Binary Number System

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***Abstract*- In today's world, computer plays a very significant role. It comes in different sizes, shapes and applications and had made our life simpler. The language used by the computers is in the form of binary numbers that is in 0 and 1 form .It is the lowest level that helps the machine to read. Computer usually works in binary but gives answer in decimals and that helps it to save the space. This is important as it simplifies the design of computer and related technologies. That's why it is considered as the perfect numbering system for computer. It is also considered easy and there is no comparison how much easier binary is than decimal. In this, we only need 2 digits, o and 1 while in decimal we need 10 digits that made the process much harder. It is a method of storing simple numbers such as 35 and 380 as pattern of 0's and 1's. Due to its digital nature, computers electronic can easily manipulate numbers stored in binary by treating as "on "and "off." Computers are having circuits that perform the arithmetical operations such as add, subtract, multiply, divide, and do many other things to numbers stored in binary.**

Index terms- Binary, On, Off, Arithmetical.

I. INTRODUCTION

Binary numbers was first recognized by Claude Shannon, a mathematician at bell laboratories and gave his huge contribution in the era of modern computers but despite of the fact, that, it was invented by Gottfried Leibniz in 1689. This system represents the number as the linear combination of the power of two. It is basically written in base two. Computers code the decimal digits into binary, while the purely binary machines use full binary arithmetic. In the binary number system, each digit represents a place value. The first, (from right to left) represents the number of units; the second, represents the number of two's; the third, the number of fours; the fourth the number of eights, and so on. Examples of binary numbers are: -100,101,110 and so on. It is considered as the machine language so computer basically operates in binary number system. There are lots of advantages from the use of binary numbers such as we can make flawless copies with the help of binary data, it can be made easily, easy to understand, low- level language, takes less space and any huge numbers can be represent with a chunk of bits. It is an effective number system for computers because it is to implement with digital electronics. It is inefficient for humans to use binary, however, because it requires so many digits to represent a number. For example, the no 77, takes only two digits in decimal but in binary it takes upto seven digits 1001101. It can be converted into other number system such as Decimal, Octal, and Hexadecimal. The base power used in these number systems is larger than binary. Hence, it takes more space in the microprocessor and that also affects the time.

II.CONVERSIONS

A. From Binary to Decimal:

Conversion from binary (base-2) to decimal (base-10) numbers and vice-versa is an important concept to understand as the binary number forms the basis for computer and digital systems. The decimal counting system uses the base of 10 numbering system where each digit takes the place from 0 to 9. The value of any decimal number will be equal to the sum of its digits multiplied by their respective weights.

For example-7980(Seven Thousand Nine Hundred and Eighty) in a decimal format is equal to: 7000+900+80=7980 or it also can be written as- (7*1000) + (9*100) + (8*10) =7980. In the decimal number system, the left most digits are most significant while the right most digits are less significant. Now, in order to convert binary number to decimal, first of all, Write down the binary number and list the powers of 2 from left to right. Then, increment the exponent by one for each power. Stop

when the amount of elements in the list is equal to the amount of digits in the binary number.

For example-To convert binary number 1001110 into decimal, then, it will be converted as (1*2^6)+(0*2^5)+(0*2^4)+(1*2^3)+(1*2^2)+(1*2^1)+(0*2^0)=64+0+0+8+4+2+0=78. If decimal has to convert in binary, then the decimal number is divided by 2 and the remainder will give the required binary number. For example- Decimal number 179 to be converted in binary, then, it will be done as:-

2	179	
2	89	1
2	44	1
2	22	0
2	11	0
2	5	1
2	2	1
2	1	0
	0	1

The resultant binary number from the decimal number 179 with the base 10 is 10110011 with the base 2.

B. From Binary to Octal

Octal system provides convenient way of converting large binary numbers into more compact and smaller groups. It can be done by dividing the binary number in the group of three and after that those groups will be converted according to their value using only three bit.

For example:- To convert binary number 100110100 to octal, then, it will be converted as:

100	110	100

NOTATIONS USED:

DECIMAL	BINARY	OCTAL
0	000	0
1	001	1
2	010	2
3	011	3
4	100	4
5	101	5
6	110	6
7	111	7

As per the notation, 100 signify 4, 110 signify 6 in octal number system. Then the binary number 100110100 with the base 2 is converted as the octal number 464 with the base 8. If the octal number is converted into binary, then, it will be done by dividing the octal number by 8, and then the remainder will signify the resulted binary number. For example: -

To convert octal number 126 with the base 8 to binary, with the base 2. As per the notation 1 resembles 001, 2 resembles 010 and 6 resembles 110 in octal and by clubbing it, the final binary we will get is 1010110 with the base 2.

C. Binary to Hexadecimal

The base of this system is 16. It is widely used by programmers and developers as this system is human friendly. It uses the decimal numeral system where the digits are from 0 to 9 and after that it uses six extra symbols that denotes the value from 10 to 15.

These symbols lie from A to F. To convert the binary into hexadecimal

First, of, all, the entire binary no will be divided into the small and compact groups of four and from the specified notation of hexadecimal that particular group will be given the specific value.

For example:-

Consider a binary number 100110001100.

1001	1000	1100

Certain notations have been used in order to simplify the binary numbers that is huge and complex. These notations give a specific idea about the binary representation and the methods used for it. As Hexadecimal considered as the user - friendly representation because of it alphabetical representation

NOTATIONS USED:

DECIMAL	BINARY	HEXADECIMAL
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

As per the notation, 1001 signifies 9, 1000 signifies 8, and 1100 signifies 12 that is C. so, the resultant hexadecimal number formed from binary number is 98C with base 16. SO, the notations help to make it simpler.

TWO'S COMPLEMENT

All computers represent integers in a manner that allows both positive and negative numbers. So, in order to represent positive numbers, simply use its binary representation. Negative numbers represents with the help of two's complement. To find the two's complemented of a binary number, change each one to zero and each zero to one. For Example: - What is the two's complement of 10010010. Solution- First find the binary representation without negative number and then represents it with the help of two's complement. The two's complement is 00101101 that represent the negative number.

BINARY CODES

ASCII CHARACTER CODES

CONTROL CHARACTERS

NUL	NULL	DLE	DATA LINK ESCAPE
SOH	START OF HEADING	DC1	DEVICE CONTROL 1
STX	START OF TEXT	DC2	DEVICE CONTROL 2
ETX	END OF TEXT	DC3	DEVICE CONTROL 3
EOT	END OF TRANSMISSION	DC4	DEVICE CONTROL 4
BS	BACKSPACE	CAN	CANCEL
HT	HORIZONTAL TAB	EM	END OF MEDIUM
LF	LINE FEED	SUB	SUBSTI
VT	VERTICAL TAB	ESC	ESCAPE
FF	FORM FEED	FS	
CR	CARRIAGE RETURN	GS	GROUP SEPARATE
SO	SHIFT OUT	RS	RECORD SEPARATE
SI	SHIFT IN	US	UNIT SEPARATE
SP	SPACE	DEL	DELETE

III. CONCLUSION

In this paper, we discussed about binary numbers and its contribution In future and present scenarios. It is considered as the machine language this works on the principle of 'ON' and 'OFF'. The particular binary number can be converted into other forms due to which the complex number can be changed into the simpler ones. Binary numbers has the significant role in artificial intelligence as AI uses the machine language. It plays a huge role in the world of internet as the signal passé with the help of information given by it. It also considered as human friendly as some of the instances can be easily understood by human. All over, it's a very easy language and understandable and had created a revolution in the world of computers.

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