolution graphics
    - Powerful multimedia user interfaces incorporating sound, voice recognition, touch, photography, video, and television
    - Integrated global telecommunications incorporating data, television, telephone, fax, the Internet, and the World Wide Web
    - Wireless data communications
    - Massive storage devices
    - Ubiquitous computing

Number Systems and Base Conversions

- **The Decimal System**

- The decimal number system has the value of the base as 10. Thus, in the decimal system we have 10 different digits, which are 0; 1; 2; 3; 4; 5; 6; 7; 8; and 9.

- Example:

$$873_{10} = 800 + 70 + 3 = 8 \cdot 10^2 + 7 \cdot 10^1 + 3 \cdot 10^0.$$

- The decimal number system is great for calculations done by humans, but it is not a suitable system for a computer to use.

Number Systems and Base Conversions

- **The Binary System**

- A digital computer contains elements that can be in either of two states: on or off. We sometimes even see an electrical switch with two numbers 0 and 1 where 0 means off while 1 means on.

- The binary number system is also a positional notation numbering system, but in this case, the base is not ten, but is instead two. Each digit position in a binary number represents a power of two. So, when we write a binary number, each binary digit is multiplied by an appropriate power of 2 based on the position in the number.

- Example:

$$\begin{aligned} 101101_2 &= 1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 \\ &= 1 \cdot 32 + 0 \cdot 16 + 1 \cdot 8 + 1 \cdot 4 + 0 \cdot 2 + 1 \cdots 1 \\ &= 32 + 8 + 4 + 1. \end{aligned}$$

Number Systems and Base Conversions

- **Conversion between Decimal and Binary numbers**
- Converting a number from binary to decimal is quite easy. All that is required is to find the decimal value of each binary digit position containing a 1 and add them up.
- Example:

$$
\begin{aligned}
10110_2 &= 1 \cdot 2^4 + 0 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 \\
&= 1 \cdot 16 + 0 \cdot 8 + 1 \cdot 4 + 1 \cdot 2 + 0 \cdot 1 \\
&= 16 + 4 + 2 \\
&= 22.
\end{aligned}
$$

Number Systems and Base Conversions

- **Conversion between Decimal and Binary numbers**
- The method for converting a decimal number to binary is one that can be used to convert from decimal to any number base.
- It involves using successive division by the base until the dividend reaches 0. At each division, the remainder provides a digit of the converted number, starting with the least significant digit.
- Example:

$$\begin{aligned} 37/2 &= 18 \quad remainder\ 1 \\ 18/2 &= 9 \quad remainder\ 0 \\ 9/2 &= 4 \quad remainder\ 1 \\ 4/2 &= 2 \quad remainder\ 0 \\ 2/2 &= 1 \quad remainder\ 0 \\ 1/2 &= 0 \quad remainder\ 1 \end{aligned}$$

The resulting binary number is 100101

Number Systems and Base Conversions

- **Octal Number System**
- The octal numeral system is the base 8 number system, and uses the digits 0, 1, 2…, 7.
- **Conversion From Binary to Octal**
- Octal numerals can be made from binary numerals by grouping consecutive binary digits into groups of three (starting from the right) and add zeros on the left as needed. For example:

$$1001010 = (001)(001)(010)$$

- Thus

$$1001010 = (001)(001)(010) = 112_8$$

- In the octal system each place is a power of eight. For examples:

$$112_8 = 1 \times 8^2 + 1 \times 8^1 + 2 \times 8^0 = 64 + 8 + 2 = 74_{10}$$

Number Systems and Base Conversions

- **From Octal to Binary**
- Replace each octal digit with the corresponding 3-bit binary string. For examples:

$$213_8 = (010)(001)(011) = 10001011_2$$

- **From Octal to Decimal**
- The conversion can be performed in the conventional mathematical way, by showing each digit place as an increasing power of 8. For example:

$$345_8 = (3 \cdot 8^2) + (4 \cdot 8^1) + (5 \cdot 8^0) = (3 \cdot 64) + (4 \cdot 8) + (5 \cdot 1) = 229_{10}$$

- **Conversion of decimal to octal (base 10 to base 8)**
- Example:

$$177/8 = 22 \ \ remainder \ 1$$

$$22/8 = 2 \ \ remainder \ \ 6$$

$$2/8 = 0 \ \ remainder \ \ 2$$

- thus

$$177_{10} = 261_8.$$

Number Systems and Base Conversions

- **Hexadecimal number system**

- Another number system often used in computer . The hexadecimal numbers are also called Hex in short . This number system has 16 symbols . Those are - 0 , 1 , 2 , 3 , 4 , 5 , 6 , 7, 8, 9, A, B, C, D, E, F.

- **Conversion of hex to decimal (base 16 to base 10)**

- Example:

$$F4C_{16} = (F \cdot 16^2) + (4 \cdot 16^1) + (C \cdot 16^0)$$
$$= (15 \cdot 256) + (4 \cdot 16) + (12 \cdot 1).$$

- **Conversion of decimal to hex (base 10 to base 16)**

- Example:

$$4768/16 = 298 \qquad remainder\ 0$$
$$298/16 = 18 \qquad remainder\ 10 = A$$
$$18/16 = 1 \qquad remainder\ 2$$
$$1/16 = 0 \qquad remainder\ 1$$

- thus $4768_{10} = 12A0.$

Computer Components

- **Hardware**

- Computer hardware is the collection of physical elements that constitutes a computer system.
  - **Input devices:** users interact with a computer using input devices. Input devices usually a keyboard and mouse are used by a user in order to provide instructions to a computer.
  - **Central Processing Unit (CPU):** A CPU is brain of a computer. It is responsible for all functions and processes. Regarding computing power, the CPU is the most important element of a computer system. The CPU is comprised of three main parts :

    1.Arithmetic Logic Unit (ALU): Executes all arithmetic and logical operations. Arithmetic calculations like as addition, subtraction, multiplication and division. Logical operation like compare numbers, letters, or special characters

Computer Components

- **Hardware**

2.Control Unit (CU): controls and co-ordinates computer components.

- 1.Read the code for the next instruction to be executed.
- 2. Increment the program counter so it points to the next instruction.
- 3. Read whatever data the instruction requires from cells in memory.
- 4. Provide the necessary data to an ALU or register.
- 5. If the instruction requires an ALU or specialized hardware to complete, instruct the hardware to perform the requested operation.

3.Registers : Stores the data that is to be executed next, "very fast storage area".

Computer Components

- **Hardware**
  - **Primary Memory:**
    - **RAM:** Random Access Memory (RAM) is a memory scheme within the computer system responsible for storing data on a temporary basis, so that it can be promptly accessed by the processor as and when needed. It is volatile in nature, which means that data will be erased once supply to the storage device is turned off. RAM stores data randomly and the processor accesses these data randomly from the RAM storage. RAM is considered "random access" because you can access any memory cell directly if you know the row and column that intersect at that cell.
    - **ROM (Read Only Memory):** ROM is a permanent form of storage. ROM stays active regardless of whether power supply to it is turned on or off. ROM devices do not allow data stored on them to be modified.

Computer Components

- **Hardware**
  - **Secondary or Mass storage device:** enables a computer to permanently store large amounts of data. Commonly used mass storage devices include disk drives and tape drives.
  - **Output devices:** computer uses a screen or monitor, printer, or other device to display outputs.

Computer Components

- **Software:**

- A software is set of instructions that hardware executes to carry out a specific task for you.
  - **Application software:** enables you to solve specific problems or perform specific tasks.
  - **System software:** handles tasks specific to technology management and coordinates the interaction of all technology devices . There are two main types of system software
    - **Operating system software** : controls application software and manages hardware devices
    - **Utility software :** provides additional functionality to your operating system
      - Anti-virus
      - Screen saver
      - etc.