Career College, Bhopal

Topic: Number system

(Conversion from one base to another)

Subject :Digital Computer Organisation

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WHAT IS NUMBER SYSTEM?

A number system relates quantities and symbols. The base or radix of a number system represents the number of digits or basic symbols in that particular number system. In decimal system the base is 10, because of use the numbers 0, 1, 2,3,4,5,6,7,8 and 9.

Decimal number system

- This system has ten specific symbols like:0,1,2,3,4,5,6,7,8,9; which are called digits.
- By using only these ten digits we can represent any value.
- This is also called the “Base-10” system because it has ten digits.

Binary number system

- In binary number system, the value of the base is 2.
- Hence it has only two symbols or digits (0,and 1)
- Bit is the short form of “binary digit”
- A “bit” in computer terminology means either a 0 or 1

Octal number system

- Octal number system has a base of 8 i.e., it has eight basic symbols. First eight decimal digits 0, 1,2,3,4,5,6,7 are used in this system.

- In the octal number system each digit corresponds to the powers of 8.

Hexadecimal number system

- In hexadecimal number system, the base is 16.
- The first 10 digits are the same digits of decimal number system 0 to 9.
- The remainig six digits are the symbols A,B,C,D,E and F representing decimal values 10,11,12,13,14,and 15 respectively.

Number system conversion

- It includes the process of converting a number of one number system into another number system.

Following conversions are possible :

1. Binary to decimal
2. Octal to decimal
3. Hex to decimal
4. Decimal to binary
5. Decimal to octal
6. Decimal to hex
7. Octal to binary
8. Binary to octal
9. Hex to binary
10. Binary to hex

Conversions

The *base* of a number system represents the number of symbols it has:

Name	Base	Symbols
Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Binary	2	0, 1
Hexadecimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F
Octal	8	0, 1, 2, 3, 4, 5, 6, 7

Positional number systems use *exponentiation* to determine a symbol's value based on its place. We can use this idea to convert from any system into the decimal system:

System	Base	Value	Conversion Formula	Decimal Value
Decimal	10	104	$(1 \times 10^2) + (0 \times 10^1) + (4 \times 10^0)$	$100 + 0 + 4 = 104$
Binary	2	111	$(1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$	$4 + 2 + 1 = 7$
Octal	8	104	$(1 \times 8^2) + (0 \times 8^1) + (4 \times 8^0)$	$64 + 0 + 4 = 68$
Hexadecimal	16	FEC	$(F \times 16^2) + (E \times 16^1) + (C \times 8^0)$	$15 \times 256 + 14 \times 16 + 12 \times 1 = 3840 + 224 + 12 = 4076$

Conversion from decimal to different bases

e.g.: $(125)_{10}$ to $(\ )_2$

2	125	
2	62	1
2	31	0
2	15	1
2	7	1
2	3	1
2	1	1
	0	1

Answer : $(1111101)_2$

Decimal to Binary Conversion

$(160)_{10}$

2	160	
2	80	0
2	40	0
2	20	0
2	10	0
2	5	0
2	2	1
	1	0

Thank you