

Engineering Problem Solving With C++ An Object Based Approach

Fundamental Concepts

Chapter 1

Engineering Problem Solving

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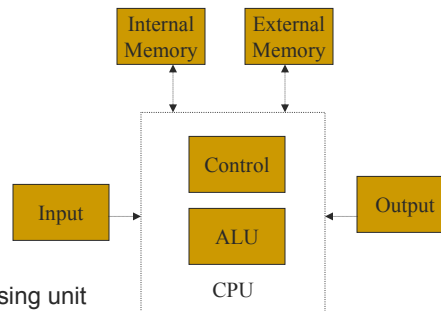
Objectives

- 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 -

01000001
01000000
01010001
01001101

- 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, ...

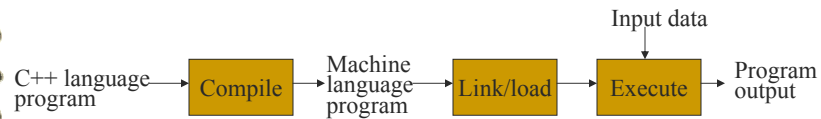
- Software Tools

- word processors (MS Word, WordPerfect, ...)
- spreadsheet programs (Excel, Lotus1-2-3, ...)
- mathematical computation tools (MATLAB, Mathematica, ...)

- Computer Languages

- machine language
- assembly 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; You may see it in the output generated

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

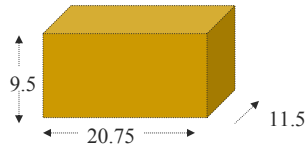
1. Write a program to compute the volume of box.

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>
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;
}
/* **** */
```