Introduction to Information Technology

CSC109

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5. Data Representation

- ✓ **Number system**
- ✓ **Conversion from Decimal to binary, octal, hexadecimal**
- ✓ **Conversion of binary, octal, hexadecimal to decimal**
- ✓ **Conversion of Binary to Octal, Hexadecimal**
- ✓ **Conversion of Octal, Hexadecimal to Binary**
- ✓ **Binary arithmetic**
- ✓ **Signed and unsigned numbers**
- ✓ **Binary Data Representation**
- ✓ **Binary Coding Schemes**
- ✓ **Logic Gates**

Data Representation

Data refers to the symbols that represent people, events, things, and ideas. Data can be a name, a number, the colors in a photograph, or the notes in a musical composition

Data Representation refers to the form in which data is stored, processed, and transmitted.

Devices such as smartphones, ipods and computer store data in digital formats that can be handled by electronic circuitry.

Data Representation

Digitization is the process of converting information, such as text, numbers, photo, or music, into digital data that can be manipulated by electronic devices.

The ***Digital Revolution*** has evolved through four phases, beginning with big, expensive, standalone computers, and progressing to today's digital world in which small, inexpensive digital devices are everywhere.

5.1 Introduction

Data stored in different kinds

1. Numeric (0,1,2..9)
2. Alphabetic (A, B, C…Z)
3. Alphanumeric
4. Special Characters

All of them is represented in terms of 0s and 1s

And their unique combinations

5.1 Introduction

Our discussion is focus on following number systems

(1) Decimal number

2) Binary number system,

(3) Octal number system, and

(4) Hexadecimal number system.

Base or Radix

Position of digit?

Base/radix	Name
2	Binary numeral system
8	Octal system
10	Decimal system
16	Hexadecimal system

5.2 Number System

Face value;

Face value of a digit in a number is the value of the digit itself. Wherever it appears.

Place value/Position Value

Place value of a digit in a number is the value of the digit where it to appear.

Eg 1. 768534, find place value and face value of 5 in given no;

Face Value of 5 is ; 5

Place Value of 5 is; 5*100= 500

2. 0.03721; **find place value of 3.**

Another way;

The **Place Value/Position value** of a digit is 【**Base** $^{\textbf{Position}}$】

In 768534 **Place Value/Position value** of 5 is $=10^2$ -->$5* 10^2$

A number in a particular base is written as $【(number)_{base\ of\ number}】$

For example, $(23)_{10}$ means that the number 23 is a decimal number

$(345)_8$ shows that 345 is an octal number.

5.2.1 Decimal Number System

- ✓It consists of 10 digits number—0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.
- ✓probably the most commonly used number system
- ✓All number in this numbering system are combination of 0-9 digits
- ✓Represented by **base or radix** 10/ base 10 number system

Position	3	2	1	0	-1	-2	-3
Position Value	10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}
Quantity	1000	100	10	1	1/10	1/100	1/1000

5.2.2 Binary Number System

- ✓The binary number system consists of two digits—0 and 1.
- ✓All binary numbers are formed using combination of 0 and 1.
- ✓All number in this numbering system are unique combination of 1s & 0s
- ✓Represented by **base or radix** 2

Position	3	2	1	0	-1	-2	-3
Position Value	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}
Quantity	8	4	2	1	1/2	1/3	1/8

5.2.3 Octal Number System

- ✓The octal number system consists of eight digits—0 to 7.
- ✓All octal numbers are represented using these eight digits
- ✓Also called “oct” in short, is the base-8 number system

Position	3	2	1	0	-1	-2	-3
Position Value	8^3	8^2	8^1	8^0	8^{-1}	8^{-2}	8^{-3}
Quantity	512	64	8	1	1/8	1/64	1/512

5.2.4 Hexadecimal Number System

- ✓ The hexadecimal number system consists of sixteen digits—0 to 9, A, B, C, D, E, F, where (A is for 10, B is for 11, C-12, D-13, E-14, F-15).
- ✓ All hexadecimal numbers are represented using these 16 digits.
- ✓ In short "hex"
- ✓ Base 16 Number System

Position	3	2	1	0	-1	-2	-3
Position Value	16^3	16^2	16^1	16^0	16^{-1}	16^{-2}	16^{-3}
Quantity	4096	256	16	1	1/16	1/256	1/4096

Decimal	Binary	Octal	Hexadecimal
Base-10	Base-2	Base-8	Base-16
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F