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## Decimals to Binary & Binary to Decimals – Computers YouTube Lecture Handouts for Competitive Exams

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### Binary: Base-2 Numeral System with 0 and 1

### Decimal: Base-10

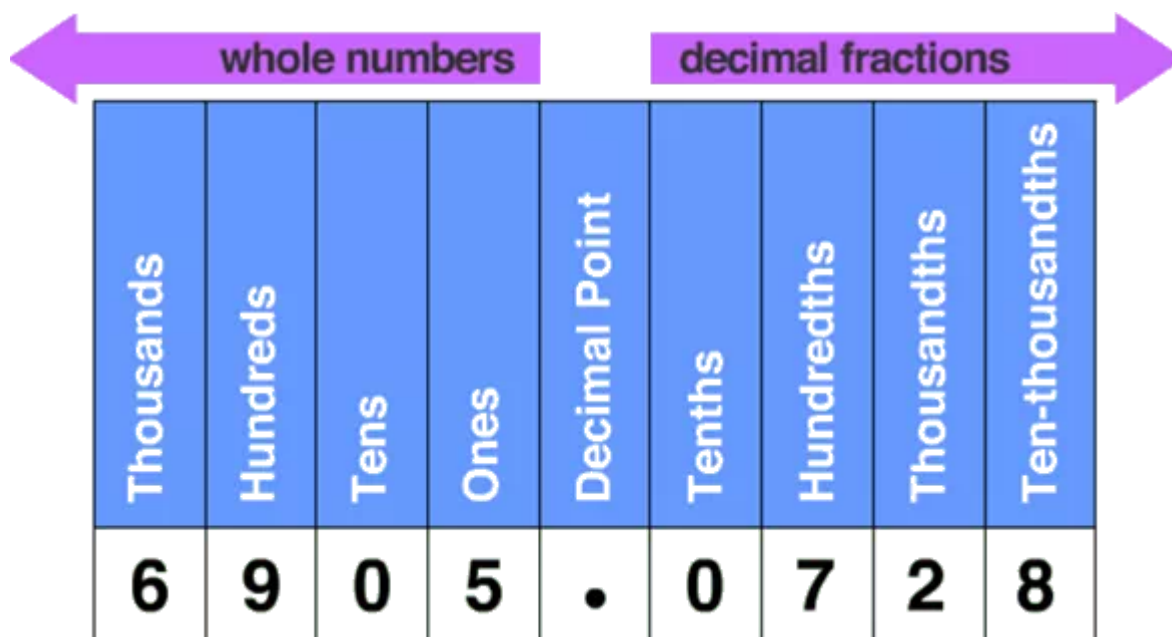


Image of Whole Numbers and Decimal Fractions

### Decimal Expansion

$$(6905.0728)_{10} = 6 \times 10^3 + 9 \times 10^2 + 0 \times 10^1 + 5 \times 10^0 + 0 \times 10^{-1} + 7 \times 10^{-2} + 2 \times 10^{-3} + 8 \times 10^{-4}$$

### Binary to Decimal

$$(101.11)_2 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2}$$

Solving this we get,

$$(101.11)_2 = (5.75)_{10}$$

Let's work around converting numbers

### Decimal to Binary

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## Without Decimal Fraction

- Move from Bottom to Top
- Example 1:
- 29 to binary

$$\begin{array}{r|l} 2 & 29 \\ 2 & 14 \quad 1 \\ 2 & 7 \quad 0 \\ 2 & 3 \quad 1 \\ & 1 \quad 1 \end{array}$$

- Answer will be  $(11101)_2$
- Example 2:
- 107 to binary

$$\begin{array}{r|l} 2 & 107 \\ 2 & 53 \quad 1 \\ 2 & 26 \quad 1 \\ 2 & 13 \quad 0 \\ 2 & 6 \quad 1 \\ 2 & 3 \quad 0 \\ & 1 \quad 1 \end{array}$$

Answer will be  $(1101011)_2$

## With Decimal Fraction

- Move from Top to Bottom
- Example 1:
- Working with 0.40625

$$0.40625 \times 2 = 0.8125 \Rightarrow 0$$

$$0.8125 \times 2 = 1.625 \Rightarrow 1$$

$$0.625 \times 2 = 1.25 \Rightarrow 1$$

$$0.25 \times 2 = 0.50 \Rightarrow 0$$

$$0.50 \times 2 = 1.0 \Rightarrow 1$$

- Answer will be  $(0.01101)_2$

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- Example 2:
- Working with 0.15

$$0.15 \times 2 = 0.30 \Rightarrow 0$$

$$0.30 \times 2 = 0.60 \Rightarrow 0$$

$$0.60 \times 2 = 1.20 \Rightarrow 1$$

$$0.20 \times 2 = 0.40 \Rightarrow 0$$

$$0.40 \times 2 = 0.80 \Rightarrow 0$$

$$0.80 \times 2 = 1.60 \Rightarrow 1$$

$$0.60 \times 2 = 1.20 \Rightarrow 1$$

$$0.20 \times 2 = 0.40 \Rightarrow 0$$

Answer will be  $(0.00100110)_2$

## Binary to Decimal

Without Binary Fraction

- Example 1:
- 101 to Decimal

$$(101)_2 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

Answer will be 5

- Example 2:
- 11001 to Decimal

$$(11001)_2 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

Answer will be 25

With Binary Fraction

Remember

$$2^{-1} = \frac{1}{2} = 0.5$$

$$2^{-2} = \frac{1}{4} = 0.25$$

$$2^{-3} = \frac{1}{8} = 0.125$$

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$$2^{-4} = \frac{1}{16} = 0.0625$$

$$2^{-5} = \frac{1}{32} = 0.03125$$

- Example 1:
- 0.11 to Decimal

$$(0.11)_2 = 1 \times 2^{-1} + 1 \times 2^{-2}$$

Answer will be 0.75

- Example 2:
- 0.1011 to Decimal

$$(0.1011)_2 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} + 1 \times 2^{-4}$$

Answer will be 0.6875

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-Mayank