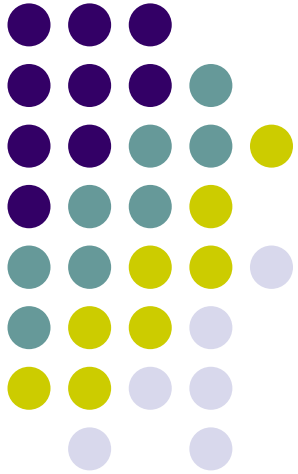
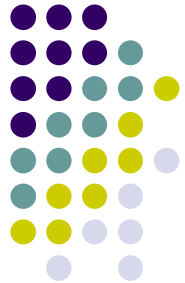
Chapter 1. Basic Structure of Computers

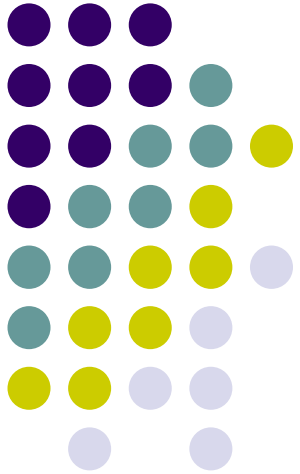


1.1 Computer Types



- Types of computer exist that differ widely in
  -Size
  -Cost
  - Computational power
  - Use
- Types
  - Personal computers (Desktops)
  - Notebook computers
  - Workstations for interactive design work.
  - Enterprise systems and servers Used in business data processing requiring more storage and computing power.
  - Supercomputers Used in large scale numerical calculations used for weather forecasting and aircraft design and simulation.

1.2 Functional Units



Functional Units

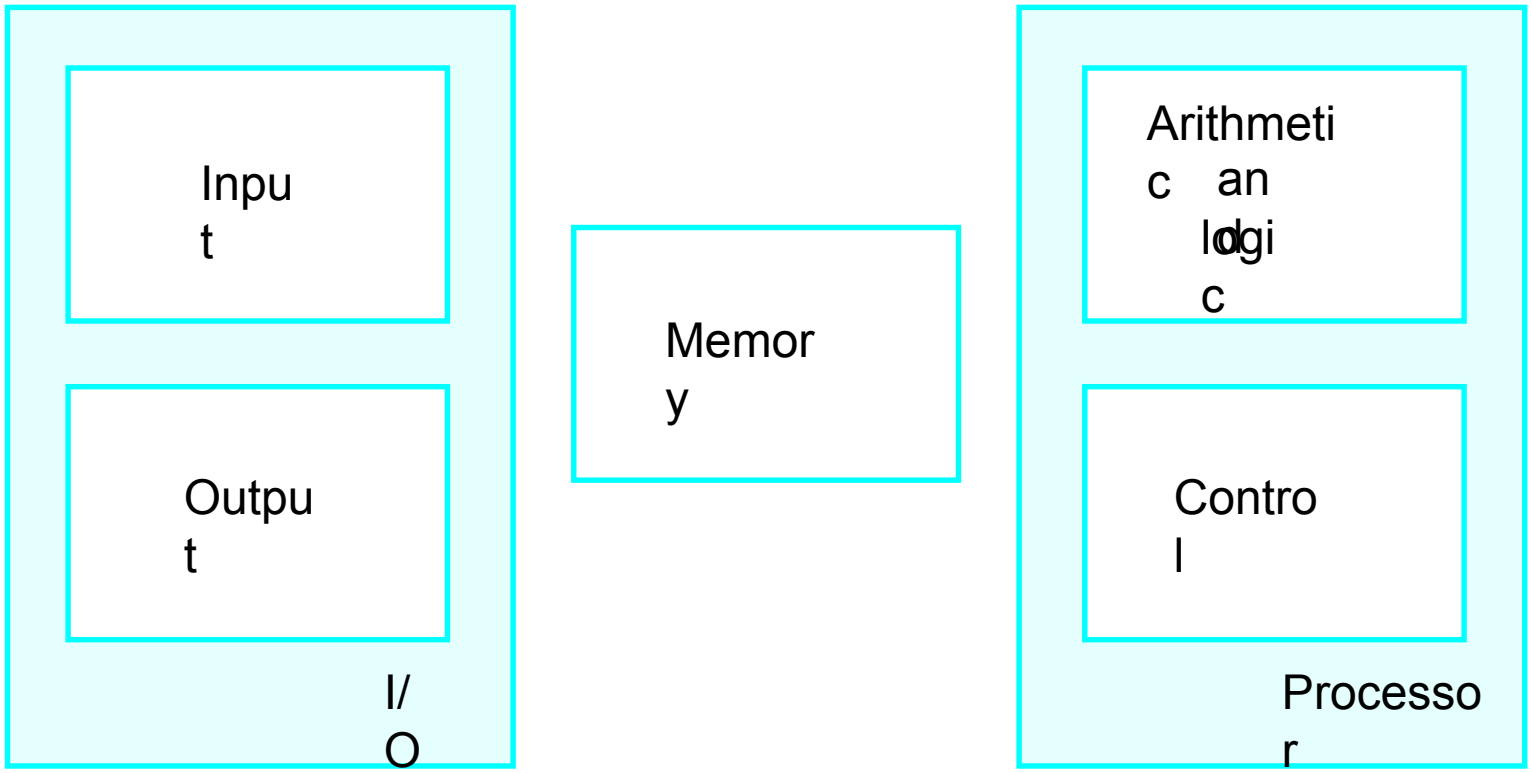
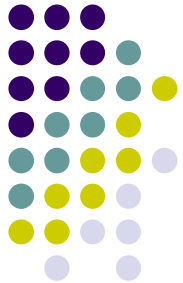
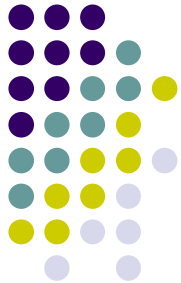


Figure 1.1. Basic functional units of a computer.

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
- A list of instructions that perform task is called Program
- Data
- Used as operands by the instructions
- Entire prg can be used as data for another program.
- Encoded in binary code – 0 and 1



- Several coding schemes have been developed.
- Two of most widely used are

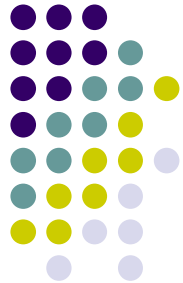
  ASCII _____ character is represented with 7 –bit code

  EBCDIC_____ character is represented by 8-bit code.

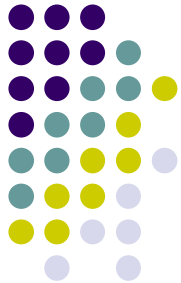
1.2.1 Input unit

- computer accepts coded information through input devices.
- Common input devices are Keyboard, joysticks, mouse etc.
- Graphic input devices in conjunction with displays.
- Microphones used to capture audio data.

1.2.2 Memory Unit

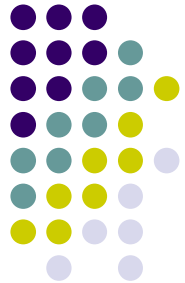


- Store programs and data
- Two classes of storage
- Primary storage
  - Fast
  - Programs must be stored in memory while they are being executed
  - Large number of semiconductor storage cells
  - Processed in words
  - Address
  - RAM and memory access time- time required to access one word
  - Memory hierarchy – cache, main memory
- Secondary storage – larger and cheaper



- Address is associated with each word location
- Number of bits in each word is called Wordlength.
- Memory Hierarchy: -
- - registers
- - Cache
  - Main memory
  -Back up store.

Arithmetic and Logic Unit (ALU)

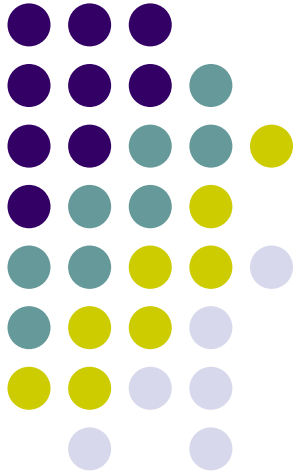


- Most computer operations are executed in ALU of the processor.
- Load the operands into memory – bring them to the processor – perform operation in ALU – store the result back to memory or retain in the processor.
- When operands are brought into the processor , stored in high speed Registers
- Faster device.

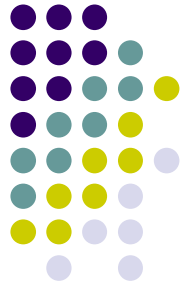
Control Unit

- 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

1.3 Basic Operational Concepts

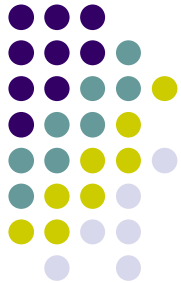


Review



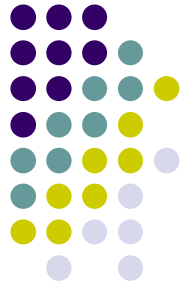
- Activity in a computer is governed by instructions.
- To perform a task, an appropriate program consisting of a list of instructions is stored in the memory.
- Individual instructions are brought from the memory into the processor, which executes the specified operations.
- Data to be used as operands are also stored in the memory.

A Typical Instruction



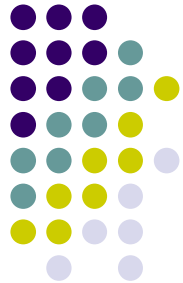
- Add LOCA, R0
- Add the operand at memory location LOCA to the operand in a register R0 in the processor.
- Place the sum into register R0.
- The original contents of LOCA are preserved.
- The original contents of R0 is overwritten.
- Instruction is fetched from the memory into the processor – the operand at LOCA is fetched and added to the contents of R0 – the resulting sum is stored in register R0.

Separate Memory Access and ALU Operation

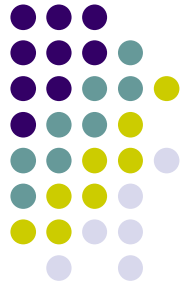


- Load LOCA, R1
- Add R1, R0
- Which contents will be overwritten?

Connection Between the Processor and the Memory

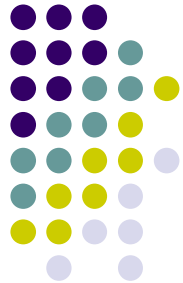


Registers



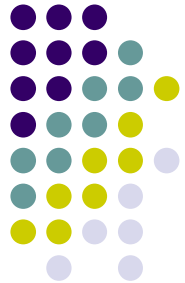
- Instruction register (IR)
- Program counter (PC)
- General-purpose register (R_0 – R_{n-1})
- Memory address register (MAR)
- Memory data register (MDR)

Typical Operating Steps



- Programs reside in the memory through input devices
- PC is set to point to the first instruction
- The contents of PC are transferred to MAR
- A Read signal is sent to the memory
- The first instruction is read out and loaded into MDR
- The contents of MDR are transferred to IR
- Decode and execute the instruction

Typical Operating Steps (Cont')



- Get operands for ALU
  - General-purpose register
  - Memory (address to MAR – Read – MDR to ALU)
- Perform operation in ALU
- Store the result back
  - To general-purpose register
  - To memory (address to MAR, result to MDR – Write)
- During the execution, PC is incremented to the next instruction