LOGIC CIRCUIT

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ELX 212.3
Logic Circuits (3-1-3)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Objectives of this course

1. To provide basic of logic systems.
2. To provide basic design a simple digital computer.
3. Study of logic circuits that build digital system.
4. Study of combinational and sequential logical circuits
5. Study of Numbers, codes and Boolean alzebra

Course Contents

1. Introduction (3 hrs)

Numerical representation, Digital number system, Digital and analog system,

2. Number System and Codes (6 hrs)

Binary to decimal and decimal to binary conversions, Octal, hexadecimal number

system and conversions, Binary Arithmetic 1&9;s complement and 9's complements, gray code, Instruction codes, Alphanumeric characters, Modulo2 system and 2s complement, Binary Coded Decimal (BCD) and hexadecimal codes, Parity method for error detection.

3. Boolean Algebra and Logic Gates (4 hrs)

Basic definition, Basic properties and theorem of Boolean algebra, De-Morgans Theorem, Logic gates and truth tables, Universality of NAND and NOR gates. Tristate logic.

4. Simplification of Boolean Function (5 hrs)

Venn diagram and test vectors, Karnaugh maps up to five variables, Minimum

realization, don't care conditions, Logic gates implementation, practical design steps.

5. Combination Logic (4 hrs)

Design procedure, Adders and subtractors, Code conversion, Analysis procedure.

Multilevel NAND and NOR circuits, Parity generation and checking.

6. MSI and LSI Components in Combinational Logic Design (5 hrs)

Binary adder and subtractor, Decimal adder, Magnitude comparator, Decoder and encoder, Multiplexer and demultiplexer, Read-only memory (ROM), Programmable Logic Array (PLA).

7. Sequential Logic (6 hrs.)

Event driven model and state diagram, flip-flops and their types. Analysis of clocked sequential circuits, Decoder as memory devices, State reduction and assignment, Synchronous and asynchronous logic, Edge triggered device. Master slave flip-flops, JK and T flip-flops.

8. Registers, Counters and Memory Unit (6 hrs.)

Registers, shift registers, Superposition of registers, generation of codes using registers, Ripple, Synchronous and Johnson Counters, Design of multiple input circuits, Random Access Memory (RAM). Memory decoding, error-correction code, Output hazards races.

9. Arithmetic Logic Units (5 hrs.)

Nibble adder, Adder/ substrata unit, Design of arithmetic logic unit. Status register, Design of shifter, Processor unit, Design of accumulator.

Laboratory Work:

1. Familiarization with logic gates.
2. Familiarization with encoder
3. Familiarization with decoder
4. Multiplexer and demultiplexer
5. Design of simple combination circuits such as half adder .
6. Design of full adder and full subtractor
7. Design of RS flip-flop and Jk flipflop
8. Design of T flipflop and D flipflop.
9. Design of Clock driven sequential circuits such as counter
10. Design of shift registers

Reference Books:

1) M. Mano, Digital Logic and Computer Design, Prentice Hall of India 1998.

2) M. Mano, Computer System Architecture, Prentice Hall of India, 1998.

3) M. Mano, Digital Design, Prentice Hall of India, 1998.

Introduction to Digital Electronics / logic circuits

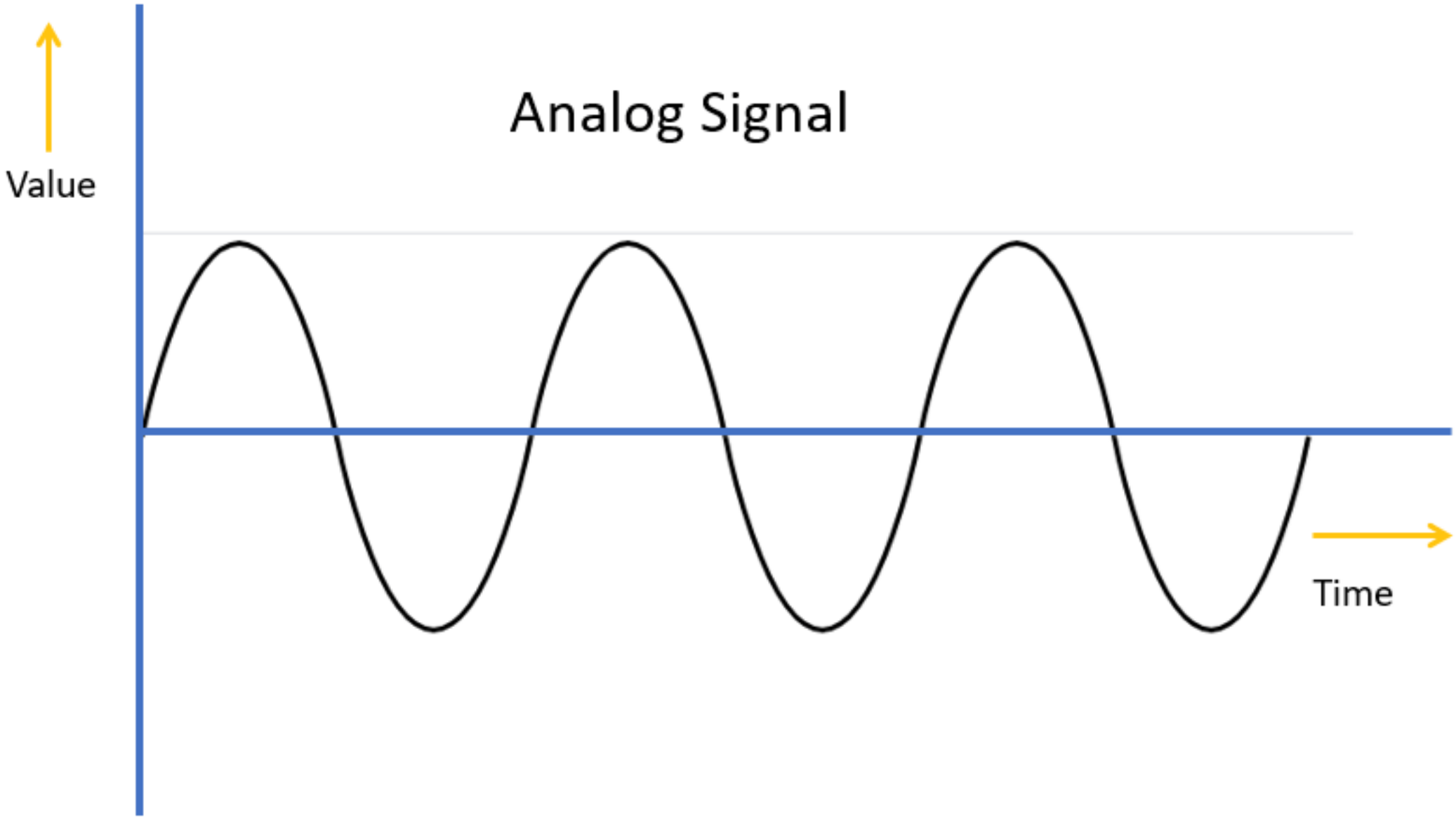
Signal:

The physical quantity that contain the information.

The function of one or more variables which contains information.

Types of signal:

a) Analog signal
b) Digital signal


Analog Signal
Value
Time

- Analog signal is a continuous signal in which one time-varying quantity represents another time-based variable.
- These kind of signals works with physical values and natural phenomena such as earthquake, frequency, volcano, speed of wind, weight, lighting, etc.

Characteristics OF Analog Signal

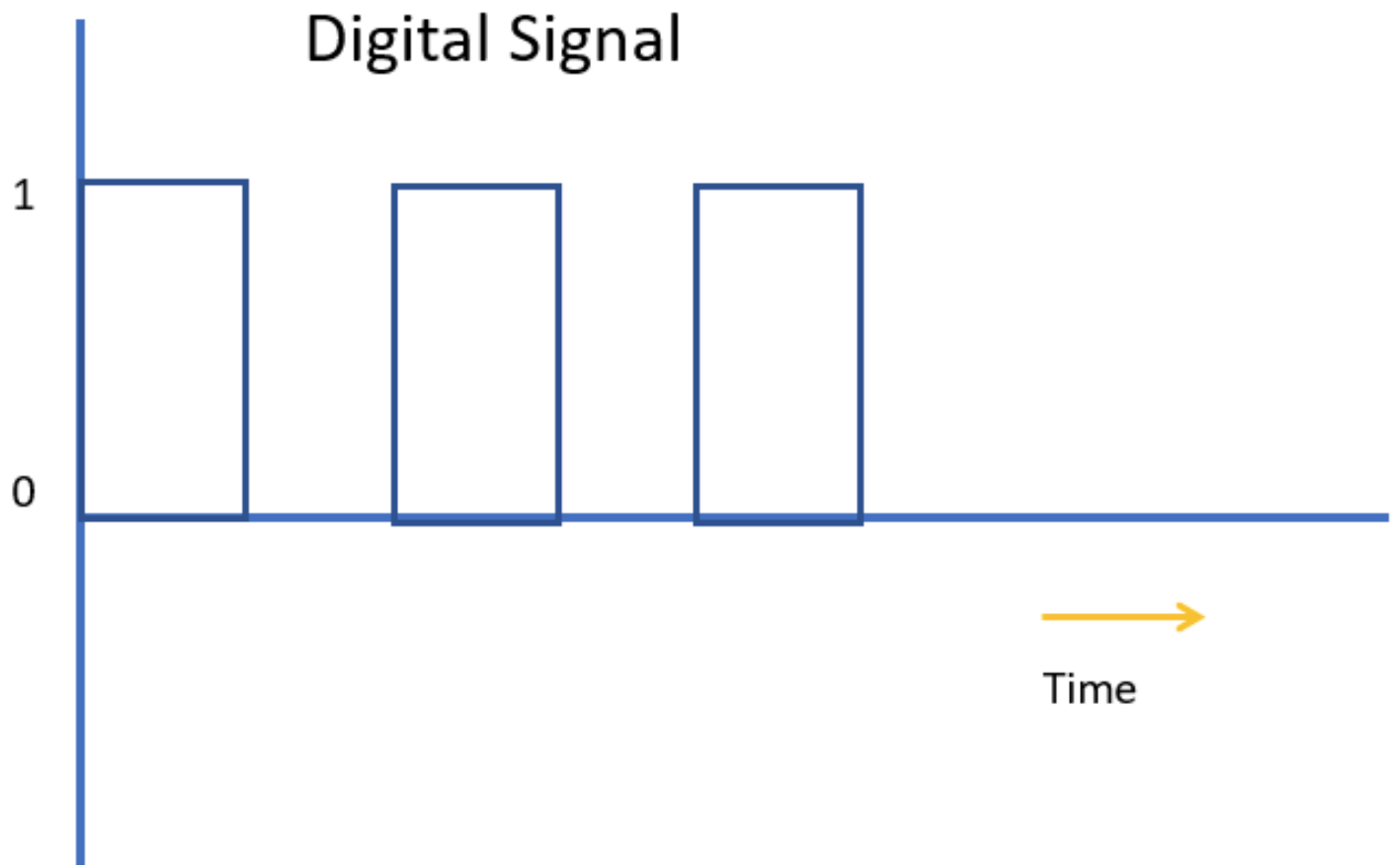
- These type of electronic signals are time-varying
- Minimum and maximum values which is either positive or negative.
- It can be either periodic or non-periodic.
- Analog Signal works on continuous data.
- The accuracy of the analog signal is not high when compared to the digital signal.
- It helps you to measure natural or physical values.
- Analog signal output form is like Curve, Line, or Graph, so it may not be meaningful to all.

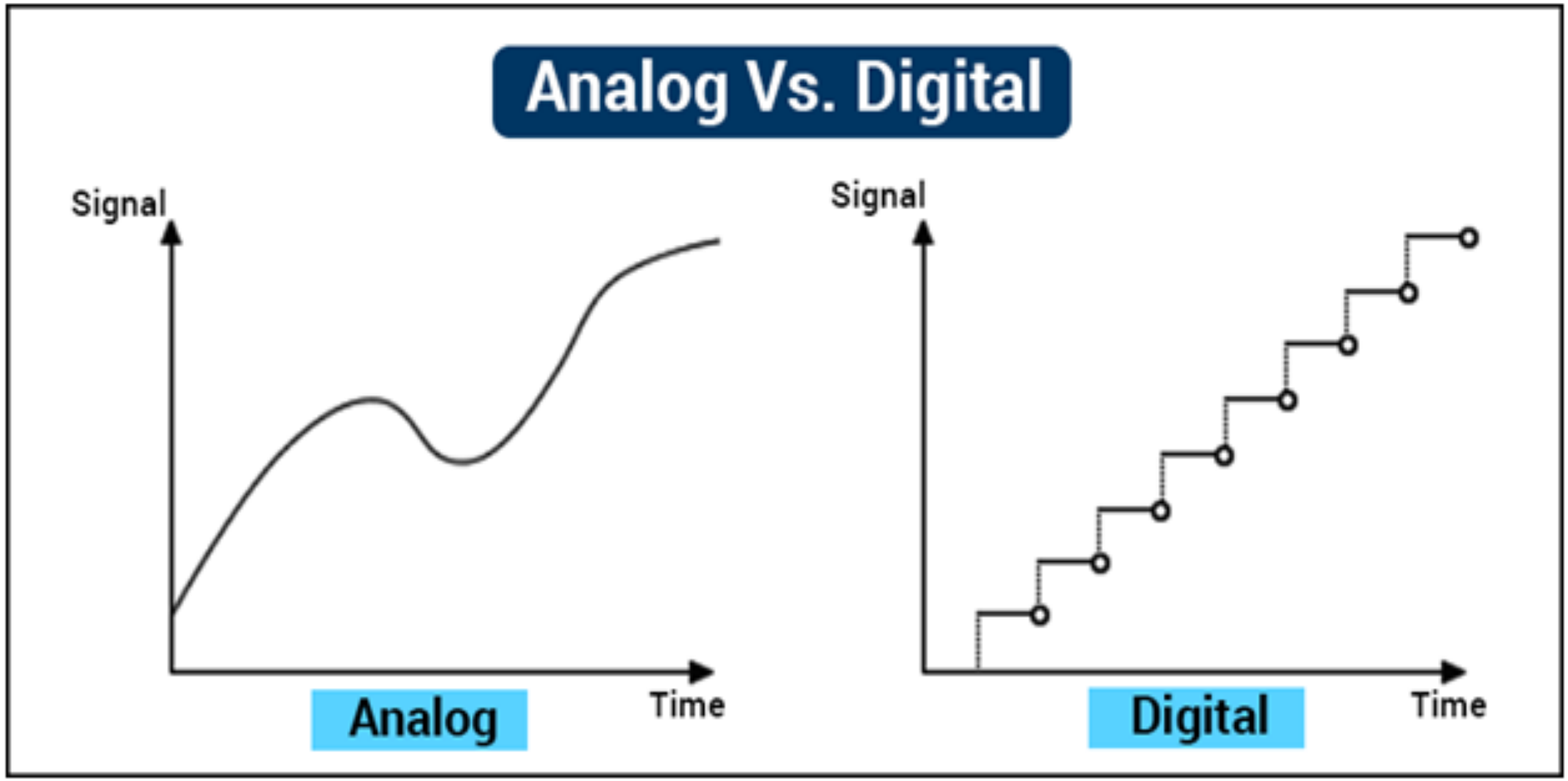
Digital signal

- A digital signal is a signal that is used to represent data as a sequence of separate values at any point in time.
- It can only take on one of a fixed number of values. This type of signal represents a real number within a constant range of values.

Characteristics of Digital Signals

- Digital signal are discrete signals.
- This type of electronic l signals can be processed and transmitted better compared to analog signal.
- Digital signals are versatile, so it is widely used.
- The accuracy of the digital signal is better than that of the analog signal.


Digital Signal
1
0
Time


Analog Vs. Digital
Signal
Time
Analog
Signal
Time
Digital

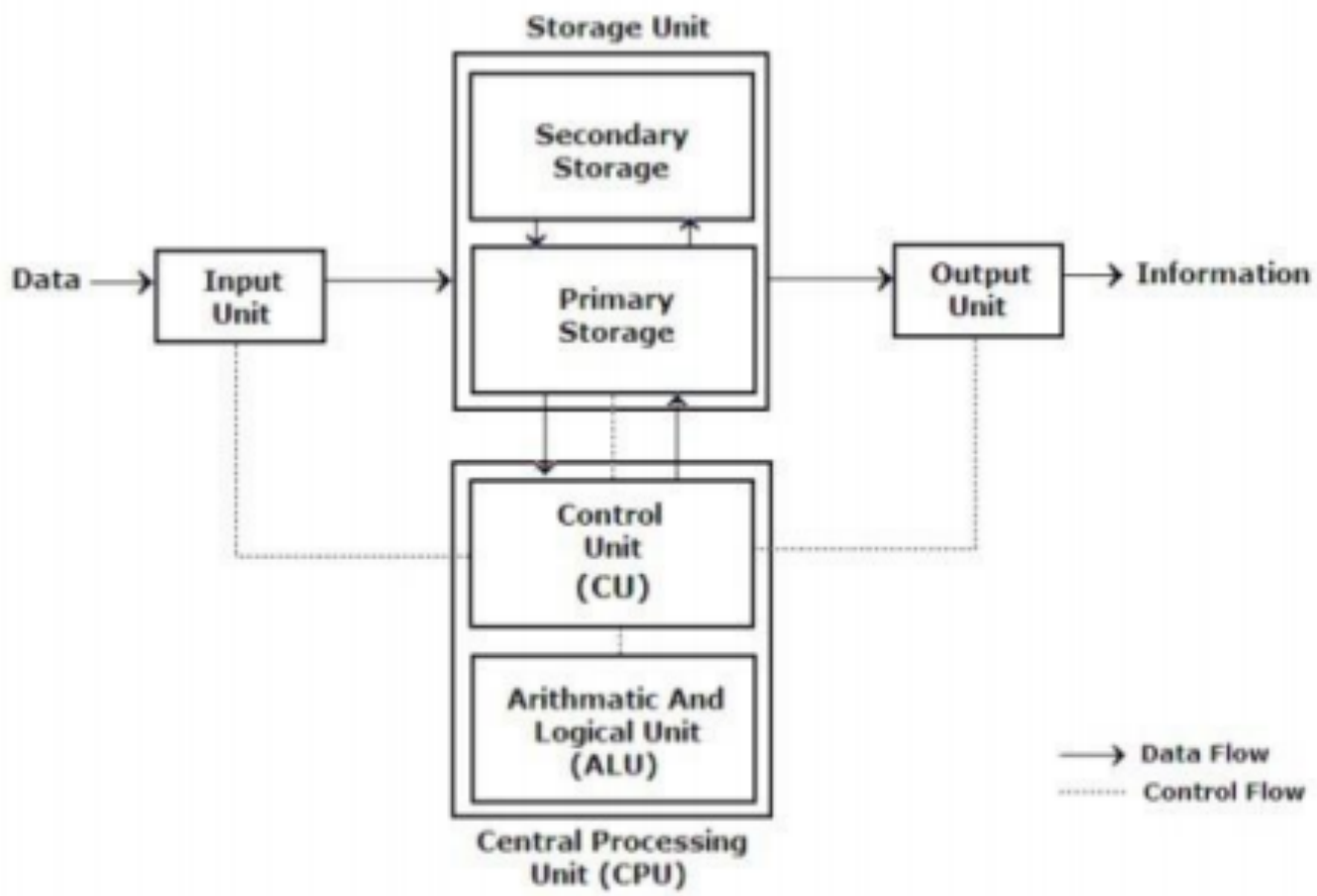
Differences between analog and digital signal.

- An analog signal is a continuous signal whereas Digital signals are time separated signals.
- Analog signal is denoted by sine waves while It is denoted by square waves
- Analog signal uses a continuous range of values that help you to represent information on the other hand digital signal uses discrete 0 and 1 to represent information.
- The analog signal bandwidth is low while the bandwidth of the digital signal is high.
- Analog instruments give considerable observational errors whereas Digital instruments never cause any kind of observational errors.
- Analog hardware never offers flexible implementation, but Digital hardware offers flexibility in implementation.
- Analog signals are suited for audio and video transmission while Digital signals are suited for Computing and digital electronics.

Analog system vs Digital system

Parameters	Digital System	Analog System
Signal Type	Digital System uses discrete signals as on/off representing binary format. Off is 0, On is 1.	Analog System uses continous signals with varying magnitude.
Wave Type	Digital System uses square waves.	Analog system uses sine waves.
Technology	Digital system first transform the analog waves to limited set of numbers and then record them as digital square waves.	Analog systems records the physical waveforms as they are originally generated.
Transmission	Digital transmission is easy and can be made noise proof with no loss at all.	Analog systems are affected badly by noise during transmission.
Flexibility	Digital system hardware can be easily modulated as per the requirements.	Analog system's hardwares are not flexible.
Bandwidth	Digital transmission needs more bandwidth to carry same information.	Analog tranmission requires less bandwidth.
Memory	Digital data is stored in form of bits.	Analog data is stored in form of waveform signals.
Power requirement	Digital system needs low power as compare to its analog counterpart.	Analog systems consume more power than digital systems.
Best suited for	Digital system are good for computing and digital electronics.	Analog systems are good for audio/video recordings.
Cost	Digital system are costly.	Analog systems are cheap.
Example	Digital system are: digital multimeter,Computer, CD, DVD. etc	Analog systems are: analog multimeter, voice radio using AM frequency, amplifiers etc

Block Diagram of Digital computer



- The **digital computer** is a digital system that performs various computational tasks.
- The word **digital** implies that the information in the computer is represented by variables that take a limited number of discrete values.
- These values are processed internally by components that can maintain a limited number of discrete states.
- The decimal digits 0, 1, 2, ..., 9, for example, provide 10 discrete values.
- The first electronic digital computer, developed in the late 1940s, was used primarily for numerical computations and the discrete elements were the digits. From this application the term **digital** computer emerged.

- Digital computers use the binary number system, which has two digits: 0 and 1.
- A binary digit is called a **bit**. Information is represented in digital computers in groups of bits.
- By using various coding techniques, groups of bits can be made to represent not only binary numbers but also other discrete symbols, such as decimal digits or letters of the alphabet.
- *A digital computer is considered to be a calculating device that can perform arithmetic operations at enormous speed. It is defined as a device that operates upon information/data. To be able to process data the computer is made of various functional units to perform its specified task.*

1. Input Unit:

- Computers need to receive data and instruction in order to solve any problem.
- Therefore, we need to input the data and instructions into the computers.
- The input unit consists of one or more input devices. Keyboard is the one of the most commonly used input device.
- Other commonly used input devices are the Mouse, Scanner, Microphone etc.

All the input devices perform the following functions.

- Accept the data and instructions from the outside world.
- Convert it to a form that the computer can understand.
- Supply the converted data to the computer system for further processing.

2. Central Processing Unit:

The Control Unit (CU) and Arithmetic Logic Unit (ALU) of the computer are together known as the Central Processing Unit (CPU).

The CPU is like brain performs the following functions:

- It performs all calculations.
- It takes all decisions.
- It controls all units of the computer.

Arithmetic Logical Unit: All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer.

- It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations viz, >,<,= etc .
- Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then it is send to the output unit for displaying results.

Control Unit:

- It controls all other units in the computer. The control unit instructs the input unit, where to store the data after receiving it from the user.
- It controls the flow of data and instructions from the storage unit to ALU.
- It also controls the flow of results from the ALU to the storage unit.
- The control unit is generally referred as the central nervous system of the computer that control and synchronizes its working.

3.Storage Unit:

The storage unit of the computer holds data and instructions that are entered through the input unit, before they are processed.

It preserves the intermediate and final results before these are sent to the output devices. It also saves the data for the later use.

The various storage devices of a computer system are divided into two categories.

a) Primary Storage: Stores and provides very fast.

This memory is generally used to hold the program being currently executed in the computer, the data being received from the 2 input unit, the intermediate and final results of the program.

The primary memory is temporary in nature.

The data is lost, when the computer is switched off.

In order to store the data permanently, the data has to be transferred to the secondary memory.

The cost of the primary storage is more compared to the secondary storage.

Therefore, most computers have limited primary storage capacity.

b) Secondary Storage: Secondary storage is used like an archive.

It stores several programs, documents, data bases etc.

The programs that you run on the computer are first transferred to the primary memory before it is actually run. Whenever the results are saved, again they get stored in the secondary memory. The secondary memory is slower and cheaper than the primary memory.

Some of the commonly used secondary memory devices are Hard disk, CD, etc.,

4. Output Unit:

- The output unit of a computer provides the information and results of a computation to outside world.
- Printers, Visual Display Unit (VDU) are the commonly used output devices.
- Other commonly used output devices are Speaker, Headphone, Projector etc.

Types of Computer

- Computers can be broadly classified by their speed and computing power.

1	PC (Personal Computer)	It is a single user computer system having moderately powerful microprocessor
2	WorkStation	It is also a single user computer system which is similar to personal computer but have more powerful microprocessor.
3	Mini Computer	It is a multi-user computer system which is capable of supporting hundreds of users simultaneously.
4	Main Frame	It is a multi-user computer system which is capable of supporting hundreds of users simultaneously. Software technology is different from minicomputer.
5	Supercomputer	It is an extremely fast computer which can execute hundreds of millions of instructions per second.


Shuttle

End of chapter 01