INFORMATION

Objective

To be able :

- to define different types of information
- to ask a question with a binary answer
- to simplify a problematic and find a digital explanation
- to convert a decimal value in a binary value

What is Information

Definition

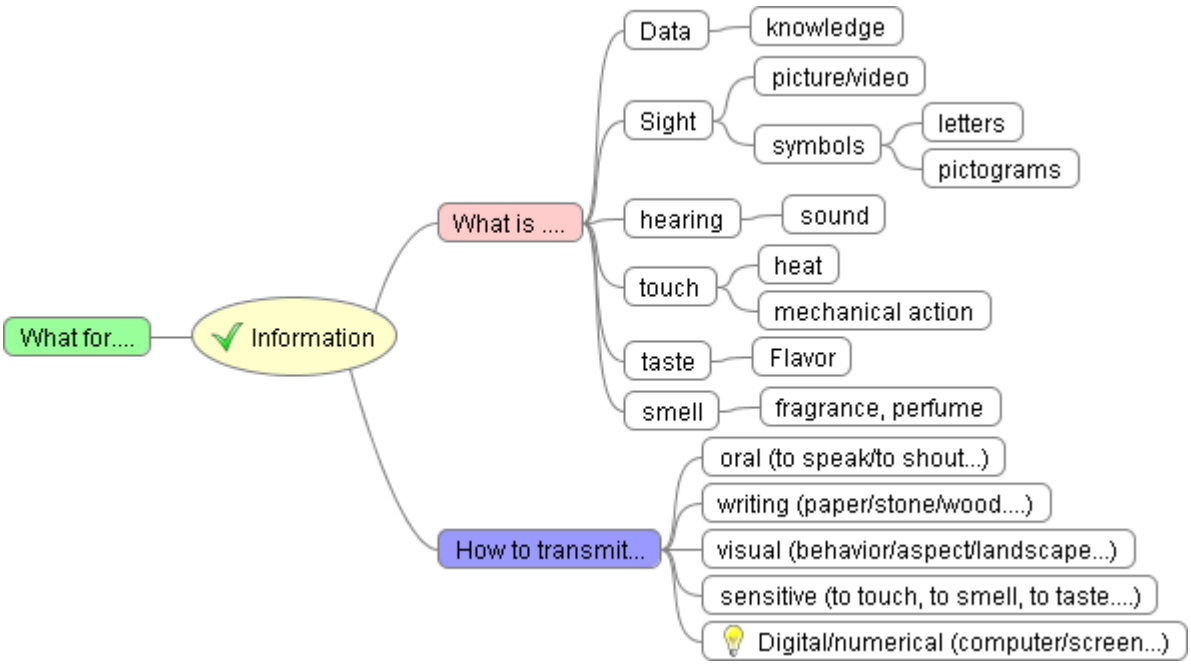
*"**Information** (shortened as info or info.) is something that informs, i.e. from which data can be derived. Information is conveyed either as the content of a message or through direct or indirect observation of some thing." adapted from Wikipedia*

Our definition : *Information is all the multiform data which give us knowledge.*

We get information through five sens :

- *sight*
- *hearing*
- *Smell*
- *Touch*
- *Taste*

Information



How to transmit Information

Look at the mind map below

Human transmission :

- speaking/shouting
- writing/drawing
- showing
- diffusing
- touching
- behavior

Technical transmission :

- wires
- waves
- light-signals
- networks

What is a Digital Information

Definition

Digital :

Derived from the capacity to count on fingers (latin : digitalis).
By extension, DIGITAL describes electronic technology that manages (stores, modifies, etc...) data in terms of two states.
In opposition, ***analog*** technology manage information by changing the amplitude or the frequency.

When we talk about a digital value, it implies that this value could be used by a digital device like a computer.

Numerical :

Used to talk about counted values. It's the generic word for a value.
A digital value is also a numerical value, but a numerical value is not necessarily a digital value.

What is in a computer's mind ?

Binary states

There can be no ambiguity in a digital device.

All the elementary digital information have just two possibilities :

- **FALSE or TRUE**
- **OPEN or CLOSED**

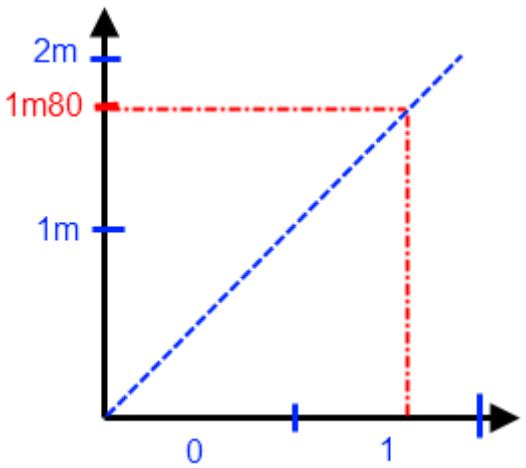
Actually, all digital devices have a logical behavior, and both states are defined as "0" and "1".

So it's possible to use base-two which has just two numbers.... 0 and 1.

Example 1:
The switch position :

Switch position	Binary value
OFF	0
ON	1

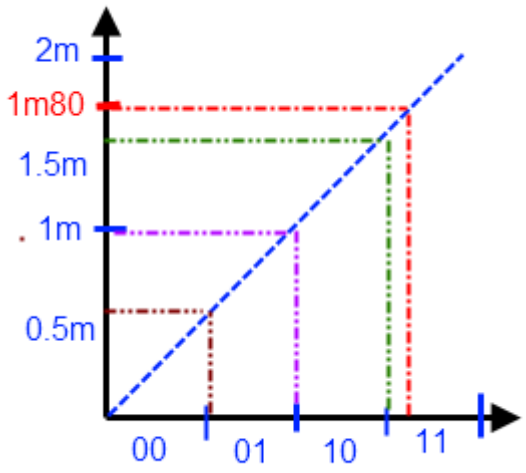
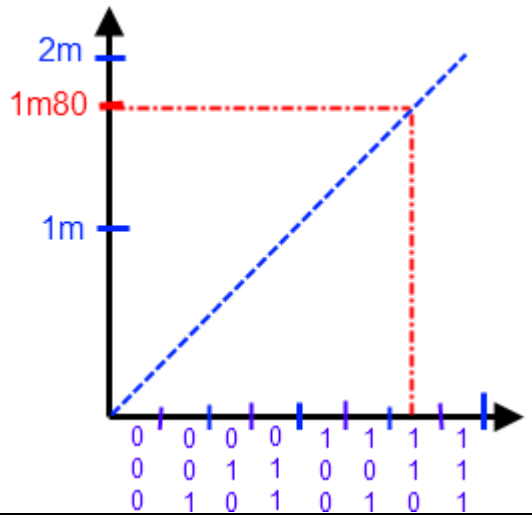
Example 2 :
John is 1,8meter tall.
Is John taller than 1meter ?
The answer is YES
John=1



This binary unit is called *BIT* (from the contraction of BInary digiT).

More than two.....

In this last example, we can see that John's height is not very precise.
Most of the time, it's necessary to be more precise but, **with a digital conversion we always lose information.**

To have 4 steps in this problematic, we need 2 bit. An so we can give a more precise value : John's height is between 1,5m and 2m. Every value represents a range of 50cm.	
To have 8 steps we need 3 bit. Every value represents a range of 25cm.	

The use of more than one bit gives us the possibility to define more than two pieces of information.

Number of bit	Number of possibilities
1	2
2	4
3	8
4	16
n	2^n

A binary value with more than one bit is called a *Binary Word* or a *Word*.
An eight bit word is called a *BYTE*.
A *n* binary word has 2^n (2 to the power of n) different values from 0 to 2^n-1

Let' come back to our example :
John is 180cm tall.
The easiest way to be more precise is to convert 180 in a binary word. In this case we have centimeter-level precision.
With n=8, the different possibilities are going from 0 to 255

How to manage Digital values Conversion

From decimal to binary

In a binary word, every bit represents a power of two. From the right to the left, each value is multiplied by two as we can see in this table :

128	64	32	16	8	4	2	1

To convert a decimal value to a binary word, we need to decompose the value in an sum of power of two.

For example :

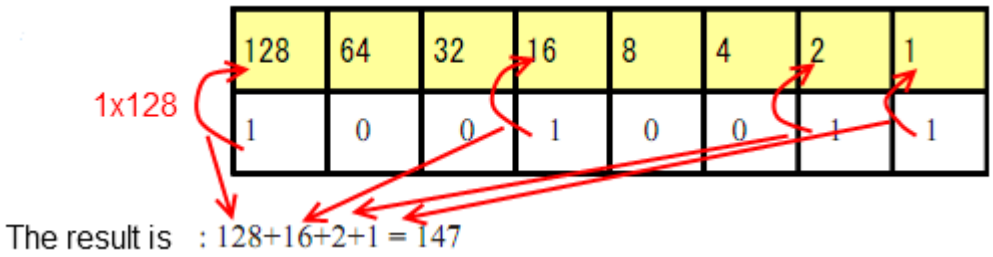
180 = 128+32+16+4

128	64	32	16	8	4	2	1
1	0	1	1	0	1	0	0

The binary word will be : 1 0 1 1 0 1 0 0

From binary to decimal

We have to use the same table with the reverse operation

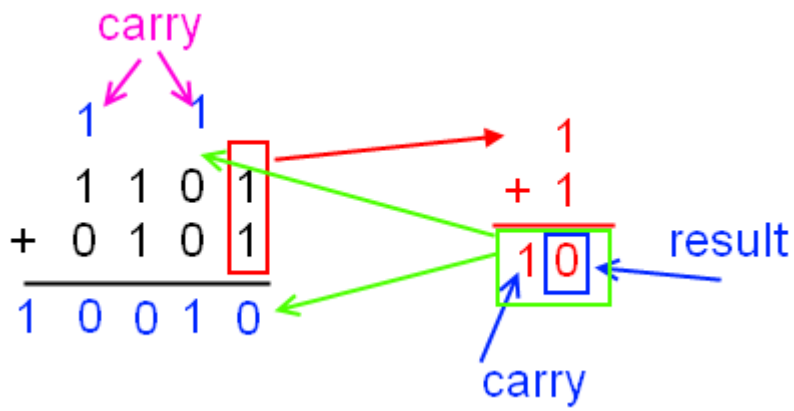


Sum

In binary counting, the only possible values are 0 and 1.

And so 1 + 1 = 10

When we add 1101 with 0101 the result will be 10010



Another base : hex

It could be difficult to write or read binary words because many letters are needed for large values.

For this reason, most of the time, another counting base is used : The hex base or hexadecimal.

In Hex code the letters A to F represent the values 10 to 15 as we can see in this table :

Décimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Héxa	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Conversion from binary to hex

To convert a binary word to an hexadecimal value, we need to make 4 bit groups from the right to the left. After this, convert each group in hex value.

Example : $(1100)_2=8+4=12_{10}=C_{16}$

Binary	1	1	0	1	0	1	0	0	0	1	1	1	1	1	0	0
Héxa	D				4				7				C			

$(1101010001111100)_2 = (D47C)_{16}$

Conversion from Hex to binary

It's quite the same operation. Convert the hex letters in 4bit binary words

Digital Information Overview

As we have seen, a computer manipulates binary data.
All kinds of informations must be converted first in "0" or "1".

But this conversion introduces often losses.

Some examples

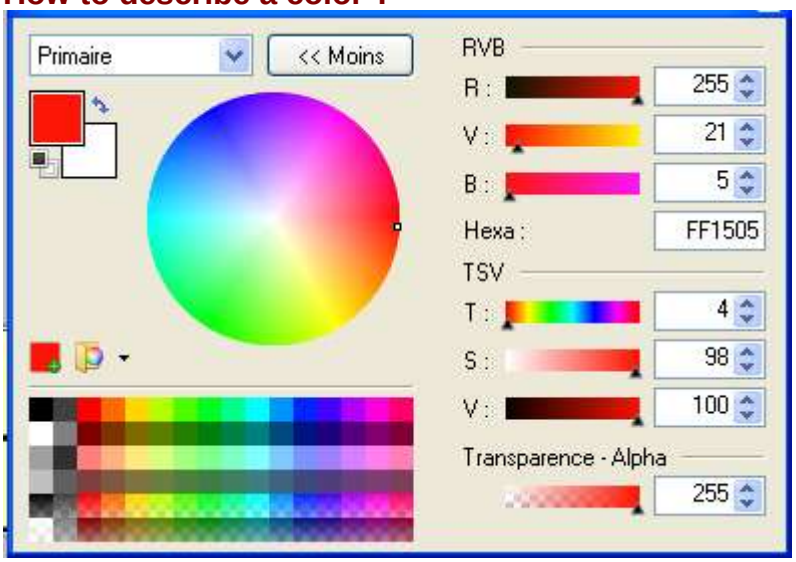
How to describe letters ?

The standard ASCII table describe the letters :

Example ADNA is coded : 41 44 4E 41

LSB \ MSB		0 000	1 001	2 010	3 011	4 100	5 101	6 110	7 111
0	0000	NUL	DLE	SP	0	@	P	`	p
1	0001	SOH	DC1	!	1	A	Q	a	q
2	0010	STX	DC2	"	2	B	R	b	r
3	0011	ETX	DC3	#	3	C	S	c	s
4	0100	EOT	DC4	$	4	D	T	d	t
5	0101	ENQ	NAK	%	5	E	U	e	u
6	0110	ACK	SYN	&	6	F	V	f	v
7	0111	BEL	ETB	'	7	G	W	g	w
8	1000	BS	CAN	(	8	H	X	h	x
9	1001	HT	EM	)	9	I	Y	i	y
A	1010	LF	SUB	*	:	J	Z	j	z
B	1011	VT	ESC	+	;	K	[	k	}
C	1100	FF	FS	,	<	L	\	l	|
D	1101	CR	GS	-	=	M	]	m	{
E	1110	SO	RS	.	>	N	^	n	~
F	1111	SI	US	/	?	O	_	o	DEL

How to describe a color ?



The standard picture files need 24 bit words to describe a color. This suppose that there are 2^{24} different colors.

How to describe a picture ?


The contents of a JPG file looks like this :

```
00000000: ff d8 ff e0 00 10 4a 46 49 46 00 01 02 01 00 60 .
00000010: 00 60 00 00 ff ed 08 d6 50 68 6f 74 6f 73 68 6f .
00000020: 70 20 33 2e 30 00 38 42 49 4d 03 ed 0a 52 65 73 p
00000030: 6f 6c 75 74 69 6f 6e 00 00 00 00 10 00 60 00 00 o
00000040: 00 01 00 01 00 60 00 00 00 01 00 01 38 42 49 4d .
00000050: 04 0d 18 46 58 20 47 6c 6f 62 61 6c 20 4c 69 67 .
00000060: 68 74 69 6e 67 20 41 6e 67 6c 65 00 00 00 00 04 h
00000070: 00 00 00 78 38 42 49 4d 04 19 12 46 58 20 47 6c .
00000080: 6f 62 61 6c 20 41 6c 74 69 74 75 64 65 00 00 00 o
00000090: 00 04 00 00 00 1e 38 42 49 4d 03 f3 0b 50 72 69 .
000000a0: 6e 74 20 46 6c 61 67 73 00 00 00 09 00 00 00 00 n
000000b0: 00 00 00 00 01 00 38 42 49 4d 04 0a 0e 43 6f 70 .
000000c0: 79 72 69 67 68 74 20 46 6c 61 67 00 00 00 00 01 y
000000d0: 00 00 38 42 49 4d 27 10 14 4a 61 70 61 6e 65 73 .
000000e0: 65 20 50 72 69 6e 74 20 46 6c 61 67 73 00 00 00 e
000000f0: 00 0a 00 01 00 00 00 00 00 00 00 02 38 42 49 4d .
00000100: 03 f5 17 43 6f 6c 6f 72 20 48 61 6c 66 74 6f 6e .
00000110: 65 20 53 65 74 74 69 6e 67 73 00 00 00 48 00 2f e
00000120: 66 66 00 01 00 6c 66 66 00 06 00 00 00 00 00 01 f
00000130: 00 2f 66 66 00 01 00 a1 99 9a 00 06 00 00 00 00 .
```

But we lose informations :


Visible after a zoom :


How to describe a sound ?

It's the same story... hex code which describes binary words

Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00000000	FF	FB	90	04	00	00	00	00	00	00	00	00	00	00	00	00
00000010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000020	00	00	00	00	49	6E	66	6F	00	00	00	0F	00	00	00	25
00000030	00	00	3E	09	00	06	06	0D	0D	0D	14	14	14	1B	1B	22
00000040	22	22	29	29	29	30	30	37	37	37	3E	3E	3E	45	45	45
00000050	4C	4C	53	53	53	59	59	59	60	60	67	67	67	6E	6E	6E
00000060	75	75	7C	7C	7C	83	83	83	8A	8A	8A	91	91	98	98	98
00000070	9F	9F	9F	A6	A6	AC	AC	AC	B3	B3	B3	BA	BA	C1	C1	C1
00000080	C8	C8	C8	CF	CF	CF	D6	D6	DD	DD	DD	E4	E4	E4	EB	EB
00000090	F2	F2	F2	F9	F9	F9	FF	FF	00	00	00	39	4C	41	4D	45
000000A0	33	2E	39	39	72	01	AA	00	00	00	00	00	00	00	00	14
000000B0	80	24	06	40	46	00	00	80	00	00	3E	09	41	BE	91	BD
000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000100	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000110	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000120	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000130	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000140	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000150	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000160	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

But we lose informations. The audio quality is not so fine.

How to transmit data through the Internet ?

```
    13 3.955387                    85.90.60.225          192.168.0.4
    14 5.037156                    FreeboxS_c5:de:54     AsustekC_77:8a:5e

0000  00 1b fc 77 8a 5e 00 07  cb c5 de 54 08 06 00 01   ...w.^.. ...T....
0010  08 00 06 04 00 01 00 07  cb c5 de 54 c0 a8 00 fe   ........ ...T....
0020  00 00 00 00 00 00 c0 a8  00 04 00 00 00 00 00 00   ........ ........
0030  00 00 00 00 00 00 00 00  00 00 00 00 00 00         ........ ......
```

Vocabulary

Behavior	Le comportement
Computer	Ordinateur
Data	données
Device	appareil, composant
Flavor	Parfum
the **knowledge**	La connaissance
the **sight**	La vue
the **smell**	L'odorat
to sum up	additionner
the **taste**	Le goût
a **Word**	un mot