Logical Design

Lecture 1 :Number Systems

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What is the Logical Design

- **logic design**, basic organization of the circuitry of a **computer.** All digital computers are based on a **two-valued logic system**—1/0, on/off. Computers perform calculations using components called logic gates (or logic circuits), which are made up of integrated circuits that receive an input signal, process it, and change it into an output signal.

- Many **number systems** are in use in digital technology. The most common are the decimal, binary, octal, and hexadecimal systems. The decimal system is clearly the most familiar to us because it is the tool that we use every day.

Types of number systems

- Non- positional number systems: Each symbol represents the same value regardless of its position in the number.

1	I	6	𝍸 I
2	II	7	𝍸 II
3	III	8	𝍸 III
4	IIII	9	𝍸 IIII
5	𝍸	10	𝍸 𝍸

- Positional number systems: Use only a few symbols called digits, these symbols represent different values depending on the position they occupy in the number.

Decimal Number System

The decimal number system is a **base 10** system with ten digits ranging from **0** to **9**. This means that these ten digits can be used to represent any numerical quantity. A positional value system is the decimal number system. This indicates that the value of digits is determined by their placement. To further comprehend this, consider the following scenario.

Suppose we have three numbers – 734, 971 and 207. The value of 7 in all three numbers is different

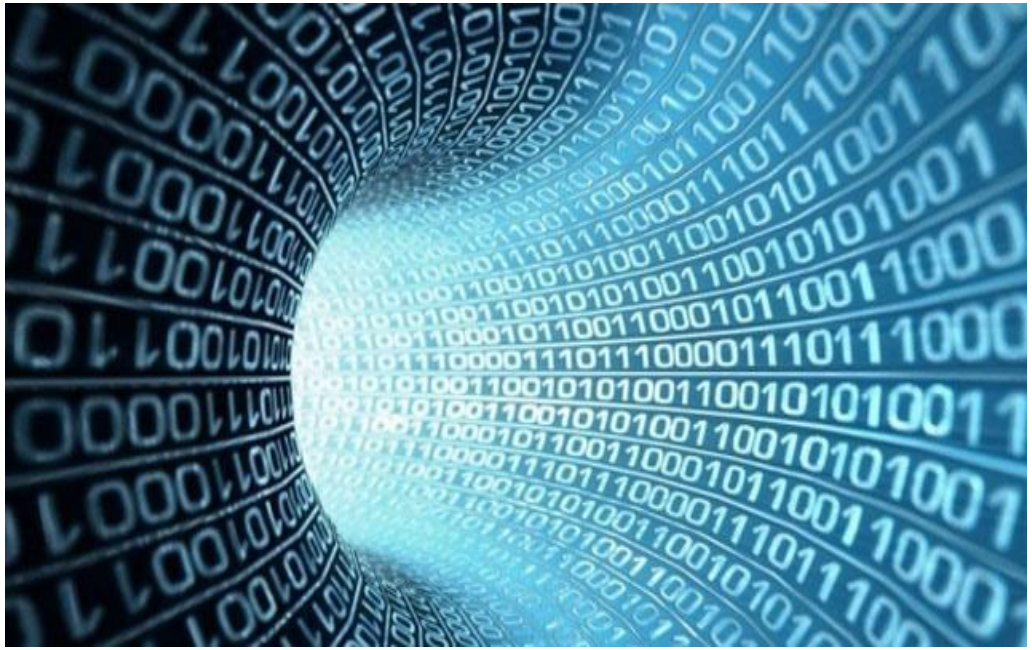
- In 734, value of 7 is 7 hundreds or 700 or 7×100 or 7×10^2
- In 971, value of 7 is 7 tens or 70 or 7×10 or 7×10^1
- In 207, value 0f 7 is 7 units or 7 or 7×1 or 7×10^0

The weightage of each position can be represented as follows:

10^5	10^4	10^3	10^2	10^1	10^0

Digital Systems

- In digital systems, instructions are given through electric signals; variation is done by varying the voltage of the signal. Having 10 different voltages to implement decimal number system in digital equipment is difficult. So, many number systems that are easier to implement digitally have been developed. Let’s look at them in detail.



Binary Number System

A binary number is a number that has been expressed in the base 2 numeral system. It uses two distinct symbols to represent numerical values: 1 (one) and 0 (zero).

Because of its direct application in electronic circuits utilizing logic gates, the binary system is used internally by all modern computers and computer-based devices. Every digit is referred to as a **bit**. where each digit has a value expressed in powers of 2, as displayed here.

decimal equivalent of this number is sum of product of each digit with its positional value.

$11010_2 = 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 0\times2^0$

$= 16 + 8 + 0 + 2 + 0$

$= 26_{10}$

Computer Memory Measurement

Computer memory is measured in terms of how many bits it can store. Here is a chart for memory capacity conversion.

1 byte (B) = 8 bits

1 Kilobytes (KB) = 1024 bytes

1 Megabyte (MB) = 1024 KB

1 Gigabyte (GB) = 1024 MB

1 Terabyte (TB) = 1024 GB

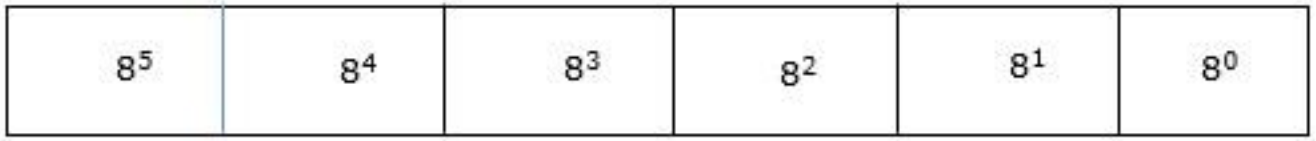
1 Exabyte (EB) = 1024 PB

1 Zettabyte = 1024 EB

1 Yottabyte (YB) = 1024 ZB

Octal Number System

Octal number system has eight digits – 0, 1, 2, 3, 4, 5, 6 and 7. Octal number system is also a positional value system with where each digit has its value expressed in powers of 8, as shown



Decimal equivalent of any octal number is sum of product of each digit with its positional value.

$726_8 = 7\times8^2 + 2\times8^1 + 6\times8^0$

$= 448 + 16 + 6$

$= 470_{10}$

Hexadicemal Number System

Hexadicemal Number has 16 symbols – **0** to **9** and **A** to **F** where A is equal to 10, B is equal to 11 and so on till F.
Hexadecimal number system is also a positional value system with where each digit has its value expressed in powers of 16.

16^5	16^4	16^3	16^2	16^1	16^0

Decimal equivalent of any hexadecimal number is sum of product of each digit with its positional value.

$27FB_{16} = 2\times16^3 + 7\times16^2 + 15\times16^1 + 10\times16^0$

$= 8192 + 1792 + 240 + 10$

$= 10234_{10}$