BME208
Logic Design and Circuits

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Definition

- Digital electronics is
  - the branch of electrical and electronics engineering that deals with study of design, working, and applications of digital signals and systems.
- Digital electronics covers
  - the comprehensive study of digital signals, digital circuits, and digital technologies which are used in electronics, electrical, computers, and communications.

Advantages & Disadvantages

Advantages	Disadvantages
Digital signals represent information more accurately.	Sources of electricity required for operation of digital systems is not readily available.
Digital systems are less susceptible to noise and interference.	Digital signals can have quantization errors, as they cannot perfectly represent information using finite binary digits.
Digital electronics provides easy and reliable storage, processing, and transmission of information using binary numbers.	Analog to digital conversion is involved, hence, digital systems are slower.
Digital systems can perform complex operations more precisely.	Due to sophisticated design and manufacturing process, digital systems are expensive to produce.
Design and manufacturing of digital system is easier and faster.	Repairing process of digital systems require technical expertise.
Digital systems are highly energy efficient.	Due to very high compactness, digital systems cannot be repaired.

Applications

- Computers
- Communication Systems
- Home Appliances
- Automotives
- Industrial Control and Automation
- Medical Devices
- Military
- Space Research
- Data Processing
- etc.

Digital System

- Characteristic is
  - the ability of manipulating discrete elements of information
- Discrete sets
  - have a finite number of elements containing discrete information
- Example discrete sets are
  - Decimal digits {0, 1, 2, ..., 9}
  - Alphabet {A, B, C, ..., Z}
  - Binary digits {0, 1}

How to represent

- In electronics, we have two electrical quantities
  - Voltage (Volts, V)
  - Current (Amperes, A)
- Binary set is the easiest
  - Two elements: 0 and 1
  - Just two voltage levels: 0V and 5V

Binary system

- Binary set {0, 1}
  - The elements are binary digits
  - Digit = Bit
- Elements of any discrete set can be represented using groups of bits:
  - 9 -> 1001
  - 10 -> 1010
  - ‘A’ -> 65 -> 01000001 (ASCII system)

How many bits ?

- #symbols <= 2 ^ #bits
- {0, 1, 2, 3} -> 00, 01, 10, 11
- {0, 1, 2, 3, 4, 5, 6, 7} -> 000, 001, 010, 011, 100, 101, 110, 111
- {ON, OFF} -> 0, 1
- {OFF, ON} -> 0, 1
- {YES, NO} -> 0, 1
- {GREEN, YELLOW, RED, RED+YELLOW} -> 00, 01, 10, 11
- etc.

Nature of information

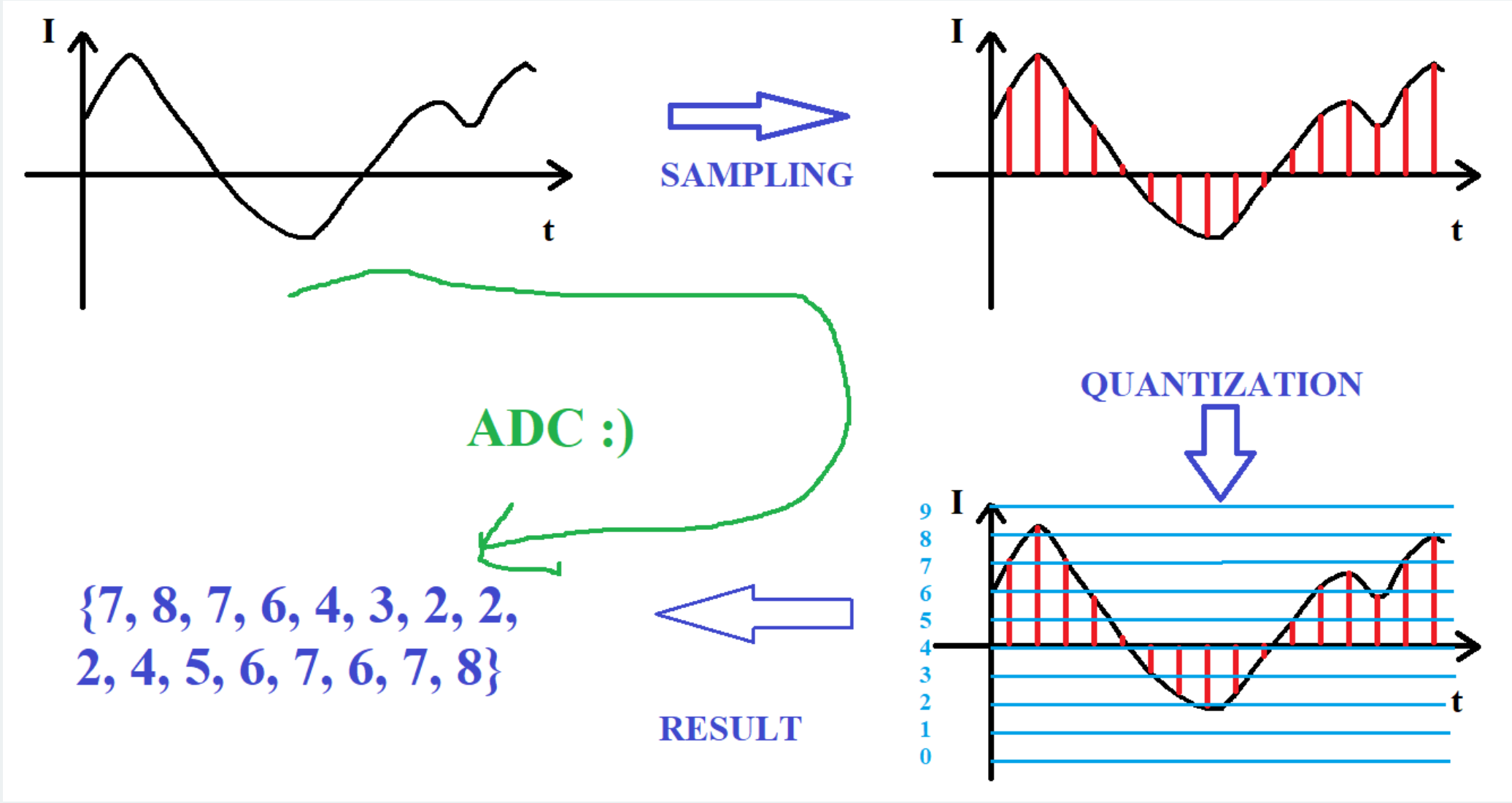
- Is information of discrete nature?
  - Sometimes, but usually not.
- Analog-to-Digital Convertor (ADC)
  - Converts analog information to digital information
- Digital-to-Analog Convertor (DAC)
  - Converts digital information to analog information

Analog – Discrete – Digital

- Analog signal
  - is continuous in both scale time and amplitude.
- Discrete signal
  - may be discrete in time (mainly) or discrete in amplitude.
- Digital signal
  - is discrete in both scale time and amplitude.

- Digital signals
  - are more resistant to noise and distortion than analog signals, and they can be processed and manipulated more easily by digital devices.

Conversion


I
t
SAMPLING
I
t
QUANTIZATION
I
9
8
7
6
5
4
3
2
1
0
t
ADC :)
{7, 8, 7, 6, 4, 3, 2, 2,
2, 4, 5, 6, 7, 6, 7, 8}
RESULT

Thanks

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