PRESENTATION ON

NUMBER SYSTEM

&

CONVERSION

WHAT IS NUMBER SYSTEM…?

The **number system** that we use in our day-to-day life is the decimal **number system**. Decimal **number system** has base 10 as it uses 10 digits from 0 to 9. In decimal **number system**, the successive positions to the left of the decimal point represent units, tens, hundreds, thousands and so on.

COMPLEMENT OF NUMBER

One's complement: In binary system, if each 1 is replaced by 0 and each 0 by 1, then resulting number is called as one's complement of the that number.

- If first number is positive then resulting will be negative with the same magnitude and vice versa.
- In binary arithmetic 1's complement of a binary number N is obtained by the formula = $(2^n - 1) - N$

Where n is the no of bits in binary number N.

EXAMPLE

Convert binary number 111001101 to 1's complement.

Method:

N = 111001101

n = 9

2^n = 256 = 100000000

2^n -1 = 255 = 11111111

1's complement of N = (100000000 – 1) -111001101

011111111

– 111001101

= 000110010

Answer:

1's complement of N is 000110010

TWO'S COMPLEMENT

Two's complement: If 1 is added to the complement of a number then resulting number is known as two's complement.

- If MSB is 0 then the number is positive else if MSB is 1 then the number is negative.
- 2’s complement of a binary number N is obtained by the formula (2^n) – N ,Where n is the no of bits in number N

EXAMPLE

- **Convert binary number 111001101 to 2’s complement**
- Method:

2’s complement of a binary no can be obtained by two step process

Step 1

1’s complement of number N = 000110010

Step 2

1’s complement + 1

  000110010

+ 000000001

= 000110011

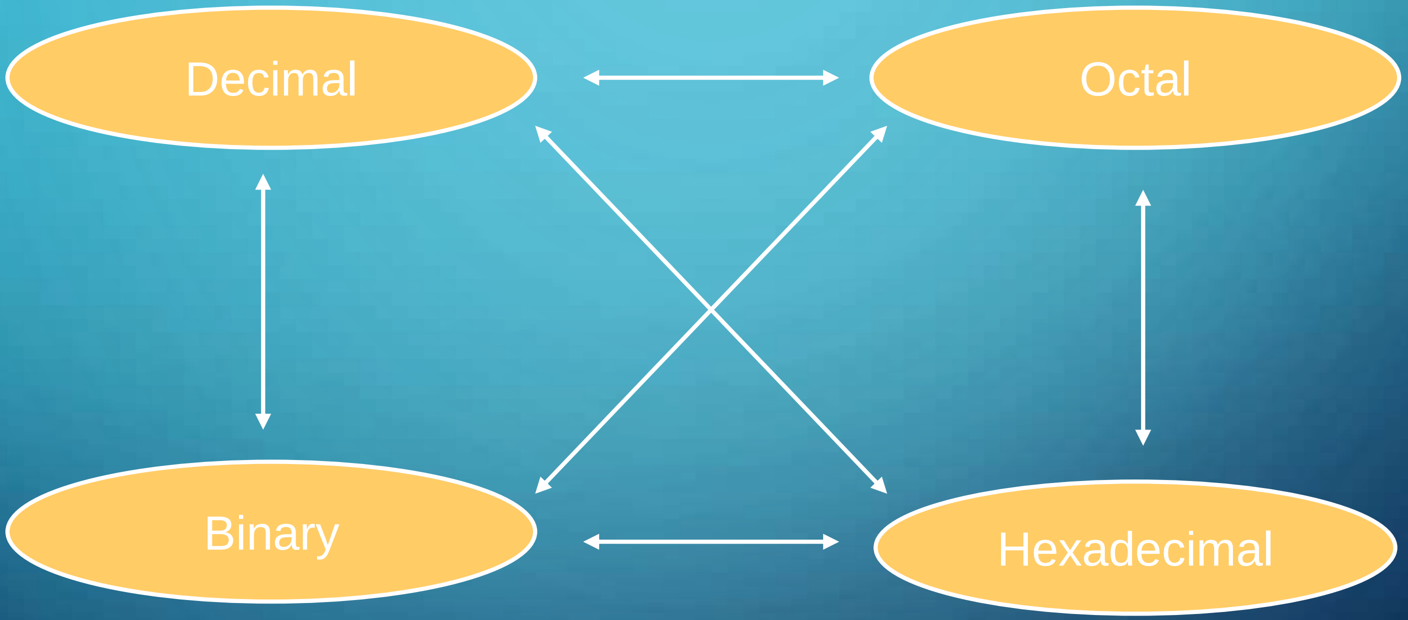
Answer

2’s complement of a binary no 111001101 is 000110011

CONVERSION

CONVERSION AMONG BASES

- The possibilities:

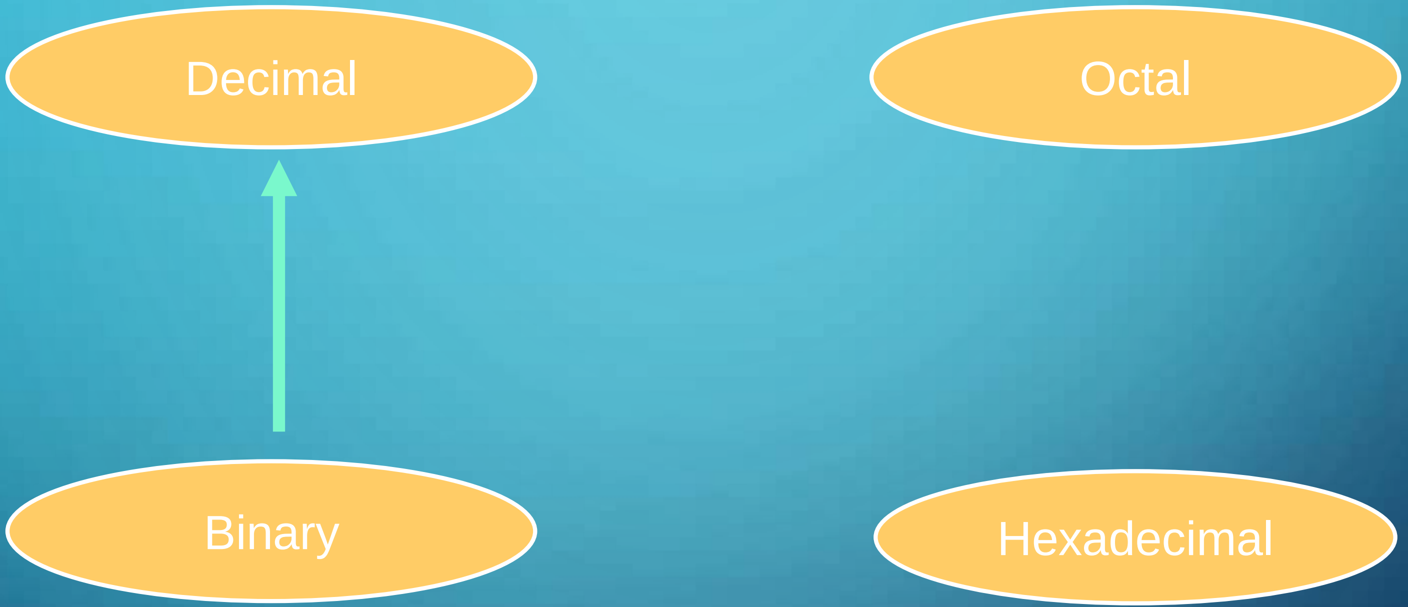


EXAMPLE

$(25)_{10} = 11001_2 = 31_8 = 19_{16}$

Base

BINARY TO DECIMAL



BINARY TO DECIMAL

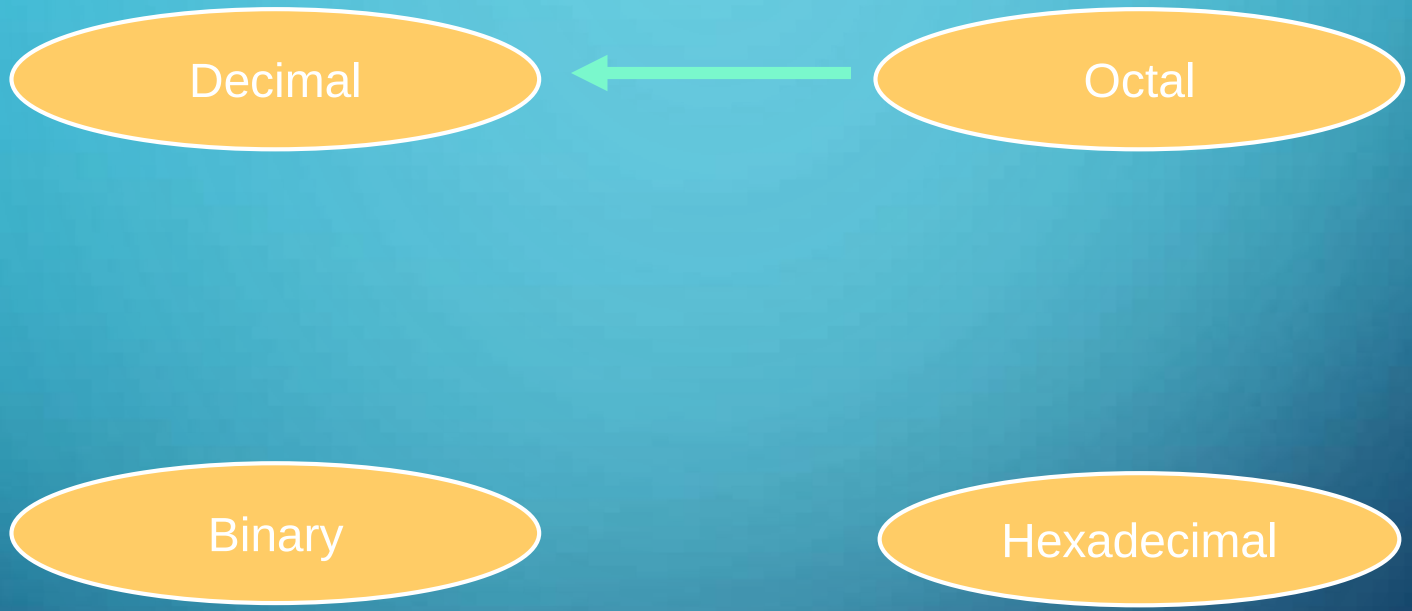
- Technique
  - Multiply each bit by 2^n, where n is the “weight” of the bit
  - The weight is the position of the bit, starting from 0 on the right
  - Add the results

EXAMPLE

Bit "0"

$$101011_2 \Rightarrow \begin{array}{l} 1 \times 2^0 = 1 \\ 1 \times 2^1 = 2 \\ 0 \times 2^2 = 0 \\ 1 \times 2^3 = 8 \\ 0 \times 2^4 = 0 \\ 1 \times 2^5 = 32 \\ \hline \quad 43_{10} \end{array}$$

OCTAL TO DECIMAL



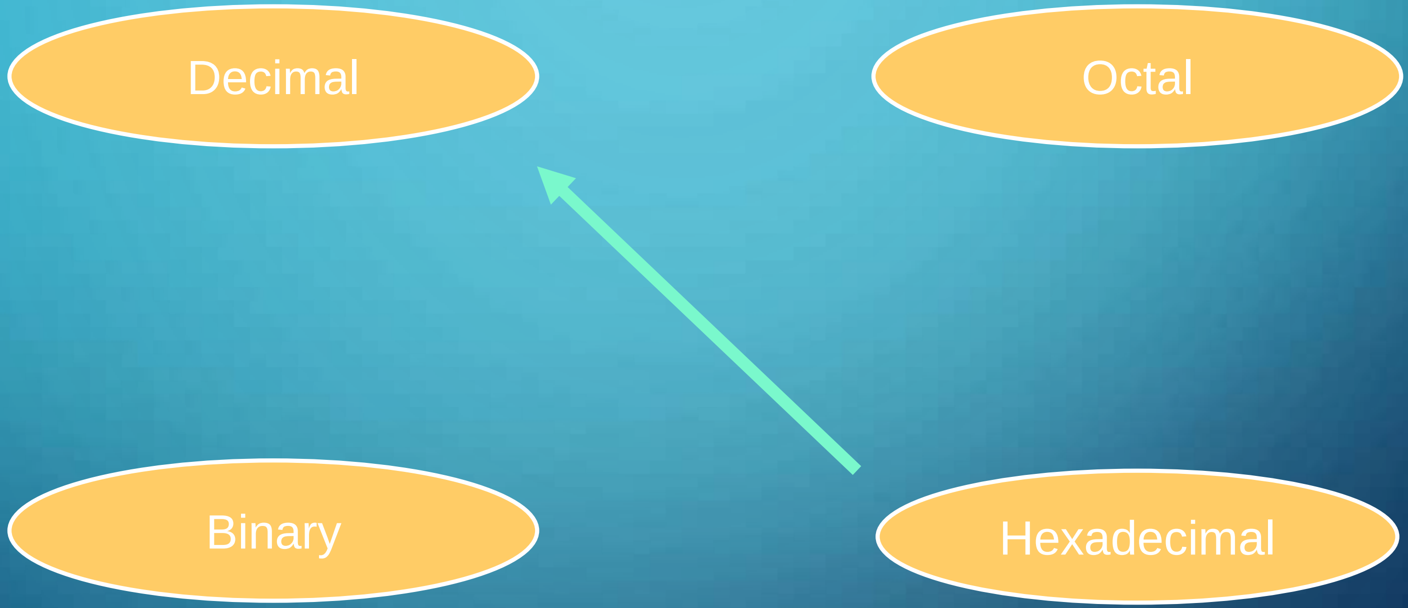
OCTAL TO DECIMAL

- Technique
  - Multiply each bit by 8^n, where *n* is the “weight” of the bit
  - The weight is the position of the bit, starting from 0 on the right
  - Add the results

EXAMPLE

724_8 =>	4×8^0 =	4	
	2×8^1 =	16	
	7×8^2 =	448	
		468_{10}	

HEXADECIMAL TO DECIMAL



HEXADECIMAL TO DECIMAL

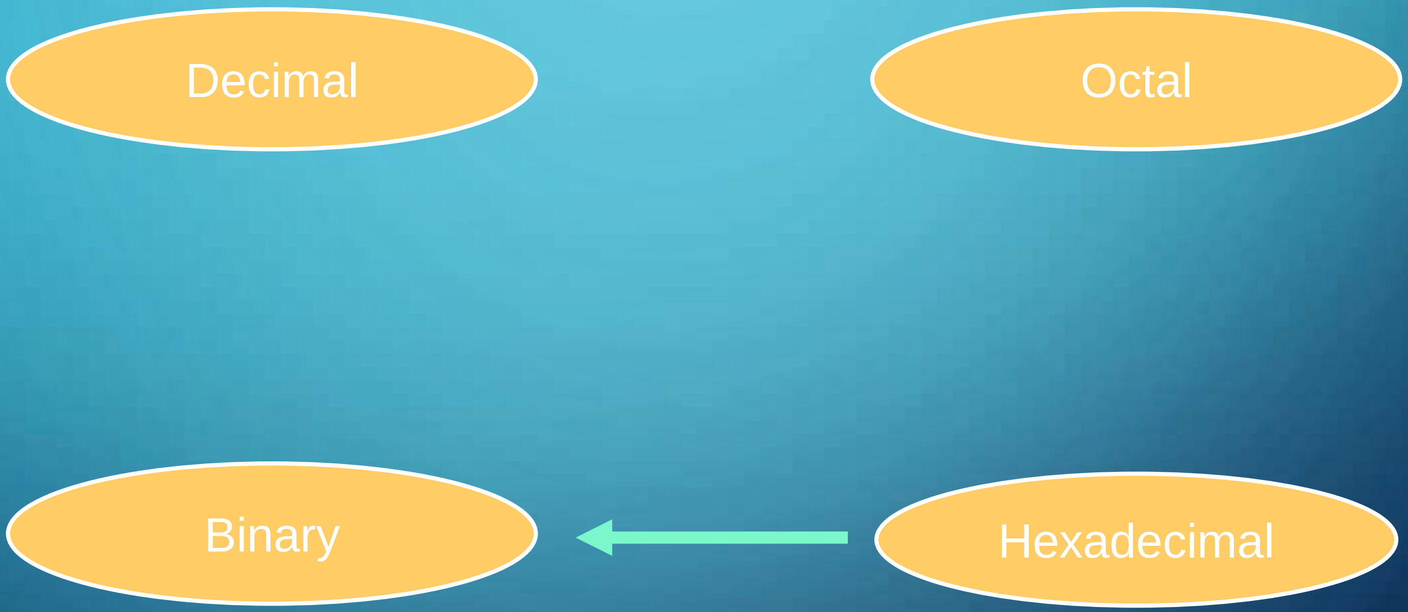
- Technique
  - Multiply each bit by 16^n, where *n* is the “weight” of the bit
  - The weight is the position of the bit, starting from 0 on the right
  - Add the results

EXAMPLE

ABC_{16} =>

$$
\begin{array}{l}
C \times 16^0 = 12 \times 1 = 12 \\
B \times 16^1 = 11 \times 16 = 176 \\
A \times 16^2 = 10 \times 256 = \underline{2560} \\
\qquad\qquad\qquad\qquad\qquad 2748_{10}
\end{array}
$$

HEXADECIMAL TO BINARY



HEXADECIMAL TO BINARY

- Technique
  - Convert each hexadecimal digit to a 4-bit equivalent binary representation

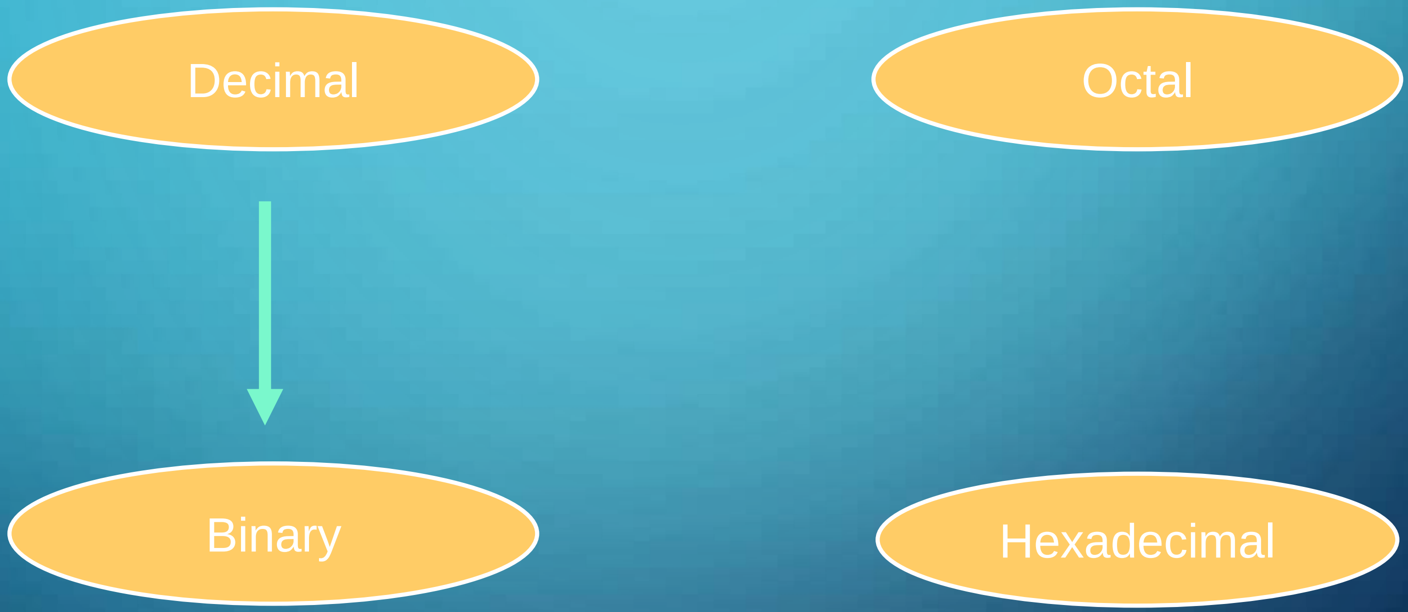
EXAMPLE

$10AF_{16} = ?_2$

1	0	A	F
0001	0000	1010	1111

$10AF_{16} = 0001000010101111_2$

DECIMAL TO BINARY



DECIMAL TO BINARY

- Technique
  - Divide by two, keep track of the remainder
  - First remainder is bit 0 (LSB, least-significant bit)
  - Second remainder is bit 1
  - Etc.

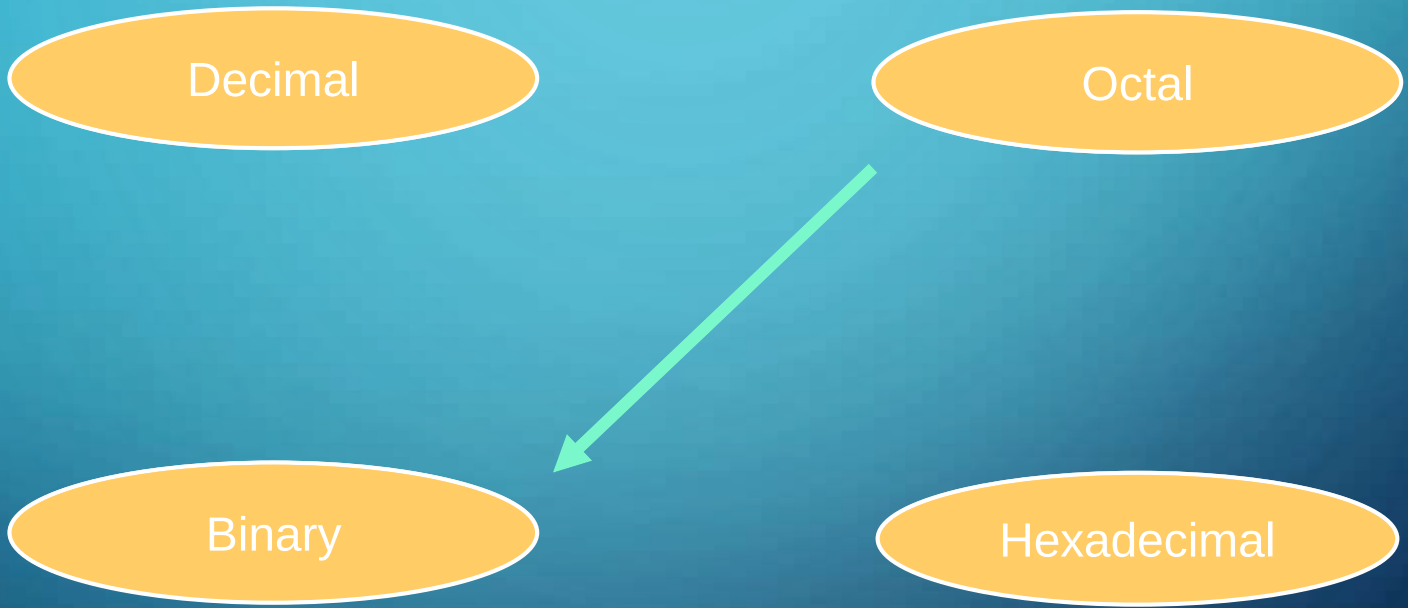
EXAMPLE

$125_{10} = ?_2$

2	125	
2	62	1
2	31	0
2	15	1
2	7	1
2	3	1
2	1	1
	0	1

$125_{10} = 1111101_2$

OCTAL TO BINARY



OCTAL TO BINARY

- Technique
  - Convert each octal digit to a 3-bit equivalent binary representation

EXAMPLE

$705_8 = ?_2$

7	0	5
↓	↓	↓
111	000	101

$705_8 = 111000101_2$

OCTAL TO HEXADECIMAL

- $132_8 = (?)_{16}$
- Octal ↔ Binary ↔ Hex

$$\underbrace{0\,0\,1}_{1}\ \underbrace{0\,1\,1}_{3}\ \underbrace{0\,1\,0}_{2}\,{}_{2} \quad = \quad \overbrace{0\,1\,0\,1}^{5}\ \overbrace{1\,0\,1\,0}^{A}\,{}_{16}$$

FRACTIONS

- Binary to decimal

10.1011 =>

$1 \times 2^{-4} = 0.0625$
$1 \times 2^{-3} = 0.125$
$0 \times 2^{-2} = 0.0$
$1 \times 2^{-1} = 0.5$
$0 \times 2^{0} = 0.0$
$1 \times 2^{1} = 2.0$

2.6875