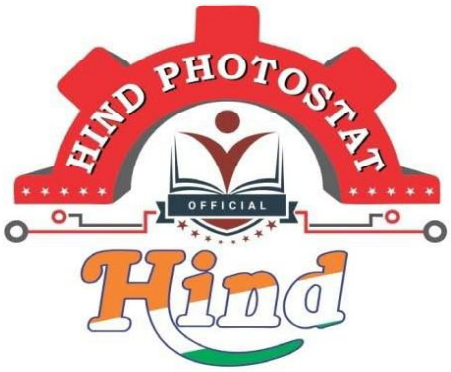


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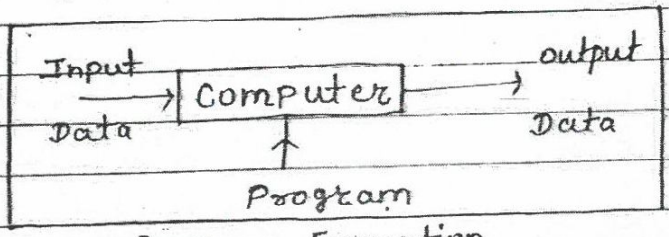
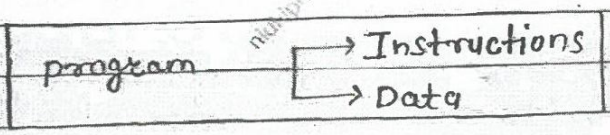
# Data Representation

# Computer →
It is a computational device used to process the data under the control of a application program which is inetiated by the user So computer system functionality is program execution.



Program Execution

# Program →
It is a sequence of instructions along with a data used to perform some task.




# Instructions →
It is a binary code which is predefined in the processor to perform some operation

| Binary Code | Bind with | operation |
|---|---|---|

eg→ If CPU-X supports "8" diff. operation then
Binary code [opcode] size = $\log_2^8$ bit
= $\log_2^{2^3}$ = 3 bit

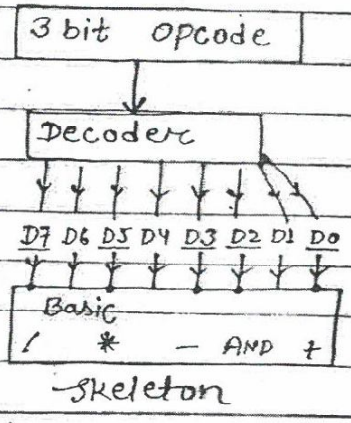
| Binary Code | operation | | | |
|---|---|---|---|---|
| 000 → | + → Decided by designer | Prepare the instruction Manual | ⇒ | Submitted to the user |
| 001 → | − | ROM | | |
| 010 → | * | control unit (Brain of CPU) | | |
| ⋮ | | | | |
| 111 → | AND | | | |

Q. → 1. Consider a system with 200 instructions (operation) opcode size is _____ ?

Q. → 2. Consider a system with 9 bit opcode. Instruction set size (# instruction) is _____ ?

Q. → 3. Consider a system with 1020 instructions, 40 registers and 8K cells of a memory –
(i) opcode size is _____ ?
(ii) Register Address is _____ ?
(iii) Memory Address is _____ ?

Q. → 4. Consider the following design –



Skeleton

(i) What is the opcode of a 'multiplication'?
(ii) What is the opcode of a 'AND' operation?
(iii) What is the opcode of a 'division' operation?
(iv) What is the size of 'Instruction set'?

Ans. 1 Opcode = $\log_2^{200}$ bit

= $\log_2 2^8$ bit = 8 bit

Ans. 2 Instructions = $2^9$ = 512

Ans. 3 (i) $\log_2^{1020}$ bit

= $\log_2^{2^{10}}$ bit = 10 bit opcode size

(ii) $\log_2^{40}$ bit

= $\log_2 2^6$ bit = 6 bit Reg. add.

(iii) $\log_2$ 8K bit

= $\log_2 2^3 \times 2^{10}$ bit = $\log_2^{2^{13}}$ = 13 bit Memory add.

Ans. 4 (i) 101

* → $D_5$

(ii) 010

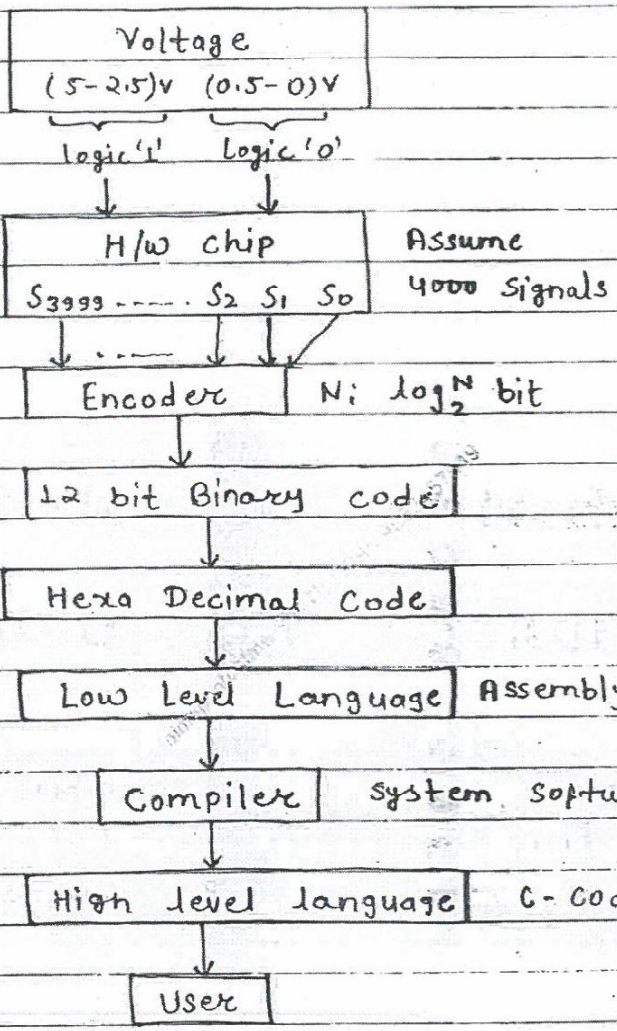
AND → $D_2$

(iii) 111

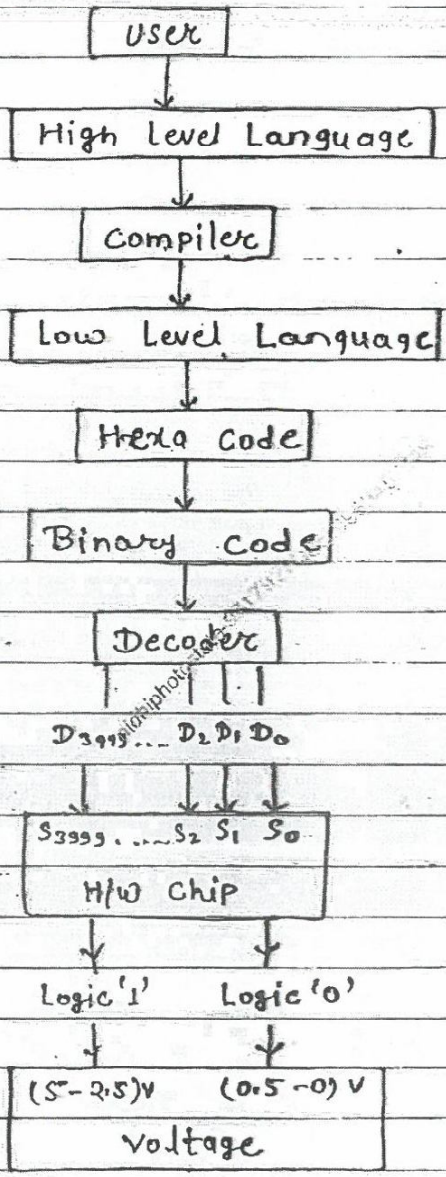
/ → $D_7$

(iv) # instruction = 5

# Designer View →

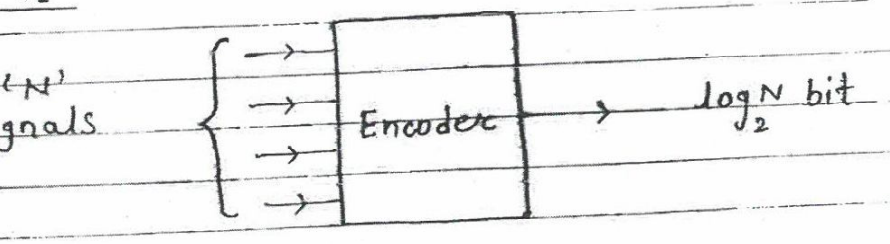


# User View →


User
High Level Language
Compiler
Low Level Language
Hexa Code
Binary Code
Decoder
D3999.... D2 D1 D0
S3999.... S2 S1 S0
H/W Chip
Logic '1'
Logic '0'
(5-2.5)V
(0.5-0) V
Voltage

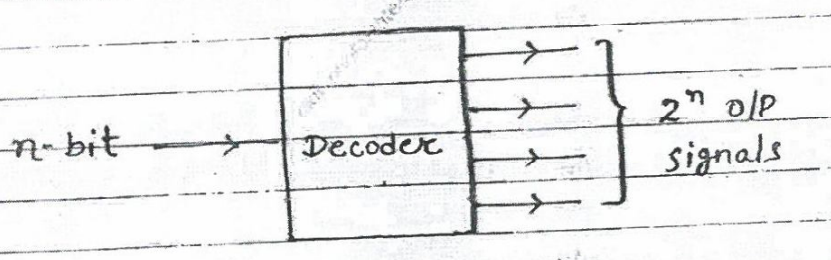
# Encoding →

In this process, N signals are representing with $\log_2 N$ bit format.




# Decoding →

In this process, n-bit decoder produces $2^n$ o/p signals.




# Data →

It is a binary code which is associated with a value base on the data format.

| Binary Code | Bind with | value |
|---|---|---|

eg → $(101)_2$

① $\overset{2}{1}\ \overset{1}{0}\ \overset{0}{1} = 5$

$(1*2^2) + (0*2^1) + (1*2^0)$

$4 + 0 + 1$

$5$ unsigned format

② $101 = -1$ Signed format

③ $101 = -2$

$101 \rightarrow 010\ (2)$ 1's complement

④ $101 = -3$

$101 \rightarrow 010$

$+\ 1$

$011\ (3)$ 2's Complement

⑤ fraction = floating point

# Data Representation →