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16 August 20

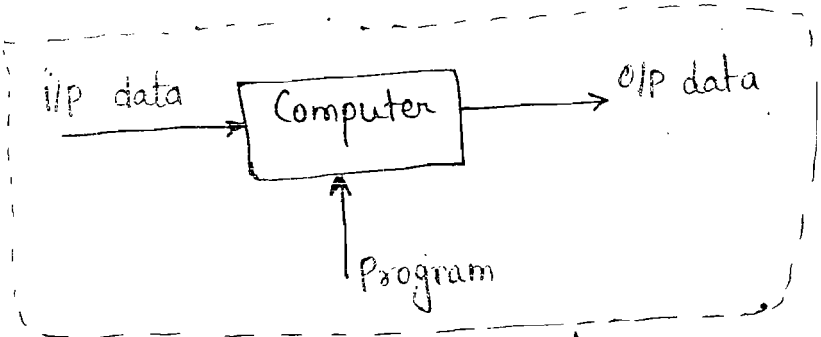
Contents

Chapter - 1

Data Representation

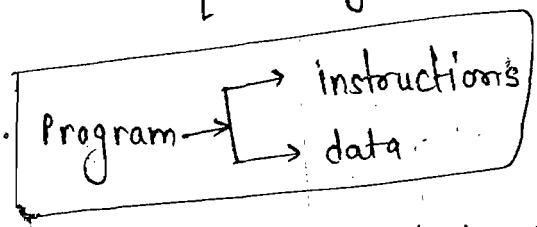
keywords

(1) Computer ⇒ it is a computational machine used to process the data under the control of a application program which is initiated by the user (or) programmer therefore computer system functionality is program execution.



Program Execution

(2) Program ⇒ Program is a sequence of instructions along with a data.



3) Instructions ⇒ It is a binary code which is designed inside the procesor to perform some task.

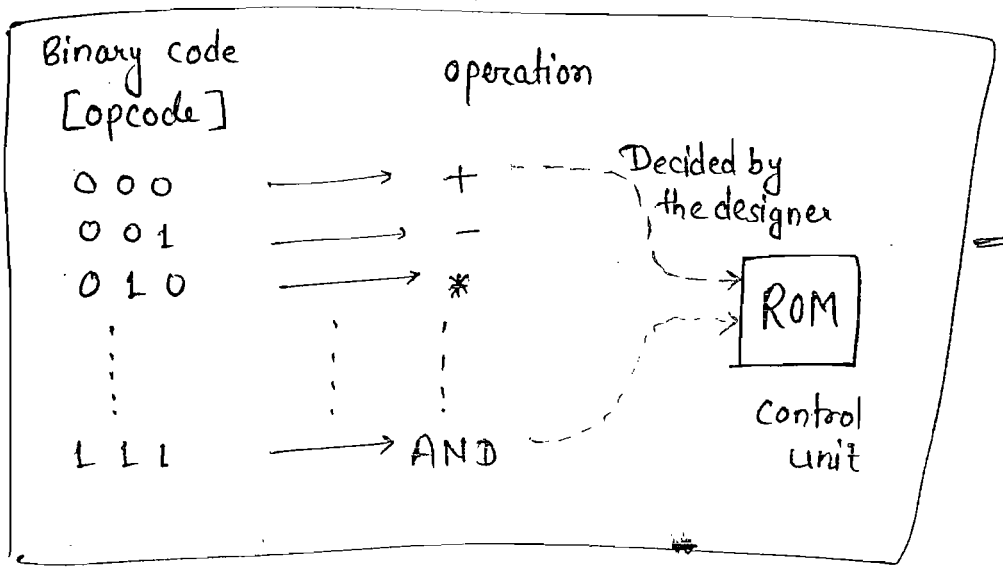
Binary code – Bind with – operation

Example:- Suppose CPU-X supports '8' ~~bit~~ different operation then

opcode size = $\log_2 8$ bit

= $\log_2 2^3$ bit

= 3 bit



⇒ Prepare the Istruction manual

(4) Design time ⇒

designer view

this flow diagram related to designer view

EE

Voltage

(5 – 2.5)V (0.5 – 0)

logic '1' logic '0'

EC

hardware chip

S_2 S_1 S_0

encoder { N: $\log_2 N$ bit }

Binary code

Hexa code

Low-level language → Assembly code

COA

CS

compiler

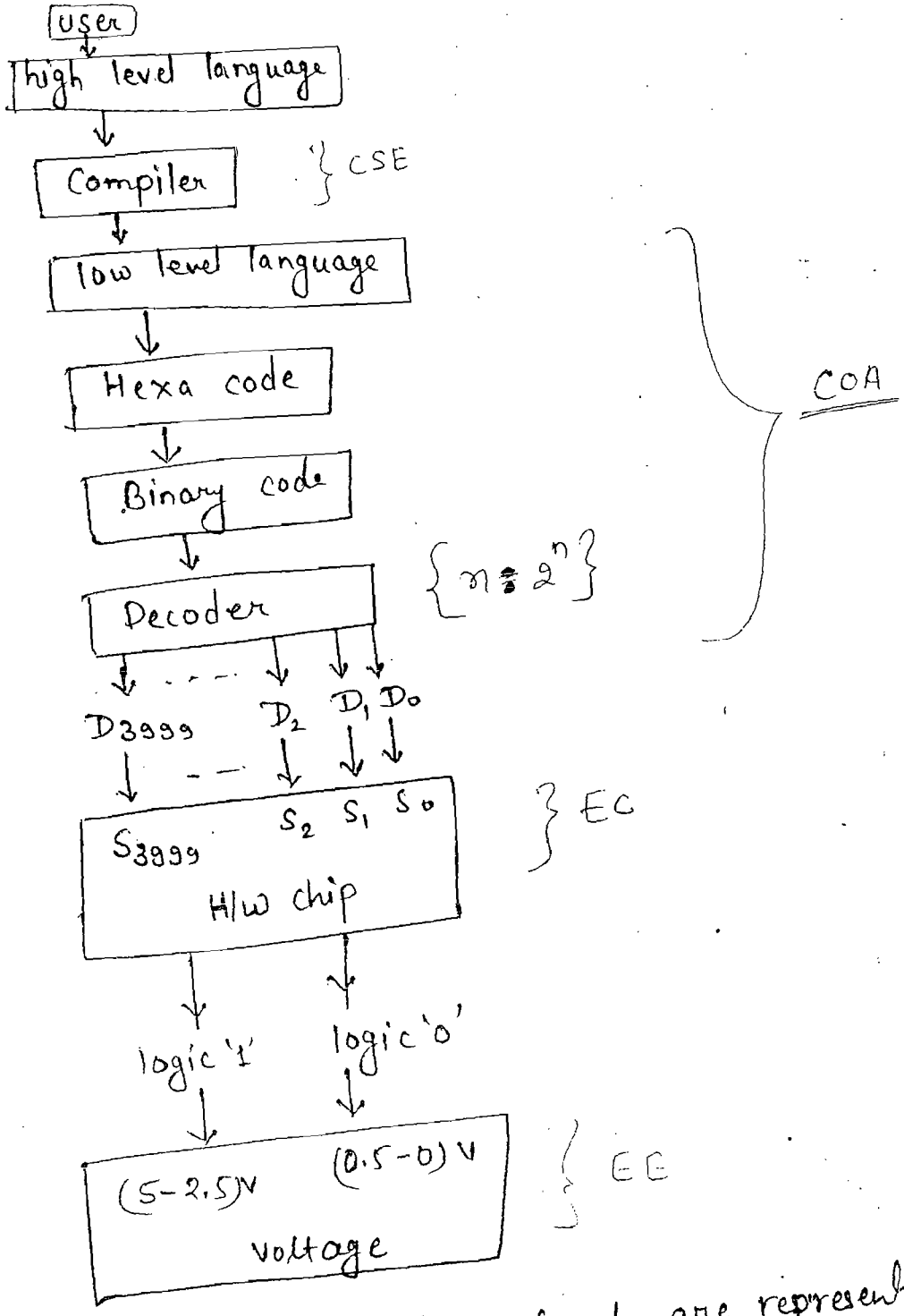
S/S & Software

High level language

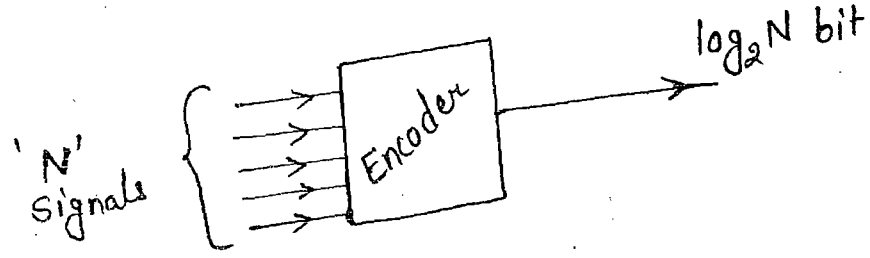
C code

User

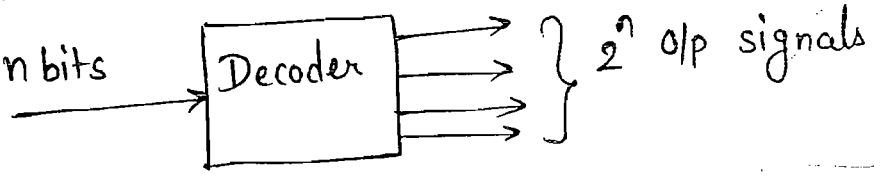
User view



5) Encoding :- In this process, 'N' signals are represented 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 based on the data format.

> Binary code — Bind with — Value

eg $(101)_2$: 5 , -1 , -2 , -3 , fraction

$(1\times2^2)+(0\times2^1)+(1\times2^0)$

$4+0+1$

5 ---- unsigned format (by default)

101 : -1 ---- sign magnitude format

101 : -2 ---- 1's complement format

101 → 010 (2)

101 : -3

101 → 010

+ 1

011 (3)

floating point format

2's complimet format

[Computer] — [user]

{Base=2} {Base=10}

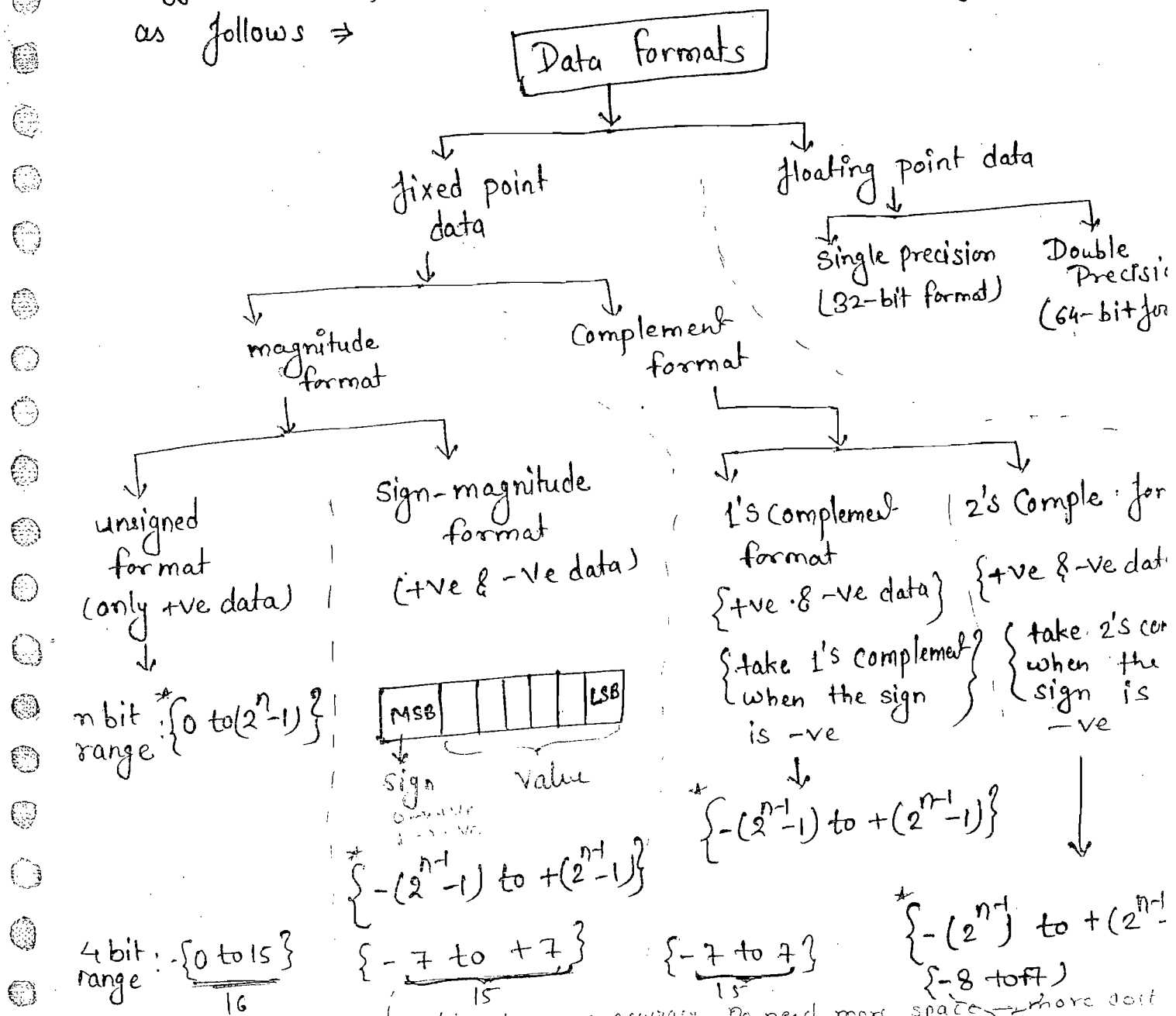
$(101)_2$ → ? Value → {5} data

$(101)_2$ → ? operation

↑

decided by designer

Different data formates used in the computer system is as follows ⇒



fixed-point data

n bit CPU :- word size = n bit
{Data size}

Eg → 4 bit CPU :- Data size = 4 bit

4 bit binary	unsigned Data	sign-magnitude Data	1's complement Data	2's complement Data
0000	0	+0	+0	+0
0001	1	+1	+1	+1
0010	2	+2	+2	+2
0011	3	+3	+3	+3
0100	4	+4	+4	+4
0101	5	+5	+5	+5
0110	6	+6	+6	+6
0111	7	+7	+7	+7
1000	8	-0	-7	-8
1001	9	-1	-6	-7
1010	10	-2	-5	-6
1011	11	-3	-4	-5
1100	12	-4	-3	-4
1101	13	-5	-2	-3
1110	14	-6	-1	-2
1111	15	-7	-0	-1

Same as sign-mgn for +ve

for 0000 → +{ }
0111
sign value

1000 → -{ }
1111
sign value

1000
-7
1000
0111
7

1001 → -6
1001 → 0110 = 6

1000 → -8
1000 → 0111
+1
1000
8

1001 → -7
1001 → 0110
+1
0111 = 7

Conclusion

Data type → data format

fixed point data →
- unsigned data (only +ve data) → unsigned format
- signed Data (+ve & -ve data) →
  - sign-magnitude format
  - 1's compl. format
  - 2's compl format

} Not in use (to contain 2 possible codes)

So **bydefault signed data is 2's compl data**

Note: **2's complement of "N" & "−N"**

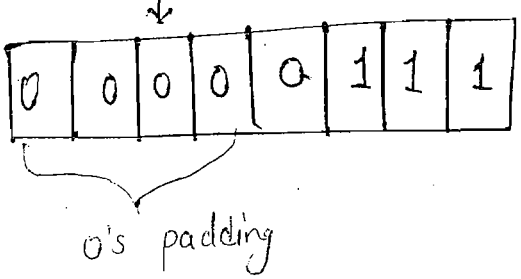
eg 2's compl of '5' & '−5'

4 bit code

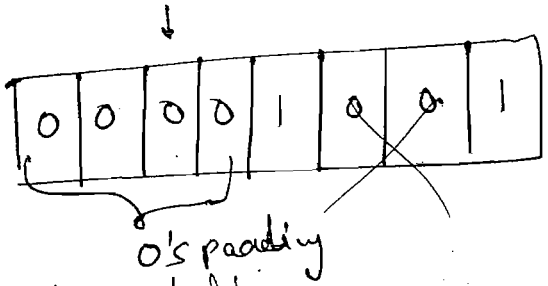
5 : 0101
↓ 2's compli
1010
+ 1
−5 ← 1011

7 : 0111
↓ 2's comp
1000
+ 1
−7 ← 1001

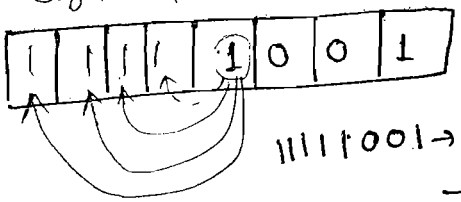
unsigned data
↓
7 : 0111
↓ stored in 8 bit register



signed data
↓
−7 : 1001
↓ stored in 8 bit regist



sign extention



11111001 → 00000
+
00001

Q) Consider the following binary code 10001010 what is its decimal equivalent when the data is in

(1) Unsigned
(2) Sign - magnitude
(3) 1's compl
(4) 2's comple format

Soln

binary code → $2^7\ 2^6\ 2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0$
1000 1010

8 x 8 x 2
64 x 2
128

(i) unsigned : $= (1\times2^7) + (1\times2^3) + (1\times2^1)$

$= 128 + 8 + 2$

$= 138$

(ii) sign - magnitude = 1 000 1010
8+2
(10)
↓
−10

iii) 1's complement of 1000 1010 : (−117)

1's 1000 1010
0111 0101
$2^6\ 2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0 \rightarrow 2^6+2^5+2^4+2^2+1 = 117$

iv) 2's complement of 1000 1010 : (−118)

1000 1010
0111 0101
+ 1
0111 0110
$2^6+2^5+2^4+2^2+2^1 = 118$

Q) which of the following codes are redundent codes in the CPU using sign - magnitude & 1's comp format.

(i) 00 & AF
(ii) 80 & 80
(iii) 00 & FF
(iv) 00 & CF

Soln

Sign magnitude:
0000 0000 : +0
1000 0000 : −0

1's compliment:
0000 0000 : +0
1111 1111 : −0