University of San Carlos | Department of
COMPUTER ENGINEERING

CpE 3202
Computer Organization & Architecture

Introduction

Architecture & Organization

- **Architecture** is those **attributes visible to the programmer**
  - Those attributes that have a **direct impact on the logical execution of a program**
  - **Examples of architectural attributes:** *instruction set, number of bits used for data representation, I/O mechanisms, memory addressing techniques*
  - e.g. Is there a multiply instruction?

Architecture & Organization

- **Organization** refers to **how features are implemented**
  - Refers to the **operational units and their interconnections** that realize the architectural specifications
  - **Organizational attributes** include those **hardware details transparent to the programmer**: *control signals, interfaces, memory technology*
  - e.g. Is there a hardware multiply unit or is it done by repeated addition?

Architecture & Organization

- A family of computer models, all with **the same architecture but with differences in organization**. These different models have **different price and performance characteristics**.

- Furthermore, **a particular architecture may span many years and encompass a number of different computer models**, its organization changing with changing technology.
  - All Intel x86 family share the same basic architecture
  - The IBM System/370 family share the same basic architecture
  - This gives code compatibility – at least backwards
  - Organization differs between different versions

Structure & Function

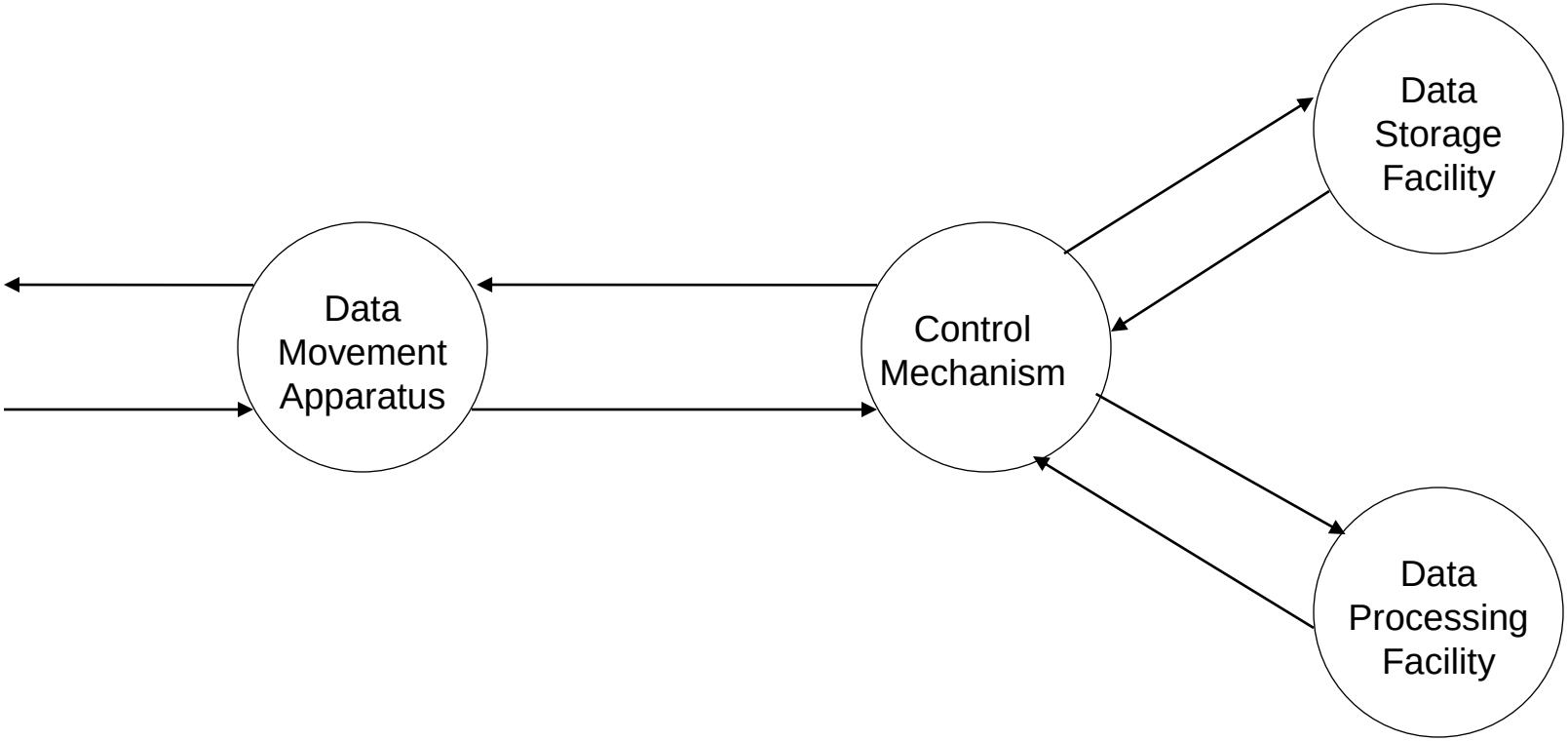
- A computer is clearly described in terms of its **hierarchical nature**. At each level, the designer is concerned with **structure and function**:
  - **Structure** is the way in which components relate to each other
  - **Function** is the operation of individual components as part of the structure
- Choices for design or description: **bottom-up** or **top-down approach**?

Function

- **All computer functions are:**
  - Data processing
  - Data storage
  - Data movement
  - Control

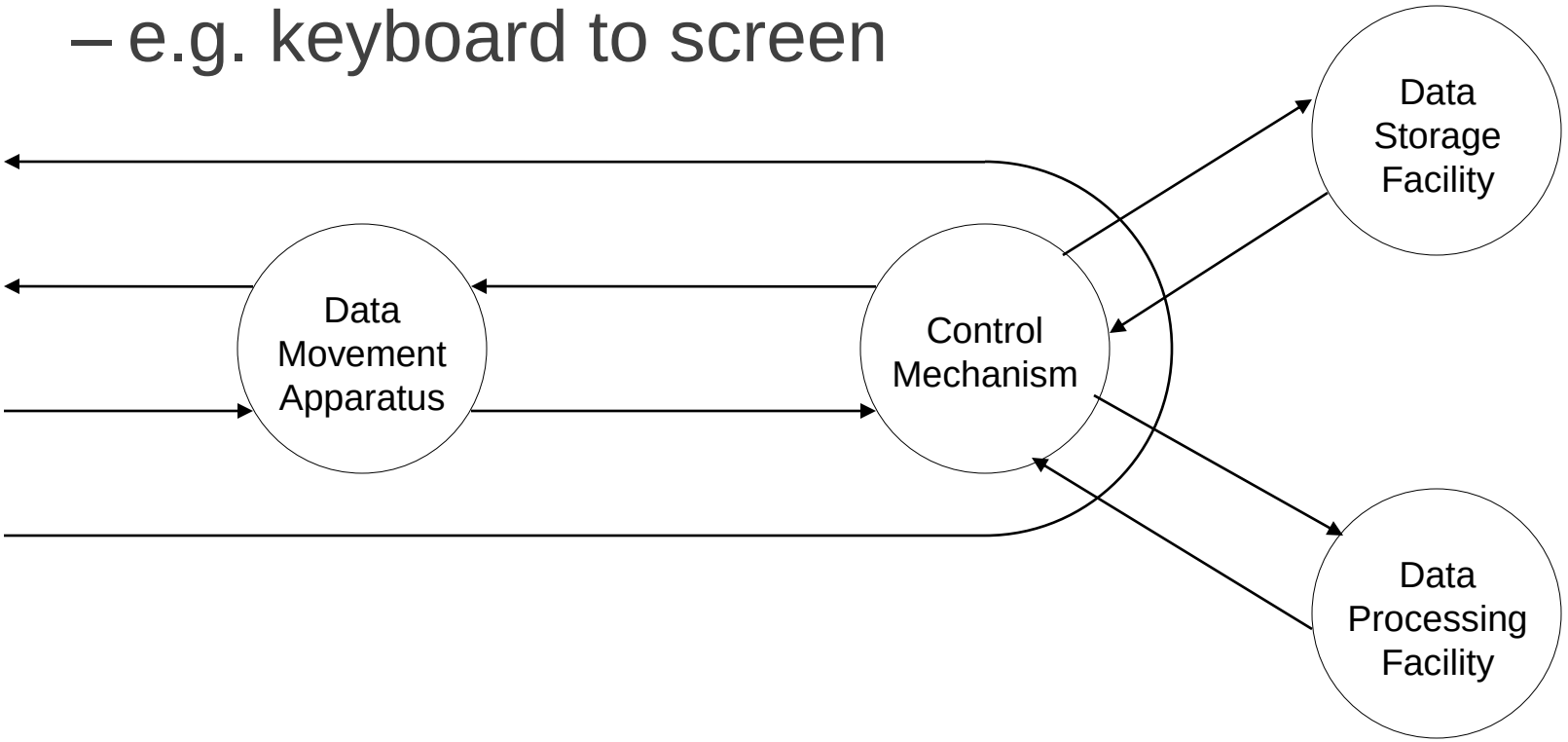
Functional view

- **Functional view of a computer**



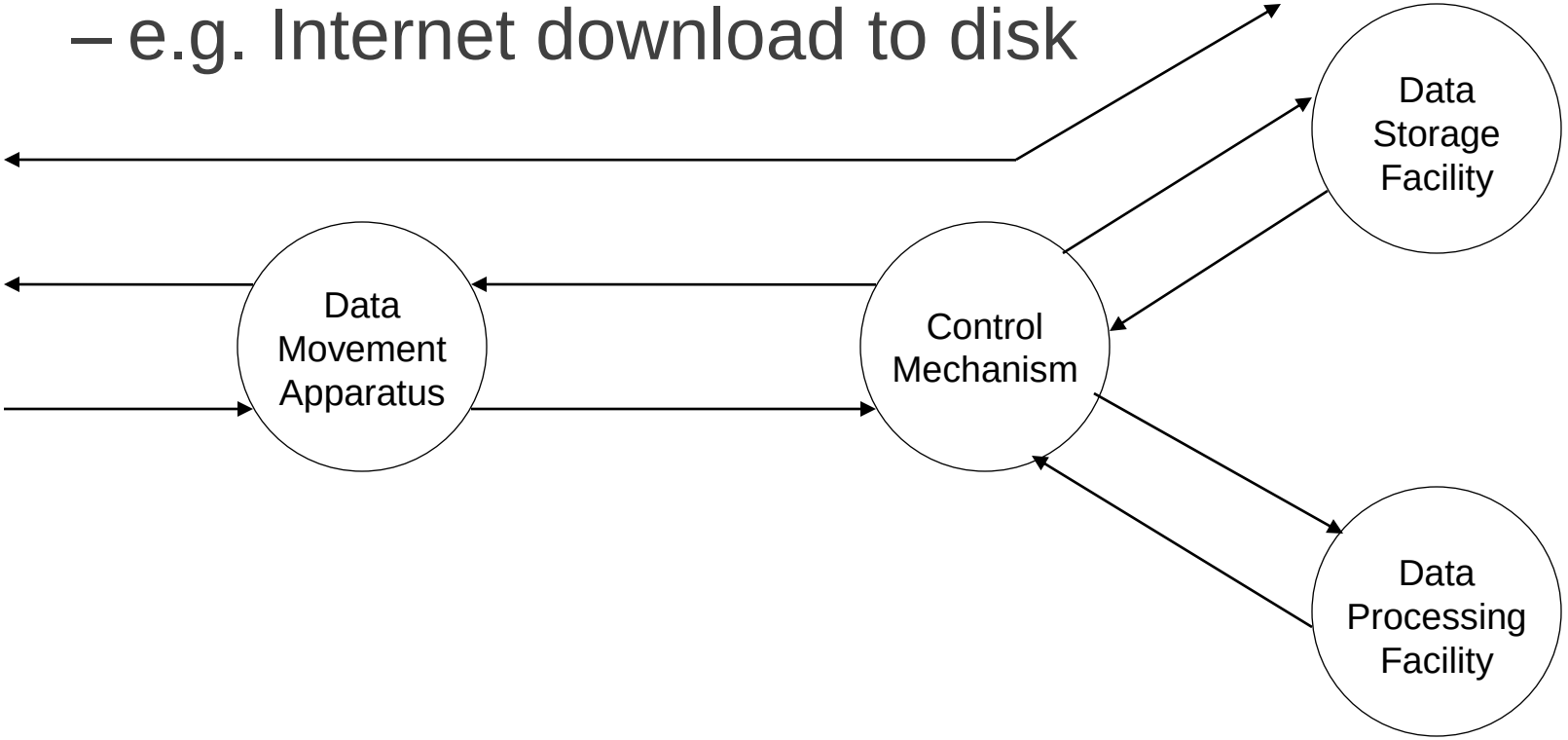
Operations (1)

- **Data movement**
  - e.g. keyboard to screen



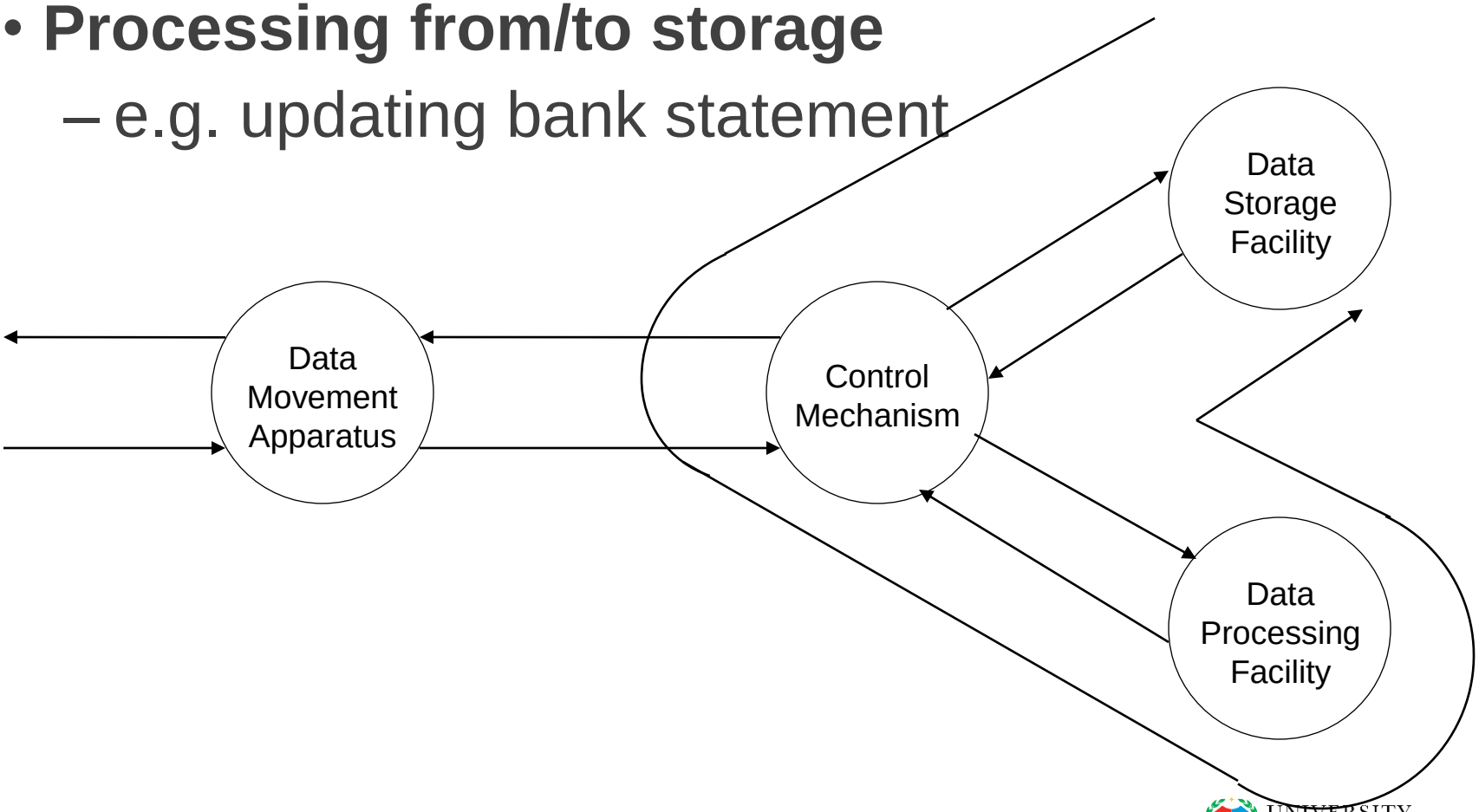
Operations (2)

- **Storage**
  - e.g. Internet download to disk



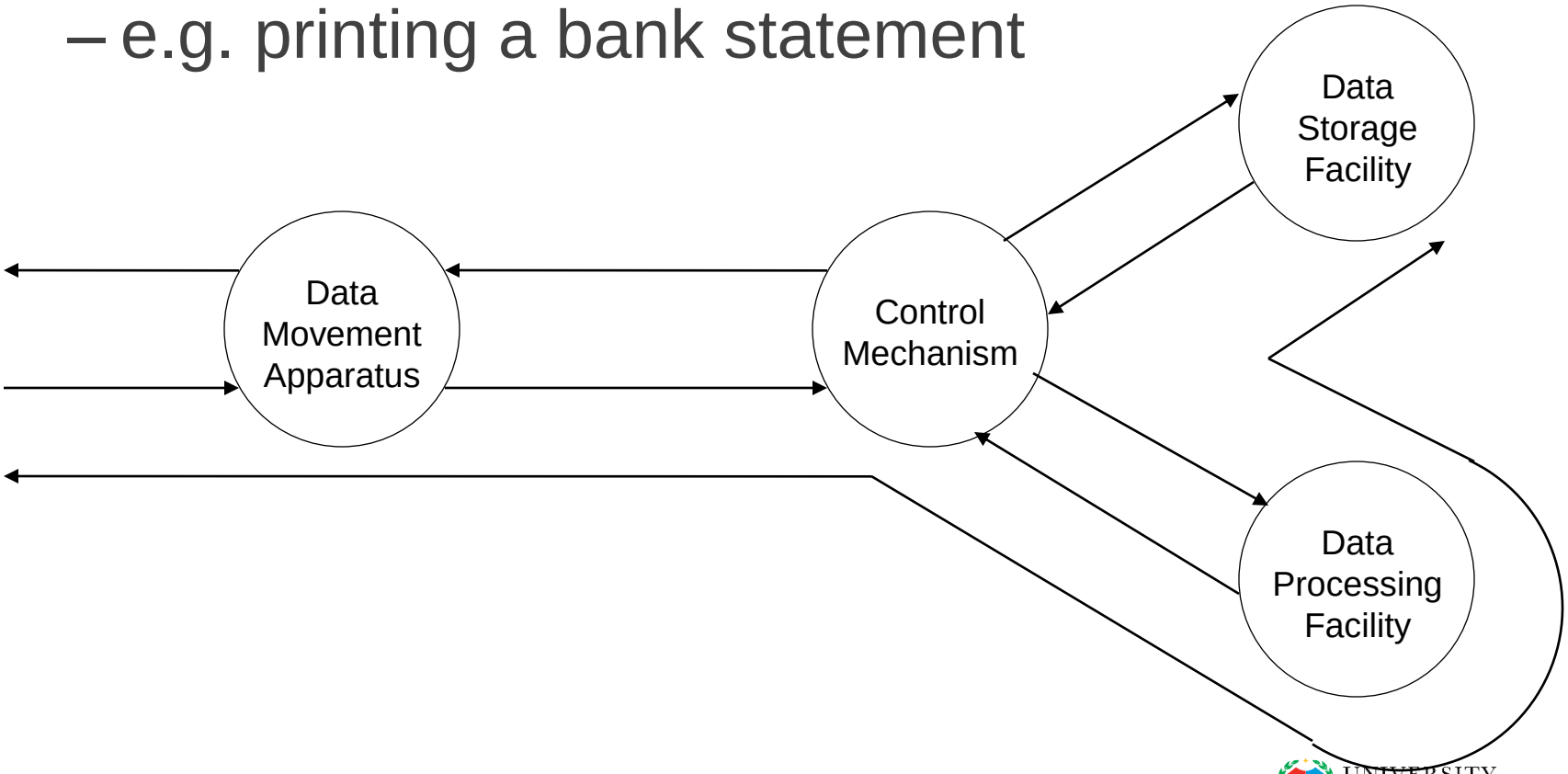
Operations (3)

- **Processing from/to storage**
  - e.g. updating bank statement

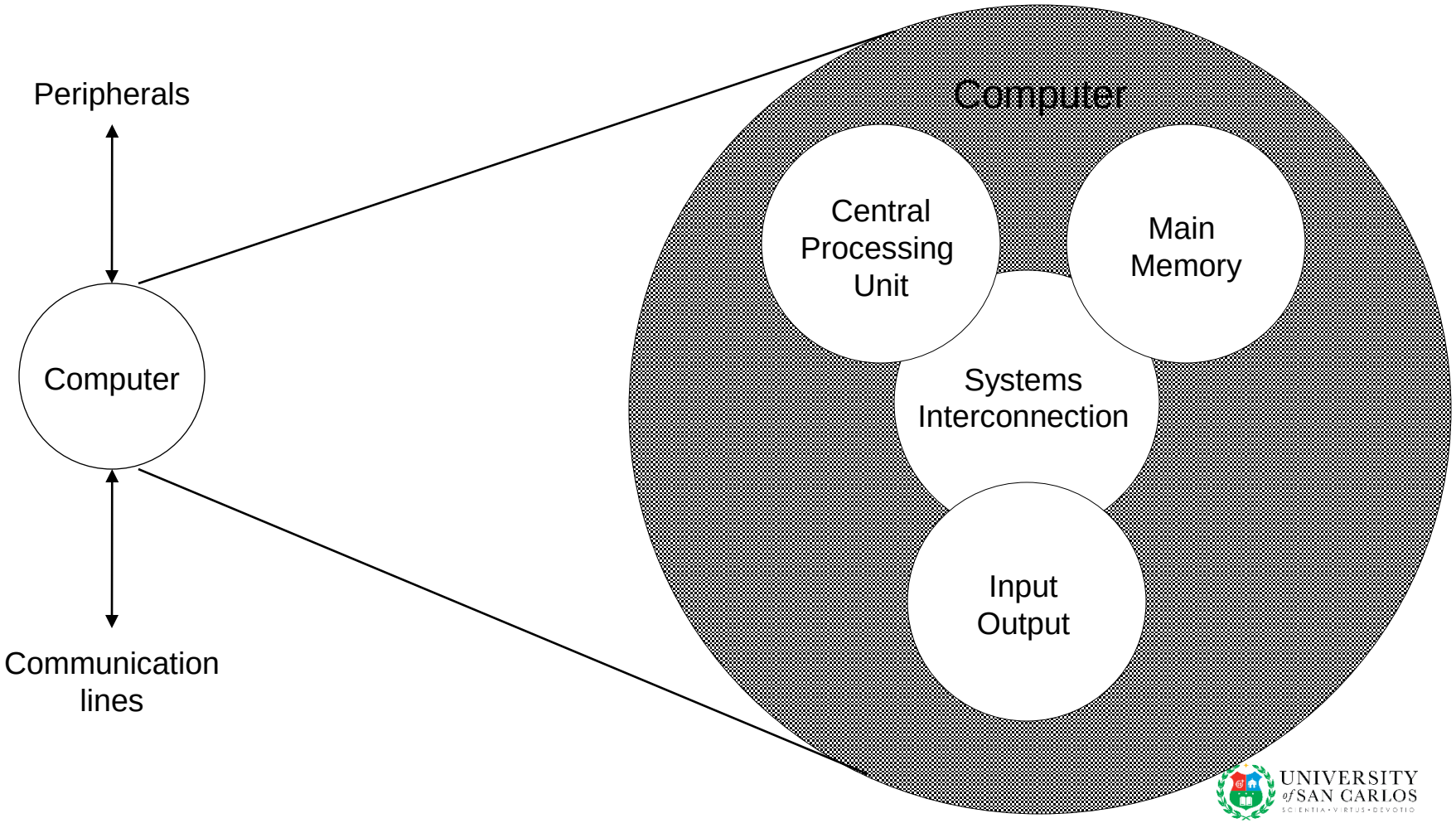


Operations (4)

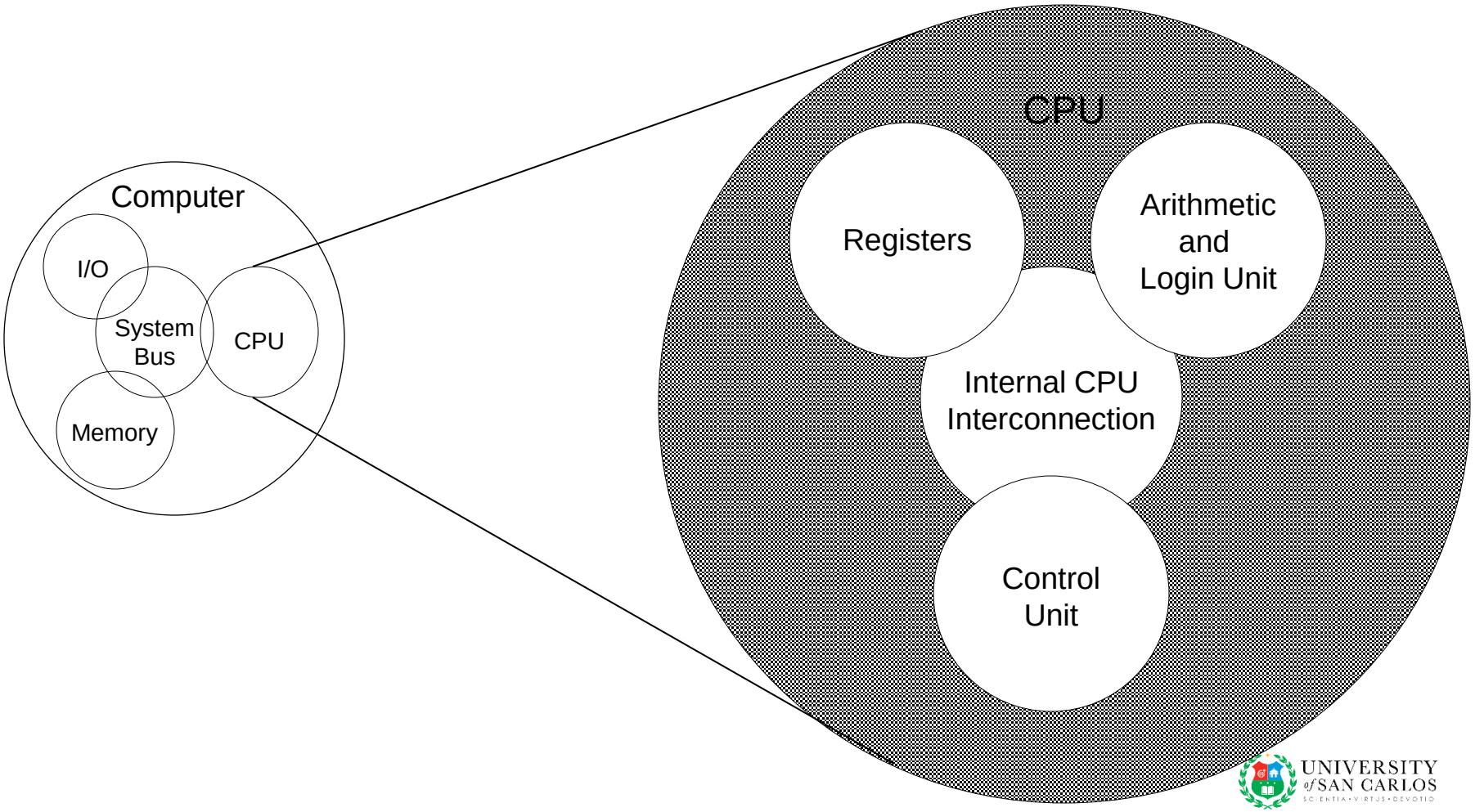
- **Processing from storage to I/O**
  - e.g. printing a bank statement



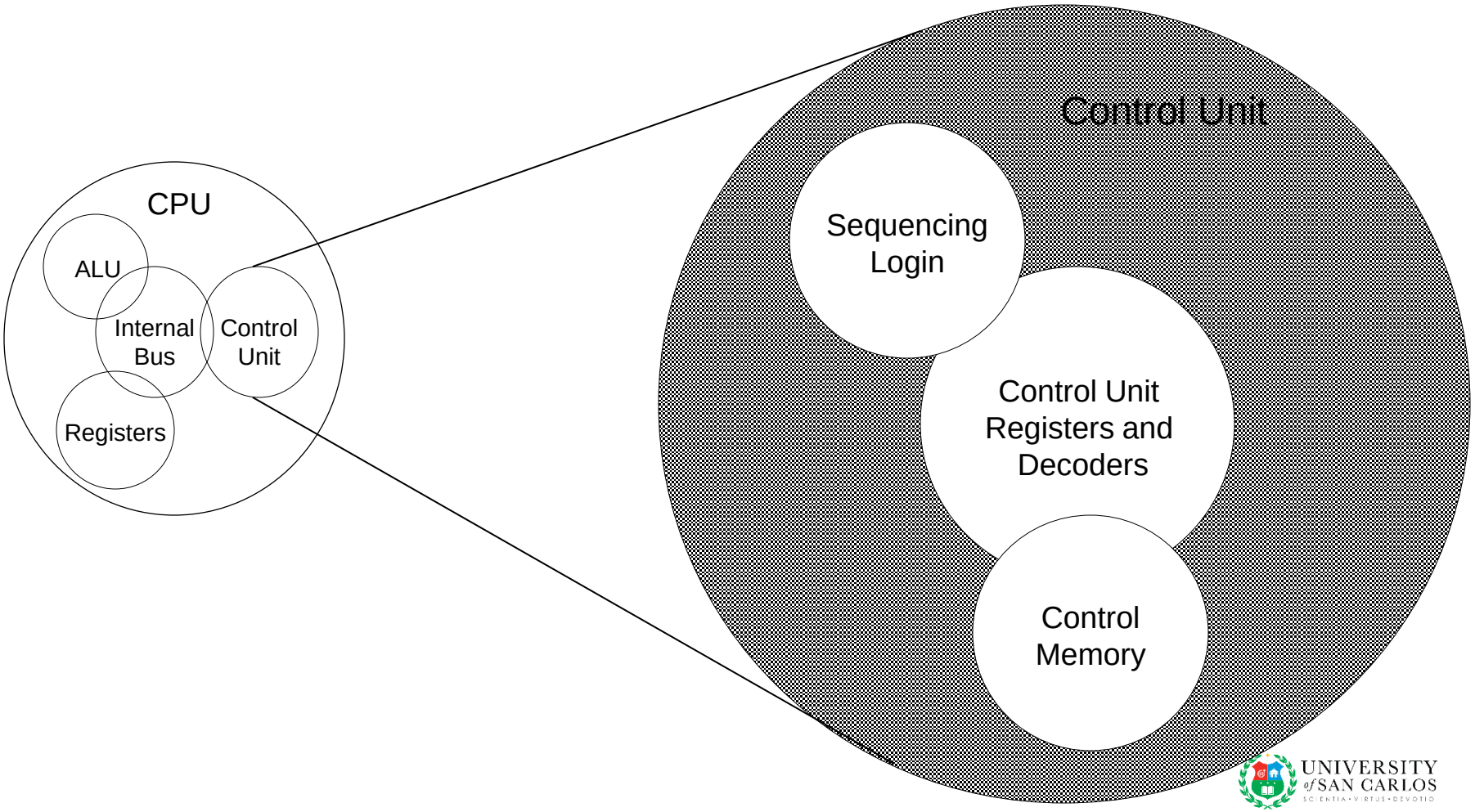
Structure - Top Level



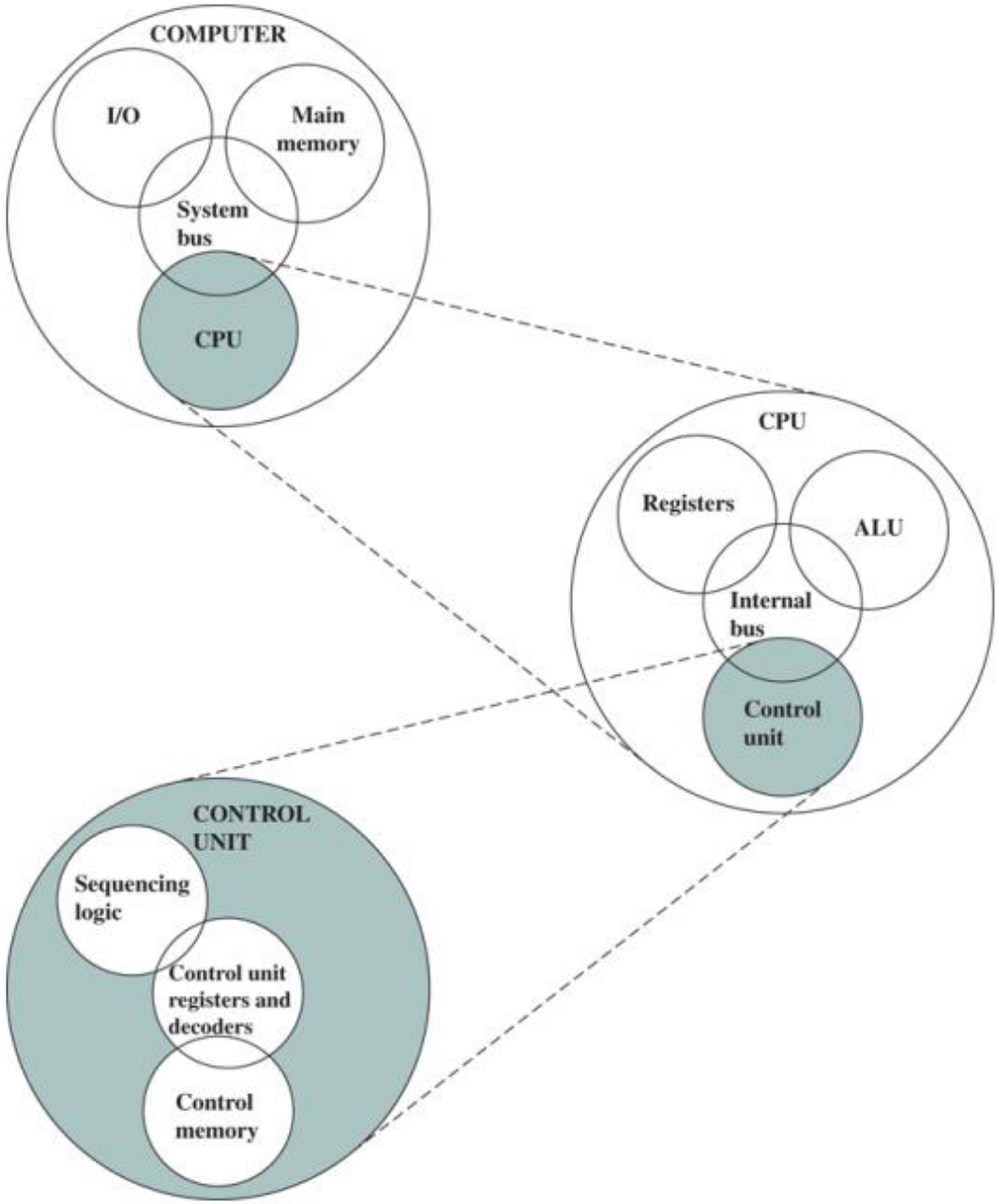
Structure - The CPU



Structure - The Control Unit

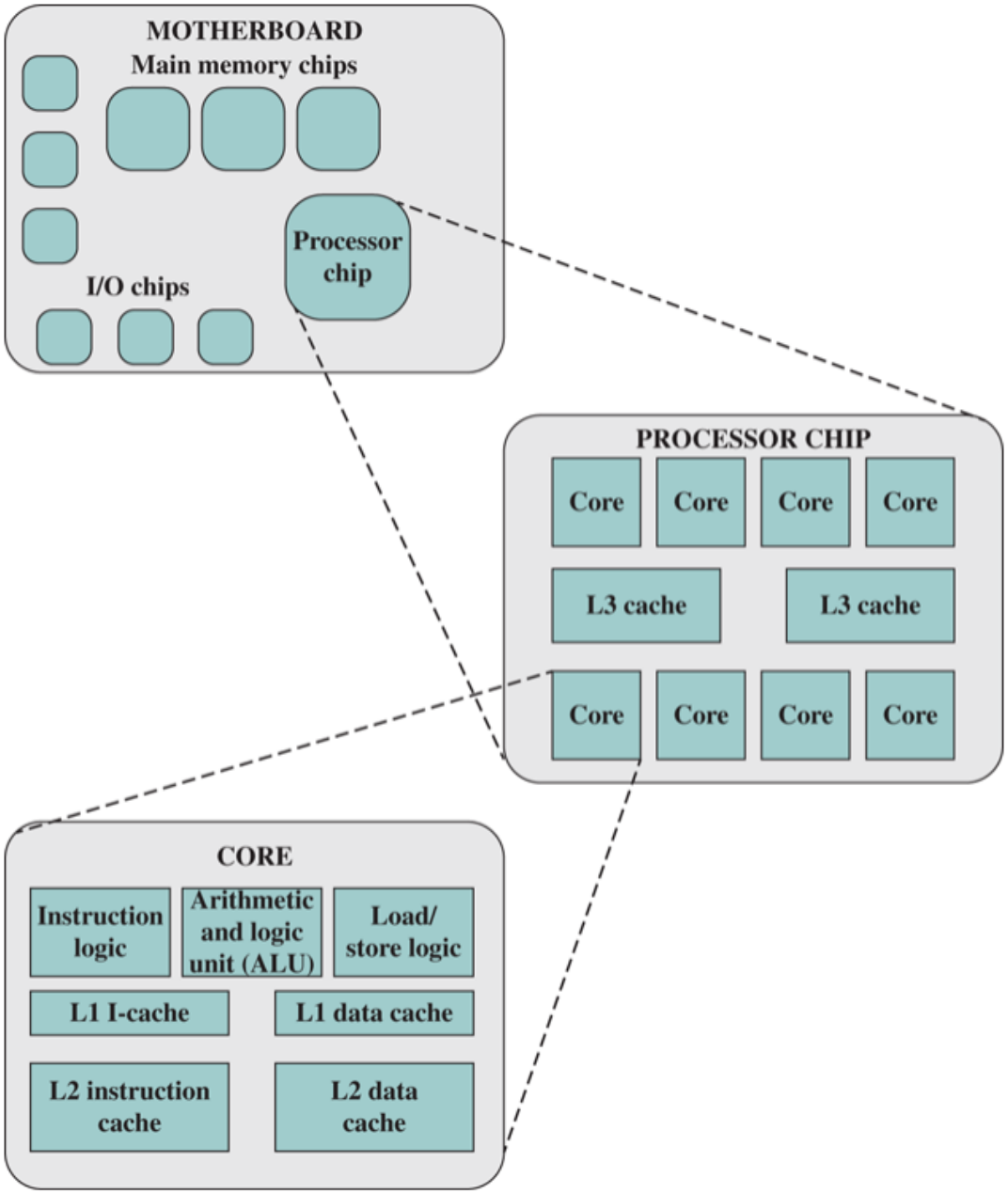


Top-Level Structure



Multi-core Computer:

Simplified View of Major Elements



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End of Lecture

References:

- Brey, Barry B. *The Intel microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit extensions: architecture, programming, and interfacing* / Barry B. Brey—8th ed.
- Stallings, W. Computer Organization and Architecture, 6th edition, Pearson Education, Inc. (2003).
- Stallings, W. Computer Organization and Architecture, 11th edition, Pearson Education, Inc. (2019).