


Binary Number System

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An Introduction to Binary Number System

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To define a number in a binary system, the Binary Number System is used. The binary system is the representation of numbers in terms of 0's and 1's. The Binary Number System is generally used in computer languages like Java, C++. This is due to the fact that the computer only understands the binary language that is 0 or 1. All inputs given to a computer are decoded into a series of 0's or 1's.

Number System is generally used for number representation in computer architecture. The Number System is classified into four types, they are

- Binary Number System (base 2)
- Octal Number System (base 8)
- Decimal Number System (base 10)
- Hexadecimal Number System (base 16).

Both in Mathematics and Digital Electronics, a Binary Number System is a way of presenting numerals that have to base equals to 2 and the same is a combination of 0s and 1s. Here, we have provided a Binary Number System example. Take a look!
110100

History of Binary Number System

Thomas Harriot, Gottfried Leibniz, and Juan Caramuel y Lobkowitz studied the binary system during the 16 and 17th centuries. This is termed the modern binary system. Nevertheless, other representation methods of binary numbers were found in an earlier time in various nations like India, China, Egypt, etc.

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In the following table, you will get to see the values of decimal to binary numbers from 1 to 30.

Decimal to Binary Numbers From 1 to 30

Number	Respective Binary Number	Number	Respective Binary Number	Number	Respective Binary Number
1	1	11	1011	21	10101
2	10	12	1100	22	10110
3	11	13	1101	23	10111
4	100	14	1110	24	11000
5	101	15	1111	25	11001
6	110	16	10000	26	11010
7	111	17	10001	27	11011
8	1000	18	10010	28	11100
9	1001	19	10011	29	11101
10	1010	20	10100	30	11110

Arithmetic Calculations in Binary Number System

Almost all kinds of fundamental arithmetical operations like addition, subtraction, multiplication and division are possible on binary digits. Let us study them individually.

Sum binary numbers are the simplest operation that uses a form of carrying.

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 0, \text{ here carry } 1 \text{ as } 1 + 1 \text{ is } 2 \text{ which is } 0 + (1 \times 2^1)$$

Addition of two digits (here “1”) gives zero, and the carryover needs to be added with the second number. This is exactly the same as we perform in the decimal system while adding two single-digit numbers. For example:

$5 + 5 = 0$ and carry over 1

Here, you can check an example showing the addition of two binary expressions.

Add 10101 and 11011

Binary Number System Addition

+	1	1	1	1	
	1	0	1	0	1
	1	1	0	1	1
1	1	0	0	0	0

Similar to addition, subtraction also follows the same procedure:

$0 - 0 = 0$

$0 - 1 = 1$, borrow 1

$1 - 0 = 1$

$1 - 1 = 0$

When you subtract 1 from 0, it gives out 1, and the same has to be reduced from the next number. This is called borrowing.

Here, you can check an example showing the subtraction of two binary expressions.

Subtract 1010110 – 101010

Binary Number System Subtraction

	1		1			
1	0	1	0	1	1	0
-	1	0	1	0	1	0
	1	0	1	1	0	0

The process to multiply two binary numbers is the same as it is done for decimal numbers. As binary numbers are a combination of two digits only, there will be only two outcomes. By going through the example below, you will get to comprehend it better.

Multiply 10111 by 1101

Binary Number System Multiplication

X		1	1	0	1
		1	0	1	0
		0	0	0	0

			1	1	0	1	
		0	0	0	0		
	1	1	0	1			
1	0	0	0	0	0	1	0

The binary division is again the same way as it is done for decimal numbers. Check the example below:

Binary Number System Division

10)1	0	1	0(101
	1	0			
		0	1	0	
			1	0	
				0	

Solved Binary Number System Problems

Problem 1. Convert the Following Binary Number to a Decimal Number.

(a) 1011_2

(b) 101_2

(c) 10101_2

Solutions:

(a)

2^4	2^3	2^2	2^1	2^0
	1	0	1	1

$$1011_2 = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$= 8 + 0 + 2 + 1$$

$$= 11_{10}$$

(b)

2^4	2^3	2^2	2^1	2^0
-------	-------	-------	-------	-------

		1	0	1

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

$$= 4 + 0 + 1$$

$$5_{10}$$

(c)

2^4	2^3	2^2	2^1	2^0
1	0	1	0	1

$$10101_2 = 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$= 16 + 0 + 4 + 0 + 1$$

$$= 21_{10}$$

Vedantu provides the above discussion about the Binary Number System of computers and its arithmetical calculations. If you are looking for study materials for other Number Systems, please download the app immediately.

Binary Number System

A number that can be expressed in the binary system or with the base 2 numeral system is called a binary number. It only has two numerical values such as 1 (one) and 0 (zero).

The binary system is an internal application used by almost every latest computer and computer-based device due to the direct implementation of electronic circuits that use logic gates. Every digit is denoted as a bit.

Binary Number Table

Number	Binary Number	Number	Binary Number	Number	Binary Number
1	1	11	1011	21	10101
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Binary Arithmetic Operations

It is the same as the arithmetic operations in numerals. We can perform addition, subtraction, multiplication, and division operations on Binary numbers in a similar way.

Adding two binary numbers will give a binary number itself. It is the simplest method compared to other arithmetic operations. The addition of two single-digit binary numbers is as follows.

Binary Addition

Binary Numbers		Addition
0	0	0
0	1	1
1	0	1
1	1	0; Carry \rightarrow 1

For example: Add 1101_2 , and 1001_2 .

Solution: $1101 + 1001 = 10110$

Subtracting two binary numbers will give a binary number itself. It is one of the straightforward methods. The subtraction of two single-digit binary numbers is as follows.

Binary Subtraction

Binary Numbers		Subtraction
0	0	0
0	1	1; Borrow 1
1	0	1

1	1	0
---	---	---

For example: Subtract 1101_2 , and 1010_2 .

Solution: $1101_2 - 1010_2 = 0011_2$

Binary Multiplication

The multiplication process is exactly similar to binary numbers and numerals.

For example Multiply 1101_2 and 1010_2 .

Solution: $1101 \times 1010 = 10000010$

Binary Division

The binary division is the same as the decimal number division method.

For example Divide 1010_2 by 10_2

Solution: $1010 / 10 = 0$

Uses of Binary Number System

Binary numbers are usually used in computer applications. All the coding and languages in computers use binary digits 0 and 1 to write a program or encode any digital data such as C, C++, Java, etc. This is due to the fact that computers only understand only the coded language. Therefore these 2-digit Number Systems are used to represent a set of data or information in the form of bits of information.

Is this page helpful?

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FAQs (Frequently Asked Questions)

1. What is a Binary Number System?

A number that can be expressed in the binary system or with the base 2 numeral system is called a binary number. It only has two numerical values such as 1 (one) and 0 (zero). The Binary Number System is generally used in computer languages like Java, C++. The binary system is an internal application used by almost every latest computer and computer-based device due to the direct implementation of electronic circuits that use logic gates. Every digit is denoted as a bit.

2. What are the uses of the Binary Number System?

3. Explain Binary Addition and Binary Multiplication?

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4. Explain Binary Subtraction and Binary Division?



5. What is a Number System?



6. What are the Applications of a Binary Number System?



7. What is Meant by Boolean Logic?



8. What are the Types of Number Systems?



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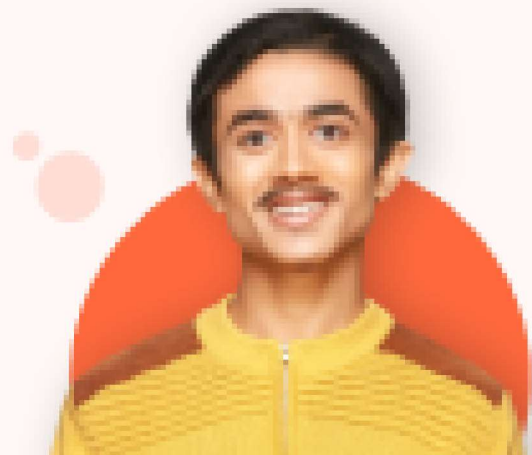


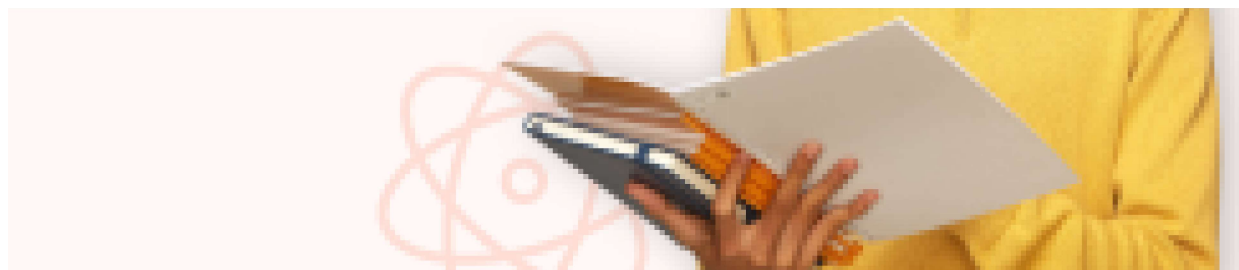
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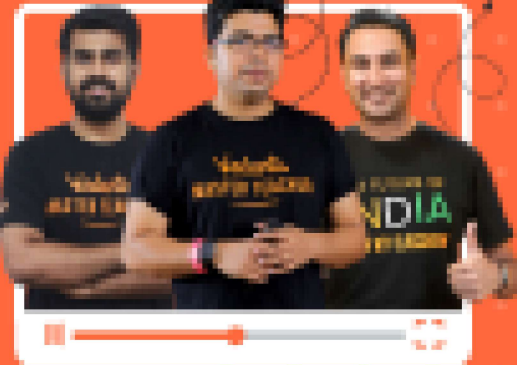
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