Digital Data 1/8/25

I) Introduction

Communicating with a computer requires

a) An understanding of our own convention

b) An understanding of the computer's convention.

The basic idea behind using a computer is to understand that information will be conveyed by an "on/off" switch.

"box": ☐ is either  or a 

bit

Types of information to be translated:

a) Numbers

b) Text

c) Sound

d) Images

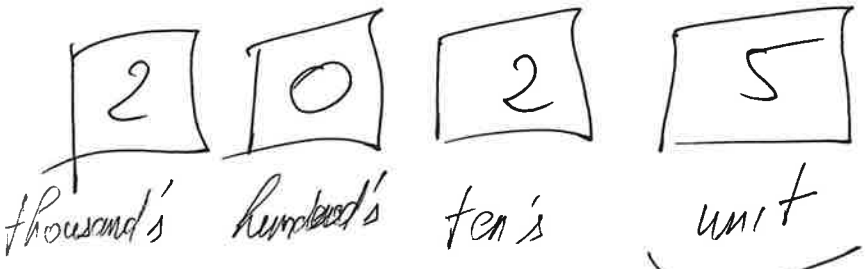
II) Information / Numbers

4 types of numbers:
- Natural numbers: 1, 2, 3, ... (+∅)
- Integers
- Rational numbers
- Real numbers.

II. 1) Natural numbers (+∅)

Our convention: 2025

Convention #1: We read from left to right



10^3 10^2 10^1 10^0

Any number with four digits is represented a:

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

i.e $N = a\,10^3 + b\,10^2 + c\,10 + d$

where $a, b, c, d \in \{0, 1, 2, \ldots 9\}$

Now, if I want to represent a number on a computer,

(1) $\rightarrow a, b, c, d \in \{0, 1\}$

(2) We need to replace the powers of 10 with powers of 2.

$$N = a\,2^3 + b\,2^2 + c\,2^1 + d$$

Example:

$$(1\ 0\ 1\ 0)_2 = (10)_{10}$$

$2^3\ \ 2^2\ \ 2\ \ 2^0$

$$(1\ 1\ 0\ 1)_2 = (13)_{10}$$

$$(1\ 1\ 1\ 1)_2 = (15)_{10}$$

On 4 "places":

the smallest number is: $(0\,0\,0\,0)_2 = (0)_{10}$

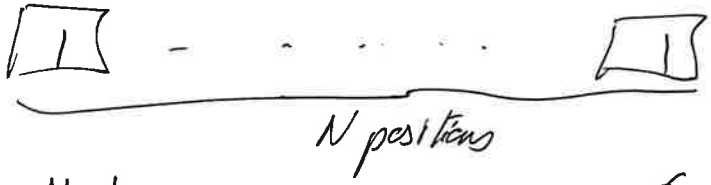
the largest number is $(1\,1\,1\,1)_2 = (15)_{10}$

but we can represent 16 numbers
$(1, \ldots, 15 + 0)$

On N "places"

the smallest number is $[0 - - - - - 0] = (0)_{10}$
1 N

the largest number:



2^{N-1} 2^0

largest number: $2^{N-1} + 2^{N-2} + \ldots 2^0 = 2^N - 1$

How many numbers can we represent:

$0, 1, \ldots \ldots 2^N - 1$: 2^N numbers

"place": bit