Computer Organization

Basic Structure of Computers,
Machine Instructions and
Programs

☐ Text Books:

Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian: Computer Organization and Embedded Systems, 6th Edition, Tata McGraw Hill, 2012.

☐ Reference Books:

☐ William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015.

- Progress in computer technology
 - Underpinned by Moore's Law
- Makes novel applications feasible
 - Computers in automobiles
 - Cell phones
 - Human genome project
 - ☐ World Wide Web
 - Search Engines
- Computers are universal

Classes of Computers

- Desktop/laptop computers
 - ☐ General purpose, variety of software
 - ☐ Subject to cost/performance tradeoff
- Workstations
 - ☐ More computing power used in engg. applications, graphics etc.
- ☐ / Enterprise System/ Mainframes
 - ☐ Used for business data processing
- Server computers (Low End Range)
 - Network based
 - ☐ High capacity, performance, reliability
 - ☐ Range from small servers to building sized
- ☐ Supercomputer (High End Range)
 - Large scale numerical calculation such as weather forecasting, aircraft design
- Embedded computers
 - Hidden as components of systems
 - Stringent power/performance/cost constraints

What You Will Learn

- How programs are translated into the machine language
 - And how the hardware executes them
- ☐ The hardware/software interface
- What determines program performance
 - And how it can be improved
- How hardware designers improve performance

Understanding Performance

- Algorithm
 - Determines number of operations executed
- Programming language, compiler, architecture
 - Determine number of machine instructions executed per operation
- Processor and memory system
 - Determine how fast instructions are executed
- ☐ I/O system (including OS)
 - Determines how fast I/O operations are executed

Functional Units

A computer consists of five functionally independent main parts input, memory, arithmetic logic unit (ALU), output and control unit.

Functional Units

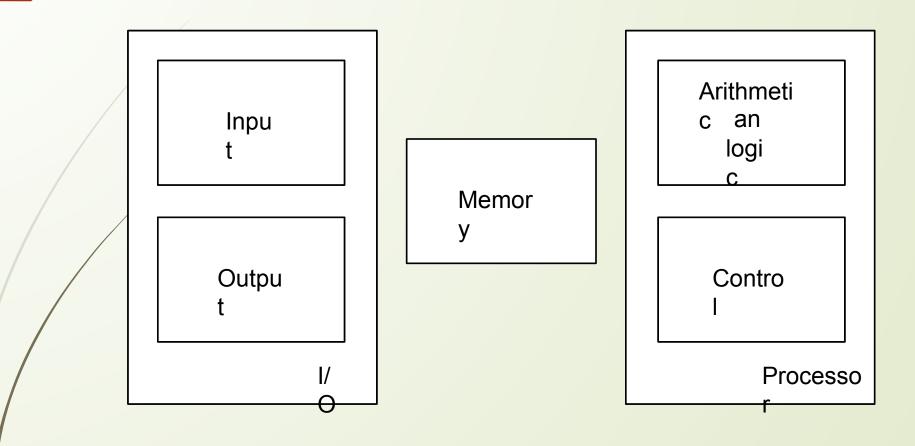


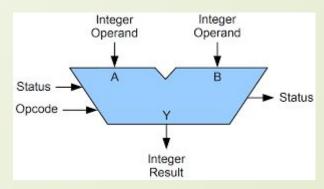
Figure 1.1. Basic functional units of a computer.

Information Handled by a Computer

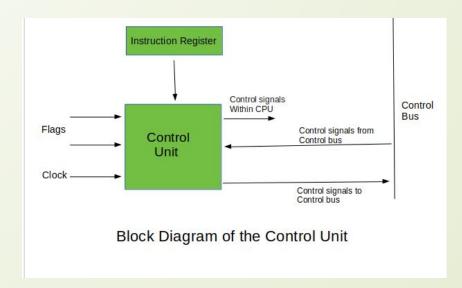
- Instructions/machine instructions
- Govern the transfer of information within a computer as well as between the computer and its I/O devices
- Specify the arithmetic and logic operations to be performed
- Program
- Data
- Used as operands by the instructions
- Source program
- ☐ Encoded in binary code 0 and 1

Arithmetic and Logic Unit (ALU)

- Most computer operations are executed in ALU of the processor.
 - Load the operands into memory
 - bring them to the processor
 - perform operation in ALU
 - ☐ store the result back to memory or retain in the processor.
- Registers
- Fast control of ALU



- All computer operations are controlled by the control unit.
- The timing signals that govern the I/O transfers are also generated by the control unit.
- Control unit is usually distributed throughout the machine instead of standing alone.
- Operations of a computer:
- Accept information in the form of programs and data through an input unit and store it in the memory
- Fetch the information stored in the memory, under program control, into an ALU, where the information is processed
- Output the processed information through an output unit
- Control all activities inside the machine through a control unit



The operations of a computer

- The computer accepts information in the form of programs and data through an input unit and stores it in the memory.
- Information stored in the memory is fetched under program control into an arithmetic and logic unit, where it is processed.
- ☐ Processed information leaves the computer through an output unit.
- ☐ All activities in the computer are directed by the control unit.