IT #college-studies #computer

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Computer

- It is an electronic device, which takes data as an input and store's it, process it and gives a desirable output.
- Computer is a calculator.
- A Computer is a programmable machine designed to perform logical operations on the input given by the user and give us the desired output.

Computer components are divided in two:

- *Hardware:*
  - It is the machine itself and it's connected devices such as keyboard, CPU , mouse, etc.
- *Software:*
  - It is the set of program that make use of hardware for performing various functions.

Characteristics of Computer:

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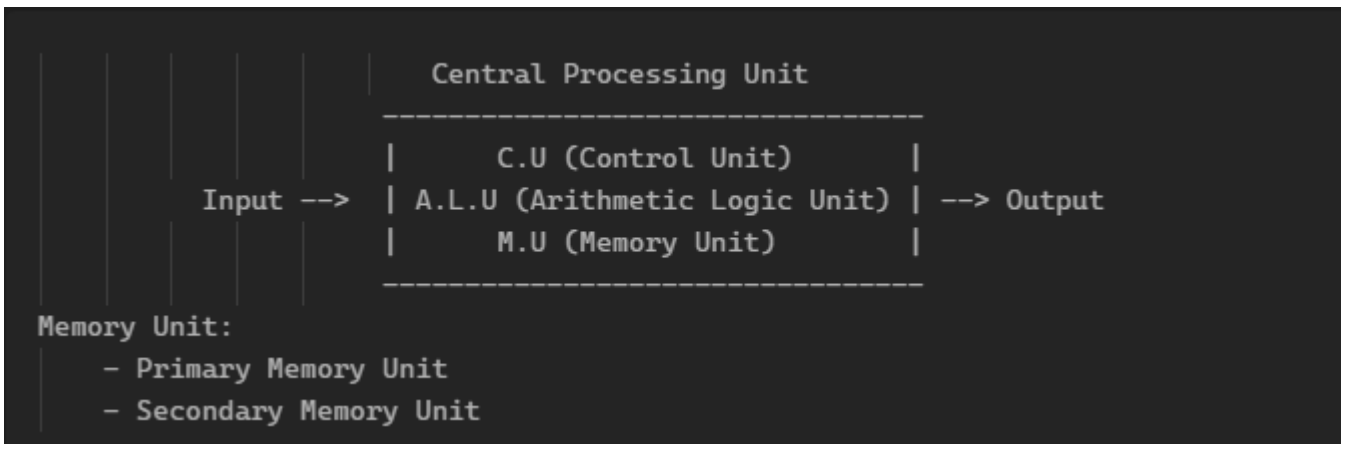
1. *Speed:* Computer work at an incredible speed. A powerful computer (Supercomputer) is capable of performing about 3-4 million simple instructions per second.
2. *Accuracy:* Unlike human beings computers are highly consistent. They don't suffer human traits of tiredness resulting in lack of concentration.
3. *Versatility:* Computers are versatile machines and are capable of performing any as long as it can be broken down into a series of logical steps.
4. *Storage:* Today's Computer can store large volume of data. A piece of information once recorded in the computer, can never be forgotten and can be retrieved.
5. *Power of Remembering:* Computer has a power of storing any amount of information and data.
6. No feeling
7. *No IQ:* Computer is a dump machine and it can't any without instructions.

Block Diagram of Computer



Input Unit:

Computer need to receive data and instructions in order to solve any problem. The Input Unit consist of one or more input devices. Keyboard is one of the commonly used input device. All the input devices perform following function:

- Accept the data and instructions from outside world.
- Convert it to a form that computer will understand.
- Supply the converted data to the computer system for further processing.

Storage Unit (Memory Unit):

The storage unit of the computer holds data and instructions that the input unit, before they are processed. It preserves the intermated and final result before this are sent the final result before this are sent the output devices.

It has divided into two categories:

- *Primary:*
  - It stores and provides very fast.
  - This memory is generally used to hold the program being currently executed in the computer.
- *Secondary:*
  - It stores several programs and docs, database etc.
  - The program that you can run on the computer are first transferred the primary memory before it actually run.
  - The secondary memory is slower and cheaper than primary memory.
    - e.g: Hard drive, CD etc.

Output Unit:

- This Unit of computer provides the information and result after processing the input data.
- Printers, monitors, speakers etc are output devices.

ALU (Arithmetical Logical Unit):

- All calculations are performed in ALU computer.
- The ALU can perform basic operations such as addition, subtraction, multiplication, and division and logical operations. (<, >, &, = etc)

CU (Control Unit):

- It controls all units of units of computer.
- It instructs the input unit where to store the input data after receiving it from user.
- It controls flow of data and instructions to storage unit.
- It also controls the flow of result to from ALU to SU.
- It generally perform an central nervous sytem.

CPU (Central Processing Unit):

- The CU, ALU and MU of computer together known as CPU.
- The CPU is like brain which performs following functions.
  - It performs all calculations.
  - It takes all the decisions'.
  - It controls all units of computer.

Types of Computers

1. *Analog Computers:*
   - Analog Computer is a computer which is used to measure physical quantity.
   - It is used to measure electric current, frequency and resistance .
   - Physical quantities are temp. , pressure, speed, length etc.
   - We use these computer in daily life like speedometer.
2. *Digital Computers:*
   - Computer that work on binary numbers (0,1) are called Digital Computers.
   - The first Digital computer was developed in 1940s, it was developed for only mathematical work.
3. *Micro Computers:*
   - A micro computer is a small computer that can be used by only one person at a time. It is known as *Personal Computer*.
   - First micro computer was build with 8 bit processor.
4. *Super Computer:*
   - Most Powerful , most expensive computer.
   - Used for most scientific applications that requires huge processing power.
   - They are special purpose computer that are designed to perform some specific task.
   - The cost of super computer is depended on processing capacity and configuration.
     - e.g: PARAM, EKA etc
5. *Mainframe Computer:*
   - Every powerful computer which is capable of supporting thousands of users simultaneously.
   - It is capable to run multiple and expensive computers with having larger internal storage capacity and high processing speed.
   - Mainly used to handle bulk of data and information for processing.
   - IBM are major vendors of mainframes.
     - e.g: IBM, HP, HCL.
6. *Mini Computer:*
   - Less expensive than mainframe computer, capable of supporting 2 to 100 user simultaneously .
   - In 1970s it contains 8 bit and 12 bit processor.
   - Gradually it has grown and got 16, 32, 64 bit processor.
     - e.g: IBM AS500
7. *Hybrid Computer:*
   - It combines good features of both analog and digital computer.
   - It has a speed of analog computer and accuracy of digital computer.

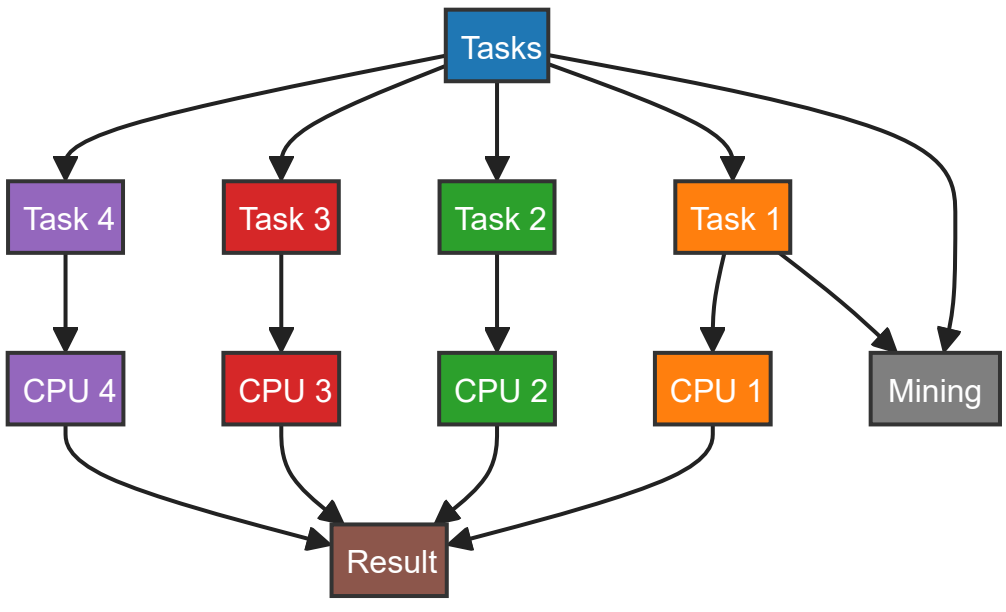
Generation of Computer

1. *First Generation:*
   - Duration: 1940s to 1950s
   - Technology: Vacuum Tube
   - Used as calculating device.
   - Too bulky in size and complex design.
   - Require large room.
   - Generates too much heat.

- Air conditioner rooms are required.
- Limited commercial use
    - e.g: ENIAC, EDVAC

2. *Second Generation:*
    - Duration: 1950s - 1960s
    - Technology: Transistor
    - Ten times smaller in size than 1st Generation computer.
    - Less heat than first generation computer.
    - Consume less power than first generation computers.
    - Air conditioner is required.
    - Wider commercial Use.
    - Large and fast primary, secondary storage than first generation.
3. *Third Generation:*
    - Duration: 1960s - 1970s
    - Technology: IC Chips
    - Smaller than first and second generation.
    - Perform More Calculations than first and second generation.
    - Large and fast primary/ Secondary storage than 1^{st} & 2^{nd} .
    - Air Conditioner is required.
    - High level languages like COBAL/FORTAN are allowed to write program.
4. *Forth Generation:*
    - Duration: 1970s - 1980s
    - Technology: Micro-processor chip
    - Based on LSI & VLSI microprocessor chip
    - small in size
    - possible to use network concept to connect computers together
    - No air conditioners required
    - cheapest in price
5. *Fifth Generation:*
    - Duration: 1990s -
    - Technology: ULSI , microprocessor chip
    - Much handle and small
    - speed increased
    - consume less power
    - more user friendly
    - high level languages are allowed to write a program

Parallel Computing



- Parallel Computing usages various processing elements to solve a problem.

- Problem gets divided into chunks and are processed parallelly using multiple processor. The multiple processor intercommunicate through shared memory and result are merged later.
- To manage the excessive amount of data in the real world, parallel computing is key concept.
- It reduces line, cost and memory utilization.
- Managing complex and large data set efficiently require parallel computing models.

Distributed Computing

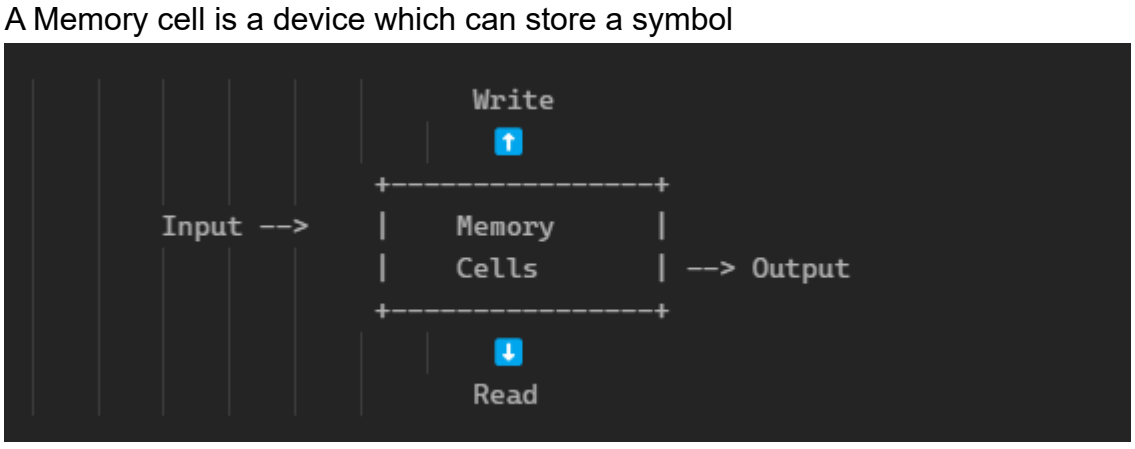
- The team distributed computing/system refers to a system that is composed of components located on multiple machines.
- All components interact in a coordinated way as a unified system.
- *Sharing of Resources:* Resources are shared among different nodes in a network.
- *Open Software:* Many software are developed and shared with others.
- *Transparency:* The degree too which one node can locate and communicate with other nodes in system.

Memory

- Memory is a just like human brain it stores data and instructions.
- Memory is a collection of memory cells.

Memory Cells

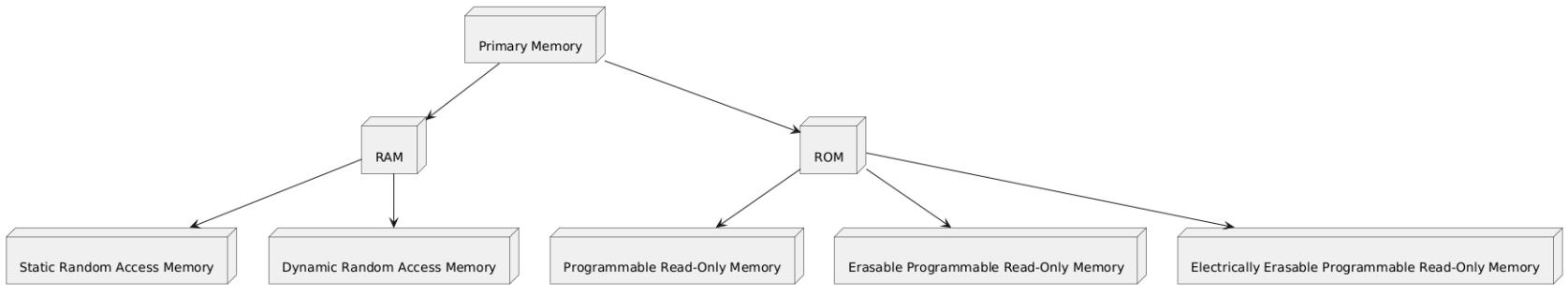
- A Memory cell if of 1 bit.
- A Memory cell is a device which can store a symbol



- The time taken to read a symbol, from a cell is called Read time, and time taken to write a symbol is write time.

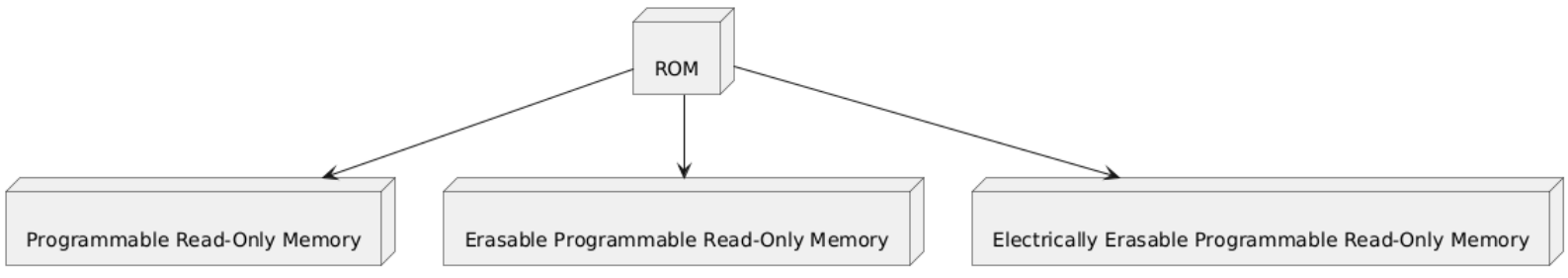
Types of Memory

1. Primary Memory
    - Is Called as Main Memory.
    - It is internal memory of computer.
    - The primary memory provides main working space to computer.



    - RAM (Random Access Memory)
        - Volatile Memory: Loses its data when power is turned Off.
        - Fast read/write : Essential for running applications and the operating system.
        - Types: SRAM (Static Random Access Memory) & DRAM (Dynamic Random Access Memory)
        - Uses: Main memory in computers and devices for temporary data storage.
    - SRAM (Static RAM)
        - Volatile Memory: Loses its data when power is turned Off.

    - No need for refresh: Retains data as long as power is supplied.
    - Fast and reliable : Faster than DRAM, used in cache memory.
    - More expensive: Higher cost due to complexity and larger size of cells.
- DRAM (Dynamic RAM)
    - Volatile Memory: Loses its data when power is turned Off.
    - Needs to refresh: Must be periodically refreshed to Retains data.
    - Dense and cheaper: More cost-effective and can store more data per chip than SRAM.
    - Common Use: Main system memory in computers.
- **ROM (Read-Only Memory)**
    - Non-volatile Memory: Retains its data even when power is turned off.
    - Used to store firmware and system-level software that does not change frequently.
    - Types: PROM (Programmable Read-Only Memory), EPROM (Erasable Programmable Read-Only Memory), and EEPROM (Electrically Erasable Programmable Read-Only Memory).
    - Provides essential instructions for hardware boot-up processes.



- **PROM (Programmable Read-Only Memory)**
    - Non-volatile Memory: Retains data when power is turned off.
    - Once programmed, it cannot be modified.
    - Useful for hardware programming, but lacks flexibility for updates.
    - Common Use: Embedded systems, microcontrollers.
- **EPROM (Erasable Programmable Read-Only Memory)**
    - Non-volatile Memory: Retains data when power is turned off.
    - Can be erased and reprogrammed by exposing it to ultraviolet light.
    - Used for systems that need updates but require manual intervention for erasing.
    - Common Use: BIOS chips, early microcontrollers.
- **EEPROM (Electrically Erasable Programmable Read-Only Memory)**
    - Non-volatile Memory: Retains data when power is turned off.
    - Can be erased and reprogrammed electrically, allowing for easy updates.
    - Often used for systems that need frequent updates or modifications.
    - Common Use: Firmware updates, small-scale data storage like configuration settings.

Differences between **Primary Memory** and **Secondary Memory**:

Aspect	Primary Memory	Secondary Memory
Also Known As	Main Memory	External or Auxiliary Memory
Volatility	Volatile (e.g., RAM)	Non-volatile
Data Retention	Loses data when power is turned off (for most types)	Retains data even when power is turned off
Speed	Faster (nanoseconds access time)	Slower (milliseconds access time)
Capacity	Limited (typically in GBs)	Larger (can range from GBs to TBs)
Cost	More expensive per unit of storage	Less expensive per unit of storage
Usage	Used for active processes and tasks	Used for long-term data storage
Examples	RAM (Random Access Memory), ROM	Hard Disk Drives (HDD), Solid State Drives (SSD), CDs, DVDs
Data Access	Directly accessible by the CPU	Requires intermediate steps for access
Power Dependency	Requires power to maintain data (for RAM)	Independent of power for data retention
Physical Location	Internal (mounted on the motherboard)	External or internal (storage drives)
Read/Write Operations	Fast read/write operations	Slower read/write operations

- **Cache Memory**
    - Volatile Memory: Loses its data when power is turned off.
    - Extremely fast: Faster than RAM, helps in reducing the CPU's time to access data.

- Stores frequently accessed data: Holds the most recently used instructions and data for quick retrieval by the CPU.
- Common Use: Speeding up data access for the CPU to improve system performance.

2. **Secondary Memory**
   - Non-volatile Memory: Retains data even when power is turned off.
   - Large capacity: Can store vast amounts of data, ranging from gigabytes to terabytes.
   - Slower access: Compared to primary memory, secondary memory has slower read/write speeds.
   - Used for long-term storage: Ideal for storing large files and data that don't need to be accessed frequently by the CPU.
   - Examples: Hard Disk Drives (HDD), Floppy Disks (FD), CDs, DVDs, and Magnetic Tape.
   - **FD (Floppy Disk)**
     - Non-volatile Memory: Retains data without power.
     - Small storage capacity: Typically 1.44 MB, now largely obsolete.
     - Portable: A small, removable storage device used in the early days of personal computing.
     - Slow access: Much slower than modern storage devices.
     - Common Use: Data transfer between computers before USB drives and modern storage took over.
   - **HDD (Hard Disk Drive)**
     - Non-volatile Memory: Retains data when power is turned off.
     - Large storage capacity: Ranges from hundreds of gigabytes to several terabytes.
     - Magnetic storage: Uses spinning platters coated with magnetic material to store data.
     - Slower than SSDs but cost-effective: HDDs are cheaper per gigabyte than SSDs but have slower read/write speeds.
     - Common Use: Long-term storage of files, applications, and operating system data in computers.
   - **Magnetic Tape**
     - Non-volatile Memory: Retains data even when power is turned off.
     - Sequential access: Data is read in sequence, making it slower to access specific files.
     - High durability and capacity: Can store large amounts of data, used for archival purposes.
     - Common Use: Long-term data backup and archiving in industries due to its large capacity and durability.
   - **CD (Compact Disc)**
     - Non-volatile Memory: Retains data when power is off.
     - Optical storage: Uses laser technology to read and write data.
     - Capacity: Typically holds 700 MB of data.
     - Common Use: Music, software distribution, and small file storage.
   - **DVD (Digital Versatile Disc)**
     - Non-volatile Memory: Retains data without needing power.
     - Optical storage: Similar to CDs but with a higher data capacity.
     - Capacity: Typically holds 4.7 GB (single-layer) or up to 8.5 GB (dual-layer).
     - Common Use: Movies, video games, software, and large file storage.

Here’s an improved and corrected version of your notes:

Number System

In a number system of base (n), the digits range from (0) to (n-1). The base is also referred to as the **radix** of the number system. Each number is represented as a sequence of digits, and the base (n) is written as a subscript.

Common Number Systems:

- **Binary (Base 2)**:
  Digits are $((0, 1))$ and the representation is written as: $((0, 1)_2)$
- **Octal (Base 8)**:
  Digits are $((0, 1, 2, 3, 4, 5, 6, 7))$ and the representation is written as: $((0, 1, \ldots, 7)_8)$

- **Decimal (Base 10)**:
  Digits are $((0, 1, 2, 3, 4, 5, 6, 7, 8, 9))$ and the representation is written as: $((0, 1, \ldots, 9)_{10})$
- **Hexadecimal (Base 16)**:
  Digits are $((0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F))$
  The representation is written as: $((0, 1, \ldots, 9, A, B, C, D, E, F)_{16})$

Conversions

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1. **Converting from Decimal to Binary**:
   - Take the decimal number you want to convert.
   - Divide the number by 2 (the base of binary) and note the remainder.
   - Continue dividing the quotient by 2 until the quotient becomes zero.
   - Collect the remainders in reverse order to get the binary equivalent.

   Example:
   Convert 13 to binary:

2	13	1
2	6	0
2	3	1
2	1	

   Read the remainders from bottom to top: $13_{10} = 1101_2$

---

2. **Converting from Decimal to Octal**:

   - Divide the decimal number by 8 (the base of octal) and note the remainder.
   - Continue dividing the quotient by 8 until the quotient becomes zero.
   - Collect the remainders in reverse order to get the octal equivalent.

   Example:
   Convert 65 to octal:

8	65	1
8	8	0
8	1	1
	0	

   Read the remainders from bottom to top: $65_{10} = 101_8$
   Convert 12345 to octal:

8	12345	1
8	1543	7
8	192	0
8	24	0
8	3	

   Read the remainders from bottom to top: $12345_{10} = 30071_8$

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3. **Converting from Decimal to Hexadecimal**:

   - Divide the decimal number by 16 (the base of hexadecimal) and note the remainder.
   - Continue dividing the quotient by 16 until the quotient becomes zero.
   - Convert any remainder greater than 9 into its hexadecimal letter equivalent (A = 10, B = 11, etc.).
   - Collect the remainders in reverse order to get the hexadecimal equivalent.

   Example:
   Convert 255 to hexadecimal:

16	255	15
16	15	

Remainder 15 corresponds to F in hexadecimal:
$255_{10} = FF_{16}$

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4. **Converting from Binary to Decimal**:

   - Multiply each binary digit by 2 raised to the power of its position, starting from 0 on the right.
   - Sum all the products to get the decimal equivalent.

   Example:
   Convert (1101_2) to decimal:
   $(1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$
   $= 8 + 4 + 0 + 1 = 13$
   $1101_2 = 13_{10}$

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5. **Converting from Octal to Decimal**:

   - Multiply each octal digit by 8 raised to the power of its position, starting from 0 on the right.
   - Sum all the products to get the decimal equivalent.

   Example:
   Convert (101_8) to decimal:
   $(1 \times 8^2) + (0 \times 8^1) + (1 \times 8^0)$
   $= 64 + 0 + 1 = 65$
   $101_8 = 65_{10}$

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6. **Converting from Hexadecimal to Decimal**:

   - Multiply each hexadecimal digit by 16 raised to the power of its position, starting from 0 on the right.
   - Convert any letters (A = 10, B = 11, etc.) to their decimal equivalents before multiplying.
   - Sum all the products to get the decimal equivalent.

   Example:
   Convert (FF_{16}) to decimal:
   $(15 \times 16^1) + (15 \times 16^0)$
   $= 240 + 15 = 255$
   $FF_{16} = 255_{10}$

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7. **Converting from Binary to Octal**:

   - Group the binary number into sets of three digits, starting from the right.
   - Convert each group to its octal equivalent.

   Example:
   Convert (110101_2) to octal:

   $$\begin{array}{ccc|c} 1 & 1 & 0 & 1 \\ 0 & 1 & & 5 \end{array}$$

   Grouped as: $((110)(101)) \text{ gives } ((6)(5))$
   Answer: $110101_2 = 65_8$

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8. **Converting from Binary to Hexadecimal**:

   - Group the binary number into sets of four digits, starting from the right.
   - Convert each group to its hexadecimal equivalent.

   Example:
   Convert (11010101_2) to hexadecimal:

$$\begin{array}{cccc} 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \end{array}$$

Grouped as: $((1101)(0101))$ gives $((D)(5))$
$11010101_2 = D5_{16}$

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9. **Converting from Octal to Binary**:

   - Convert each octal digit to its binary equivalent, using three binary digits for each octal digit.

   Example:
   Convert (47_8) to binary:

$$\begin{array}{c|c} 4 & 100 \\ \hline 7 & 111 \end{array}$$

   Answer: $47_8 = 100111_2$

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10. **Converting from Octal to Hexadecimal**:

    - Convert the octal number to decimal first, then convert from decimal to hexadecimal.

    Example:
    Convert (27_8) to hexadecimal:
    Convert to decimal: $(2 \times 8^1) + (7 \times 8^0) = 16 + 7 = 23_{10}$
    Now, convert 23 to hexadecimal:

$$\begin{array}{c|c|c} 16 & 23 & 7 \\ \hline 16 & 1 & \end{array}$$

    Answer: $27_8 = 17_{16}$

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11. **Converting from Hexadecimal to Binary**:

    - Convert each hexadecimal digit to its binary equivalent, using four binary digits for each hexadecimal digit.

    Example:
    Convert $(2F_{16})$ to binary:

$$\begin{array}{c|c} 2 & 0010 \\ \hline F & 1111 \end{array}$$

    Answer: $2F_{16} = 00101111_2$

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12. **Converting from Hexadecimal to Octal**:

    - Convert the hexadecimal number to decimal first, then convert from decimal to octal.

    Example:
    Convert $(2A_{16})$ to octal:
    Convert to decimal: $(2 \times 16^1) + (10 \times 16^0) = 32 + 10 = 42_{10}$
    Now, convert 42 to octal:

$$\begin{array}{c|c|c} 8 & 42 & 2 \\ \hline 8 & 5 & 0 \end{array}$$

    Answer: $2A_{16} = 52_8$
