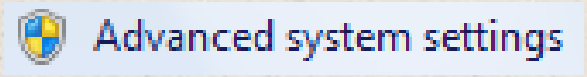
Introduction to Computer Organization and Architecture (COA)

Explore Hardware
Do it Yourself

- Right click the Computer item in the Start Menu
- Choose Properties
- You can see information about the CPU, Ram capacity, OS
- Choose the item 

- Choose the tag **Hardware** in the **System Properties** window
- Click the button **Device Manager**
- Expand the item **Processors** in the Device Manager window you can see information about processors in your computer

Explore Hardware
Do it Yourself

- Type **Ctrl + Alt + Delete**
- Choose **Start Task Manager**
- In the **Windows Task Manager** window,
  - Choose the tab **Applications**, count number of running applications
  - Choose the tab **Processes**
  - Click the button **Show processes from all users** at the bottom of the window, count number of running processes.
- You knew number of processors in your computer and number of running processes.
  - In average, how many processes are executed by one processor?
  - How some processes can run on one processor?

Why should COA be studied? Course Objectives

- Important questions:
  - How are computers organized?
  - How are computers made?
  - How are combinational circuits made?
  - How may we understand the way computers work?
  - How can computers allow many programs running concurrently?
- What are answers for above questions?

Course Resource

- Book: William Stallings, 2012, Computer Organization and Architecture: Design for Performance, 9th Edition, Prentice Hall.
- Tool: MASM32 SDK version 11(masm32v11r.zip), MASM64

Free Download Link:

http://www.masm32.com/

https://www.microsoft.com/en-us/download/details.aspx?id=12654

http://www.windows8downloads.com/win8-masm-64.html

MASM 64(Important): Make sure you have Visual C++ 2005 Express Edition installed on your computer. This is a prerequisite for the installation of this package. It will not install otherwise.

Course Description

- Chapter 1: Introduction
- Chapter 2: Computer Evolution and Performance"
- Chapter 3: A Top-Level View of Computer Function and Interconnection
- Memories
  - Chapter 4: Cache Memory
  - Chapter 5: Internal Memory
  - Chapter 6: External Memory

Course Description

- Chapter 7: Input/Output
- Chapter 8: Operating System Support
- Chapter 11: Digital Logic
- Instruction Set of CPU
  - Chapter 12: Instruction Sets: Characteristics and Functions
  - Chapter 13: Instruction Sets: Addressing Modes and Formats, Assembly Language

Course Description

- CPUs
  - Chapter 14: Processor Structure and Function
  - Chapter 15: Reduced Instruction Set Computers
  - Chapter 16: Instruction-Level Parallelism and Superscalar Processors
  - Chapter 17: Parallel Processing
  - Chapter 18: Multicore Computers

Course plan

- See it on CMS

Course Rules

- **How to conduct**
  - Prepare contents of the next session at home
  - Following lessons in classrooms
  - Completing chapter assessment in time and Quizzes (via CMS)
- **Communication**
  - Class
  - Interchange by FU-HCM CMS, Forum
  - Discussing actively in your teams and in classrooms
  - Free to question and answer
- **Others**
  - Off phone/ No game, no chat in class
  - Use laptops under teacher’s instruction

Evaluation Strategy

- Must attend more than 80% of contact hours (if not, not allow to take exam).
- Evaluating
  - 4 Exercises (E) 30 %
  - 2 Assignment (A) 30% (Assembly programs)
  - Final Exam (FE) 40 %
- Total score=30%(E)+30%(A)+40% (FE)
- Pass: All on-going assessment > 0 and Total score ≥ 5 and Final Examination ≥ 4 (of 10)
- Retake only the Final Exam when not passed

How to study?

- This course is complex knowledge (however, it's attractive and exciting), so you need to keep tight grip on it
  - Read
    - On the books to get the general concept
    - Reference, study, collection from anywhere else (internet, your classmate, forum …)
  - Attend lectures
    - Listens, understand, then make your own notes
    - Give your explanation about some topic in lectures
    - Ask questions
    - Practice all the exercises, demo to make your sense
  - After classes
    - Discuss your classmate in directly, on forum
    - Do the lab, assignments to submit via CMS, and do more exercises
    - Build your teams in yourselves to support together in studying

Academic Policy

- Cheating, plagiarism and breach of copyright are serious offenses under this Policy.
  - Cheating
    - Cheating during a test or exam is construed as talking, peeking at another student’s paper or any other clandestine method of transmitting information.
  - Plagiarism
    - Plagiarism is using the work of others without citing it; that is, holding the work of others out as your own work.
  - Breach of Copyright
    - If you photocopy a textbook without the copyright holder's permission, you violate copyright law.

Enjoy the Course

- Be enthusiastic about the material because it is interesting, useful and an important part of your training as an IT engineer.
- We will do our best but we need your help.
- So let’s all have fun together with COA!!!

Chapter 1: Introduction

William Stallings, Computer Organization and Architecture. 9th Edition

Objectives

- Why should we study this chapter?
  - Distinguishing architecture and organization
  - What is a hierachical system?
  - What are basic computer functions?
  - What are main structural components of the computer?

System: an assemblage of related parts in which there exists an operating mechanism.
Hierarchical system: a system in which each part have a level but without a like or equal

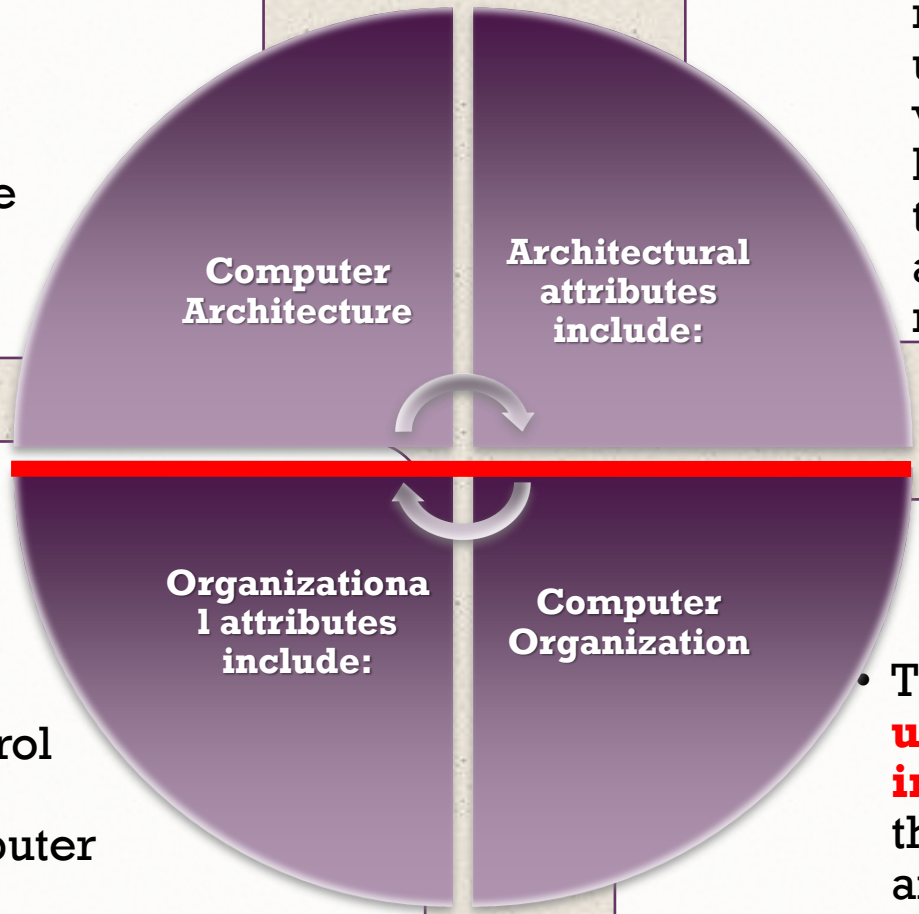
Contents

- 1.1- Organization and Architecture.
- 1.2- Structure and functions

1.1- Computer Organization and Architecture

- **Attributes** of a system visible to the programmer
- Have a direct impact(affect) on the logical execution of a program

Differences:



- **Instruction set**, number of bits used to represent various data types, I/O mechanisms, techniques for addressing memory

- **Hardware details** transparent to the programmer, control signals, interfaces between the computer and peripherals, memory technology used

- The **operational units and their interconnections** that realize the architectural specifications

Read by yourself: IBM System/370 Architecture

- IBM System/370 architecture
  - Was introduced in 1970
  - Included a number of models
  - Could upgrade to a more expensive, faster model **without** having to abandon (chối bỏ) original software
  - New models are introduced with improved technology, but retain the same architecture so that the customer's software investment is protected
  - Architecture has survived to this day as the architecture of IBM's mainframe product line
- More details: https://en.wikipedia.org/wiki/IBM_System/370

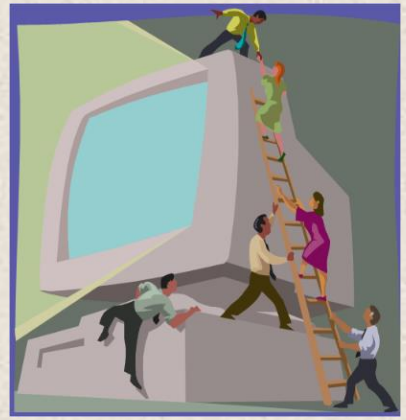
Building Block

- Who are interested in computers with architectral look?
- Who are interested in computers with organizational look?

1.2- Structure and Function

- Hierarchical system
  - Set of interrelated subsystems (modules)
- Hierarchical nature of complex systems is essential to both their design and their description
- Designer need only deal with a particular level of the system at a time
  - Concerned with structure and function at each level

- **Structure**
  - The way in which components relate to each other
- **Function**
  - The operation of individual components as part of the structure



Modularity is the degree to which system's components may be separated and recombined
Module is a specific discrete thing/named code/circuit which has it's own function to use

Functions

A computer can perform four basic functions:

- Data processing
- Data storage
- Data movement
- Control

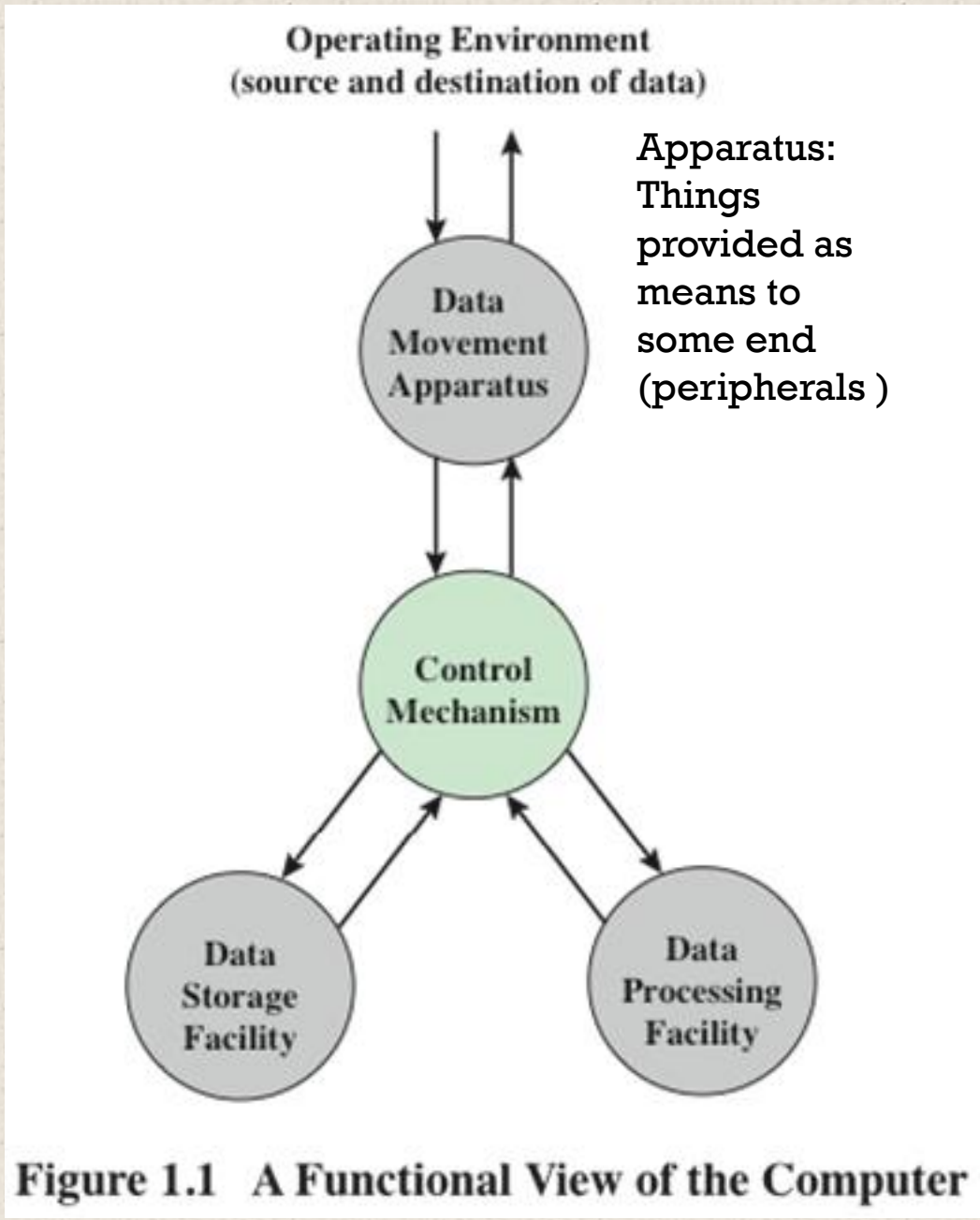


Figure 1.1 A Functional View of the Computer

Apparatus: Things provided as means to some end (peripherals)

Practical & Discussion

- Open the **Notepad** application
- Input text to this application
- Minimize the **Notepad** window and all opened windows to the task bar
- Type the keyboard the text: “I hate you”
- Give your explanation about things happened

Operations

(a)
Data movement

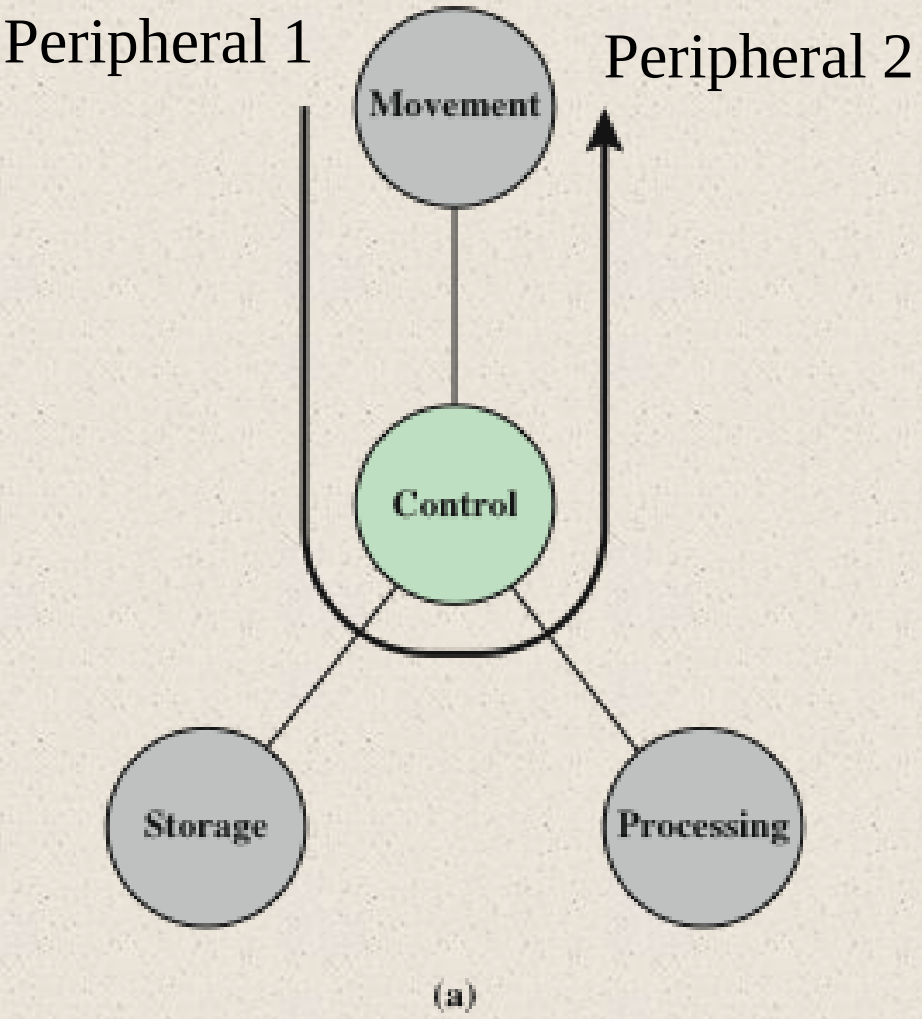
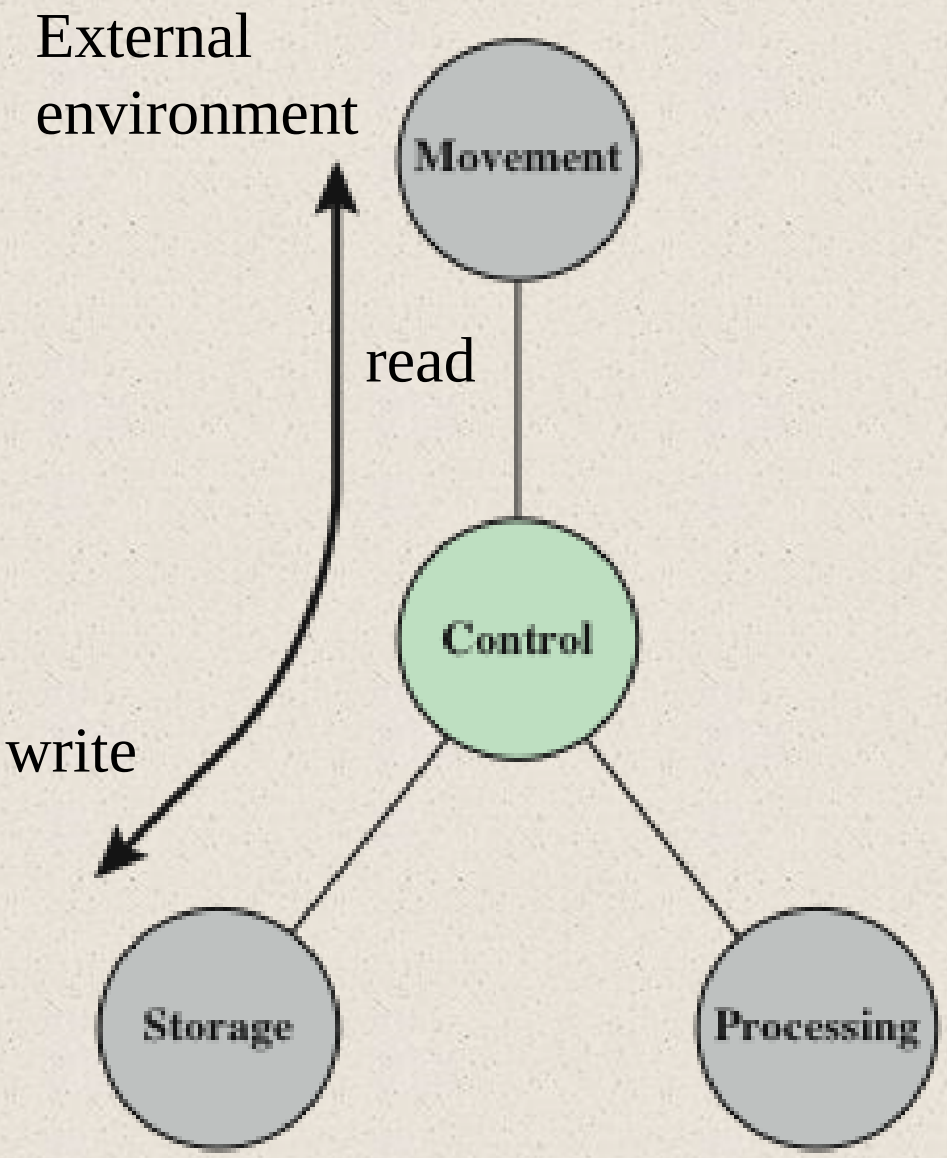


Figure 1.2 Possible Computer Operations

Operations

(b)
Data storage

Building block:
Why data from an external device can not move to storage automatically?



(b)

Figure 1.2 Possible Computer Operations

Operations

(c)
Data movement

Building block:
Open the Calculator to compute some numeric operations. Give your explanation

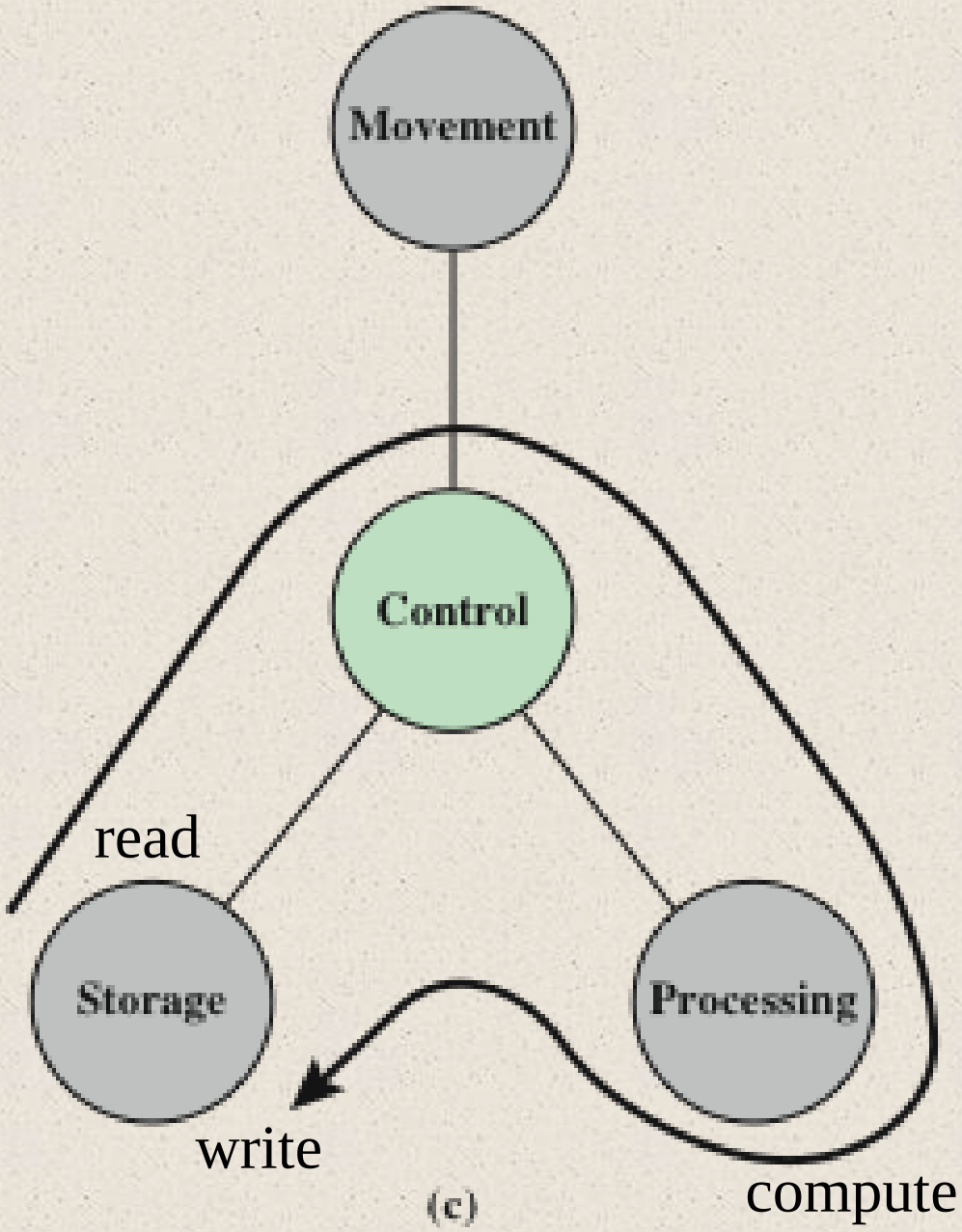
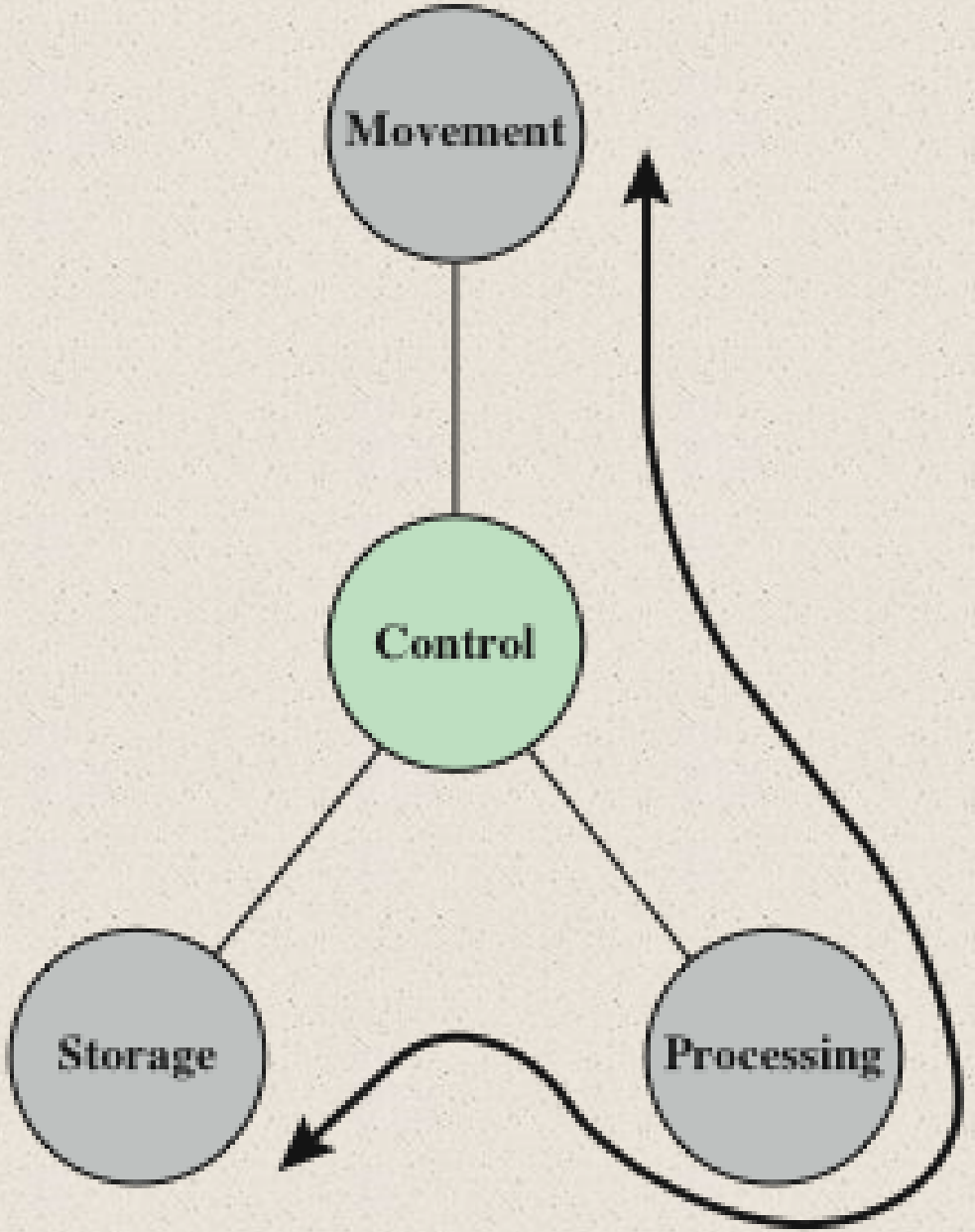


Figure 1.2 Possible Computer Operations

Operations

(d)
Control



(d)

Figure 1.2 Possible Computer Operations

The Computer

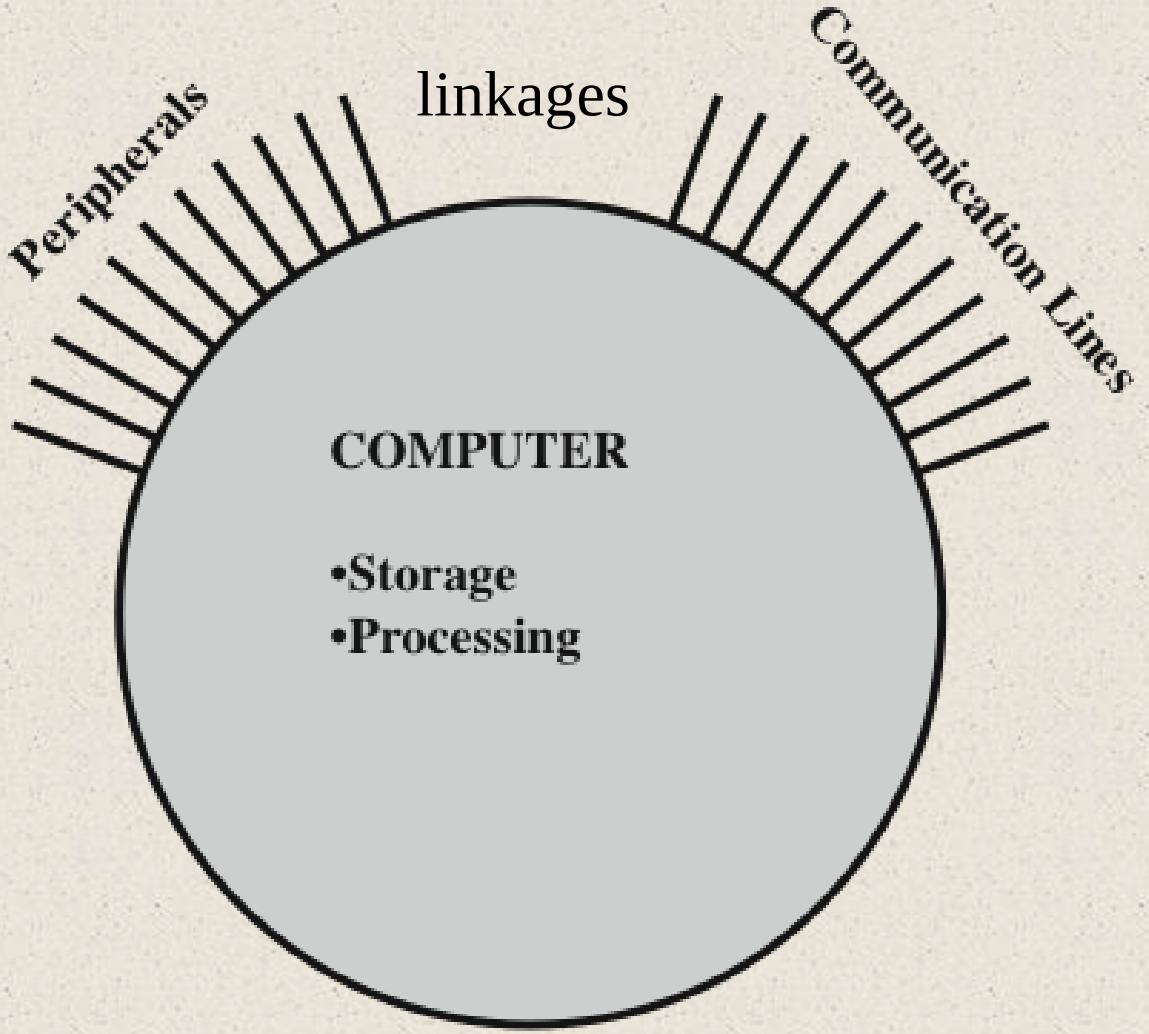
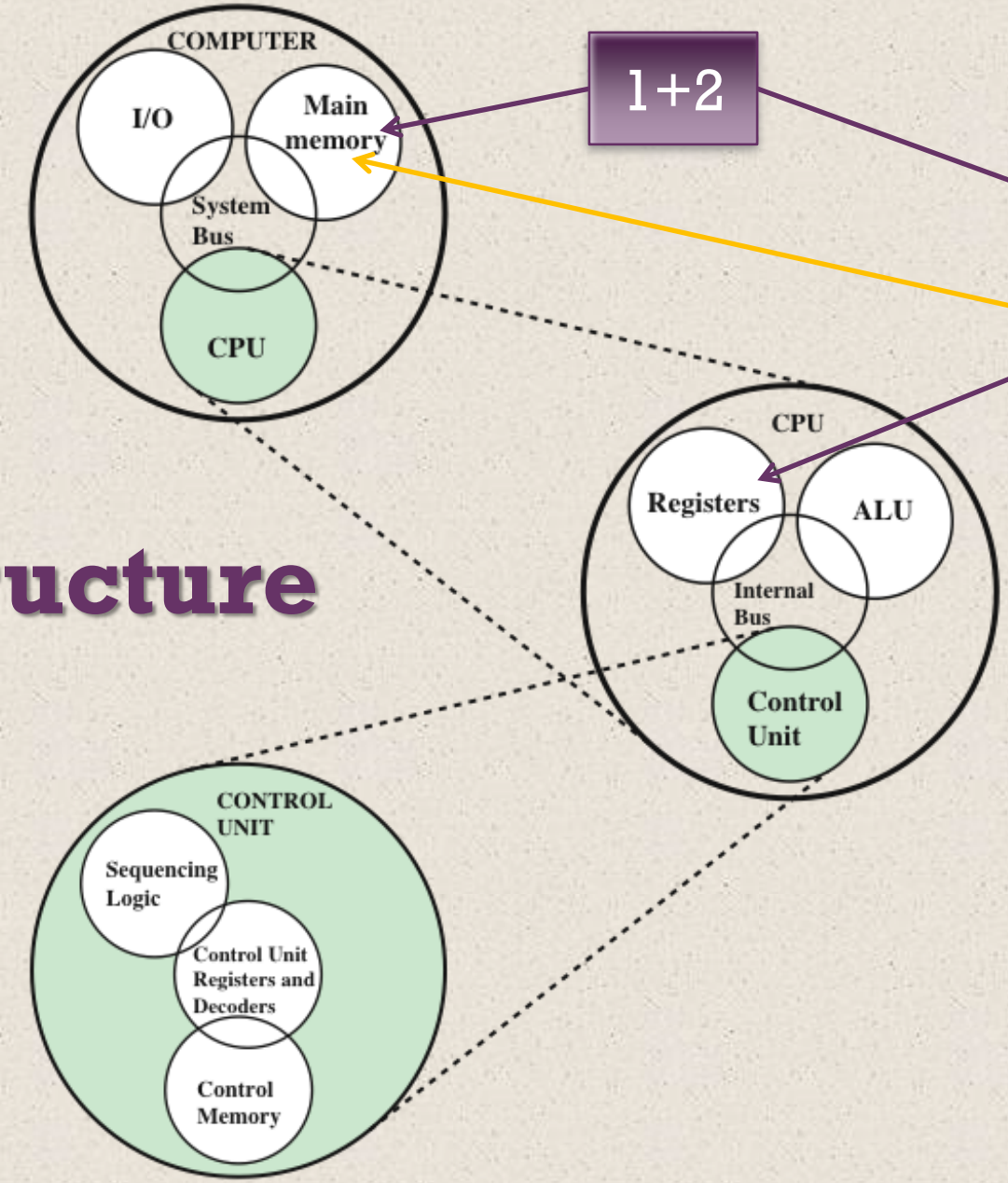
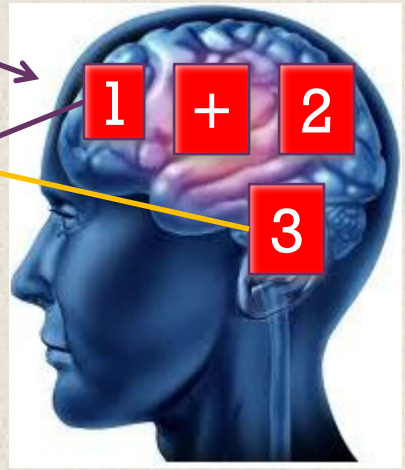


Figure 1.3 The Computer

Structure



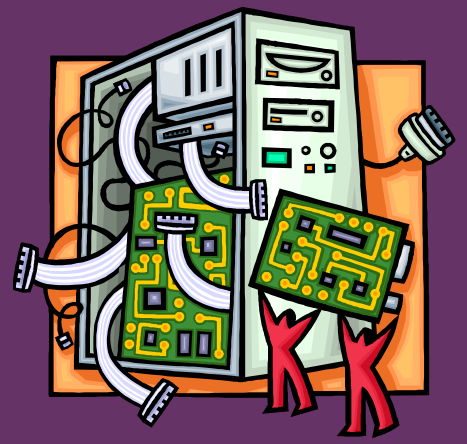
1+2



Try to verify

Figure 1.4 A Top-Down View of a Computer

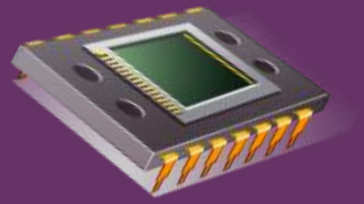
There are four main structural components of the computer:

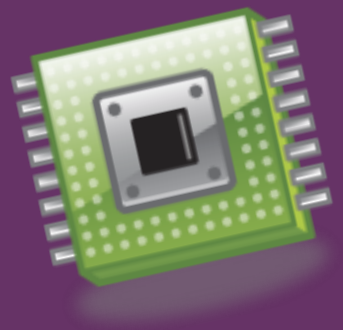


- **CPU** – controls the operation of the computer and performs its data processing functions
- **Main Memory** – stores data
- **I/O** – moves data between the computer and its external environment
- **System Interconnection** – some mechanism that provides for communication among CPU, main memory, and I/O

CPU

Major structural components:





- Control Unit
  - Controls the operation of the CPU and hence the computer
- Arithmetic and Logic Unit (ALU)
  - Performs the computer's data processing function
- Registers
  - Provide storage internal to the CPU
- CPU Interconnection
  - Some mechanism that provides for communication among the control unit, ALU, and registers

Exercises
(Write your answers to your notebook)

- 1.1 What, in general terms, is the distinction between computer organization and computer architecture?
- 1.2 What, in general terms, is the distinction between computer structure and computer function?
- 1.3 What are the four main functions of a computer?
- 1.4 List and briefly define the main structural components of a computer.
- 1.5 List and briefly define the main structural components of a processor.

Summary

Chapter 1

Introduction

- Computer Organization
- Computer Architecture
- Function
  - Data processing
  - Data storage
  - Data movement
  - Control
- Structure
  - CPU
  - Main memory
  - I/O
  - System interconnection
- CPU structural components
  - Control unit
  - ALU
  - Registers
  - CPU interconnection

Internet Resources - Web site for book

- http://WilliamStallings.com/COA/COA9e.html
  - Links to sites of interest
  - Links to sites for courses that use the book
  - Errata list for book
  - Information on other books by W. Stallings
- http://WilliamStallings.com/StudentSupport.html
  - Math
  - How-to
  - Research resources
  - Misc