

Data Storage

- Binary digit (bit)
 - 0
 - 1
- 8 bit → 1 byte
- memory
- $(ABCD)_{16}$

logic gates

boolean operations

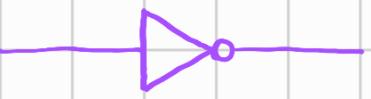
And

OR

XOR

Not

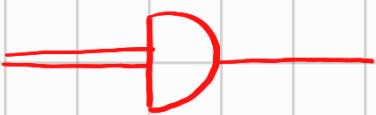
x	output
0	1
1	0



Red horizontal line representing the output of the inverter.

And

x	y	output
0	0	0
0	1	0
1	0	0
1	1	1



Purple horizontal line representing the output of the AND gate.

OR

x	y	output
0	0	0
0	1	1
1	0	1
1	1	1



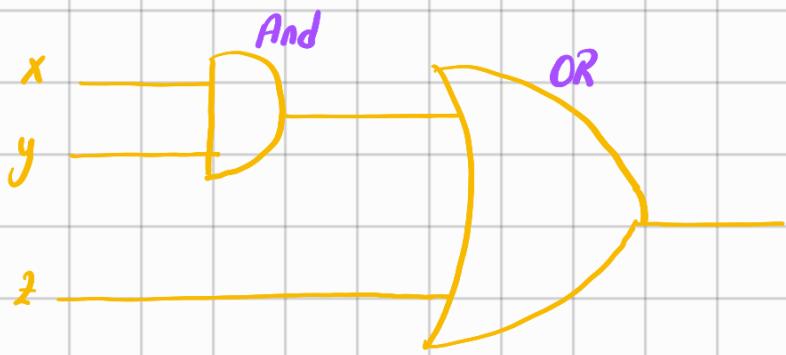
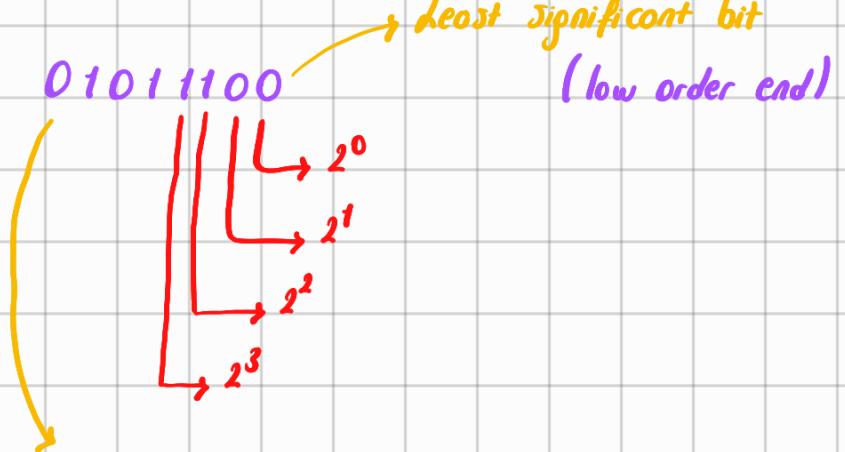
XOR (exclusive OR)

x	y	output
0	0	0
0	1	1
1	0	1
1	1	0



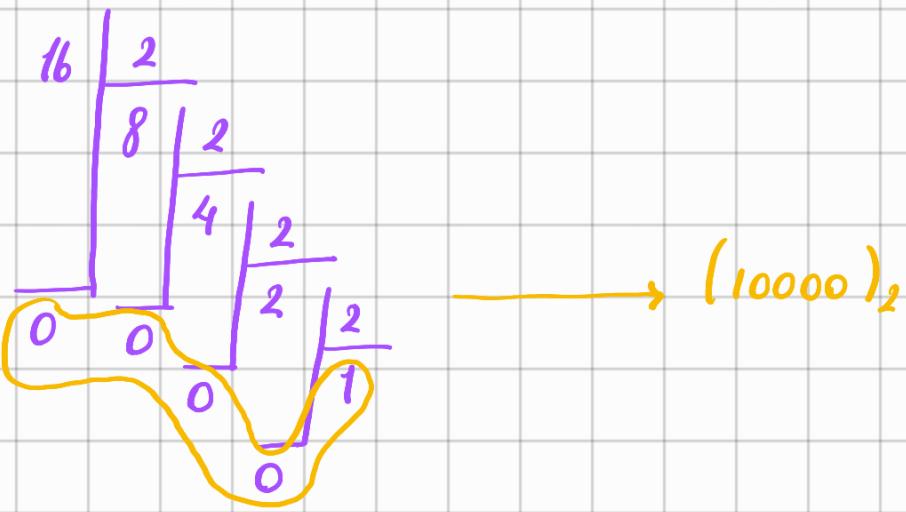
	Address	
Cell 1	0x0000	0xABCD
Cell 2	0x0001	0xABCE
Cell 3	0x0009	0xABCF
Cell 4	0x000A	0xABDØ
	0x000F	
	0x0010	

Main memory



Output

x	y	z	output
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



Unsigned number

$$\begin{array}{r}
 (1\ 1\ 1\ 0\ 0\ 0\ 0\ 0)_2 \rightarrow (224)_{10} \rightarrow (340)_8 \rightarrow (E8)_{16}
 \end{array}$$

Arrows show the conversion from binary to decimal, decimal to octal, and octal to hexadecimal. Red arrows point to powers of 8 and 16: 8^2 , 8^1 , 8^0 , 16^1 , and 16^0 .

$$\begin{array}{r}
 (0001\ 0000)_2 \rightarrow (16)_{10} \rightarrow (20)_8 \rightarrow (10)_{16}
 \end{array}$$

$$\begin{array}{r}
 (1000\ 0000)_2 \underset{8 \quad 0}{\substack{\longrightarrow \\ \longrightarrow}} (128)_{10} \rightarrow (200)_8 \rightarrow (80)_{16}
 \end{array}$$

Represently information or bit patterns

Numbers

Characters (text) 'A' 'B' "ob"

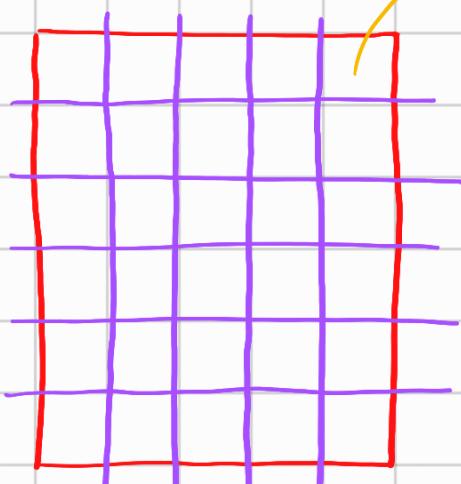
image

video

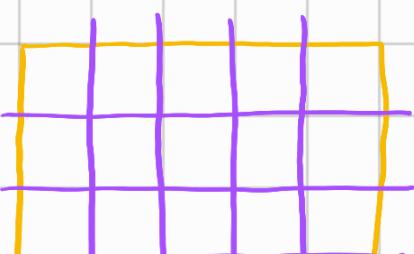
sound

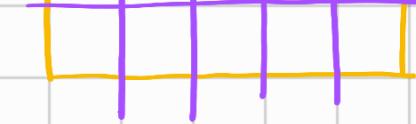
Image

→ pixel (picture element)



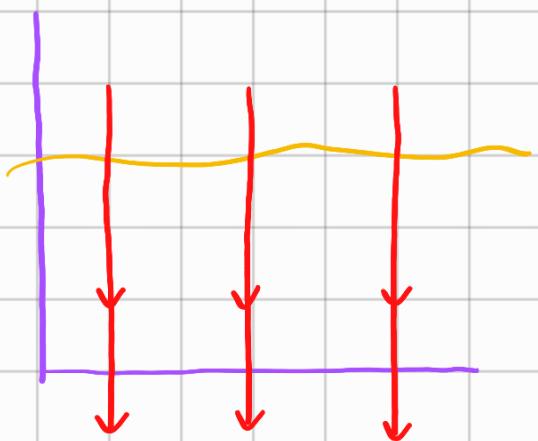
Video





30 fps
240 fps

Analog re digital



Asci table

(American standard code information
interchange)

65 'o'
48 '0'

:

49 '1'

'2'

ANSI

97 '0'

American National Standard Institute

1 byte → en fazla 255 sayıını oluşturabilir 256 farklı sayı oluşturabilir

UTF-8 Unicode transformation format 8-bit

2 byte 65536 $\rightarrow 2^{16}$

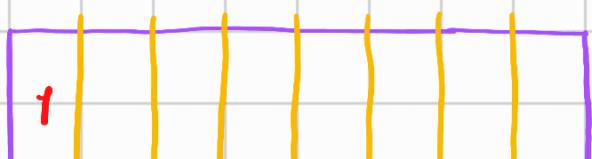
Negative Numbers

two's complement

Excess Notation

-5

two's complement notation



negatif

One's complement

$$\begin{array}{r} 0000111 \\ 1111000 \end{array}$$

$$\begin{array}{r} 01011001 \\ 10100110 \end{array}$$

Two's complement

- One's complement
- Odd 1

$$\begin{array}{r} 00001111 \\ 11110000 \\ + \quad \quad \quad 1 \\ \hline 11110001 \end{array}$$

2's complement

$$\begin{array}{r} 01011001 \\ 10100110 \\ + \quad \quad \quad 1 \\ \hline 10100111 \end{array}$$

$$\begin{array}{r}
 00111100 \\
 11000011 \\
 + \quad \quad \quad 1 \\
 \hline
 11000100 \quad \text{2's Complement}
 \end{array}$$

Signed number System

$$(01100000)_2 \rightarrow (96)_{10}$$

$$(10000000)_2 \rightarrow (-128)_{10}$$

Negative

$$\begin{array}{r}
 01111111 \\
 + \quad \quad \quad 1 \\
 \hline
 10000000
 \end{array}$$

$$\begin{array}{r}
 (11000001) \\
 + \quad \quad \quad 1 \\
 \hline
 00111110
 \end{array}$$

signed $(-63)_{10}$
 unsigned $(193)_{10}$
 Negative

$$\begin{array}{r}
 00111110 \\
 + \quad \quad \quad 1 \\
 \hline
 00111111
 \end{array}$$

Two's complement notation

0 1 1	3
0 1 0	2
0 0 1	1
0 0 0	0
1 1 1	-1
1 1 0	-2
1 0 1	-3
1 0 0	-4

0 1 1 0



1 0 1 0

0 1 1 0

1 0 0 1

+ 1

1 0 1 0

1 1 1 1 1 1 1 → -8

0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 → 8

Excess Notation

1 1 1	3	→ 7-4	→ 3
1 1 0	2	→ 6-4	→ 2
1 0 1	1	→ 5-4	→ 1
1 0 0	0	→ 4-4	→ 0
0 1 1	-1	→ 3-4	
0 1 0	-2	→ 2-4	
0 0 1	-3	→ 1-4	
0 0 0	-4	→ 0-4	

Excess -4 notation

(-4, 3)

Excess 8 notation

1 1 1 1	15-8	7
1 0 0 0	0	
0 0 0 0	0-8	-8

1 byte \rightarrow Unsigned (0, 255)

1 byte \rightarrow Signed (-128, 127)

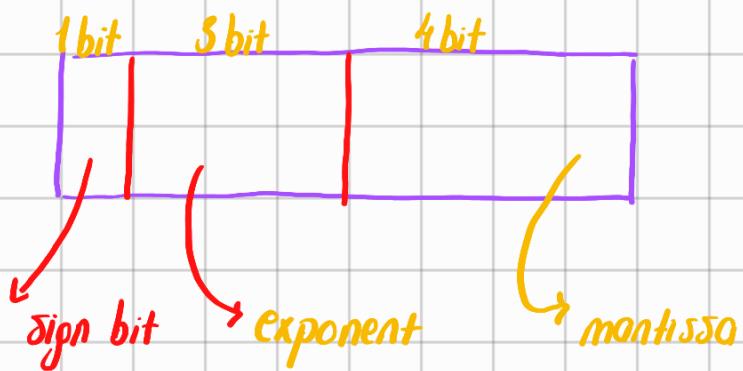
Storing fractions

$$(5.25)_{10}$$

$$(100,11)_2 \rightarrow 4.75 \rightarrow 4 \frac{3}{4} \rightarrow 4 + \frac{1}{2} + \frac{1}{4}$$

$$(10,01)_2 \rightarrow 2.25 \rightarrow 2 \frac{1}{4}$$

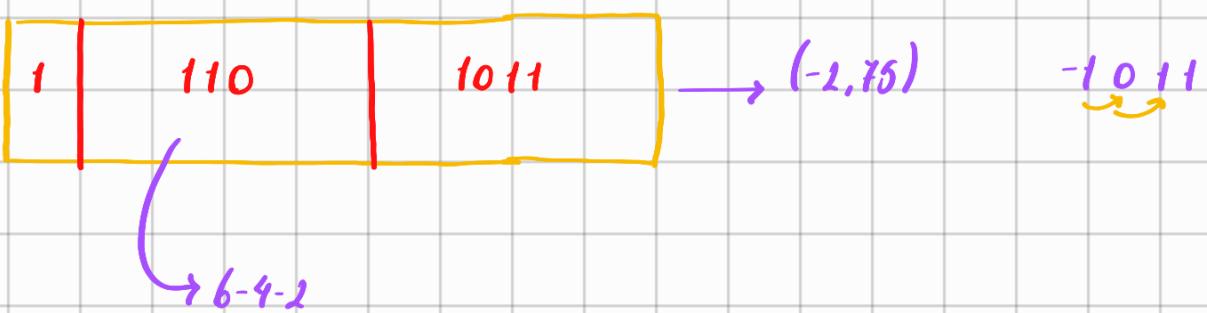
Floating point notation



0 | 110 | 1011 . (1.11)...



$-1 \underbrace{0}_{\rightarrow} 11$ Not loysi 2 sago
ilerletiriz $10.11 \rightarrow 2 \frac{3}{4}$



$(01011100)_2$

\hookrightarrow positive

011

$3\text{-}4 \rightarrow -1$

, 1100

$.01100 \rightarrow \frac{1}{4} + \frac{1}{8} \rightarrow \frac{3}{8}$

$1 \frac{1}{2} \rightarrow (1.5)_{10} \rightarrow (01011100)_2 \rightarrow (1.5)$

1.1000

.1100

1.1 → (1.5)₁₀

3/8

.011 → 1'i ilk gördüğün onde basla 0011
yapma o'lar boşuna
yer kaplar



-32 → 00100000

11011111

+ 1

-32 ← 11100000

$$\begin{array}{r}
 -1 \rightarrow 00000001 \\
 +11111110 \\
 \hline
 11111111
 \end{array}$$



$$-1.75 \quad 1.11$$

Add and subtraction operators

Overflow problem

$$\begin{array}{r}
 00001011 \\
 +00000111 \\
 \hline
 00010010
 \end{array}$$

$$\begin{array}{r}
 11111111 \\
 +11111111 \\
 \hline
 ①11111110
 \end{array}$$

3

t 2

5