

CMS 10 11 - 2 - 10



Signed Integer:

$$\begin{cases} 1 = -\text{sign} \\ 0 = +\text{sign} \end{cases}$$

Sign-magnitude:

Ex 8 Bit Sign-mag

$$\begin{array}{l} \underbrace{1}_{\uparrow \text{Sign}} \underbrace{0011011}_{\uparrow \text{mag}} = -27 \\ \downarrow \quad \downarrow \\ \underbrace{0}_{\downarrow \text{Sign}} \underbrace{0011011}_{\downarrow \text{mag}} = +27 \end{array}$$

Given 8 Bit Sign-mag Red.

Range:  $-(2^7 - 1)$

To  
 $+(2^7 - 1)$

# of #s =  $2^8 - 1$  (not  $2^8$ )

Remember;

(# bit strings of length  $n$ ) =  $2^n$

Problem:

2 Representations of zero

0 00000000

1 00000000

# Two's complement Representation

EX. 4-BIT Two's complement

	<u>Dec</u>
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	-8
1001	-7
1010	-6
1011	-5
1100	-4
1101	-3
1110	-2
1111	-1

Addition

$$\begin{array}{r}
 1 \\
 0010 = 2 \\
 \hline
 1010 = -6 \\
 1100 = -4
 \end{array}$$

# of #s = 16 =  $2^4$

Ex. 8-BIT Two's complement

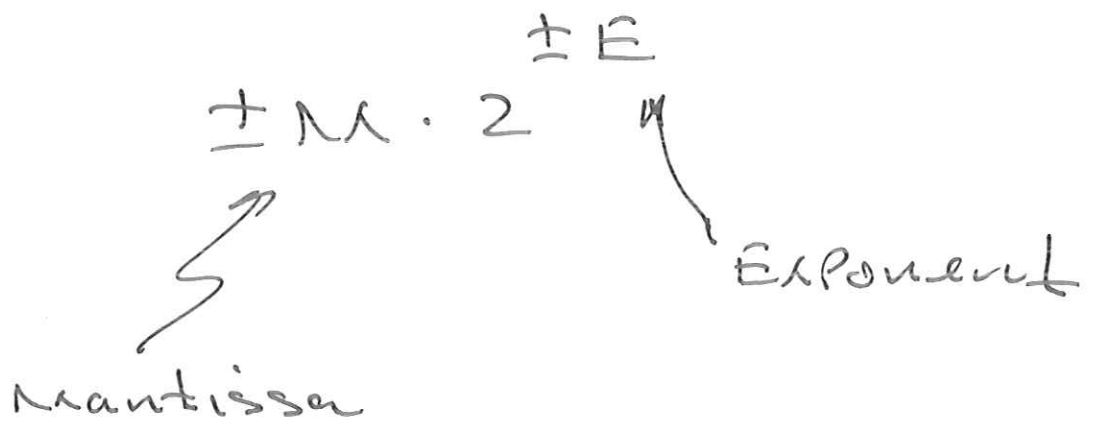
	<u>Dec</u>
0000 0000	0
0000 0001	1
0000 0010	2
⋮	⋮
0111 1111	$2^7 - 1$
1000 0000	$-2^7$
1000 0001	$-2^7 + 1$
⋮	⋮
1111 1111	-1

# Floating Point numbers

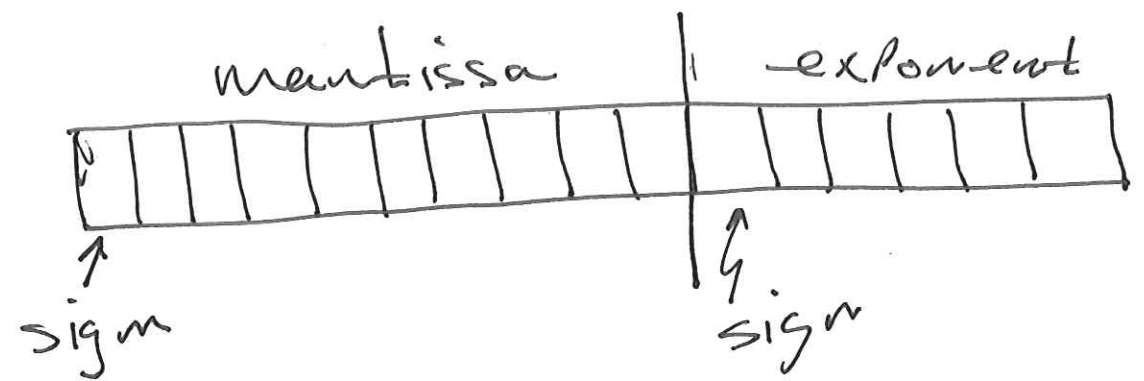
Ex. 12.75

Ex. - 0.2109375

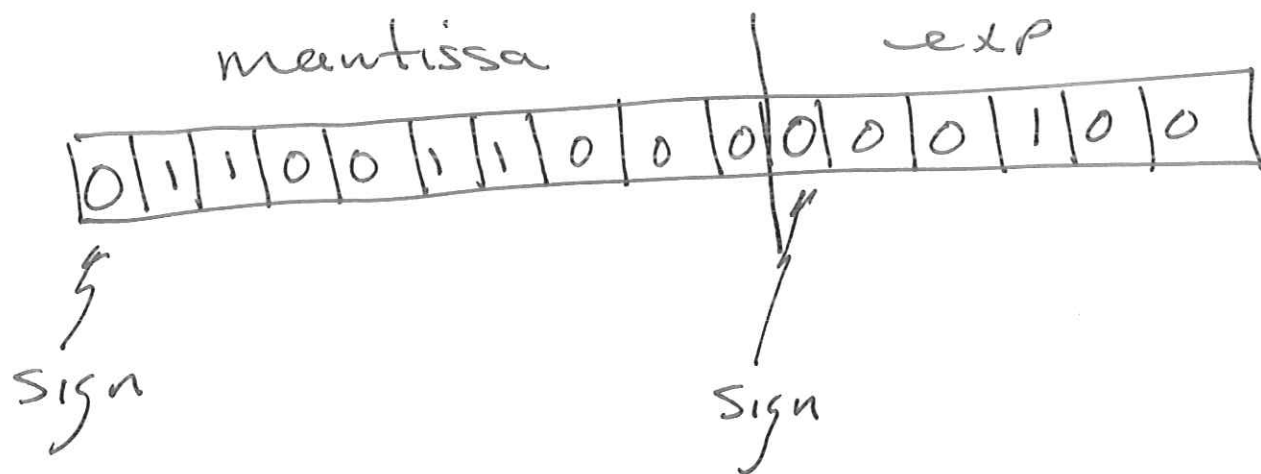
1<sup>st</sup> convert to scientific notation



Ex. 16 Bit Floating Point with 10 Bit mantissa, 6 Bit exponent



$$\begin{aligned}
 \underline{\text{Ex.}} \quad 12.75 &= 8 + 4 + \frac{1}{2} + \frac{1}{4} \\
 &= 2^3 + 2^2 + 2^{-1} + 2^{-2} \\
 &= [1100.11]_2 \\
 &= [0.110011]_2 \cdot 2^4 \\
 &= [0.110011]_2 \cdot 2^{[100]_2}
 \end{aligned}$$



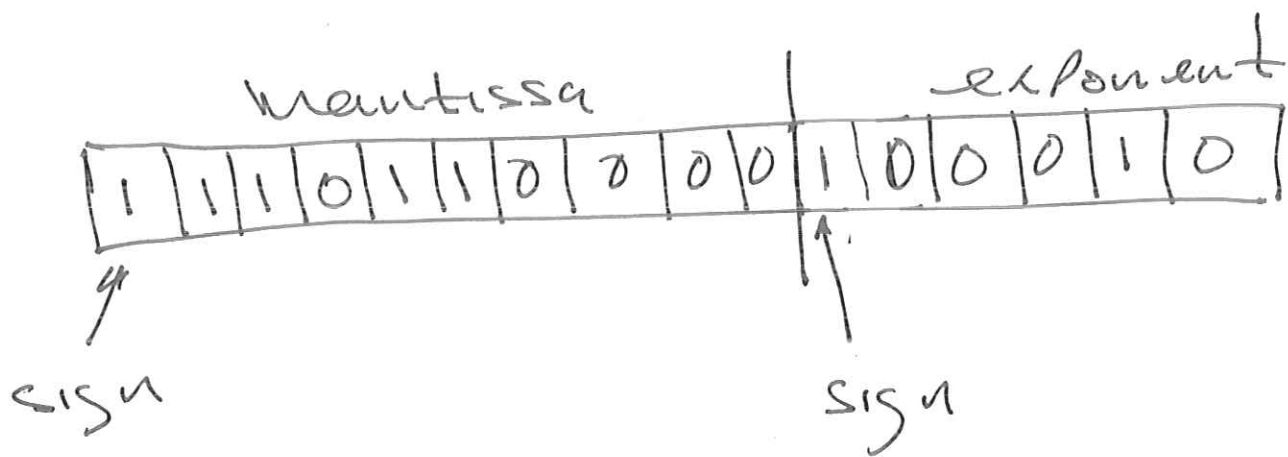
mantissa : left justified  
 exponent : right justified

Ex.  $- .2109375 = - \left( \frac{1}{8} + \frac{1}{16} + \frac{1}{64} + \frac{1}{128} \right)$  □

$= - [ .0011011 ]_2$

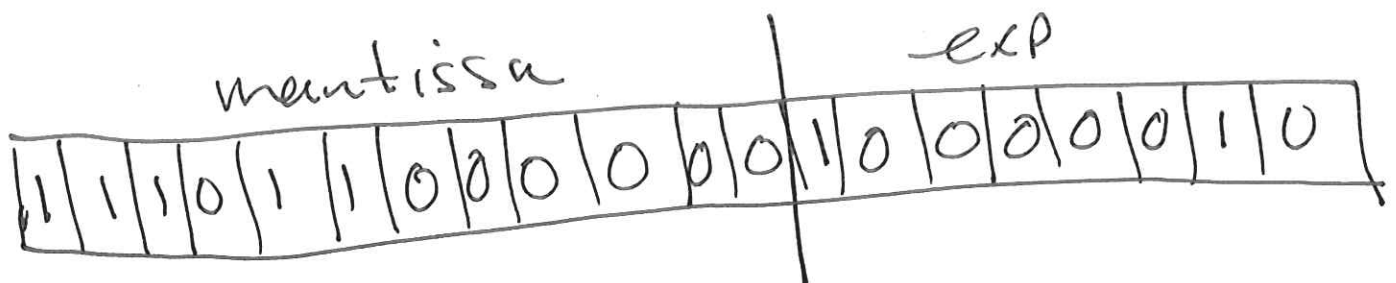
$= - [ .11011 ]_2 \cdot 2^{-2}$

$= - [ .11011 ]_2 \cdot 2^{-[10]_2}$



Ex. another architecture

20 BIT F.P. (12 bit mantissa, 8bit exp)



Text:

Character encoding Schemes

- Ascii 8-BITS
- Unicode 16-BITS

Ascii  $2^8 = 256$  Bit strings

<u>Dec</u>	<u>Bin</u>	<u>Hex</u>	<u>char</u>
0	<u>00000000</u>	00	
⋮			
32	00100000	20	Space
⋮			} Printable chars
126	...	..	
⋮			
255	11111111	FF	



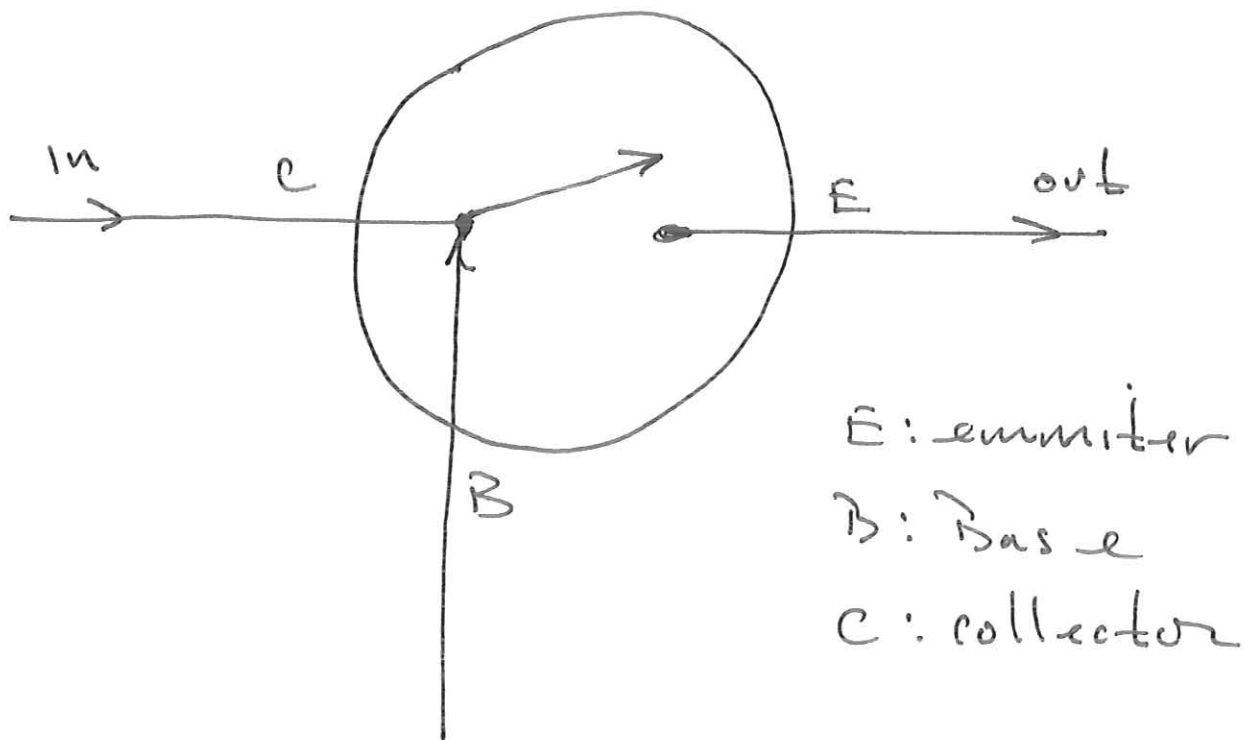
Ex, Unicode 16 bit

$$\# \text{ Bitstrings} = 2^{16} \approx 65,536$$

Dec	Bin	Hex	char
52	00000000000100000	0020	space

### Bistable Device:

- (1) 2 stable energy states (0 & 1)
- (2) states separated by energy barrier
- (3) can read state without changing,
- (4) can change state by applying suff. amount of energy

Transistor

high voltage at B: closes switch  
current flows  
from in to out.

low voltage at B: opens switch