

CHAPTER

4

**Software:  
Systems and  
Application  
Software**

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Software and Hardware

- Software can represent 75% or more of the total cost of an IS.
  - Less costly hdwr.
  - More complex sftwr.
  - Expensive developers



Software vs.  
Hardware Costs

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Types of Software

- Systems Software
  - Programs that coordinate the activities and functions of the hardware and various other programs.
- Application Software
  - Programs that help users solve particular computing problems.

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## Information Systems Spheres of Influence

- Personal
  - Individual users (personal productivity)
- Workgroup
  - Two or more people who work together to achieve a common goal
- Enterprise
  - An entire company interacting with customers, suppliers, government, etc.

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## Software by Sphere of Influence

	Personal	Workgroup	Enterprise
Systems Software	PC and workst'n operating systems	Network operating systems	Midrange and mainframe OS
Application Software	WP, DB, Sprdsheet, graphics (Pers Prod)	E-Mail, Group Scheduling, Workflow	Accounting Order entry, Payroll, HR

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## Software Issues and Trends

- Software Licensing
  - Protection by software vendors to prevent unauthorized use.
    - ◆ Software keys
    - ◆ Multi-user licenses
    - ◆ Software Publishing Association
- Software bugs: program defects that prevent proper performance
- Open source software: freely available and modifiable

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## Software Piracy

- **SIIA (SPA) Settles Suit Against Pirate Selling Software Via Internet Auctions**
  - Came on the heels of an SIIA sting operation designed to search for, and to enter into transactions with sellers offering illegal copies of software on popular auction sites such as e-Bay and Yahoo Auctions
  - Liable for up to \$150,000 per violation

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## Software Issues and Trends

- Software Upgrades
  - A revised version of software that usually includes fixes of known problems, plus enhancements to existing capabilities
    - ◆ Costly? Risky?
    - ◆ Covered by maintenance agreements?
    - ◆ Risk of discontinued support

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## SYSTEMS SOFTWARE

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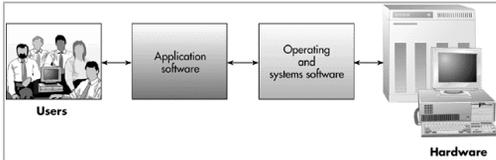
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## Role of Systems Software

- Operating Systems
  - Control the computer hardware and act as an interface with applications programs.



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## Operating System Functions

### Operating System Functions

Perform common computer hardware functions (e.g. I/O)  
Provide a user interface  
Provide a degree of hardware independence  
Manage system memory  
Manage processing tasks  
Provide networking capability  
Control access to system resources  
Manage files

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## User Interface

- A function of the operating system that allows individuals to access and command the computer.
  - Text-Based User Interface (e.g. DOS)
    - ◆ Requires text commands be given to the computer to perform basic activities.
  - Graphical User Interface (GUI)
    - ◆ Uses pictures (icons) and menus displayed on the screen to send commands to the computer system.

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## GUI Advantages?

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## Hardware Independence

- Provides a layer between the application software and the hardware.
  - Application Program Interface (API)
  - Same software can be used on various hardware; the OS makes adjustments
  - Changes in hardware may not require a change in application software

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## Memory Management

- Controls how memory is accessed and maximizes available memory and storage.
  - ◆ Translates logical addresses to physical addresses
  - ◆ Protects memory used for OS
  - ◆ Provides virtual memory

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## Virtual Memory

- Virtual Memory
  - Memory that allocates space in secondary storage to supplement the immediate, functional memory capacity of RAM.
- Paging
  - A function of virtual memory that allows the computer to store currently needed pages in RAM while the rest of these programs wait in secondary storage.
- Invalid Page Fault
  - The operating system cannot find the data requested

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## Processing Tasks

- Multitasking
  - A processing activity that allows a user to run more than one application at the same time.
- Multithreading
  - The ability of a program to manage its use by more than one user at a time without having to have multiple copies of the program.
- Time-sharing
  - Multiple users simultaneously using the resources of a single processor (scalability).

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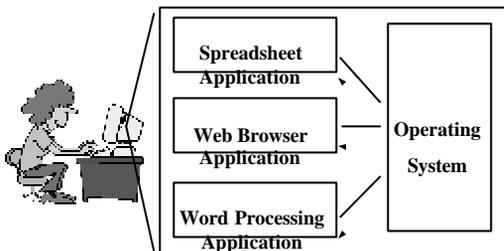
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## Multitasking



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## Multi-User Tasks

- Network capability
  - Aids in connecting the computer to a network.
- Access to system resources
  - Provides security for unauthorized access.
- File management
  - Ensures that files in secondary storage are available when needed, and they are protected against unauthorized usage.

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## PC Operating Systems

- Examples?

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## Network Operating Systems

- Windows NT Server
- Windows 2000 Server
  - Up to 32 processors
- Novell Netware

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## Utility Programs

- Utility Programs
  - Programs used to merge and sort sets of data, keep track of computer jobs being run, compress files of data before they are stored or transmitted over a network, check for viruses, and perform other important tasks. (Examples?)

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## APPLICATION SOFTWARE

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## Types of Application Software

- Proprietary Software
  - Designed to solve a unique and specific problem.
  - In-House Developed or Contract
- Off-The-Shelf Software
  - An existing software program that can be used without considerable changes expected.

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## Types of Application Software

- Customized Package
  - Blend of off-the-shelf software and internal/contract software development.
  - Application Service Provider
- Source Code?

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## Pros & Cons of Proprietary

- PROS
- CONS

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## Pros & Cons of Off-the-Shelf

- PROS
- CONS

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## Personal Application Software

- Examples?

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## Object Linking and Embedding (OLE)

- A software feature that allows you to copy, link or embed objects between one program and another program or document.
  - ◆ Server application supplies
  - ◆ Client application accepts
  - ◆ Object = picture, graph, text, spreadsheet, etc.

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## Object Linking and Embedding (OLE)

- Copy
  - Copy data from server application and place it in client application.
  - Data must be changed on server application and re-copied.

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## Object Linking and Embedding (OLE)

- Link
  - Create a link in the client application to an object in the server application.
  - Changes must be made in server application.
  - Any changes made to the server object will automatically appear in all linked client objects.

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## Object Linking and Embedding (OLE)

- Embed
  - An embedded object becomes part of the client document
  - Double-clicking opens server application
  - The server document is no longer needed.

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## Dynamic Data Exchange (DDE)

- Enables DDE-compatible Windows applications to share data easily with other compatible applications

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## Workgroup Application Software

- GroupWare
  - Software that helps groups of people work together more efficiently and effectively
    - ◆ E-Mail
    - ◆ Group Scheduling (PIMs)
    - ◆ Contact Management
    - ◆ Lotus Notes (workflow, threaded discussions)

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## E&Y Three C's for Groupware

- Convenient
  - If it's hard to use, it doesn't get used
- Content
  - Constant stream of rich, relevant and personalized content
- Coverage
  - Accessible any time from anywhere

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## Enterprise Application Software

- Software that benefits the entire organization.

Accounts receivable	Sales ordering
Accounts payable	Order entry
Cash-flow analysis	Check processing
Manufacturing control	Receiving
General Ledger	Retail Operations

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## Enterprise Resource Planning (ERP)

- Enterprise Application programs that aim to improve the cooperation and interaction between all departments such as product planning, purchasing, manufacturing, sales and customer service
  - Often industry-specific
  - SAP, Oracle, PeopleSoft, Baan

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## Benefits of Enterprise Resource Planning

- Eliminate inefficient systems
- Improved data access for decision making
- Facilitate the adoption of improved work processes
- Supply chain management

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## Downside of Enterprise Resource Planning

- Costly
- Changed business processes
- Employee resistance

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## PROGRAMMING

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## Algorithms

- Computers are fast, but not intelligent
- They need algorithms...
- A precise set of instructions that describes how to perform a specific task.
  - Describes the environment and the steps
  - e.g. A recipe
- The algorithms must be provided in a language the computer can understand...

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## Programming Languages

- Coding schemes used to write both systems and application software.
- Function is to provide instructions (algorithms) that the computer system can understand so that it can perform a processing activity (execute).
- A variety of languages
  - Basic, Cobol, C++, Perl, Java...

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## Program

- A set of algorithms written using a programming language (source code)
- Must be translated into something the computer can understand (execute)

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## Language Translators

- Systems software that converts a programmer's source code into its equivalent in machine language (object code) and detects syntax errors.
  - Interpreters translate one program statement at a time as a program is running
  - Compilers (assemblers) convert a complete program into machine language that the computer can process in its entirety

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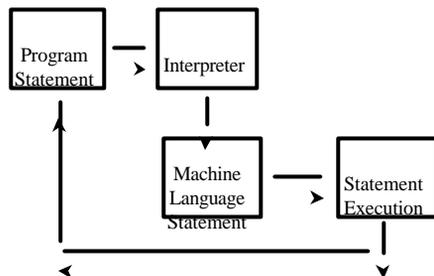
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## Interpreter



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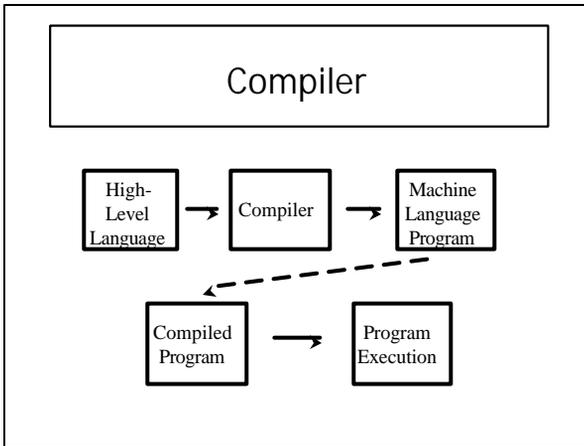
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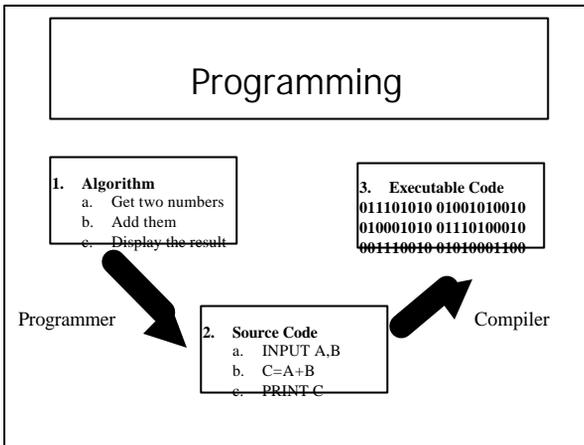
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## Syntax

All languages have a syntax...

- The grammar, structure, or order of the elements in a language statement
- Syntax can be extremely rigid as in the case of most assembler languages or less rigid in others

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## 1GL - Machine Language

- Machine code is the elemental (low-level) language of computers, consisting of a stream of 0's and 1's (binary code)



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## Machine Language

- The computer's processor reads in and processes a certain number of 0's and 1's at a time. 1 statement = 1 instruction.
  - A 32-bit processor reads in 32 bits at a time
- To make machine language easier to read, one hexadecimal can represent four binary digits. Two hexadecimal digits can represent eight binary digits, or a byte (e.g. 1111 0111=F7=247).

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## 2GL – Assembly Language

- Uses symbols rather than binary digits to communicate instructions
- Then converted into machine code by a program called an assembler

e.g. L 8,3000 = load the value at memory location 3000 into register 8

Programmers still had to keep track of where everything was stored in memory.

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## 3GLs

- Basic, COBOL, C, C++, Fortran
- Use English-like commands
- One or two keywords (macros) replaced 5-7 assembly instructions
  - e.g. READ HOURS\_WORKED
- Labels replaced memory locations
- The keywords and labels are converted into machine codes

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## 4GLs

- More English-like than 3GLs
- Non-procedural
  - Programmers do not have to give step by step instructions to perform a function
  - e.g. for every worker
    - if hours are greater than 40
    - multiply overtime by 1.5
- Each statement in a 4GL language can be converted to 30 to 50 assembly instructions

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## 4GLs

- Structured Query Language (SQL)
  - A standardized language often used to perform database queries and manipulations.
- Oracle, Powerhouse, FOCUS, 4GL

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## Object Oriented Languages

- A revolutionary concept that changed the rules in computer programming
- Organized around objects
  - Modeled after real-world objects (e.g. houses)

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## Object Oriented Languages

- Polymorphism: One procedure can work with multiple objects.
- Inheritance: an object in a particular class gets attributes of that class
  - Lower costs
  - Reduced testing
  - Faster implementation

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## Visual Programming Languages

- Languages that use a mouse, icons, or symbols on the screen and pull-down menus to develop programs.
  - Easy to use; intuitive
  - Tend to run slowly
  - Poor connectivity features
  - Lack power and flexibility
  - Visual Basic, VBA, Visual C++

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## Fifth-Generation Languages

- Knowledge-based programming
  - An approach to the development of computer programs in which you do not tell a computer how to do a job, but what you want it to do.
    - ◆ Natural Language, Artificial Intelligence
    - ◆ No programming experience required
    - ◆ Prolog, LISP

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## Selecting a Language

- Trade offs of language characteristics, cost, control & complexity
- Assembly language programs are fast & efficient & offer the programmer control over the hardware
- Third- and fourth- generation languages are easier to learn & use

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