ACOL 215 (02 Sept. 2025)

$\boxed{\text{Digital Circuits and their logical function}}$

operates on a given data

Digitals systems are everywhere

→ special purpose digital computer

a general computing device

program

it can follow a sequence of instructions ability to represent and manipulate discrete elements of information

represented in a digital system by physical quantities called signals

Electrical signals such as voltages and current } most common

typically enabled by electronic devices called transistors

In most present-day digital systems, the signals use just two discrete values

binary

A binary digit - bit - has two numerical values - 0 and 1.

the decimal numbers 0 to 9 can be represented using 4-bit binary codes.

groups of bits

binary code

to represent information

$7 = (0111)_2$

Digital devices

made with

digital circuits

programmable

the same hardware can be used for many different applications

We need to understand the operation of each digital component in a digital device

Binary Numbers

$(7392)_{10}$

7392

7 thousands 3 hundred 9 tens
and 2 ones

$$\underline{7} \times 10^3 + \underline{3} \times 10^2 + \underline{9} \times 10^1$$
$$+ \underline{2} \times 10^0$$

$$\boxed{87392.4513}$$

0

$$8\times 10^{4} + 7\times 10^{3} + 3\times 10^{2} + 9\times 10^{1} + 2\times 10^{0} + 4\times 10^{-1} + 5\times 10^{-2} + 1\times 10^{-3} + 3\times 10^{-4}$$

increase . decrease

$$7 = \underbrace{(0111)_2}$$

$$\underbrace{0\times 2^3}_{0} + \underbrace{1\times 2^2}_{4} + \underbrace{1\times 2^1}_{2} + \underbrace{1\times 2^0}_{1}$$

$$= 7$$

$$(26.75)_{10} = (11010.11)_2$$

$$\underbrace{1\times 2^4}_{16} + \underbrace{1\times 2^3}_{8} + \cancel{0\times 2^2} + \underbrace{1\times 2^1}_{2} + \cancel{0\times 2^0} + \underbrace{1\times 2^{-1}}_{0.5} + \underbrace{1\times 2^{-2}}_{+\,0.25}$$

The **radix** of a number system determines the number of distinct values that can be used to represent any number.

The decimal number system has a **radix** **10**

0 to 9

base The binary number system has radix 2. **0, 1**

base - r

different number system with different bases.

$$a_n \dots a_2\, a_1\, a_0 \,.\, a_{-1}\, a_{-2}\, a_{-3} \dots a_{-m}$$

$$a_n \cdot r^n + a_{n-1} \cdot r^{n-1} + \dots + a_2 r^2 + a_1 r^1 + a_0 r^0 + a_{-1} r^{-1} + a_{-2} r^{-2} + a_{-3} r^{-3} + \dots a_{-m} r^{-m}$$

$$(4021.2)_5$$

$$= 4 \times 5^3 + 0 \times 5^2 + 2 \times 5^1 + 1 \times 5^0 + 2 \times 5^{-1}$$

$$= 500 + 0 + 10 + 1 + \cancel{\frac{2}{5}}\ 0.4$$

$$= (511.4)_{10}$$

$0 \ldots 4$

$0 \ldots 9$

Octal

$$(127.4)_8$$

$$= 1 \times 8^2 + 2 \times 8^1 + 7 \times 8^0 + \frac{\cancel{4}}{\cancel{8}}$$

$$= 64 + 16 + 7 + 0.5$$

$$= (87.5)_{10}$$

Hexadecimal number system

0 . . . 9

A	B	C	D	E	F
10	11	12	13	14	15

$(B65F)_{16}$

$= B\times16^3 + 6\times16^2 + 5\times16^1 + F\times16^0$

$= 11\times16^3 + 6\times16^2 + 5\times16^1 + 15\times16^0$

$= (\quad)_{10}$

How do we add, subtract, and multiply numbers in a <u>different</u> base?
(different from base 10)

How do we convert from one base to another?