Chapter 4

Software: Systems and Application Software

At a Glance

Instructor's Manual Table of Contents

Overview

Chapter 4 provides insight into the processes and methods for instructing information systems to perform value-adding tasks in ways desired by organizational users. This is accomplished through the use of software. Two types of software are important to information system users: systems software and application software. Systems software coordinates the activities of the hardware and various application programs, while application software consists of programs that help users solve particular computing problems. An operating system, which plays a central role in the functioning of a computer system, is an example of systems software. Accounting packages, decision support software, word processing software, and graphic software are all examples of applications.

Principles and Objectives

Principles	Learning Objectives
Systems and application software are critical in helping individuals and organizations achieve their goals.	• Identify and briefly describe the functions of the two basic kinds of software. • Outline the role of the operating system and identify the features of several popular operating systems.
Do not develop proprietary application software unless doing so will meet a compelling business need that can provide a competitive advantage.	• Discuss how application software can support personal, workgroup, and enterprise business objectives. • Identify three basic approaches to developing application software and discuss the pros and cons of each.
Choose a programming language whose functional characteristics are appropriate to the task at hand, considering the skills and experience of the programming staff.	• Outline the overall evolution of programming languages and clearly differentiate between the generations of programming languages.
The software industry continues to undergo constant change; users need to be aware of recent trends and issues to be effective in their business and personal life.	• Identify several key issues and trends that have an impact on organizations and individuals.

Teaching Tips

Why Learn About Software?

Software is indispensable for any computer system, and computer systems are important for almost all organizations. In this chapter, students will learn about systems and application software. Without systems software, computers would not be able to input data from a keyboard, make calculations, or print results. Different types of application software allow computers to serve the unique computing needs of diverse users, such as sales representatives, stick and bond traders, and scientists.

Regardless of their job, students will most likely use software throughout their careers for work-related tasks, education, and advancement. Students can also use software to perform personal tasks, such as preparing personal income taxes, keeping a budget, finding information on the Internet, and playing games.

An Overview of Software

Software refers to computer programs that control the workings of the computer hardware. Computer programs are sequences of instructions for the computer. On screen or printed documentation provide the user information on how to operate the computer system. Both systems and application software can be used to meet the needs of an individual, a group, or an enterprise.

Systems Software

Systems software is the set of programs that coordinates the activities and functions of the hardware and other programs throughout the computer system. Operating systems, utility programs, and middleware, which are all examples of systems software, are discussed in later sections. Each type of systems software is designed for a specific CPU and class of hardware.

Application Software

Application software consists of programs that help users solve particular computing problems. There are many types of application software, some of which are discussed later in the chapter.

Supporting Individual, Group, and Organizational Goals

Most organizations have three spheres of influence: personal, workgroup, and enterprise. You can find software to support of each of these spheres of influence.

Information systems that operate within the personal sphere of influence serve the needs of an individual user. These information systems help users improve their personal effectiveness, increasing the amount and quality of work they can do.

When two or more people work together to achieve a common goal, they form a workgroup. An information system in the workgroup sphere of influence helps a workgroup attain its common goals.

Information systems that operate within the enterprise sphere of influence support the firm in its interaction with its environment. The surrounding environment includes customers, suppliers, shareholders, competitors, special interest groups, the financial community, and government agencies.

Installing and Removing Software for PCs

Before you can use software on a computer, you must install it on the computer. Installing software usually involves reading a EULA, selecting a destination folder, beginning the setup, and waiting for the setup program to install the files.

Most operating systems have an add/remove program feature that allows you to easily remove software. However, this feature does not work with all software and it does not always remove all elements of the software.

Teaching Tip	Demonstrate the process of installing and removing a software product from the computer using the add/remove program feature of an operating system.

Systems Software

Systems software controls the operations of computer hardware and supports the problem-solving capabilities of application programs. Types of system software include operating systems, utility programs, and middleware.

Operating Systems

An operating system (OS) is a set of computer programs that controls the computer hardware and acts as an interface with application programs. It plays a central role in the functioning of the complete computer system and is usually stored on disk. It is also responsible for the execution of the following activities:

- Performing common computer hardware functions
- Providing a user interface and input/output management
- Providing a degree of hardware independence
- Managing system memory
- Managing processing tasks
- Providing networking capability
- Controlling access to system resources
- Managing files

Teaching Tip	Ask students to describe the features they would find useful in an operating system.

Quick Quiz 1

1. _____ are sequences of instructions for the computer.
   ANSWER: Computer programs

2. The combination of a particular hardware configuration and systems software package is known as a(n) _____.
   ANSWER: computer system platform

3. _____ describes the program functions to help the user operate the computer system.
   ANSWER: Documentation

4. What is the element of the operating system that allows individuals to access and command the computer system?
   ANSWER: User interface

5. What is the term used to describe the ability of a computer to smoothly handle an increasing number of concurrent users?
   ANSWER: Scalability

6. _____ software is the set of programs that coordinates the activities and functions of the hardware and other programs throughout the computer system.
   ANSWER: Systems

7. What kind of software consists of programs that help users solve particular computing problems?
   ANSWER: Application software

Current Operating Systems

Popular operating systems include the early command-based MS-DOS for PCs as well as GUIs such as Windows 95, 98, Windows NT, Windows 2000, Windows Millennium Edition, Windows XP, Windows Vista, Mac OS, and Linux.

The Windows operating systems are developed by Microsoft. Windows XP was released in the fall of 2001. Previous consumer versions of Windows were notably unstable and crashed frequently, requiring frustrating and time-consuming reboots. With XP, Microsoft sought to bring reliability to the consumer.

Windows XP also improved the security of the PC by providing a firewall. Vista is the most recent revision of the Windows OS. Microsoft hopes that Vista is more secure and stable than previous operating systems.

The Apple OSs have also evolved over a number of years and often provide features not available from Microsoft. Starting in July 2001, the Mac OS X was installed on all new Macs. Tiger, also called Mac OS X.4, is the most recent version of OS X released in 2005.

Linux is an open-source operating system developed by Linus Torvalds in 1991. It is increasingly used by individuals and companies to decrease costs and avoid the security flaws in Microsoft OSs.

Workgroup Operating Systems

Powerful and sophisticated OSs are needed to run the servers that meet the business needs of workgroups. These include Windows Server from Microsoft, UNIX, NetWare from Novell, Red Hat Linux, and Mac OS X Server from Apple Computer.

Enterprise Operating Systems

Mainframe computers are the computing platform of choice for mission-critical business applications for many companies. z/OS from IBM, MPE/iX from Hewlett-Packard, and Red Hat Linux for IBM are three examples of mainframe operating systems.

Operating Systems for Small Computers, Embedded Computers, and Special-Purpose Devices

Operating systems are not only used in PCs; they are also used in devices such as personal digital assistants (PDAs), cell phones, digital cameras, TVs, etc. These OSs are called embedded operating systems because they are typically embedded within a device, such as an automobile, TV recorder, etc.

PalmSource makes the Palm operating system that is used in handheld computers and smartphones manufactured by Palm, Inc., and other companies. Windows Embedded is a family of Microsoft OSs included with or embedded into small computer devices. Windows Embedded includes Windows CE .Net and Windows XP Embedded. Windows Mobile is a family of Microsoft OSs for mobile or portable devices. Windows Mobile includes Pocket PC, Pocket PC Phone Edition, and SmartPhone.

Utility Programs

Utility programs help to perform maintenance or correct problems with a computer system. There are many types of utility programs available including hardware utilities, virus-detection and recovery utilities, file-compression utilities, spam and pop-up blocker utilities, network and Internet utilities, and server and mainframe utilities.

Middleware

Middleware is software that allows different systems to communicate and exchange data. Middleware can also be used as an interface between the Internet and older legacy systems.

Quick Quiz 2

1. Which is the most recent version of the Windows operating system?
   ANSWER: Windows Vista

2. _____ is a network OS sold by Novell that can support users on Windows, Macintosh, and UNIX platforms.
   ANSWER: NetWare

3. The _____ is IBM's first 64-bit enterprise OS.
   ANSWER: z/OS

4. Windows _____ is a family of Microsoft OSs for mobile or portable devices.
   ANSWER: Mobile

5. _____ is software that allows different systems to communicate and exchange data.
   ANSWER: Middleware

Application Software

The primary function of application software is to apply the power of the computer to give people, workgroups, and the entire enterprise the ability to solve problems and perform specific tasks.

Overview of Application Software

The key to unlocking the potential of any computer system is application software. A company can either develop a one-of-a-kind program for a specific application (called proprietary software), or purchase and use an existing software program (sometimes called off-the-shelf software). Some companies opt to combine the two approaches and customize off-the-shelf software.

The advantages and disadvantages of proprietary software development are as follows:

Advantages:

- Software more closely matches needs
- Development results are more controllable
- More flexibility in making changes

Disadvantages:

- Development is generally longer
- It may be difficult for in-house system development staff to provide the required level of ongoing support and maintenance
- Greater risk of performance problems

The purchase of off-the-shelf software also has its share of advantages and disadvantages, some of which are given below.

Advantages:

- Lower costs
- Lower risks
- Higher quality

Disadvantages:

- Organization may be paying for features it doesn't require
- Software may lack important features
- Work processes may need to be changed to match software

Personal Application Software

Personal application software includes general-purpose tools and programs that can support a number of individual needs. Word processing programs, spreadsheet programs, database programs, and graphics programs are some examples. Software suites are collections of single application programs packaged in bundles.

Teaching Tip	Demonstrate the use of several types of personal application software in class. Ask students to work in groups and experiment with one of the applications with which they are not familiar.

Workgroup Application Software

Another class of application software is aimed at the workgroup sphere of influence. Packages such as Lotus Notes are called groupware, and are developed to facilitate collaborative computing.

Enterprise Application Software

Application software in this class benefits an entire organization. Organizations can no longer respond to market changes using nonintegrated information systems based on overnight processing of yesterday's business transactions, conflicting data models, and obsolete technology. As a result, many corporations are turning to enterprise resource planning (ERP) software, a set of integrated programs that manage a company's vital business operations for an entire multisite, global organization.

Application Software for Information, Decision Support, and Specialized Purposes

Specialized application software programs for information, decision support, and other purposes are being used in every industry. For example, genetic researchers are using software to visualize and analyze the human genome, while music executives use decision support software to help pick the next hit.

Quick Quiz 3

1. What is the term used to describe one-of-a-kind software for a specific application?
   ANSWER: Proprietary software

2. What type of software is best suited for writing a memo?
   ANSWER: Word processing software

3. _____ applications are ideal for storing, manipulating, and retrieving data.
   ANSWER: Database

4. _____ application software is designed to support teamwork.
   ANSWER: Workgroup

Programming Languages

Both operating systems and application software are written in coding schemes called programming languages. The primary function of programming languages is to provide instructions to the computer system so that it can perform a processing activity.

The Evolution of Programming Languages

The evolution of programming languages is typically discussed in terms of generations of languages as shown in Table 4.9 (page 157).

Generation	Language	Approximate Development Date	Sample Statement or Action
First	Machine language	1940s	00010101
Second	Assembly language	1950s	MVC
Third	High-level language	1960s	READ SALES
Fourth	Query and database languages	1970s	PRINT EMPLOYEE NUMBER IF GROSS PAY>1000
Beyond Fourth	Natural and intelligent languages	1980s	IF gross pay is greater than 40, THEN pay the employee overtime pay.

Table 4.9: The Evolution of Programming Languages

Today, programmers often use visual and object-oriented languages. These languages are generally easier to use than older generation languages. Visual languages use a graphical or visual interface for program development. Visual Basic was one of the first visual programming languages.

Object-oriented languages are based upon the use of objects. An object consists of data and the actions that can be performed on the data. One of the main advantages of an object-oriented language is that it makes it easy to reuse code. Some of the most popular object-oriented programming languages include Smalltalk, Visual Basic .NET, C++, and Java.

Programming languages used to create artificial intelligence or expert systems applications are often called fifth-generation languages (5GLs). These languages are also sometimes called natural languages because they use even more English-like syntax than fourth-generation languages. They allow programmers to communicate with the computer by using normal sentences such as, “How many athletic shoes did our company sell last month?”

Teaching Tip	Invite a professional programmer in to talk about his or her job in the software industry. Ask him or her to discuss current trends in programming as well.

Quick Quiz 4

1. True or False: Programming languages are only used to write application programs, not systems software.
   ANSWER: False

2. A set of rules associated with a programming language is referred to as the _____ of the language.
   ANSWER: syntax

3. In programming, a(n) _____ consists of data and the actions that can be performed on the data.
   ANSWER: object

4. True or False: With third-generation and higher-level programming languages, each statement in the language translates into several instructions in machine language.
   ANSWER: True

5. What kind of software program converts the programmer's source code into machine-language instructions?
   ANSWER: A compiler

Software Issues and Trends

Major software issues and trends in today's computer systems include software bugs, copyrights, software licensing, open-source software, shareware and public domain software, multiorganizational software development, software upgrades, and global software support.

Software Bugs

A software bug is a defect in a computer program that keeps it from performing in the manner intended. Some software bugs are obvious and cause the program to terminate unexpectedly. Others are more subtle and allow errors to creep into your work. According to the Pentagon and the Software Engineering Institute at Carnegie Mellon University, there are typically 5 to 15 bugs in every 1,000 lines of code.

Copyrights and Licenses

Software manufacturers want to license their software in order to lock in a steady, predictable stream of revenue from customers. Software manufacturers also want to encourage customers to move to the latest releases of their software products in order to minimize the effort required to support out-of-date products. As such, there are numerous types of software licenses available, such as usage-based licenses, capacity-based licenses, and subscription licensing.

Open-Source Software

Open-source software refers to applications that are freely available to anyone in a form that can be easily modified. Users can download source code and build the software themselves, or the software's developers can make executable versions available along with the source.

A number of open-source software packages are widely used, including the following: the Linux system; Apache, the most popular Web server in the world; Sendmail, a program that delivers e-mail for most systems on the Internet; and Perl, a programming language used to develop Internet application software.

Shareware, Freeware, and Public Domain Software

Many software users turn to shareware and freeware in an effort to reduce their software costs. The terms shareware and freeware refer to software that is very inexpensive or free, usually for use in personal computers, but whose source code cannot be modified. Shareware and freeware that is in the public domain is called public domain software. This software is not protected by copyright laws and can be freely copied and used.

Software Upgrades

Software companies revise their programs and sell new versions periodically. The revised software may or may not offer additional capabilities. Software upgrades usually cost much less than the original purchase price.

Global Software Support

Many software vendors sell licenses for their software around the world. However, some of these vendors may find it a challenge to provide adequate support for their software customers in all regions of the world. Slower technology growth markets, such as Eastern Europe and Latin America, might not have any official vendor presence. Instead, large vendors such as Sybase, IBM, and Hewlett-Packard typically contract with local providers to support their software.

Quick Quiz 5

1. A software _____ is a defect in a computer program that keeps it from performing in the manner intended.
   ANSWER: bug

2. _____ software is freely available to anyone in a form that can be easily modified.
   ANSWER: Open-source

3. The terms _____ and _____ are used to describe software that is very inexpensive or free, but whose source code cannot be modified.
   ANSWER: shareware, freeware

4. True or False: Software upgrades usually cost much less than the original purchase price.
   ANSWER: True

Class Discussion Topics

1. What are some effects of open-source software on the quality of software products?

2. Discuss how the widespread use of personal productivity software in the workplace impacts the employee and the company.

Additional Projects

1. Choose two operating systems offered by different companies that are used in the same sphere of influence. Research these operating systems and write a 1-2 page report summarizing the key features, as well as any potential problems of each.

2. Using the Internet, find two relatively new software programs that can be purchased online. Are they systems software or application software? In which sphere of influence do they operate – personal, workgroup, or enterprise? Are they shareware or freeware? If not, does the license give you unlimited use of the software on one or two computers, or do you pay based on how much you use the software? Summarize your findings in 2-3 paragraphs.

Additional Resources

- GNU Operating System - Free Software Foundation: www.gnu.org/

- History and Evolution of Computer Languages: www.scriptol.org/history.php

- How Operating Systems Work: http://computer.howstuffworks.com/operating-system.htm

Key Terms

- **Application program interface (API)** - an interface that allows applications to make use of the operating system.
- **Application service provider (ASP)** - a company that provides software, support, and the computer hardware on which to run the software from the user's facilities.
- **Command-based user interface** - a user interface that requires you to give text commands to the computer to perform basic activities.
- **Compiler** - a special software program that converts the programmer's source code into the machine-language instructions consisting of binary digits.
- **Computer programs** - sequences of instructions for the computer.
- **Documentation** - the text that describes the program functions to help the user operate the computer system.

- **Enterprise sphere of influence** - the sphere of influence that serves the needs of the firm in its interaction with its environment.
- **Graphical user interface (GUI)** - an interface that uses icons and menus displayed on screen to send commands to the computer system.
- **Kernel** - the heart of the operating system, which controls the most critical processes.
- **Middleware** - software that allows different systems to communicate and exchange data.
- **Open-source software** - software that is freely available to anyone in a form that can be easily modified.
- **Operating system (OS)** - a set of computer programs that controls the computer hardware and acts as an interface with application programs.
- **Personal productivity software** - the software that enables users to improve their personal effectiveness, increasing the amount of work they can do and its quality.
- **Personal sphere of influence** - the sphere of influence that serves the needs of an individual user.
- **Programming languages** - sets of keywords, symbols, and a system of rules for constructing statements by which humans can communicate instructions to be executed by a computer.
- **Shareware and freeware** - software that is very inexpensive or free, but whose source code cannot be modified.
- **Software suite** - a collection of single application programs packaged in a bundle.
- **Syntax** - a set of rules associated with a programming language.
- **User interface** - the element of the operating system that allows you to access and command the computer system.
- **Utility programs** - programs that help to perform maintenance or correct problems with a computer system.
- **Workgroup** - two or more people who work together to achieve a common goal.
- **Workgroup application software** - software that supports teamwork, whether in one location or around the world.
- **Workgroup sphere of influence** - the sphere of influence that serves the needs of a workgroup.