ERASMUS PLUS

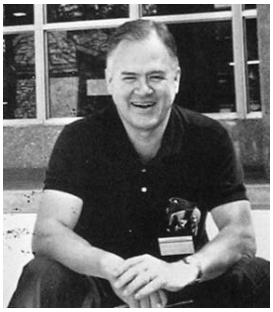
Wednesday 21st March 2018

« Everyday life as a result of historical events : Bytes and codes »

I. Bits and Bytes

- **bit** the smallest unit of storage
  binary **i**nformation digi**t** : 1 or 0

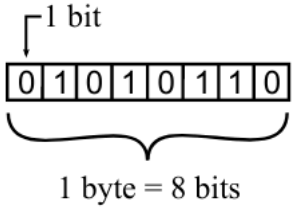
  Origin John Tukey (Bell Labs) January 1947
  Claude Shannon (1948 A Mathematical Theory of Communication)


John Tukey (1915-2000)


Claude Shannon (1916-2001)

- **byte** a group of 8 bits, an **octet**

  Example 0 1 0 1 1 0 1 0
  8 spaces , $\underbrace{2 \times 2 \times \ldots \times 2}_{8\,times} = 2^8 = \mathbf{256}$ possibilities



II. Binary numbers

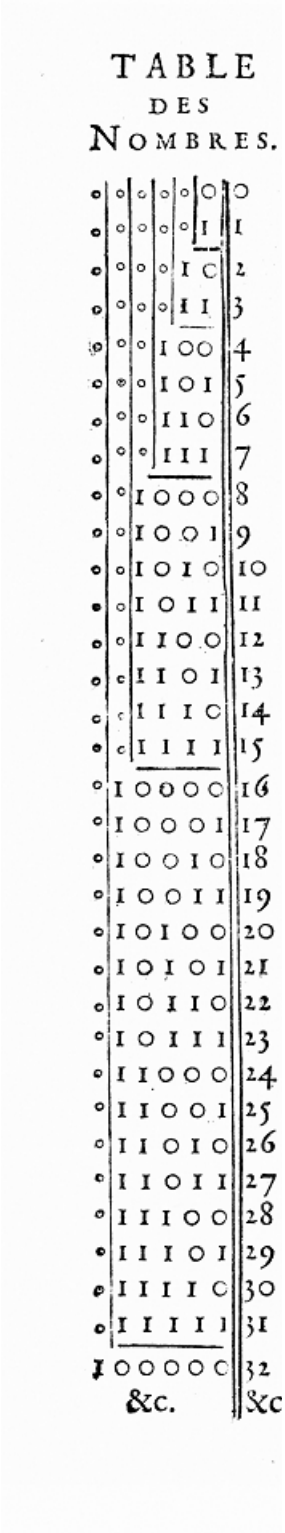

Leibniz

Leibniz (1646-1716) wanted to write numbers using **only 2 digits** :

0 and 1

His aim was to avoid human error.

« Explanation of Binary Arithmetic, which uses only the characters 1 and 0 »



To write a number with only 2 digits 0 and 1, we don't make piles of powers of 10 (1, 10, 100, 1000 ...) as usual but piles of powers of 2 (1, 2, 4, 8, 16, 32, 64...)

$$\begin{aligned} \text{For instance, } 9 &= 8+1 \\ &= 1\times 8+0\times 4+0\times 2+1 \\ &= \mathbf{1}\times 2^3+\mathbf{0}\times 2^2+\mathbf{0}\times 2^1+\mathbf{1}\times 2^0 \end{aligned}$$

So the binary writing of 9 is 1001.

Your turn

- What is the following binary number of 1010111 ?
- Write the decimal number 45 as a binary number.

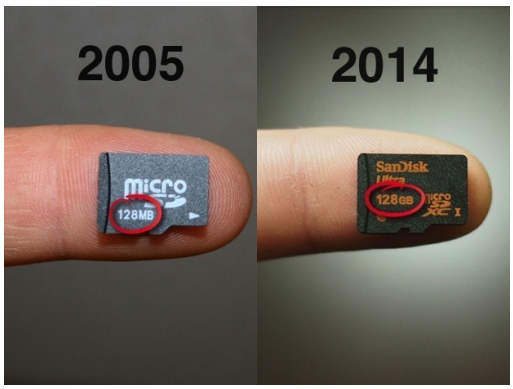
128	64	32	16	8	4	2	1

- Do you recognize the binary number 10101011 (find the decimal writing) ?

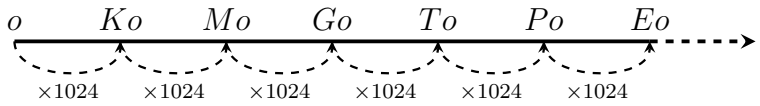
- Try to add the two binary numbers 0101010 and 101100 (check your answer with the decimal writing)

$$\begin{array}{rr} & 0101010 \\ + & 101100 \\ \hline & \end{array}$$

III. Memory and bits



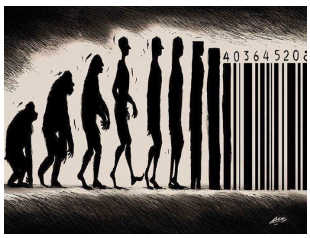
octet, Kilo octet, Mega octet, Giga octet, Tera octet, Peta octet, Exa octet, . . .



Your turn

One Peta octet (or ≈ Go) of average MP3-encoded songs would require 2000 to play.

IV. Codes and check digits

- Universal Product Code (UPC-A) barcode for tracking trade items in stores.
-  ISBN (books), QR code
- Credit cards. . .

With a check digit, one can detect simple errors in the input of a series of characters.

Your turn

The last digit is a **check digit**

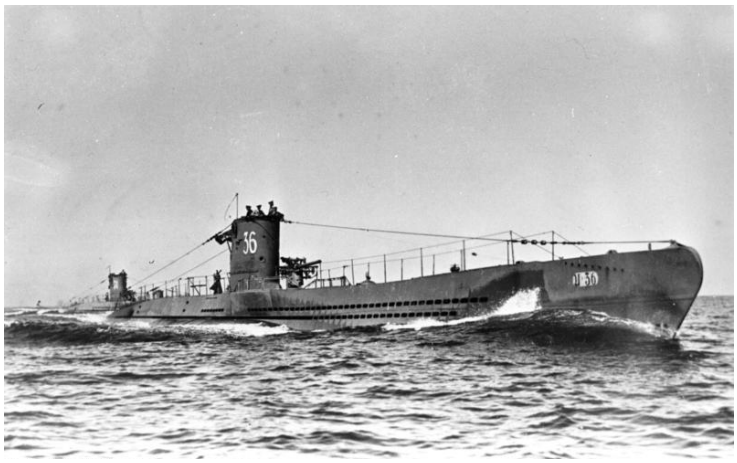
How to check the code $a_1a_2a_3a_4a_5a_6a_7a_8a_9a_{10}a_{11}a_{12}$?

The code is right if S is a multiple of 10 where

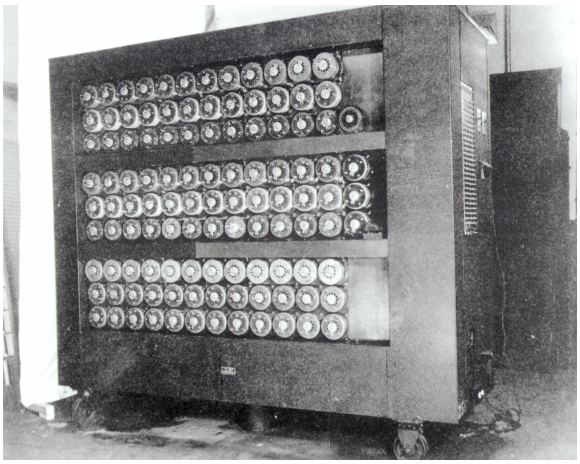
$$S = 3\,a_1 + a_2 + 3\,a_3 + a_4 + \cdots + 3\,a_9 + a_{10} + 3\,a_{11} + a_{12}$$

Check if the « smiley UPC » is right or not.

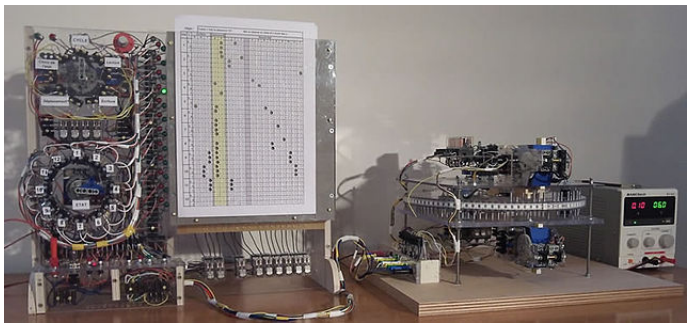
V. Codes ans Second World War : Alan Turing

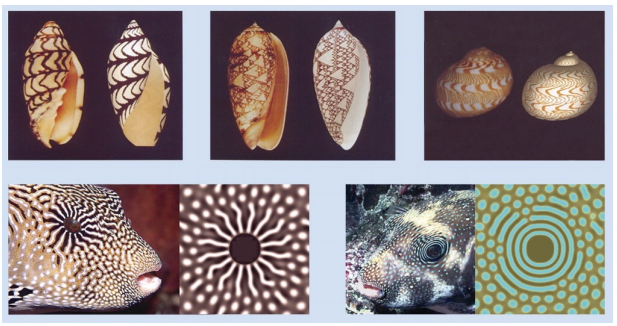


During the Second World War, German transmissions for U-Boat were encrypted with the enigma machine.



Alan Turing created a kind of computer named Bomba that craked the Enigma code.
He saved thousands of lives during the battle of the Atlantic.





- **Turing machine** a mathematical model of a computer.
- **Turing patterns** patterns on animals skins