University Of Diyala
College Of Engineering
Computer Engineering Department

COMPUTER ARCHITECTURE I

PART 1: INTRODUCTION

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Second stage

2022-2023

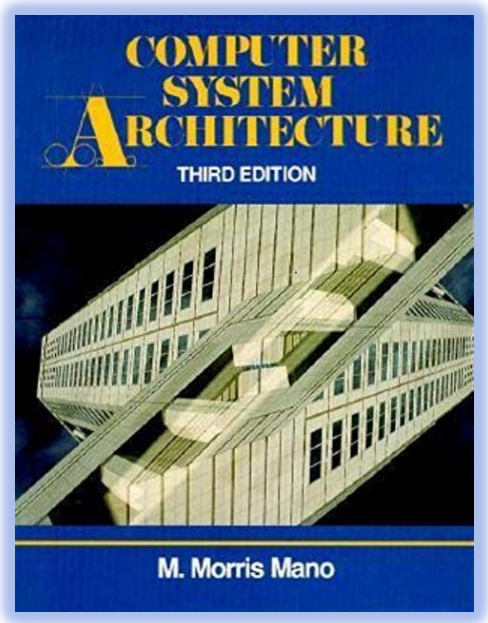
Pre-requisites:

- Fundamentals of Logic Design
- Digital Logic Circuits I

Textbook:

- **Morries Mano, *Computer System Architecture*, 3rd edition, 1993**
- Willian Stalling, *Computer Organization and Architecture*, 6th edition, 1999.

- **Chapter 1:** Introduction (Digital Computer system)
- **Chapter 4:** Register Transfer and Microoperations
- **Chapter 5:** Basic Computer Organization and Design
- **Chapter 6:** Programming the Basic Computer
- **Chapter 7:** Microprogrammed Control
- **Chapter 8:** Central Processing Unit
- **Chapter 9:** Pipeline and Vector Processing



COMPUTER SYSTEM ARCHITECTURE

COMPUTER ARCHITECTURE : is concerned with the structure and behaviour of the computer as seen by the user. It includes the information formats, the instruction set, and techniques for addressing memory. The architectural design of a computer system is concerned with the specifications of the various functional modules, such as processors and memories, and structuring them together into a computer system.

COMPUTER ORGANIZATION: is concerned with the way the hardware components operate and the way they are connected together to form the computer system. The various components are assumed to be in place and the task is to investigate the organizational structure to verify that the computer parts operate as intended.

COMPUTER DESIGN: is concerned with the hardware design of the computer. Once the computer specifications are formulated, it is the task of the designer to develop hardware for the system. Computer design is concerned with the determination of what hardware should be used and how the parts should be connected. This aspect of computer hardware is sometimes referred to as computer implementation.

ARCHITECTURE & ORGANIZATION

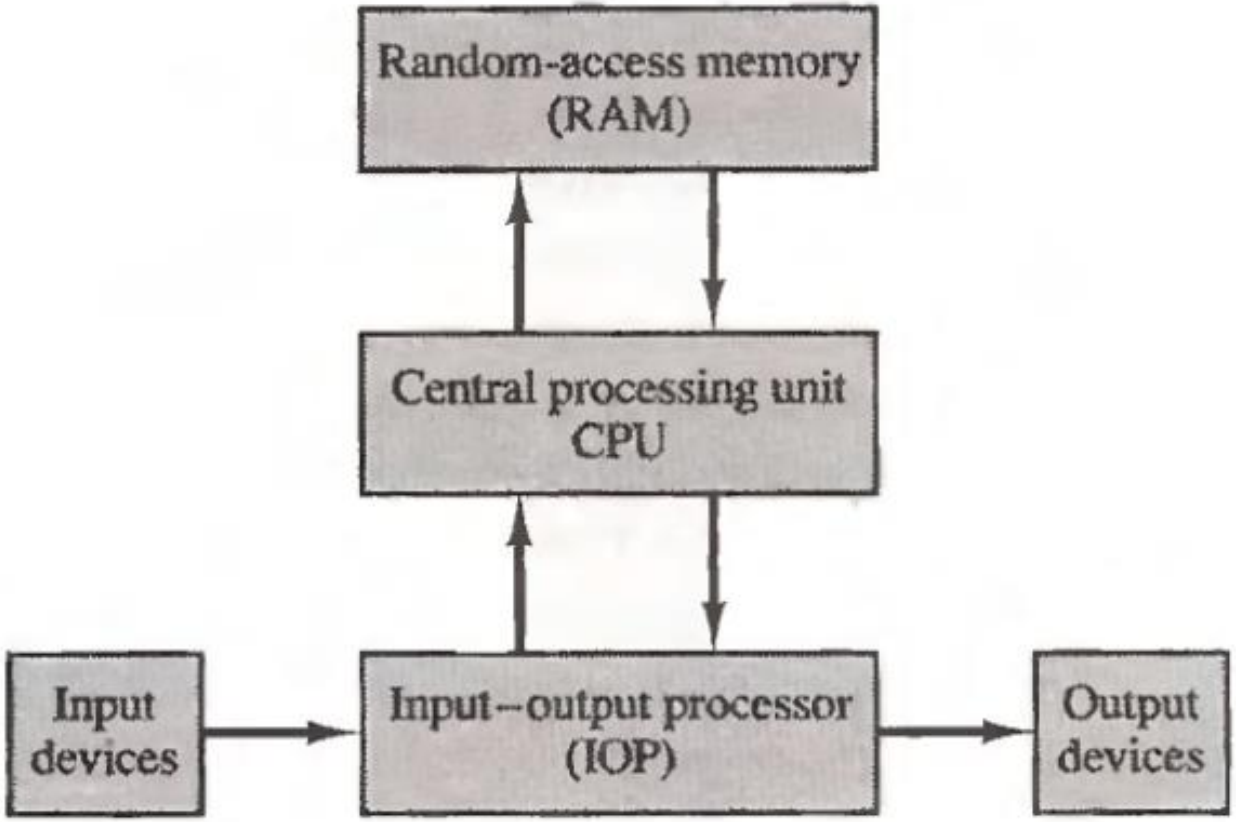
Architecture is those attributes visible to the programmer

- Instruction set, number of bits used for data representation, I/O mechanisms, addressing techniques.
- All Intel x86 family share the same basic architecture
- The IBM System/370 family share the same basic architecture

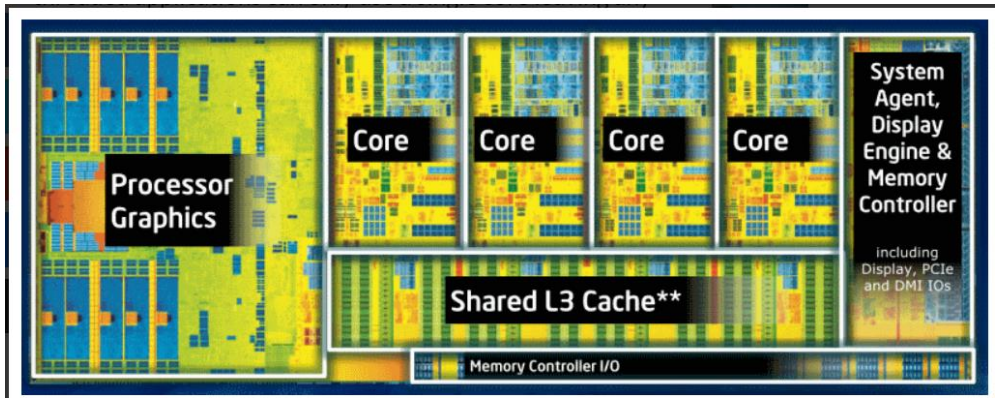
Organization is how features are implemented

- Realization and implementation of architecture
- Control signals, interfaces, memory technology.
- Organization differs between different versions

BLOCK DIAGRAM OF A DIGITAL COMPUTER.



INTEL CORE I3, I5 AND I7 HAVE SAME ARCHITECTURES?



Model	Core i3	Core i5	Core i7
Number of cores	2	4	4
Hyper-threading	Yes	No	Yes
Turbo boost	No	Yes	Yes
K model	No	Yes	Yes

STRUCTURE & FUNCTION

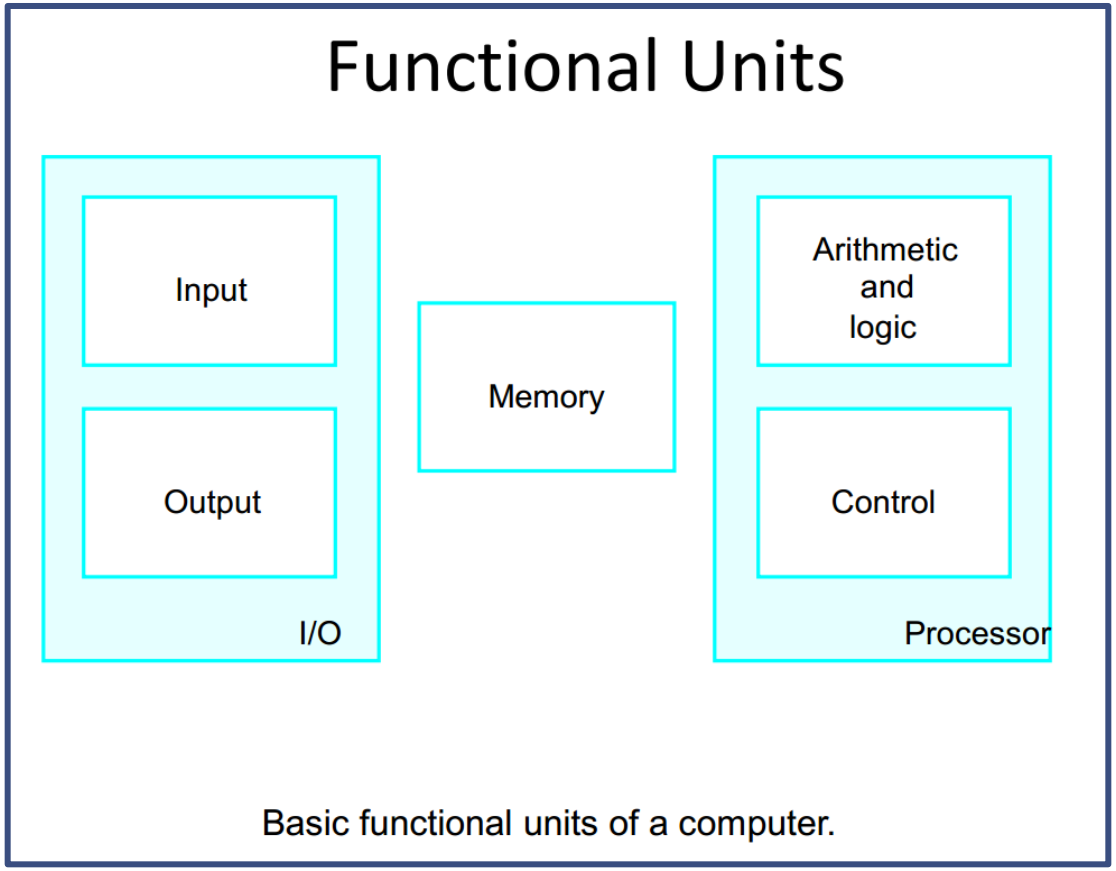
Structure is the way in which components relate to each other

Function is the operation of individual components as part of the structure

FUNCTION

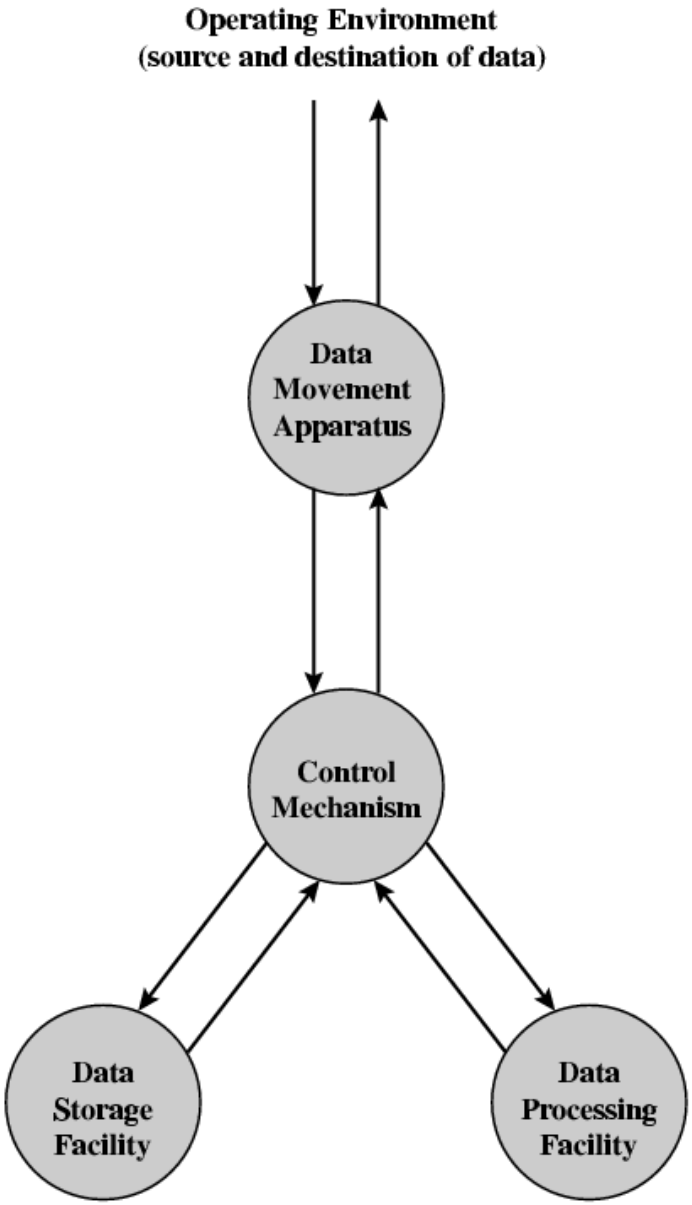
All computer functions are:

- Data processing
- Data storage
- Data movement
- Control

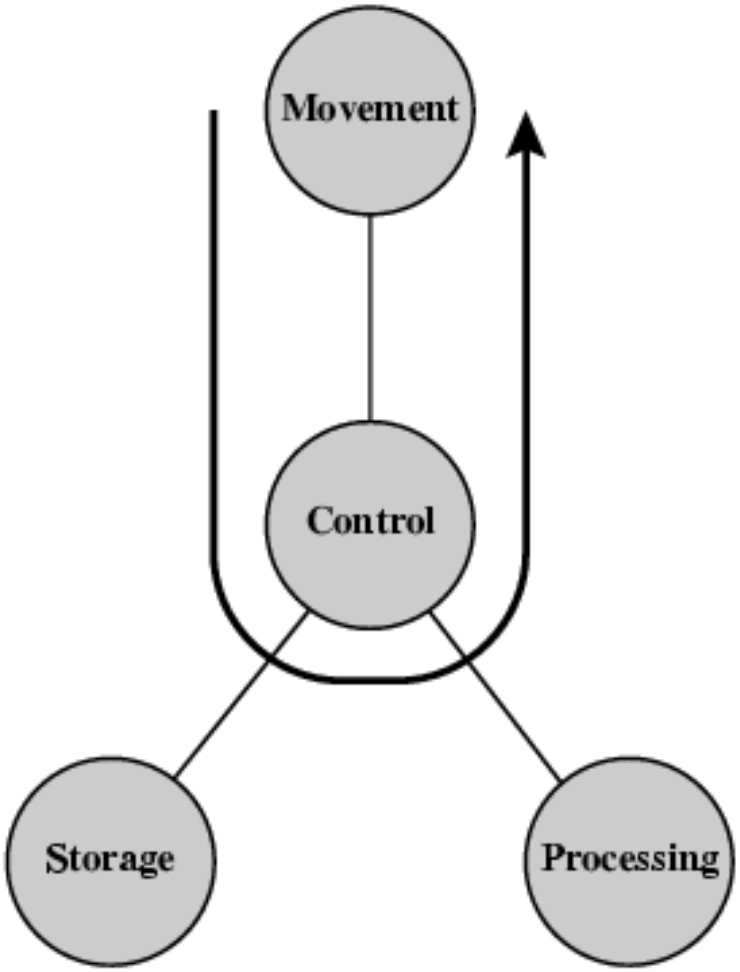


Basic functional units of a computer.

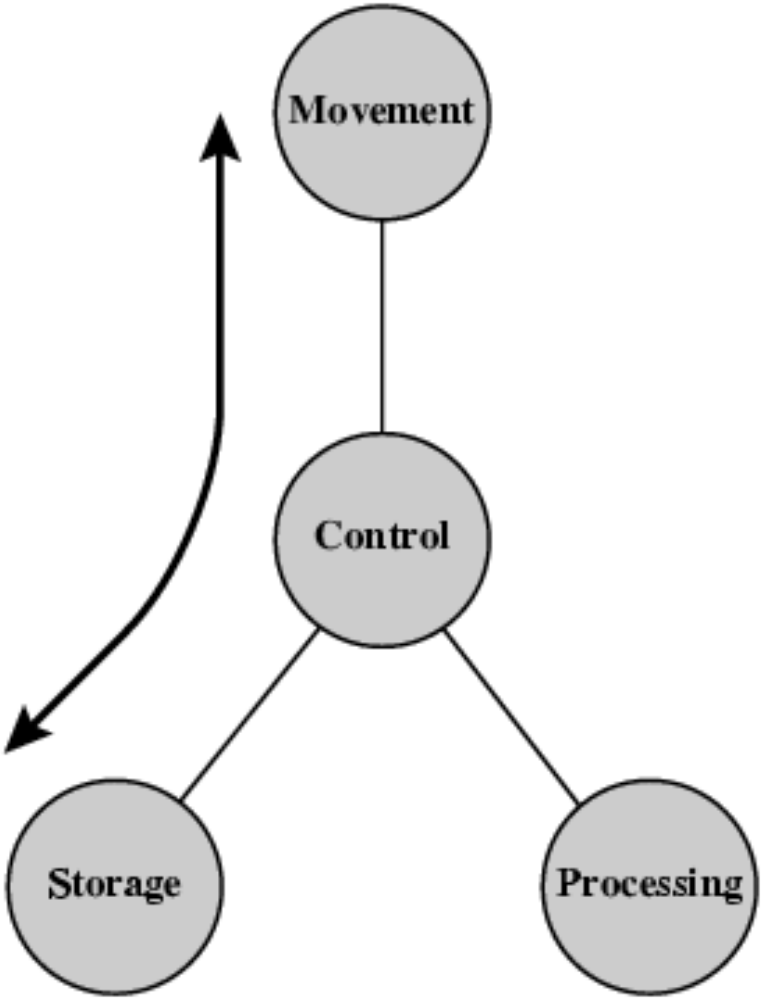
FUNCTIONAL VIEW



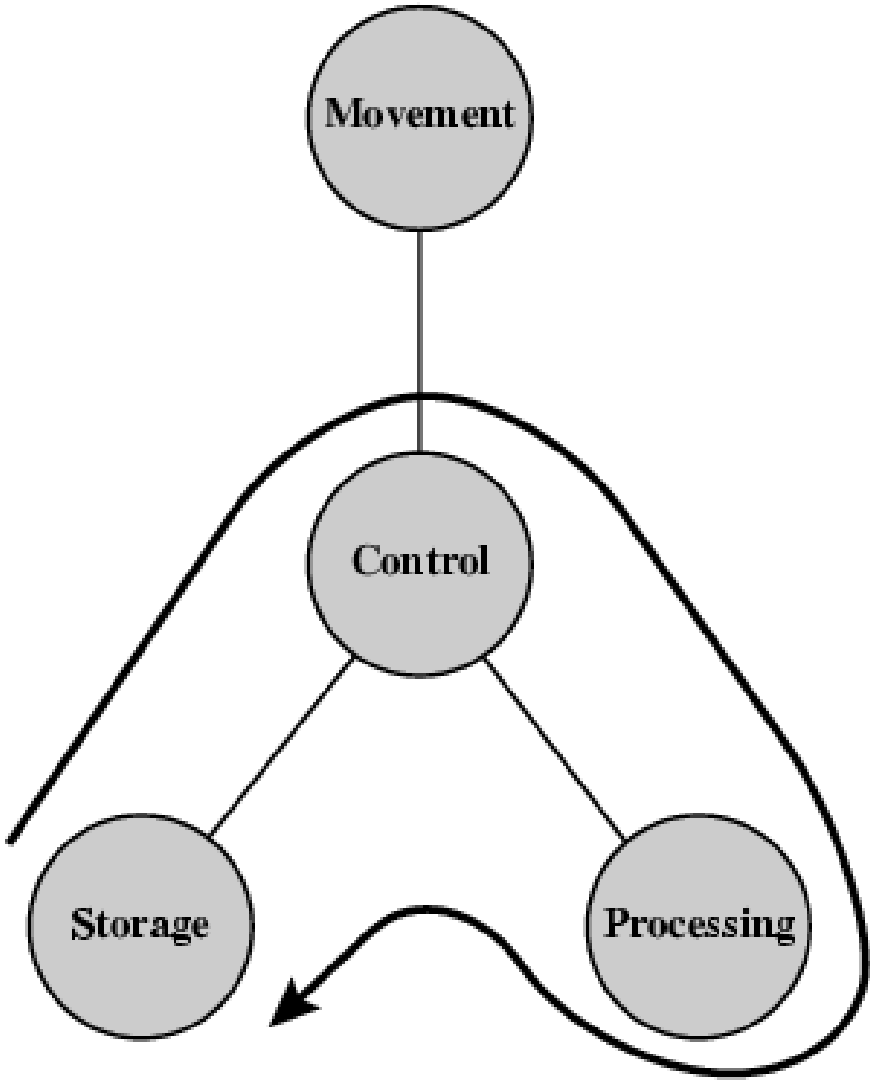
OPERATIONS
(1) DATA MOVEMENT



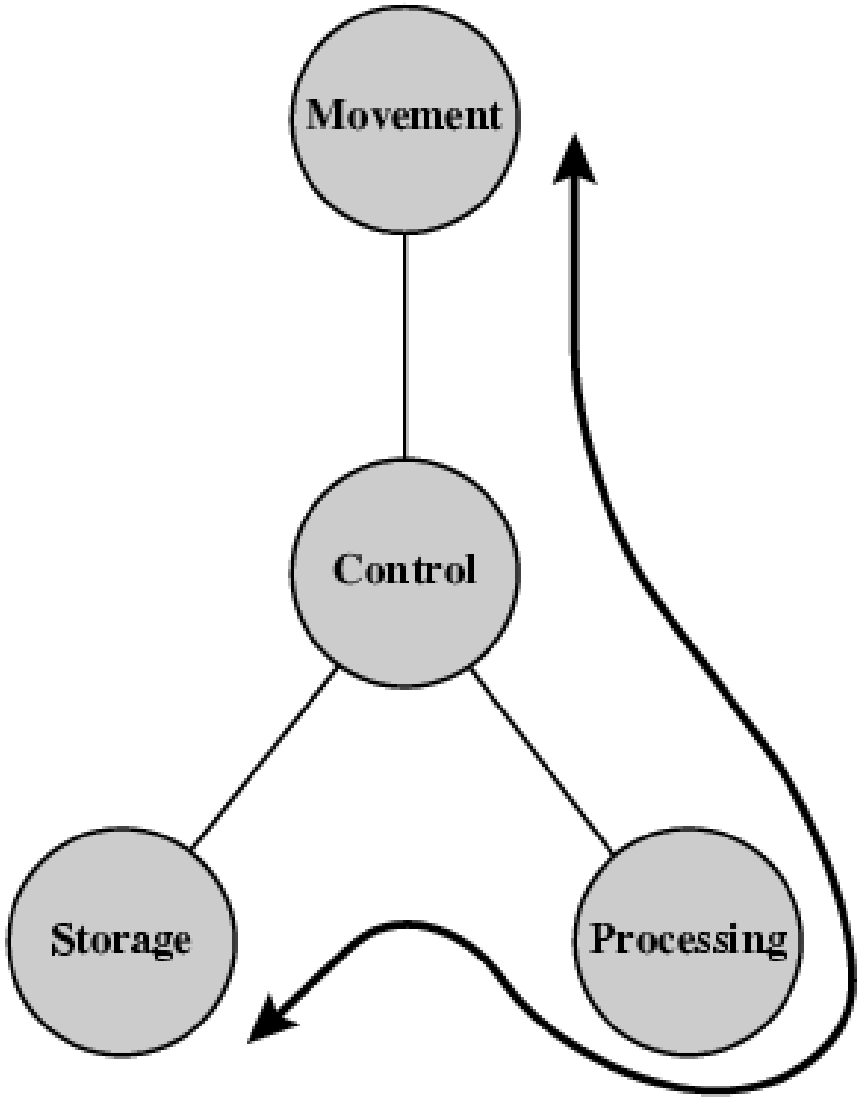
OPERATIONS
(2) STORAGE



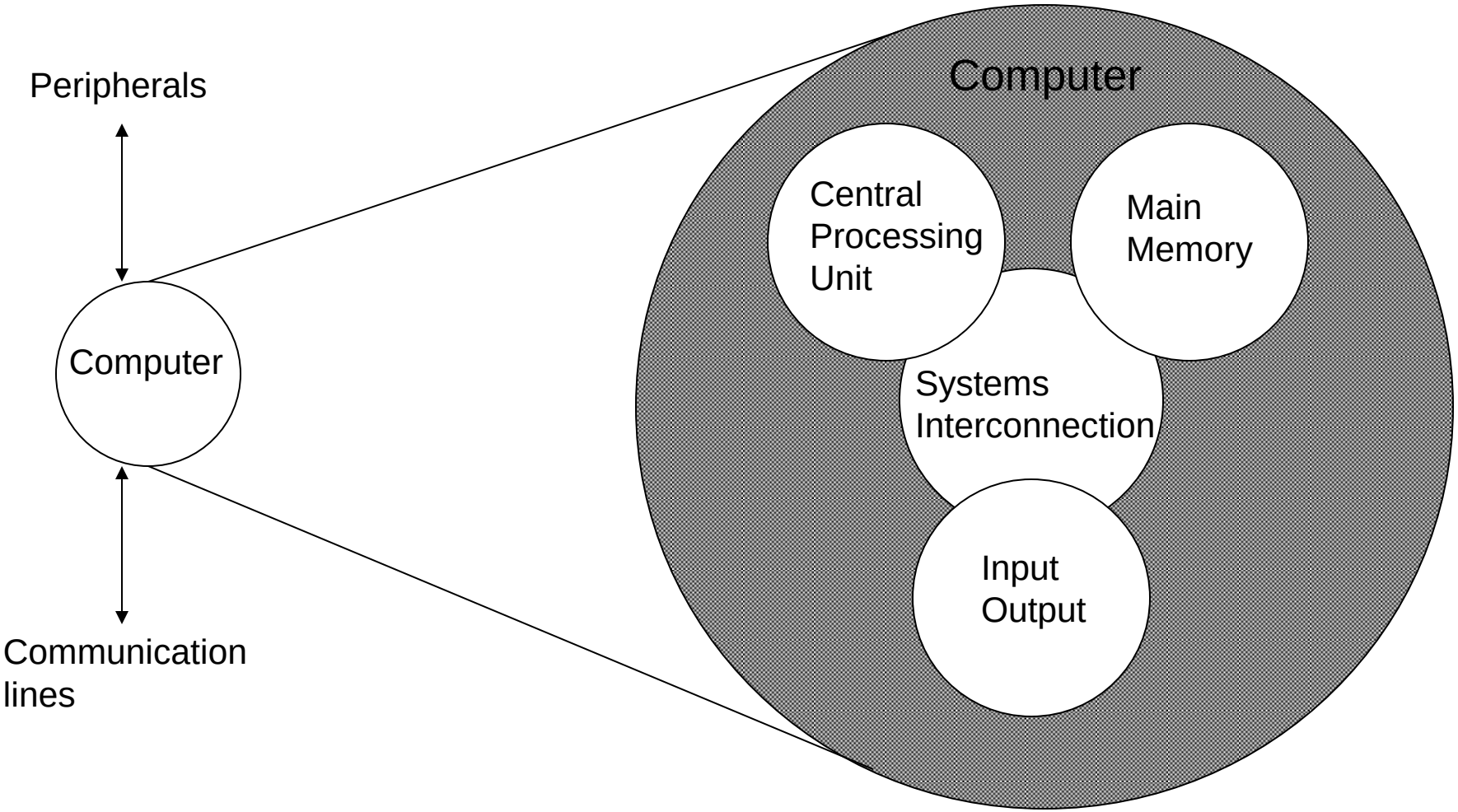
OPERATIONS
(3) PROCESSING FROM/TO STORAGE



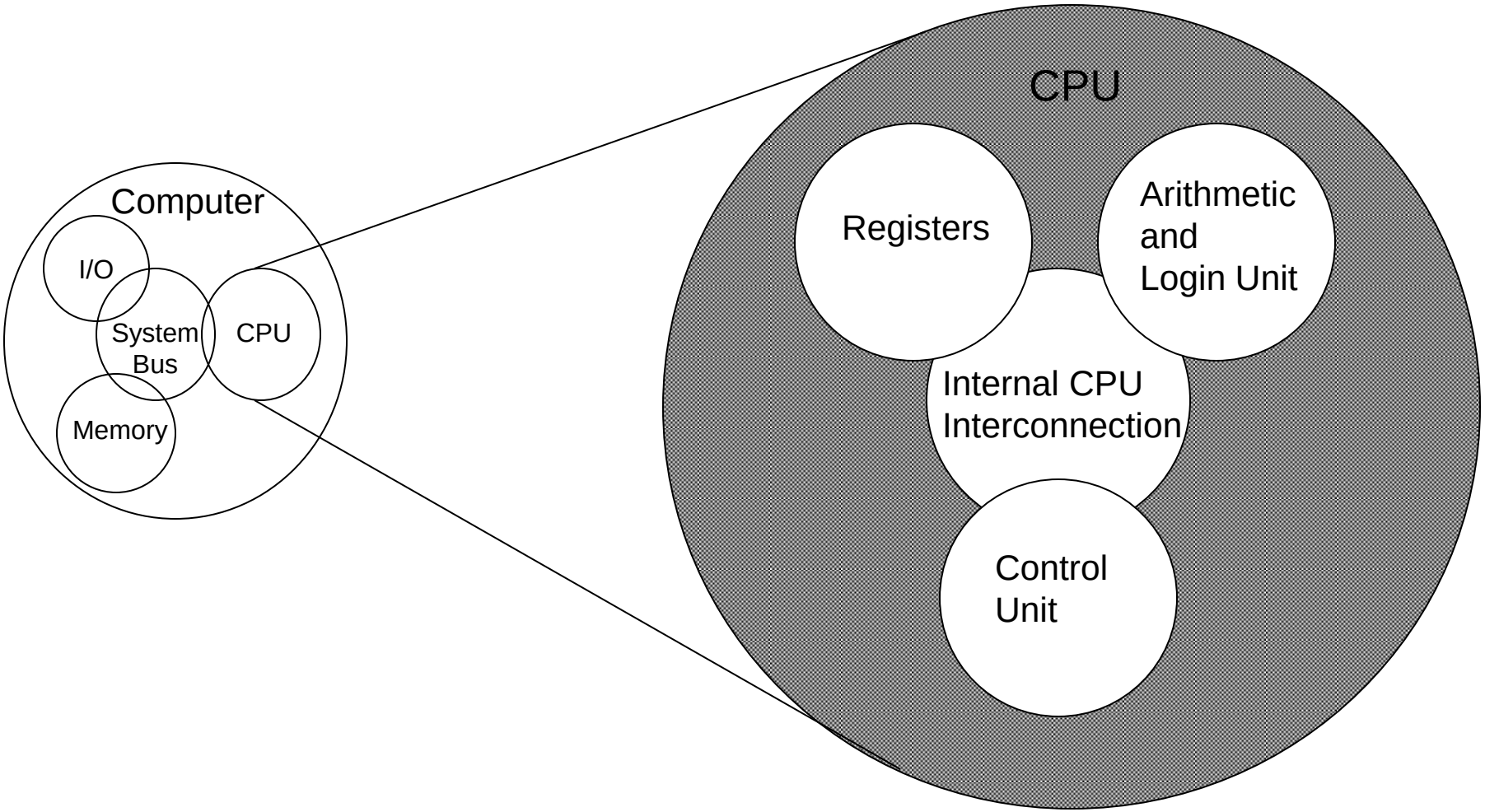
OPERATIONS
(4) PROCESSING FROM STORAGE TO I/O



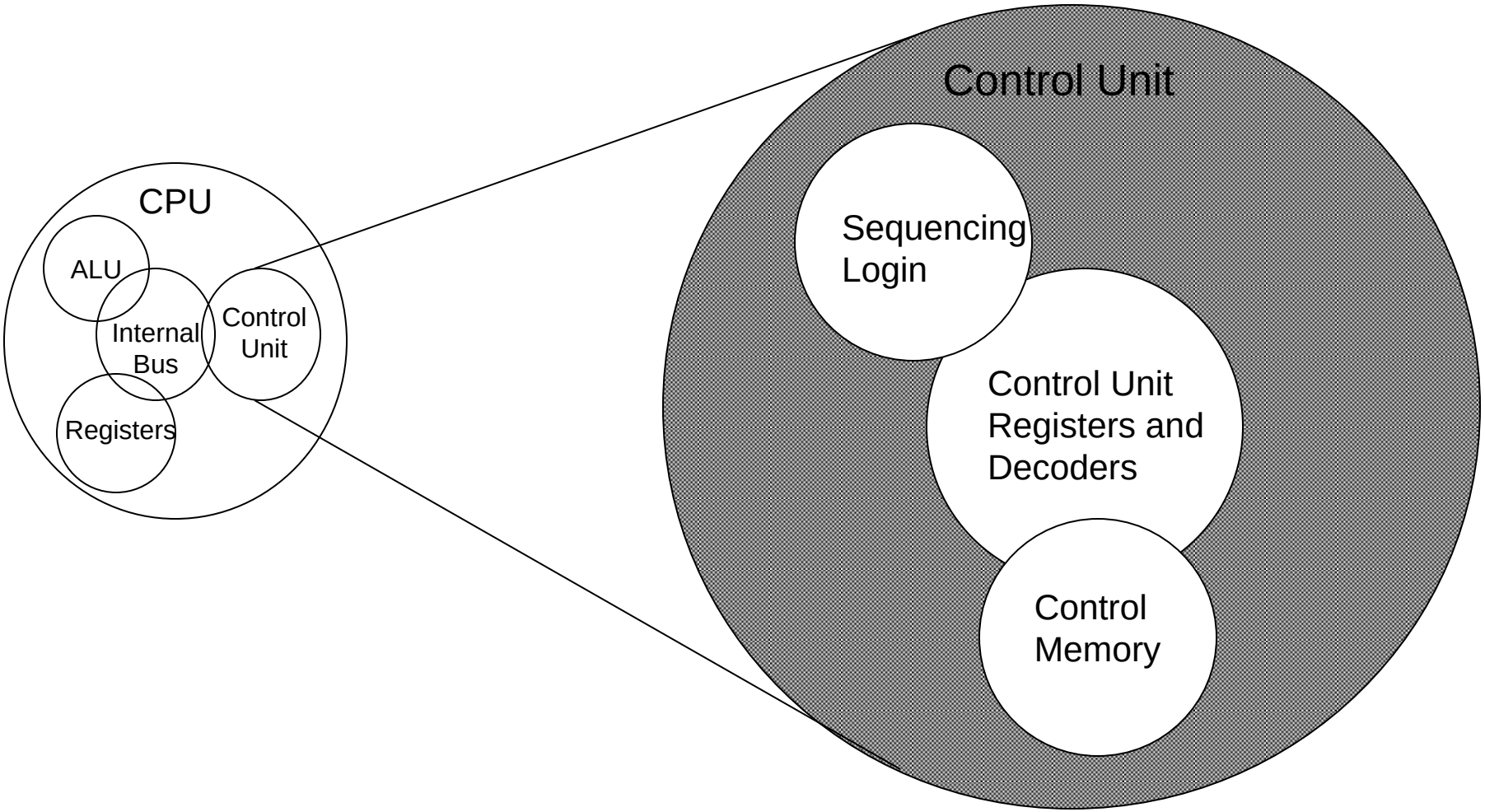
STRUCTURE - TOP LEVEL



STRUCTURE - THE CPU



STRUCTURE - THE CONTROL UNIT

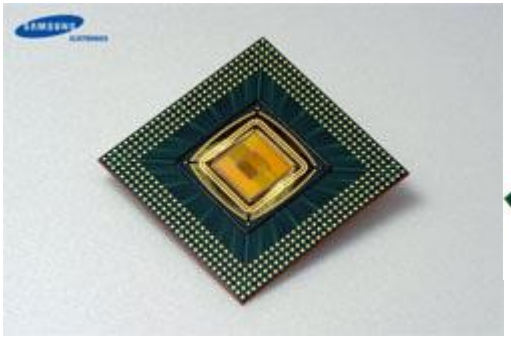


MAJOR COMPONENTS OF A COMPUTER

Central Processing Unit (CPU)

Random Access Memory (RAM)

Hard Drive / Disk



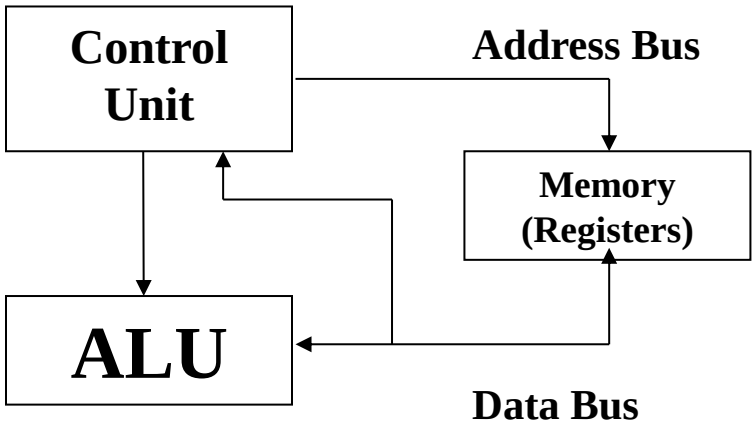
COMPUTER MEMORY

- **Memory ~ RAM**
- **Looks like a table**
- **Address and Data**
- **Address is the location**
- **Data is the actual value**
- **Memory stores both data and assembly instructions**

Address	Data
0	36
1	3765
2	786
3	356
4	252
5	67980
6	2355
7	4234
8	3466

CENTRAL PROCESSING UNIT (CPU)

- **Also called the "chip" or "processor"**
- **The brain of the computer**
- **Major components:**
  - Arithmetic Logic Unit (ALU)
    - calculator
  - Control unit
    - controls the calculator
  - Memory (Registers)
  - Communication bus systems

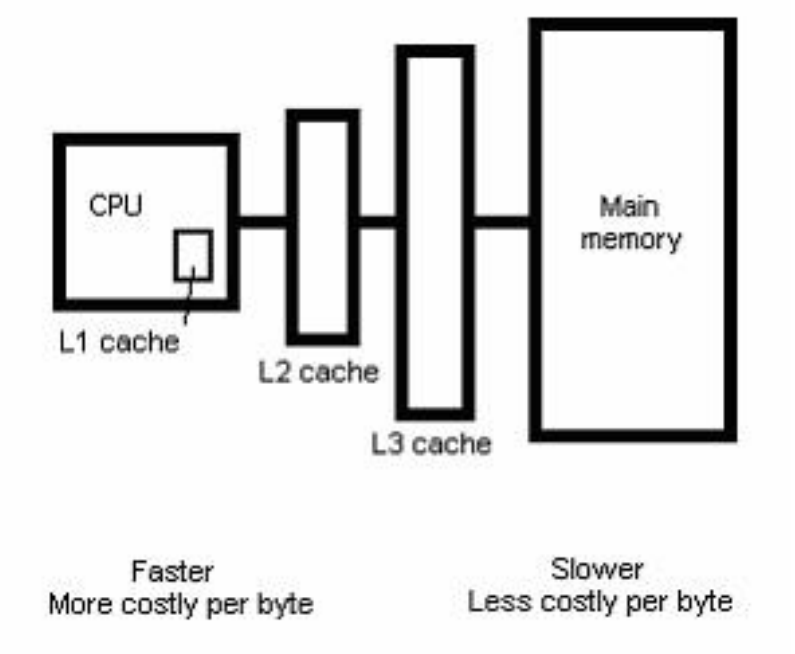


REGISTERS

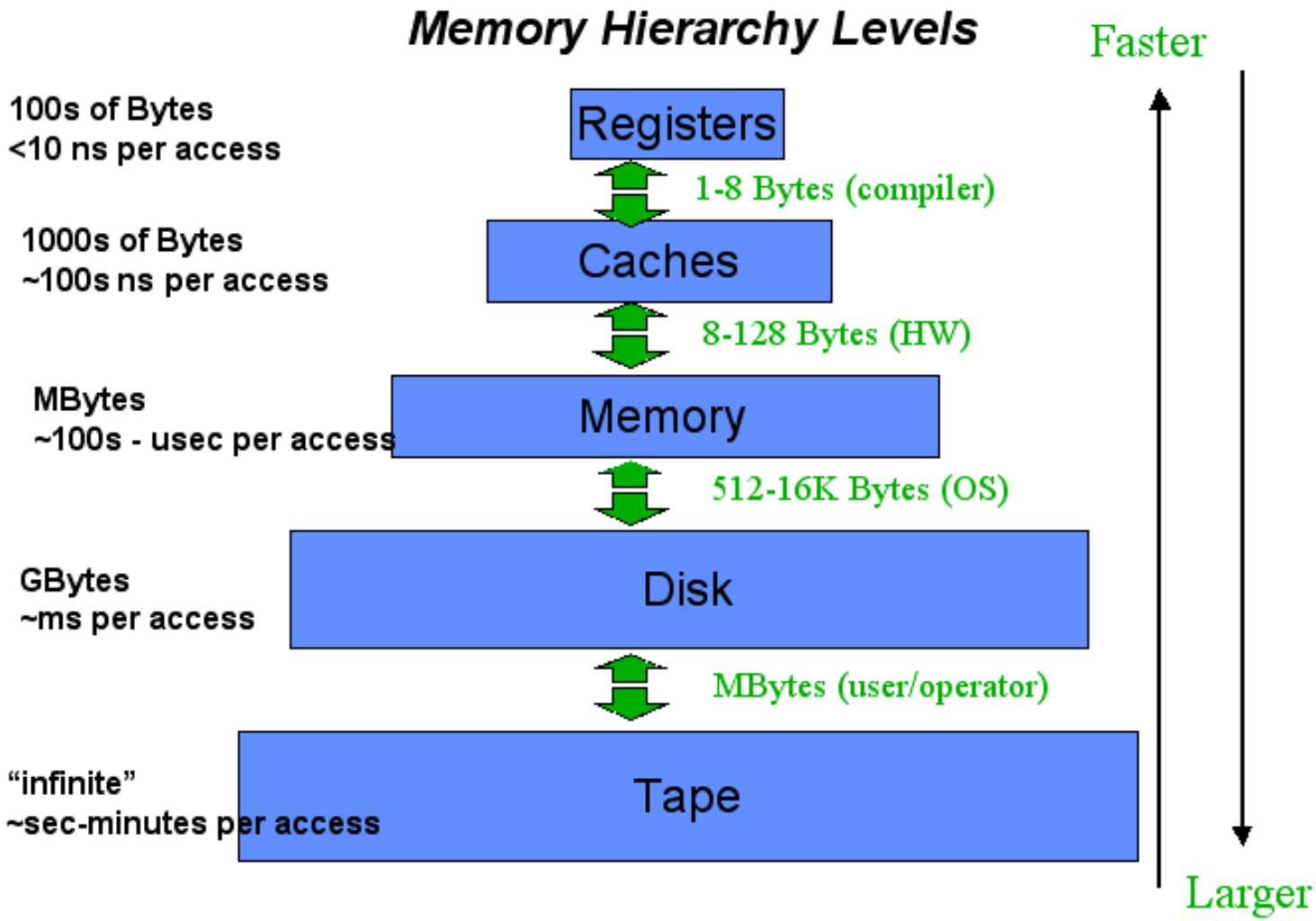
- **Temporary storage containers used inside the CPU**
- **Extremely fast**
- **Fixed size, usually multiples of 8-bits**
  - Also called a “word”
  - Example: 32-bit machines (4-byte words)

CACHE

- Slower than registers
- Faster than RAM
- Located in front of main RAM
- Different levels of cache
- Level1 (L1) and Level2 (L2)
- Size is usually around 1 MB



MEMORY HIERARCHY



HOMEWORK 1

1. Hierarchy of Memory system.
2. Cache memory.
3. RISC and CISC instruction sets
4. Parallel architectures.
5. Multicore Architectures
6. Multicore memory hierarchy
7. CPU Performance Improvement techniques
8. Micro-controllers for embedded applications
9. GPU Architectures
10. Von Neumann architecture
11. Harvard Architecture