Lecture 2c
Digital Logic - Digital (Preliminaries 3)

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Having studied LOGIC !! ....
Let us have a look about the DIGITAL .. in DIGITAL LOGIC

Digital and Analog Quantities

Analog Quantities

Analog Quantities [1]

Analog Quantity

An **analogue** quantity is one having continuos values

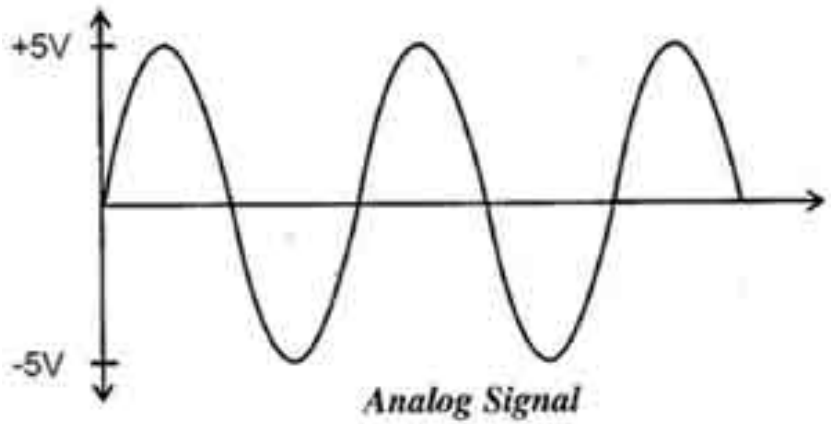


Figure: Analog Signal

The Analog Advantage

- One of the major advantages of the analog signal is that they have power to define infinite amount of data.
- Potential for an infinite amount of signal resolution - compared to digital signals, analog signals are of higher density.
- Analog signals have easy processing.

E.g. A public address system, used to amplify sound so that it can be heard by a large audience.

Digital Quantities

Digital Quantities

Digital Quantity

An **digital** quantity is one having discrete set of values

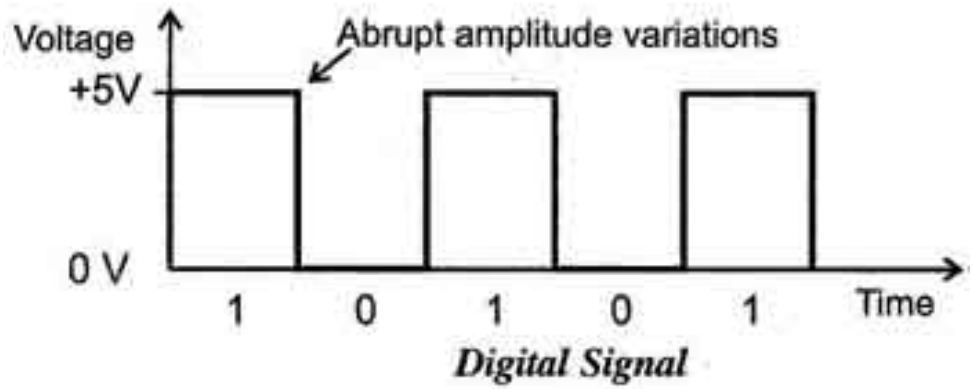


Figure: Digital Signal

The DIGITAL Advantage

- Digital data can be processed and transmitted more efficientlt and reliably than analog data.
- Dital data has a great advantage when storage is necessary.

E.g. Music when converted to digital form can be stored more compactly and reproduced with greater accuracy and clarity than is possible when it is in analog form

- Noise (unwanted voltage fluctuations) does not affect data nearly as much as it does analog signals.

Digital to Analog

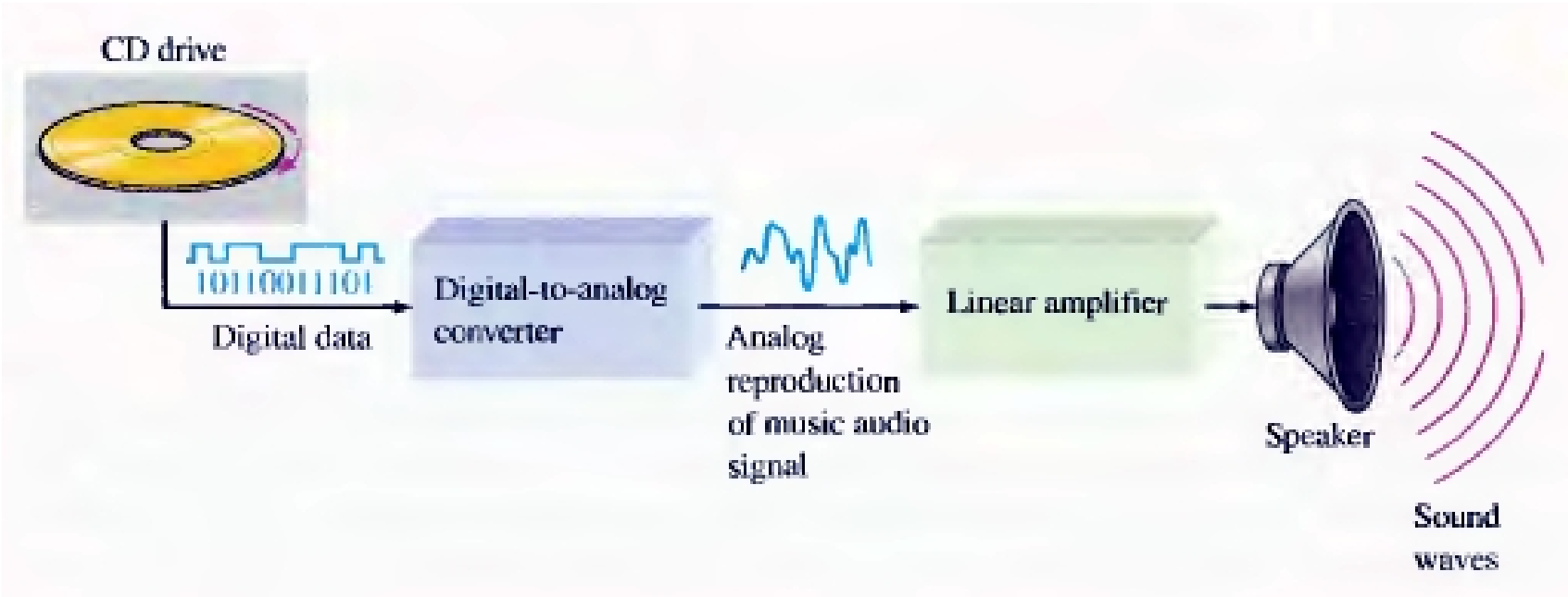


Figure: Basic Principle of a CD-Player

Question : Figure out how data is stored in the CD.

What is DIGITAL ??

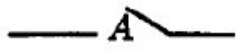
From Boolean Algebra to Digital

From Boolean Algebra to Digital

To understand the relation between Boolean algebra and digital, let us consider a small example with the help of circuits.

Let us go through some basic concepts in circuits

Basic concepts in circuits [2]

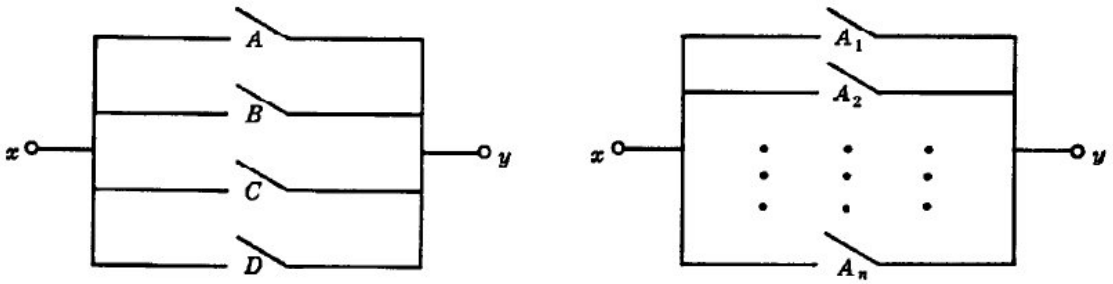
- A *switch* is a device which is attached to a point in an electric circuit and which may assume either of two states, *closed* or *open*.
- In the closed state the switch allows current to flow through the point, whereas in the open state no current can flow through the point.
- We shall indicate a switch by means of the symbol 

where A denotes a sentence such that the switch is *closed* when A is **TRUE (T)** and *open* when A is **FALSE (F)**
- We say that two points are connected by a switching circuit if and only if they are connected by wires (lines) on which a *finite* number of switches are located.

Parallel switches

Parallel Switches

- Points x and y are connected by a switching circuit by *parallel* switches.
- The current flows between x and y *if and only if* $A \vee B \vee C \vee D$ is **TRUE** [Figure 4(a)].



(a) Parallel Four switches (b) Parallel switches

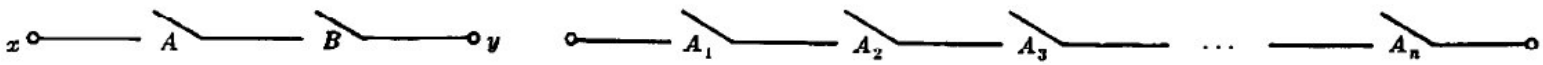
Figure: Parallel Connection

- Current flows through the circuit of [Figure 4(b)] if and only if $A_1 \vee A_2 \vee \ldots \vee A_n$

Series Switches

Series Switches

- Points x and y are connected by a switching circuit by *series* switches.
- The current flows between x and y *if and only if* $A \wedge B$ is **TRUE** [Figure 5(a)].



(a) Series Two switches (b) Series switches

Figure: Series Connection

- Current flows through the circuit of [Figure 5(b)] if and only if $A_1 \wedge A_2 \wedge \ldots \wedge A_n$

Combination of Switches

The Switches can be connected in parallel and series also.

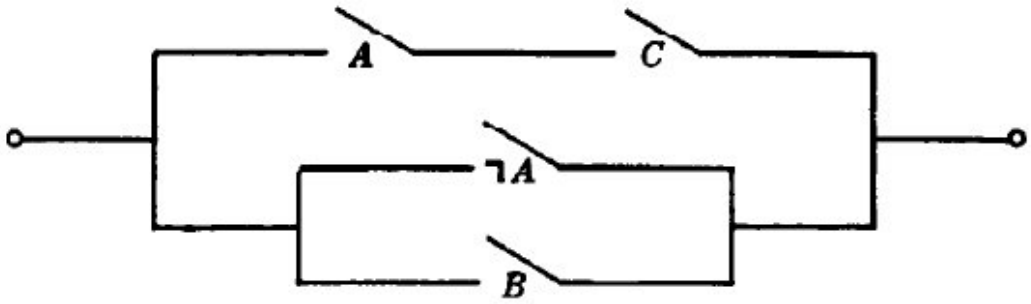


Figure: Switches combined in connection for $(A \wedge C) \vee (\neg A \vee B)$

A condition for flow of current through a series-parallel switching circuit can be written by means of *conjunctions* and *disjunctions*, starting from the expressions representing the closure of the individual switches.

Example I

Situation

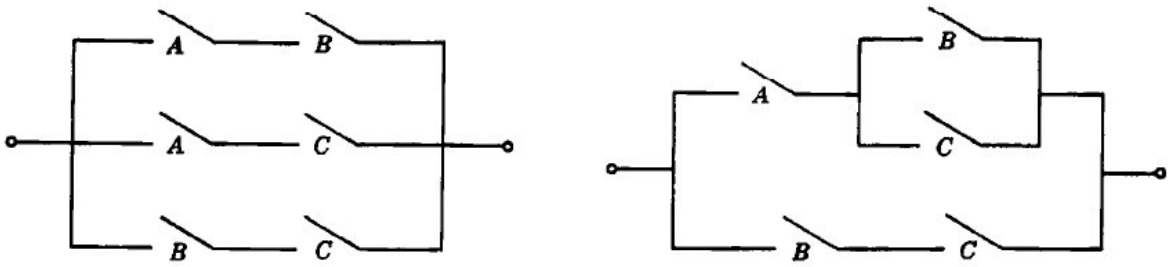
A committe of three decides questions by majority vote. Each member can press a button to signify a "YES" vote. Construct a switching circuit which will pass current when and only when a majority votes "YES"?

- Let A stand for "member 1 approves"
- Let B stand for "member 2 approves"
- Let C stand for "member 3 approves"

Example II

Then a necessary and sufficient condition for a majority vote is [Figure 7(a)]

$$(A \wedge B) \vee (A \wedge C) \vee (B \wedge C)$$



(a) Solution 1 (b) Solution 2

Figure: Solutions

An alternate solution is given in [Figure 7(b)], *which is equivalent to [Figure 7(a)]*

Digital

SO ..... What is DIGITALLLL ??

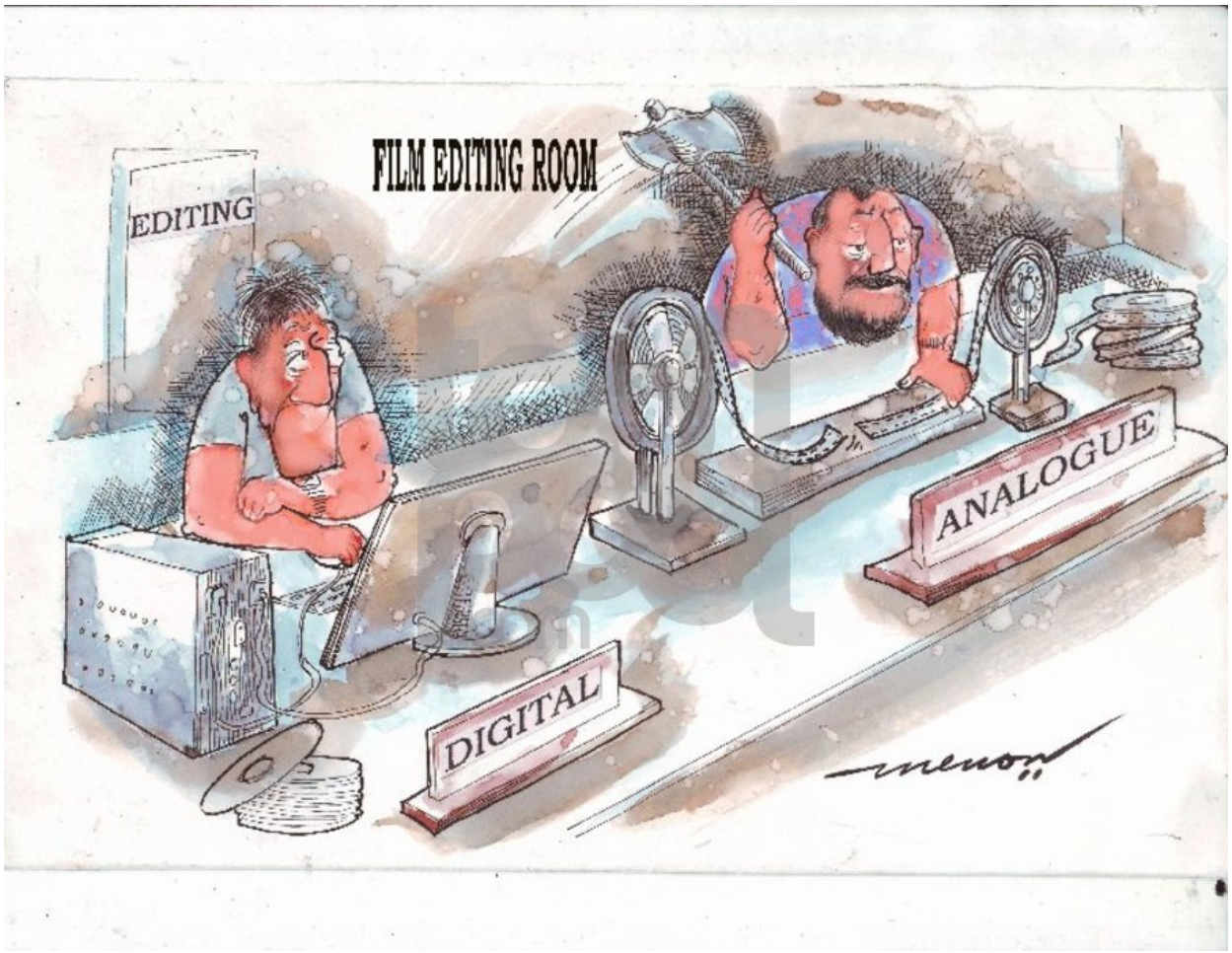
What is DIGITAL ??

Expressed as series of the digits **0** and **1**, typically represented by values of a physical quantity such as voltage or magnetic polarization, where **HIGH = 1** and **LOW = 0**.
NOTE: This is referred to as *positive* logic.

Another system in which a **LOW = 1** and **HIGH = 0** is referred to as *negative* logic.

A review of the Analog and Digital world !!

Advantages of being DIGITAL !!



Advantages of being DIGITAL !!

Disadvantages of being DIGITAL !!

Disadvantages of being DIGITAL !!

"I thought we'd go for a digital tree this year."

References

[1] Thomas L. Floyd.
Digital Fundamentals, 8th edition.
Pearson Education Inc., 2003.

[2] E. Mendelson.
Schaum's Outline of Theory and Problems of Boolean Algebra and Switching Circuits.
Schaum's outline series in mathematics. McGraw-Hill, 1970.

QUESTIONS !!!