

Digital Data

1/7/26①

1) Introduction

• Data means:

• "Numbers" $\left\{ \begin{array}{l} \text{Natural numbers: } 1, 2, 3 \\ \text{Integer} \left\{ \begin{array}{l} \text{positive} \\ \text{Rational numbers} \\ \text{Real} \end{array} \right. \end{array} \right.$

• Text

• Images

• Sound

• Translation:

Convention: We need to understand our conventions, and the computer's convention.

A computer "understands" On / Off

II) Positive integers

Let us understand first our convention about numbers:

two thousand twenty six

2 0 2 6



Convention #1: Left to right.

2 0 2 6

thousands hundreds tens digit

$$2 \times 1000 + 0 \times 100 + 2 \times 10 + 6$$

$$2 \times 10^3 + 0 \times 10^2 + 2 \times 10^1 + 6 \times 10^0$$

A number up to 9999 is written as

$$a \times 10^3 + b \times 10^2 + c \times 10^1 + d \times 10^0$$

a, b, c, d: digits:

Range: $[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]$

On the computer:

③

Try to mimic

$$a \times 10^3 + b \times 10^2 + c \times 10 + d$$

$$\hookrightarrow \text{but } (a, b, c, d) \in \{0, 1\}^4$$

$$\hookrightarrow a \times 2^3 + b \times 2^2 + c \times 2 + d$$

$$(1 \quad 1 \quad 1 \quad 1)_2$$

$$1 \times 2^3 + 1 \times 2^2 + 1 \times 2 + 1 = (15)_{10}$$


bit







8 bits $\rightarrow$ 1 byte.

1 bit

 largest,

but 2 numbers.

4 bits:

15 largest,

but 16 numbers.

N bits:

$2^N - 1$

but 2^N numbers.