

# Digital Data

1/12/26

①

## I) Numbers

Our world:

4-digit number:  $N = a 10^3 + b 10^2 + c 10 + d$

In the computer world

4="digit"  
bit number:  $N = a 2^3 + b 2^2 + c 2 + d$

In the computer world,

Hexa decimal:

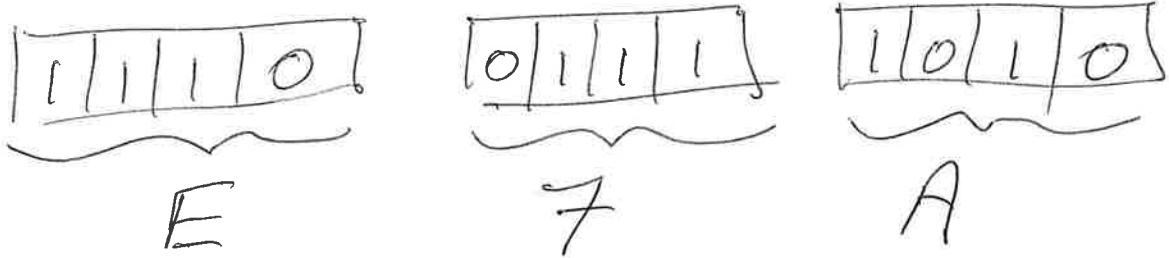
$$N = a 16^3 + b 16^2 + c 16 + d$$

a { decimal system:  $\underbrace{\{0, 1, 2, 3, \dots, 9\}}_{10}$   
binary system:  $\underbrace{\{0, 1\}}_2$   
hexa decimal:  $\underbrace{\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F\}}_{16}$

Binary / Decimal / Hexadecimal

| Binary | Decimal | Hexadecimal |
|--------|---------|-------------|
| 0000   | 0       | 0           |
| 0001   | 1       | 1           |
| 0010   | 2       | 2           |
| 0011   | 3       | 3           |
| 0100   | 4       | 4           |
| 0101   | 5       | 5           |
| 0110   | 6       | 6           |
| 0111   | 7       | 7           |
| 1000   | 8       | 8           |
| 1001   | 9       | 9           |
| 1010   | 10      | A           |
| 1011   | 11      | B           |
| 1100   | 12      | C           |
| 1101   | 13      | D           |
| 1110   | 14      | E           |
| 1111   | 15      | F           |

Binary to hexadecimal:



$$(E7A)_{16} = \#E7A$$

Hexadecimal to binary:

#FF



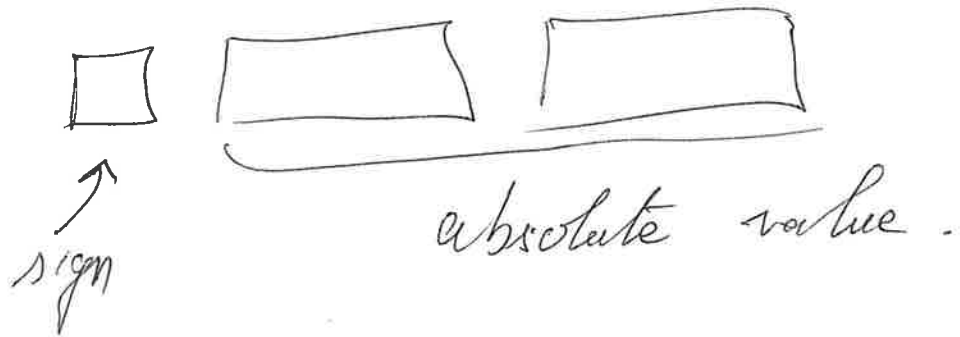
## II) Integers

A new convention for sign:

we define what I call a  
sign bit

|   |   |           |
|---|---|-----------|
| { | 0 | positive  |
|   | 1 | negative. |

Representing an integer:



$$\boxed{0} \quad \boxed{1} \boxed{1} \boxed{1} \boxed{1} \boxed{1} \quad \equiv \quad +15$$

$$\boxed{1} \quad \boxed{1} \boxed{1} \boxed{1} \boxed{1} \boxed{1} \quad \equiv \quad -15$$

Notes:

a) Careful about ambiguities.

A diagram of a 5-bit register represented as a horizontal row of five boxes. The first, third, and fifth boxes contain the number '1', while the second and fourth boxes are empty. An arrow points down to the third box. To the right of the register is a large curly brace grouping the values +15 and -7.

$$\left\{ \begin{array}{l} +15 \\ -7 \end{array} \right.$$

on 8 bits:

Unsigned:

Largest:  $2^8 - 1 = 255$

Signed integer:

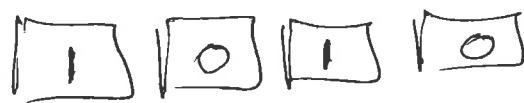
Largest:  $2^7 - 1 = 127$

In "real" life: (4)  
2-complement of the number:

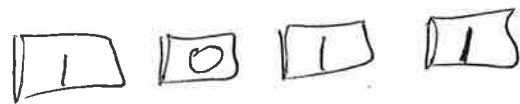


→ Number 5

reverse  
all the bits:



add 1



→ Number -5

III) Rational number.

$q$ : ratio of 2 integers  $\frac{a}{b}$ ,  
with  $b \neq 0$ .

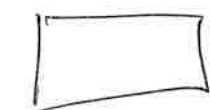
A rational number  $q$  is represented with  
the representations of the 2 integers  $a$  and  $b$ .

# IV Real numbers:

5

Convention for real number:

scientific notation:



sign



integral  
part



decimal  
value

mantissa or  
significand



exponent