Digital Electronic

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Chapter One

Lecture 2

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1.3.3 Binary versus decimal numeration system:

- Let us count from 0 to 15 using binary and decimal systems of numeration

Binary				Decimal
D(MSB)	C	B	A(LSB)	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

- It is obvious that the representation of a quantity in binary numeration system takes mores ciphers than in decimal system.
- We can therefore ask ourselves why the binary system is preferred to decimal system in computer sciences?
- The reason is that in electronics, it is easier to materialise two quantities “0” and “1” (by two different voltages for example) than to materialises 10 different quantities “0” ,”1”,”2”,”3”,”4”,”5”,”6”,”7”,”8”, and ”9” (by 10 different voltages).
- In fact, in digital circuits, 0 and 1 are materialised by specific ranges of voltages or current; this will be discussed later.

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Binary Base = 2

	Column 8	Column 7	Column 6	Column 5	Column 4	Column 3	Column 2	Column 1
Base^{exp}	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Weight	128	64	32	16	8	4	2	1

$2^0 = 1$

$2^1 = 2$

$2^2 = 2 * 2 = 4$

$2^3 = 2 * 2 * 2 = 8$

$2^4 = 2 * 2 * 2 * 2 = 16$

$2^5 = 2 * 2 * 2 * 2 * 2 = 32$

$2^6 = 2 * 2 * 2 * 2 * 2 * 2 = 64$

$2^7 = 2 * 2 * 2 * 2 * 2 * 2 * 2 = 128$

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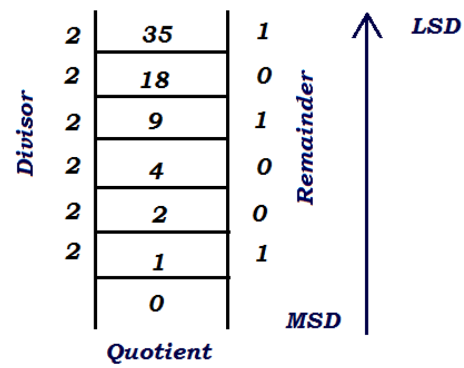
Find the Binary equivalent for Decimal 35



MSD - most significant digit
LSD - least significant digit
Therefore, the binary equivalent for 35 is 100101

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Decimal = 41

Division	Quotient	Remainder
41/2	20	1
20/2	10	0
10/2	5	0
5/2	2	1
2/2	1	0
1/2	0	1

Binary = 101001

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Remark 1.1:

- With n bits we can represent 2^n different binary numbers.
- The higher H number is given using the following formula.

$$H = 2^n - 1$$

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Example 1.4:

- With 4 bits we can represent

$$2^4 = 16$$

- different binary numbers (from 0 to 15),
- and the higher number is

$$H = 2^4 - 1 = 15.$$

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Remark 1.2:
Conversion from binary to decimal

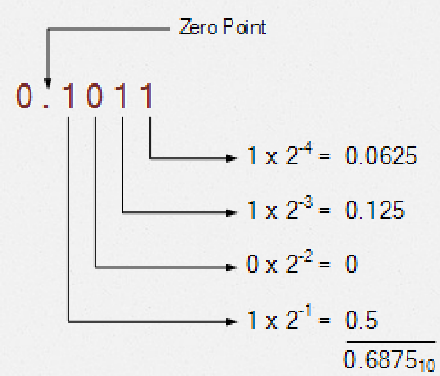
- To convert a number written in binary numeration system to its equivalent in decimal,
- we just have to calculate the products of the bits with their respective weights, as in example 1.3 above.
- For binary numbers with “binary point” (equivalent of decimal point for decimal numbers), the conversion is done as follow.

2 1 0 -1 -2 -3

A= 1 0 1. 1 0 1

$A = 1\times2^{2} + 0\times2^{1}+1\times2^{0} +1\times2^{-1}+0\times2^{-2}+1\times2^{-3}$

$A = 5.625_{10}$



1.3.4 Octal numeration system:

- The octal numeration system is a place **weighted system** with **a base of eight**.
- Valid ciphers include the symbols **"0","1","2","3","4","5","6", and "7".**
- To convert from binary to octal numeration system, **we just have to divide the number into groups of binary** numbers having **3 bits** each.
- And each group of **3 bits** is **replaced** by its **equivalent in octal**.

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Binary to Octal Conversion

$(1101011.00101)_2$

1101011.00101

Binary	Octal
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

www.geekyshows.com

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Example 1.5:

- Let's convert the following binary numbers in octal:

- A = 10110101
- B = 11010111.01

A = 010 110 101

2 6 5_8

$10110101_2 = 265_8$

Example 1.5:

- The bits are grouped from the right to the left.
- A zero has been added to the two firs bits to form a group of 3 bits. That zero is called an implied zero.

B = 011 010 111 . 010

3 2 7 . 2_8

$11010111.01_2 = 327.2_8$

Example 1.5:

- The bits are grouped from the right to the left.
- A zero has been added to the two firs bits to form a group of 3 bits. That zero is called an implied zero.

B = 011 010 111 . 010

3 2 7 . 2_8

$11010111.01_2 = 327.2_8$

- Two implied zeros have been added to the number to form groups of 3 bits.

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Exercise 1.2:

- Convert the following binary numbers to decimal numbers: om to the Octal number.

- A = 10110.01
- B = 11110111.1011
- C = 111.111
- D = 10110101101.111101

- Watch the videos
- https://www.youtube.com/watch?v=OezK_zTyvAQ
- https://www.youtube.com/watch?v=bmgZf4VMhHc

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