Course Details

CSE 259: Computer Architecture and Organization

3.00 Credit, 3 Hours/Week

Micro-computer Organization and Its Basic Components: Carry look ahead adders, Carry save adder, Multipliers (e.g. Booth's algorithm), Divider, Fixed and Floating point (IEEE754) number representations, Finite State Machine (FSM) representation. Basic Accumulator based CPU: Organization, Instruction set, Programming considerations, RISC and CISC Processors-Instruction Sets, Addressing modes. Introduction to the Basic MIPS: Instruction set. Fixed Point ALUs: Combinational and sequential ALUs, ALU expansion. Floating Point Arithmetic Circuits: Pipelined processing, Systolic arrays, Resolving structural, Data, Control and Name hazards, Analyzing processor performance, Memory mapping (e.g. RAM, cache), Non-blocking cache memories, Memory protection, Translation and Virtualization, Synchronization, Consistency and Coherence, Direct-mapped and Associative caches, Write-through and write-back caches, Pipelined caches, Analyzing memory performance. Processor Architecture: Superscalar execution, Out-of-order execution, Register renaming, Memory disambiguation, Branch prediction, Speculative execution, Multithreaded, VLIW and SIMD processors. Hardwired and Micro programmed Control Design. Buses, Bus arbitration, I/O control, Interrupts and Direct Memory Access (DMA), Virtual memory mapping and Addressing.

Reference Books

1. David A. Patterson, John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Morgan Kaufmann, 5th edition, 2013.
2. John L. Hennessy, David A. Patterson, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann, 5th edition, 2011.
3. William Stallings, *Computer Organization and Architecture*, Prentice Hall, 9th edition, 2012.
4. Douglas E. Comer, *Essentials of Computer Architecture*, Addison-Wesley, 1st edition, 2004.
5. John P. Hayes, *Computer Architecture*, McGraw-Hill International Educations, 1998.
6. V. Carl Hamacher, Safwat G. Zaky, Zvonko G. Vranesic, *Computer Organization*, McGraw-Hill Publication.

All the information of the PPTs (CSE 259) are collected from books, research articles, and online source.

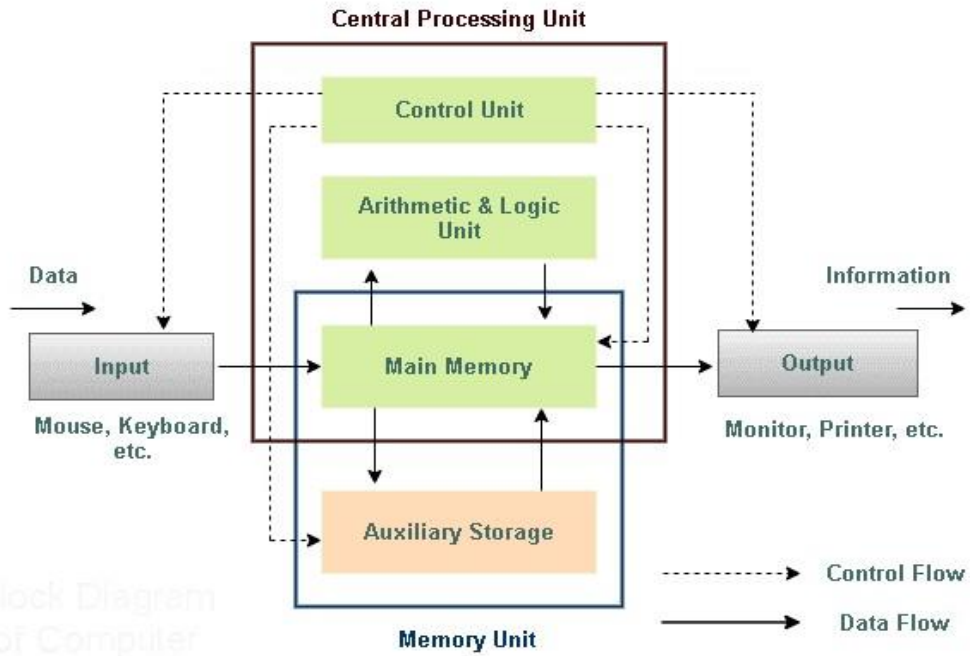
Computer Architecture

- It refers to how a computer system is designed.
- It is a set of rules stating how computer software and hardware are joined together and interact to make a computer work.
- It consists of rules and methods or procedures which describe the implementation and functionality of the computer systems.
- It is the structure of a digital computer that encompasses the design and layout of its instruction set and storage registers.
- Organization of a computer system defines the way system is structured.

Computer Architecture vs. Computer Organization

Computer Architecture	Computer Organization
Computer Architecture is concerned with the way hardware components are connected together to form a computer system.	Computer Organization is concerned with the structure and behaviour of a computer system as seen by the user.
It acts as the interface between hardware and software.	It deals with the components of a connection in a system.
Computer Architecture helps us to understand the functionalities of a system.	Computer Organization tells us how exactly all the units in the system are arranged and interconnected.
A programmer can view architecture in terms of instructions, addressing modes and registers.	Whereas Organization expresses the realization of architecture.
While designing a computer system architecture is considered first.	An organization is done on the basis of architecture.
Computer Architecture deals with high-level design issues.	Computer Organization deals with low-level design issues.
Architecture involves Logic (Instruction sets, Addressing modes, Data types, Cache optimization)	Organization involves Physical Components (Circuit design, Adders, Signals, Peripherals)

Block Diagram of a Computer



Functions of Different Units

- Input Unit: Consists of hardware devices such as keyboard, mouse, scanner, etc.
  - Works as a medium between the user and computer for inputting data or instructions.
  - Converts the data or instructions into binary for processing.
  - Sends data to the main memory.
- CPU: Processes all the operations of a computer.
  - Control unit (a part of the CPU) controls input/output, memory, and other devices connected to the CPU.
  - Control unit (CU) controls all the activities of a computer, handles all control signals.
  - The CU selects and retrieves instructions from the main memory and interprets them so that other functional elements get active and perform their operations.
  - The CU controls data flow inside the processor.

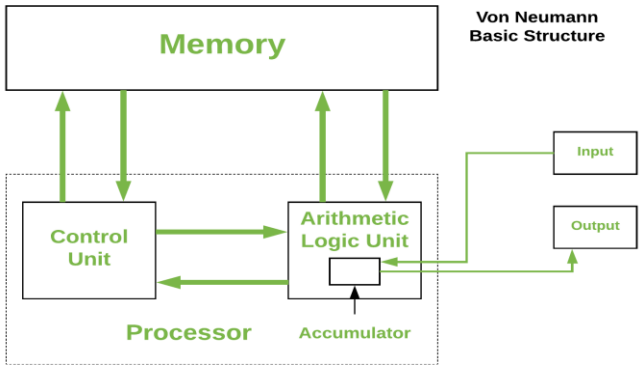
Functions of Different Units$_{\text{contd.}}$

- Arithmetic Logic Unit (ALU), another part of the CPU, performs all arithmetic and logic operations.
- The CU tells the ALU what operation to perform.
- The ALU loads data from the input registers (a small amount of storage as a part of the CPU), performs operation and stores result in the output registers.

- Memory Unit: Capacity of storage unit. Storage capacity is expressed in terms of bytes.
  - Stores all data and instructions for processing.
  - Holds all intermediate results.
  - Receives and sends all inputs and outputs.
- Output Unit: Delivers the result from the computer to an external device. Monitor, speaker, printer, etc.
  - Translates the result/output, received by the processor, to a usable/understandable form for the user.

Von Neumann Architecture

- The modern computers are based on the concept introduced by John Von Neumann.
- All digital computers are based on this fundamental architecture.
- This architecture was proposed by the mathematician John von Neumann in 1945.
- Instructions can only be done one at a time and can only be carried out sequentially. This is commonly referred to as the ‘Von Neumann bottleneck’.



Question:

Difference between electric and electronic devices??