

# Digital Data (3)

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①

## I) Natural numbers

Hexadecimal system: powers of 16

$$16 = 2^4$$

Mapping binary with hexadecimal.

(1111 1111)<sub>2</sub>

0111      1111

↓

7

F

(7F)<sub>16</sub> ↔ #7F

↔ (1111 1111)<sub>2</sub>

## II) Other numbers:

### A) Integers:

Integers include natural numbers but also include negative numbers.

In decimal, the convention to represent integers is to add a sign (+ or -) in front of the number:

+ 63

is different from - 63

On a binary system, the convention is a little different:

a) We add a bit to represent the sign:

$\boxed{0} \rightarrow +$

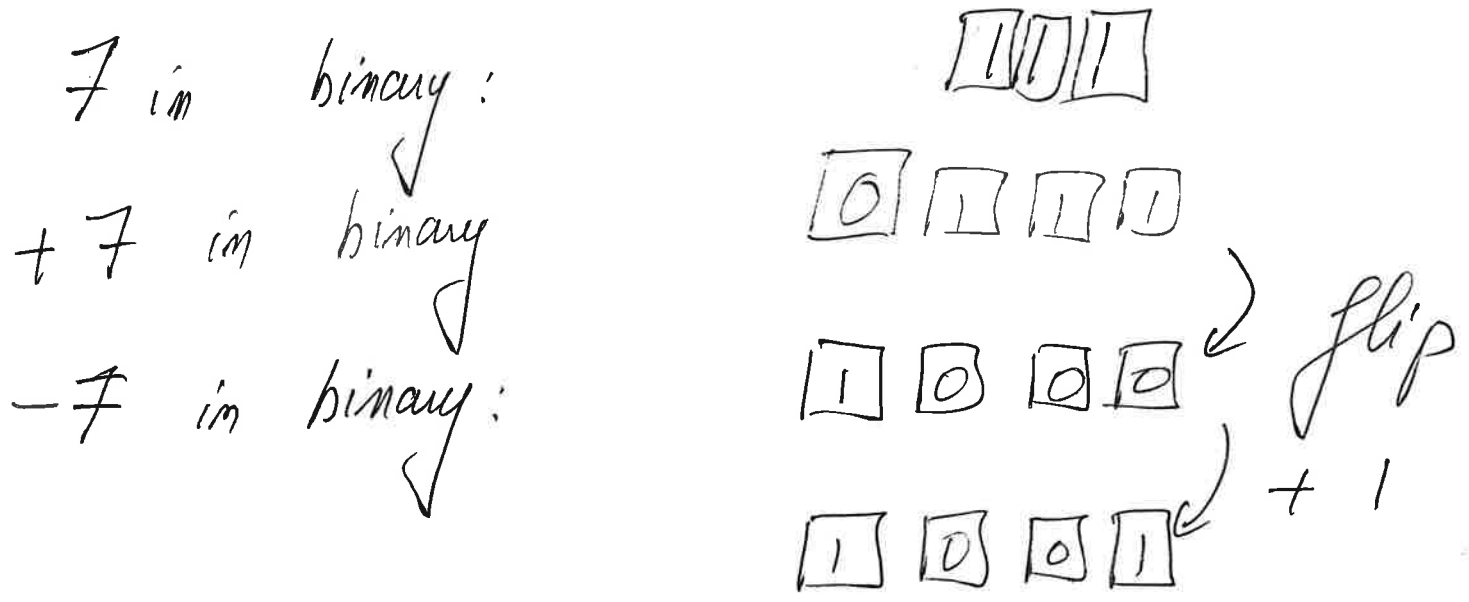
$\boxed{1} \rightarrow -$

binary representation of negative integers use the concept of "two-complement".

If a <sup>positive</sup> number  $a$  is represented by  $a_2 = ( \quad )_2$  over  $N$  bits,

the negative number  $b (= -a)$  is represented with the binary representation  $b_2$  such that  $(b)_2 = 2^N - (a)_2$

How do we get and represent a negative number?



Something important.

(4)

1 0 0 1

## B) Rational numbers

A rational number is the ratio of two integers, with the second one non zero.

$$q = \frac{a}{b}$$

A rational number is represented by 2 "blocks" of bits, one block for  $a$ , one block for  $b$ .

## C) Real numbers:

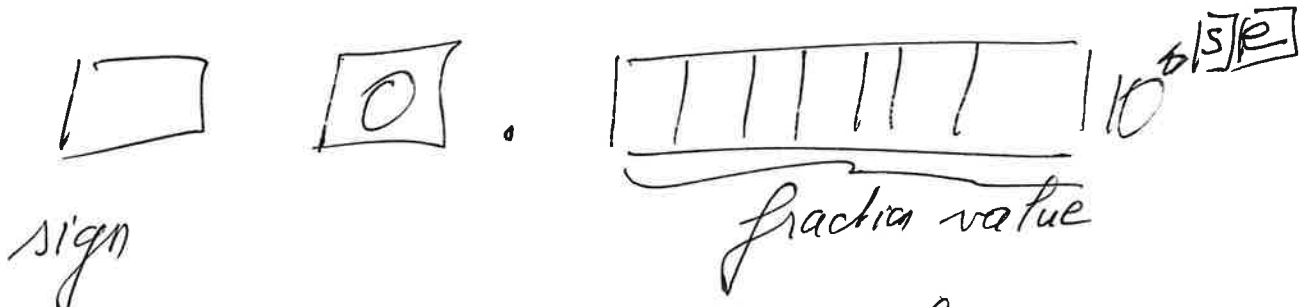
1012.67

Scientific representation:

$$+ 1.01267 \times 10^3$$

$$+ 0.101267 \times 10^4$$

If a real number is represented  
as:



Its binary representation will include:

- 1 bit for sign
- some bits from the fraction value
- 1 bit for the sign of the exponent
- some bits for the exponent itself.

