# Introduction

BME208 – Logic Circuits
Yalçın İŞLER
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# Lecture

- 6 ECTS course
  - Three hours theory
  - One hour laboratory
  - No other sections
- Wednesday: 13:30 – 16:15 (B2-08 for theory)
- Attendance is compulsory as usual

# Laboratory

- 9 experiments
  - Check from the CANVAS
- It is obligatory to do all the assignments
- Contact the assistants
  - Bartu and Mazlum
- If you take under 60 from laboratory, you will fail directly and it is not necessary to attend final and resit exams, etc.

# Grading

- One mid-term exam
  - Weight: 40%

- Final exam
  - Weight: 40%

- Laboratories
  - Weight: 20%
  - You need to learn VHDL

# Contact Information

- Yalçın İŞLER

- Place: Central Offices #1, 2nd Floor, Room 124
- e-mail: islerya @ yahoo.com

- Office hours:
  - Whenever you find me
  - Or by appointment via e-mail

# Course Website (theory sessions)

- You can download all presentations as PDF from

http://me.islerya.com/bme208.php

# Motivation

- Analysis & design of digital electronic circuits

- Why digital circuits?
  - They are everywhere and generic
  - digital computers, smart phones, data communication, digital recording, digital TV, many others
- Fundamental concepts in the design of digital systems
- Basic tools for the design of digital circuits
- Logic gates (AND, OR, NOT)
  - Boolean algebra

# What is a Digital System?

- One characteristic:
  - Ability of manipulating discrete elements of information
- A *set* that has a finite number of elements contains discrete information
- Examples for discrete sets
  - Decimal digits {0, 1, …, 9}
  - Alphabet {A, B, …, Y, Z}
  - Binary digits {0, 1}
- One important problem
  - how to represent the elements of
    physical systems?

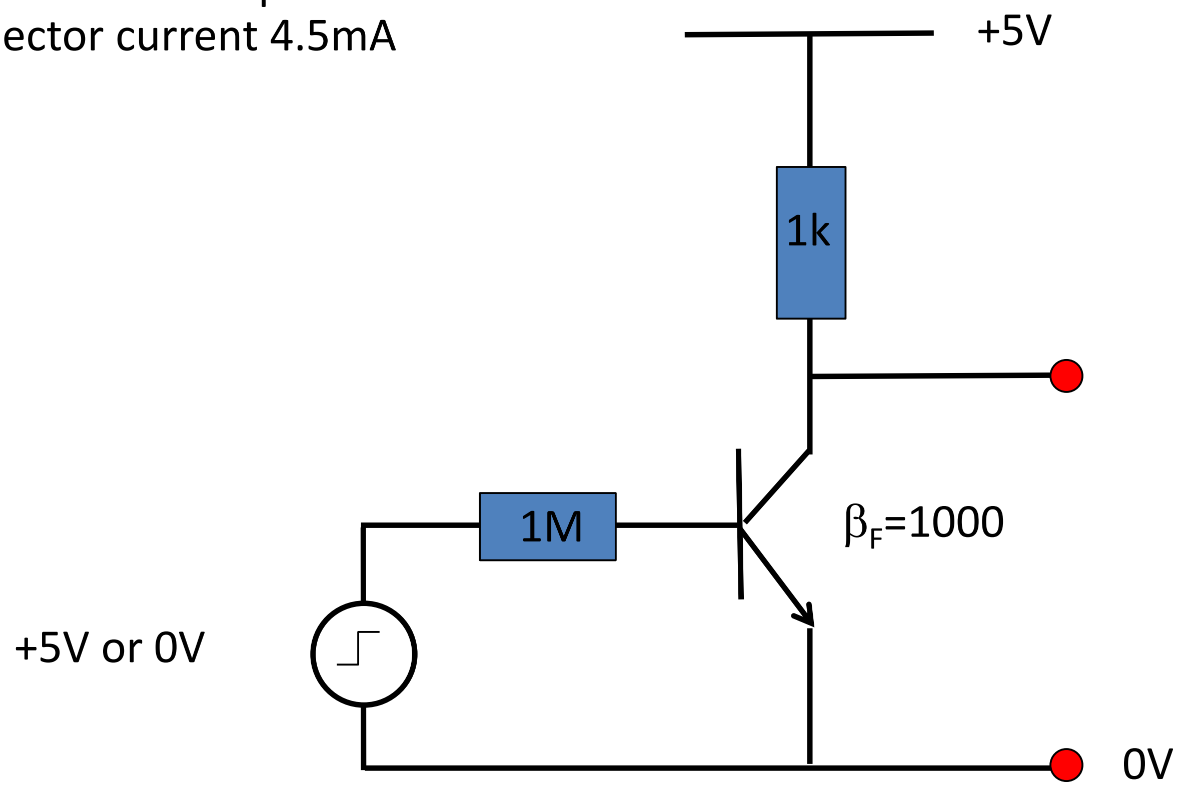
# How to Represent?

- In electronics circuits, we have electrical signals
  - voltage
  - current
- Different strengths of a physical signal can be used to represent elements of the discrete set.
- Which discrete set?
- Binary set is the easiest
  - two elements {0, 1}
  - Just two signal levels:  0 V and 5 V
- This is why we use binary system to represent the information in digital systems.

# How to Represent?

- In electronics circuits, we have electrical signals
  - voltage
  - current

  - Base current 4.5 μA
  - Collector current 4.5mA



# Binary System

- Binary set {0, 1}
  - The elements of binary set, 0 and 1 are called “binary digits”
  - or shortly “bits”.
- How to represent the elements of other discrete sets
  - Decimal digits {0, 1, …, 9}
  - Alphabet {A, B, …, Y, Z}


- Elements of any discrete set ca esented using <u>groups of bits.</u>
  - 9 → 1001
  - A → 1010

# How Many Bits?

- What is the formulae for number of bits to represent a discrete set of *n* elements
- {0, 1, 2, 3}
  - 00 → 0, 01 → 1, 10 → 2, and 11 → 3.
- {0, 1, 2, 3, 4, 5, 6, 7}
  - 000 → 0, 001 → 1, 010 → 2, ands 011 →
  - 100 → 4, 101 → 5, 110 → 6, ands 111 → 7.

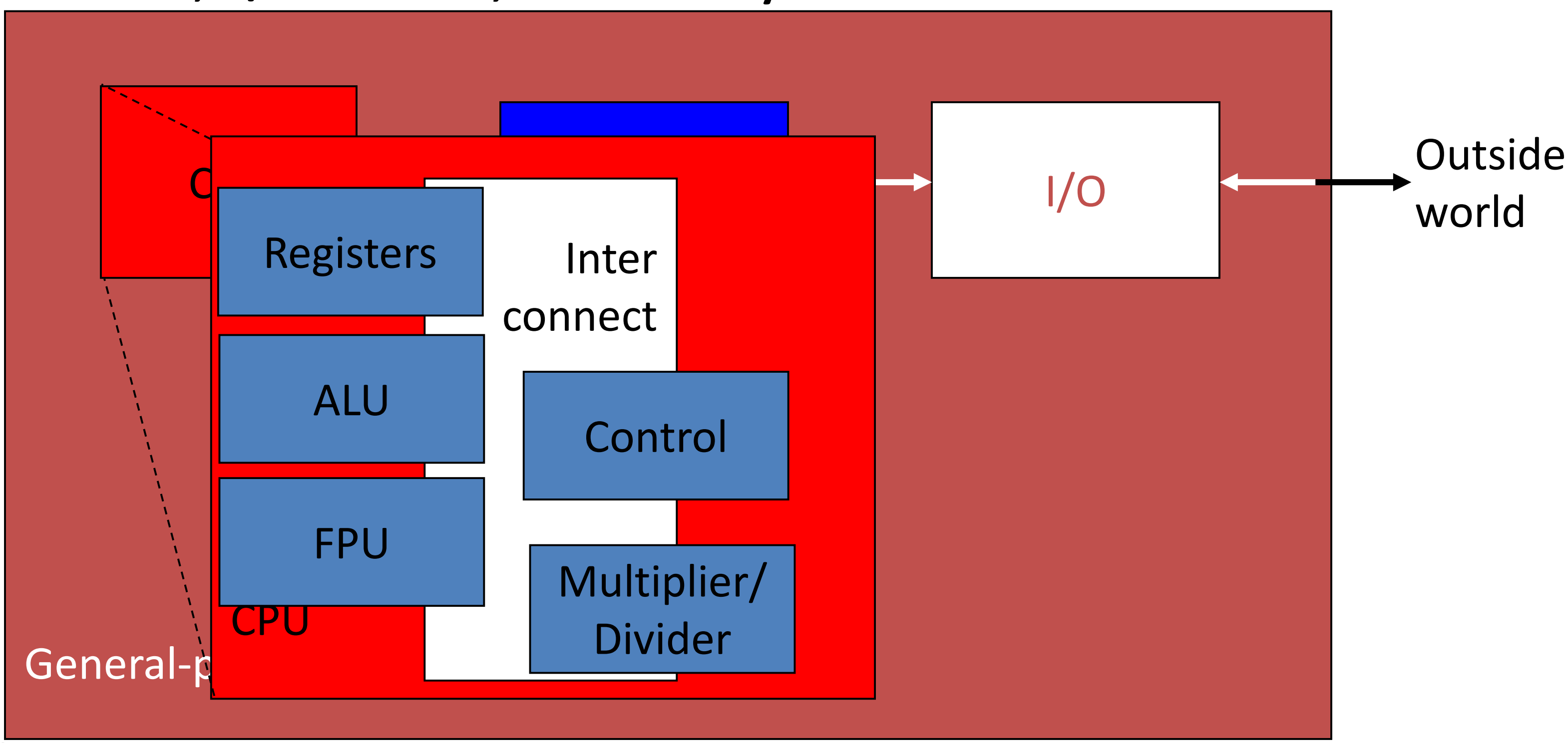
- The formulae, then,
  - #of bits required= $\lceil \log_2 \text{\#of Symbols} \rceil$
  - If n = 9, then ? bits are needed

# Nature of Information


- Is information of discrete nature?
- Sometimes, but usually not.
  - Anything related to money (e.g. financial computations, accounting etc) involves discrete information
- In nature, information comes in a continuous form
  - temperature, humidity level, air pressure, etc.
- Continuous data must be converted (i.e. quantized) into discrete data
  - lost of some of the information
  - We need ADC (DAC)

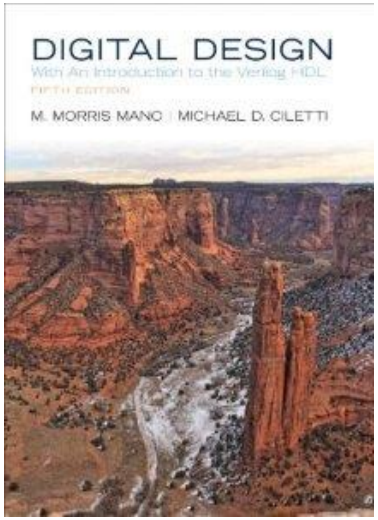
# General-Purpose Computers

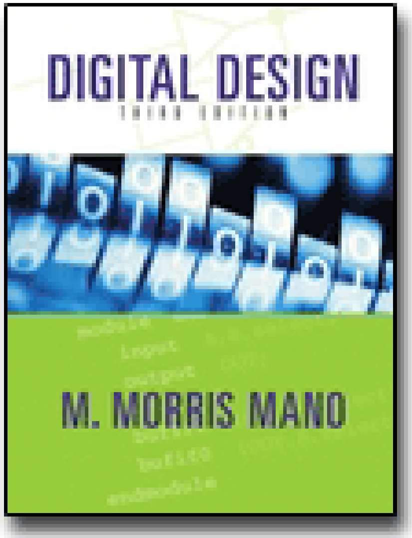
- Best known example for digital systems
- Components
  - CPU, I/O units, Memory unit



# Textbook & References

- Textbook
  - M. Morris ManoDigital Design: With an Introduction to the Verilog HDL, 5th Edition, Prentice Hall, 2013.
- Other references
  - Tens of digital design books
  - Lectures from MIT Open Courseware and Stanford

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