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NUMBER SYSTEMS

Decimal-Binary Conversion:

A decimal integer number can be converted into its equivalent binary number by dividing the number successively by 2 and keeping a track of the remainder until a quotient of zero is obtained. Taking the remainder in the reverse order we get the binary equivalent.

Example: Convert the decimal number (29) to an equivalent binary number.

Soln.

2	29		↑ (LSB)
2	14	1	
2	7	0	
2	3	1	
2	1	1	
	0	1	(MSB)

Therefore, equivalent binary number corresponding to the decimal number, $(29)_{10} = (11101)_2$

Convert decimal fraction to binary fraction:

For decimal fraction the conversion is done by successive multiplication by 2 and recording each time a carry in the integer position. The process is continued untill the fractional part is zero or it starts repeat again.

Example: Convert the decimal fraction, 0.6875 into equivalent binary fraction.

Soln.

$0.6875 \times 2 = 1.375 = 0.375$ plus a carry 1 (MSB)

$0.375 \times 2 = 0.750 = 0.750$ plus a carry 0

$0.750 \times 2 = 1.500 = 0.500$ plus a carry 1

$0.500 \times 2 = 1.000 = 0.000$ plus a carry 1 ↓ (LSB)

Therefore, the equivalent binary fraction $(0.1011)_2$

Example: Conver the decimal number $(15.25)_{10}$ into equivalent binary number.

2	15		↑ (LSB)
2	7	1	
2	3	0	
2	1	1	
	0	1	(MSB)

$0.25 \times 2 = 0.50$ carry 0

$0.50 \times 2 = 0.00$ carry 1 ↓

$\therefore \quad (15.25)_{10} = (1111.01)_2$

Binary to decimal number:

Any binary number can be easily converted into equivalent decimal number using the weights assigned to each bit position.

Example: Convert the binary number $(101101)_2$ into its equivalent decimal number.

Soln. $(101101)_2 = 1\times 2^5 + 0\times 2^4 + 1\times 2^3 + 1\times 2^2 + 0\times 2^1 + 1\times 2^0$

$= 32 + 0 + 8 + 4 + 0 + 1 = (45)_{10}$

Example: Convert the binary number (0.0101)2 into its equivalent decimal number.

Soln. $(0.0101)_2 = 0\times 2^{-1} + 1\times 2^{-2} + 0\times 2^{-3} + 1\times 2^{-4} = 0 + \frac{1}{4} + 0 + \frac{1}{16} = 0.25 + 0.0625 = (0.3125)_{10}$

Octal number systems:

The octal number system is a base eight system. It use eight digits 0, 1, 2, 3, 4, 5, 6 and 7.

Example: Covert $(175)_{10}$ to octal.

Soln.

$$\begin{array}{r|l l} 8 & 175 & \\ \hline 8 & 21 & 7 \\ \hline 8 & 2 & 5 \\ \hline & 1 & 2 \end{array} \quad \uparrow \; \text{(LSB) to (MSB)}$$

(LSB) ↑ (MSB)

$\therefore \quad (175)_{10} = (257)_8$

Example: Convert $(0.22)_{10}$ to octal number.

Soln. 0.22×8 = 1.76 = 0.76 plus a carry 1 (MSB)

0.08×8 = 6.08 = 0.08 plus a carry 6

0.08×8 = 0.64 = 0.64 plus a carry 0

0.64×8 = 5.12 = 0.12 plus a carry 5 ↓ (LSB)

$\therefore \quad (0.22)_{10} = (0.1605.....)_8$

Note: $(175.22)_{10} = (175)_{10} + (0.22)_{10} = (257)_8 + (0.1605....)_8 = (257.1605....)_8$

Example: Convert $(257.5)_8$ into decimal equivalent.

Soln. $(257.5)_8 = 2\times 8^2 + 5\times 8^1 + 7\times 8^0 + 5\times 8^{-1}$

$= 128 + 40 + 7 + 0.625 = (175.625)_{10}$