

Principles of Combinational Logic

Number Systems

i Numbers (Def.) \Rightarrow Mathematical values or figures used for the purpose of measuring or calculating quantities

\rightarrow Value determined by the digit, its place value in the number, and the base of the number system

ii Definition:- Elementary system to express numbers and figures. It is the unique way of representing of ~~an~~ numbers in arithmetic and algebraic structures.

iii Types: Based on the base base values

a Decimal - base value of 10

b Binary - base value of 2

c Octal - base value of 8

d Hexadecimal - base value of 16

Decimal Number System

- i Number system with base value of 10
- ii 10 digits used (0-9)
- iii Place value is a multiple of 10^n (where n is place)

Example:

$$12265 \Rightarrow (1 \times 10^4) + (2 \times 10^3) + (2 \times 10^2) + (6 \times 10^1) + (5 \times 10^0)$$

Place	4	3	2	1	0
Number	1	2	2	6	5

Binary Number System

- i Number ~~sys~~ system with base value of 2
- ii 2 digits used (0 & 1)
- iii ~~Place~~ Place value determined by a multiple of 2^n (where n is place)

iv

decimal	0	1	2	3	4	5	6	7	8	9
Binary	0	1	10	11	100	101	110	111	1000	1001

Example 12265 in Binary = $(1011111101001)_2$

2	12265	0
2	6132	1
2	3066	0
2	1533	1
2	766	0

2	1 2 2 6 5 0	1
2	6 1 3 2	0
2	3 0 6 6	0
2	1 5 3 3	1
2	7 6 6	0
2	3 8 3	1
2	1 9 1	1
2	9 5	1
2	4 7	1
2	2 3	1
2	1 1	1
2	5	1
2	2	0
2	1	

Writing hexadecimal in decimal code I've got

$(12265)_{16} = (160000000)_{10}$

Because of only 2 digits it is often used in electronic and logic circuits, 0 being off and 1 being on

Octal Number System

- Number system with base value of 8
- 8 digits used (0-7)
- Place value is a multiple of 8^n (where n is place)

iv	Decimal	D	1	2	3	4	5	6	7	8	9
	Octal	O	1	2	3	4	5	6	7	10	11

Example

12265 in Octal = $(27751)_8$

8	12265	1
8	1533	5
8	191	7
8	23	7
	2	2

Writing remainders in reverse we get

$$(12265)_{10} = (27751)_8$$

Octal are useful for the representation of UTF8 Numbers

Hexadecimal

- Number system with a base value of 16
- It uses 16 digits (0-9 & A-F)
- Place value is a multiple of 16^x (where x is place)
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Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Example

12265 in Hexadecimal = $(2FE9)_{16}$

16	12 2 6 5	9
16	7 6 6	14 (E)
16	4 7	15 (F)
16	2	

Writing remainder in reverse we get

$$(12256)_{10} = (2FE9)_{16}$$

Hexadecimal Numbers ~~system~~ are useful for handling memory address locations.