# *Digital Planet:*

## *Tomorrow's Technology and You*

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Tenth Edition

# Digital Planet:
# Tomorrow's Technology and You

## Chapter 4

# Software Basics

## The Ghost in the Machine

# Chapter 4 Objectives

- ✓ Describe three fundamental categories of software and their relationships

- ✓ Explain the relationship of algorithms to software

- ✓ Compare and contrast PC applications and Web applications

- ✓ Describe the role of the operating system in a modern computer system

# Objectives (cont.)

✓ Explain how file systems are organized

✓ Outline the evolution of user interfaces from machine-language programming to futuristic interfaces

✓ Describe some challenges of applying intellectual property laws to software

# Processing with Programs

✓ Software enables people to communicate certain types of problems to the computer.

✓ Software makes it possible for computers to communicate solutions back to people.

✓ An *algorithm* is a set of step-by-step procedures for accomplishing a task.

✓ Programmer's job is to turn the algorithm into a program by adding details, testing procedures, and debugging or correcting errors.

# Linus Torvards talking to Linux Fans

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# LINUX Operating System

✓ Pronounced "Linn-uks" by its creator

✓ Initially developed by Linus Torvalds, based on a scaled-down version of the UNIX operating system.

✓ Code is freely available under the GNU (General Public License)

✓ Anyone can give away, modify, or even sell Linux as long as the source code (program instructions) remain available for others to modify.

✓ Called "Open Source Software.

# Open Source Software

✓ Thousands of programmers around the world have contributed to Linux.

✓ Has matured into a powerful, versatile operating system.

✓ Very popular among groups who have to operate on a tight budget, including third world countries.

✓ Has motivated many other groups to release open source software.

# Categories of Software

✓ *Compilers* and translator programs

- Enable programmers to create other software

✓ Software applications

- Serve as productivity tools to help users solve problems

✓ System software

- Coordinates hardware operations

# A Fast, Stupid Machine

✓ Typical computer is only capable of:

- Performing basic arithmetic operations
    - Such as 7 + 3 and 15 − 8
- Performing simple logical comparisons
    - Is this number less than that number?
    - Are these two values identical?

✓ Computers seem smart because they perform these operations quickly and accurately.

# Interacting with Computers

✓ Software allow people to interact with computers.

✓ Since computers only recognizes 0's and 1's, software provides the bridge that allows programmers to develop software that allow others to solve their problems using computers.

✓ A key step was based on the <u>stored-program</u> concept.

- I.e.,recognizing that programs instructions could be stored in the same manner as data in the memory of a computer.

# Creating Programs

✓ Instead of flipping switches and patching wires together, today's programmers write <u>program</u>.

  • I.e., sets of computer instructions designed to solve problems.

✓ The large collection of programs stored on a computer to solve problems is computer software

# SUZANNE'S FRENCH TOAST FANTASTIQUE: THE ALGORITHM

1. Prepare the batter by following these instructions.
   1a. Crack 2 eggs so whites and yolks drop in bowl; discard shells.
   1b. Beat eggs 30 seconds with wire whisk, fork, or mixer.
   1c. Mix in 1 teaspoon vanilla extract, $\frac{1}{2}$ teaspoon cinnamon, and $\frac{2}{3}$ cup milk.
2. Place 1 tablespoon butter in frying pan and place on 350° heat.
3. For each of six pieces of bread, follow these steps:
   3a. Dip slice of bread in mixture.
   3b. For each of the two sides of the bread do the following steps:
      3b1. Place the slice of bread in the frying pan with this (uncooked) side down.
      3b2. Wait 1 minute then peek at underside of bread; if lighter than golden brown, repeat this step.
   3c. Remove bread from frying pan and place on plate.
4. Serve bread with maple syrup, sugar, or tart jelly.

# The Language of Computers

✓ Every computer processes instructions in *machine language*.

- Numeric codes used to represent basic operations:
  - Adding and subtracting numbers
  - Comparing numbers
  - Moving numbers
  - Repeating instructions

✓ Programmers use *high-level languages*.

- C++, Java, and Visual Basic

# Executing a Program

✓ Most programs are composed of millions of simple machine-language instructions.

✓ The program counter inside the CPU keeps track of the address of the next instruction to be executed.

✓ The instruction execution cycle has a three-step rhythm:

   1. Fetch the instruction

   2. Increment the program counter

   3. Perform the specified task

**2.** The CPU increases the value of the program counter to contain the address of the next instruction.

**5.** The CPU increases the value of the program counter to contain the address of the next instruction.

CPU

| 100 | Program Counter |
| LOAD A,2000 | Instruction Register |
| 99.00 | A |
| ? | B | ALU |
| ? | C |

| 104 | Program Counter |
| LOAD B,2004 | Instruction Register |
| 99.00 | A |
| 0.05 | B | ALU |
| ? | C |

**3.** The CPU loads the contents of memory location 2000 into register A.

RAM

| LOAD A,2000 | 100 |
| LOAD B,2004 | 104 |
| Multiply C,A,B | 108 |
| STORE C,2008 | 112 |
| 99.00 | 2000 |
| 0.05 | 2004 |
| ? | 2008 |

RAM

| LOAD A,2000 | 100 |
| LOAD B,2004 | 104 |
| Multiply C,A,B | 108 |
| STORE C,2008 | 112 |
| 99.00 | 2000 |
| 0.05 | 2004 |
| ? | 2008 |

**1.** The program counter is 100. The CPU loads the instruction at address 100 into the instruction register.

**4.** The program counter is 104. The CPU loads the instruction at address 104 into the instruction register.

**6.** The CPU loads the contents of memory location 2004 into register B.
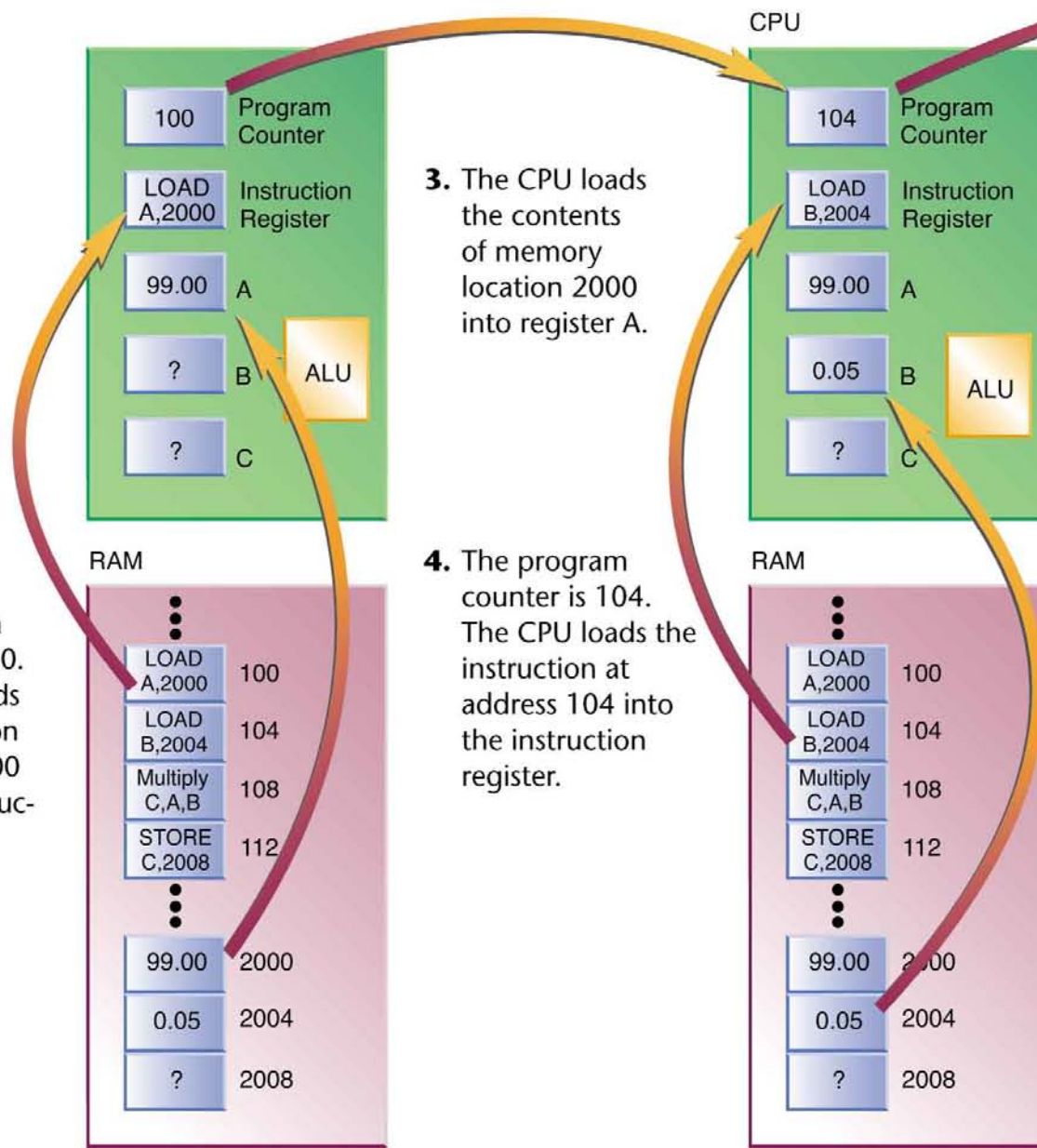
# Software Applications: Tools for Users

Software applications enable users to control computers without having to think like programmers.

# Consumer Applications

- Thousands of software titles are available:
  - Publishing programs
  - Accounting software
  - Graphics programs
  - Educational titles
  - Games
  - Personal-information managers
  - Programs to solve a wide range of mathematical problems
  - … and many other

# Documentation

✓ *Documentation:* Instructions for installing and using software—may be printed manuals or digital files

- Often include "Read Me" files with installation instrutions
- "Help Files" that provide are often replacements for traditional manuals.
- These help files can be accessed through local help files on the users computer or else at the company's website.

# Updating and Upgrading Software (Added)

✓ Software companies often provide minor free updates that provide bug fixes and improvements several times a year.

✓ Major upgrades are often provided every year or two.

✓ An upgrade to the next major version of the program usually requires an upgrade fee

✓ Most software companies use decimals after the major version number to indicate minor upgrades.

# Compatibility (Added)

- ✓ *Compatibility Requirement:* Specify the computer or operating systems requirement for a software package.

- ✓ Requirements such as "Windows 7 required" are usually essential.

- ✓ Likewise, requirements such as "Requires 2 GB of RAM" are typically also essential.

# Disclamers and Licensing
## (Added)

✓ Disclaimer—an *end-user license agreement (EULA)*—protects companies from errors in programs

- Software is essentially never error-free

✓ *Licensing:* Buy software license not program

- You will get compiled code, so you do not have to compile it before installing it.

- Also, prevents you from gaining access to proprietary programs or being able to change them.

✓ Distribution by direct sales or download from Web

- Includes *public-domain software* and *shareware*

# Web Applications

✓ Growing trend toward using applications that run on remote Internet servers instead of local PCs.

- Google Docs

- Photoshop.com

- Webmail programs: Gmail, Hotmail, Yahoo! Mail

- Multiplayer games

- Wikis: Wikipedia

- Retail sites: Amazon.com and online auctions, eBay

- Online communities: Facebook

# Web Applications (cont.)

✓ *Mashups:* Web applications that provide new services by combining data or functionality from two or more external sources

- Web site might combine crime statistics from a police Web site with maps from Google to create visual representations of where crimes are occurring

- Another might combine language translation with Web search to allow a user to search for terms in another language

# Vertical-Market and Custom Software

✓ Basic office applications are used in homes, schools, government offices, and all types of businesses.

✓ Other applications are job specific:

- Medical billing software

- Library cataloging software

- Legal reference software

- Restaurant management software

✓ Tend to cost far more than mass-market applications

# System Software:
# The Hardware-Software Connection

✓ *System software:* Class of software that includes the operating system and utility programs

✓ Handles low-level details and hundreds of other tasks behind the scenes

✓ User does not need to be concerned about details

# What the Operating System Does

✓ Every computer depends on an *operating system* to:

- Keep hardware running efficiently

- Make process of communication with hardware easier

- Maintains file system

  o Keeps track of the location of all programs and data files on the hard drive.

- Supports *multitasking*

  - In concurrent execution of concurrent processes, the operating system creates dozens of tasks Since CPU can only execute one task at a time, the operating system must do task scheduling.

# What does the Operating System Do (cont)

- Manages *virtual memory*

    - Space on the hard drive that simulates random access memory. Virtual memory is like RAM, except slower. Processes that are currently inactive can be stored temporarily in virtual memory.

- Manages <u>authentications</u> (verifying users are who they claim to be) and <u>authorization</u> (ensuring users have permission to perform certain actions)

✓ Operating system runs continuously when computer is on

# What the Operating System Does
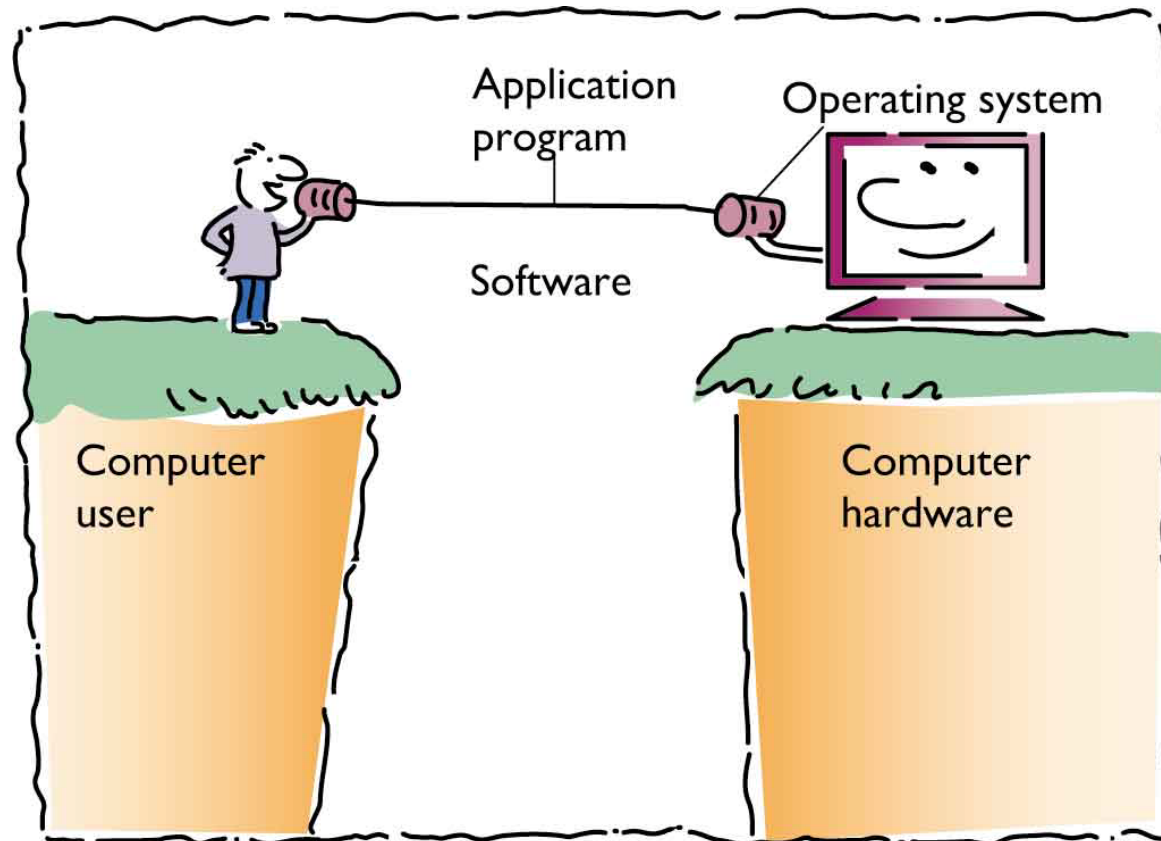


The User's View

# Utility Programs

✓ Serve as tools for doing system maintenance and repairs not handled by operating system

✓ Utilities make it easier for users to:

- Copy files between storage devices

- Repair damaged data files

- Translate files so different programs can read them

- Guard against viruses and other harmful programs

- Compress files so they take up less space

# Device Drivers

✓ Small programs that enable input/output devices to communicate with the computer, such as:

- Keyboards

- Mice

- Printers

✓ Some *device drivers* are included in the operating systems.

✓ Many are bundled with peripherals

✓ Others are sold as separate products

# **Where the Operating System Lives**

✓ Some computers store operating systems in ROM

- Game machines, smart phones, special purpose computes

✓ Most modern PCs hold only a small portion of the operating system in ROM

✓ Remainder of operating system is loaded during *booting*, when computer is turned on

✓ Handheld devices may store operating system in flash memory

# The Operating System

When you turn on the computer, the CPU automatically begins executing instructions stored in ROM. The operating system (OS) loads from the disk into part of the system's memory.
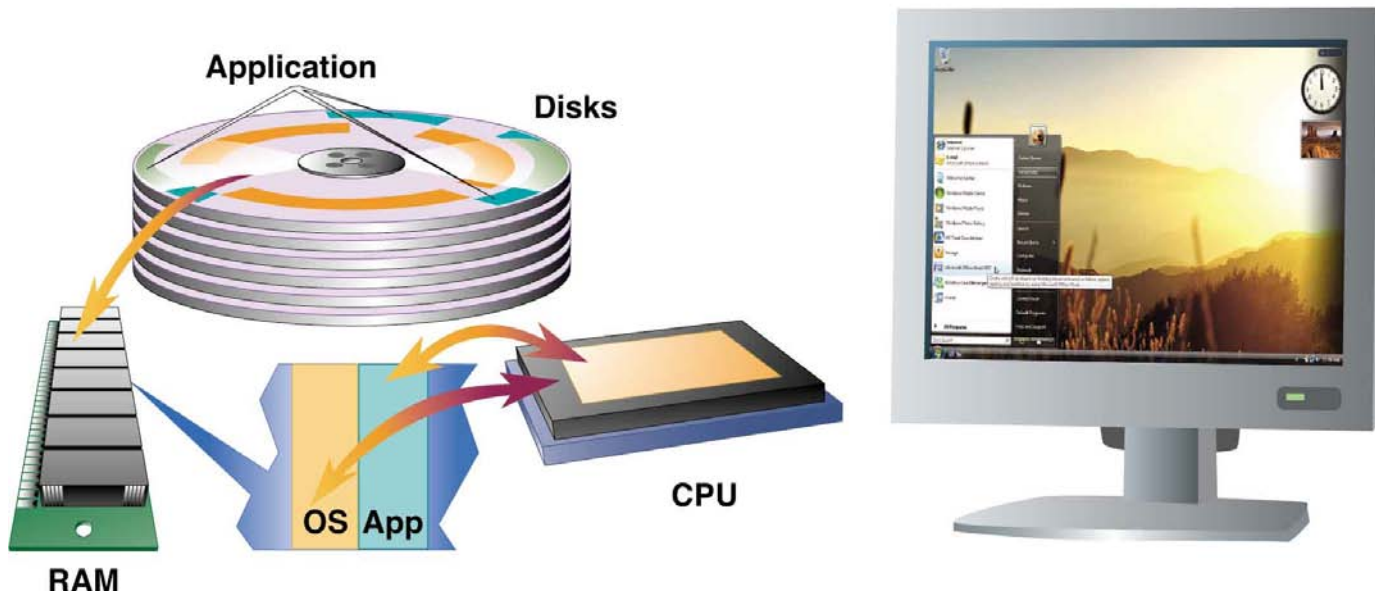
# The Operating System (cont.)

The OS loads the application program into memory and remains in memory, so it can provide services to the application program—display on-screen menus, communicate with the printer, and perform other common actions.
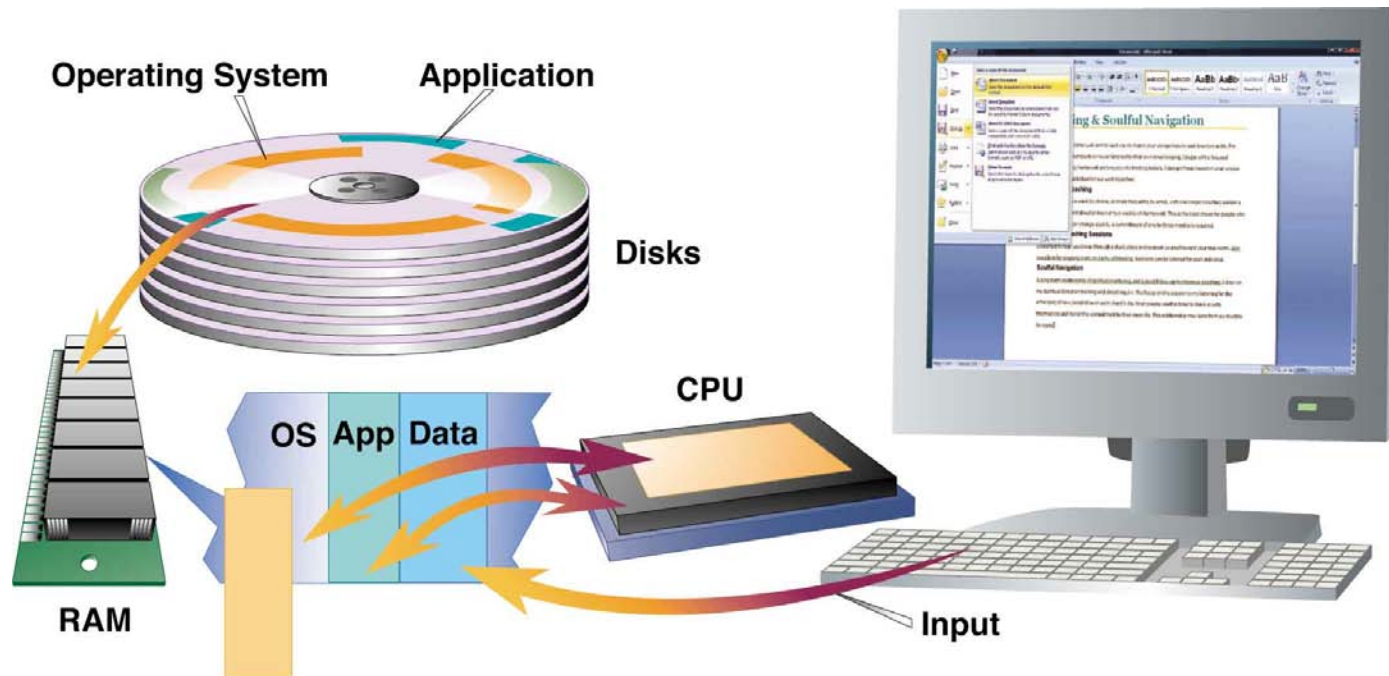
# The Operating System (cont.)

To avoid losing your data file when the system is turned off, save it to the disk. When you reopen the file, the OS locates it on the disk and copies it into memory.
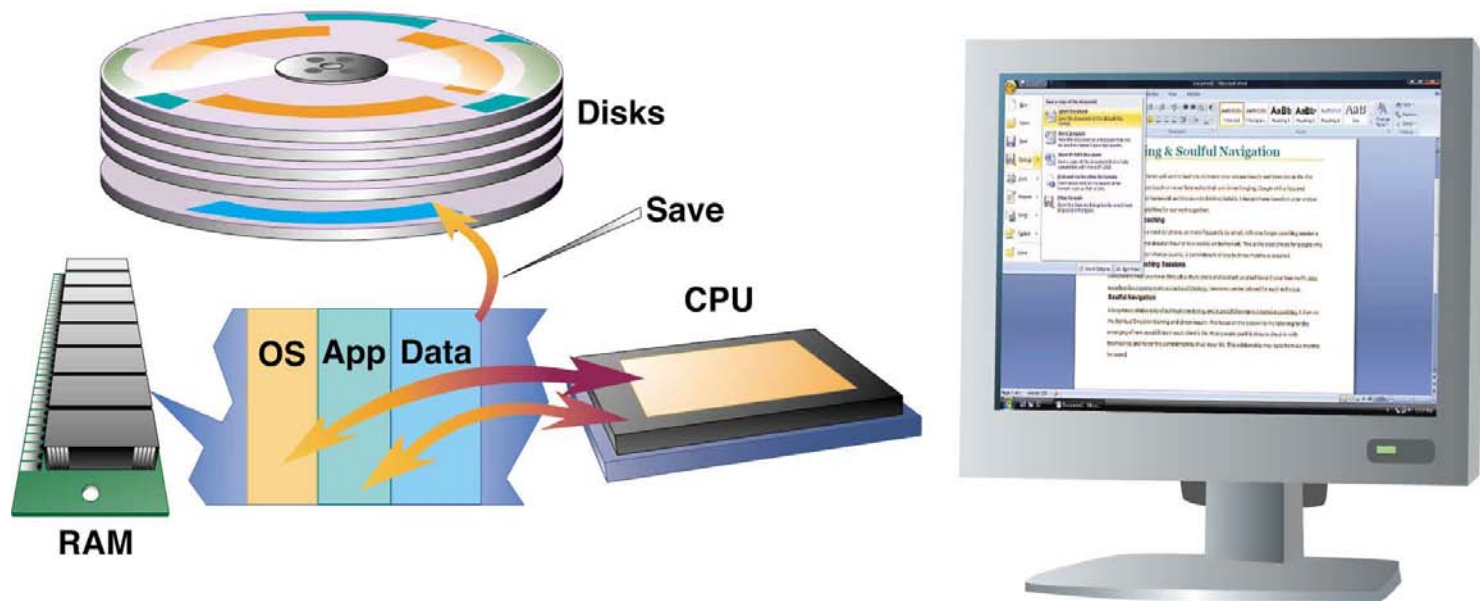
# The User Interface:
# The Human–Machine Connection

✓ *User interface:* Critically important component of software

✓ Early users spent tedious hours writing and debugging machine-language instructions.

✓ Later users programmed using easier languages that were still challenging.

✓ Now, most users work with preprogrammed applications.

# Desktop Operating Systems

✓ ***MS-DOS:*** Standard on IBM-compatible computers in 1981

- Used ***command-line interface*** that required users to type commands

✓ Apple Macintosh introduced windows, icons, and mouse-driven, drop-down menus in 1984.

✓ Windows and Mac OS started as single-user operating systems but today support multiple users.

# Early Operating Systems

✓ MS-DOS (Microsoft Disk Operating Systems) became the standard operating system on IBM compatible computers

  • Had a command-line interface and user typed commands that the computer responded to.

  • Applications usually had a menu-driven interface that allowed users to choose commands from on-screen lists.

✓ The Apple Macintosh introduced in 1984 replaced typed commands and menu lists with windows, icons, and mouse-driven drop-down menus

# Early Operating Systems (cont)

✓ The Mac was the first low-cost computer that had an operating system designed with a graphical user interface (GUI) , called "gooey"

✓ Windows and Mac OS have evolved over the years, adding new features to their GUIs that make them easier to use.

✓ While both were single user operating systems originally, they both support multiple users today.

# UNIX and Linux

✓ *UNIX:* Command-line, character-based OS

- Internet is populated with computers running UNIX

- Enables timesharing computer to communicate with several other computers at one time

- OS of choice for workstations and mainframes in research and academic settings

- Favored by many who require an industrial-strength, multiuser OS

✓ Linux, a UNIX clone, is distributed and supported free

# UNIX and Linux (cont)

- ✓ UNIX is a command-line character-based operating system.

- ✓ The command-line interface called its <u>shell</u> is similar to MS-DOS, but commands are different and much more powerful.

# When Good Software Goes Bad

- Restart the application
- Recover your work
- Reboot the system
- Recheck for updates
- Reboot in safe mode
- Research your problem
- Request help

- Reinstall the program
- Restore the operating system
- Repair the hardware
- Replace the system
- Recycle your old computer

# When Good Software Goes Bad

✓ Be sure to save your work first, if possible.

✓ If system freezes, use system's force-quit option to shut it down

- In windows, Ctrl + Alt + Del, and then click Task Manager. Next, select the frozen program from list and click on End Task.

✓ Some applications have an "automatic save" that saves your work every few minutes.

✓ You should save your work frequently, to avoid loss

# Good Software Goes Bad (cont)

✓ Rebooting the system will solve an amazing number of problems.

- Cleans out bad data and resets parameters that may be messed up due to buggy software

✓ If computer is locked down, force a shutdown by holding down the power button on your computer for a few seconds.

✓ Check you application software for updates and download and install them if needed.

✓ Reboot in safe mode – to avoid problems with other programs that run in the background

- On windows, press F8 key on keyboard as machine is booting and then select arrow to choose "Safe Mode"

# Hardware and Software Platforms

✓ **Microsoft Windows 7:** Introduced in 2009 is latest version

✓ **Microsoft Windows Server:** Runs on small servers to the mightiest hardware

✓ **Windows Embedded CE:** Designed for devices such as robots, voting machines, music players, etc.

✓ **Windows Phone 7:** New OS for mobile phones

✓ **Mac OS X (10):** Standard for the Mac

# Hardware and Software Platforms (cont.)

✓ **iOS:** Used for iPhone, iPad, and iPod

✓ **Linux**, **Sun Solaris**, and other Unix variations

✓ **Google Chrome OS:** Linux based OS for low-cost PCs, netbooks, and tablet devices

✓ **Google Android:** Designed for smart phones

✓ **Blackberry OS:** Proprietary multitasking OS

✓ **Palm WebOS:** Proprietary smart phone OS

# Compatibility Issues
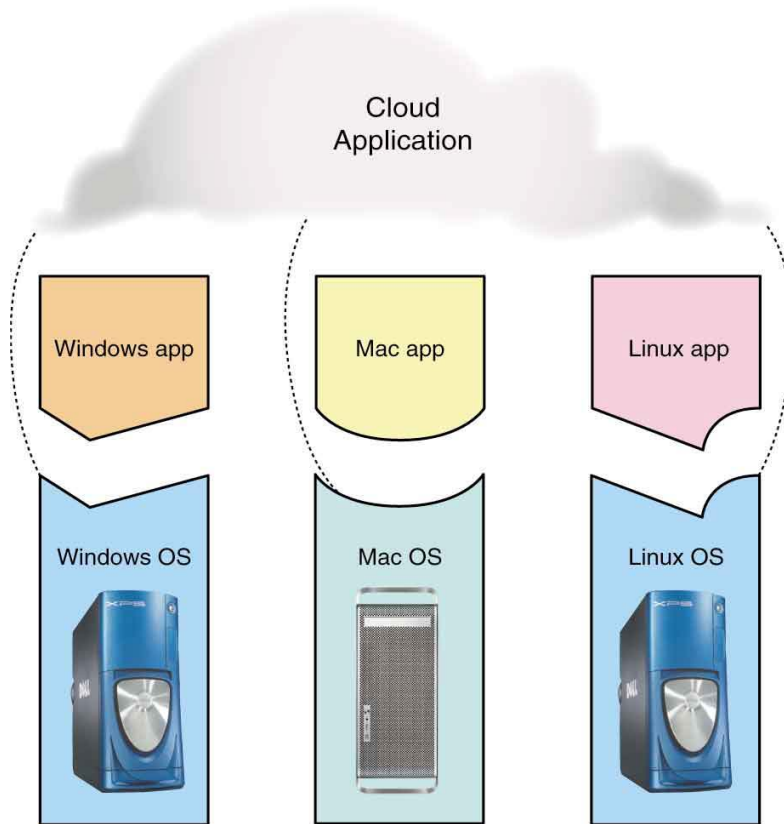


- Operating systems are designed to run on particular hardware platforms.

- Applications are designed to run on particular operating systems.

- Most cloud applications are designed to run on multiple platforms.

# File Management: Where's My Stuff?

✓ One of the challenges of working with a computer is keeping track of the masses of information that can be collected, edited, and stored on disks.

✓ Most computers use some kind of hierarchical file system involving directories or folders to organize files.

# Organizing Files and Folders

✓ Files may be placed in folders.

✓ Folders can be placed inside folders.

✓ Every file and folder has a unique *pathname*.
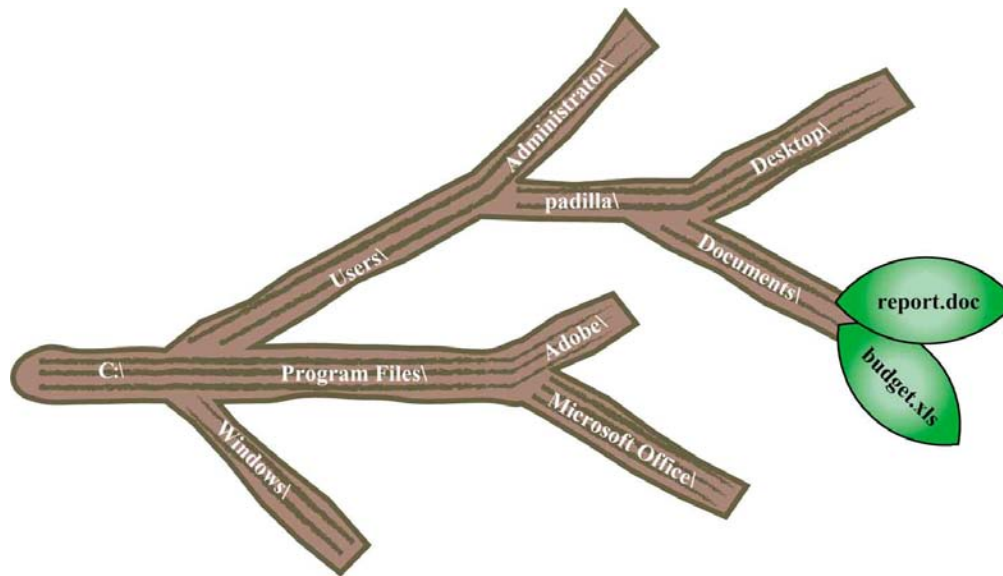
# Windows Explorer and the Finder: File Managers

✓ *File management utility:* Makes it easy to view, rename, copy, move, and delete files and folders

- In Windows it is called Windows Explorer
- In the Mac OS it is called the Finder

✓ Can display information about a file such as size, its type, and the last time it was modified

# Windows Explorer and the Finder: File Managers (cont.)

✓ Windows Explorer allows you to see the contents and location of the folder in the storage device's hierarchy.
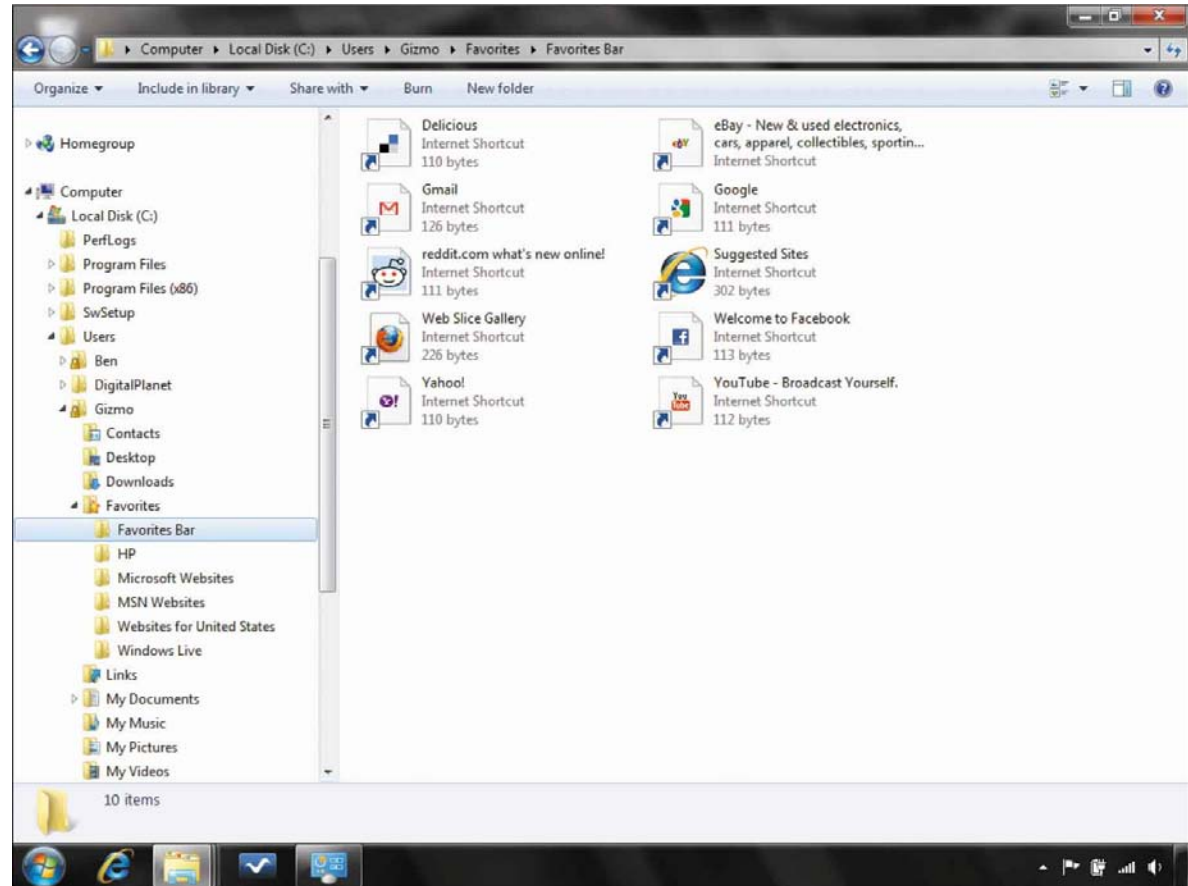
# Managing Files from Applications

✓ Most applications support four basic file-management operations:

- **Open:** Allows you to select the file you want to work on

- **Save:** Writes current application as a disk file

- **Save As:** Allows you to choose the location and name of the file

- **Close:** Allows you to stop working on a project without quitting the application

# Locating Files

✓ Organize files logically

- Store documents in folder called Documents

- Store photos in folder called Pictures

- Store music in folder called Music

✓ Modern operating systems include search tools

- Search for filenames or for words and phrases

- Virtual folders contain files that match certain criteria no matter where they are located

# Disk Formatting

✓ Hard disks are formatted by manufacturer before installing operating system:

- Electronic marks are put on disk.

- Disk is divided into series of concentric tracks.

- *Tracks* are divided into sectors.

- *Sectors* are bundled into *clusters* or *blocks*.

✓ File system provides way to link multiple clusters to store large files

# Defragmentation



- Contents of file may become scattered over clusters.

- Accessing information is faster if file is assigned to contiguous clusters.

- A *defragmentation utility* eliminates fragmented files.
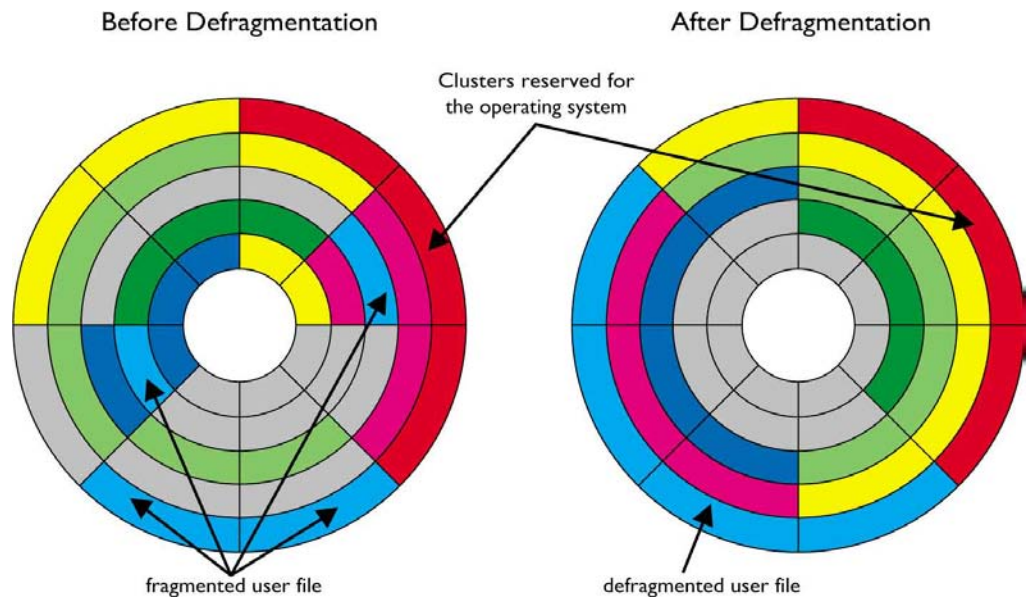
# Software Piracy and Intellectual Property Laws

✓ Software piracy: Illegal duplication of copyrighted software—is rampant

✓ Few software companies use physical copy protection methods and that makes copying easy

✓ Many people unaware of laws

✓ Others simply look the other way

# The Piracy Problem

✓ Software industry loses billions of dollars every year to software pirates.

✓ Business Software Alliance (BSA) estimates that more than one-third of software in use is illegally copied.

✓ Piracy is particularly hard on small companies.

✓ Piracy rates are highest in developing countries.

✓ Industry organizations work with law enforcement agencies to crack down on piracy.

# Intellectual Property and the Law

✓ *Intellectual property:* Includes the results of intellectual activities in the arts, science, and industry

✓ *Copyright* laws: Protects books, plays, songs, paintings, photographs, and movies

✓ *Trademark* law: Protects symbols, pictures, sounds, colors, and smells.

✓ *Patent* law: Protects mechanical inventions

✓ *Contract* law: Covers trade secrets

✓ Under the law, software does not fit in these categories.

# Chapter 4 Summary

- ✓ Software provides communication link between humans and computers.

- ✓ Three main categories: translator programs, applications, and system software.

- ✓ Applications and documentation can be delivered on physical media or downloaded from the Web.

- ✓ Programmers develop vertical-market and custom packages when general commercial programs won't do the job.

# Summary (cont.)

- ✓ Computer's operating system functions behind the scenes, translating software's instructions into messages hardware can understand.

- ✓ Popular operating systems include: Microsoft Windows, Mac OS X, UNIX, and Linux.

- ✓ Operating system manages programs and data files.

- ✓ Utility programs handle problems that operating system can't solve.

# Summary (cont.)

✓ Well-designed user interface shields user from bits and bytes.

✓ Computer industry has moved towards friendlier graphical user interfaces.

✓ Future interfaces are likely to depend more on voice, 3D-graphics, and animation.

✓ Computers use hierarchical file system.

✓ Software piracy has flourished in many countries.