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FACULTY OF ENGINEERING & TECHNOLOGY

CSPS-106 Computer Organization

Lecture-03

Mr. Dilip Kumar J Saini

Assistant Professor

Computer Science & Engineering

OUTLINE

- **FLOATING POINT NUMBERS**
- **BINARY EQUIVALENCE**
- **FRACTIONAL PART – MULTIPLICATION METHOD**
- **FRACTIONAL PART – SUBTRACTION METHOD**
- **BINARY EQUIVALENT OF FP NUMBER**



FLOATING POINT NUMBERS

- Now you've seen **unsigned** and **signed** integers. In real life we also need to be able represent numbers with fractional parts (like: -12.5 & 45.39).
 - Called **Floating Point** numbers.
 - You will learn the IEEE 32-bit floating point representation.

In the decimal system, a decimal point (**radix point**) separates the whole numbers from the fractional part

Examples:

37.25 (whole = 37, fraction = 25/100)

123.567

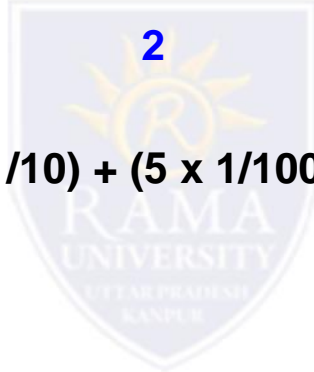
10.12345678

FLOATING POINT NUMBERS

For example, 37.25 can be analyzed as:

	10^1	10^0		10^{-1}		10^{-2}
Tens		Units		Tenths	Hundredths	
	3		7		2	5

$$37.25 = (3 \times 10) + (7 \times 1) + (2 \times 1/10) + (5 \times 1/100)$$



BINARY EQUIVALENCE

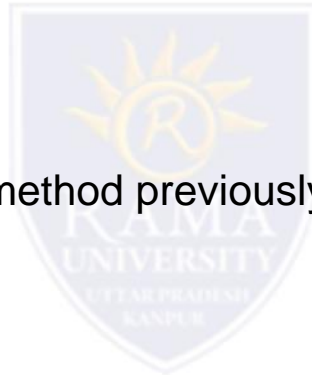
The binary equivalent of a floating point number can be determined by computing the binary representation for each part separately.

1) For the **whole** part:

Use subtraction or division method previously learned.

2) For the **fractional** part:

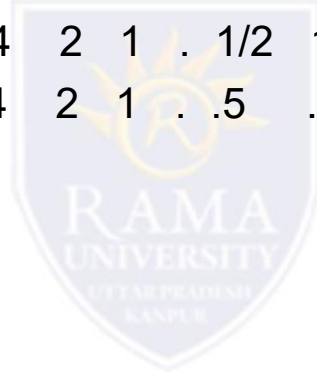
Use the subtraction or multiplication method (to be shown next)



FRACTIONAL PART – MULTIPLICATION METHOD

In the binary representation of a floating point number the column values will be as follows:

...	2^5	2^4	2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	2^{-4}	...
...	32	16	8	4	2	1	.	1/2	1/4	1/8	1/16	...
...	32	16	8	4	2	1	.	.5	.25	.125	.0625	...

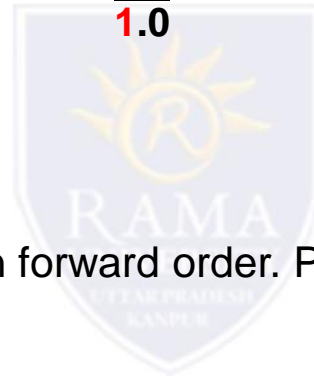


FRACTIONAL PART – MULTIPLICATION METHOD

Ex 1. Find the binary equivalent of **0.25**

Step 1: Multiply **the fraction** by 2 until the fractional part becomes 0
.25

$$\begin{array}{r} \underline{\times 2} \\ 0.5 \\ \underline{\times 2} \\ 1.0 \end{array}$$



Step 2: Collect the whole parts in forward order. Put them after the radix point

$$\begin{array}{r} . \text{ .5} \quad \text{.25} \quad \text{.125} \quad \text{.0625} \\ . \text{ 0} \quad \text{1} \end{array}$$

FRACTIONAL PART – MULTIPLICATION METHOD

Ex 2. Find the binary equivalent of **0.625**

Step 1: Multiply **the fraction** by 2 until the fractional part becomes 0
.625

$$\begin{array}{r} \underline{x \ 2} \\ 1.25 \\ \underline{x \ 2} \\ 0.50 \\ \underline{x \ 2} \\ 1.0 \end{array}$$



Step 2: Collect the whole parts in forward order. Put them after the radix point

$$\begin{array}{r} . \ 5 \quad .25 \quad .125 \quad .0625 \\ . \ 1 \quad 0 \quad 1 \end{array}$$

FRACTIONAL PART – SUBTRACTION METHOD

Start with the column values again, as follows:

...	2^0	.	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6} ...
...	1	.	1/2	1/4	1/8	1/16	1/32	1/64...
...	1	.	.5	.25	.125	.0625	.03125	.015625...



FRACTIONAL PART – SUBTRACTION METHOD

Starting with 0.5, subtract the column values from left to right. Insert a 0 in the column if the value cannot be subtracted or 1 if it can be. Continue until the fraction becomes .0

Ex 1.


$$\begin{array}{r} .25 \\ - .25 \\ \hline .0 \end{array} \quad \begin{array}{r} .5 \\ .0 \end{array} \quad \begin{array}{r} .25 \\ 1 \end{array} \quad \begin{array}{r} .125 \\ \end{array} \quad \begin{array}{r} .0625 \\ \end{array}$$



BINARY EQUIVALENT OF FP NUMBER

Ex 2. Convert 37.25, using subtraction method.

64 32 16 8 4 2 1 . .5 .25 .125 .0625
 2^6 2^5 2^4 2^3 2^2 2^1 2^0 . 2^{-1} 2^{-2} 2^{-3} 2^{-4}



$$\begin{array}{r}
 1 \quad 0 \quad 0 \quad 1 \quad 0 \quad 1 \quad . \quad 0 \quad 1 \\
 \quad \quad 37 \\
 \quad \quad \underline{-32} \\
 \quad \quad \quad 5 \\
 \quad \quad \quad \underline{-4} \\
 \quad \quad \quad \quad 1 \\
 \quad \quad \quad \quad \underline{-1} \\
 \quad \quad \quad \quad \quad 0
 \end{array}$$

$$37.25_{10} = 100101.01_2$$

BINARY EQUIVALENT OF FP NUMBER

Ex 3. Convert 18.625, using subtraction method.

64	32	16	8	4	2	1	.	.5	.25	.125	.0625
2^6	2^5	2^4	2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	2^{-4}
		1	0	0	1	0	1	0	1		

$$\begin{array}{r} 18 \\ - 16 \\ \hline 2 \\ - 2 \\ \hline 0 \end{array}$$

$$\begin{array}{r} .625 \\ - .5 \\ \hline .125 \\ - .125 \\ \hline 0 \end{array}$$

$$18.625_{10} = 10010.101_2$$

Multiple Choice Question

MUTIPLE CHOICE QUESTIONS:

Sr no	Question	Option A	Option B	OptionC	OptionD
1	Which registers can interact with the secondary storage?	MAR	PC	IQ	IR
2	During the execution of a program which gets initialized first?	MAR	PC	IR	IQ
3	Which of the register/s of the processor is/are connected to Memory Bus?	PC	IR	MAR	IQ
4	ISP stands for _____	Instruction Set Processor	Interchange Standard Protocol	Information Standard Processing	Interrupt Service Procedure
5	The internal components of the processor are connected by _____	Processor intra-connectivity circuitry	Processor Bus	memory bus	ram bus

REFERENCES

- <http://www.engppt.com/search/label/Computer%20Organization%20and%20Architecture>
- <http://www.engppt.com/search/label/Computer%20Architecture%20ppt>

