EEE130 Digital Electronics I Lecture #1

By
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About this lecture (1)

- My part:
  - Chapter 1 until Chapter 6 (including subtractor)
- Grading scheme:
  - 30:70
  - 10% assignment, 20% test and 70% exam
- Consultation hour:
  - Wednesday 14:00 to 16:00 hours
- URL:
  - http://ee.eng.usm.my/eeacad/shahrel/index.html

About this lecture (2)

- Text book:
  - "Digital Fundamentals", Thomas L. Floyd, 9th Edition, Pearson Education International, Prentice Hall.
- Other references:
  - Check our homepage for this

Lecture schedule

- Our lecture schedule can be found at EEE130 website.

- Changes, teaching materials, questions, solutions, announcements and etc. will be made/given in the given URL, so please CHECK!!!!

Chapter 1 – Digital Concepts

- What we will learn in this chapter?
  - Digital and analog quantities
  - Binary digits, logic levels, digital waveforms
  - Basic logic operation
  - Overview of basic logic functions
  - Fixed-function integrated circuits
  - Introduction to programmable logic
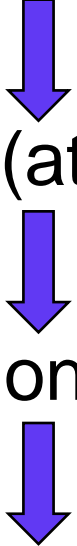 - Test and measurement instruments

1-1 Digital and analog quantities

- Definition of analog and digital:
  - Analog: a quantity that has continuous values
    - Examples: air temperature (or any quantities that cannot change abruptly, instantaneously)
  - Digital: a quantity that has discrete values
    - Examples: air temperature sampled at a given period
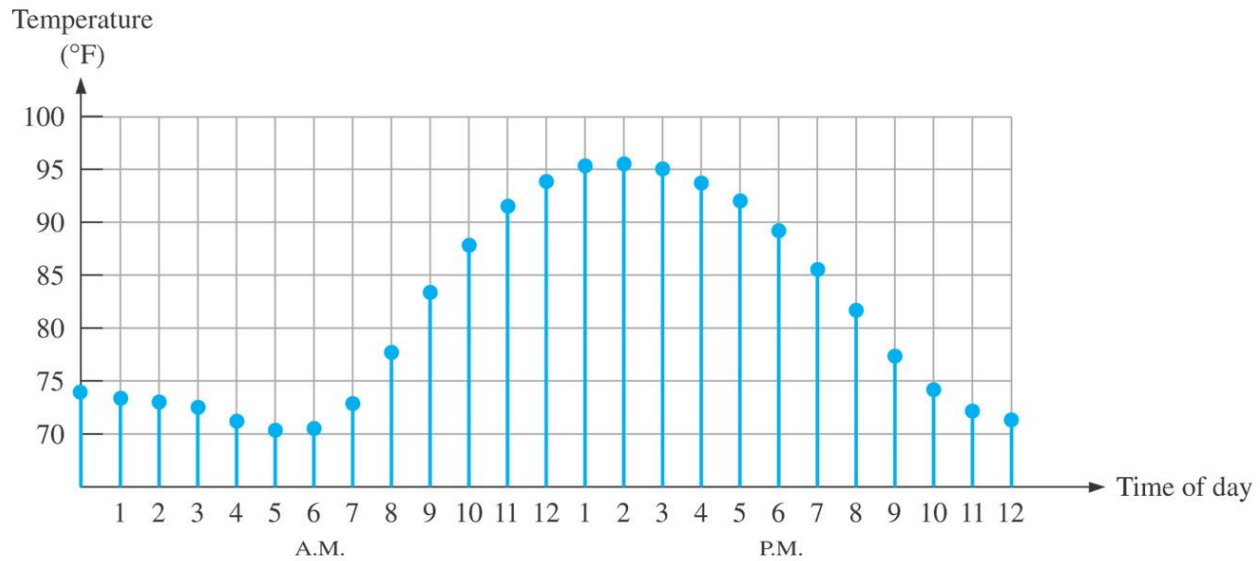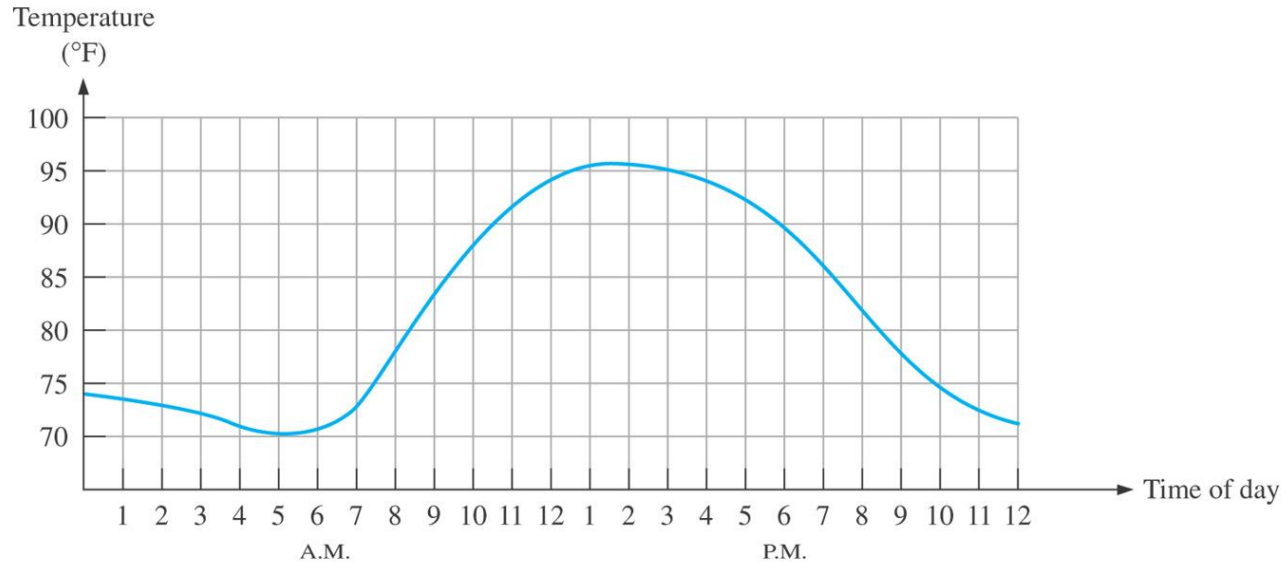- Can you think of some other examples??

The advantage of digital

- Digital data can be processed and transmitted more efficiently and reliably than analog data

- Digital data requires less space
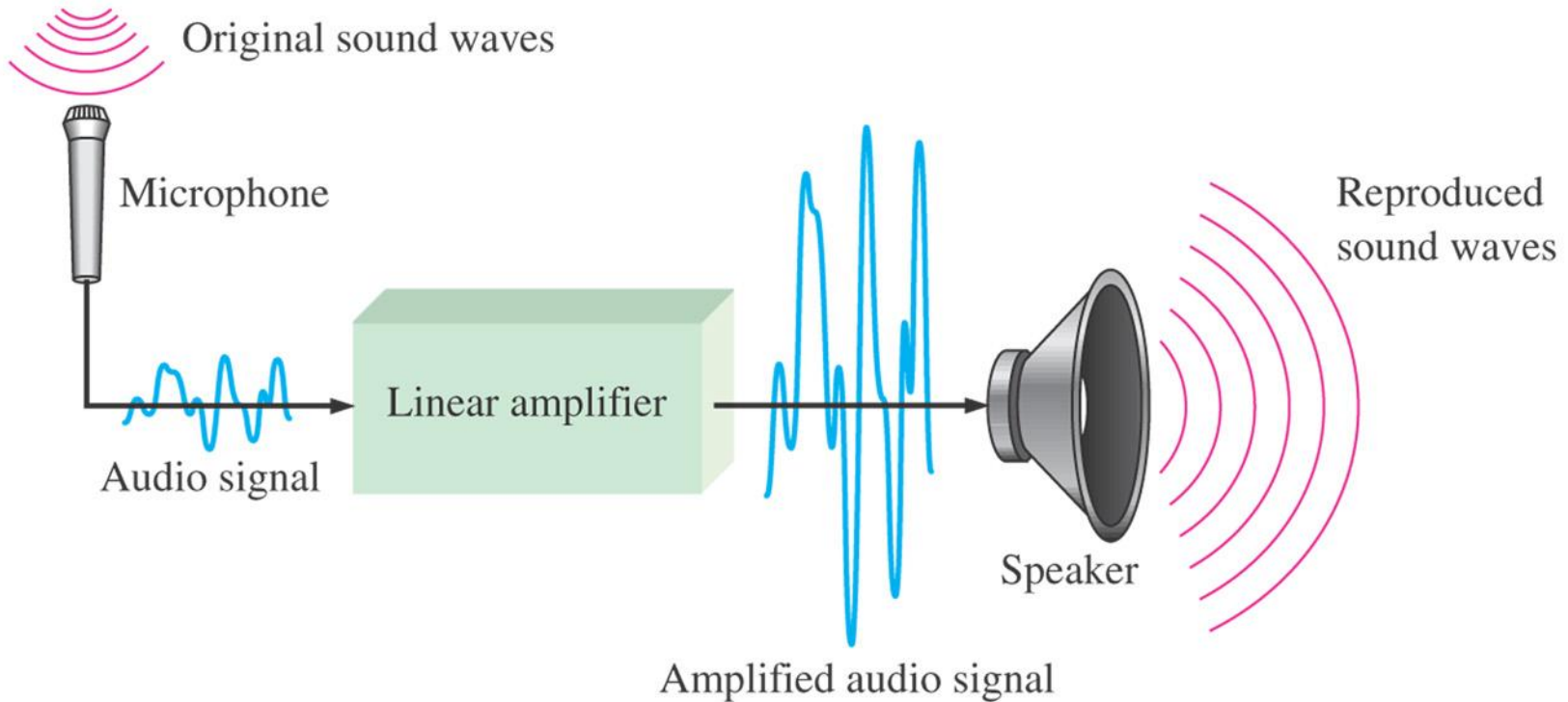
- Digital data reduces noise

How to get digital signals?

- Through 'digitizing' process
  - Analog signals as input

  - Sampling (at certain frequency rates)
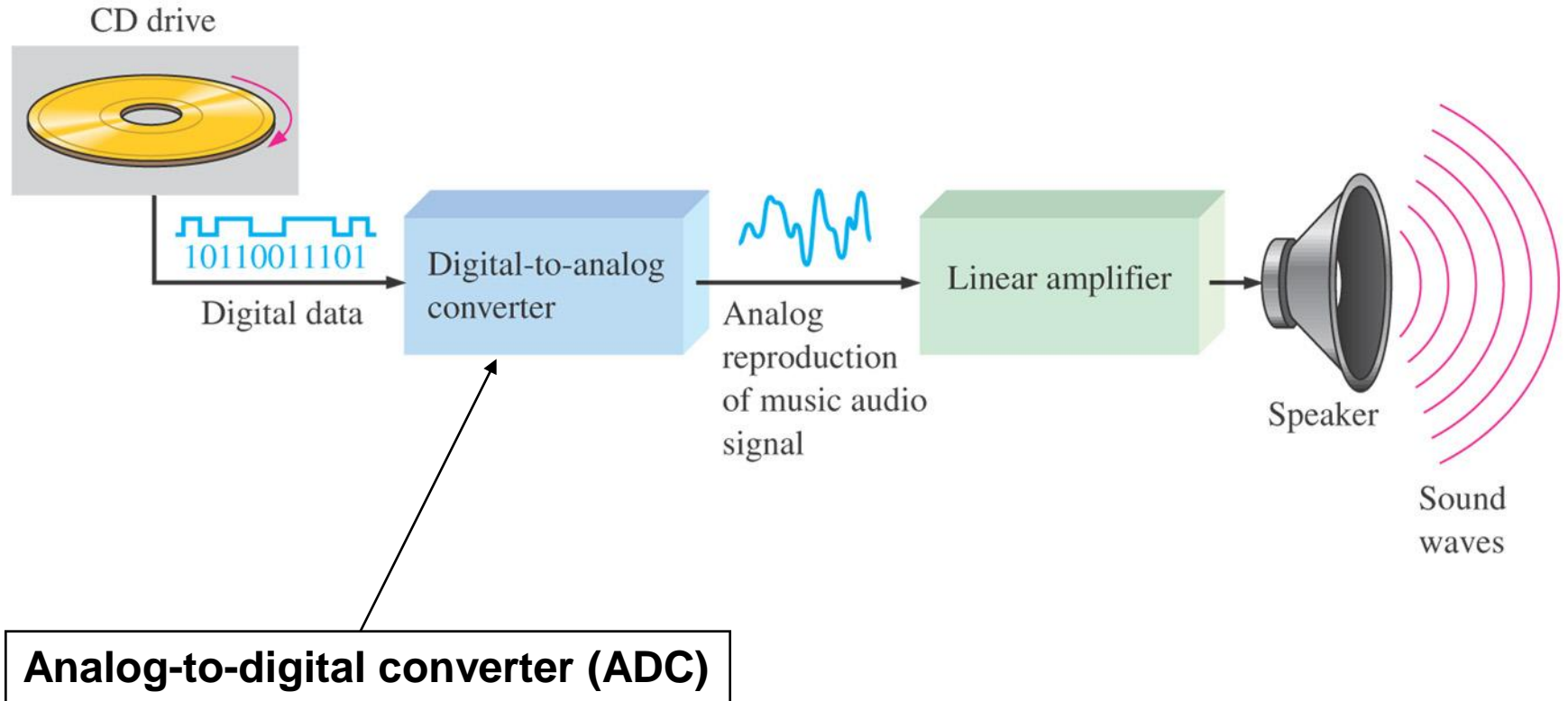
  - Quantization

  - Digital signals

Example

An analog electronic system

Original sound waves

Microphone

Audio signal

Linear amplifier

Amplified audio signal

Speaker

Reproduced sound waves

A system using digital and analog methods

CD drive

10110011101
Digital data

Digital-to-analog converter

Analog reproduction of music audio signal

Linear amplifier

Speaker

Sound waves

**Analog-to-digital converter (ADC)**

1-2 Binary Digits

- Important information about binary digits
  - HIGH(1) and LOW(0)
  - Bit is *binary digit*
  - Positive logic: 1 is HIGH and 0 is LOW
  - Negative logic: 0 is HIGH and 1 is LOW
  - HIGH and LOW are actually representing voltage level
 - Codes: groups of bits → to represent numbers, letters, symbols, etc.

1-2 Logic Levels

- The meaning of logic levels:
  - The voltages to represent a 1 and 0
- HIGH:
  - within a specified minimum and maximum high voltage value
- LOW:
  - within a specified minimum and maximum low voltage value
- Examples:
  - CMOS type IC – HIGH: (2,3.3)V, LOW: (0,0.8)V

$V_{H(max)}$

HIGH (binary 1)

$V_{H(min)}$

Unallowed

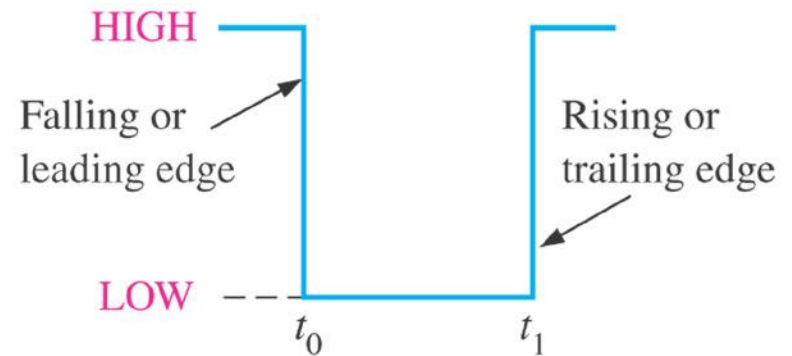$V_{L(max)}$

LOW (binary 0)

$V_{L(min)}$
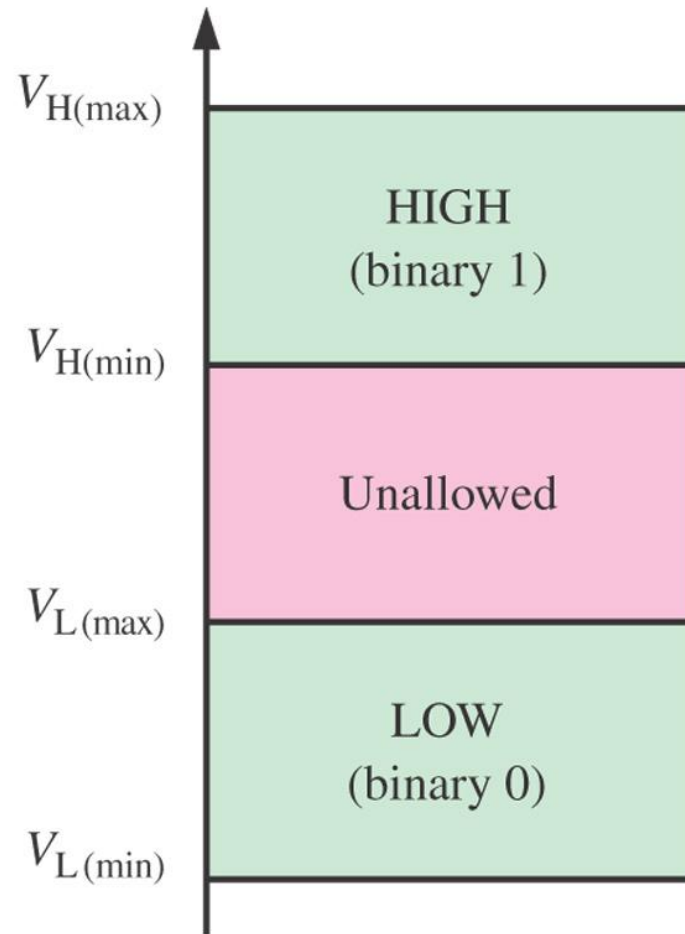
1-2 Digital Waveforms

- Consists of voltage level that are changing back and forth between HIGH and LOW levels or states
- There are positive-going, and negative going pulses

HIGH – – –
Rising or leading edge
Falling or trailing edge
LOW
t_0 t_1
(a) Positive–going pulse
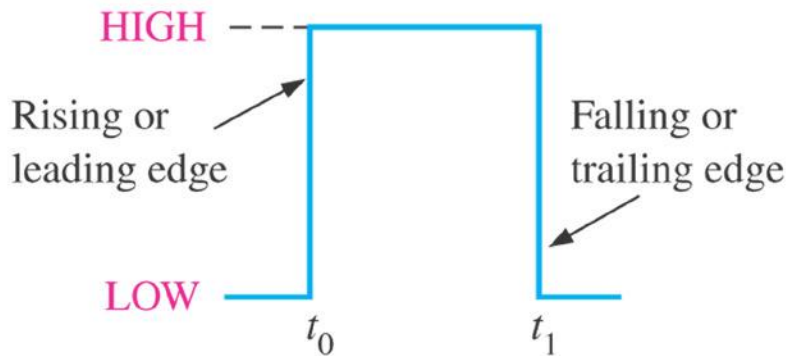
HIGH
Falling or leading edge
Rising or trailing edge
LOW – – –
t_0 t_1
(b) Negative–going pulse

More about digital waves

- Pulse (ideal case):
  - We should know the leading and trailing edges. What are these??
    - Leading edges: this can be rising or falling edge depending on the pulses type. This edge starts at time t_0
    - Trailing edges: this can be rising or falling edge depending on the pulses type. This edge occurs at time t_1

More about digital waves

- Pulse (non ideal case):