

# The Components of the System Unit

## The System Unit

### What is the **system unit**?

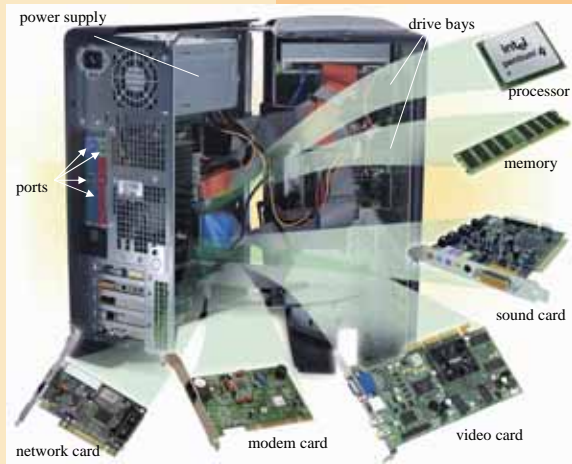
- Case that contains electronic components of the computer used to process data
  - Sometimes called the **chassis**



## The System Unit

### What are common components inside the system unit?

- **Processor**
- **Memory**
- **Adapter cards**
  - Sound card
  - Modem card
  - Video card
  - Network card
- **Ports**
- **Drive bays**
- **Power supply**



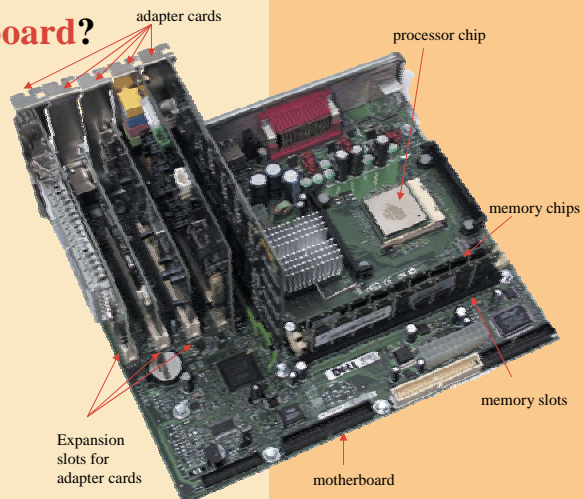
p. 4.03 Fig. 4-2

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## The System Unit

### What is the **motherboard**?

- **Main circuit board in system unit**
- **Contains adapter cards, processor chips, and memory chips**
- **Also called **system board or main board****



<http://computer.howstuffworks.com/motherboard.htm/printable>

p. 4.04 Fig. 4-3

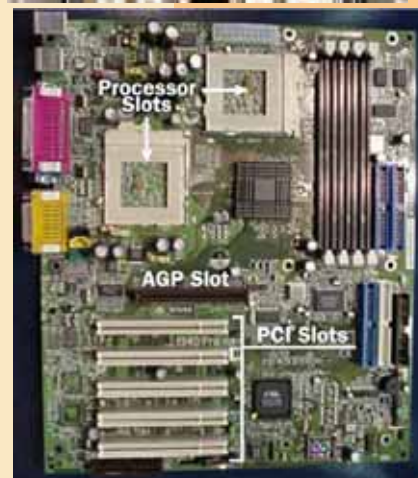
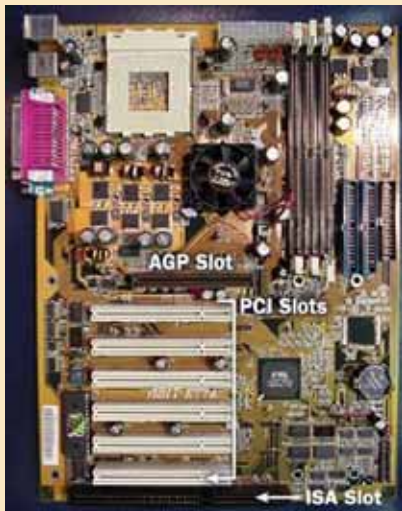
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## Background

The original IBM PC contained the original PC motherboard. In this design, which premiered in 1982, the motherboard itself was a large printed circuit card that contained the 8088 **microprocessor**, the **BIOS**, sockets for the CPU's **RAM** and a collection of slots that auxiliary cards could plug into. If you wanted to add a **floppy disk drive** or a **parallel port** or a **joystick**, you bought a separate card and plugged it into one of the slots. This approach was pioneered in the mass market by the Apple II machine. By making it easy to add cards, Apple and IBM accomplished two huge things:

1. They made it easy to add new features to the machine over time.
2. They opened the computer to creative opportunities for third-party vendors.

## Motherboards



## Data Bus Width

Modern Pentium class motherboards have a data bus with **64 bits**. That is the width of the data highway that goes in and out of the processor. The Pentium processors, however, do use 32-bit registers to handle 32-bit instructions.

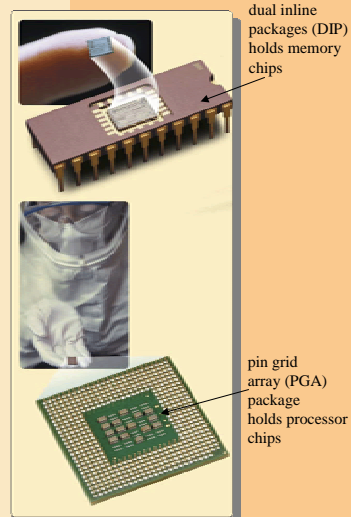
Bus speeds and widths have increased due to faster processors and the needs of multimedia applications. Typical bus names and widths are:

1. Industry Standard Architecture (ISA) - 8 or 16 bits
2. Peripheral Component Interconnect (PCI) - 32 or 64 bits
3. Accelerated Graphics Port (AGP) - 32 bits

## The System Unit

### What is a **chip**?

- Small piece of semi-conducting material on which integrated circuits are etched
  - Integrated circuits contain many microscopic pathways capable of carrying electrical current
- Chips are packaged so they can be attached to a circuit board



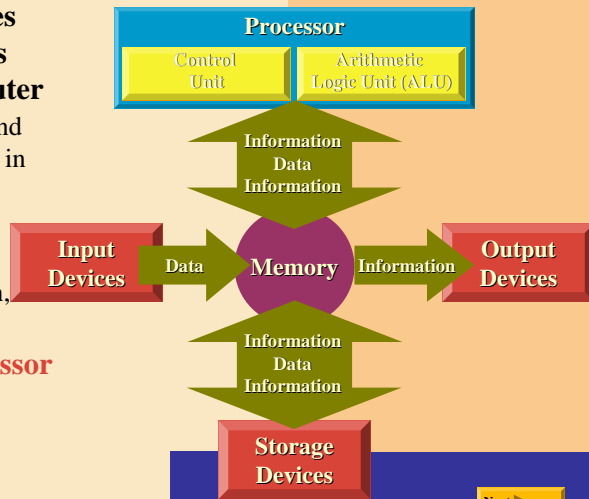
dual inline packages (DIP) holds memory chips

pin grid array (PGA) package holds processor chips

# Central Processing Unit

## What is the central processing unit (CPU)?

- **Interprets and carries out basic instructions that operate a computer**
  - **Control unit** directs and coordinates operations in computer
  - **Arithmetic logic unit (ALU)** performs arithmetic, comparison, and logical operations
- **Also called the processor**



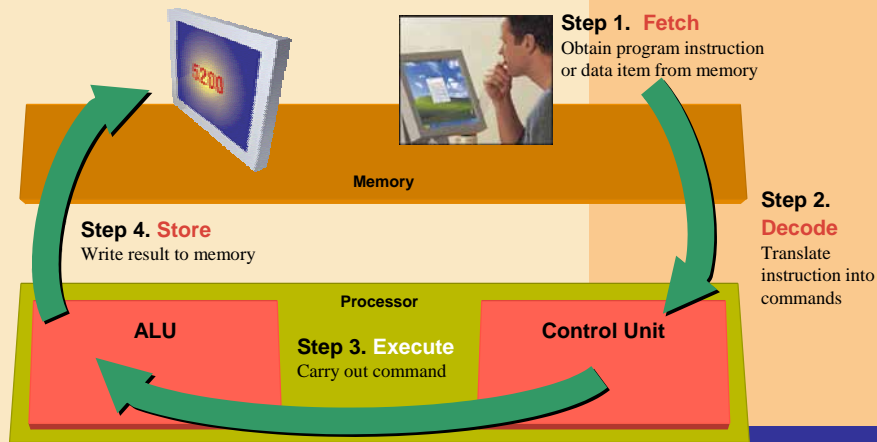
<http://computer.howstuffworks.com/microprocessor.htm/printable>

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# Central Processing Unit

## What is a machine cycle?

- **Four operations of the CPU comprise a machine cycle**



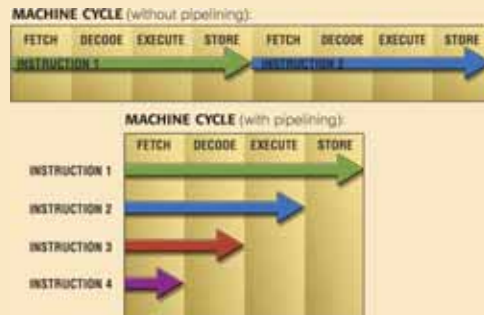
p. 4.06 Fig. 4-6

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## Central Processing Unit

### What is **pipelining**?

- CPU begins fetching second instruction before completing machine cycle for first instruction
- Results in faster processing



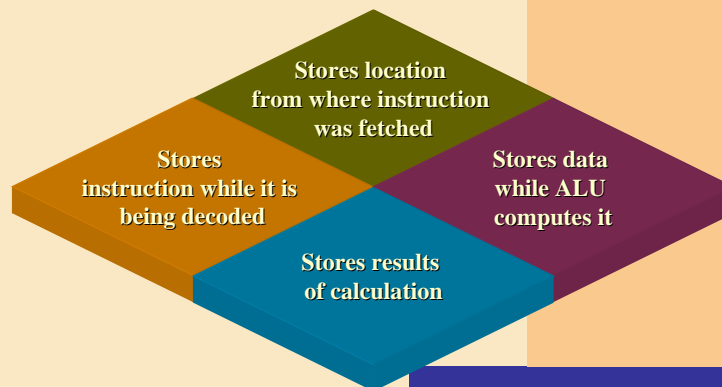
p. 4.07 Fig. 4-7

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## Central Processing Unit

### What is a **register**? (\*\*\*)

- Temporary high-speed storage area that holds data and instructions



p. 4.07

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## Chipsets

Chipsets provide the support for the processor chip on the motherboard. The chipset is the heart of the computer since it controls and determines how fast and which type of processor, memory, and slots are used. Another chip on the motherboard is called the Super I/O controller. Its main function is to control the floppy disk drive, keyboard, mouse, serial and printer ports. Check out PCGuide's Super I/O Controller Functions to learn more.

Recent motherboard designs include additional chips to support USB, sound card, video adapter, computer host and network adapter. These chips save the cost of an adapter slot.

## Central Processing Unit

What is the **system clock**?

- Controls timing of all computer operations
- Generates regular electronic pulses, or ticks, that set operating pace of components of system unit

Each tick  
is a  
clock cycle

Pace of system  
clock is **clock speed**  
Most clock speeds are  
in the gigahertz (GHz)  
range (1 GHz = one  
billion ticks of system  
clock per second)

Processor speed can  
also be measured in  
**millions of instructions  
per second (MIPS)**

## Central Processing Unit

How do personal computer processors compare?

Comparison of Widely Used Personal Computer Processors		
Name	Date Introduced	Clock Speed
Itanium <sup>®</sup> 2	2002	1 GHz and up
Xeon <sup>™</sup>	2001	1.4–2.4 GHz
Itanium <sup>®</sup>	2001	733–800 MHz
Pentium <sup>®</sup> 4	2000	1.4–2.53 GHz
Pentium <sup>®</sup> III Xeon <sup>™</sup>	1999	500–900 MHz
Pentium <sup>®</sup> III	1999	400 MHz–1.2 GHz
Celeron <sup>®</sup>	1998	266 MHz–1.8 GHz
Operon <sup>™</sup>	2003	To come
Athlon <sup>™</sup> MP	2002	1.53–1.6 GHz
Athlon <sup>™</sup> XP	2001	1.33–1.73 GHz
Athlon <sup>™</sup>	1999	500 MHz–1.4 GHz

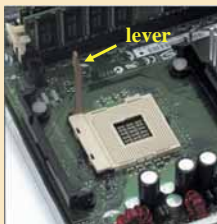
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## Central Processing Unit

What is a **zero-insertion force (ZIF)** socket?

- Allows you to install and remove chips with no force



**Step 1.**  
Lift the lever on the socket.



**Step 2.**  
Insert the chip.



**Step 3.**  
Push the lever down.

p. 4.11 Fig. 4-10

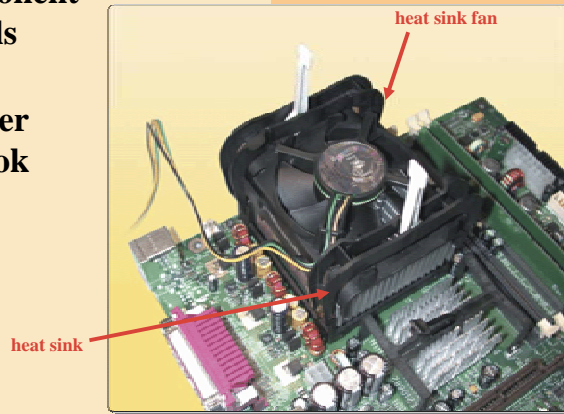
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## Central Processing Unit

What are **heat sinks** and **heat pipes**?

- **Heat sink**—component with fins that cools processor
- **Heat pipe**—smaller device for notebook computers



p. 4.12 Fig. 4-11

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## Central Processing Unit

What is a **coprocessor**?

Chip that assists processor in performing specific tasks

One type is a **floating-point coprocessor**, also known as a math or numeric coprocessor

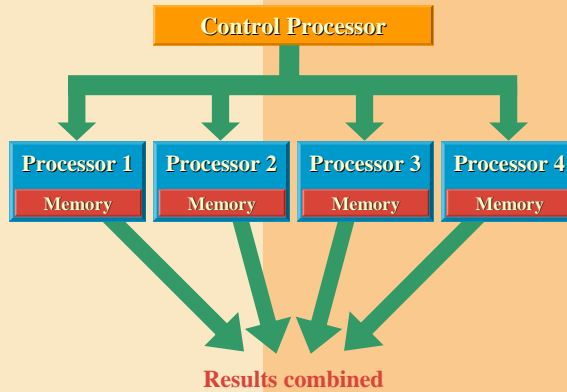
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## Central Processing Unit

### What is **parallel processing**?

- Using multiple processors simultaneously to execute a program faster
- Requires special software to divide problem and bring results together



p. 4.12 Fig. 4-12

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## Data Representation

### How do computers represent data?

- Most computers are **digital**

BINARY DIGIT (BIT)	ELECTRONIC CHARGE	ELECTRONIC STATE
1		ON
0		OFF

- Recognize only two discrete states: on or off
- Use a **binary system** to recognize two states
- Use Number system with two unique digits: 0 and 1, called **bits** (short for binary digits)

<http://computer.howstuffworks.com/bytes.htm/printable>

p. 4.13 Fig. 4-13

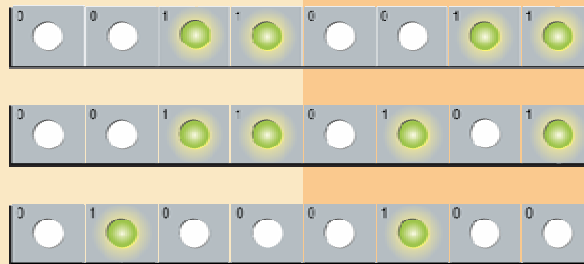
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## Data Representation

### What is a **byte**?

- **Eight bits grouped together as a unit**
- **Provides enough different combinations of 0s and 1s to represent 256 individual characters**

- Numbers
- Uppercase and lowercase letters
- Punctuation marks



p. 4.13 Fig. 4-14

Next ▶

## Data Representation

### What are three popular coding systems to represent data?

- **ASCII**—**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
- **EBCDIC**—**E**xtended **B**inary **C**oded **D**ecimal **I**nterchange **C**ode
- **Unicode**—coding scheme capable of representing all world's languages

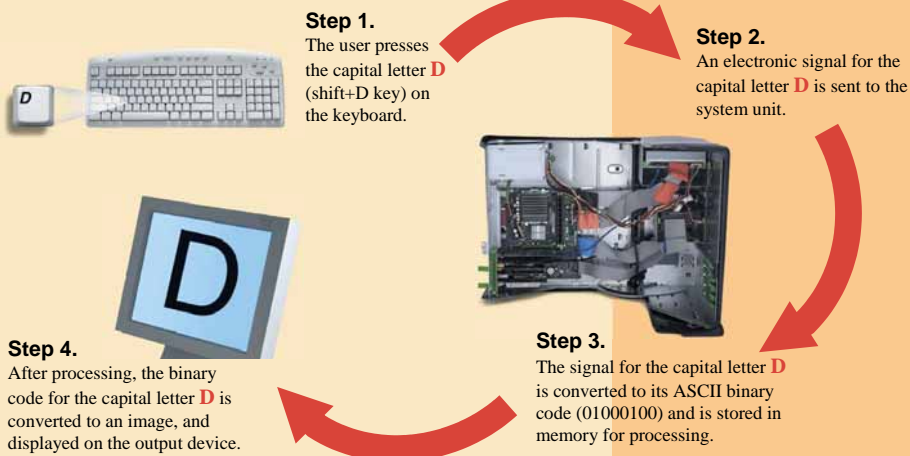
ASCII	Symbol	EBCDIC
00110000	0	11110000
00110001	1	11110001
00110010	2	11110010
00110011	3	11110011

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## Data Representation

### How is a letter converted to binary form and back?



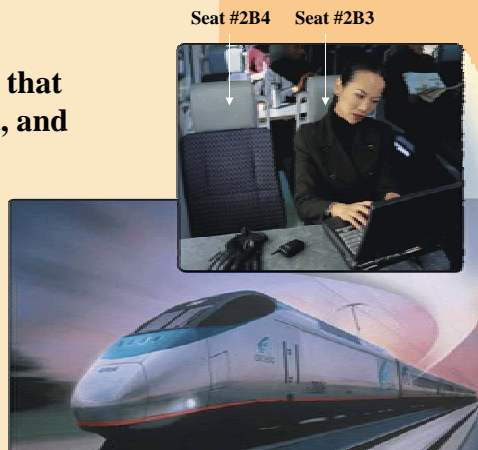
p. 4.15 Fig. 4-16

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## Memory

### What is **memory**?

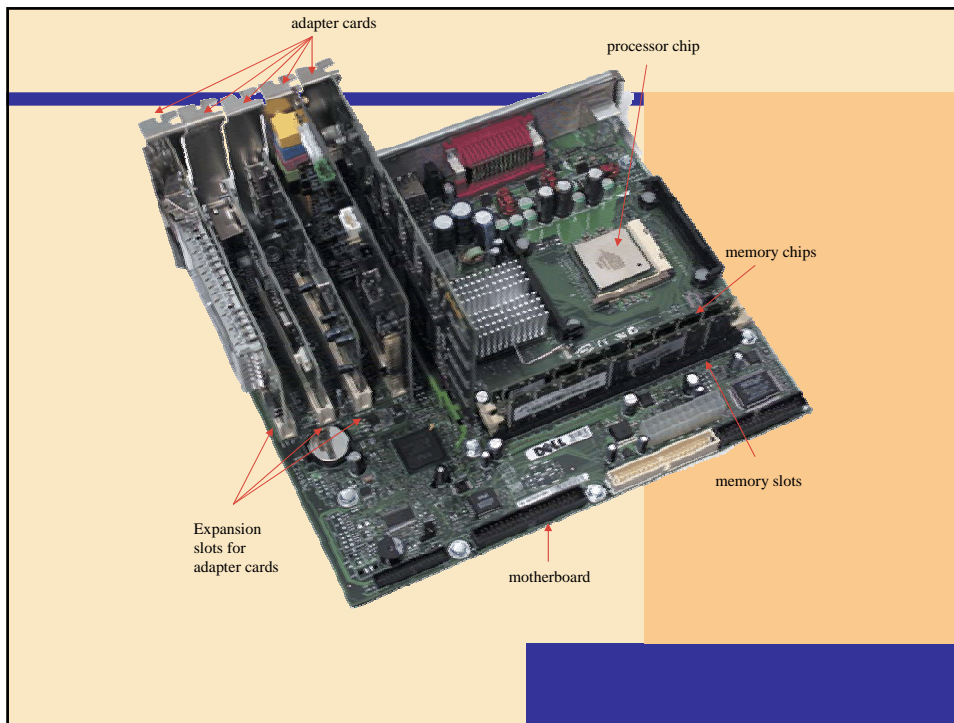
- Electronic components that store instructions, data, and results
- Consists of one or more chips on motherboard or other circuit board
- Each byte stored in unique location called an **address**, similar to addresses on a passenger train



p. 4.15 Fig. 4-17

<http://computer.howstuffworks.com/computer-memory.htm/printable>

Next ▶



## Memory

### How is memory measured?

- **By number of bytes available for storage**

Term	Abbreviation	Approximate Size
Kilobyte	KB or K	1 thousand bytes
Megabyte	MB	1 million bytes
Gigabyte	GB	1 billion bytes
Terabyte	TB	1 trillion bytes

# Memory

## What is random access memory (RAM)?



Memory chips that can be read from and written to by processor

Also called main memory or primary storage

Most RAM is volatile, it is lost when computer's power is turned off

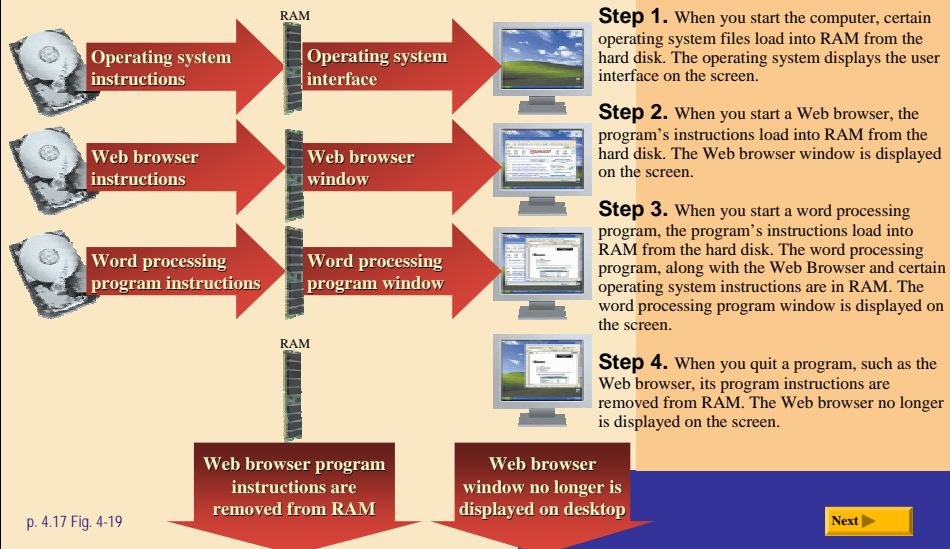
The more RAM a computer has, the faster it responds

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# Memory

## How do program instructions transfer in and out of RAM?

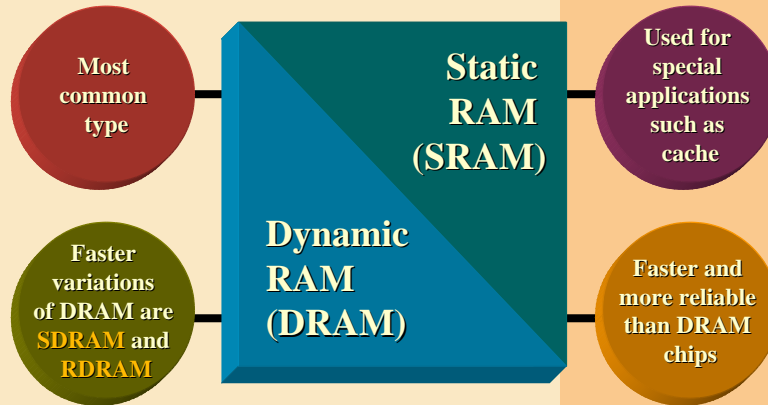


p. 4.17 Fig. 4-19

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# Memory

What are two basic types of RAM chips?



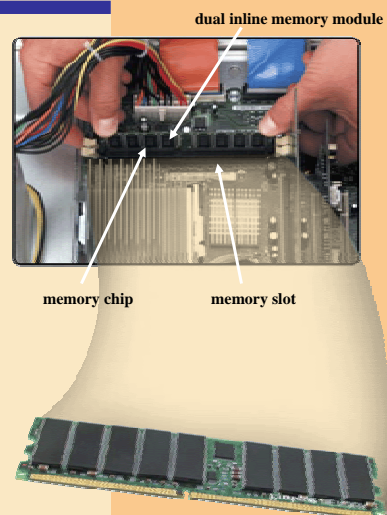
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# Memory

Where does memory reside?

- Resides on small circuit board called **memory module**
- **Memory slots** on motherboard hold memory modules

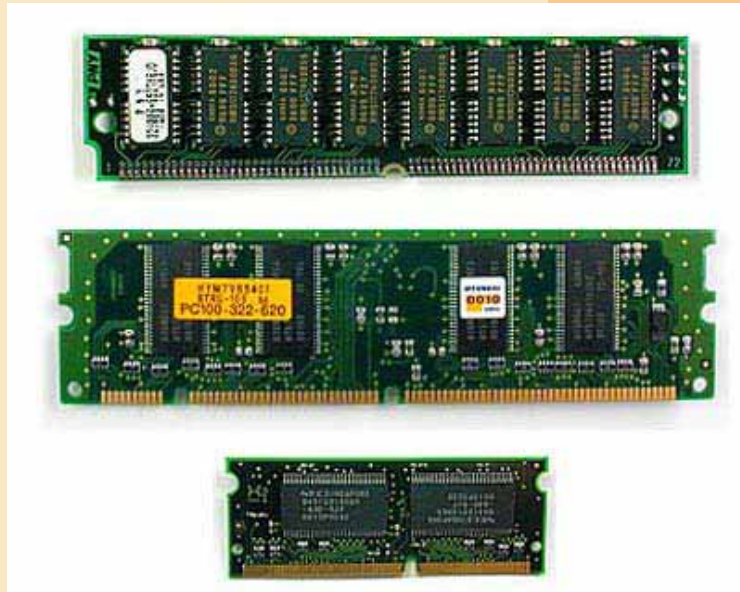


p. 4.18 Fig. 4-20

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## RAM memory modules

From the top: SIMM, DIMM and SODIMM



## Memory

How much RAM does an application require?

- Software package typically indicates RAM requirements
- For optimal performance, you need more than minimum specifications

**System Requirements**  
Windows® XP Home Edition/Professional

- Intel Pentium processor at 233MHz or higher
- AMD K6 (Athlon Duron Family processor at 233MHz or higher
- 64 MB of RAM





# Memory

## How much RAM do you need?

- **Depends on type of applications you intend to run on your computer**

RAM	128 to 256 MB	256 to 1 GB	1 GB and up
Use	<ul style="list-style-type: none"><li>• Home and business users managing personal finance</li><li>• Using standard application software such as word processing</li><li>• Using educational or entertainment CD-ROMs</li><li>• Communicating with others on the Web</li></ul>	<ul style="list-style-type: none"><li>• Users requiring more advanced multimedia capabilities</li><li>• Running number-intensive accounting, financial, or spreadsheet programs</li><li>• Using voice recognition</li><li>• Working with videos, music, and digital imaging</li><li>• Creating Web sites</li><li>• Participating in video conferences</li><li>• Playing Internet games</li></ul>	<ul style="list-style-type: none"><li>• Power users creating professional Web sites</li><li>• Running sophisticated CAD, 3D design, or other graphics-intensive software</li></ul>

p. 4.19 Fig. 4-22

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# Memory

## What is **cache**?

- **Helps speed computer processes by storing frequently used instructions and data**
- **Also called **memory cache****

The idea behind caching is to use a small amount of expensive memory to speed up a large amount of slower, less-expensive memory. (ex: librarian)

- L1 cache built into processor
- L2 cache slower but has larger capacity
- L2 **advanced transfer cache** is faster, built directly on processor chip
- L3 cache is separate from processor chip on motherboard (L3 is only on computers that use L2 advanced transfer cache)

p. 4.20 Fig. 4-23

Next ▶

# Memory

## What is **read-only memory (ROM)**?

Memory chips that store permanent data and instructions

**Nonvolatile memory**, it is not lost when computer's power is turned off

Three types:

**Firmware**—  
Manufactured with permanently written data, instructions, or information

**PROM** (programmable read-only memory)—  
Blank ROM chip onto which a programmer can write permanently

**EEPROM** (electrically erasable programmable read-only memory)—  
Type of PROM containing microcode programmer can erase

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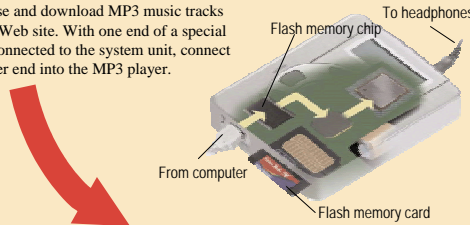
# Memory

## What is **flash memory**?

- **Nonvolatile memory that can be erased electronically and reprogrammed**
- **Used with PDAs, digital cameras, digital cellular phones, music players, digital voice recorders, and pagers**

### Step 1.

Purchase and download MP3 music tracks from a Web site. With one end of a special cable connected to the system unit, connect the other end into the MP3 player.



### Step 2.

Instruct the computer to copy the MP3 music track to the flash memory chip in the MP3 player.

### Step 3.

Plug the headphones into the MP3 player, push a button on the MP3 player, and listen to the music through the headphones.

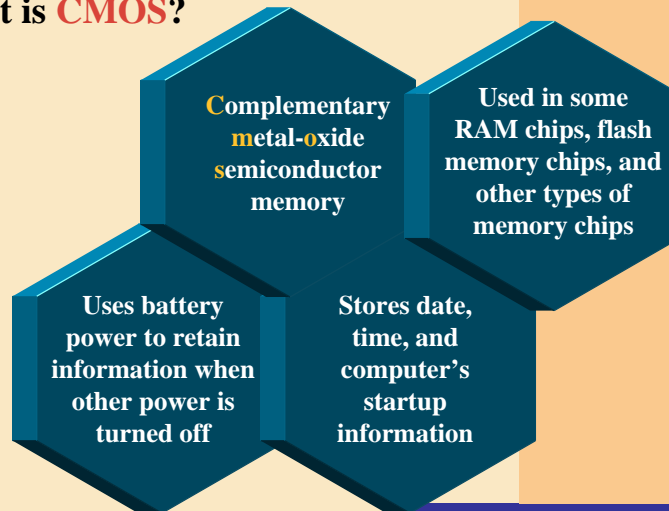


p. 4.21 Fig. 4-24

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# Memory

## What is CMOS?



p. 4.22

Next ▶

# Memory

## What is access time?

- Amount of time it takes processor to read data from memory
- Measured in nanoseconds (ns), one billionth of a second
- It takes 1/10 of a second to blink your eye; a computer can perform up to 10 million operations in same amount of time



Term	Speed
Millisecond	One-thousandth of a second
Microsecond	One-millionth of a second
Nanosecond	One-billionth of a second
Picosecond	One-trillionth of a second

p. 4.22 Fig. 4-26

Next ▶

## Expansion Slots and Expansion Cards

### What is an **adapter card**?

- Enhances system unit or provides connections to external devices called **peripherals**
- Also called an **expansion card**

#### Types of Adapter Cards

Adapter Card	Purpose
<b>Accelerator</b>	Increases the speed of the processor
<b>Disk controller</b>	Connects disk drives
<b>Game</b>	Connects a joystick
<b>I/O</b>	Connects input and output devices such as a printer or mouse; being phased out because newer motherboards support these connections
<b>Interface</b>	Connects other peripherals such as a mouse, CD, DVD, or scanner
<b>MIDI</b>	Connects musical instruments
<b>Modem</b>	Connects other computers through telephone or cable television lines
<b>Network</b>	Connects other computers and peripherals
<b>PC-to-TV converter</b>	Connects a television
<b>Sound</b>	Connects speakers or a microphone
<b>TV tuner</b>	Allows viewing of television channels on the monitor
<b>USB 2.0</b>	Connects USB 2.0 devices
<b>Video</b>	Connects a monitor
<b>Video capture</b>	Connects a camcorder

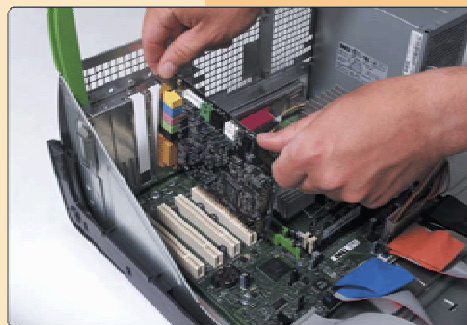
p. 4.23 Fig. 4-27

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## Expansion Slots and Expansion Cards

### What is an **expansion slot**?

- An opening, or socket, on the motherboard that can hold an adapter card
- With **Plug and Play**, the computer automatically configures cards and other devices as you install them



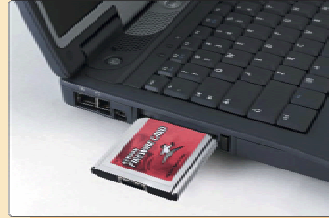
p. 4.23 Fig. 4-28

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## Expansion Slots and Expansion Cards

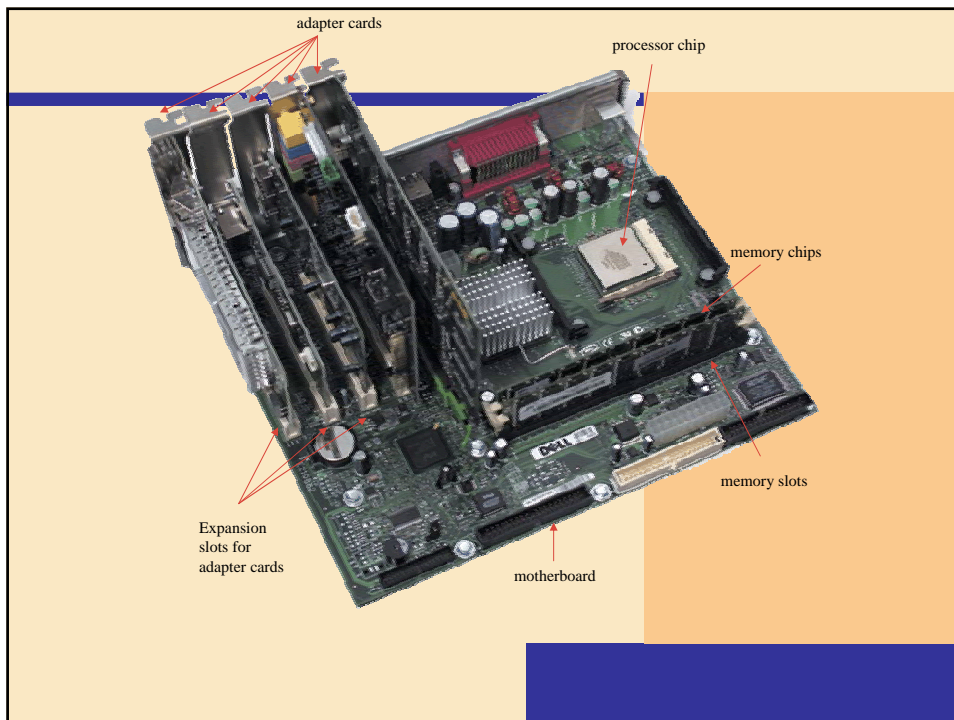
What are **PC cards** and **flash memory cards**?

- A **PC card** adds memory, sound, modem, and other capabilities to notebook computers
- A **flash memory card** allows users to transfer data from mobile devices to desktop computers
  - **Hot plugging** allows you to insert and remove cards while computer is running

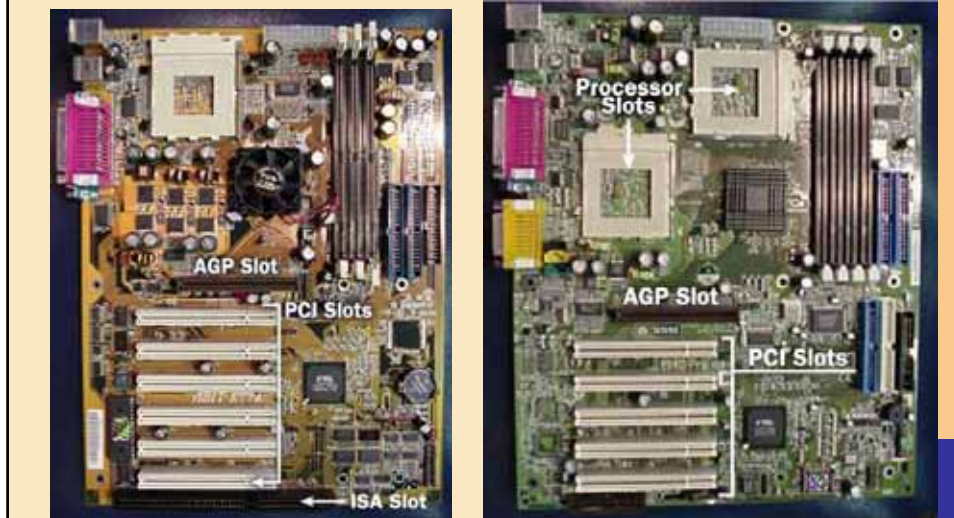


p. 4.24 Fig. 4.29-4.30

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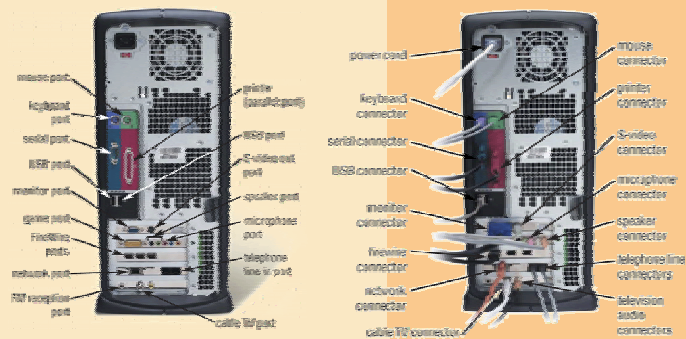
## Motherboards



## Ports

### What are **ports** and **connectors**?

- **Port** connects external devices to system unit
- **Connector** joins cable to peripheral
  - Available in one of two genders: **male** and **female**



p. 4.25 Fig. 4-31-4.32

Next ▶

# Ports

## What are different types of connectors?

CONNECTOR	DE-9, 9-pin male	DB-9, 9-pin female	DB-15HD, 15-pin high-density female	14-pin DVI
USE	serial port, external modem	EISA and ISA video	VGA and EISA video	digital video interface monitor
CONNECTOR	DB-25, 25-pin male	DB-25, 25-pin female	36-pin female, mini ribbon	
USE	serial port, external modem, SCSI	parallel port, printer, tape backup	printer	
CONNECTOR	36-pin Centronics female	50-pin Centronics female	D9-15, 15-pin female	
USE	printer	SCSI	game port	
CONNECTOR	USB	FireWire	RJ-45, 8-pin female, modular telephone	5-pin "B" female DIN
USE	connects to 121 different peripheral devices	connects to 63 different peripheral devices	telephone, modem	keyboard, MIDI
CONNECTOR	RJ-45, 8-pin female	BNC, male coaxial	5-pin male, mini DIN	Miniplug
USE	LAN	LAN	mouse, keyboard	speaker & microphone

p. 4.26 Fig. 4-33

Next ▶

# Ports

## What is a **serial port**?

- Transmits one bit of data at a time
- Connects slow-speed devices, such as mouse, keyboard, modem



p. 4.27 Fig. 4-34

Next ▶

## Ports

### What is a **parallel port**?

- Connects devices that can transfer more than one bit at a time, such as a printer



p. 4.27 Fig. 4-35

Next ▶

## Ports

### What are **USB ports**?

**USB (universal serial bus) port** can connect up to 127 different peripherals together with a single connector type

PCs typically have two to four USB ports on front or back of the system unit

Single USB port can be used to attach multiple peripherals in a **daisy chain**

First USB device connects to USB port on computer

Second USB device connects to first USB device

Third USB device connects to second USB device, and so on

p. 4.28

Next ▶



## Ports

### What are **special-purpose ports**?

- Allow users to attach specialized peripherals (digital video cameras, color printers, scanners, and disk drives) or transmit data to wireless devices
  - FireWire port
  - MIDI (Musical Instrument Digital Interface) port
  - SCSI (small computer system interface) port
  - IrDA (Infrared Data Association) port
  - Bluetooth™ port



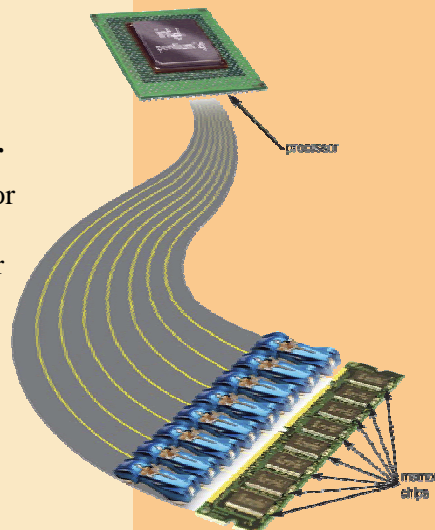
p. 4.28 Fig. 4-37

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## Buses

### What is a **bus**?

- Channel that allows devices inside computer to communicate with each other
  - **System bus** connects processor and RAM
  - **Bus width** determines number of bits transmitted at one time
  - **Word size** is the number of bits processor can interpret and execute at a given time



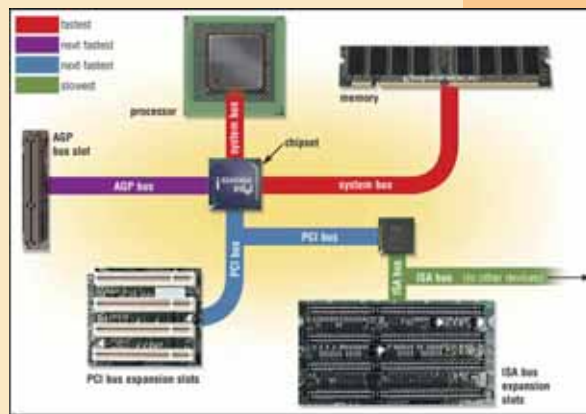
p. 4.30 Fig. 4-38

Next ▶

## Buses

What is an **expansion bus**?

- Allows processor to communicate with peripherals



p. 4.31 Fig. 4-39

Next ▶

## Bays

What is a **bay**?

- Open area inside system unit used to install additional equipment
- **Drive bays** typically hold disk drives



p. 4.32 Fig. 4-40

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## Mobile Computers

### What is a **mobile computer**?

- **Notebook, weighing between 2.5 and 8 pounds, or mobile device such as a PDA**

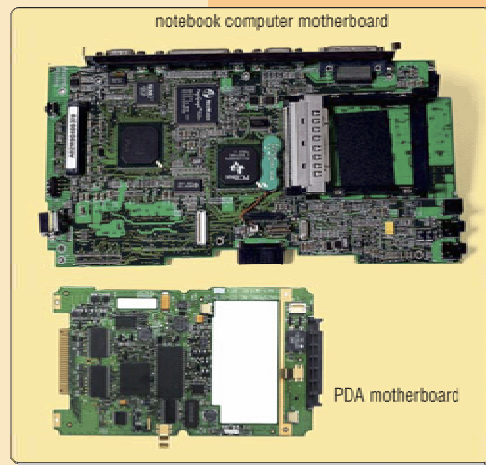


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## Mobile Computers

### What is in the system unit of a mobile computer?

- **Motherboard, processor, and memory—also devices such as the keyboard, speakers, and display**

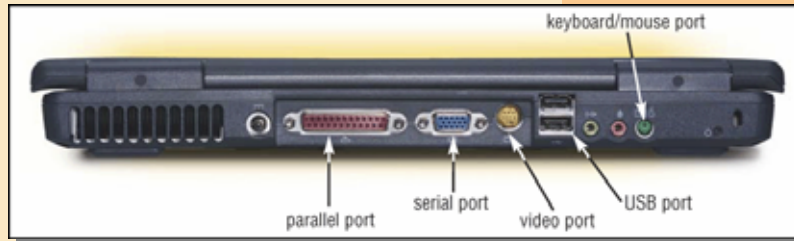


p. 4.34 Fig. 4-42

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## Mobile Computers

What ports are on a notebook computer?



p. 4.34 Fig. 4-43

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## Mobile Computers

What ports are on a tablet PC?


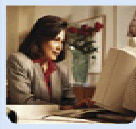
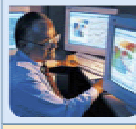



p. 4.35 Fig. 4-44

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## Putting It All Together

What are suggested processor, clock speed, and RAM requirements based on the needs of various types of users?

User	Processor and Clock Speed	User	Processor and Clock Speed
 Home	Pentium® 4 or Athlon™ XP 1.7 GHz or higher or Celeron® or Duron™ 1.2 GHz or higher  Minimum RAM: 128 MB	 Large Business	Pentium® 4 or Athlon™ XP 3 GHz or higher  Minimum RAM: 512 MB
 Small Office/Home Office	Pentium® 4 or Athlon™ XP 2 GHz or higher  Minimum RAM: 256 MB	 Power	Xeon™ or Itanium® or Athlon™ MP 2.5 GHz or higher  Minimum RAM: 1 GB
 Mobile	Pentium® 4 or Athlon™ XP 1.8 GHz or higher  Minimum RAM: 256 MB		

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## Homework #2 – Email to TA

Your name, department, year, student ID, url to your homepage  
(if there is one)

8 questions (due on October 10, 2004)

- Surfing the Internet?
- Playing games?
- Word processing?
- Spreadsheet making?
- Buying your own PC parts?
- Installing your own OS/applications?
- Programming? HTML, C, Java
- Ever heard about Linux? Used it?