The Components of the System Unit

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The System Unit

- The **system unit** is a case that contains electronic components of the computer used to process data

The System Unit

- The inside of the system unit on a desktop personal computer includes:

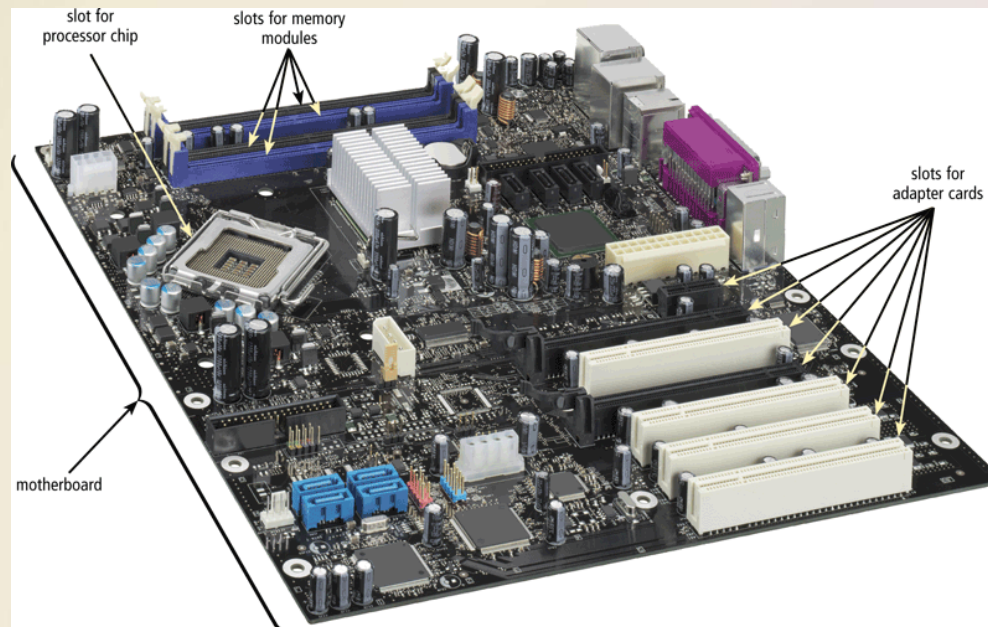Drive bay(s)

Power supply

Sound card

Video card

Processor

Memory

The System Unit

- The **motherboard** is the main circuit board of the system unit
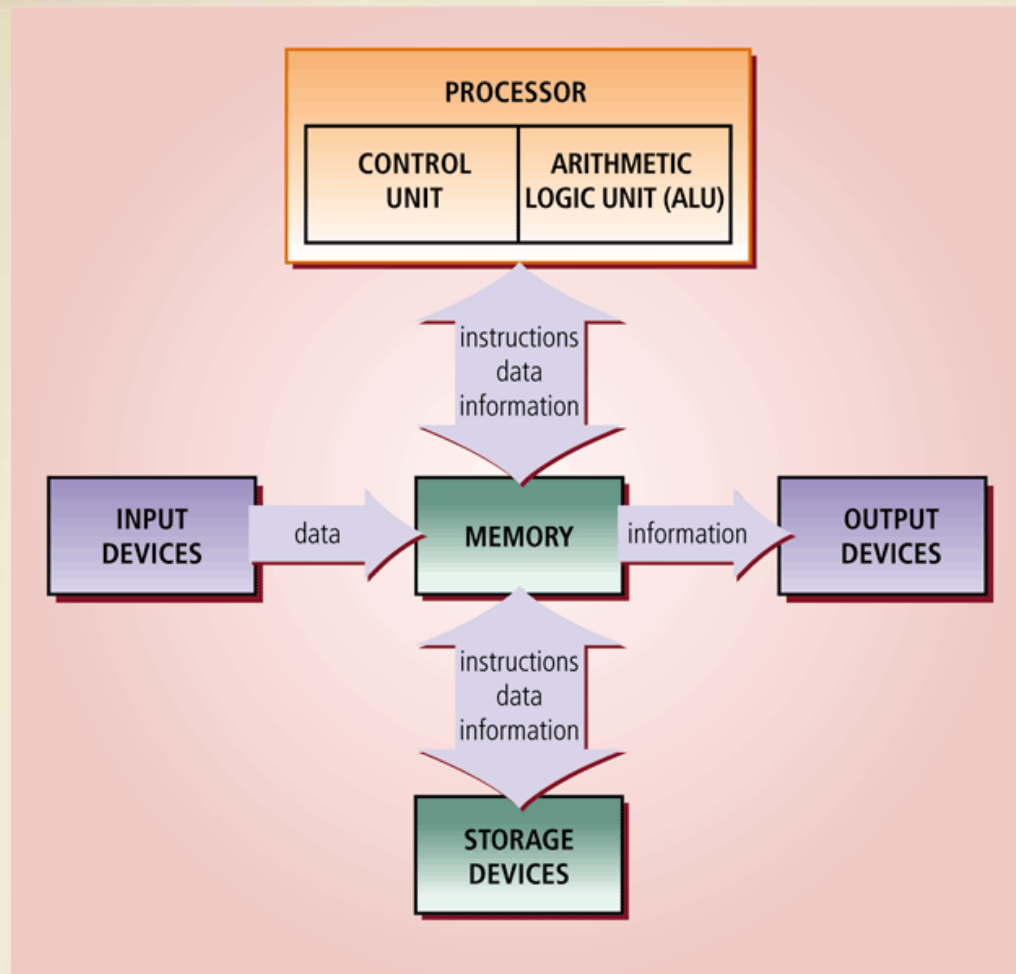 - A computer **chip** contains integrated circuits

Processor

- The **processor**, also called the **central processing unit** (**CPU**), interprets and carries out the basic instructions that operate a computer

    – Contain a control unit and an arithmetic logic unit (ALU)

Multi-core processor	**Dual-core processor**	**Quad-core processor**

Processor

Processor

- The **control unit** is the component of the processor that directs and coordinates most of the operations in the computer

- The **arithmetic logic unit** (ALU) performs arithmetic, comparison, and other operations

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click Chapter 4, Click Web
Link from left navigation,
then click Control Unit
below Chapter 4

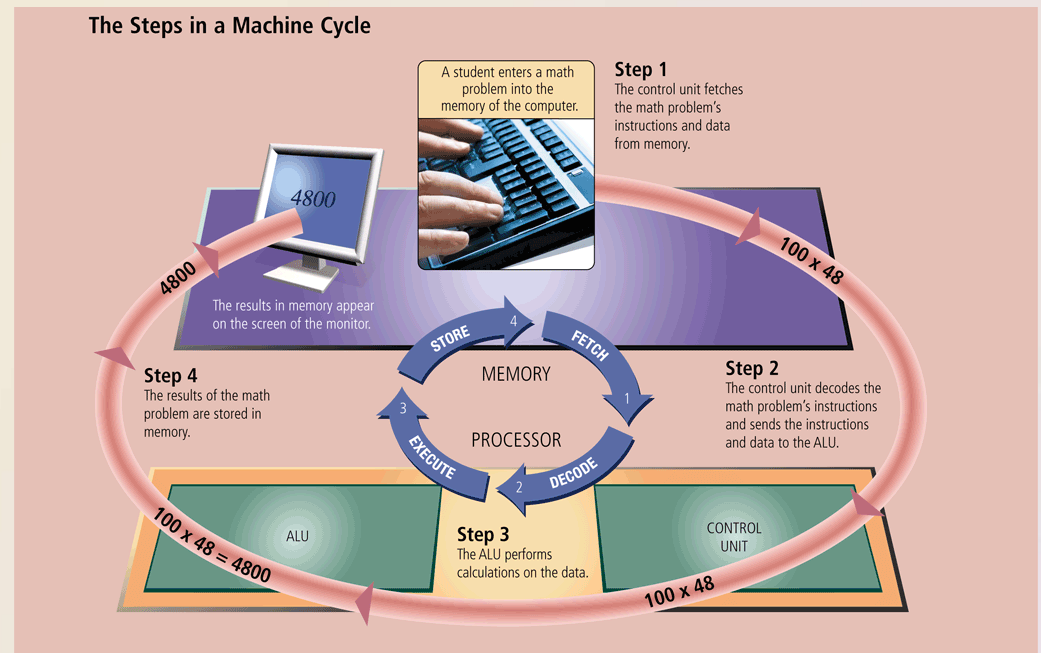Discovering Computers 2011: Living in a Digital World
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Processor

- For every instruction, a processor repeats a set of four basic operations, which comprise a machine cycle
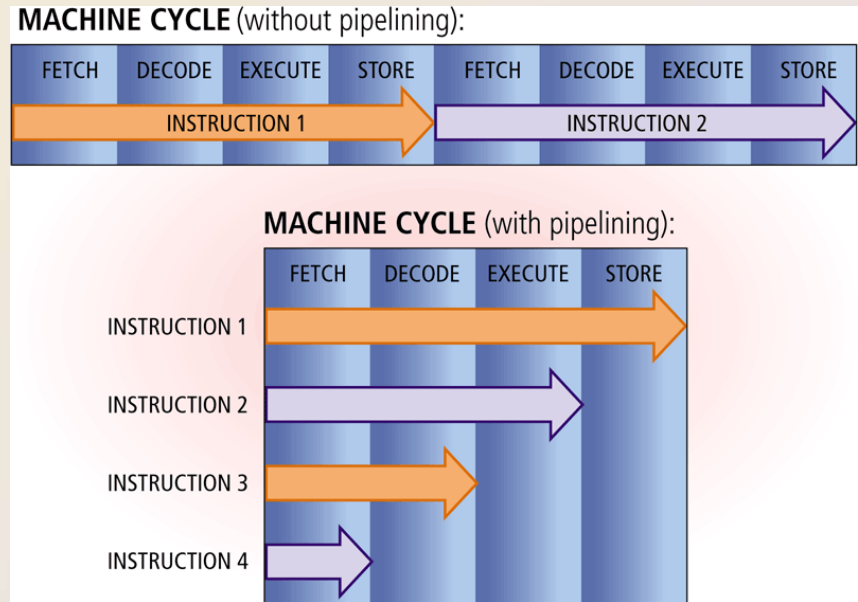
Step 1: Fetch
Step 2: Decode
Step 3: Execute
Step 4: Store

The Steps in a Machine Cycle

Processor

- Most current personal computers support pipelining
  - Processor begins fetching a second instruction before it completes the machine cycle for the first instruction

MACHINE CYCLE (without pipelining):

| FETCH | DECODE | EXECUTE | STORE | FETCH | DECODE | EXECUTE | STORE |

INSTRUCTION 1   INSTRUCTION 2

MACHINE CYCLE (with pipelining):

| FETCH | DECODE | EXECUTE | STORE |

INSTRUCTION 1
INSTRUCTION 2
INSTRUCTION 3
INSTRUCTION 4

Processor

The processor contains registers, that temporarily hold data and instructions

The **system clock** controls the timing of all computer operations

- The pace of the system clock is called the **clock speed**, and is measured in **gigahertz** (**GHz**)

Processor

- Parallel processing uses multiple processors simultaneously to execute a single program or task
  - Massively parallel processing involves hundreds or thousands of processors
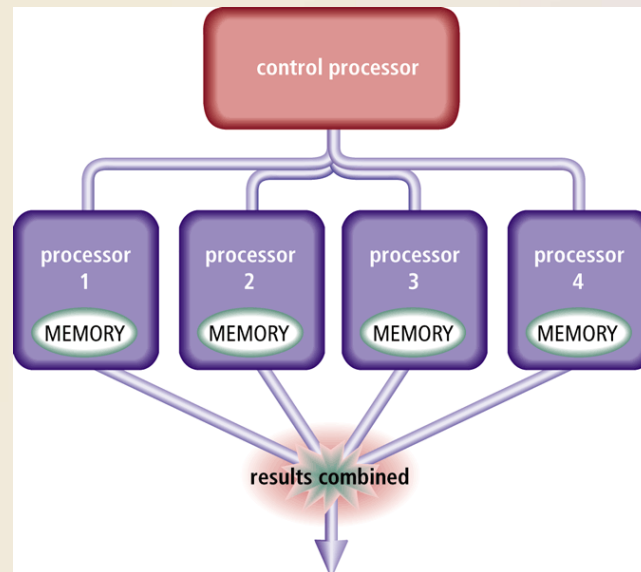
Data Representation
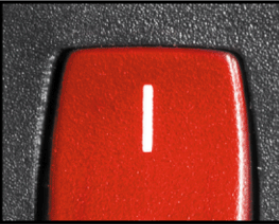
Analog signals are continuous and vary in strength and quality

Digital signals are in one of two states: on or off

- Most computers are digital
- The **binary system** uses two unique digits (0 and 1)
  - **Bits** and **bytes**

Data Representation

A computer circuit represents the 0 or the 1 electronically by the presence or absence of an electrical charge

Eight bits grouped together as a unit are called a byte. A byte represents a single character in the computer

BINARY DIGIT (BIT)	ELECTRONIC CHARGE	ELECTRONIC STATE
I	🔴	ON
O	🟢	OFF

8-BIT BYTE FOR THE NUMBER 4

| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |

8-BIT BYTE FOR THE NUMBER 6

| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |

8-BIT BYTE FOR THE LETTER E
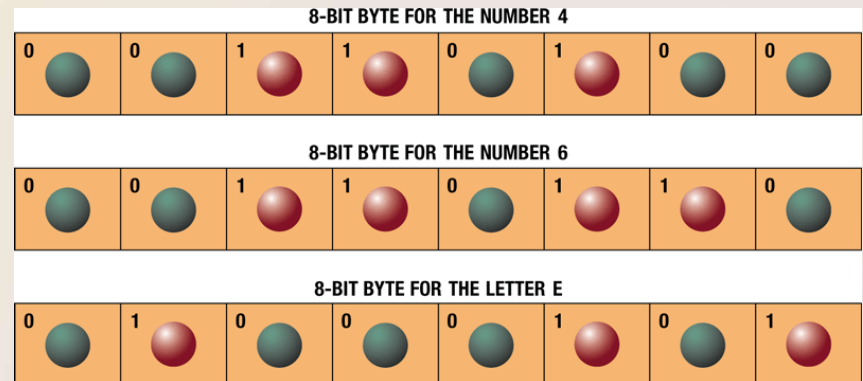
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |

Data Representation

- ASCII (American Standard Code for Information Interchange) is the most widely used coding scheme to represent data

ASCII	SYMBOL	ASCII	SYMBOL
00110000	0	01001110	N
00110001	1	01001111	O
00110010	2	01010000	P
00110011	3	01010001	Q
00110100	4	01010010	R
00110101	5	01010011	S
00110110	6	01010100	T
00110111	7	01010101	U
00111000	8	01010110	V
00111001	9	01010111	W
01000001	A	01011000	X
01000010	B	01011001	Y
01000011	C	01011010	Z
01000100	D	00100001	!
01000101	E	00100010	
01000110	F	00100011	#
01000111	G	00100100	$
01001000	H	00100101	%
01001001	I	00100110	&
01001010	J	00101000	(
01001011	K	00101001	)
01001100	L	00101010	*
01001101	M	00101011	+

Data Representation

How a Letter Is Converted to Binary Form and Back

Step 1
A user presses the capital letter **T** (SHIFT+T keys) on the keyboard, which in turn creates a special code, called a scan code, for the capital letter **T**.

Step 2
The scan code for the capital letter **T** is sent to the system unit.

Step 4
After processing, the binary code for the capital letter **T** is converted to an image and displayed on the output device.

Step 3
The system unit converts the scan code for the capital letter **T** to its ASCII binary code (01010100) and stores it in memory for processing.

Memory

- **Memory** consists of electronic components that store instructions waiting to be executed by the processor, data needed by those instructions, and the results of processing the data

- Stores three basic categories of items:

The operating system and other system software	Application programs	Data being processed and the resulting information

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Chapter 4

Memory

- Each location in memory has an address
- Memory size is measured in **kilobytes** (**KB** or **K**), **megabytes** (**MB**), **gigabytes** (**GB**), or **terabytes** (**TB**)

Memory Sizes				
Term	**Abbreviation**	**Approximate Number of Bytes**	**Exact Number of Bytes**	**Approximate Number of Pages of Text**
Kilobyte	KB or K	1 thousand	1,024	1/2
Megabyte	MB	1 million	1,048,576	500
Gigabyte	GB	1 billion	1,073,741,824	500,000
Terabyte	TB	1 trillion	1,099,511,627,776	500,000,000

Memory

- The system unit contains two types of memory:

Volatile memory

Loses its contents when power is turned off

Example includes **RAM**

Nonvolatile memory

Does not lose contents when power is removed

Examples include ROM, flash memory, and CMOS

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Chapter 4

Memory

**How Program Instructions Transfer in and out of RAM**

Step 1
When you start the computer, certain operating system files are loaded into RAM from the hard disk. The operating system displays the user interface on the screen.

hard disk → operating system instructions → RAM → operating system interface
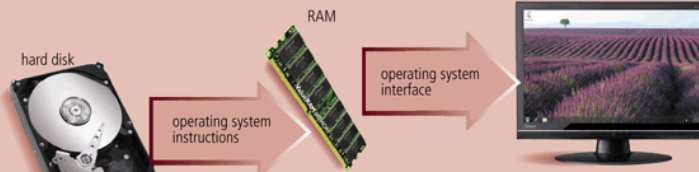
Step 2
When you start a Web browser, the program's instructions are loaded into RAM from the hard disk. The Web browser and certain operating system instructions are in RAM. The Web browser window appears on the screen.

hard disk → Web browser instructions → RAM → Web browser window
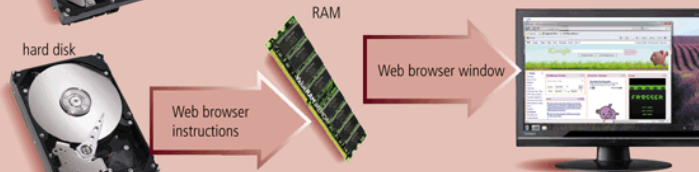
Step 3
When you start a paint program, the program's instructions are loaded into RAM from the hard disk. The paint program, along with the Web browser and certain operating system instructions, are in RAM. The paint program window appears on the screen.

hard disk → paint program instructions → RAM → Web browser and paint program windows
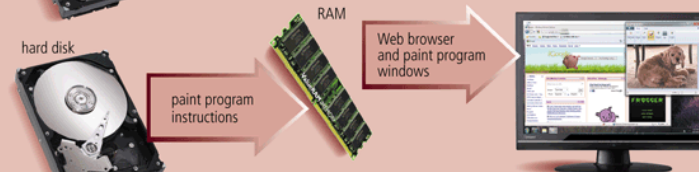
Step 4
When you quit a program, such as the Web browser, its program instructions are removed from RAM. The Web browser no longer is displayed on the screen.

RAM

Web browser program instructions are removed from RAM

Web browser window no longer is displayed on desktop
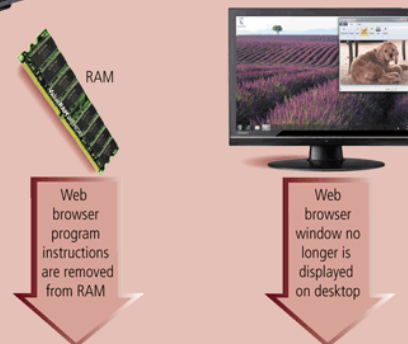
Memory

- RAM chips usually reside on a **memory module** and are inserted into **memory slots**

memory chip

dual inline memory module

memory slot
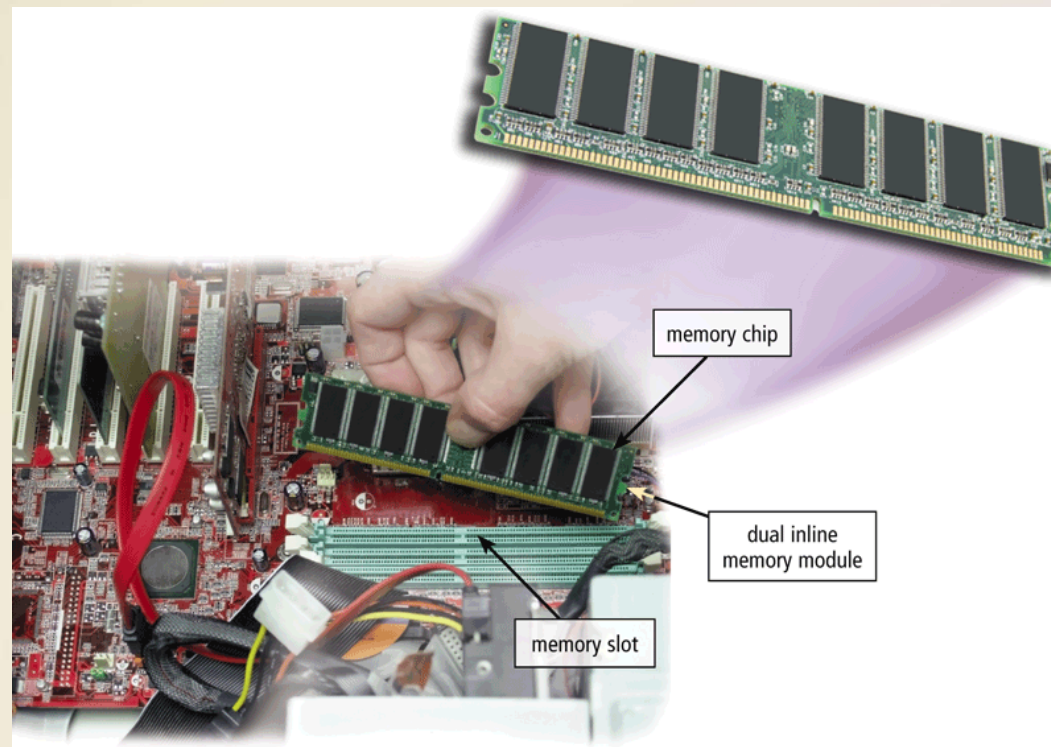
Memory

- The amount of RAM necessary in a computer often depends on the types of software you plan to use

RAM	2 GB or less	2 GB to 8 GB	8 GB and up
Use	Home and business users managing personal finances; using standard application software such as word processing; using educational or entertainment optical discs; communicating with others on the Web	Users requiring more advanced multimedia capabilities; running number-intensive accounting, financial, or spreadsheet programs; using voice recognition; working with videos, music, and digital imaging; creating Web sites; participating in video conferences; playing Internet games	Power users creating professional Web sites; running sophisticated CAD, 3-D design, or other graphics-intensive software

Memory

- **Memory cache** speeds the processes of the computer because it stores frequently used instructions and data
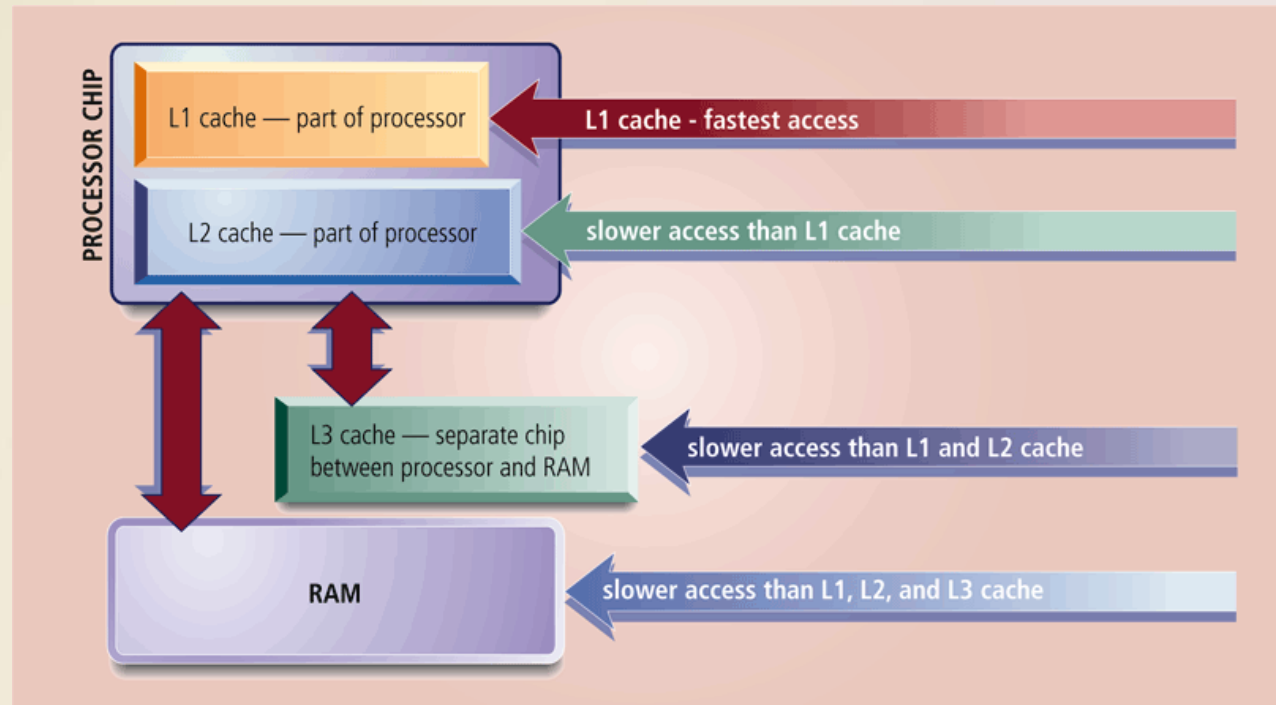
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Memory

Read-only memory (ROM) refers to memory chips storing permanent data and instructions

- **Firmware**

A PROM (programmable read-only memory) chip is a blank ROM chip that can be written to permanently
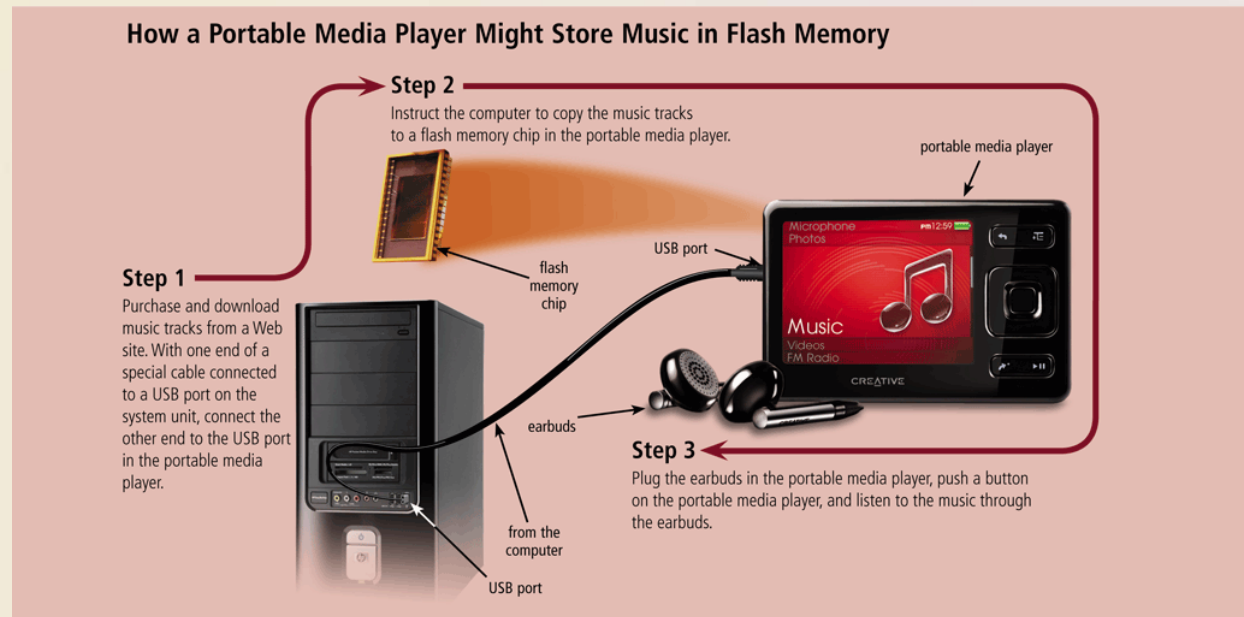
- EEPROM can be erased

Click to view Web Link, click Chapter 4, Click Web Link from left navigation, then click ROM below Chapter 4

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Chapter 4

Memory

- **Flash memory** can be erased electronically and rewritten
  - **CMOS** technology provides high speeds and consumes little power

How a Portable Media Player Might Store Music in Flash Memory

Step 2
Instruct the computer to copy the music tracks to a flash memory chip in the portable media player.

portable media player

Step 1
Purchase and download music tracks from a Web site. With one end of a special cable connected to a USB port on the system unit, connect the other end to the USB port in the portable media player.

flash memory chip

USB port

Step 3
Plug the earbuds in the portable media player, push a button on the portable media player, and listen to the music through the earbuds.

earbuds

from the computer

USB port

Expansion Slots and Adapter Cards

- An **expansion slot** is a socket on the motherboard that can hold an adapter card

- An **adapter card** enhances functions of a component of the system unit and/or provides connections to **peripherals**
 - **Sound card** and **video card**

Types of Adapter Cards	
Adapter Card	**Purpose**
CableCARD	Allows viewing of digital cable television channels
Disk controller	Connects disk drives
FireWire	Connects to FireWire devices
HDTV tuner	Allows viewing of HDTV broadcasts on the monitor
MIDI	Connects musical instruments
Modem	Connects other computers through telephone lines, cable television lines, or other transmission media
Network	Connects other computers and peripherals
PC-to-TV converter	Connects a television
Sound	Connects speakers or a microphone
TV tuner	Allows viewing of television channels on the monitor
USB	Connects to USB devices
Video	Connects a monitor
Video capture	Connects an analog video camera or VCR

Click to view Web Link, click Chapter 4, Click Web Link from left navigation, then click Video Cards below Chapter 4

Expansion Slots and Adapter Cards

- With **Plug and Play**, the computer automatically can configure adapter cards and other peripherals as you install them
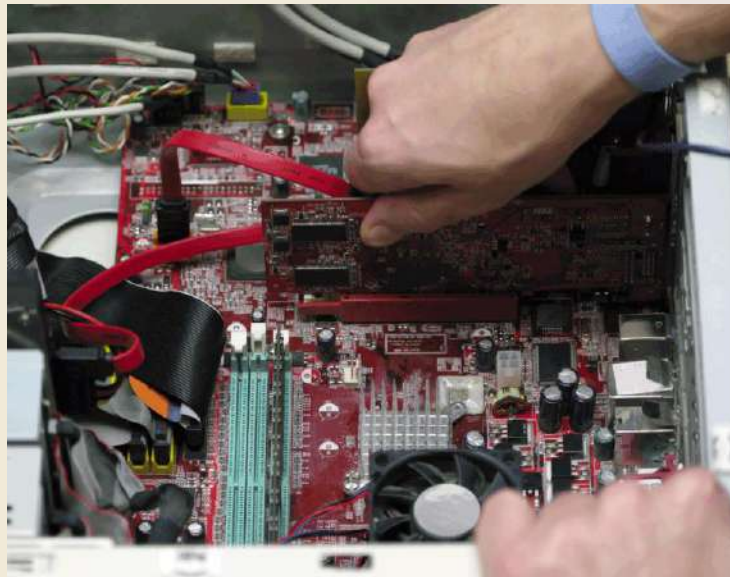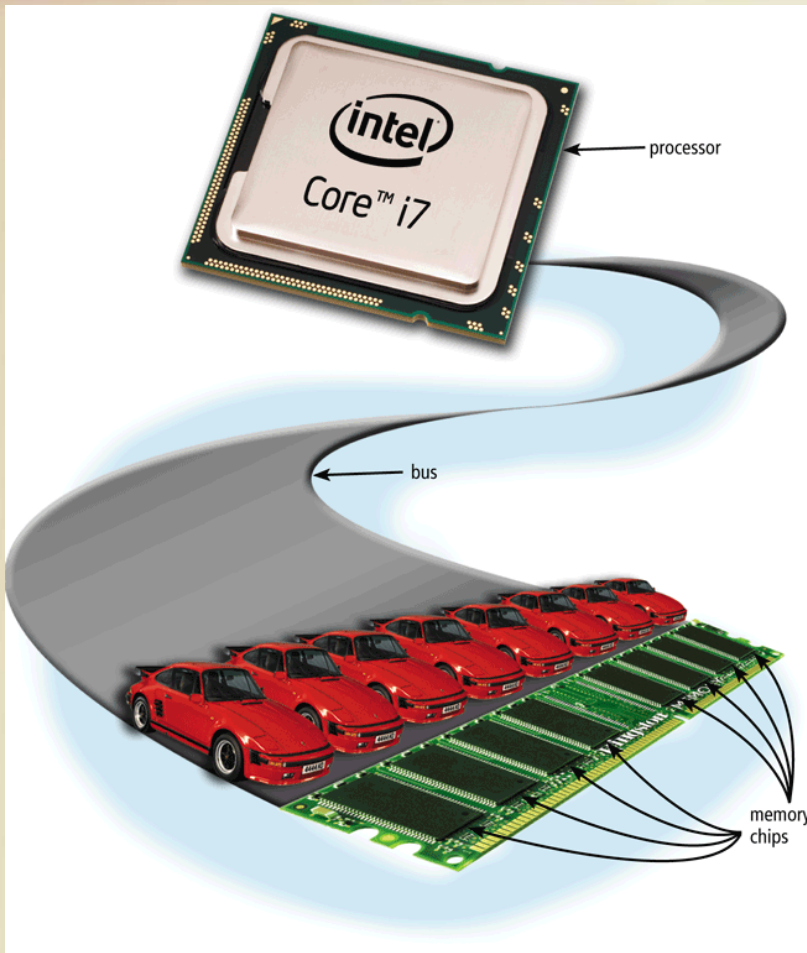
Expansion Slots and Adapter Cards

- Removable flash memory includes:
  - **Memory cards**, USB flash drives, and **PC Cards**/**ExpressCard modules**

memory card
in camera slot

ExpressCard module in
an ExpressCard slot

USB flash drive
in USB port

Buses

- A **bus** allows the various devices both inside and attached to the system unit to communicate with each other
  - Data bus
  - Address bus
- **Word size** is the number of bits the processor can interpret and execute at a given time

Buses

- Expansion slots connect to expansion buses
- Common types of expansion buses include:

PCI bus

PCI Express bus

Accelerated Graphics Port

USB and FireWire bus

PC Card bus

Click to view Web Link, click Chapter 4, Click Web Link from left navigation, then click FireWire below Chapter 4

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Chapter 4