



Dr. SNS RAJALAKSHMI COLLEGE OF ARTS & SCIENCE (Autonomous)

Coimbatore -641049

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(Recognized by UGC, Approved by AICTE, New Delhi and
Affiliated to Bharathiar University, Coimbatore)

DEPARTMENT OF GRAPHIC & CREATIVE DESIGN AND DATA ANALYTICS

**COURSE NAME : COMPUTER SYSTEM ARCHITECTURE
(23UCU402)**

I YEAR /I SEMESTER

Unit I- Data Representation

Topic 3 : Number system : Decimal



Decimal to binary conversion

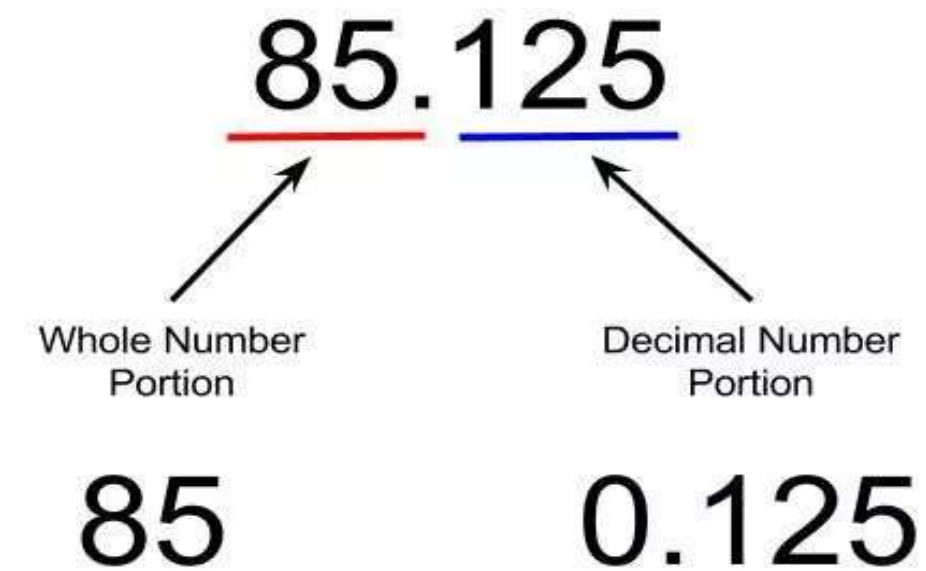
- A decimal like **19** can be converted into binary by repeatedly dividing the number by **2** and collecting the remainders (**double dabble method**)

2 19	↑	LSB
2 9 - 1		
2 4 - 1		
2 2 - 0		
1 - 0	↓	MSB

$$((19)_{10} = (10011)_2$$

Decimal fraction

- To the right of the decimal point, the digit 1 has a weight 0.1 (1/10), the digit 2 has a weight of 0.01 (1/100) and the digit 5 has a weight of 0.001(1/1000)



Decimal fraction

Decimal fraction
Consider 82.53

↑ Decimal Point

10^1	10^0	10^{-1}	10^{-2}			
8	2	5	3			
				3	x	1/100 = 0.03
				5	x	1/10 = 0.5
				2	x	1 = 2.
				8	x	10 = 80.
						82.53

Handwritten: 7/10

Binary fractions

$$2^0 = 1$$

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

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

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

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

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

Decimal fraction

Binary fractions
 Consider 11.01

↑ Binary Point

2^1	2^0	2^{-1}	2^{-2}				
1	1	0	1				
				1	x	1/4	= 0.25
				0	x	1/2	= 0.0
				1	x	1	= 1.
				1	x	2	= 2.
							3.25

7/10

Decimal to binary fraction conversion

Now lets suppose we have the following binary number of: 1101.0111₂, what will be its decimal number equivalent.

$$1101.0111 = (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) + (0 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3}) + (1 \times 2^{-4})$$

$$= 8 + 4 + 0 + 1 + 0 + 1/4 + 1/8 + 1/16$$

$$= 8 + 4 + 0 + 1 + 0 + 0.25 + 0.125 + 0.0625 = 13.4375_{10}$$

Assessment - Questions

1. Convert 1202 Decimal number to binary number
2. Convert 1202.34 Decimal number to binary number
3. Convert 1100 binary number to decimal number
4. Convert 1100.11 binary number to decimal number



1. Convert 1202 Decimal number to binary number

	Remainders
2 1,202	0
2 601	1
2 300	0
2 150	0
2 75	1
2 37	1
2 18	0
2 9	1
2 4	0
2 2	0
2 1	1
0	



$$(1202)_{10} = (10010110010)_2$$

2. Convert 1202.34 Decimal number to binary number

		Remainders	
2	1,202	0	$0.34 \times 2 = 0.68$
2	601	1	$0.68 \times 2 = 1.36$
2	300	0	$0.36 \times 2 = 0.72$
2	150	0	$0.72 \times 2 = 1.44$
2	75	1	$0.44 \times 2 = 0.88$
2	37	1	$0.88 \times 2 = 1.76$
2	18	0	$0.76 \times 2 = 1.52$
2	9	1	$0.52 \times 2 = 1.04$
2	4	0	
2	2	0	
2	1	1	



$$((1202.34)_{10} = (10010110010.01010111\dots)_2)$$

3. Convert 1100 binary number to decimal number

$$\begin{aligned} (1100)_2 &= (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (0 \times 2^0) \\ &= 8 + 4 \\ &= (12)_{10} \end{aligned}$$

$$(1100)_2 = (12)_{10}$$



4. Convert 1100.11 binary number to decimal number

$$\begin{aligned} (1100.11)_2 &= (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (0 \times 2^0) + (1 \times 2^{-1}) + (1 \times 2^{-2}) \\ &= 8 + 4 + 1/2 + 1/4 \\ &= 12 + 0.5 + 0.25 \\ &= (12.75)_{10} \end{aligned}$$



References

- 1.M.Morris Mano, “Computer System Architecture” 3rd Edition, Prentice Hall of India ,2000, ISBN-10: 0131663631
2. V.K. Puri, –DIGITAL ELECTRONICS CIRCUITS AND SYSTEMS” McGraw Hill Education (1 July 2017). ISBN-10: 9780074633175 , ISBN-13: 978-0074633175
- 3.William Stallings, “Computer Organization and Architecture, Designing for Performance” PHI/ Pearson Education North Asia Ltd., 10th Edition 2016, ISBN 978-0-13-410161-3 — ISBN 0-13-410161-8.

Thank You