

logic gates



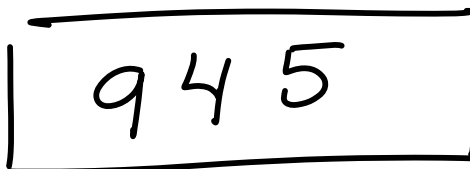
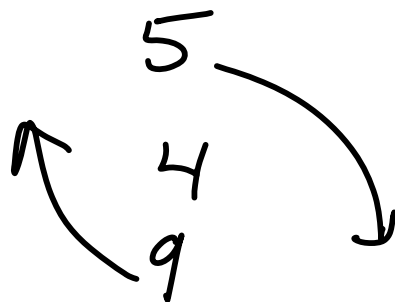
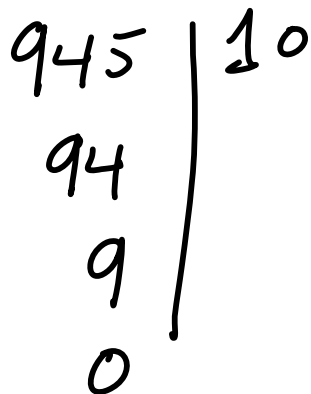
lecture 02



- Conversion from decimal to binary
- Hexadecimal Numbers

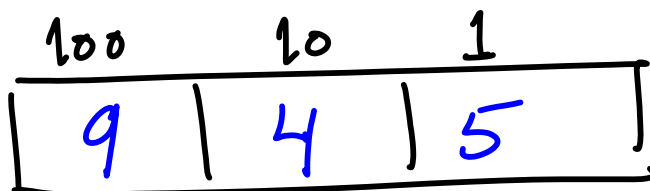
Ex How many hundreds, ten and ones
in 945

How many hundreds, ten and ones
in 945



ok

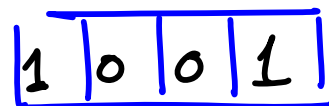
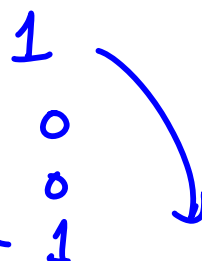
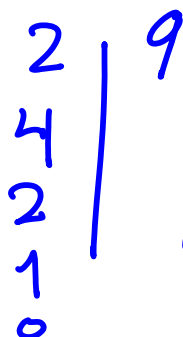
or
(945)₁₀



nine four five ones
hundreds tens

Ex

Ex $(9)_{10} \Rightarrow (\quad)_2$



Ex

$$(25)_{10} \Rightarrow (\quad)_2$$

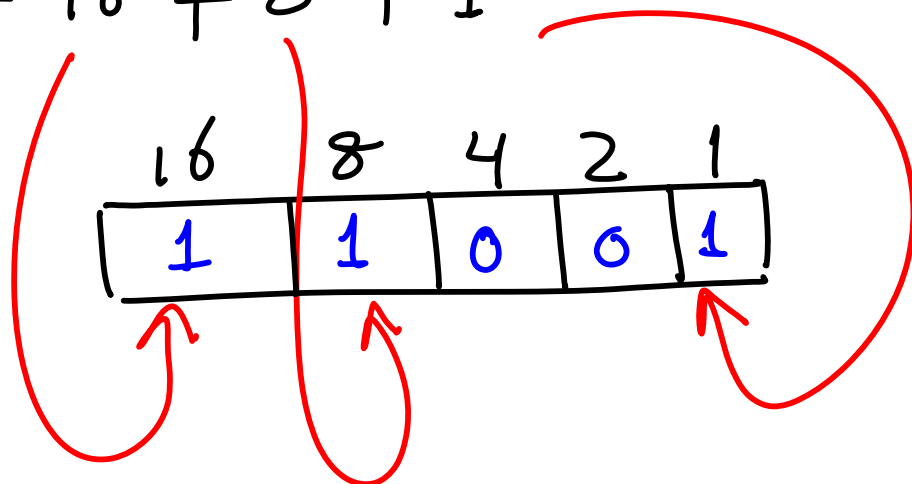
25		2	
12			1
6			0
3			0
1			1
0			1

1 1 0 0 1

2

OR You could think of number being sums of 1 or not, added to 2 or not, 4 or Not, ... ,)

$$(25)_{10} = 16 + 8 + 1$$



Ex

$$(63)_{10} = (\quad)_2$$

32	16	8	4	2	1
1	1	1	1	1	1

to represent in binary

start from power that are just below
the No.

Ex

$$(29)_{10} = (\quad)_2$$

$$(29)_{10} = \underline{\underline{16}} \rightarrow (11101)_2$$

Ex

what is minimum no. of bits do you need to represent $(23)_{10}$ in binary form

23 $\Rightarrow$ Just below $\Rightarrow 32 \Rightarrow 2^5$

You need 5 bits

$(23)_{10} \Rightarrow \overset{16}{\underline{\underline{10111}}}$ $\rightarrow$ 5-bits

N.B

ODD number in binary form start with 1 in LSB

Note

if you have n bits, you have 2^n combinations

Ex

What is the maximum No. that
can be represented by 3-bit?

000

001

010

011

100

101

110

111

$\begin{array}{ccc} 4 & 2 & 1 \\ \hline 1 & 1 & 1 \end{array} \Rightarrow (7)_{10}$

2-bit $\Rightarrow 3$

3-bit $\Rightarrow 7$

4-bit $\Rightarrow 15$

n -bit $\Rightarrow 2^n - 1$

8-bit $\Rightarrow 2^8 - 1$

$\Rightarrow 255$

||||

Ex list all combinations do you have in 4-bits

Handwritten musical notation for four staves labeled A, B, C, and D. Each staff contains a sequence of notes and rests. Staff A has 10 notes, B has 10 notes, C has 10 notes, and D has 10 notes. The notes are mostly quarter notes and eighth notes, with some rests. The notation is written on five-line staves.

$\hookrightarrow (0100)_2 \Rightarrow (4)_{10}$

$$\begin{matrix} 8 & 4 & 2 & 1 \\ \nearrow & \nearrow & \nearrow & \nearrow \\ (1 & 1 & 1 & 1)_2 \end{matrix} \Rightarrow (15)_{10}$$

$$\underline{\underline{\text{Ex}}} \quad (58)_{10} \Rightarrow (\quad)_2$$

$(58)_{10} \Rightarrow (111010)_2$

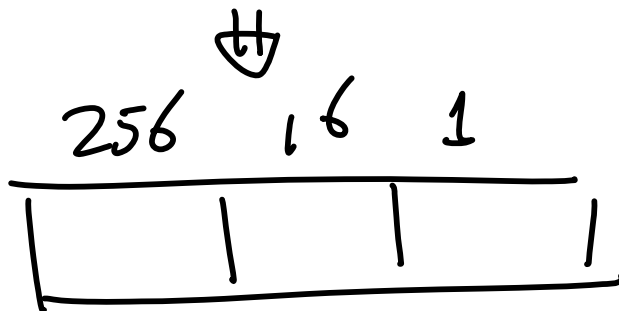
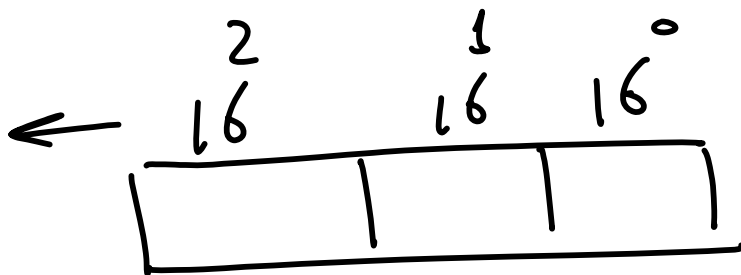
Hexadecimal number



Numbers : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
A, B, C, D, E, F

max : F

base-radix : 16



$$(17)_{16} \Rightarrow \begin{array}{|c|c|} \hline 16 & 1 \\ \hline 1 & 7 \\ \hline \end{array}$$

$$= 1 \times 16 + 7 \times 1$$

$$= 16 + 7 = (23)_{10}$$

$$(23)_{16} \Rightarrow \begin{array}{c} 16 \quad 1 \\ \hline 2 \quad | \quad 3 \end{array}$$

$$= 32 + 3 = (25)_{10}$$

$$(0F)_{16} \Rightarrow \begin{array}{c} 16 \quad 1 \\ \hline 0 \quad | \quad F \end{array}$$

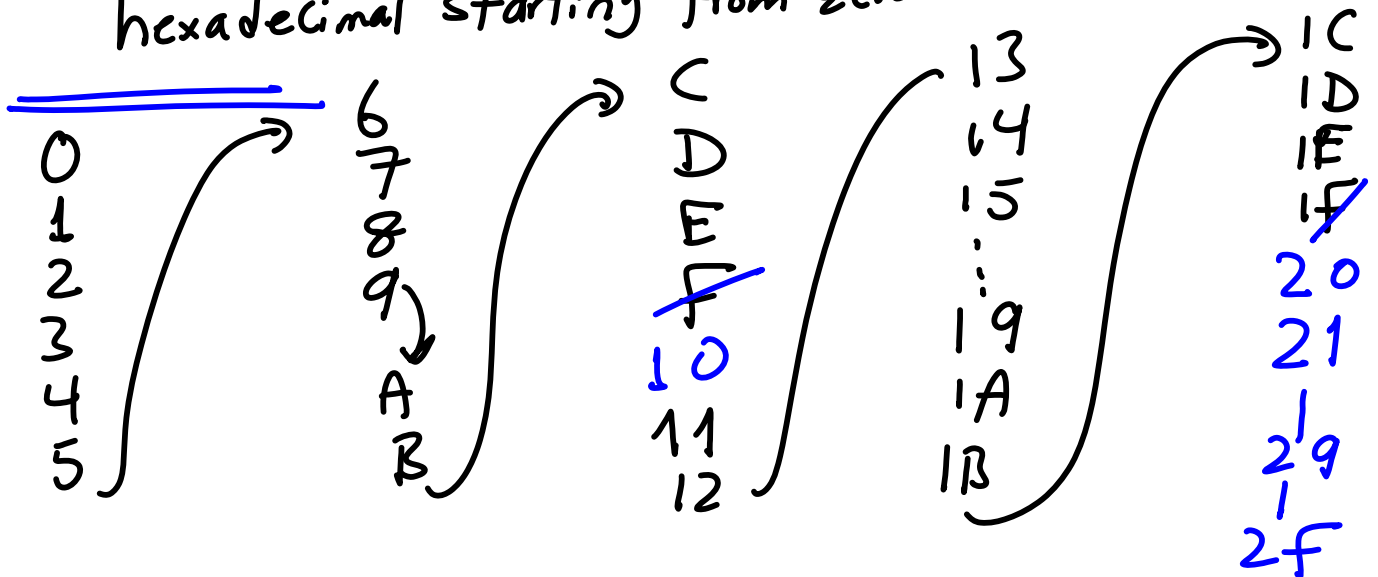
$$= 0 \times 16 + 15 \times 1$$

$$= (15)_{10}$$

$$(2A)_{16} \Rightarrow \begin{array}{c} 16 \quad 1 \\ \hline 2 \quad | \quad A \end{array}$$

$$\Rightarrow 32 + 10 = (42)_{10}$$

Ex write the first 20 Numbers of hexadecimal starting from zero



Conversion from Decimal to hexadecimal

$$(25)_{10} \Rightarrow (\quad)_{16}$$

$$\begin{array}{r|l} 25 & 16 \\ & 1 \\ & 0 \end{array} \quad \begin{array}{l} 9 \\ \uparrow 1 \end{array} \quad (19)_{16}$$

$$(28)_{10} \Rightarrow (\quad)_{16}$$

$$\begin{array}{r|l} 28 & 16 \\ & 1 \\ & 0 \end{array} \quad \begin{array}{l} (12) \rightarrow C \\ 1 \end{array} \quad (1C)_{16}$$

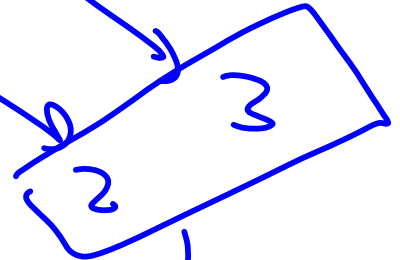
$$(47)_{10} \Rightarrow \begin{array}{|c|c|c|} \hline 256 & 16 & 1 \\ \hline & 2 & F \\ \hline \end{array}$$

∴ $(47)_{10} = 2F_{16}$ $\xrightarrow{\text{to represent hexadecimal}}$

Ex

$(35)_{10} \Rightarrow (100011)_2$ *To binary*

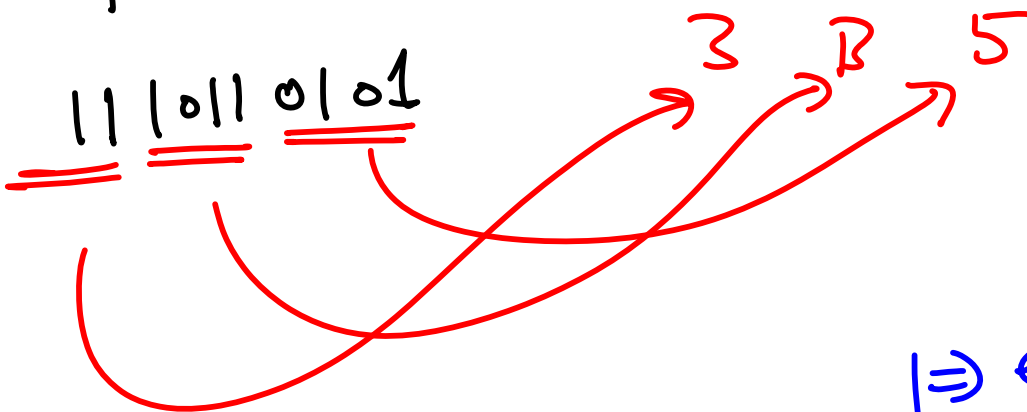
$(23)_{16}$ *To hexadecimal*



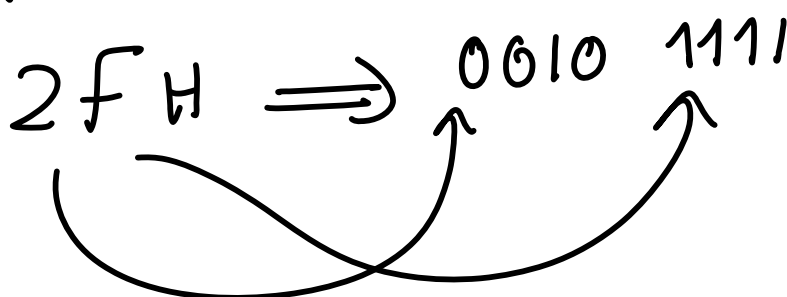
directly to hexadecimal

To Conclude

from binary to hexadecimal



from hexa $\Rightarrow$ Bin



$\Rightarrow$ express binary number using fewer digits

$\Downarrow$
memory addressing

Ex

$$\begin{array}{r} 2BH + \\ 47H \\ \hline 81 \end{array}$$

Red annotations: A red '2' is above the first column. A red arrow points from the '2' to the '11' in the second column. A red arrow points from the '11' to the '16+2' in the second column. A red arrow points from the '16+2' to the '81' in the first column.

Ex

$$\begin{array}{r} 1FH + \\ 32H \\ \hline 51 \end{array}$$

Blue annotations: A blue arrow points from the '1FH' to the '31' in the second column. A blue arrow points from the '31' to the '81' in the first column.

Ex

F7A9H

→ $(1111\ 0111\ 1010\ 1001)_2$

Ex

How many bits are required to represent

$(81)_{10}$ in binary format?

1010001

81 $\Rightarrow 2^7 \leadsto 7\text{ bit}$