

Logic gates

Lecture 01

- Numbering system
- Decimal system
 - Base — radix
 - Least significant digit
 - Most significant digit
- Binary Number
 - Least significant bit LSB
 - Most significant bit MSB
- Conversion from binary to decimal
- Arithmetic on binary number

Decimal Number

Numbers $\Rightarrow 0, 1, 2, 3, \dots, 9$

Maximum No. $\Rightarrow 9$

base — radix $\Rightarrow 10$

$$934 = 9 \times 100 + 3 \times 10 + 4 \times 1$$

100	10	1
9	3	4

radix



2 10	1 10	0 10
9	3	4

most significant
digit

least
significant
digit

Ex

16
745
189 +

Do the
same
sequence

9	3	4
---	---	---

13 14

② How many
times 14
have 10

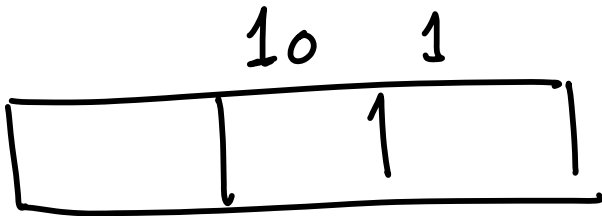
③ One and the
Remainder is 4

④

Note $\Rightarrow$ You always compare against
10 $\Rightarrow$ radix

Ex

Write down the first 20 Numbers
in Decimal System



0
1
2
3
4
5
6
7
8

~~9~~ $\Rightarrow$ maximum
in one cell
11 zero
increased

1 0
1 1
1 2

Decimal Numbers

Numbers $\Rightarrow 0, 1, 2, \dots, 9$

max $\Rightarrow 9$

base $\Rightarrow 10$

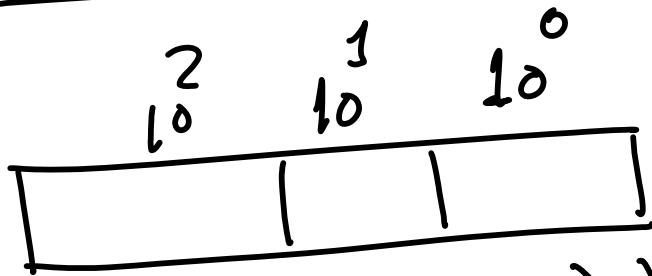
Binary Numbers

Numbers $\Rightarrow 0, 1$

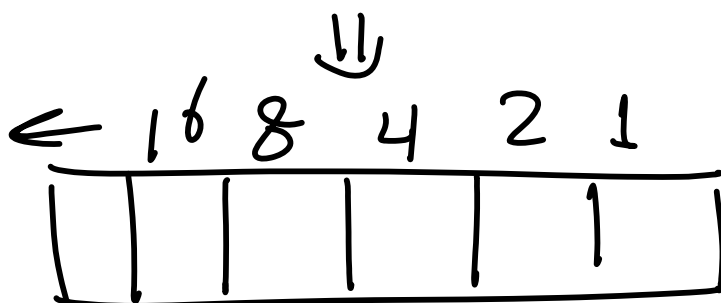
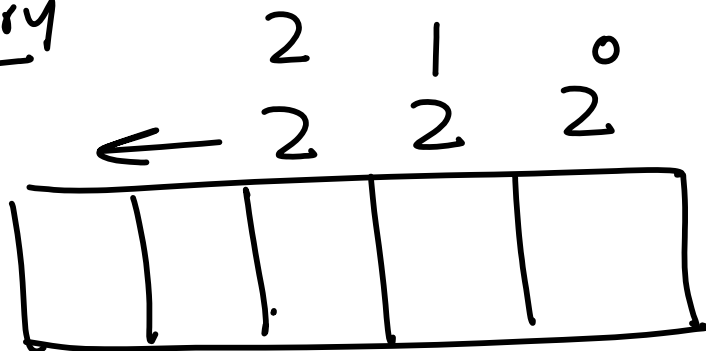
max $\Rightarrow 1$

base $\Rightarrow 2$

Decimal



Binary



Ex

4	2	1
0	1	1

$$= \underline{1 \times 1} + \underline{1 \times 2} + 0 \times 4$$

$$= 1 + 2 = 3$$

$$(011)_2 = (3)_{10}$$

Ex

8	4	2	1
1	0	1	1

$$= 1 \times 8 + 1 \times 2 + 1 \times 1$$

$$= 8 + 2 + 1 = 11$$

$$(1011)_2 = (11)_{10}$$

Ex

6	8	4	2	1
1	1	0	1	1

$$= 16 + 8 + 2 + 1$$

$$= 27$$

$$(11011)_2 = (27)_{10}$$

Ex

101111

$\Rightarrow$ No. of bits = 6

most
significant
bit

MSB

Least
significant
bit

bit

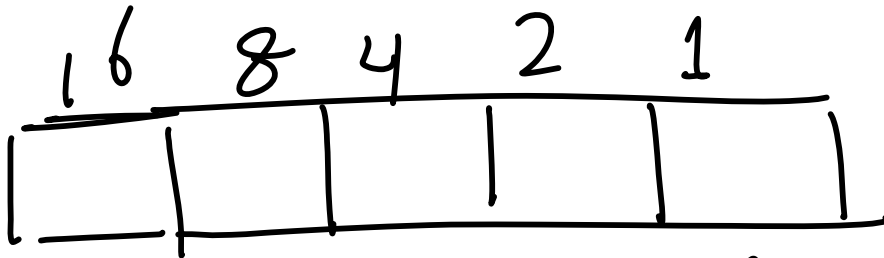
LSB

5
2

$$\hookrightarrow 32 + 8 + 4 + 2 + 1 = 47$$

Ex

write down the first 20 Numbers
in binary system



0

~~1~~

→ maximum No.
in one bit

↙

1 0

~~1~~ ~~1~~

1 0 0

1 0 1

1 1 0

~~1~~ ~~1~~ ~~1~~

1 0 0 0



1 0 0 1

1 0 1 0

1 0 1 1

1 1 0 0

ok

0	0	0	0	=
0	0	<u>0</u>	1	=
0	0	1	0	=
0	0	<u>1</u>	1	=
0	<u>1</u>	0	0	=
0	1	<u>0</u>	1	=
0	1	1	0	=
0	1	<u>1</u>	1	=
<u>1</u>	<u>0</u>	<u>0</u>	0	=
1	0	0	1	=
1	0	1	0	=
1	<u>0</u>	1	1	=

↓

Ex

How many combinations do you have in 3-bits?

1 bit $\Rightarrow$ $\begin{matrix} 0 \\ 1 \end{matrix} \Rightarrow 2$ combination

2-bit $\Rightarrow$ $\begin{matrix} 00 \\ 01 \\ 10 \\ 11 \end{matrix} \Rightarrow \begin{matrix} 4 \\ 2 \\ 2 \end{matrix}$ combinations

3-bit $\Rightarrow$

0 0 0
0 0 1
0 1 0
0 1 1
1 0 0
1 0 1
1 1 0
1 1 1

$\Rightarrow$ 8 Combination
= 2³

$n\text{-bit} \Rightarrow 2^n$ combinations

Ex

ADD $(1011)_2$ to $(0011)_2$

8 4 2 1

1 0 1 1

8 4 2 1

0 0 1 1

$\Rightarrow (11)_{10}$

$\Rightarrow (3)_{10}$

$\leftarrow (14)_{10}$

Continue

1 0 1 1

0 0 1 1 +

3 2

1 | 1 | 1 | 0

(14)₁₀

How many time
2 have 2
One and no
remainder

to conclude

$$1 + 1 = 10$$

$$1 + 1 + 1 = 11$$

$$1 + 0 = 1$$

$$0 + 1 = 1$$

Ex

$$\begin{array}{r} (1001)_2 \\ (0011)_2 + \\ \hline \end{array}$$

$$(1100)_2$$

Ex

$$\begin{array}{r} 11 \\ 10 \times \\ \hline 00 \end{array} \quad \begin{array}{l} \rightsquigarrow 3 \\ \rightsquigarrow 2 \end{array}$$

$$\begin{array}{r} 11 \\ \hline 110 \end{array} \quad \rightsquigarrow 6$$