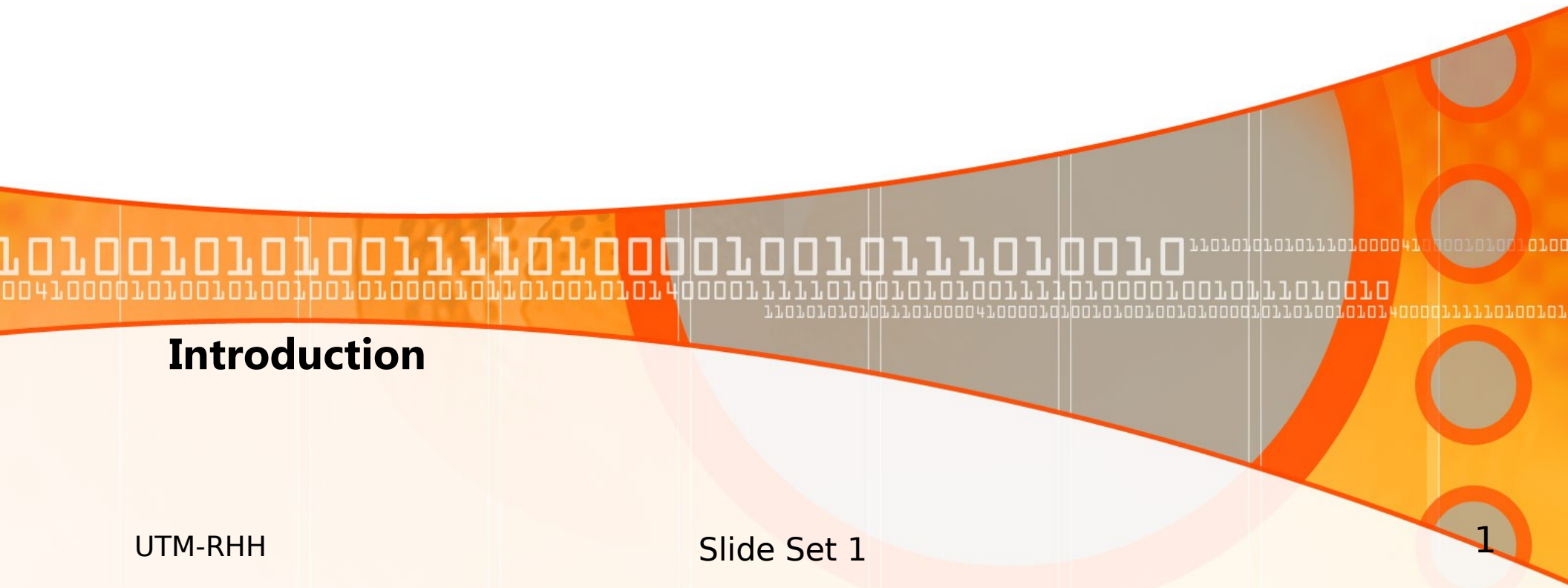
Computer Microprocessor Architecture & Programming HCA1109



Introduction

Architecture & Organization

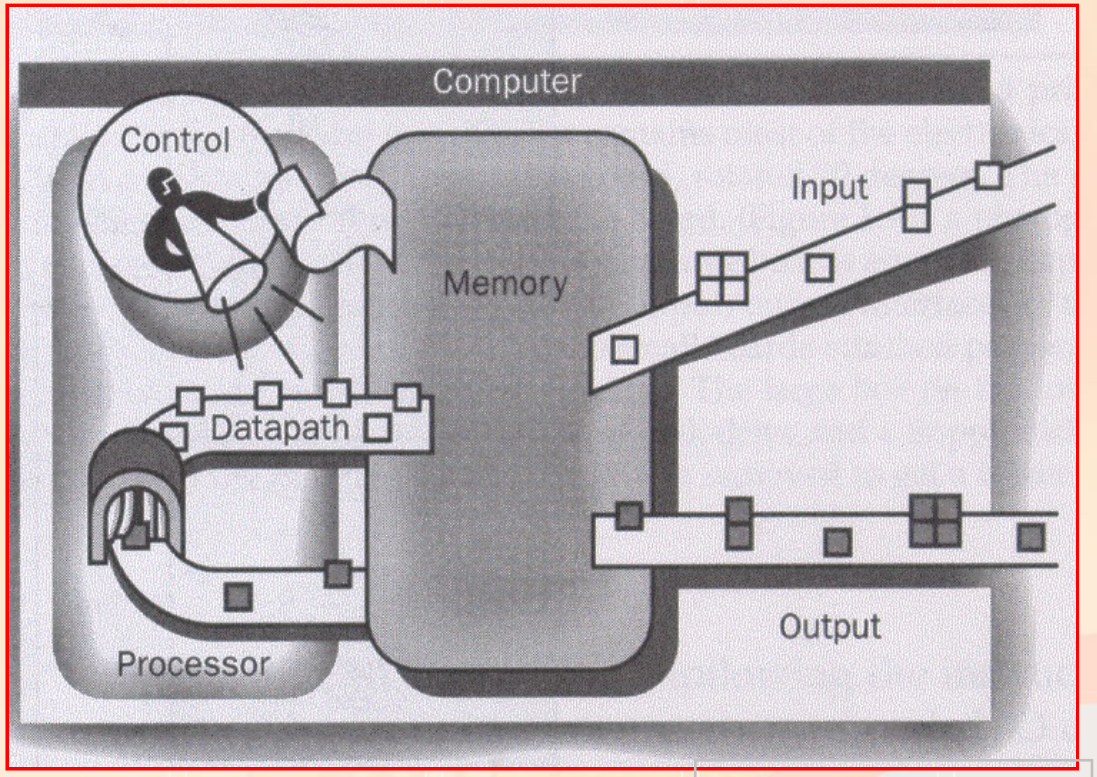
- Architecture is those attributes visible to the programmer
  - Instruction set, number of bits used for data representation, I/O mechanisms, addressing techniques.
  - e.g. Is there a multiply instruction?
  - All Intel x86 family share the same basic architecture
  - The IBM System 370 family share the same basic architecture
- Organization is how features are implemented
  - Control signals, interfaces, memory technology.
  - e.g. Is there a hardware multiply unit or is it done by repeated addition?
  - Organization differs between different versions

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

Various components of a computer

Components of a computer: Assembly Line

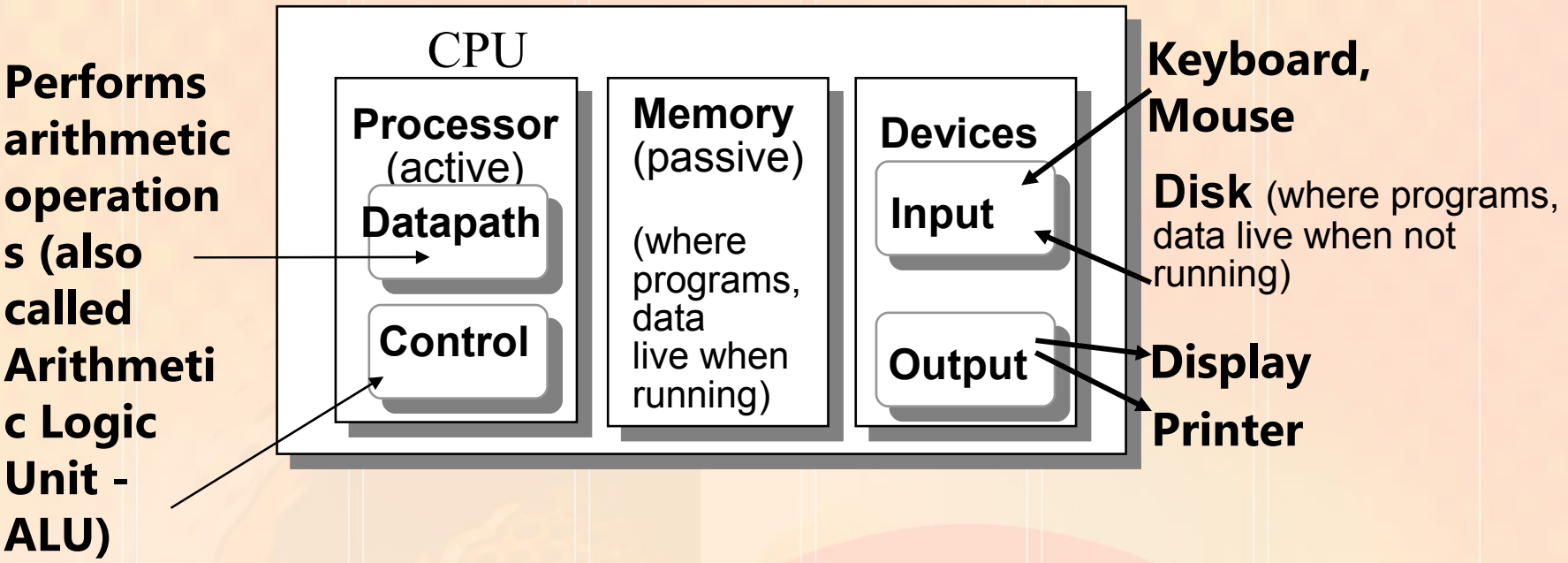


© above picture: P&H

The processor gets instruction and data from the memory. Input writes data to the memory and output reads data from the memory.

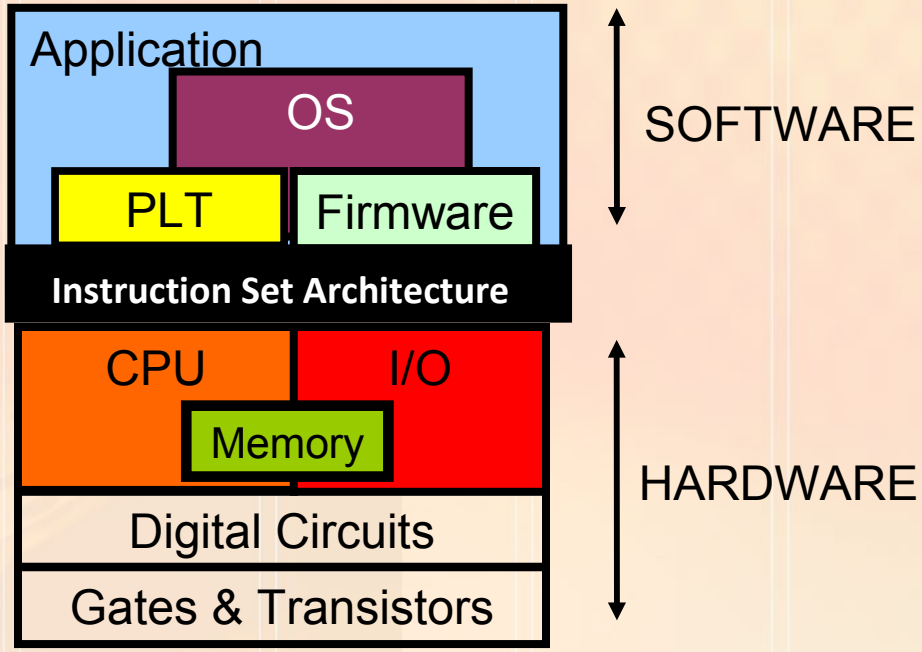
Control sends the signals that determine the operations of the datapath, memory, input and output

Anatomy: Components of any Computer



Tells the datapath, memory and I/O devices what to do according to the wishes of the program

Instruction Set Architecture: A critical Interface



- ISA represents the computer seen from the point of view of the programmer
- It insulates the software from the hardware

Types of Computers

- Supercomputers
- Mainframes
- Mini-computers
- Workstations
- Micro/Personal/Home computers

Speed

Cost

Complexity

History of Computers

- Abacus invented in Babylonia in 3000BC
- Adding machine by *Blaise Pascal* (1642)
- Difference engine and analytical engine by *Charles Babbage* (1842)
- IBM first electromechanical computer (using relays) designed by *Howard Aiken* (1937) was based on punched cards.
- Calculate table of mathematical functions

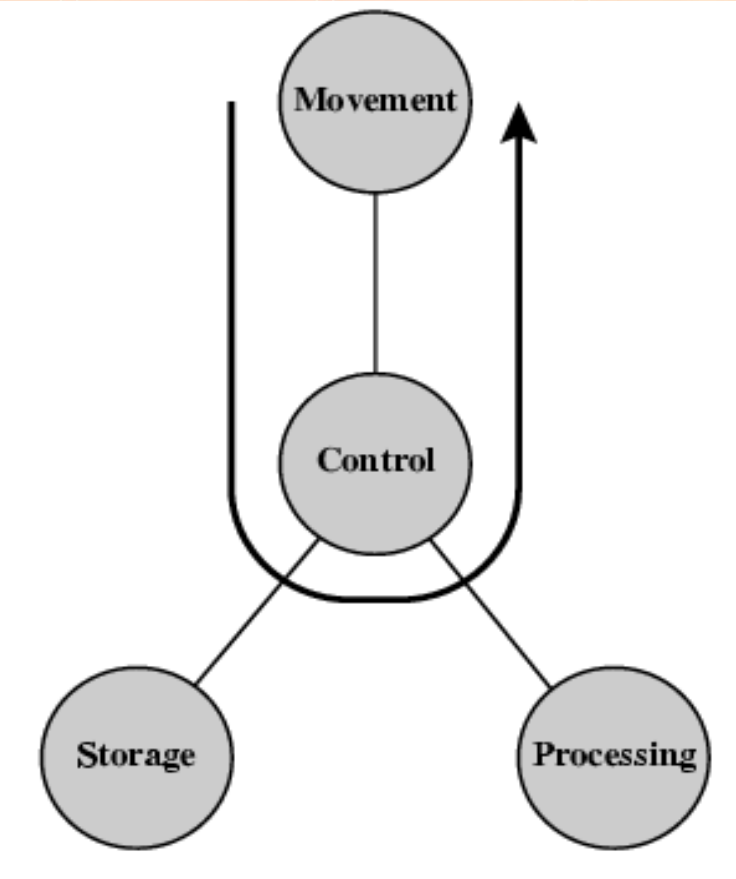
History of Computers

1st Generation Computers (1940s to early 1950s) based on vacuum tubes technology.
1943 – ENIAC: first fully electronic computer, designed by John Mauchly.
1944 – Mark I: Howard Aiken.
1946 – EDVAC: first stored program computer by Von Neumann.
2nd Generation Computers (late 50s to early 60s) based on transistors technology.
more reliable, less expensive, low heat dissipation. IBM 7000 series, DEC PDP-1.
3rd Generation Computers (late 60s to early 80s) based on Integrated Circuits (IC).
IBM 360 series, DEC PDP-8. IC – many transistors packed into single container, low prices, high packing density.

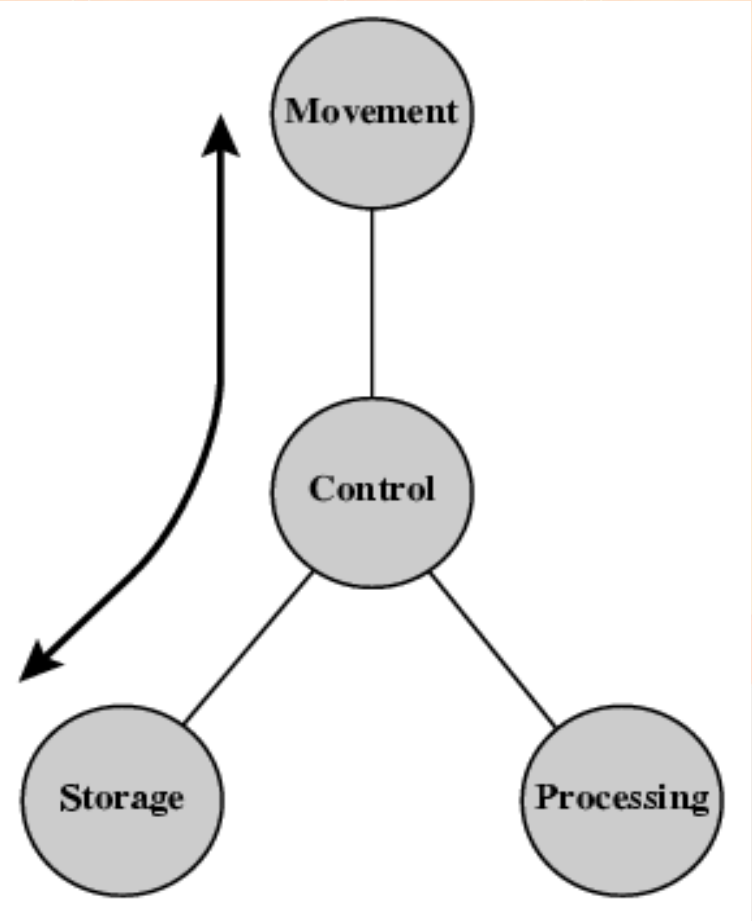
Functions

- All computer functions can be summarised as:
  - Data processing
  - Data storage
  - Data movement
  - Control

Operations: Data movement

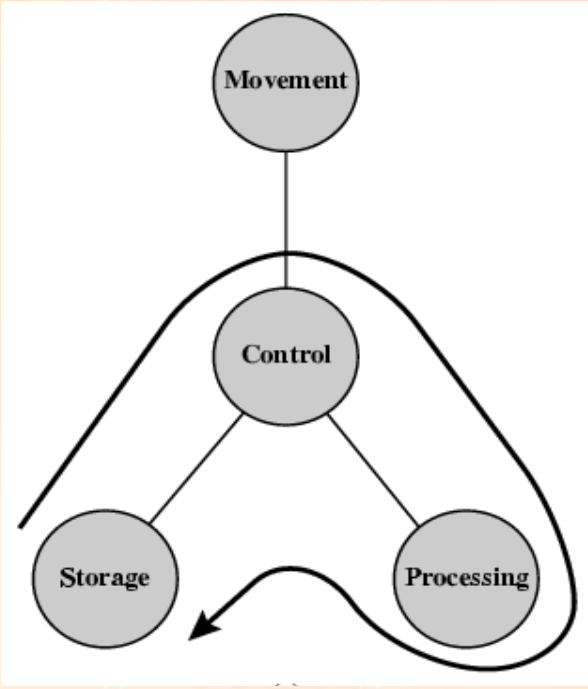


Operations: Storage

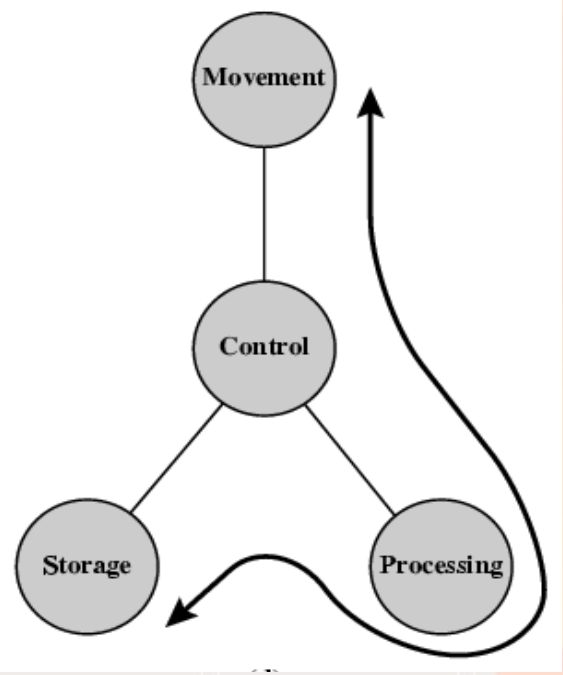


Operations:

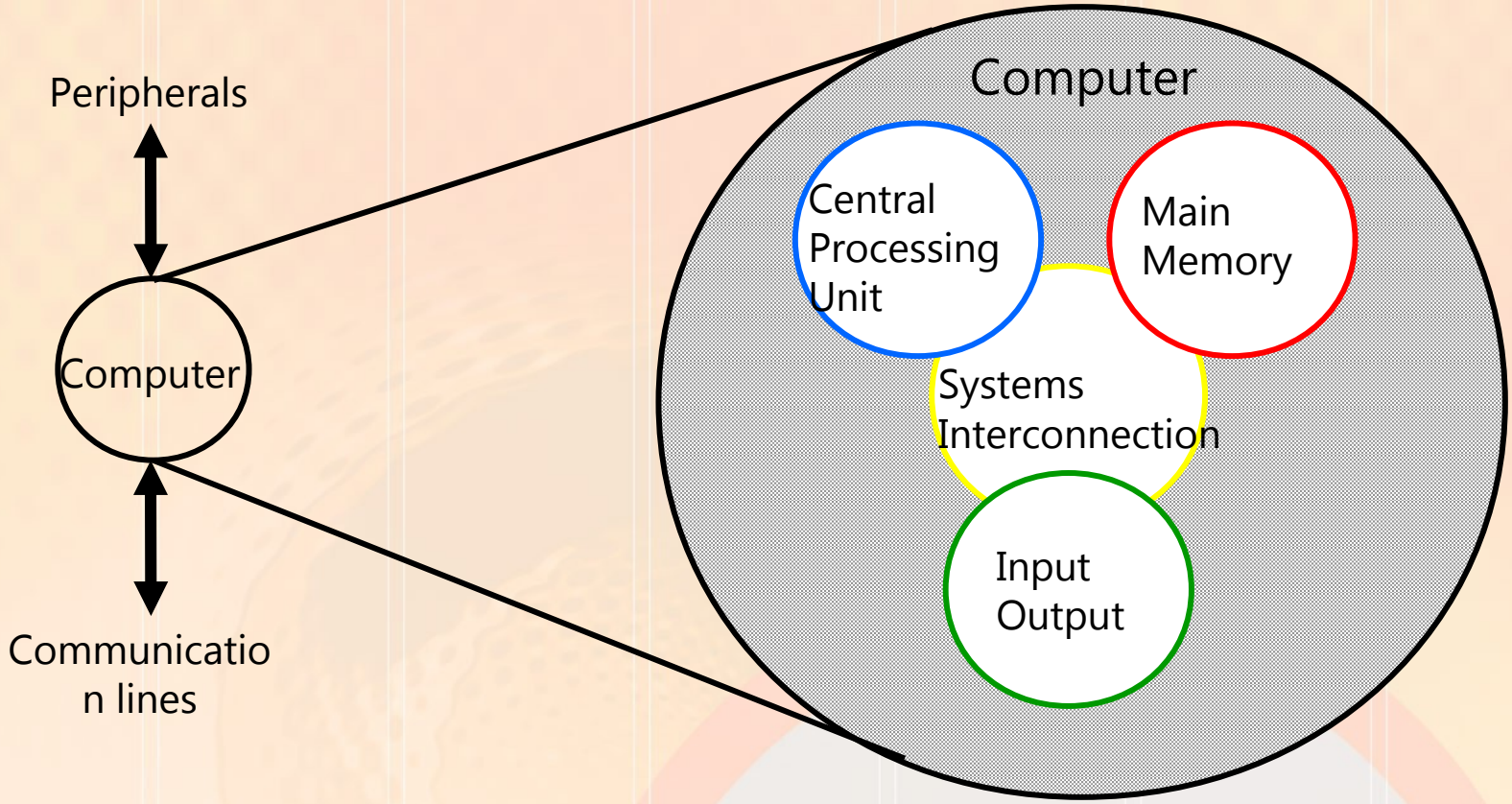
Processing from/to storage



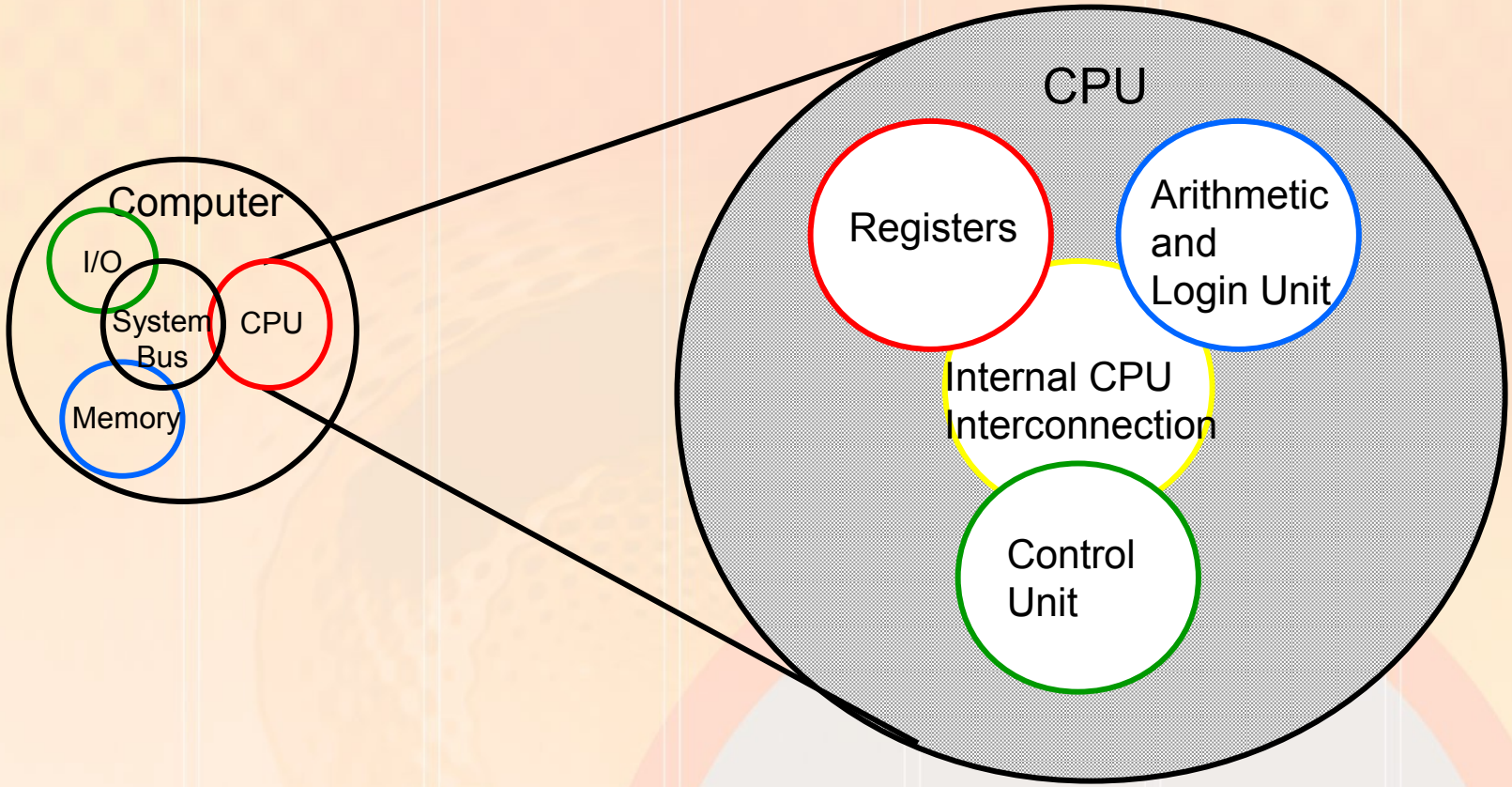
Processing from storage to I/O



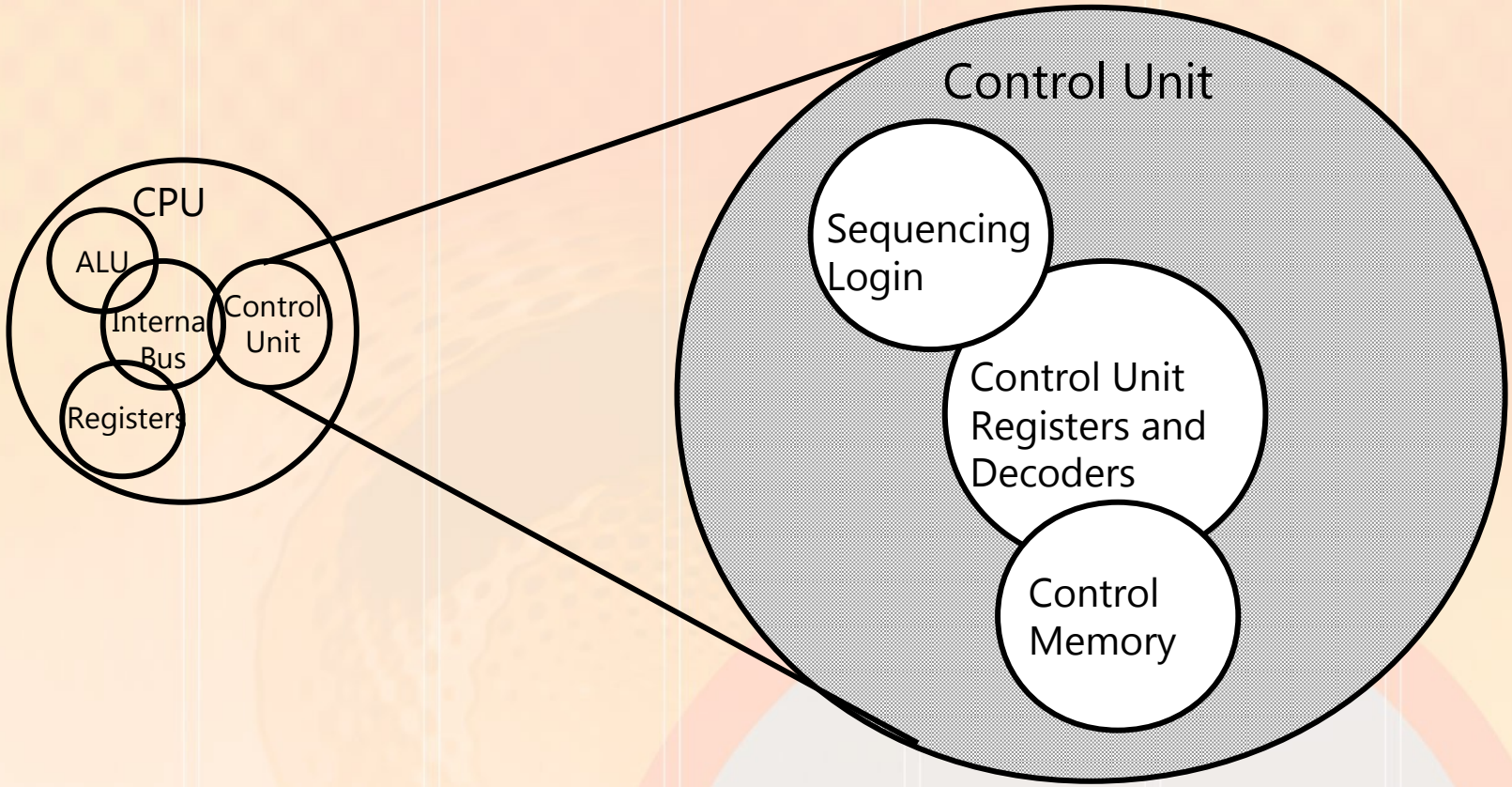
Structure - Top Level



Structure - The CPU



Structure - The Control Unit



Internet Resources- Web sites to look for

- WWW Computer Architecture Home Page
- CPU Info Center
- ACM Special Interest Group on Computer Architecture
- IEEE Technical Committee on Computer Architecture
- Intel Technology Journal
- Manufacturer's sites
  - Intel, AMD, Transmeta (acquired by NovaFora)