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INTRODUCTION TO DIGITAL DESIGN CONCEPTS

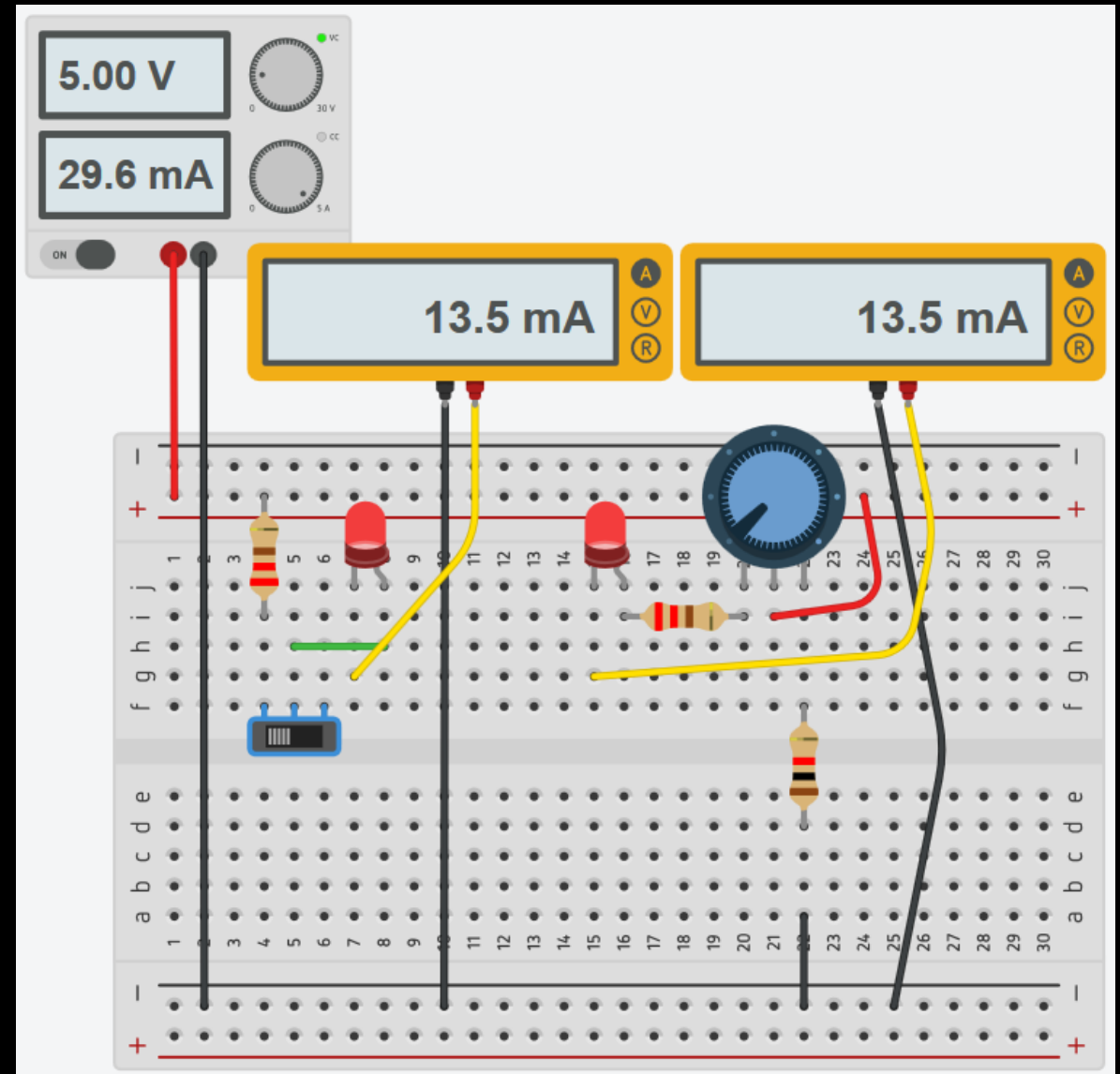


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DIGITAL VS. ANALOG

- Go to Tinkercad and Build the following Circuit...
- What is the difference between the 2 LEDs
- As pair/share teams of 2-3 discuss what other systems are Analog and what are Digital
 - 1981 TV vs 2018 TV
 - Radio vs MP3



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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

PIONEERS

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

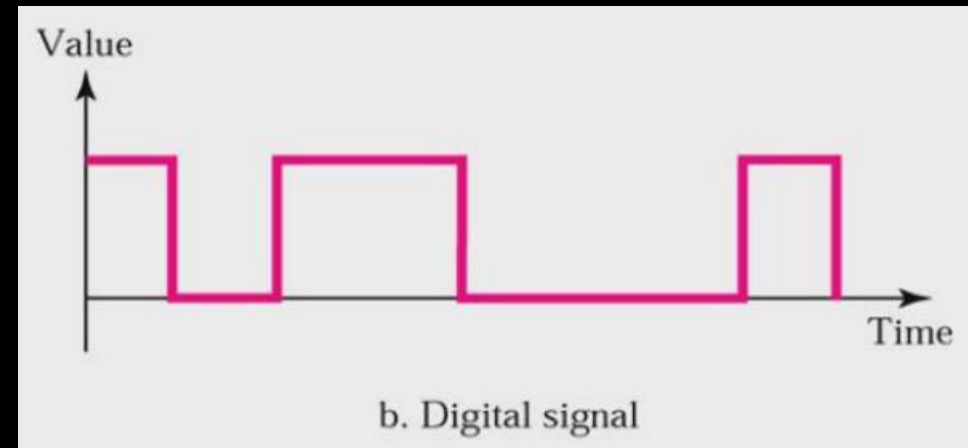
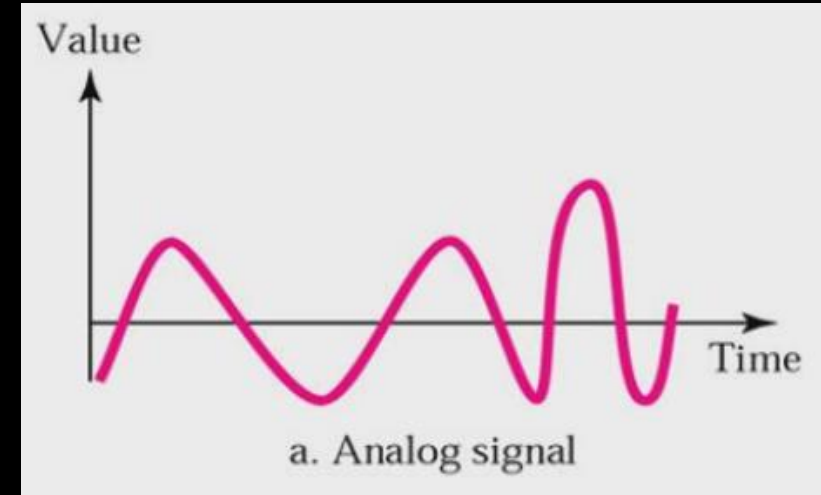
“Seldom will you find a field of study as vast as that of digital design” – William I. Fletcher

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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5 MIN OF INDIVIDUAL RESEARCH

- Click on this Spark Fun [Analog vs Digital](https://learn.sparkfun.com/tutorials/analog-vs-digital) link
 - <https://learn.sparkfun.com/tutorials/analog-vs-digital>
- Be ready to discuss:
 - Analog signals have **infinite** possibilities
 - Digital signals are **discrete** or **finite**
 - Examples of Analog and Digital signals or systems
 - Explain the 1 line of video data graphic
 - Explain the Analog Schematic
 - Explain the Digital Schematic

ANALOG AND DIGITAL DATA

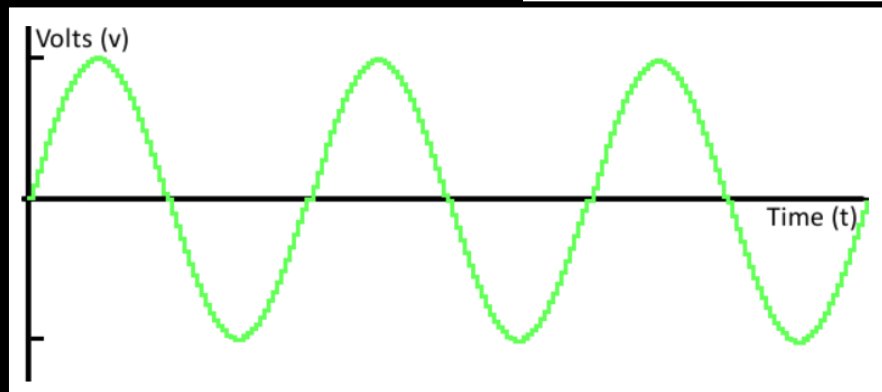
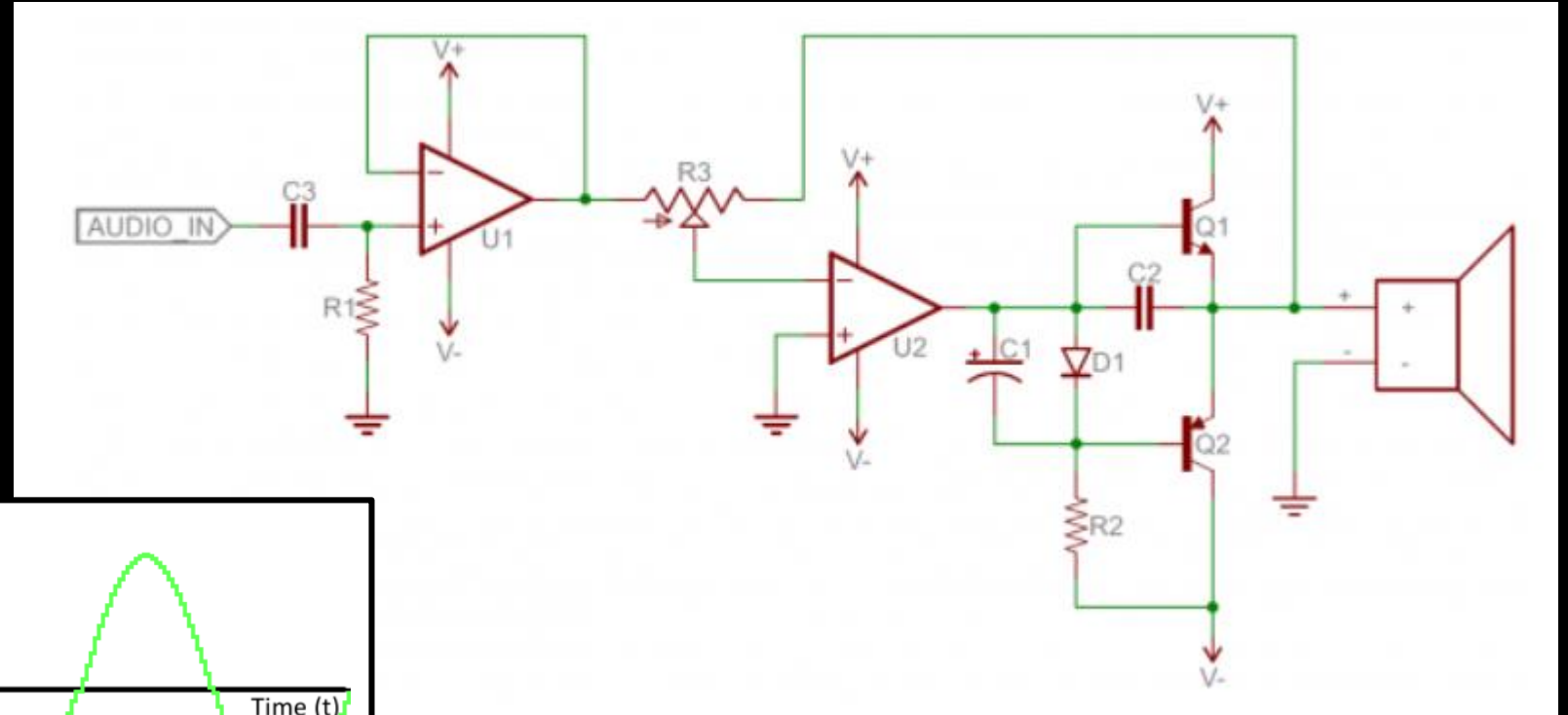
- Data can be analog or digital
- Human voice is an example of analog data.
 - When somebody speaks, a continuous wave is created in the air. This can be captured by a microphone and converted to an analog signal



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ANALOG



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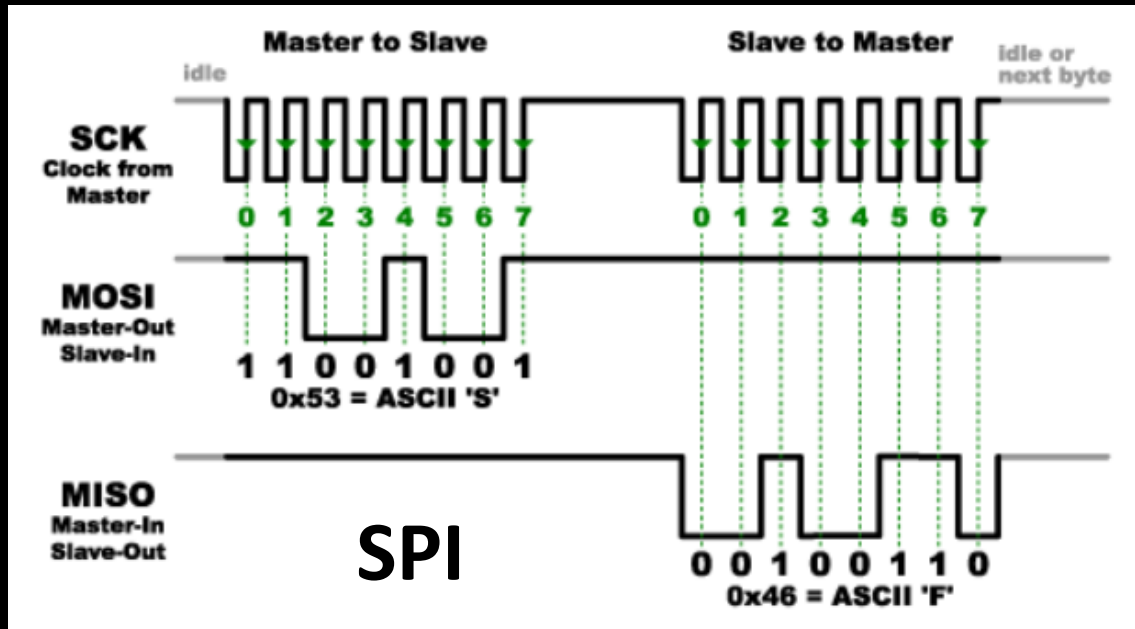
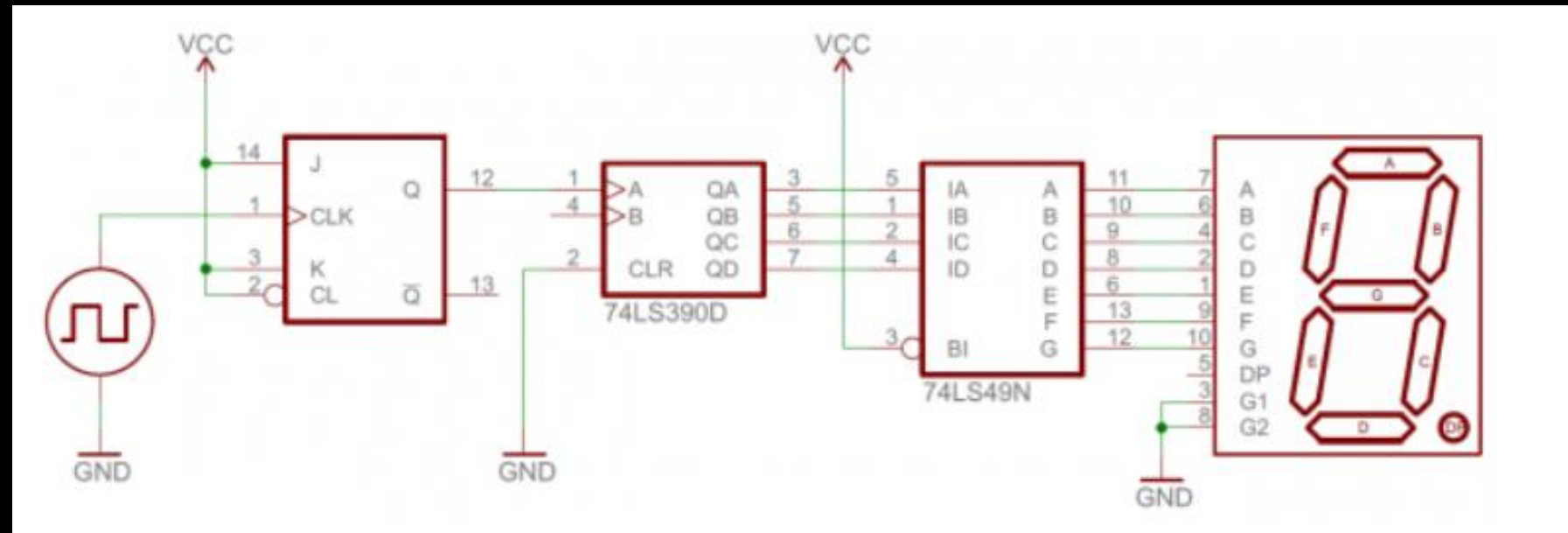
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ANALOG AND DIGITAL DATA (CONT.)

- 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



DIGITAL

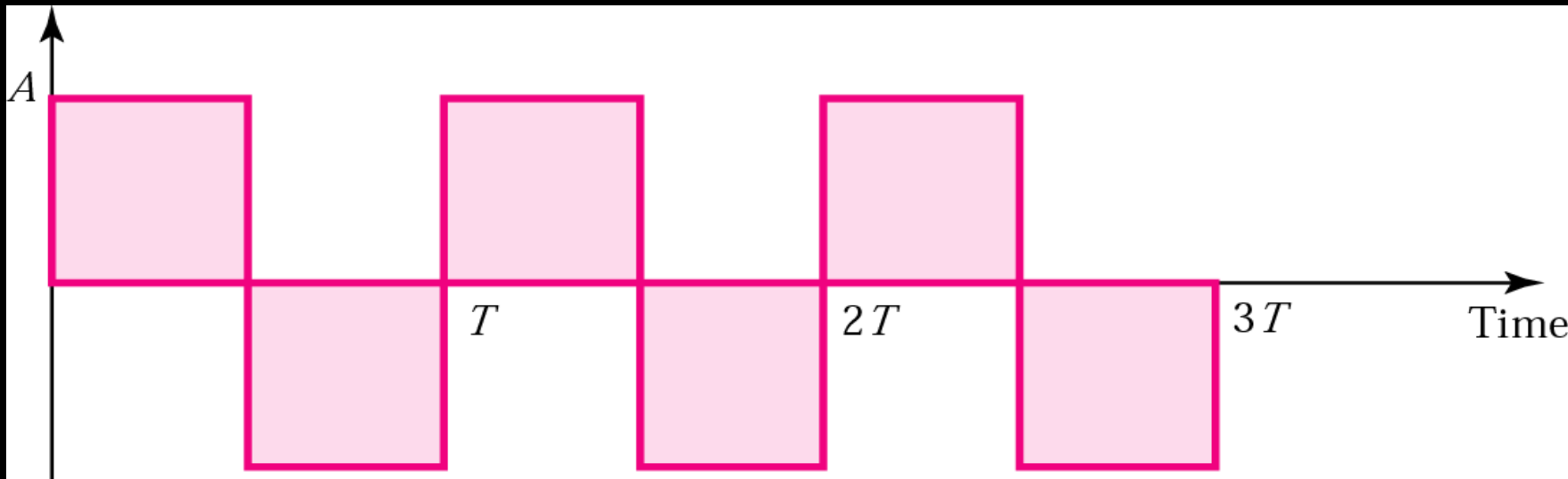


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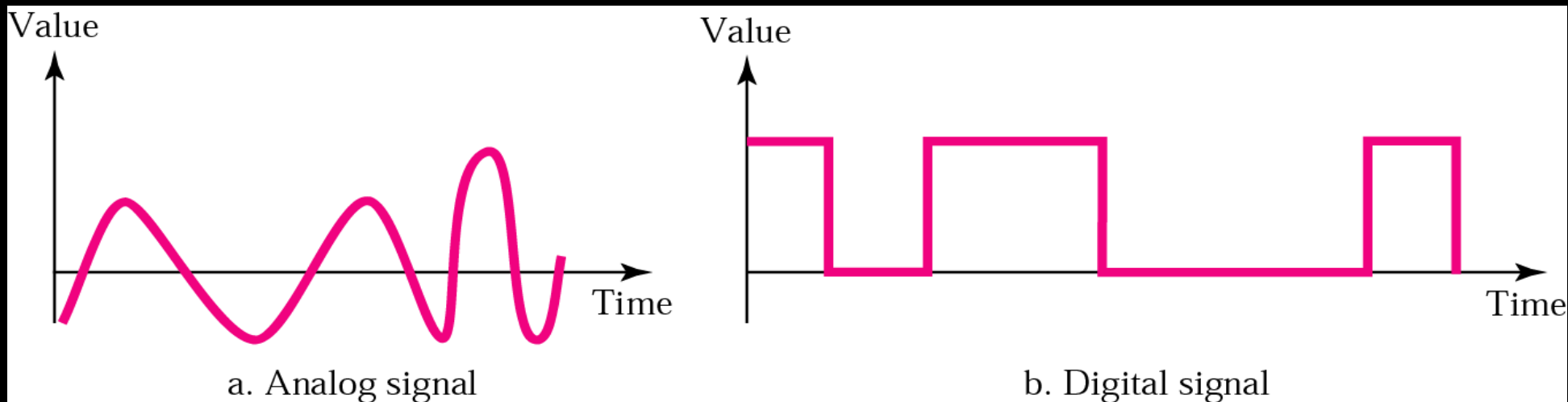
PERIODIC SIGNALS

- 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



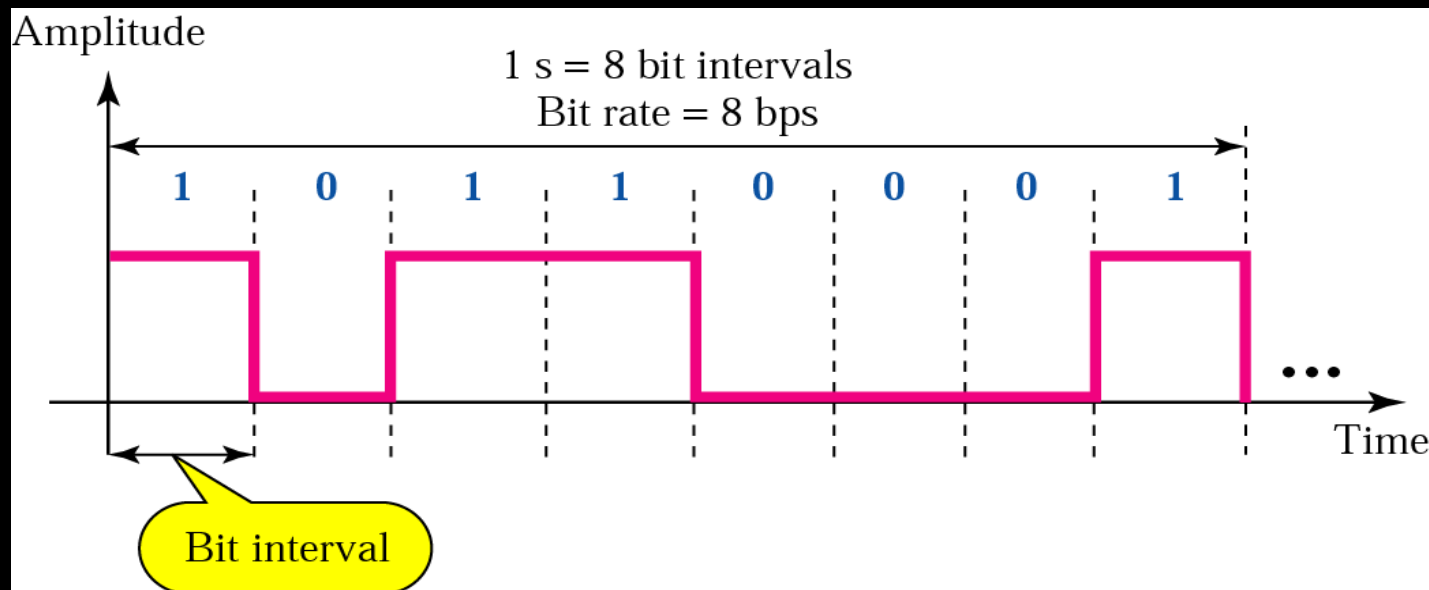
APERIODIC SIGNALS

- 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



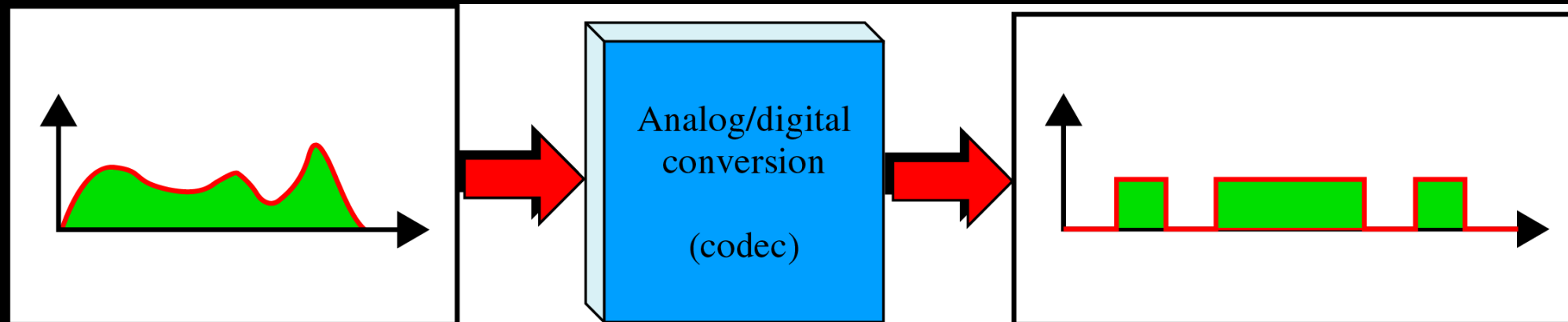
DIGITAL SIGNALS

- 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)



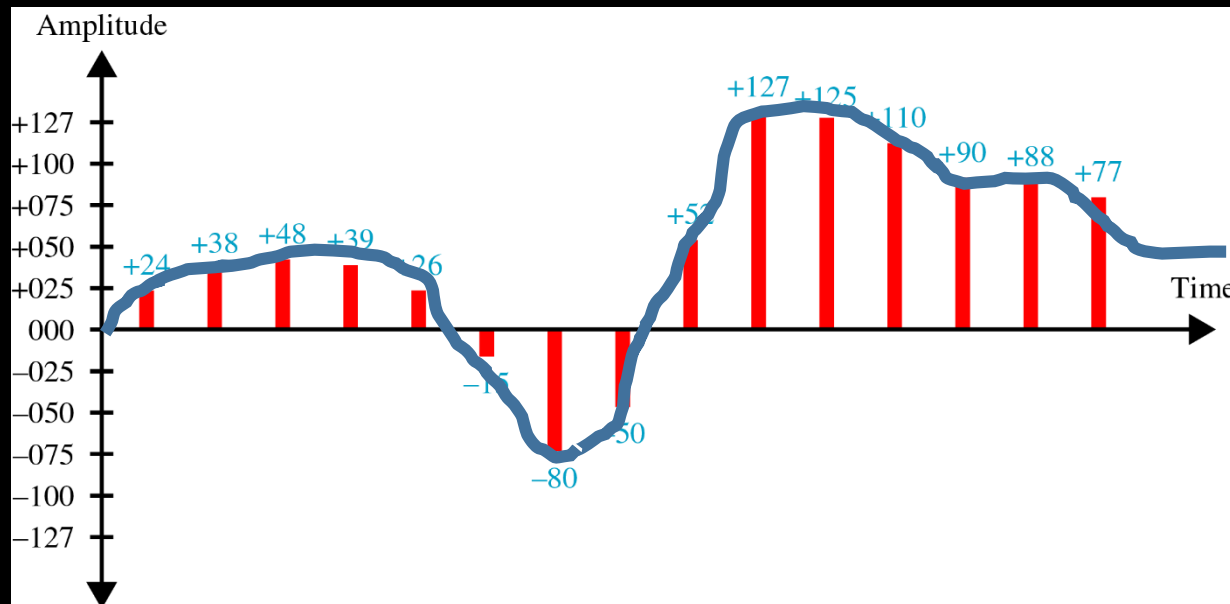
ANALOG-TO-DIGITAL CONVERSION

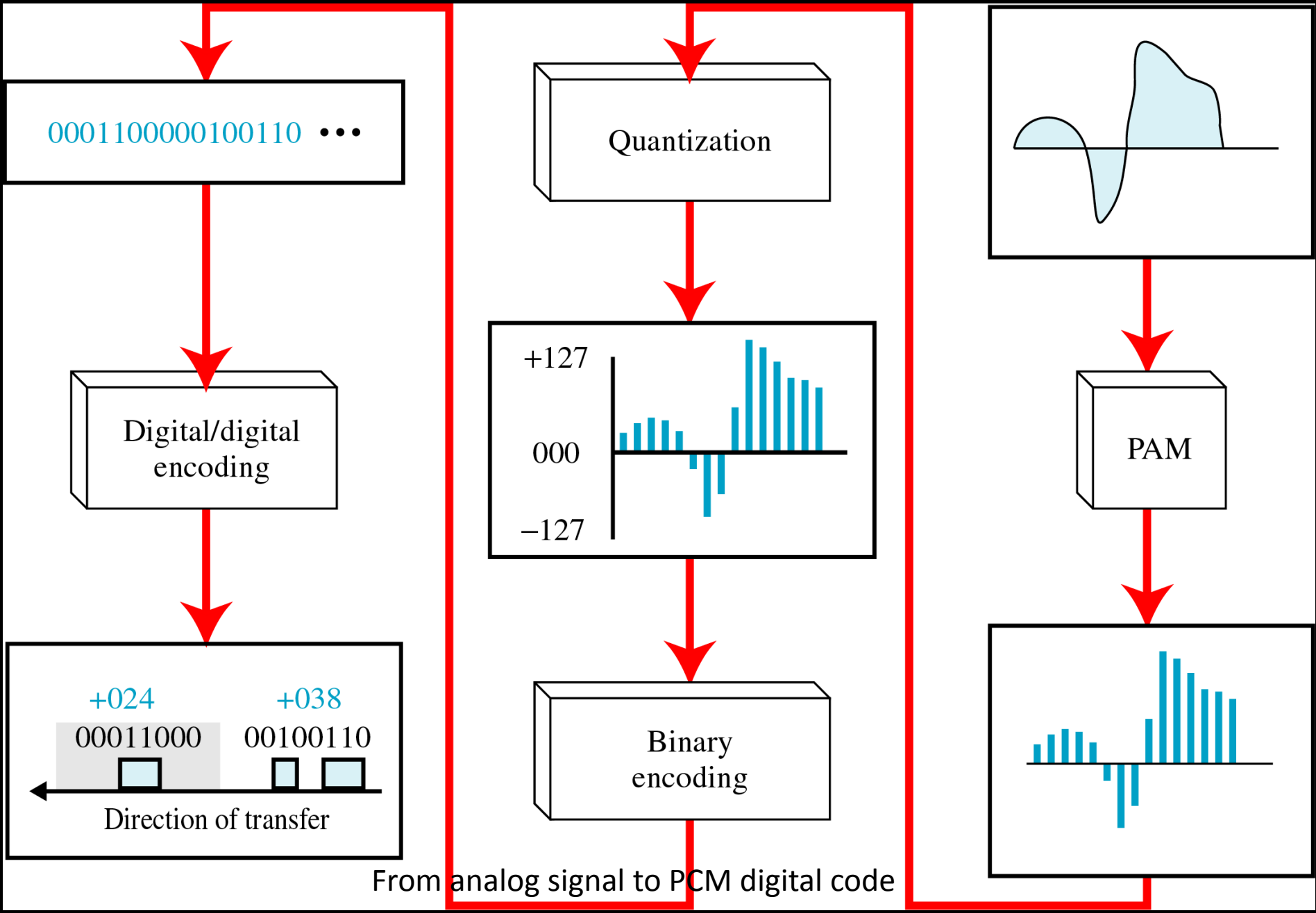
- In ADC, we are representing the information contained in continuous wave form as a series of digital pulses
- The problem is how to translate information from an infinite number of values to a discrete number of values without sacrificing sense or quality
- A well-known ADC technique is called pulse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



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



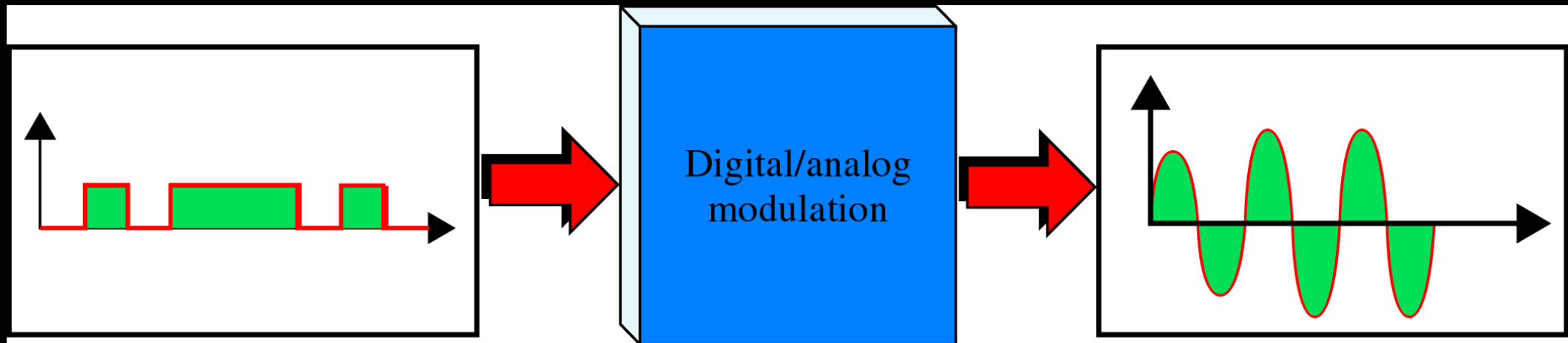


From analog signal to PCM digital code



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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APPENDIX B: ATTRIBUTION FOR SOURCES USED

- SparkFun [Analog vs Digital](#) tutorial
- [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