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INTRODUCTION TO DIGITAL DESIGN CONCEPTS

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OVERVIEW & INTRODUCTION

"Digital Design Underpins the creation of the myriad of imaginative digital devices that surround us"

-- William I. Fletcher

The very basic digital design can be defined as the science of organizing arrays of simple switches into what is called a discrete system that performs transformations on two-level-(binary) information in a meaningful and predictable way

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NEW WORDS...

- Underpins
- Myriad
- Discrete Systems
- Transformations
- Predictable
- Periodic
- Quantization

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PIONEERS

- George Boole (1854)
- Claude Shannon (1938)

“Seldom will you find a field of study as vast as that of digital design” – William I. Fletcher

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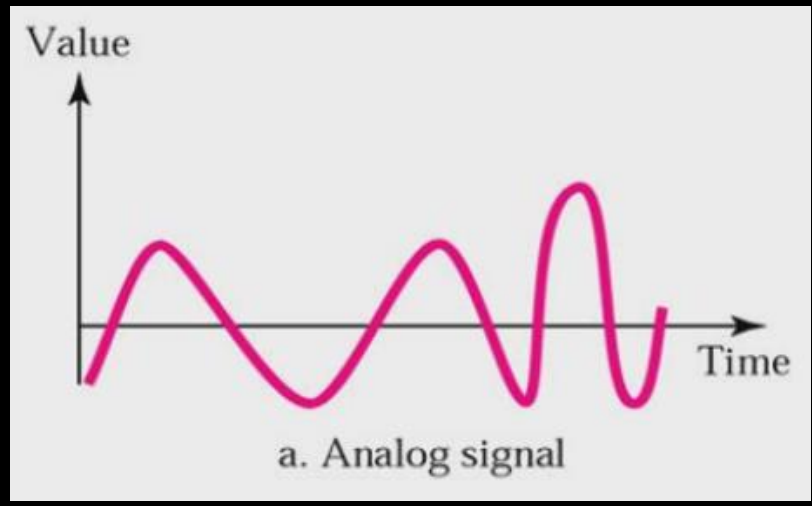
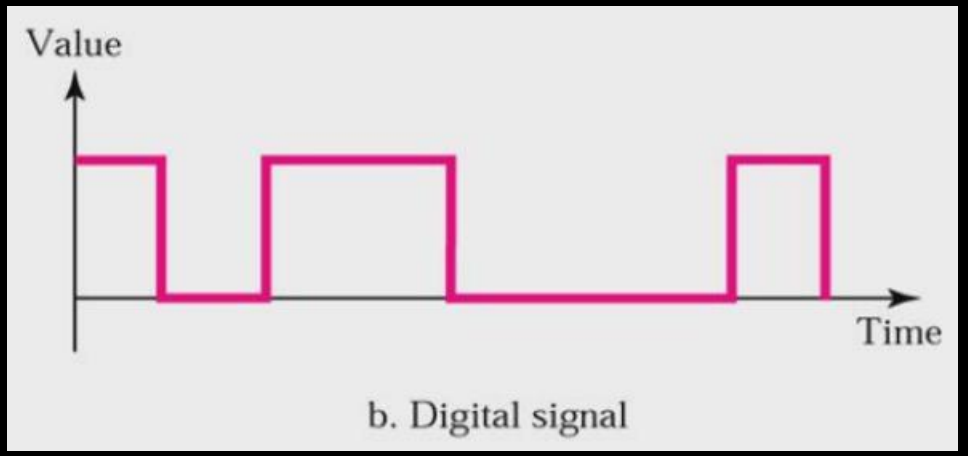
ANALOG VS DIGITAL

video

- Analog
  - Refers to something that is continuous
  - Is a set of specific points of data and all possible points in between
  - Is a continuous wave form that changes smoothly over time



- Digital
  - Refers to something that is discrete
  - Specific points of data with no other points in between
  - A digital signal is discrete. It can have only a limited number of defined values. Typically 1 and 0



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Analog and Digital Data

- Data can be analog or digital
- Human voice is an example of analog data.
  - When somebody speaks, a continuous wave is created in the air. This can be captured by a microphone and converted to an analog signal

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Analog and Digital Data (cont.)

- An example of digital data is data stored in the memory of computer in the form of 0s and 1s
- It is usually converted to a digital signal when it is transferred from one position to another inside or outside the computer

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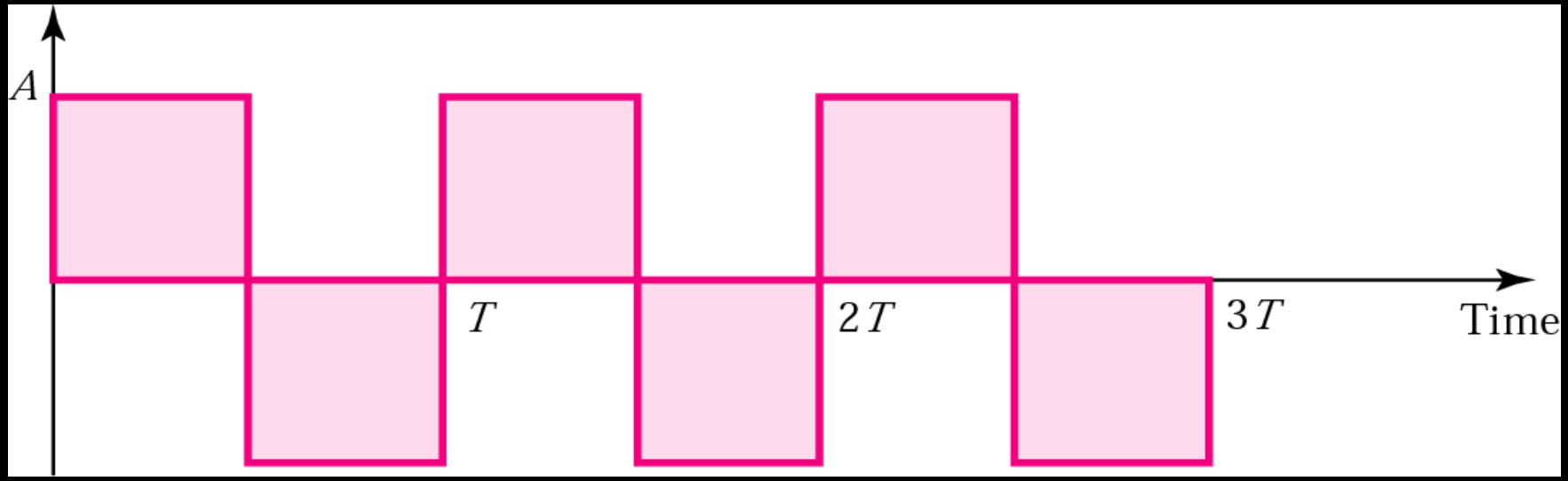
PERIODIC SIGNALS

- A signal is a periodic signal if it completes a pattern within a measurable time frame, called period, and repeats that pattern over identical subsequent periods
- The completion of one full pattern is called a cycle
- A period is defined as the amount of time (in seconds) required to complete one cycle



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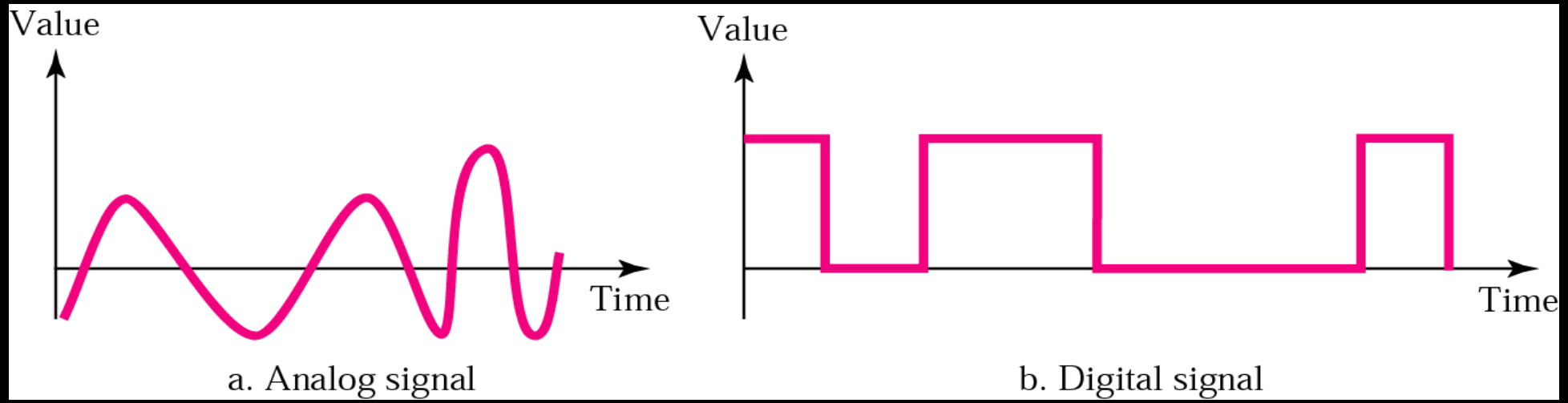
APERIODIC SIGNALS

- An aperiodic, or nonperiodic, signal changes constantly without exhibiting a pattern or cycle that repeats over time
- It has been proved by a Fourier transform that any aperiodic signal can be decomposed into an infinite number of periodic signals



a. Analog signal

b. Digital signal

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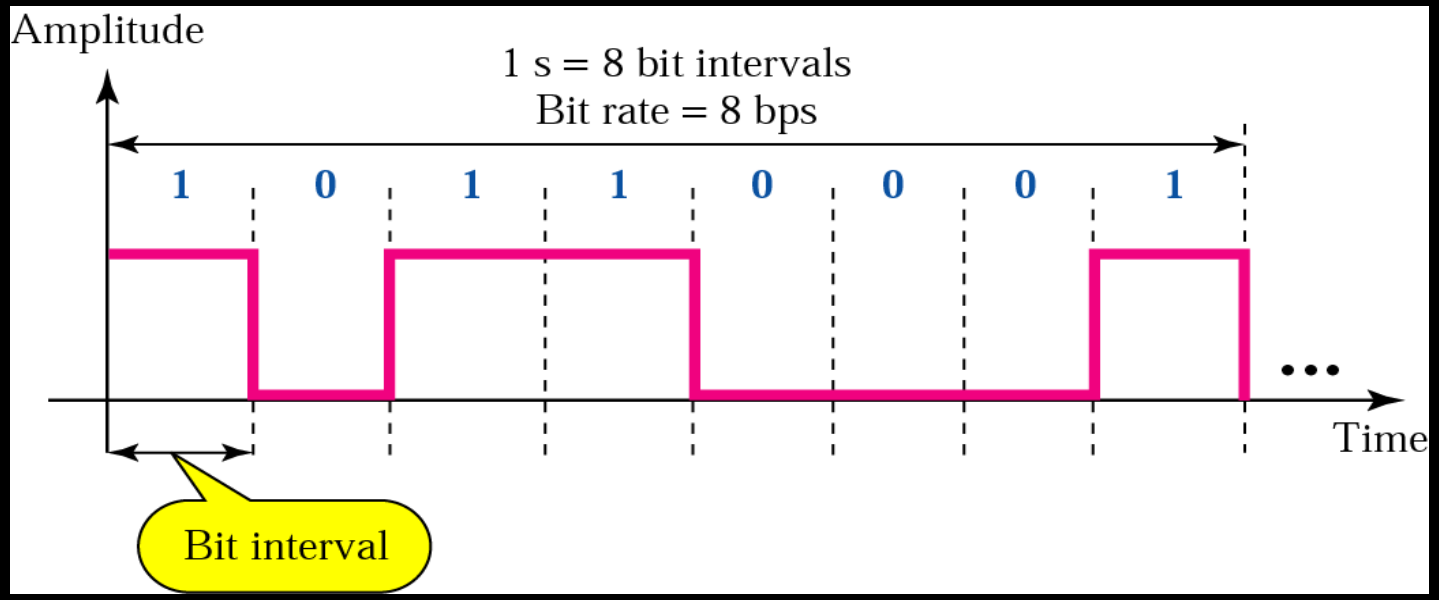
DIGITAL SIGNALS

- Most digital signals are aperiodic and period or frequency is not appropriate
- Bit interval (instead of period) and bit rate (instead of frequency) are used to describe digital signals
- The bit interval is the time required to send one single bit. The bit rate is the number of bit intervals per second (bits per second: bps)



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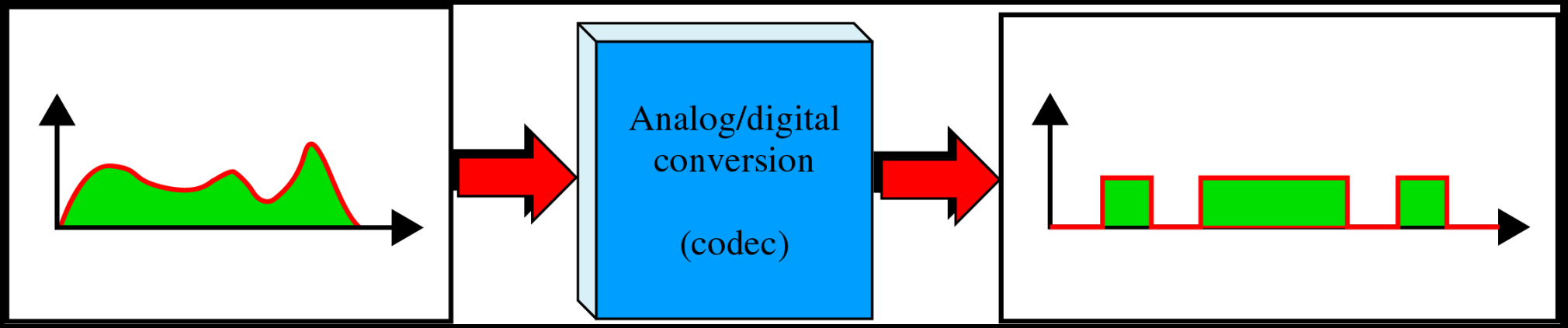
Analog-to-Digital Conversion

- In ADC, we are representing the information contained in continuous wave form as a series of digital pulses
- The problem is how to translate information from an infinite number of values to a discrete number of values without sacrificing sense or quality
- A well-known of ADC technique is called pulse code modulation (PCM)



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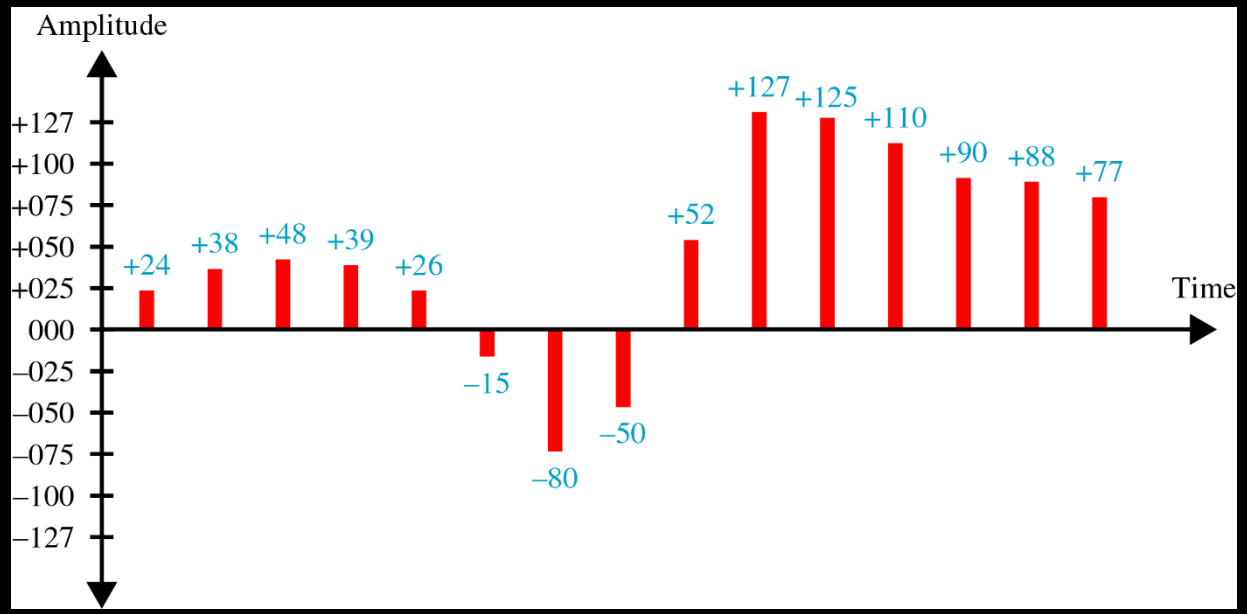
Pulse Code Modulation (PCM)

- PCM modifies the pulses created by PAM to create a completely digital signal
- To do so, PCM first quantizes the PAM pulses. Quantization is a method of assigning integral values in a specific range to sampled instances



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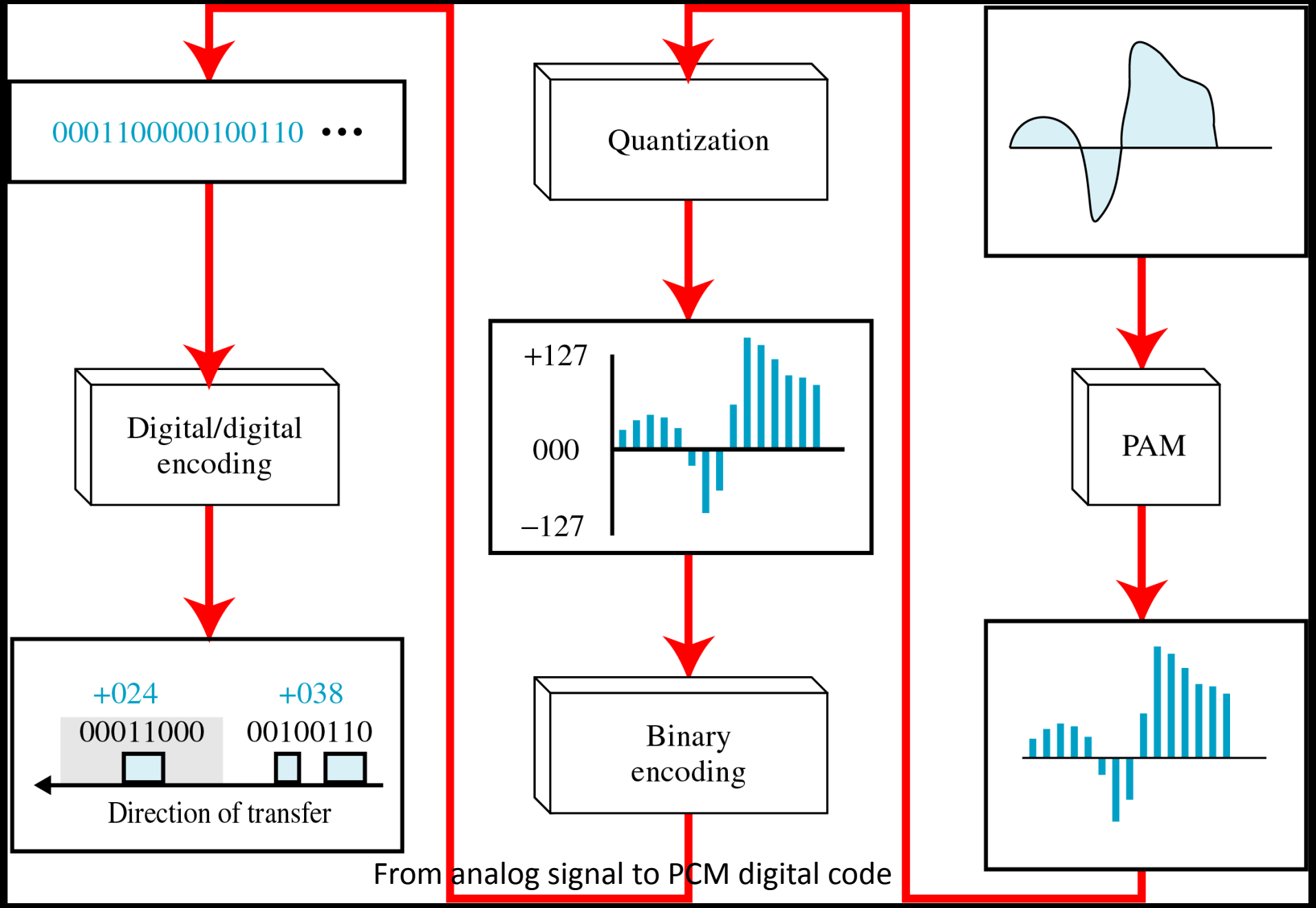

From analog signal to PCM digital code

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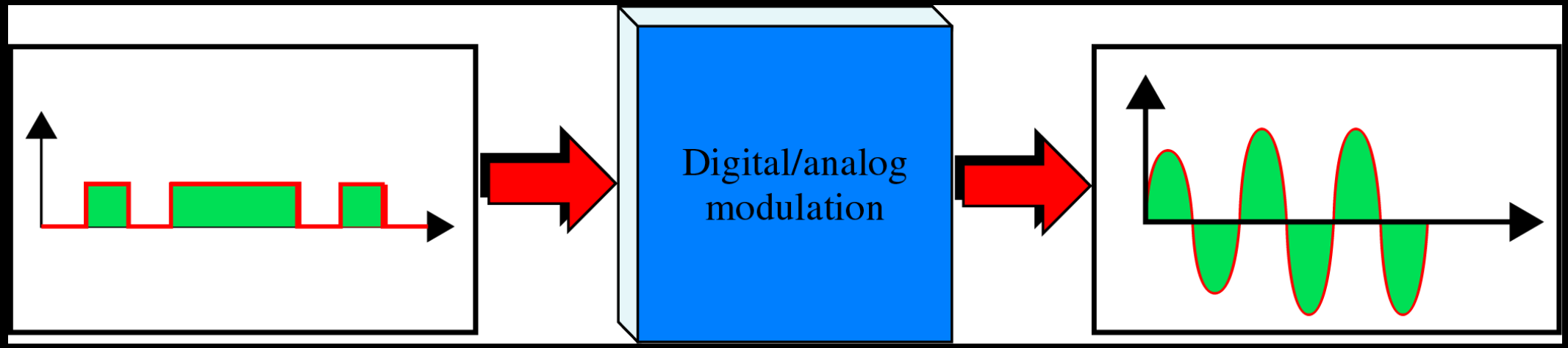
Digital-to-analog conversion

- Digital-to-analog conversion or digital-to-analog modulation is the process of changing one of the characteristics of an analog signal based on the information in a digital signal (0s and 1s)



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REFERENCE SLIDES

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Learning Domain, CTE Standards and Stuff Like That…

- Learning Domain

  [ ] cognitive [ ] affective[ ] psychomotor

  - What are some cognitive skills required for success in your pathway?
  - What are some affective skills required for success in your pathway?
  - What are some psychomotor skills required for success in your pathway?

- Time:
  - Lecture
  - Lab

- Standards
  - CTE
  - CCSS
  - NCSS

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Appendix B: Attribution for Sources Used

- An Engineering Approach To Digital Design – William I. Fletcher
- **Digital Design (3rd Edition) - Pratik Chauhan**
- **COMPLETE DIGITAL DESIGN - A Comprehensive Guide to Digital Electronics and Computer System Architecture - Mark Balch**

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