

Chapter 1: Overview of Computers and Programming

Problem Solving & Program Design in C

Seventh Edition

By Jeri R. Hanly &
Elliot B. Koffman

Addison Wesley
is an imprint of



© 2012 Pearson Addison-Wesley. All rights reserved.

Computers

- Electro-mechanical devices that receive, store, process and output data.
- Hardware and Software
- Data -> Information -> Intelligence
- All data on a computer is binary

Figure 1.2

(a) Desktop Computer, iMac.

(© Hugh Threlfall/Alamy).

(b) Hewlett-Packard Laptop.

(© Hewlett-Packard Company).

(c) iPad.

(© D. Hurst/Alamy).

d) Android phone, LG Thrill 4G.

(© Handout/MCT/Newscom).



© 2012 Pearson Addison-Wesley. All rights reserved.

1-3

Computer History

- 1930's Atanasoff and Berry at Iowa State University created the first electronic computer called the ABC machine
- 1940's Turing cracks the Enigma Cypher at Bletchley Park
- 1946 ENIAC completed at University of Pennsylvania

© 2012 Pearson Addison-Wesley. All rights reserved.

1-4

Vincent Atanasoff and ABC



© 2012 Pearson Addison-Wesley. All rights reserved.

1-5

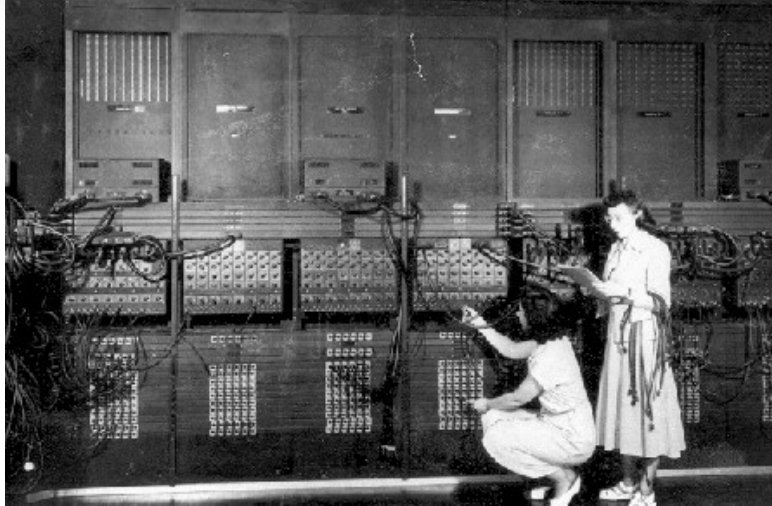
Alan Turing and the Enigma



© 2012 Pearson Addison-Wesley. All rights reserved.

1-6

ENIAC



© 2012 Pearson Addison-Wesley. All rights reserved.

1-7

Basic Components of Computers

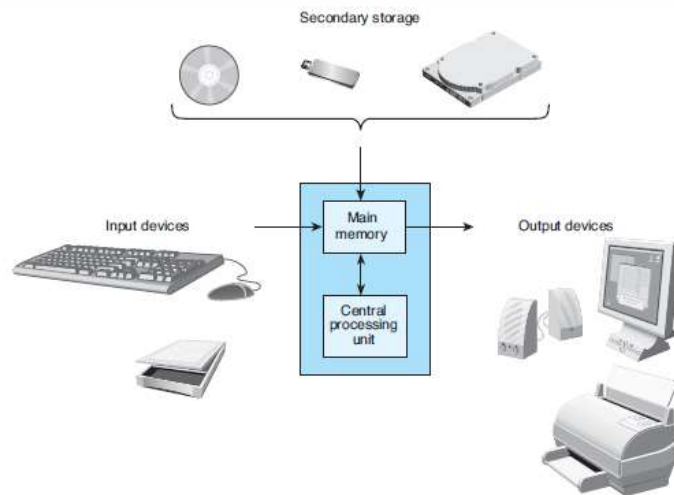
- CPU
- RAM
- Secondary Storage
- *Motherboard
- Input devices
- Output Devices

© 2012 Pearson Addison-Wesley. All rights reserved.

1-8

Figure 1.3

Components of a Computer

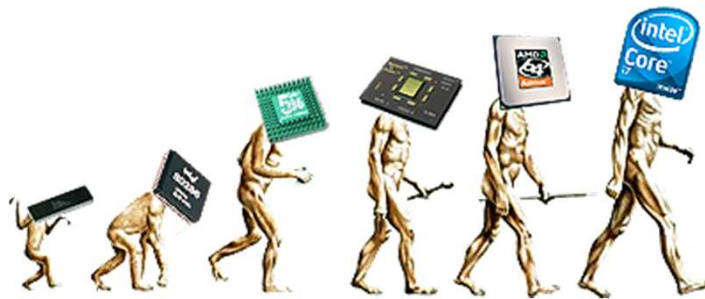


© 2012 Pearson Addison-Wesley. All rights reserved.

1-9

CPU

- Brain of computer
 - Executes instructions
 - Processes data



© 2012 Pearson Addison-Wesley. All rights reserved.

1-10

CPU (Central Processing Unit)

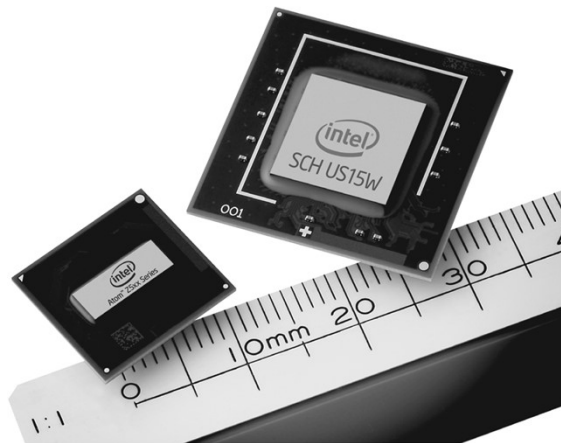
- Processing unit in computer
- Contains CU and ALU and registers
- Sends control signals to other components
- Fetches instructions and data from RAM
- Executes instructions
- Processes data
- Places results back in RAM

© 2012 Pearson Addison-Wesley. All rights reserved.

1-11

Figure 1.1

The **Intel Atom processor chip** contains the full circuitry of a central processing unit in an integrated circuit whose small size and low power requirements make it suitable for use in mobile internet devices. (Intel Corporation Pressroom Photo Archives)



© 2012 Pearson Addison-Wesley. All rights reserved.

1-12

CPU Intel 8086



1978
First 16-bit processor
4.77-10 MHz
29,000 transistors
3 micron

© 2012 Pearson Addison-Wesley. All rights reserved.

1-13

CPU Intel 80-286

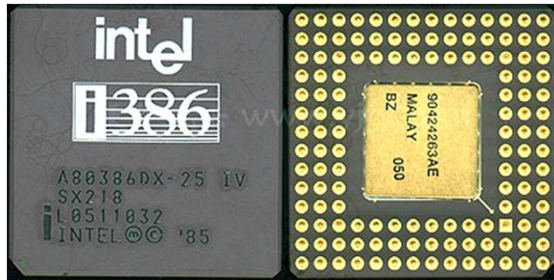


1982
Up to 16M memory
6-12.5 MHz
134,000 transistors
1.5 micron

© 2012 Pearson Addison-Wesley. All rights reserved.

1-14

CPU Intel 386



1985

First 32-bit processor

Up to 4G memory

16-33 MHz

275,000 transistors

© 2012 Pearson Addison-Wesley. All rights reserved.

1-15

CPU 486



1989

First with FPU

First with cache

25-100 MHz

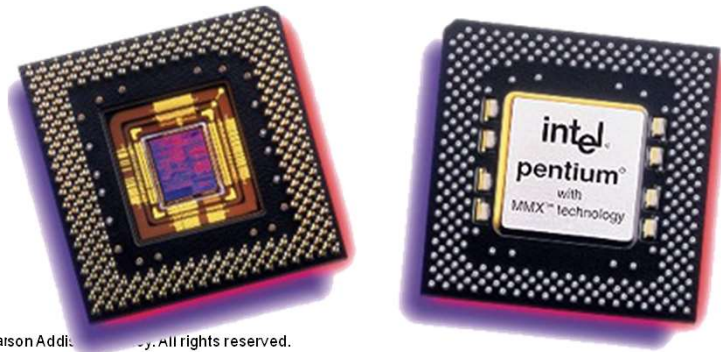
1.2 million transistors

© 2012 Pearson Addison-Wesley. All rights reserved.

1-16

CPU Intel Pentium 1993

1993
64-bit data bus
Improved FPU
60-233 MHz
0.8 and 0.35 microns
3.5M to 4.5M Transistors



© 2012 Pearson Addison-Wesley. All rights reserved.

1-17

CPU Intel Core 2



2006
Dual core
167M transistors
1.8-3.2 GHz
Faster bus speeds
65nm and 45nm

© 2012 Pearson Addison-Wesley. All rights reserved.

1-18

CPU Intel Core i7



2008
Quad core
2.66-3.2 GHz

© 2012 Pearson Addison-Wesley. All rights reserved.

1-19

Primary Memory (RAM)

- Arranged in cells
- Each cell contains a byte
- Numerically addressed
- Storage and retrieval
- Cells are combined to contain larger data
- Measured in kilobytes, megabytes or gigabytes
- Fast access and transfer of data
- Volatile

© 2012 Pearson Addison-Wesley. All rights reserved.

1-20

Figure 1.4
**1000 Memory Cells
 in Main Memory**

| Memory | |
|---------|----------|
| Address | Contents |
| 0 | -27.2 |
| 1 | 354 |
| 2 | 0.005 |
| 3 | -26 |
| 4 | H |
| ... | ... |
| 998 | X |
| 999 | 75.62 |

© 2012 Pearson Addison-Wesley. All rights reserved.

1-21

Bytes and Bits

- A bit is a single 0 or 1
- A byte is 8 bits
- A kilobyte is 2^{10} bytes (1,024)
- A megabyte is 2^{20} bytes (1,048,576)
- A gigabyte is 2^{30} bytes (1,073,741,824)
- A terabyte is 2^{40} bytes (1,099,511,627,776)

© 2012 Pearson Addison-Wesley. All rights reserved.

1-22

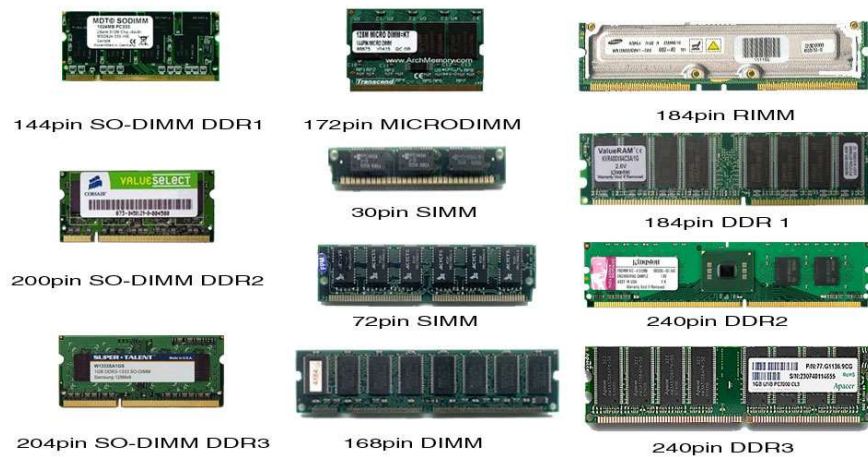
Figure 1.5
Relationship Between a Byte and a Bit



© 2012 Pearson Addison-Wesley. All rights reserved.

1-23

RAM

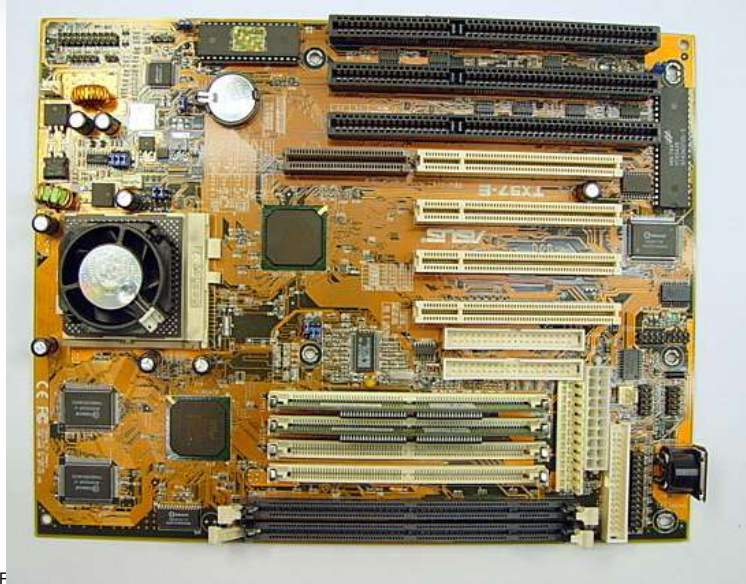


© 2012 Pearson Addison-Wesley. All rights reserved.

1-24

Motherboard

Asus Tx97-e Motherboard, Intel Pentium Mmx
233mhz, 3x Isa, 4x Simm, 2x Dimm

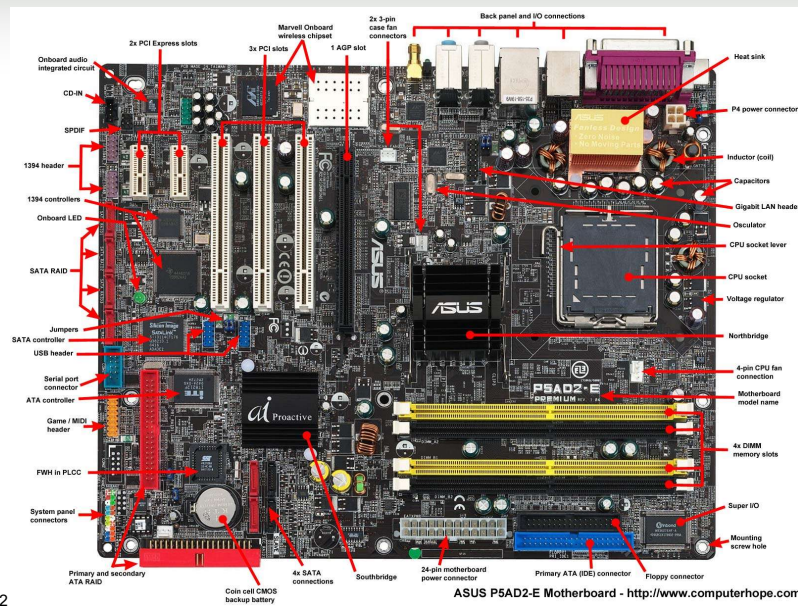


© 2012 F

1-25

Motherboard with AGP

Asus P5AD2-E

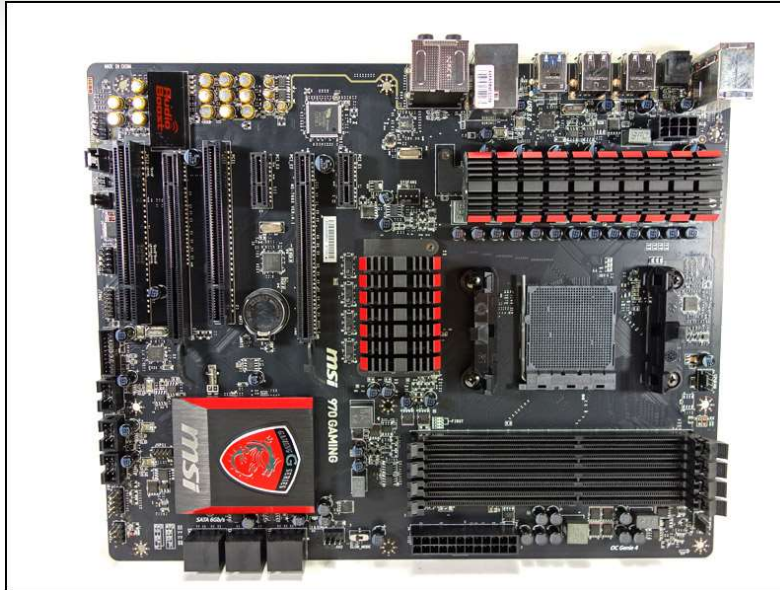


© 2012

ASUS P5AD2-E Motherboard - <http://www.computerhope.com>

1-26

Motherboard with PCI-E



© 2012 Pearson Addison-Wesley. All rights reserved.

1-27

Secondary Storage

- Hard disks, flash memory, CDs, DVDs, BDs and solid state drives
- Persistent
- Slower access and transfer of data

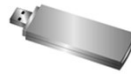
© 2012 Pearson Addison-Wesley. All rights reserved.

1-28

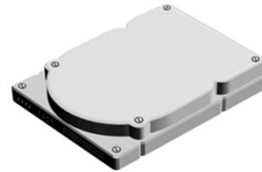
Figure 1.6 Secondary Storage Media



CD



Flash
drive



Hard
disk

© 2012 Pearson Addison-Wesley. All rights reserved.

1-29

Input and Output Devices

- Input devices
 - Keyboard, mouse, touchpad and scanner
- Output devices
 - Monitor, projector, speakers and printer
- Some devices are both
 - All-in-one printer
- Cursor marks a spot
- Function keys other keys carry out special activities

© 2012 Pearson Addison-Wesley. All rights reserved.

1-30

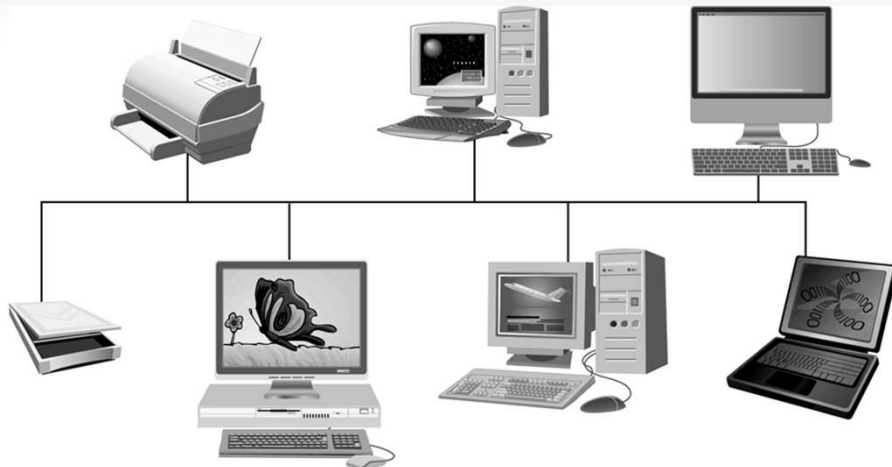
LANs (Local Area Networks)

- Contain communication medium, hardware, computers and other devices for local systems
- Usually serve a single building or complex
- Wired and wireless
- Routers, switches and cable
- File servers store, send and receive data from network

© 2012 Pearson Addison-Wesley. All rights reserved.

1-31

Figure 1.7 Local Area Network



© 2012 Pearson Addison-Wesley. All rights reserved.

1-32

WANs (Wide Area Networks)

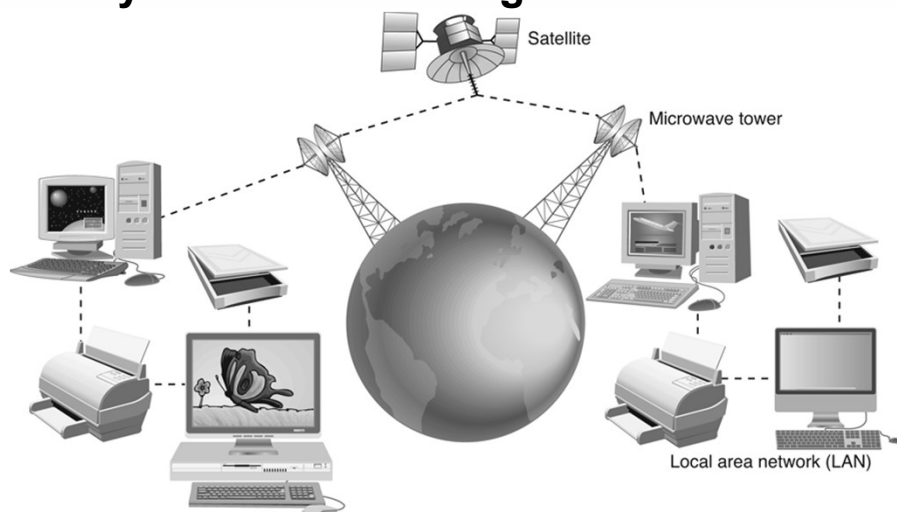
- Cover a large geographic area
- Internet covers the world (ARPA 1969)
 - Government, Education, Business and Public
 - Can operate if partially destroyed
- WWW is a protocol to view info in a graphical format (GUI)
- Modems

© 2012 Pearson Addison-Wesley. All rights reserved.

1-33

Figure 1.8

A Wide Area Network with Satellite Relays of Microwave Signals



© 2012 Pearson Addison-Wesley. All rights reserved.

1-34

OS (Operating Systems)

- A collection of utility programs that control a computer
- ROM chips (on motherboard)
- Booting the computer
 - BIOS
 - POST test
 - CMOS
 - Software

© 2012 Pearson Addison-Wesley. All rights reserved.

1-35

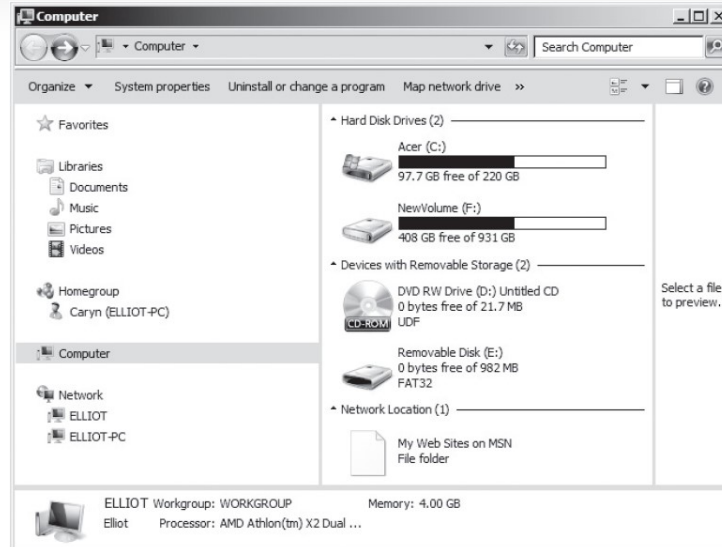
OS (Operating Systems)

1. Communicates with the user
2. Manages system resources
3. Manages input to current program
4. Conveys output to devices
5. Accessing secondary storage
6. Writing data to secondary storage

© 2012 Pearson Addison-Wesley. All rights reserved.

1-36

Figure 1.10

Accessing Secondary Storage Devices through Windows

© 2012 Pearson Addison-Wesley. All rights reserved.

1-37

Application Software

- Software that is useful to a user
- Office applications
- Web browsers
- Utilities
- Compilers
- Antivirus
- Games

© 2012 Pearson Addison-Wesley. All rights reserved.

1-38

Computer Languages

- Instructions for a computer to execute
- Machine language
- Assembly language
- High-level language
 - C, C++, Objective C, Java, VB, C#, etc.
 - Word processor or IDE
- Making an executable (.exe)
 - Source file
 - Compiler
 - Object file
 - Linker

© 2012 Pearson Addison-Wesley. All rights reserved.

1-39

Assembly function in C

```
// InlineAssembler_Calling_C_Functions_in_Inline_Assembly.cpp
// processor: x86
#include <stdio.h>

char format[] = "%s %s\n";
char hello[] = "Hello";
char world[] = "world";
int main( void )
{
    __asm
    {
        mov  eax, offset world
        push eax
        mov  eax, offset hello
        push eax
        mov  eax, offset format
        push eax
        call printf
        //clean up the stack so that main can exit cleanly
        //use the unused register ebx to do the cleanup
        pop  ebx
        pop  ebx
        pop  ebx
    }
}
```

© 2012 Pearson Addison-Wesley. All rights reserved.

1-40

Figure 1.13 Miles-to-Kilometers Conversion Program

```

1.  /*
2.  * Converts distance in miles to kilometers.
3.  */
4.  #include <stdio.h>          /* printf, scanf definitions */
5.  #define KMS_PER_MILE 1.609 /* conversion constant */
6.
7.  int
8.  main(void)
9.  {
10.     double miles, /* input - distance in miles. */
11.           kms;    /* output - distance in kilometers */
12.
13.     /* Get the distance in miles. */
14.     printf("Enter the distance in miles> ");
15.     scanf("%lf", &miles);
16.
17.     /* Convert the distance to kilometers. */
18.     kms = KMS_PER_MILE * miles;
19.
20.     /* Display the distance in kilometers. */
21.     printf("That equals %f kilometers.\n", kms);
22.
23.     return (0);
24. }

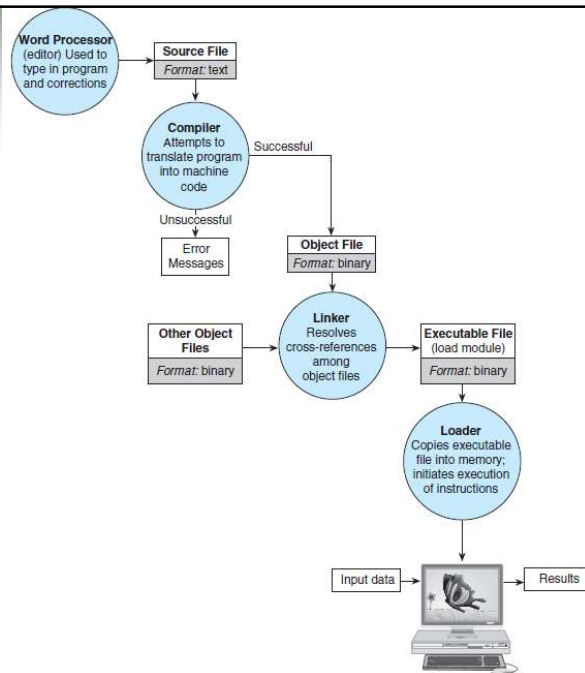
```

Sample Run
Enter the distance in miles> 10.00
That equals 16.090000 kilometers.

© 2012 Pearson Addison-Wesley. All rights reserved.

1-41

**Figure 1.11
Entering,
Translating,
and Running
a High-Level
Language
Program**



© 2012 Pearson Addison-Wesley. All rights reserved.

1-42

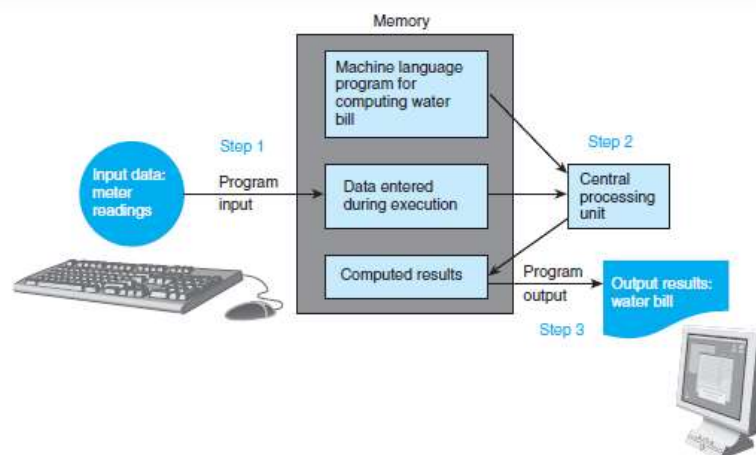
Program Execution

- Program loaded to RAM
- Processor reads instructions
- Input data read to RAM and processed
- Output data written to secondary storage

© 2012 Pearson Addison-Wesley. All rights reserved.

1-43

Figure 1.12 **Flow of Information During Program Execution**



© 2012 Pearson Addison-Wesley. All rights reserved.

1-44

Software Development Method

1. Specify the problem requirements
2. Analyze the problem
3. Design the algorithm to solve the problem
4. Implement the algorithm
5. Test and verify the completed program
6. Maintain and update the program

© 2012 Pearson Addison-Wesley. All rights reserved.

1-45

Algorithms

- Concept conceived by al-Khwarizmi
- An algorithm is a list of steps for solving a problem
- An algorithm has to be complete and correct

© 2012 Pearson Addison-Wesley. All rights reserved.

1-46

Muhammad ibn Musa al-Khwarizmi

- Arab mathematician of the court of Mamun in Baghdad born before 800 AD in central Asia

