



Dr.SNS RAJALAKSHMI COLLEGE OF ARTS AND SCIENCE

(AUTONOMOUS)

COIMBATORE-641049

**Accredited by NAAC(Cycle III) with “A+” Grade
Recognised by UGC, Approved by AICTE, New Delhi and
Affiliated to Bharathiar University, Coimbatore.**



DEPARTMENT OF COMPUTER SCIENCE

Computer System Architecture

I YEAR - I SEM

UNIT 1 – Data Representation



Agenda

- The Decimal Number System
- The Binary Number System
- The Octal Number System
- The Hexadecimal Number System
- Converting from One Number System format to another

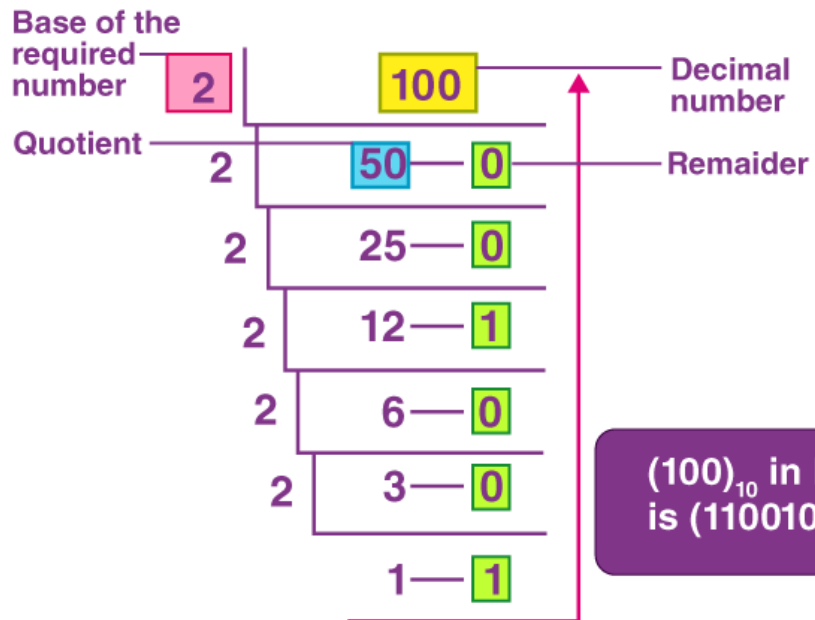


Number Systems

- Decimal (0-9)
- Binary (0 or 1)
- Octal (0-7)
- Hexadecimal. (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F)

Decimal to Binary

$(100.75)_{10}$



$$0.75 \times 2 = 1.50$$

$$0.50 \times 2 = 1.00$$

$(100)_{10}$ in Binary is $(1100100)_2$

$$(100.75)_{10} = (1100100.11)_2$$

Decimal to Binary

$(195.25)_{10}$

$195 / 2 = 97$ with remainder 1

$97 / 2 = 48$ with remainder 1

$48 / 2 = 24$ with remainder 0

$24 / 2 = 12$ with remainder 0

$12 / 2 = 6$ with remainder 0

$6 / 2 = 3$ with remainder 0

$3 / 2 = 1$ with remainder 1

$1 / 2 = 0$ with remainder 1

$$0.25 \times 2 = 0.50$$

$$0.50 \times 2 = 1.00$$

$$(195.25)_{10} = (11000011.01)_2$$

Decimal to Octal

		Remainder	
8	473		
8	59	1	MSD ↑ LSD
8	7	3	
	0	7	

$$(473)_{10} = (731)_8$$

Decimal Number	Operation	Quotient	Remainder	Octal Number
1792	$\div 8$	224	0	0
224	$\div 8$	28	0	00
28	$\div 8$	3	4	400
3	$\div 8$	0	3	3400

$$(1792)_{10} = (3400)_8$$

Decimal to Hexadecimal

Decimal Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Equivalent Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

		Remainder
16	423	
16	26	7
16	1	A
	0	1

↑

Divide by 16	Quotient	Remainder	Hex Value
$1228 \div 16$	76	12	C
$76 \div 16$	4	12	C
$4 \div 16$	0	4	4

$$(423)_{10} = (1A7)_{16}$$

$$(1228)_{10} = (4CC)_{16}$$

Binary to Decimal

Binary	0	1	10	11	100	101	110	111	1000	1001	1010	1011	1100	1101	1110	1111
Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

$(11011.101)_2$

$$\begin{array}{cccccccc}
 2^4 & 2^3 & 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} & 2^{-3} \\
 1 & 1 & 0 & 1 & 1 & \cdot & 1 & 0 & 1
 \end{array}$$

Integral Part $(11011)_2 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
 $= 16 + 8 + 0 + 2 + 1$
 $= (27)_{10}$

Fractional Part $(0.101)_2 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$
 $= 0.5 + 0 + 0.125$
 $= (0.625)_{10}$

$$(11011.101)_2 = (27.625)_{10}$$

Binary to Octal

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

$(1010111100)_2$

1 010 111 100

001 010 111 100

1 2 7 4

$(1010111100)_2 = (1274)_2$

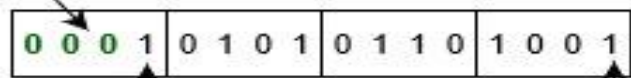
Binary to Hexadecimal

Hexa	0	1	2	3	4	5	6	7
Binary	0000	0001	0010	0011	0100	0101	0110	0111
Hexa	8	9	A	B	C	D	E	F
Binary	1000	1001	1010	1011	1100	1101	1110	1111

$$(1010101101001)_2 = (1569)_{16}$$

$$(0110.0101.110111)_2 = (65.DC)_{16}$$

These three 0's are added into MSB to complete group of 4 bits



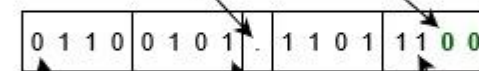
12th position (MSB)

0th position (LSB)

Extra 0 at MSB can be ignored

Binary point

These two 0's are added into LSB to complete group of 4 bits



7th position

0th position

(-6)th position (LSB)



Octal to Decimal and Binary

41_8

$$\begin{aligned}41_8 &= (4 * 8^1) + (1 * 8^0) \\ &= 4 * 8 + 1 * 1 \\ &= 32 + 1 \\ &= \mathbf{33}_{10}\end{aligned}$$

2	33		
2	16	-	1
2	8	-	0
2	4	-	0
2	2	-	0
2	1	-	0

$$33_{10} = 100001_2$$

$$41_8 = 100001_2$$

Octal to Binary

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

Example : $72_8 = (?)_2$ $72_8 =$ **7** **2**
111 **010**

$$72_8 = 111010_2$$



Octal to Hexadecimal



Hexa	0	1	2	3	4	5	6	7
Binary	0000	0001	0010	0011	0100	0101	0110	0111
Hexa	8	9	A	B	C	D	E	F
Binary	1000	1001	1010	1011	1100	1101	1110	1111

Example : $72_8 = (?)_{16}$

$$72_8 = \begin{matrix} 7 & 2 \\ 111 & 010 \end{matrix}$$

$$72_8 = 111010_2$$

$$\begin{aligned} 111010_2 &= \begin{matrix} 11 & 1010 \\ 0011 & 1010 \\ 3 & A \end{matrix} \\ &= \begin{matrix} 11 & 1010 \\ 0011 & 1010 \\ 3 & A \end{matrix} \\ &= \begin{matrix} 3 & A \end{matrix} \end{aligned}$$

$$72_8 = 3A_{16}$$

Hexa to Binary, Octal

Hexa	0	1	2	3	4	5	6	7
Binary	0000	0001	0010	0011	0100	0101	0110	0111
Hexa	8	9	A	B	C	D	E	F
Binary	1000	1001	1010	1011	1100	1101	1110	1111

$$1BC_{16} = 0001\ 1011\ 1100_2$$

$$0001\ 1011\ 1100_2 = 000\ 110\ 111\ 100$$

$$= 0\ 6\ 7\ 4$$

$$1BC_{16} = 674_2$$



Hexa to Decimal

7CA.12

$$(7CA)_{16} = (7 \times 16^2) + (12 \times 16^1) + (10 \times 16^0)$$

$$(7CA)_{16} = (7 \times 256) + (12 \times 16) + (10 \times 1)$$

$$(7CA)_{16} = 1792 + 192 + 10$$

$$(7CA)_{16} = (1994)_{10}$$

$$(12)_{16} = (1 \times 16^{-1}) + (2 \times 16^{-2})$$

$$(12)_{16} = (1 \times 1/16) + (2 \times 1/256)$$

$$(12)_{16} = (1 \times 0.0625) + (2 \times 0.0390625)$$

$$(12)_{16} = (0.0625 + 0.0078125)$$

$$(12)_{16} = 0.0703125_{10}$$

$$(7CA)_{16} = (1994.07030125)_{10}$$



Thank You