Engineering Problem Solving With C++ An Object Based Approach

Fundamental Concepts

Chapter 1

Engineering Problem Solving

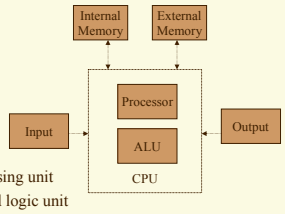
Objectives

- Understanding of basic terminology for computers.
- Understanding of a problem-solving methodology used when solving engineering problems with a computer

Computing Systems: Hardware and Software

- A **computer** is a machine designed to perform operations specified with a set of instructions called a **program.**
- **Hardware** refers to the computer equipment.
  - keyboard, mouse, terminal, hard disk, printer
- **Software** refers to the programs that describe the steps we want the computer to perform.

Computer Hardware



- CPU - Central processing unit
- ALU - Arithmetic and logic unit
- ROM - Read only memory
- RAM - Random access memory

Main Memory

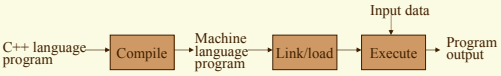
- **Main Memory -**

- **Terminology:**
  - Main memory is divided into numbered locations called **bytes**.
  - A byte is a sequence of 8 **bits**.
  - A bit is a binary digit (0 or 1).
  - The location number associated with a byte is called the **address**.
  - A group of consecutive bytes is used for storing the binary representation of a data item, such as a number or a character.
- What value is represented by the 4th byte?

Computer Software

- Operating System - Provides an interface with the user
  - unix, windows, linux, ...
- Software Tools
  - word processors (MicrosoftWord, WordPerfect, ...)
  - spreadsheet programs (Excel, Lotus1-2-3, ...)
  - mathematical computation tools (MATLAB, Mathematica, ...)
- Computer Languages
  - machine language
  - assembly language
  - binary language
  - high level languages (C, C++, Ada, Fortran, Basic, java)

Executing a Computer Program



- Compiler
  - Converts **source** program to **object** program
- Linker
  - Converts **object** program to **executable** program

Key Terms

- Source Program
  - printable/Readable Program file
- Object Program
  - nonprintable machine readable file
- Executable Program
  - nonprintable executable code
- Syntax errors
  - reported by the compiler
- Linker errors
  - reported by the linker
- Execution/Run-time errors
  - reported by the operating system
- Logic errors
  - not reported

Basic C++ Program Structure

```
/*************************************************************************
* Header Comments
*************************************************************************/
include files
global declarations

int main()
{
        declarations and executable statements
        return 0;
}//end block of main
```

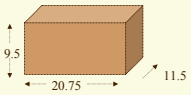

An Engineering Problem-Solving Methodology

1. PROBLEM STATEMENT
2. INPUT/OUTPUT DESCRIPTION
3. HAND EXAMPLE
4. ALGORITHM DEVELOPMENT
5. TESTING

Example

1. Write a program to compute the volume of box.
2. Input: length, width, height
   Output: volume
3. Hand Example:

volume = 20.75*11.5*9.5



4. Algorithm: input length, width and height
   compute volume
   output volume
5. Implement algorithm in C++ and test.

First Program – volume of a box

```
/*************************************************************/
/*  Program chapter1                                         */
/*                                                           */
/*  This program computes the volume of a box                */
/*************************************************************/
#include <iostream.h>
//using namespace std;

int main()
{
   // Declare and initialize objects
   double length( 20.75), width(11.5),height(9.5), volume;

   // Calculate volume.
   volume = length * width * height;
  // Print the volume.
   cout << "The volume is " <<  volume << endl;

  // Exit program.
  return 0;
}
/*************************************************************/
```