Understanding Computers

11th Edition

TODAY AND TOMORROW

CHAPTER 4

Input and Output

Learning Objectives

- Explain the purpose of a computer keyboard and the types of keyboards widely used today.
- List several different pointing devices and describe their functions.
- Describe the purposes of scanners and readers and list some types of scanners and readers in use today.
- Understand how digital cameras differ from conventional cameras.

Learning Objectives, *Cont'd.*

- Explain how audio input is accomplished.
- Describe the characteristics of a display device.
- List several types of printers and explain their function.
- Understand which hardware devices are used for audio output.

Overview

- This chapter covers:
  - Different types of keyboards and pointing devices
  - Types of scanners, readers, and digital cameras
  - What audio input is
  - Types of display devices and how they work
  - Types of printers and how they work
  - What audio output is

Keyboards

- **Keyboard:** input device containing keys, arranged in a typewriter type of configuration, that can be used to input letters, numbers, and other symbols
- Most PCs today are designed to be used with a keyboard
- Contains:
  - Standard alphanumeric keys
  - *Numeric keypad*
  - *Function keys*
  - *Directional keys* and special keys

FIGURE 4-1
A typical desktop keyboard.

Keyboards, *Cont'd*

- Can be:
  - *Wireless*
  - *Portable*
  - *Foldable*
- Handheld PCs and mobile devices today often have a built-in keyboard or *thumb pad* (keyboard designed to be pressed with just the thumbs)

Quick Quiz – Keyboards

- The key on a conventional keyboard used to end paragraphs and commands typed into the computer is the
  - space bar.
  - escape key.
  - enter key.
- True or false: Keyboards designed for desktop PCs and keyboards built into smart phones typically have the same key layout.
- A keyboard designed to be pressed with just the thumbs is called a(n) _____.

Pointing Devices

- **Pointing device:** input device that moves an onscreen pointer (arrow or insertion point) to allow the user to select objects on the screen.
- Usually buttons on the device are used to select objects
- Common types of pointing devices:
  - *Mouse*
  - *Electronic pen*
  - *Touch screen*

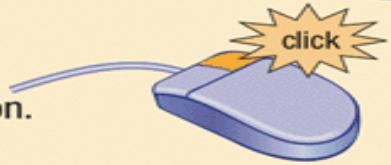
The Mouse

- **Mouse:** common pointing device that the user slides along a flat surface to move a pointer around the screen and clicks its buttons to make selections
  - Rests on the desk or other flat surface close to the user's PC
  - Older *mechanical mice* have a ball exposed on the bottom surface
  - Most mice today are *optical mice* that track movements with light
  - Can be *wireless*

POINT
Move the mouse until the mouse pointer is at the desired location on the screen.

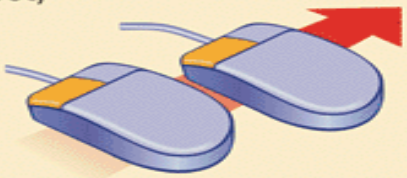
CLICK
Press and release the left mouse button.

RIGHT-CLICK
Press and release the right mouse button.



DOUBLE-CLICK
Press and release the left mouse button twice, in rapid succession.

DRAG-AND-DROP
When the mouse pointer is over the appropriate object, press and hold down the left mouse button, drag the object to the proper location on the screen by moving the mouse, and then drop the object by releasing the mouse button.

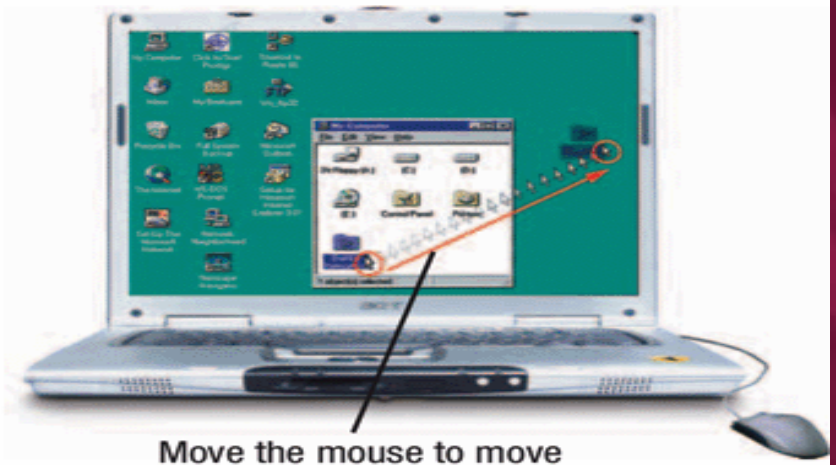


SCROLL WHEEL/BUTTON
If your mouse has a wheel or button on top of it, use it to scroll through the displayed document.

COMMON MOUSE OPERATIONS

(Top view) (Bottom view)

A LASER MOUSE



Move the mouse to move the mouse pointer.

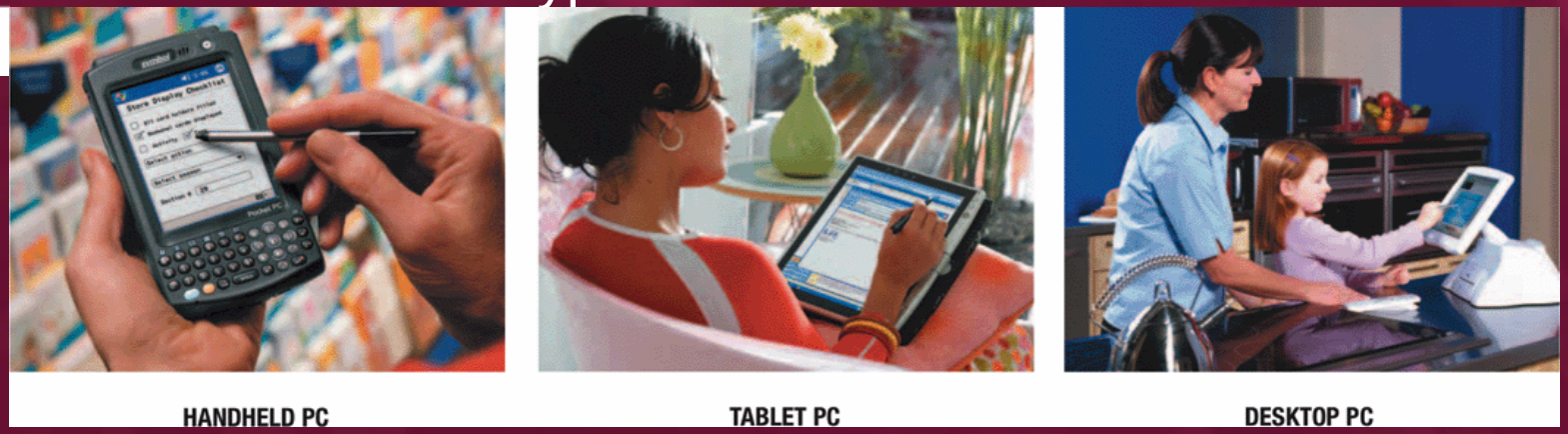
USING A MOUSE

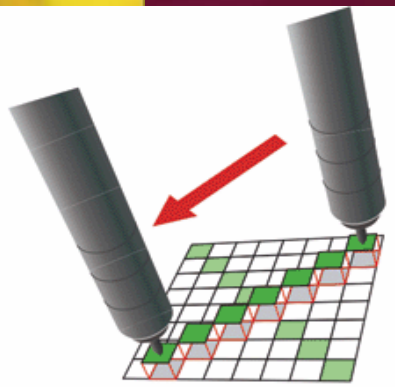
FIGURE 4-3
Using a mouse.

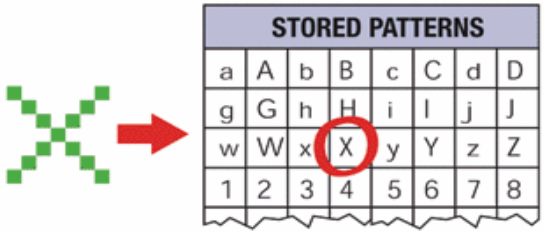
Electronic Pens

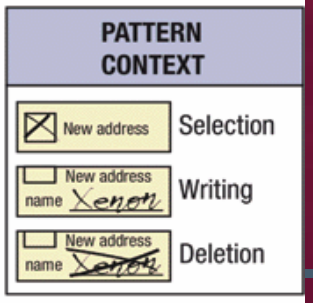
- **Electronic pen (stylus** or *digital pen)***:** used instead of a mouse to select objects, as well as to draw or write electronically on the screen
- Commonly used with pen-based PCs
  - To issue commands and input data
  - If **handwriting recognition** is used, written text can be converted to editable typed text

FIGURE 4-4
Pen-based PCs.





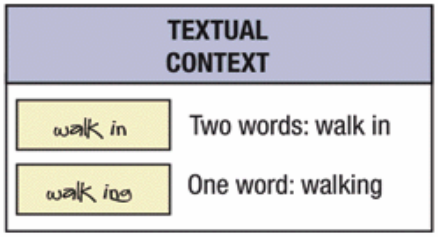




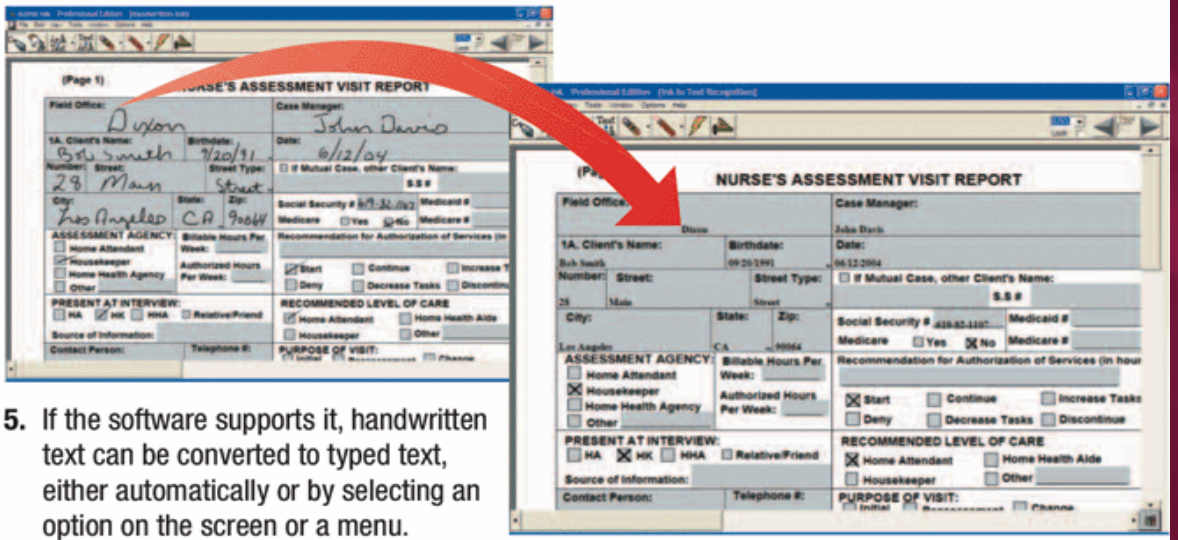
1. As the pen moves, the computer continually calculates its position, instructing the pixels it passes over to turn on.

2. The computer then compares the pattern that was input to other patterns it has stored. It makes allowances within certain limits for imprecision.

3. After a pattern is recognized, the computer looks at the context in which the pattern was made before it decides what to do. For instance, an "X" in a check box means selecting a certain action, whereas an "X" over filled-in text implies a deletion operation.



4. For text input, the computer looks at surrounding words, consults dictionaries, and uses grammar rules to determine the most likely intended input.



5. If the software supports it, handwritten text can be converted to typed text, either automatically or by selecting an option on the screen or a menu.

FIGURE 4-5
How handwriting recognition works.

Electronic Pens, *Cont'd*

- **Also used with**
  - *Digital writing systems*
  - *Graphics tablets*
  - *Signature capture devices*

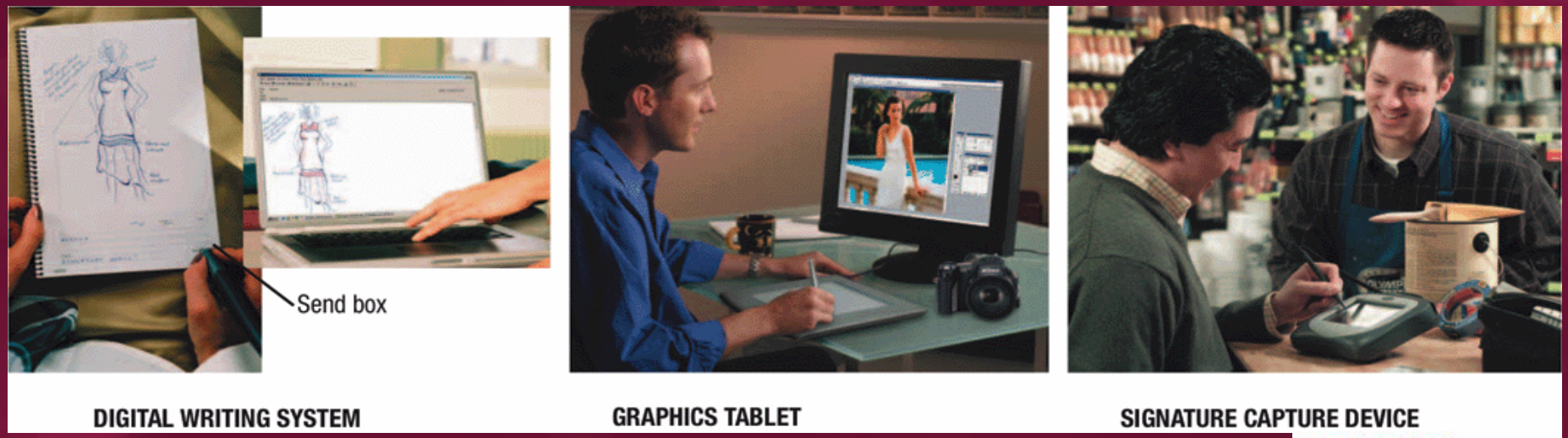


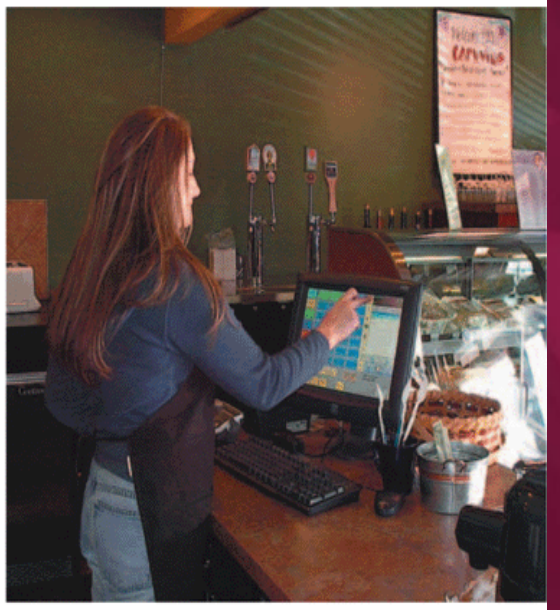
FIGURE 4-6
Other uses for electronic pens.

Touch Screens

- **Touch screen:** display device that is touched with the finger to issue commands or otherwise generate input to the connected PC
- Touch screen **kiosks** are found in retail stores, movie theaters, courthouses, fast-food restaurants, airports, and *point-of-sale (POS) systems*

FIGURE 4-7
Touch screens. Touch screens are commonly used in consumer kiosks and point-of-sale systems.

AIRLINE SELF-CHECK-IN



RESTAURANT ORDER-ENTRY SYSTEM

Other Pointing Devices

- Joysticks
- Trackballs
- Pointing sticks
- Touch pads

FIGURE 4-8
Other common pointing devices.

Quick Quiz – Pointing Devices

- An optical mouse is
  - the same as a wireless mouse.
  - a mouse that tracks movements with light instead of a ball.
  - a mouse that contains a scroll wheel on the top.
- True or false: With handwriting recognition, text is input as a graphical image so the text cannot later be edited as text.
- An input device that looks like an upside-down mouse with the ball on top is called a _____.

Scanners, Readers, and Digital Cameras

- *Source documents:* documents containing data that already exists in physical form (order form, photograph, invoice, check, or price label)
- *Source data automation:* capturing data directly from a source document
- Most common devices used in source data automation: *scanning* or *reading devices*

Scanners

- **Scanner** (*optical scanner*)**:** input device that reads printed text and graphics and transfers them to a computer in digital form
- Can scan photos, documents, drawings, etc.
- Data is typically input as a single image
- If **optical character recognition (OCR)** is used, text is input as editable, typed text

Scanners

- Types of scanners:
  - Flatbed
  - Sheetfed
  - Handheld
  - Drum
  - Three-dimensional (3D)
- Quality of scanned images indicated by *optical resolution*, measured in number of *dots per inch* (*dpi*)
- Resolution can often be specified

FIGURE 4-10
Optical scanners.

FLATBED SCANNER
Used to input photos, sketches, slides, bound books, and other relatively flat documents into the computer.

HANDHELD SCANNER
Used to capture small amounts of text.

SHEETFED SCANNER
Used to scan one flat document at a time.

96 dpi (833 KB)

300 dpi (1,818 KB)

600 dpi (5,374 KB)

RESOLUTION
Most scanners let you specify the resolution (in dpi) at which you wish to scan. High-resolution images look sharper but result in larger file sizes.

Readers

- **Barcode readers:** input devices that read barcodes
  - **Barcode:** machine-readable code that represents data as a set of bars
  - Common types:
    - *Universal Product Code (UPC)*
    - *Code 39*
    - *POSTNET code*

FIXED BARCODE READERS
Used most often in retail point-of-sale applications.

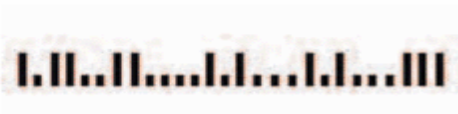
PORTABLE BARCODE READERS
Used when portability is needed.

INTEGRATED BARCODE READERS
Built into or added to portable PCs.

BARCODES
Uniquely identify a product or other item.

UPC (UNIVERSAL PRODUCT CODE)

CODE 39

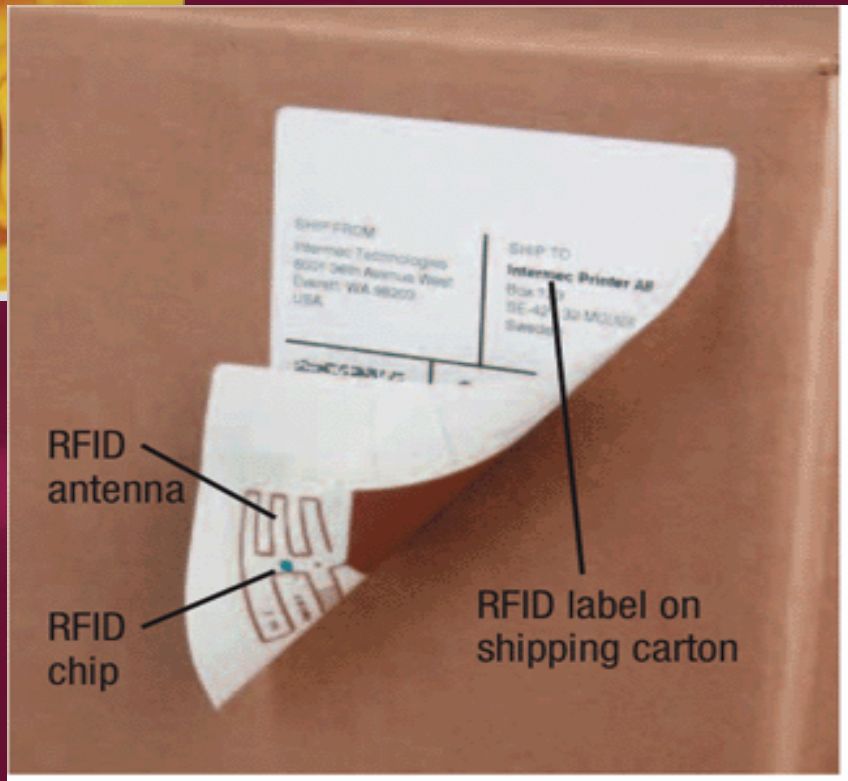


POSTNET CODE

FIGURE 4-11
Barcode readers and barcodes.

Readers, *Cont'd*

- **Radio frequency identification (RFID) readers**
  - **Radio frequency identification (RFID):** technology used to store and transmit data located in RFID tags
  - **RFID tag:** device containing tiny chips and radio antennas that is attached to objects that will be identified using RFID technology
  - Applications**:** tracking inventory pallets and shipping containers, tracking or locating livestock and other animals, tagging tractors and other large assets to keep track of their locations



RFID TAGS
RFID tags, containing a built-in chip and an antenna, are often included in shipping labels today.

RFID READERS
This portal RFID reader reads all of the RFID tags on a palette at one time, as it passes between the readers.

FIGURE 4-12
RFID readers and tags.

Readers, *Cont'd*

- *Optical mark readers (OMRs):* input data from special forms to score or tally exams, questionnaires, ballots, and so forth
  - Use pencil to fill in small circles/shapes on the form to indicate their selections
  - Forms are inserted into an optical mark reader to be scored or tallied

FIGURE 4-13
Optical mark readers. OMR readers are commonly used to score tests and tally questionnaires.

Readers, *Cont'd*

- *Optical character recognition (OCR) devices:* read optical characters
  - *Optical characters* are designed to be identifiable by humans as well as OCR device
  - Widely used in turnaround documents, such as monthly bills

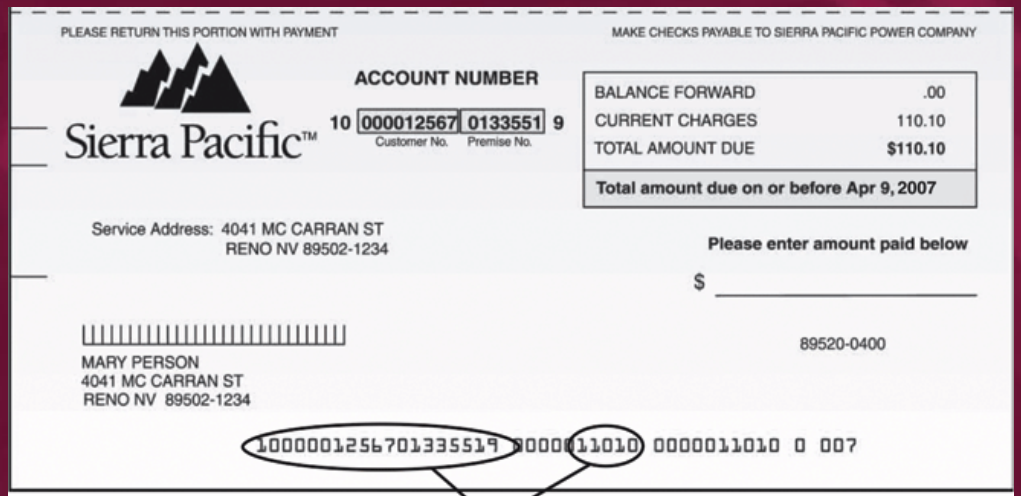


FIGURE 4-14
Optical characters.

Readers, *Cont'd*

- *Magnetic ink character recognition (MICR) readers:* read MICR characters
- Used primarily for banking
- MICR readers read the special magnetic characters and sort/process checks

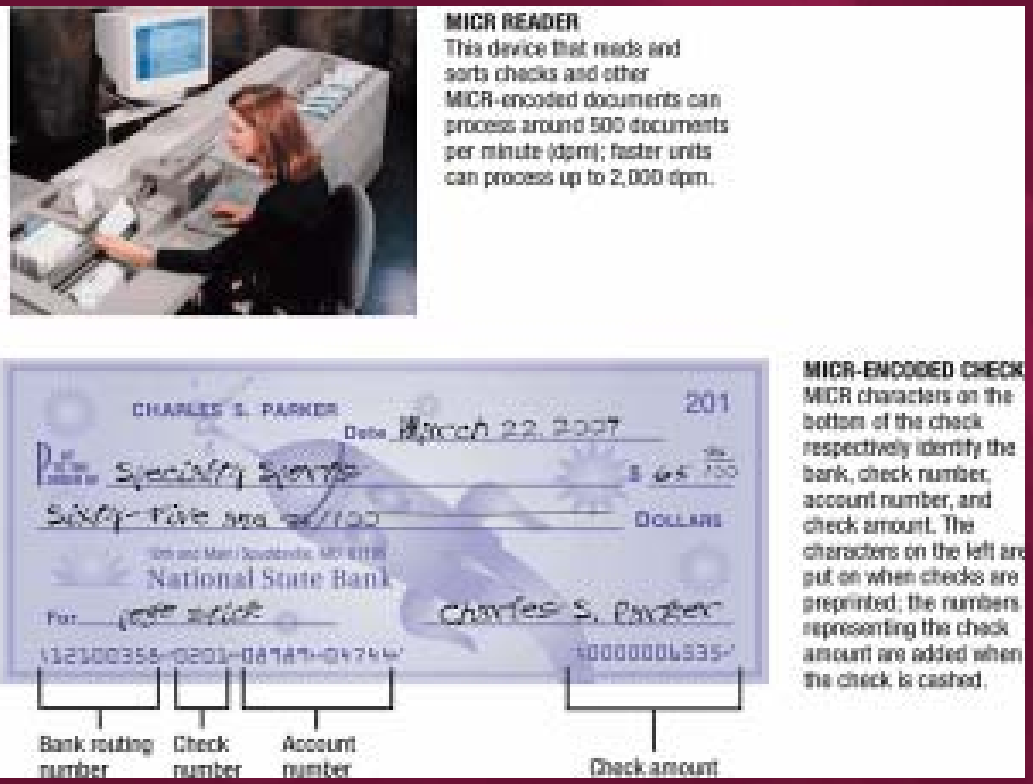


FIGURE 4-15
Magnetic ink character recognition (MICR).

Readers, *Cont'd*

- **Biometric readers:** used to input biometric data
  - **Biometric data** is based on unique physiological characteristics (fingerprint, hand geometry, face, iris of the eye) or personal traits (voice, signature)
  - Readers can be stand-alone or built into another piece of hardware (keyboard, mouse)
  - Also being built into computers and storage devices to allow access only by authorized individuals
  - Most often used for access control and to verify transactions

FIGURE 4-16

Biometric readers.
Biometric readers can be either stand-alone (left) or built into another piece of hardware (right).

STAND-ALONE HAND GEOMETRY READER
Often used for access control, such as to authenticate NHL Mighty Ducks players at the Anaheim Pond arena shown here.

BUILT-IN FINGERPRINT READER
Often used for access control or to authorize electronic financial transactions.

Digital Cameras

- **Digital camera:** input device that takes pictures and records them as digital data (instead of film or videotaped) images
  - Usually designated as:
    - *Still* cameras (take individual still photos)
    - *Video* cameras (capture moving video images)

Digital Cameras, *Cont'd*

- **Digital still cameras**
  - Available in a wide variety of sizes and capabilities
  - Images are immediately available for viewing or printing
  - Typically use flash memory for storage
  - Photos can be transferred to a PC or printer
  - Digital photos can be retouched with image editing software, posted to a Web page, or burned onto a CD or DVD disc
  - Camera quality is measured in *megapixels*

FIGURE 4-17

Digital still cameras. Digital still cameras, which record images on digital media instead of on film, are available in many shapes and sizes.

PROFESSIONAL DIGITAL CAMERA

DIGITAL CAMERA INTEGRATED INTO A MOBILE PHONE

PREVIEWS
Virtually all digital cameras let you display and erase images while shooting.

STORAGE MEDIA
Some cameras use removable storage media in addition to, or instead of, built-in storage.

TYPICAL CONSUMER DIGITAL CAMERA

Digital Cameras, *Cont'd*

- **Digital video cameras:** include *digital camcorders* and small *PC video cameras*
  - **Digital camcorders:** similar to *analog* camcorders, but they store images on digital media—typically either on mini digital video (DV) tape cartridges or rewritable DVDs
  - **PC video cameras** (PC cams, *Web cam*)**:** designed to transmit video images over the Internet, such as during a *videoconference* or *video phone call*

DIGITAL CAMCORDER
Typically allows you to view video during and after it is recorded; digital media, such as the DVD shown here, are used for storage instead of videotape.

PC VIDEO CAMERA
Commonly used to deliver video over the Internet, such as in the family videoconference shown here.

FIGURE 4-18
Digital video cameras. Common types include digital camcorders and PC video cameras.

Quick Quiz – Scanners, Readers, and Digital Cameras

- Which of the following is used in conjunction with Scantron test forms, voting ballots, and other documents in which the selection is bubbled in with a pencil or special colored pen?
  - OCR
  - MICR
  - OMR
- True or False: Flatbed scanners can be used to scan photographs, as well as documents on conventional paper.
- The most common type of bar code for groceries and other retail products is the _____.

Audio Input

- **Audio input:** process of entering audio data into the computer (voice and music)
  - **Voice input systems** (*speech recognition systems*)**:** enable a computer to recognize the human voice
    - Consist of a *microphone* or *headset* and appropriate software
    - Can be used to dictate text or commands into a PC
  - *Music input systems:* can input and record music (either original compositions or via a CD or DVD player)

Audio Input, *Cont'd*

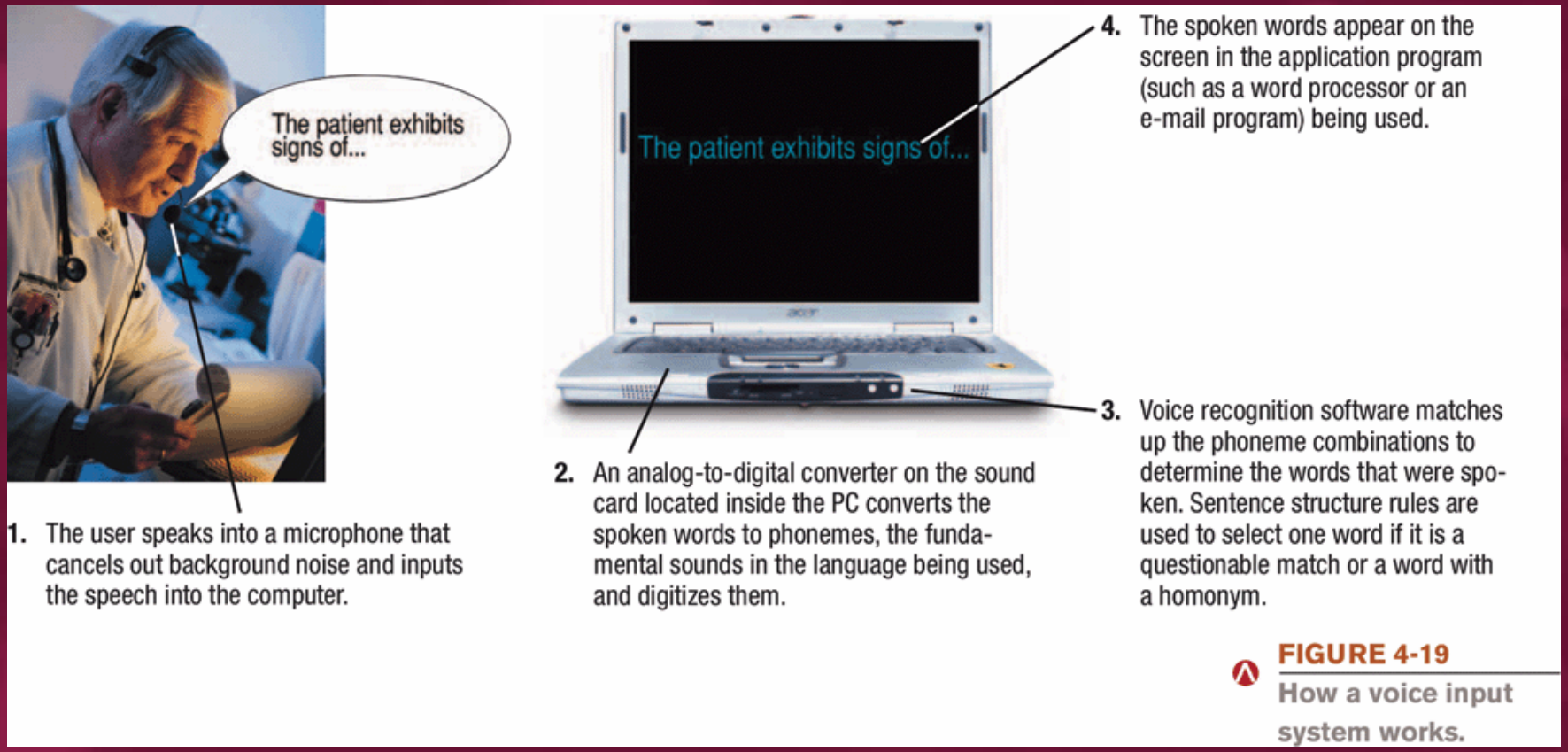


FIGURE 4-19
How a voice input system works.

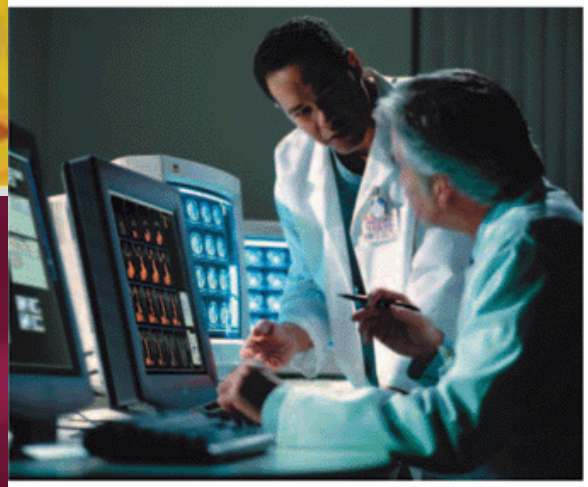
Quick Quiz – Audio Input

- Which of the following is the term that means the basic elements of speech?
  - phonemes
  - biometrics
  - MIDI
- A voice input system requires software and a(n) _____ in order to input voice data or commands into a PC.

Display Devices

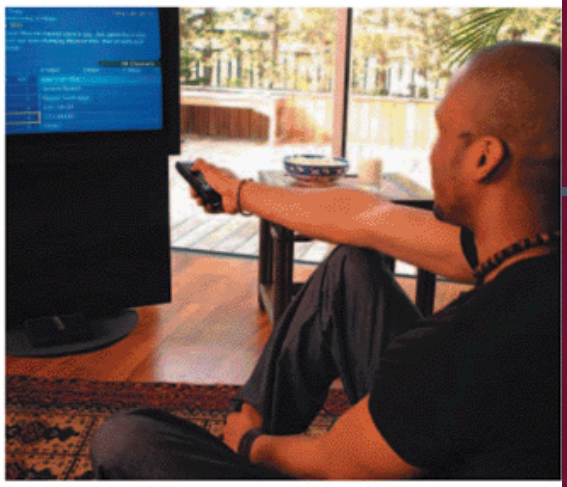
- **Display device:** output device that presents output visually
- *Soft copy:* output that appears on a display device
- **Monitor:** display device for a desktop PC
- **Display screen:** screen built into the unit of all-in-one PCs, notebook computers, handheld PCs, smart phones, consumer devices, and many other devices

FIGURE 4-21
Uses for displays.



COMPUTERS

SMART PHONES



HOME ELECTRONICS

PORTABLE MEDIA PLAYERS

DIGITAL PICTURE FRAMES

CAR NAVIGATION SYSTEMS

Display Device Characteristics

- Usually *color*, but can be *monochrome*
- Can be a **CRT monitor** or a *flat-panel display*
  - *CRT monitor*: projects images onto a display screen using technology similar to that of TVs
  - *Flat-panel display:* forms images by manipulating electronically charged chemicals or gases sandwiched between thin panes of glass

CRT vs. Flat-Panel Monitors

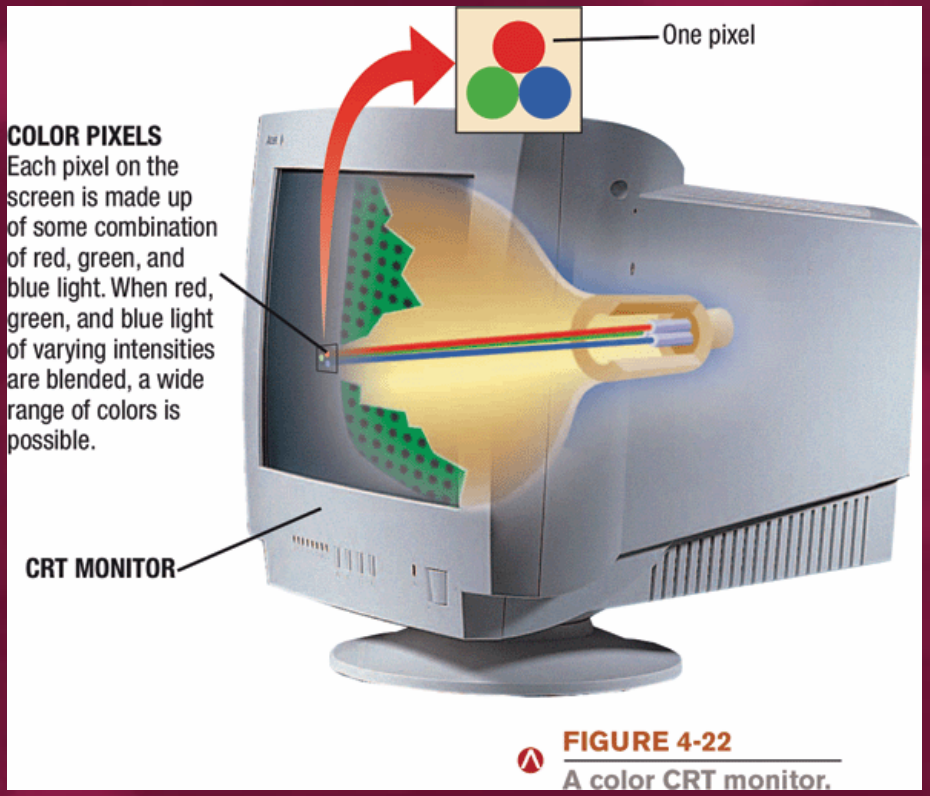


FIGURE 4-22
A color CRT monitor.

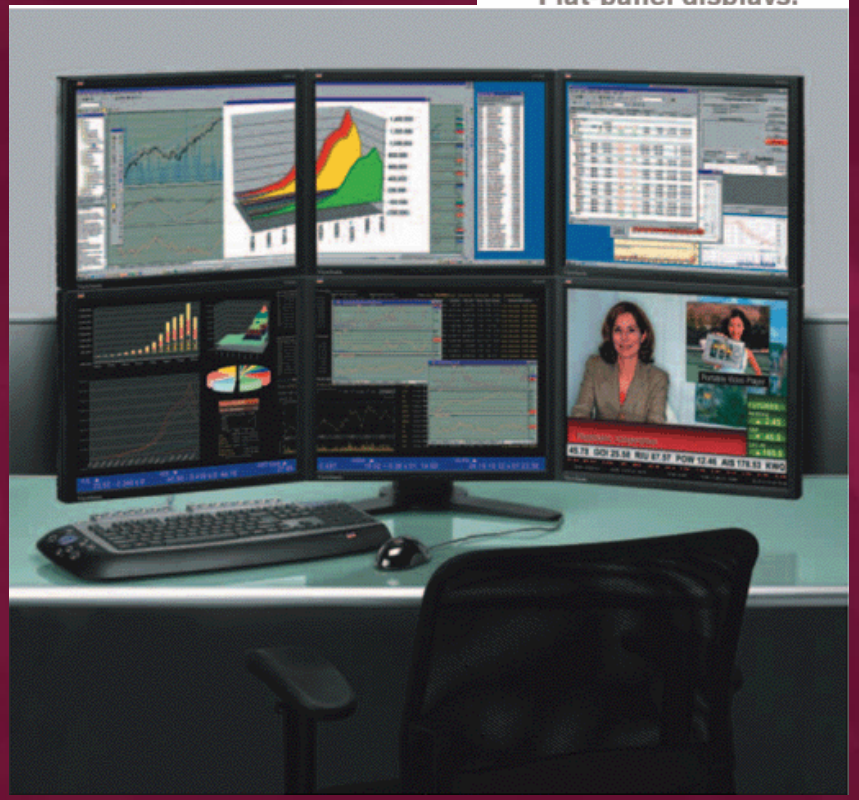


FIGURE 4-23
Flat-panel displays.

Display Device Characteristics, *Cont'd*

- Size (measured diagonally)
- Screen resolution
  - Can be changed
  - Higher resolution = more data on the screen at one time

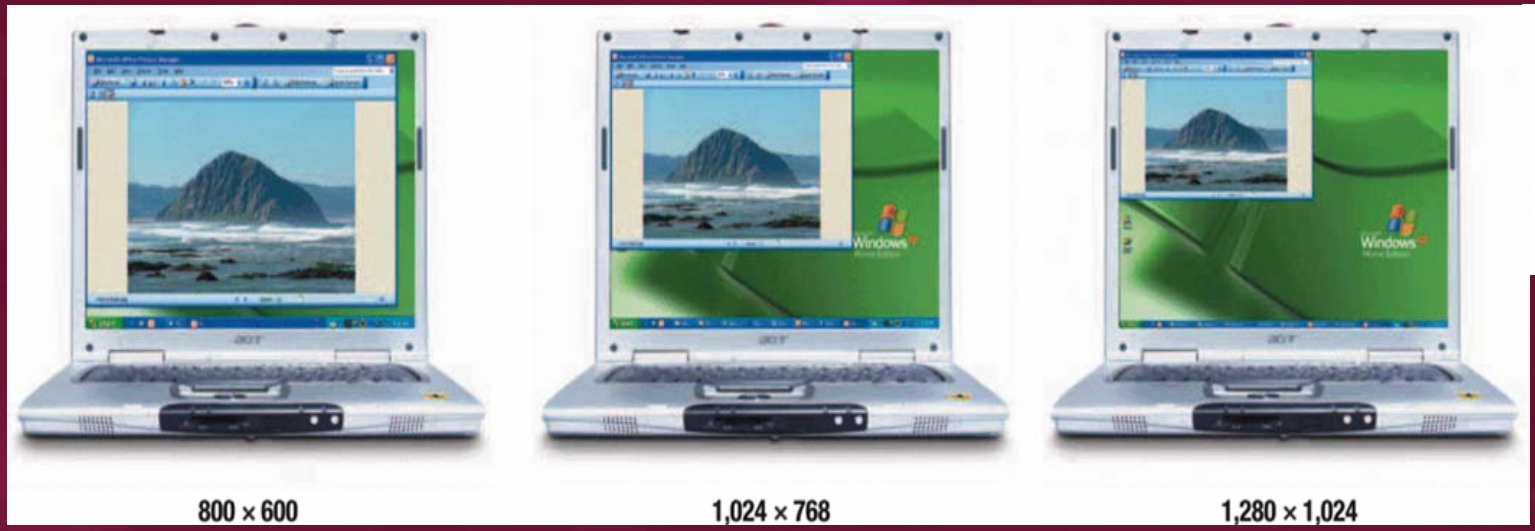


FIGURE 4-24
Screen resolution. A higher screen resolution (measured in pixels) displays everything smaller than a lower screen resolution.

Display Device Characteristics, *Cont'd*

- Video card (determines display characteristics and how monitor can connect to the PC)
- Monitors can be also be:
  - Wired or wireless
  - 2D or 3D Displays
  - Digital TV and/or HDTV ready or capable

Flat-Panel Display Technologies

- **Liquid crystal displays (LCDs):** use charged liquid crystals to display images
- **Organic light emitting diode (OLED) displays:** use emissive organic material to display brighter and sharper images
  - *Flexible OLEDs (FOLEDs)*
  - *Transparent OLEDs (TOLEDs)*
  - *Phosphorescent OLEDs (PHOLEDs)*
- **Plasma displays:** use layers of gas to display images; most often used on large displays

Flat-Panel Display Technologies, *Cont'd*

FIGURE 4-27
Flat-panel displays.

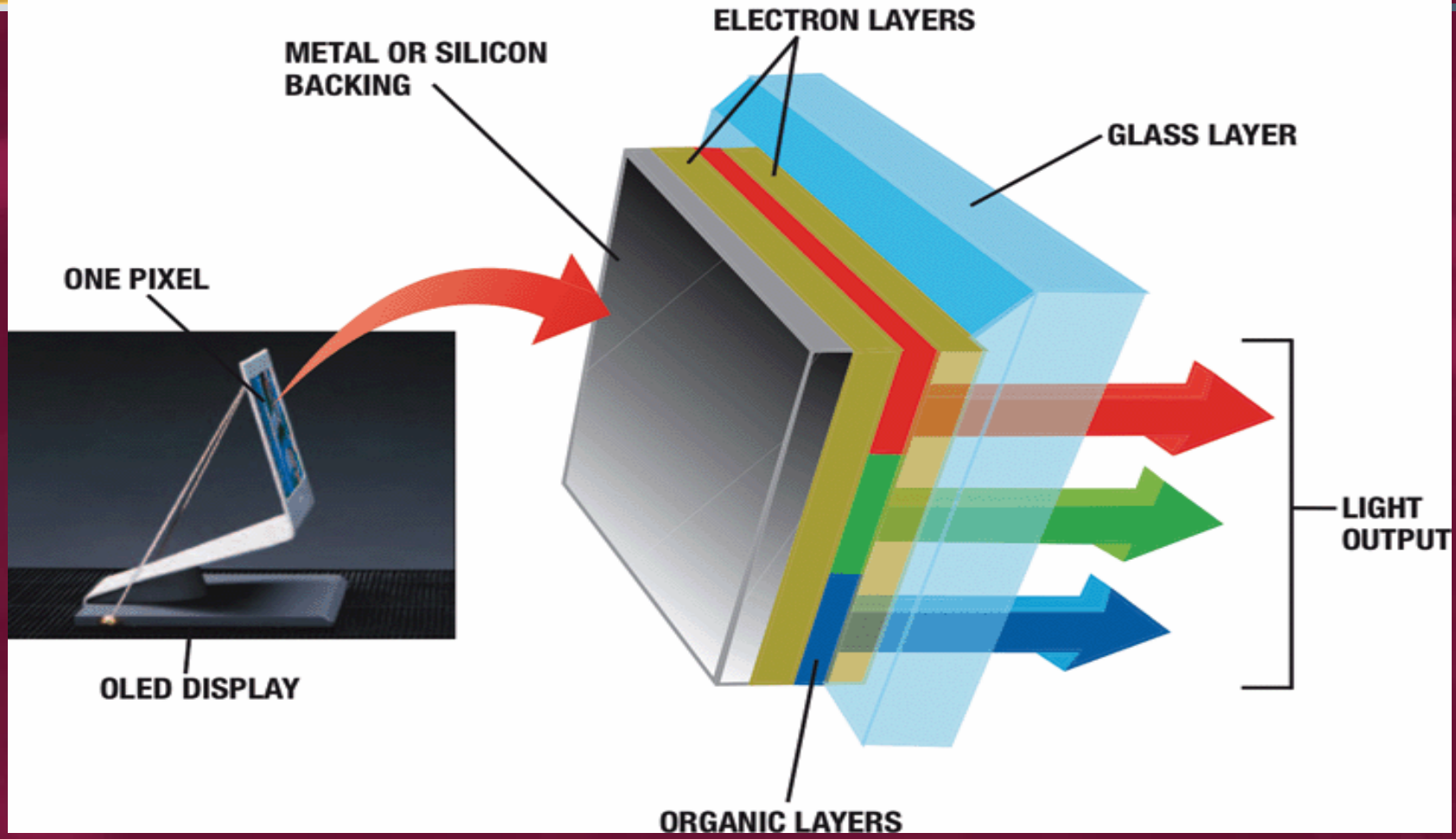
LCD DISPLAYS
The most common type of computer monitor and flat-panel television.

OLED DISPLAYS
Used primarily with smaller displays, like digital cameras and handheld PCs.

PLASMA DISPLAYS
Used primarily with large computer monitors and TVs.

FIGURE 4-28

How OLED displays work. Each pixel on an OLED display emits light in the appropriate color.



Data and Multimedia Projectors

- **Data projector:** display device that projects all computer output to a wall or projection screen

- Most data projectors today can project video, in addition to computer output.

- Can be *wireless projectors*

FIGURE 4-30
Data projectors.

Quick Quiz – Display Devices

- Which of the following types of display devices should have the largest footprint (the amount of room taken up on a desk)?
  - CRT monitor
  - OLED display
  - LCD display
- True or False: A monitor using a screen resolution of 1,024 x 768 would display more data on the screen than a monitor using a screen resolution of 640 x 480, but everything would be smaller.
- A small area on the screen of a display device that is lit up to display the image is called a(n) _____ .

Printers

- **Printer**: output device that produces output on paper
  - Produce *hard copy*
  - Can be used with both desktop and portable PCs

- Printer characteristics
  - Impact vs. nonimpact printing
    - Most printers are nonimpact
    - Impact printers (like *dot-matrix printers*) are still used for printing multipart forms and shipping documents

Printers

- Printer characteristics, *cont'd*
  - Can print in color or black-and white only
  - Can be a *personal* or *network printer*
  - Quality is called *print resolution* and measured in *dots per inch (dpi)*
  - Print speed is measured in *pages per minute (ppm)*

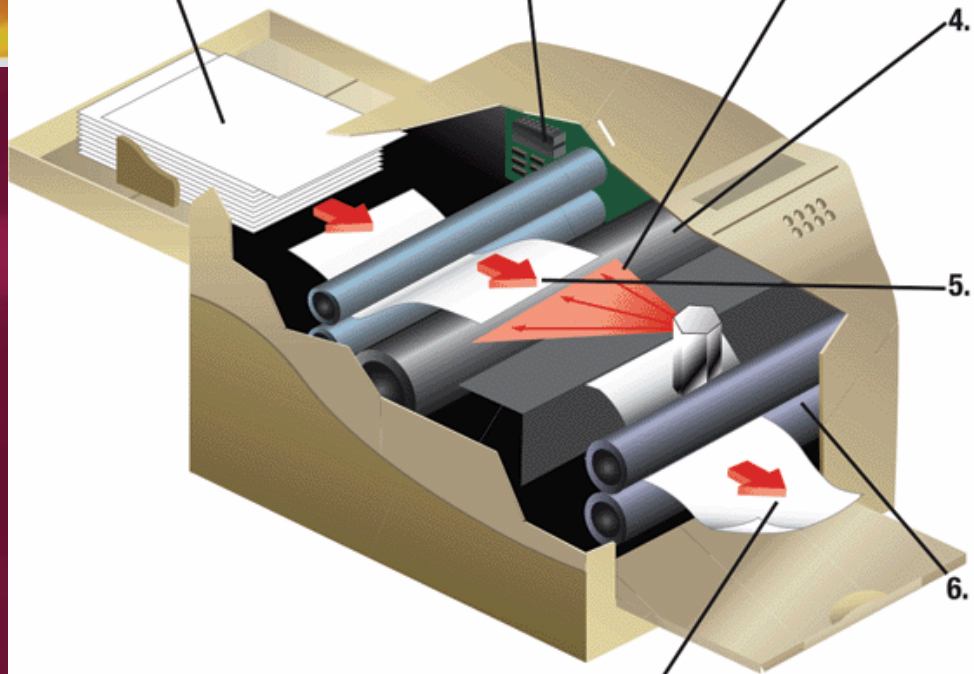
Laser Printers

- **Laser printer:** output device that uses toner powder and technology similar to that of a photocopier to produce images on paper
- The standard for business documents
- Print one entire page at a time
- Usually black and white, though color printers are available
- Common print resolution for laser printers is between 600 and 2,400 dpi

1. The paper enters the printer, and then it is given an electrical charge so the toner can stick to the paper, as explained in step 5.

2. The printer's microprocessor decodes page data sent from the computer.

3. Instructions from the printer's microprocessor control a laser beam that charges the appropriate locations on the drum so the toner will stick to the drum, as explained in step 4.



4. Toner powder is applied to the drum and sticks only to the charged areas on the drum.

5. The paper rolls over the drum and the toner is transferred to the paper, forming the image for the entire page.

6. The paper goes through the fusing unit, at which point the toner is permanently affixed to the paper through heat and pressure.

7. The paper exits the printer.

NETWORK LASER PRINTER

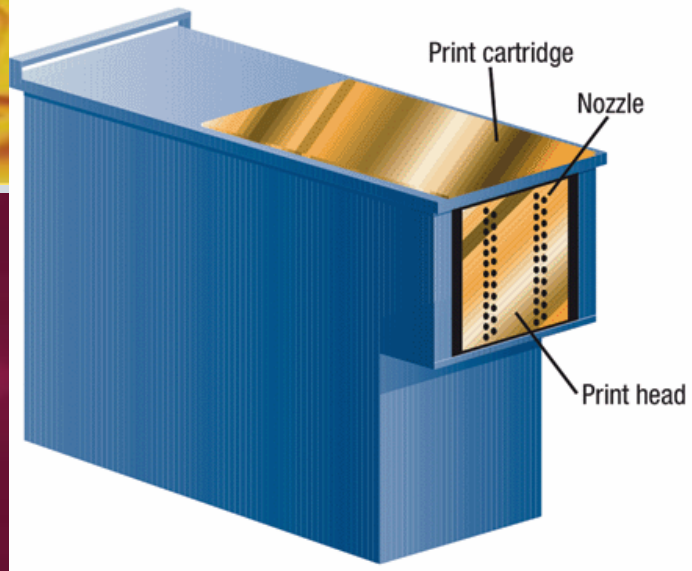
PERSONAL LASER PRINTER

FIGURE 4-32
How laser printers work.

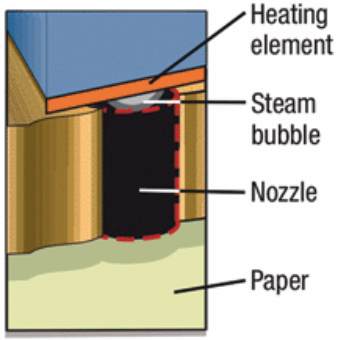
Ink-Jet Printers

- **Ink-jet printer:** output device that sprays droplets of ink to produce images on paper
- Typically print in color
- Often the choice for home use
- Print fairly slowly, one line at a time
- Quality not quite as good as a laser printer

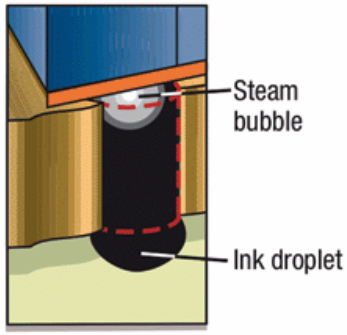
FIGURE 4-33
How ink-jet printers work.



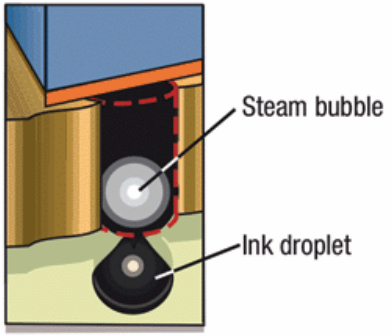
HOW INK-JET PRINTERS WORK
Color ink-jet printers create colors by mixing different combinations of four colors of ink—magenta, cyan, yellow, and black. The different colors can be in one or multiple cartridges. Each cartridge is made up of 300 or more tiny ink-filled firing chambers, each attached to a nozzle smaller than a human hair. To print images, the appropriate color ink is ejected through the appropriate nozzle.



1. A heating element makes the ink boil, which causes a steam bubble to form.



2. As the bubble expands, it pushes ink through the nozzle.



3. The pressure of the bubble forces an ink droplet to be ejected onto the paper. When the steam bubble collapses, more ink is pulled into the print head, so it is ready for the next steam bubble.

Special Purpose Printers

- **Photo printers** (designed to print photographs)
- **Barcode printers** (print barcodes; some can encode RFID tags)
- *Label printers* (print labels, electronic postage, etc.)
- *Portable printers* (designed to be carried with you)
- *Plotters* and *wide-format ink-jet printers* (print on large paper or other large materials)

PHOTO PRINTERS
Used to print digital photographs, such as those taken with a digital camera.

BARCODE PRINTERS
Used to print barcoded labels. This printer can also program RFID tags, when they are embedded inside the barcoded labels.

PORTABLE PRINTERS
Used to print from a portable PC or while on the go.

WIDE-FORMAT PRINTERS
Used for printouts that are too big for a standard-sized printer.

FIGURE 4-34
Special-purpose printers.

Multifunction Devices

- **Multifunction device:** device that offers some combination of printing, copying, scanning, and faxing capabilities
- Most commonly, these types of devices are based on color ink-jet printer technology, although laser multifunction devices are available
- Advantage: takes up less space and is less expensive than purchasing multiple machines
- Disadvantage: Lose all devices if it needs to be repaired

Quick Quiz – Printers

- Dots per inch (dpi) is a measurement of
  - printer quality.
  - printer speed.
  - printer expense.
- True or False: Laser printers can only print in black and white.
- _____ printers form images with drops of liquid ink.

Audio Output

- **Audio output:** output in the form of voice or music
- **Speakers:** connect to a PC and provide audio output for computer games, music, video, TV, videoconferencing, and other applications that have audio output
- **Voice output systems:** produce spoken output

FIGURE 4-35
Speakers.

COMPUTER SPEAKERS
Many speaker systems today come with a subwoofer, in addition to the standard two speakers.

IPOD SPEAKERS
External speakers are also available for use with mobile devices to increase quality, such as the iPod speakers shown here.

Summary

- Keyboards
- Pointing Devices
- Scanners, Readers, and Digital Cameras
- Audio Input
- Display Devices
- Printers
- Audio Output