COURSE TECHNOLOGY
CENGAGE Learning

A+ Guide to Managing and Maintaining Your PC, 7e

Chapter 1
Introducing Hardware

Objectives

- Learn that a computer requires both hardware and software to work
- Learn about the many different hardware components inside of and connected to a computer

Hardware Needs Software to Work

- Hardware
  - Computer's physical components
    - Monitor, keyboard, memory, hard drive
- Software
  - Instruction set
    - Directs hardware to accomplish a task
  - Uses hardware for four basic functions
    - Input, processing, storage, output
- Hardware components
  - Require an electrical system

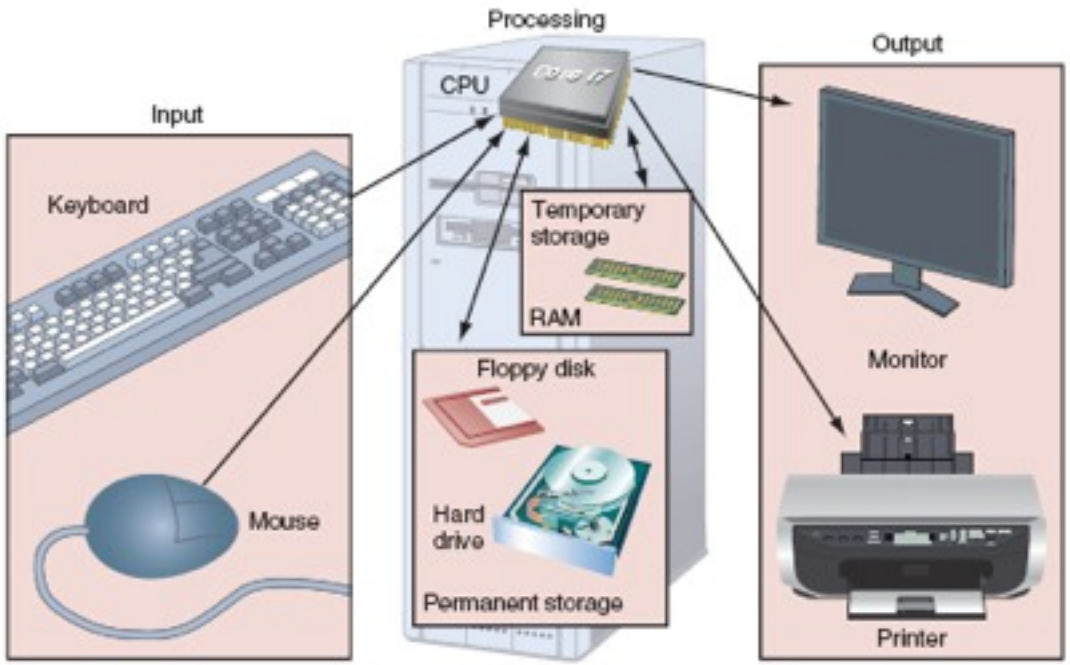

Figure 1-1 Computer activity consists of input, processing, storage, and output
Courtesy: Course Technology/Cengage Learning

Hardware Needs Software to Work (cont'd.)

- User interaction with computer
  - User and software communicate with input device
  - Hardware uses two states: on and off

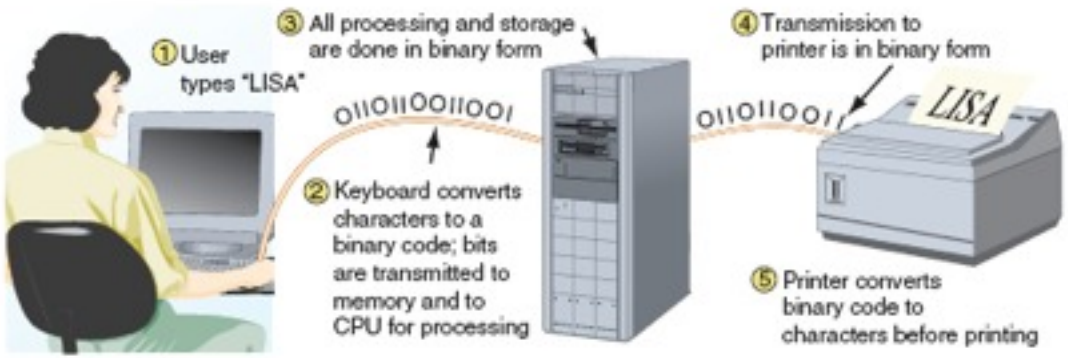

Figure 1-2 All communication, storage, and processing of data inside a computer are in binary form until presented as output to the user
Courtesy: Course Technology/Cengage Learning

Hardware Needs Software to Work (cont'd.)

- Binary number system
  - Stores and reads two states
    - Zero or one
  - Bit: binary digit
    - Value of zero or one
  - Nibble: four bits
  - Byte: eight bits
  - Used for counting, calculation, storage operations
- American Standard Code for Information Interchange (ASCII)
  - Used for storing information

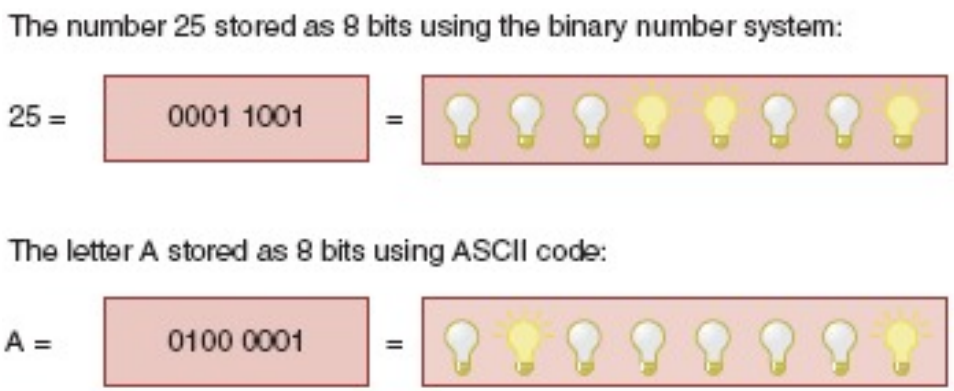

Figure 1-3 All letters and numbers are stored in a computer as a series of bits, each represented in the computer as on or off
Courtesy: Course Technology/Cengage Learning

PC Hardware Components

- Input/output (I/O) devices: external to the case
- Processing, storage devices: internal to the case
- Central processing unit (CPU)
  - Also called: processor, microprocessor
  - Reads input, processes data, writes data to storage
- Elements required by I/O, storage devices
  - Method for CPU to communicate with the device
  - Software to instruct, control the device
  - Electricity to power the device

Hardware Used for Input and Output

- I/O device communication with computer components
  - Wireless
  - Cabled using a port
    - Access point located in back or front of case
- Primary input devices
  - Keyboard, mouse
    - Requires electricity from inside case
- Primary output devices
  - Monitor: visually displays primary computer output
  - Printer: produces paper output (hard copy)

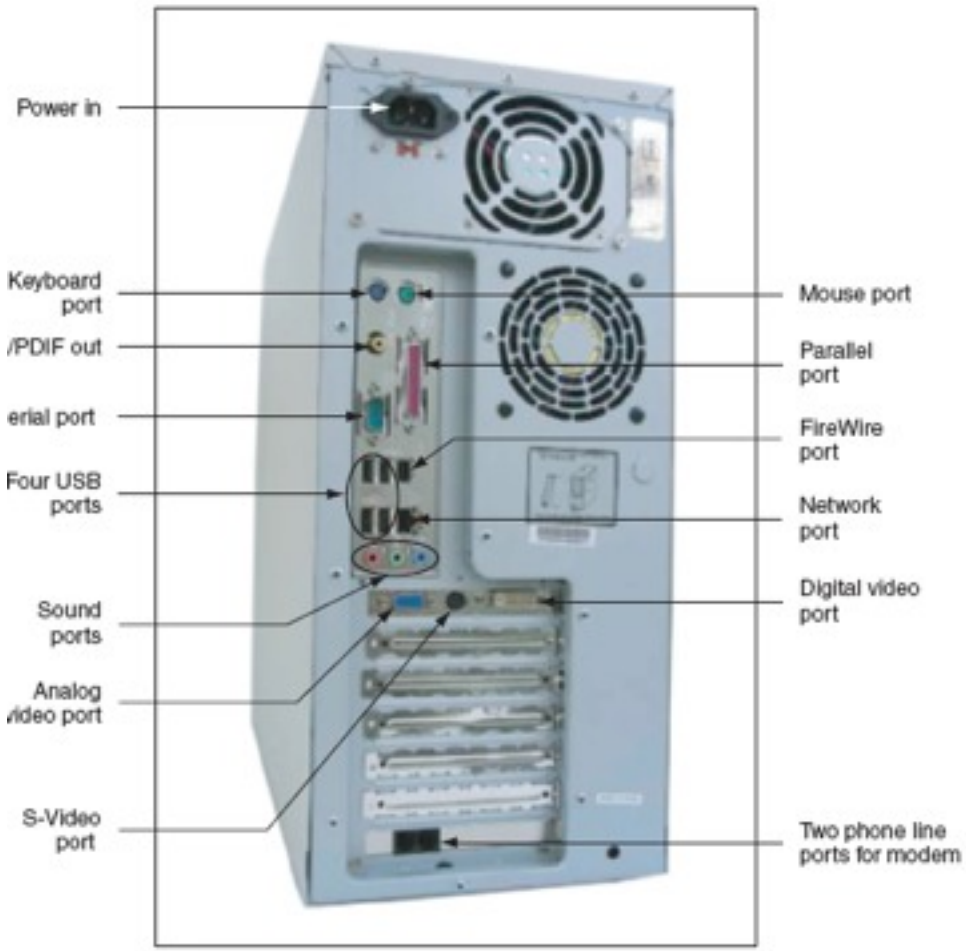

Figure 1-4 Input/output devices connect to the computer case by ports usually found on the back of the case
Courtesy: Course Technology/Cengage Learning

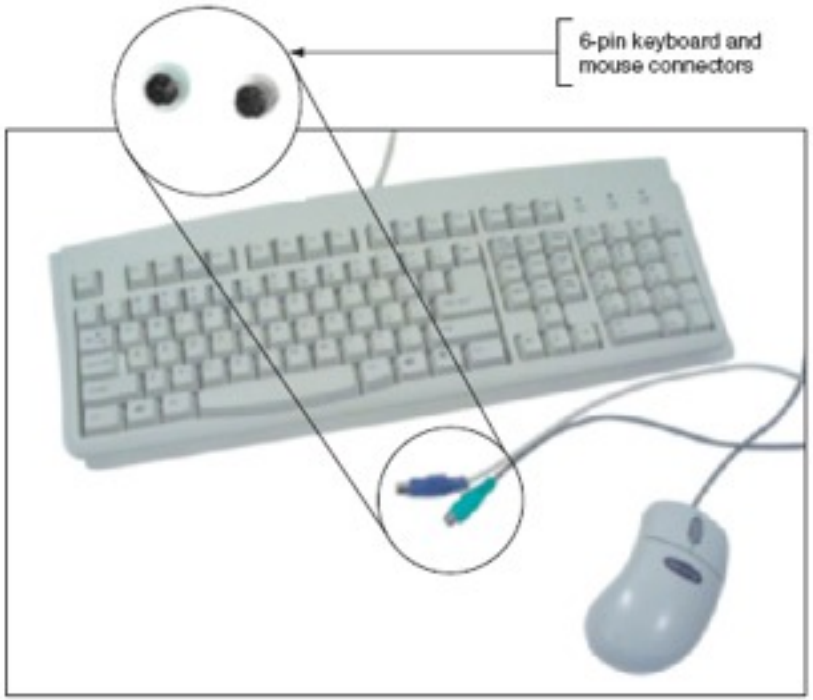

Figure 1-5 The keyboard and the mouse are the two most popular input devices
Courtesy: Course Technology/ Cengage Learning

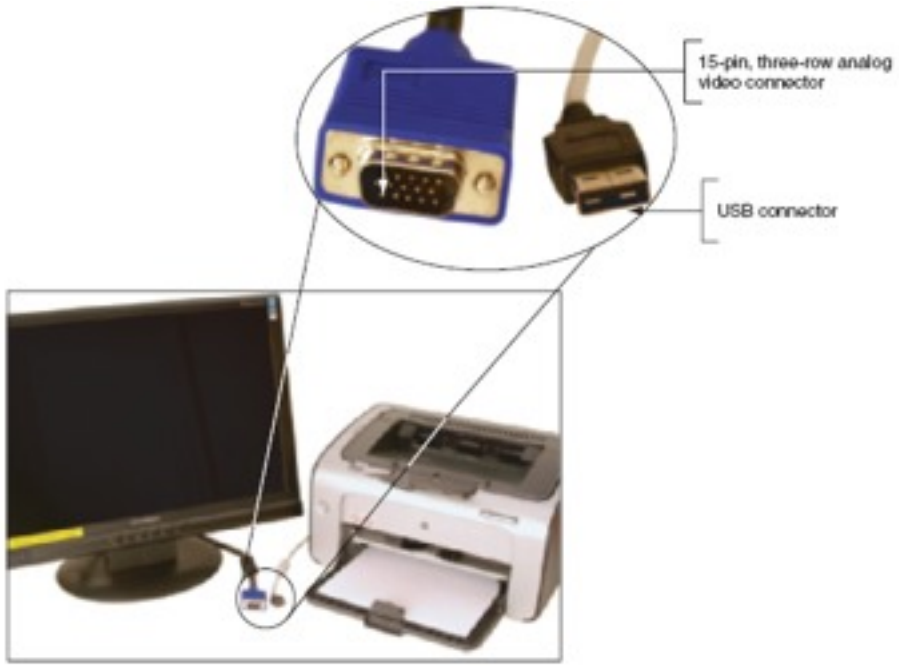

Figure 1-6 The two most popular output devices are the monitor and the printer
Courtesy: Course Technology/Cengage Learning

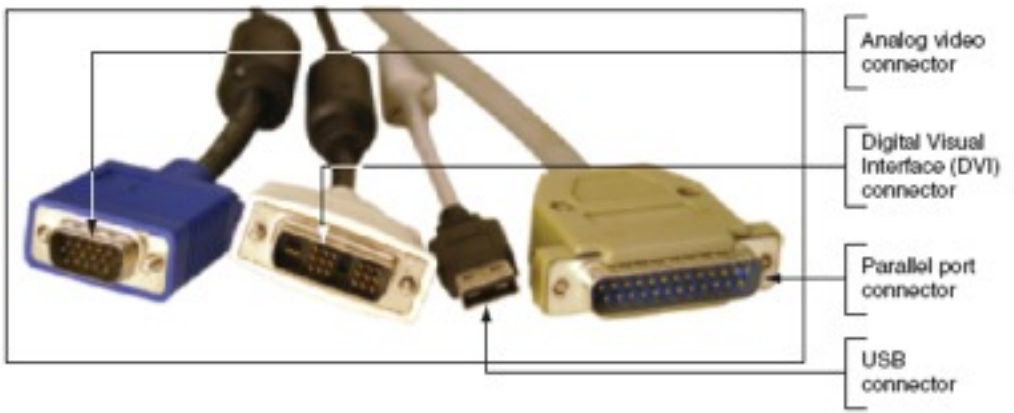

Figure 1-7 Two video connectors and two connectors used by a printer
Courtesy: Course Technology/Cengage Learning

Hardware Inside the Computer Case

- Storage and processing occurs in the case
- Internal devices common to most computers
  - Motherboard containing CPU, memory, other parts
  - Hard drive, optical drive for permanent storage
  - Power supply with power cords supplying electricity
  - Adapter cards for internal and external communication
  - Cables to connect devices
- Adapter card installed in expansion slots
- Cable types
  - Data (communication) and power

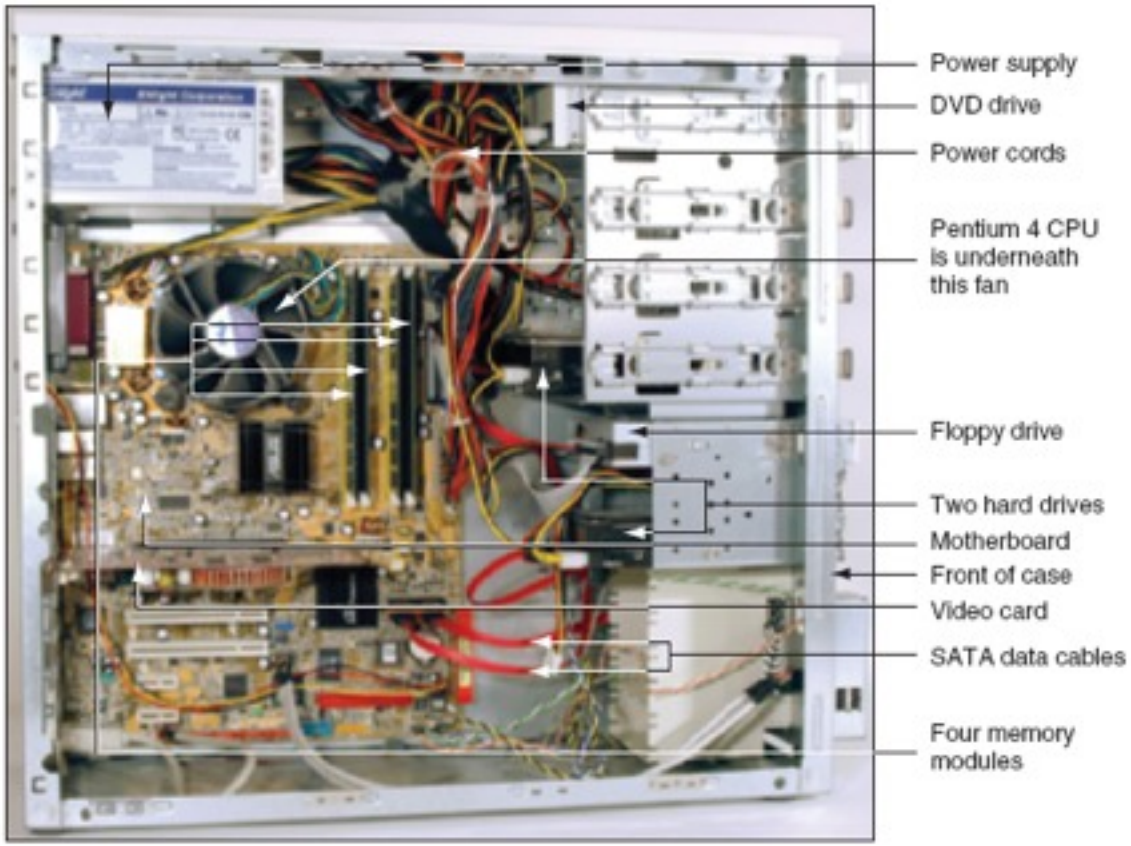

Figure 1-8 Inside the computer case
Courtesy: Course Technology/Cengage Learning

The Motherboard

- Largest, most important circuit board
  - Main board or system board
  - Contains the CPU, expansion slots, other devices
- Motherboard component categories
  - Processing, temporary storage, communication, power
- All devices communicate with motherboard CPU
- Peripheral device links to motherboard via cable
- Motherboard ports may be outside of the case
  - Keyboard, mouse, parallel, USB ports, sound ports

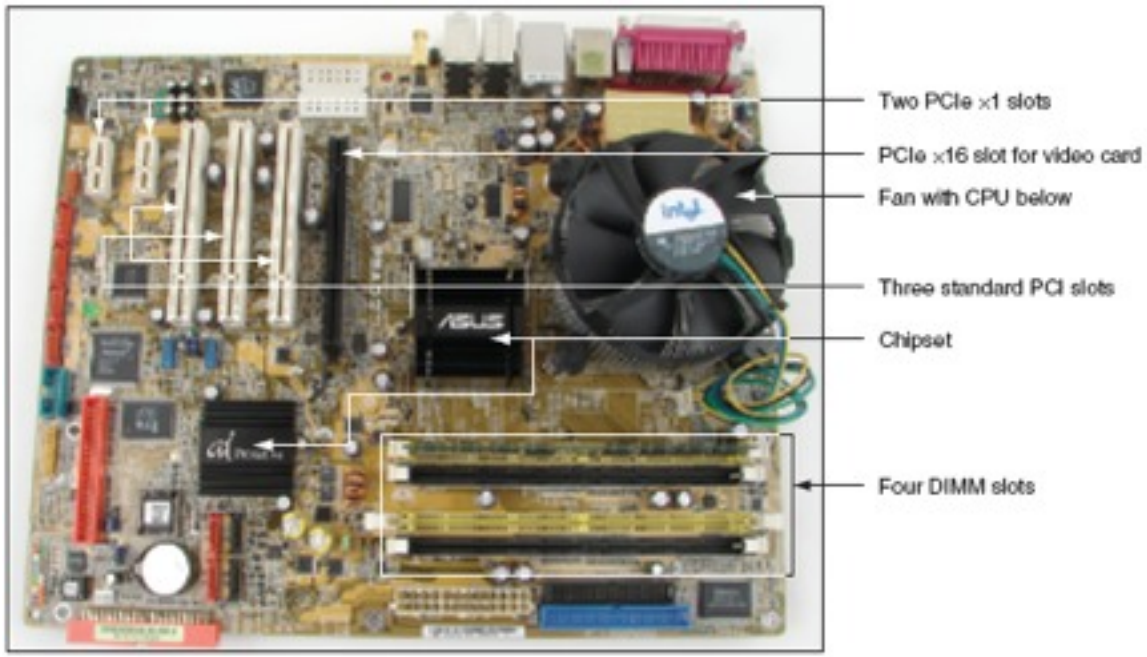

Figure 1-9 All hardware components are either located on the motherboard or directly or indirectly connected to it because they must all communicate with the CPU
Courtesy: Course Technology/Cengage Learning

Figure 1-10 A motherboard provides ports for common I/O devices
Courtesy: Course Technology/Cengage Learning

The Processor and the Chipset

- CPU
  - Chip inside the computer
  - Performs most data processing
- Chipset
  - Group of microchips controlling data flow
- Personal computer (PC)
  - Focus of this text
- Major CPU, chipsets manufacturers
  - Intel Corporation, AMD

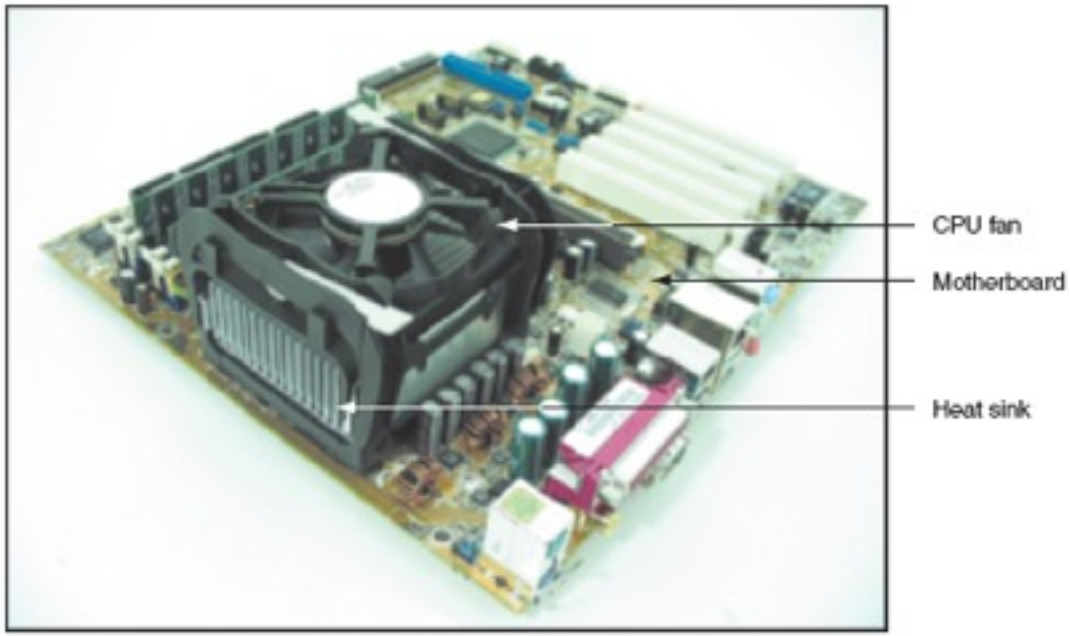

Figure 1-11 The processor is hidden underneath the fan and the heat sink, which keep it cool
Courtesy: Course Technology/Cengage Learning

Storage Devices

- Primary storage (main memory)
  - Temporary storage used by the processor
- Secondary storage (permanent storage)
  - Enables data to persist after machine turned off
  - Examples: hard drive, CD, DVD, USB drive
- Primary-secondary memory relationship analogy
  - Library book stacks: permanent storage
  - Books moved to a desk: temporary storage

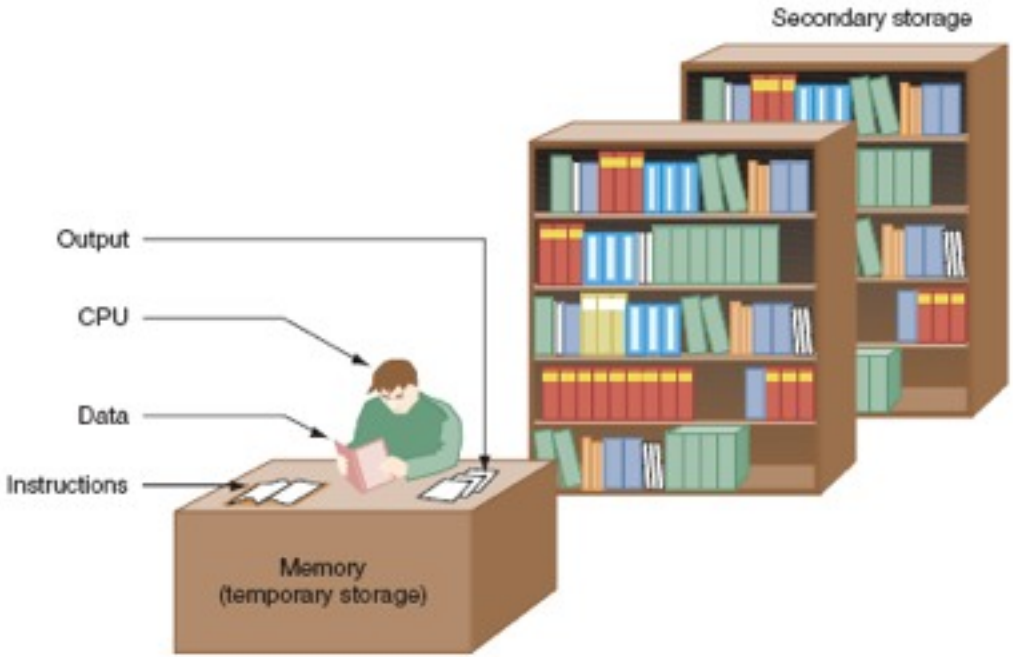

Figure 1-12 Memory is a temporary place to hold instructions and data while the CPU processes both
Courtesy: Course Technology/Cengage Learning

Primary Storage

- Provided by random access memory (RAM)
  - Located on motherboard, adapter cards
- RAM chips
  - Embedded on small board
  - Plugs into motherboard
  - Most common: dual inline memory module (DIMM)
  - Video memory: embedded on video card
- Volatile memory
- Non-volatile memory

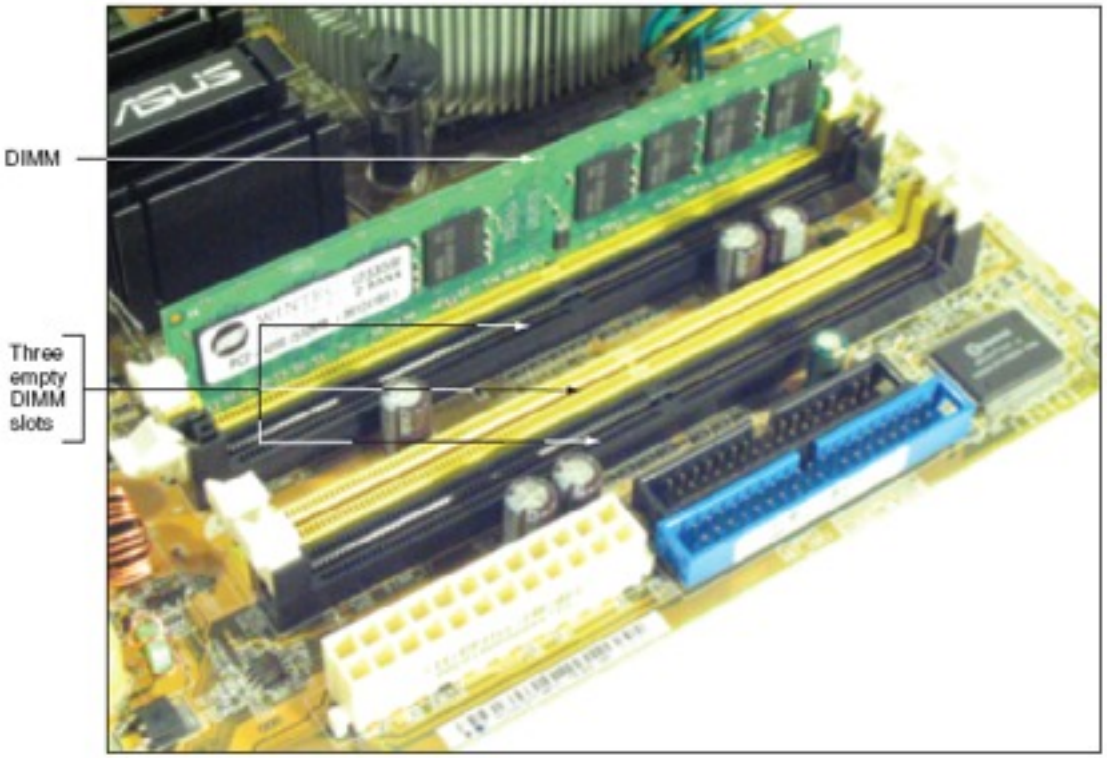

Figure 1-13 A DIMM holds RAM and is mounted directly on a motherboard
Courtesy: Course Technology/Cengage Learning

Secondary Storage

- Remote storage locations containing data and instructions
  - Cannot be directly processed by CPU
  - Permanent
- Hard drives
  - Main secondary computer storage device
  - Magnetic hard drives
    - Use Integrated Drive Electronics (IDE)
  - Solid state drive (SSD)
    - Use nonvolatile flash memory

Figure 1-15 Hard drive with sealed cover removed
Courtesy: Seagate Technologies LLC

Figure 1-16 Four SSD drives
Courtesy: Course Technology/Cengage Learning

Secondary Storage (cont'd.)

- Hard drives (cont'd.)
  - ATA (AT Attachment) standard
    - Specifies motherboard-hard drive interface
    - Types: serial ATA (SATA), parallel ATA (PATA)
  - Serial ATA standard
    - External SATA (eSATA)
    - Usually two to eight SATA and eSATA connectors
  - Parallel ATA (PATA)
    - Slower than SATA
    - Two connectors on a motherboard for two data cables
    - Accommodates up to four IDE devices

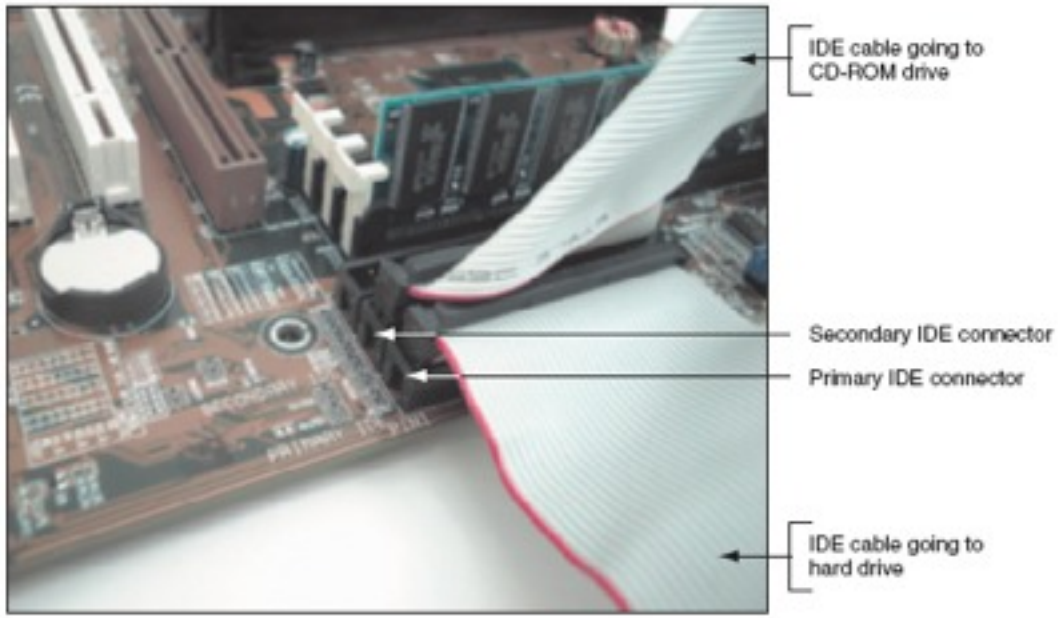

Figure 1-18 Using a parallel ATA interface, a motherboard has two IDE connectors, each of which can accommodate two devices; a hard drive usually connects to the motherboard using the primary IDE connector
Courtesy: Course Technology/Cengage Learning

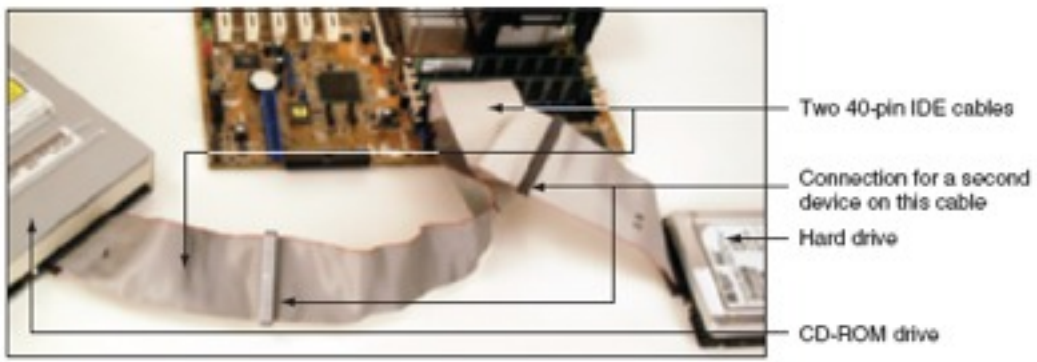

Figure 1-19 Two IDE devices connected to a motherboard using both IDE connections and two cables
Courtesy: Course Technology/Cengage Learning

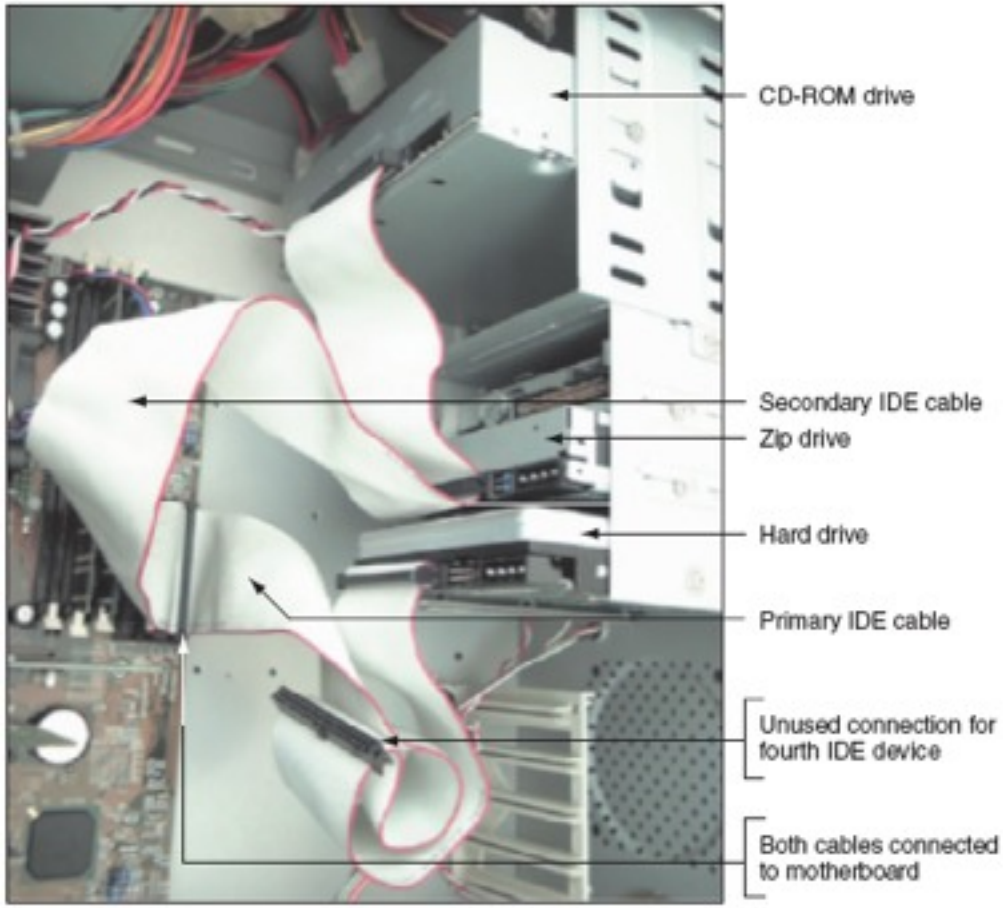

Figure 1-20 This system has a CD-ROM and a Zip drive sharing the secondary IDE cable and a hard drive using the primary IDE cable
Courtesy: Course Technology/Cengage Learning

Secondary Storage (cont'd.)

- Optical drives
  - RW can write to a disk
  - ROM (read-only memory) can only read a disc

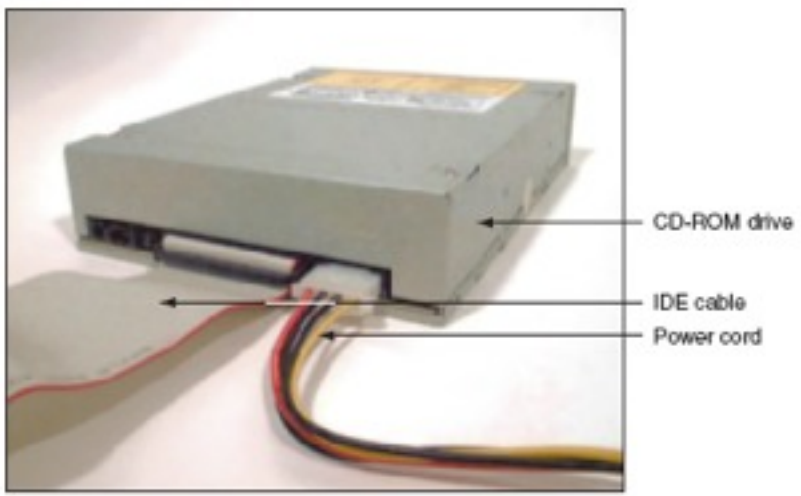

Figure 1-22 This CD drive is an EIDE device and connects to the motherboard by way of an IDE data cable
Courtesy: Course Technology/Cengage Learning

Secondary Storage (cont'd.)

- USB flash drives and memory cards
  - Popular, nonvolatile flash memory chips
  - Compact; easy to use; currently hold up to 64 GB of data

Figure 1-24 Most laptops have a memory card slot that can accommodate an SD card
Courtesy: Course Technology/Cengage Learning

Secondary Storage (cont'd.)

- Floppy drive
  - Older secondary storage device
  - 3.5-inch disk holding 1.44 MB of data
  - Floppy drive connector
    - Distinct from IDE connectors
    - Floppy drive cable accommodates one or two drives

Motherboard Components Used For Communication Among Devices

- Traces
  - Fine lines on top and bottom of the motherboard's surface
- Bus
  - System of pathways, transmission protocols
- Data bus
  - Carries the data

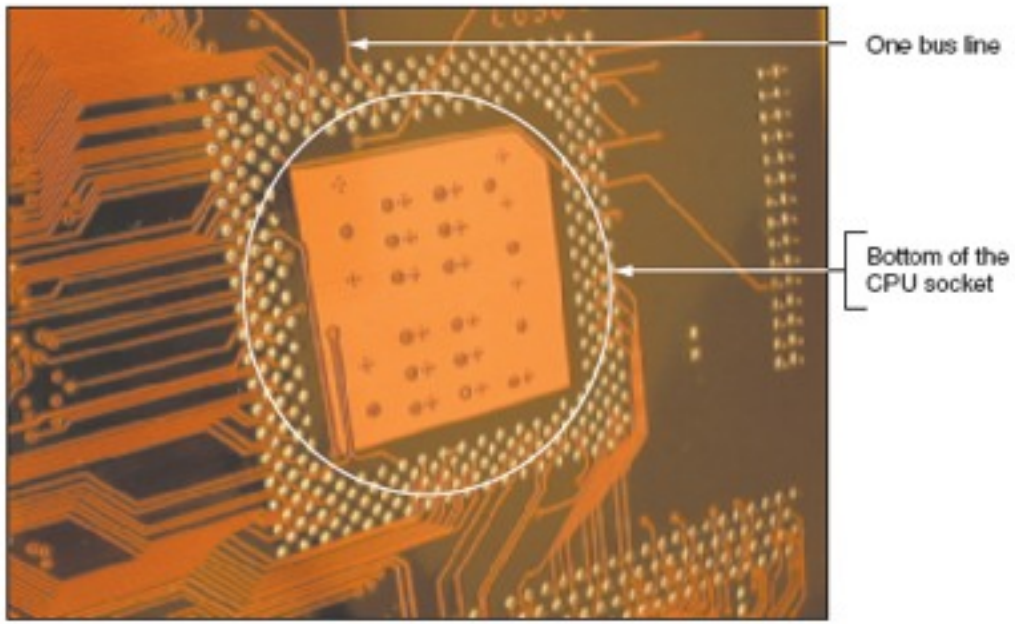

Figure 1-27 On the bottom of the motherboard, you can see bus lines terminating at the CPU socket
Courtesy: Course Technology/Cengage Learning

Motherboard Components Used For Communication Among Devices

- Binary data corresponds to voltage on the line
  - Voltage, lack of voltage interpreted as binary digits
- Data bus sizes today
  - 16, 32, 64, 128, 256 bits wide
  - Some use error checking bit

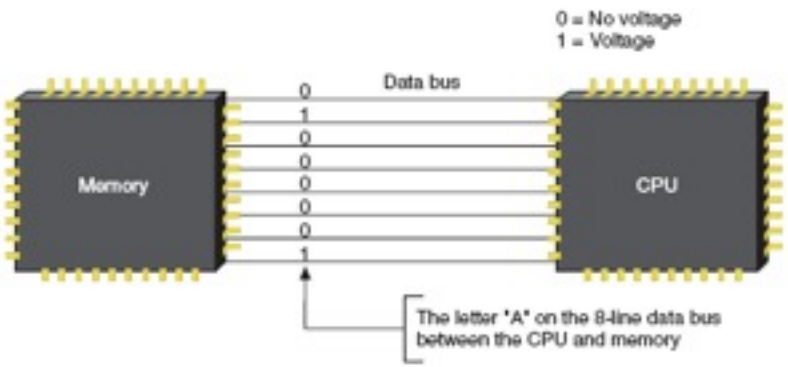

Figure 1-28 A data bus has traces or lines that carry voltage interpreted by the CPU and other devices as bits Courtesy: Course Technology/Cengage Learning

Motherboard Components Used For Communication Among Devices

- Data path size
  - Width of a data bus
- Motherboard can have more than one bus
  - Main motherboard bus
    - Communicates with CPU, memory, chipset
    - Also called system bus, front side bus (FSB), memory bus, host bus, local bus, external bus
- System clock
  - Dedicated to timing motherboard chip activities
  - Quartz crystal generates oscillation

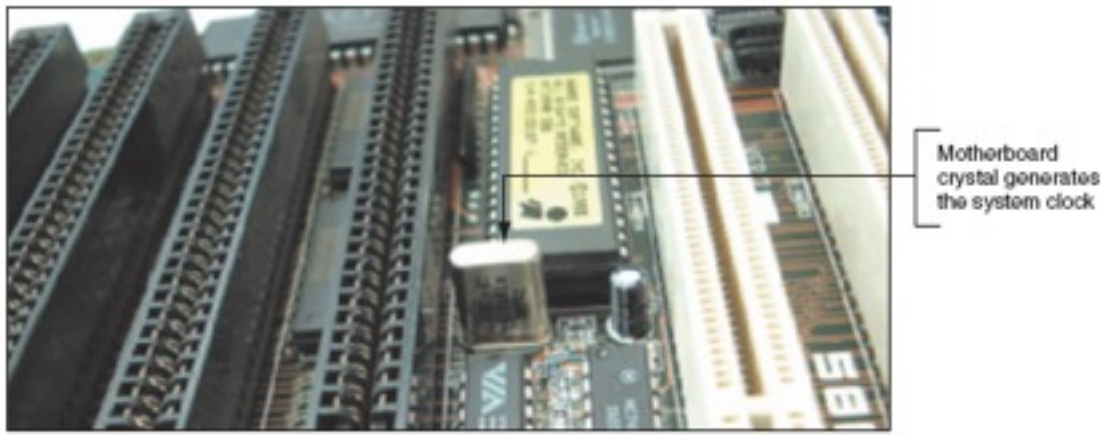

Figure 1-29 The system clock is a pulsating electrical signal sent out by this component that works much like a crystal in a wristwatch (one line, or circuit, on the motherboard bus is dedicated to carrying this pulse)
Courtesy: Course Technology/Cengage Learning

Motherboard Components Used For Communication Among Devices (cont'd.)

- Devices work according to beats (or cycles)
- Clock speed measured in hertz (cycles/second)
  - One megahertz (MHz): one million cycles per second
  - One gigahertz (GHz): one billion cycles per second
- Common ratings for motherboard buses
  - 2600 MHz, 2000 MHz, 1600 MHz, 1333 MHz, 1066 MHz, 800 MHz, 533 MHz, or 400 MHz
- Range of CPU speeds: 166 MHz to 4 GHz
- Buses for expansion slots: PCI, AGP, ISA

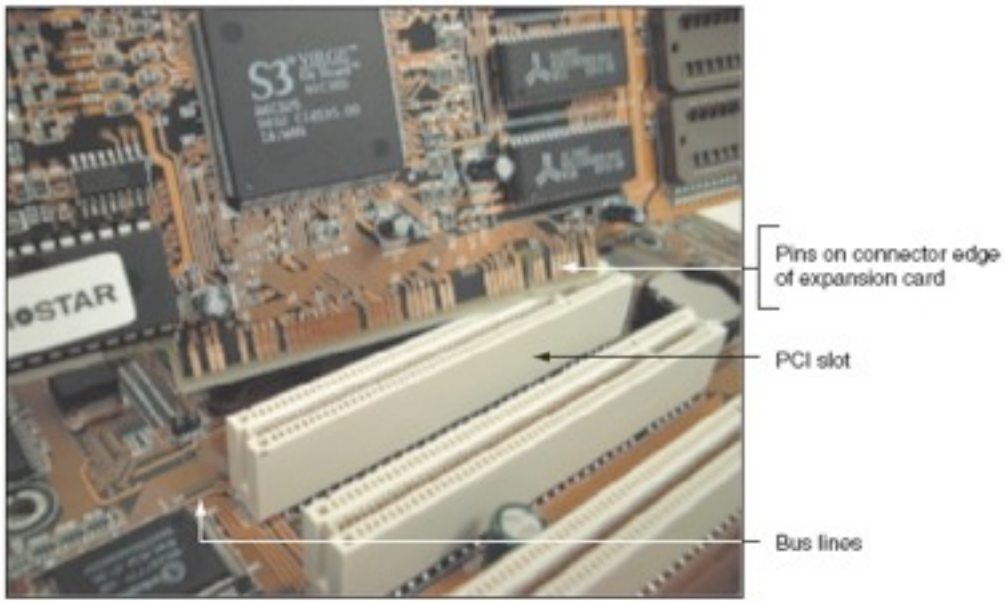

Figure 1-30 The lines of a bus terminate at an expansion slot where they connect to pins that connect to lines on the expansion card inserted in the slot
Courtesy: Course Technology/Cengage Learning

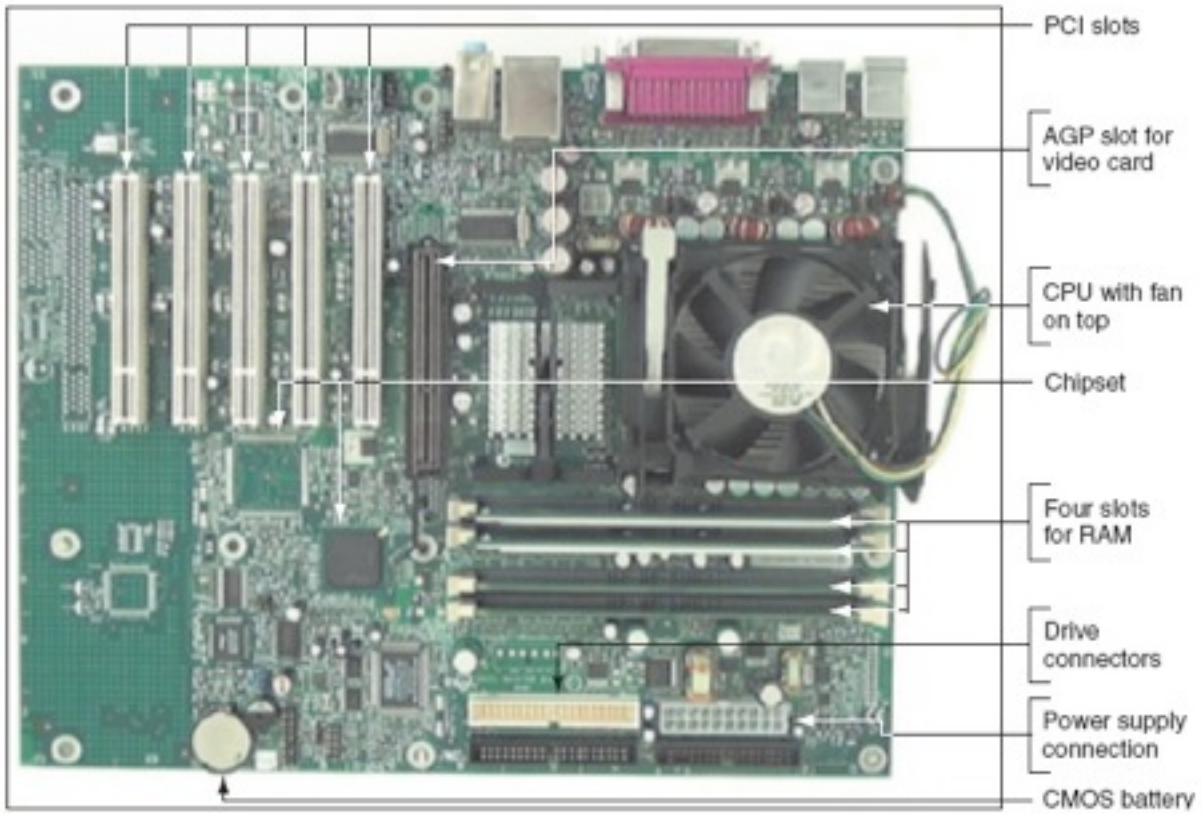

Figure 1-31 The one AGP slot used for a video card is set farther from the edge of the board than the PCI slots
Courtesy: Course Technology/Cengage Learning

Expansion Cards

- Some names for circuits mounted in expansion slots
  - Circuit cards, adapter boards, expansion cards, cards
- Cards that connect the CPU to an external device
  - Video: provides a port for the monitor
  - Sound: provides ports for speakers and microphones
  - Network: provides a port for a network cable
  - Modem: provides ports for phone lines
- Determine a card's function by identifying its port

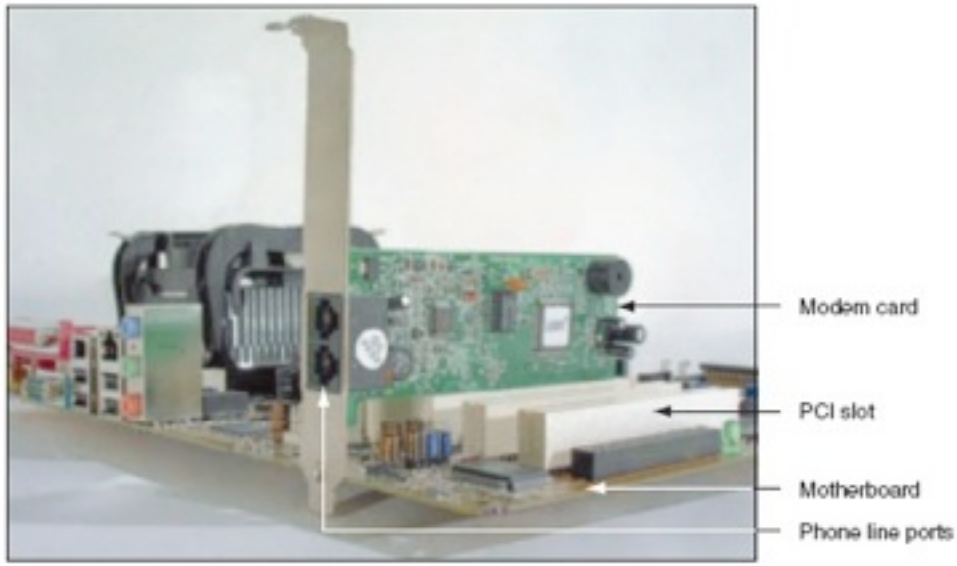

Figure 1-32 This adapter card is a modem card and is mounted in a PCI slot on the motherboard
Courtesy: Course Technology/Cengage Learning

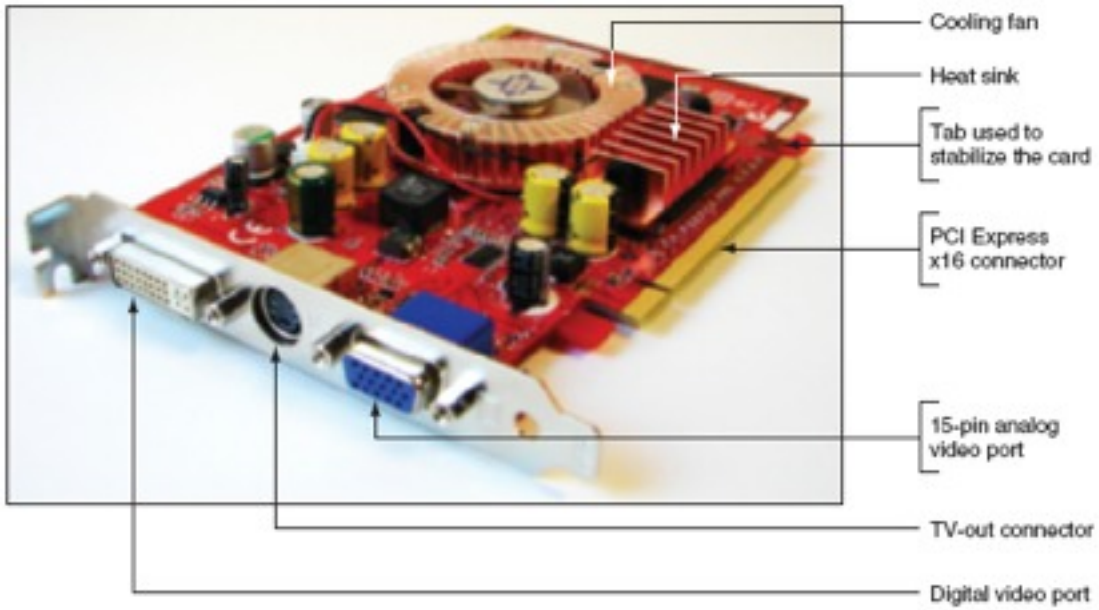

Figure 1-34 The easiest way to identify this video card is to look at the ports on the end of the card
Courtesy: Course Technology/Cengage Learning

The Electrical System

- Power supply
  - Most important electrical component
  - Converts AC voltage external source to DC voltage
  - Reduces voltage from 110-120 volts to 12 volts or less
  - Runs a fan to cool the inside of the computer case
- Temperatures > 185° F can cause component failure
- Motherboard has 1 or 2 connections to power supply

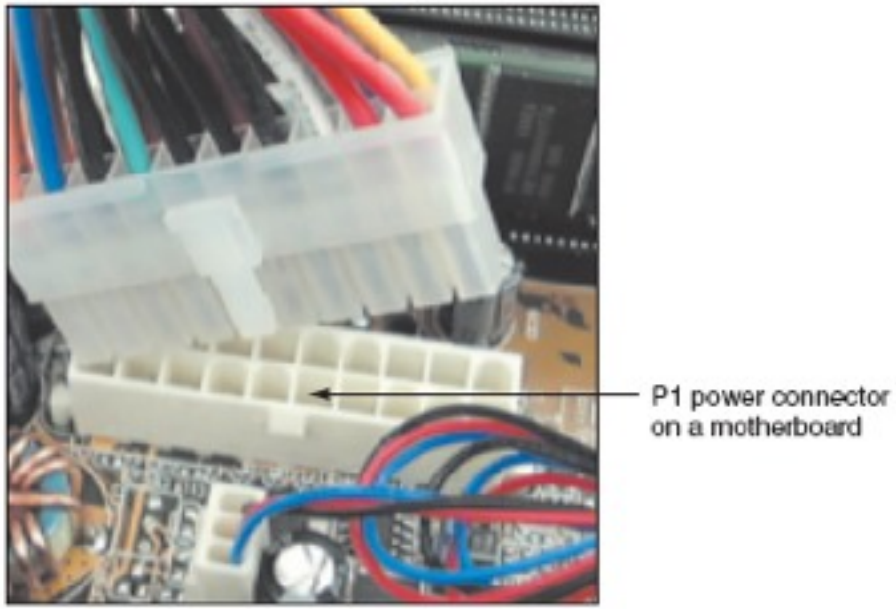

Figure 1-36 The motherboard receives its power from the power supply by way of a 20 or 24-pin connector called the P1 connector
Courtesy: Course Technology/Cengage Learning

Instructions Stored on the Motherboard and Other Boards

- BIOS (basic input/output system)
  - Data and instructions stored on ROM chips
  - ROM BIOS chips: type of firmware
- Three purposes served by motherboard ROM BIOS
  - System BIOS: manages simple devices
  - Startup BIOS: starts the computer
  - CMOS setup: changes motherboard settings
- CMOS RAM: includes date, time, port configurations
- Flash ROM
  - ROM chips that can be overwritten

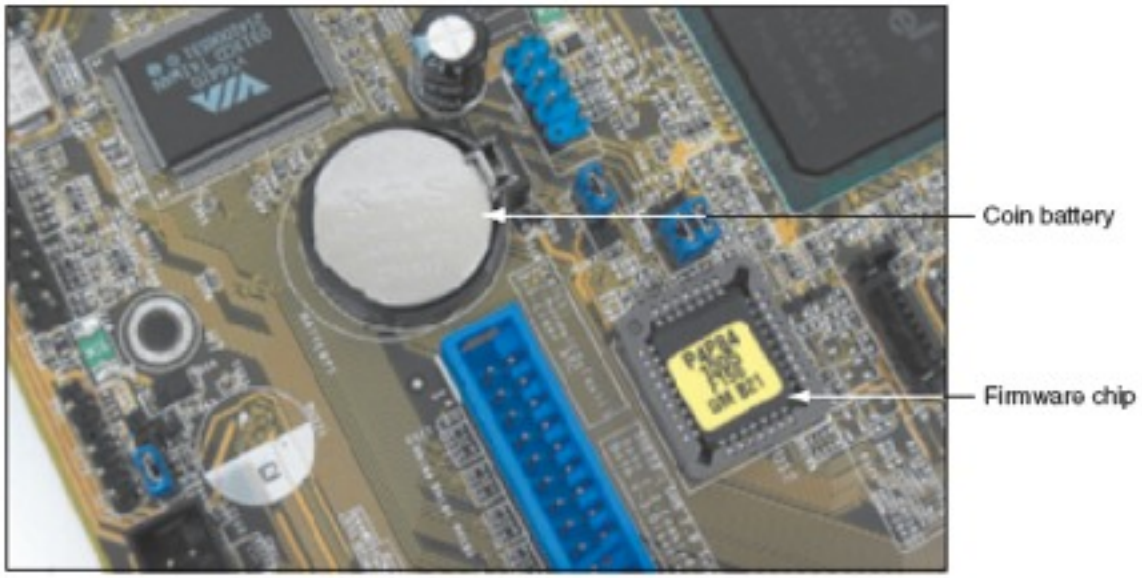

Figure 1-37 This firmware chip contains flash ROM and CMOS RAM; CMOS RAM is powered by the coin battery located near the chip
Courtesy: Course Technology/Cengage Learning

Summary

- A computer comprises hardware and software
- Main functions
  - Input, output, processing, storage
- Data stored in a binary format (one or zero, on or off)
- Input/output devices
  - Keyboard, mouse, printer, monitor
- Motherboard (system board)
  - Contains CPU, access to other circuit boards, peripherals

Summary (cont'd.)

- Primary storage (RAM): volatile
- Secondary storage: nonvolatile
- Parallel and serial ATA standards
  - Enable secondary storage devices to interface with the motherboard
- Computer bus
  - System of communication pathways, protocols
- ROM BIOS
  - Helps start PCs; manages simple devices; changes some motherboard settings