Components of the System Unit

The System Unit

- A case that contains the electronic components of the computer used to process data.

The System Unit

- The case of the system unit, or chassis, is made of metal or plastic and protects the electrical components inside.
- The trend is towards a smaller form factor, or size and shape, of desktop computers.
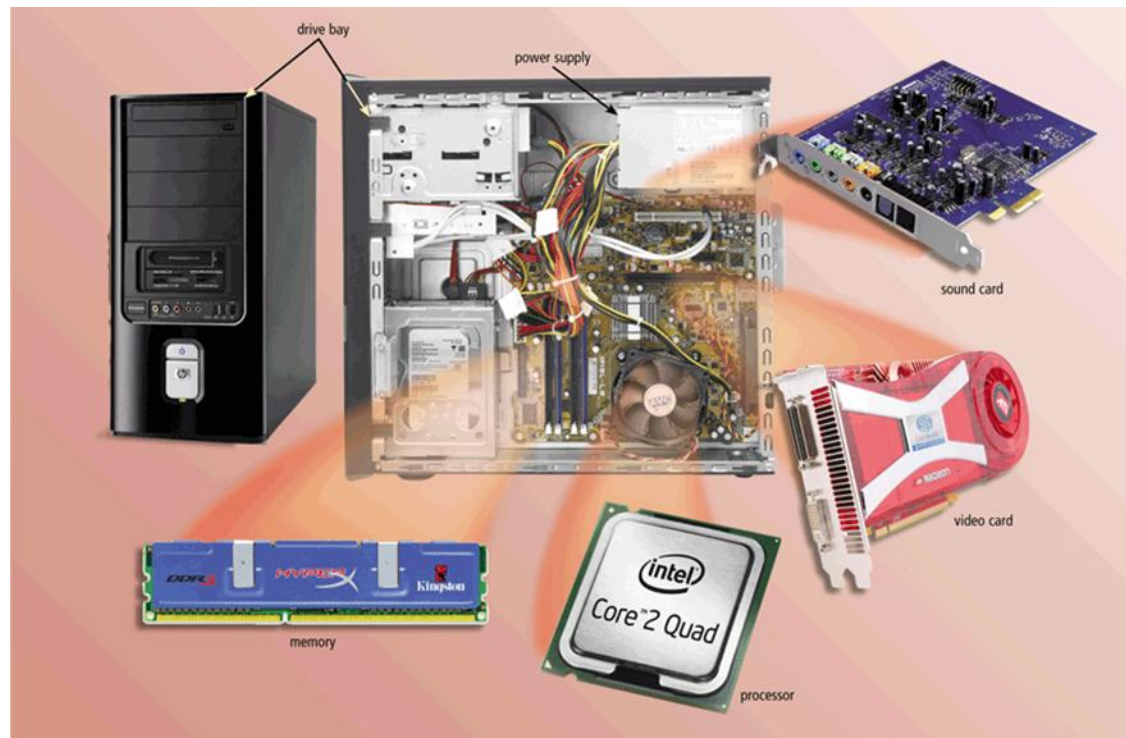
The System Unit

- Comes in a variety of shapes and sizes.

The System Unit

- It is important to know the electronic components of the system unit in the event it needs to be open.
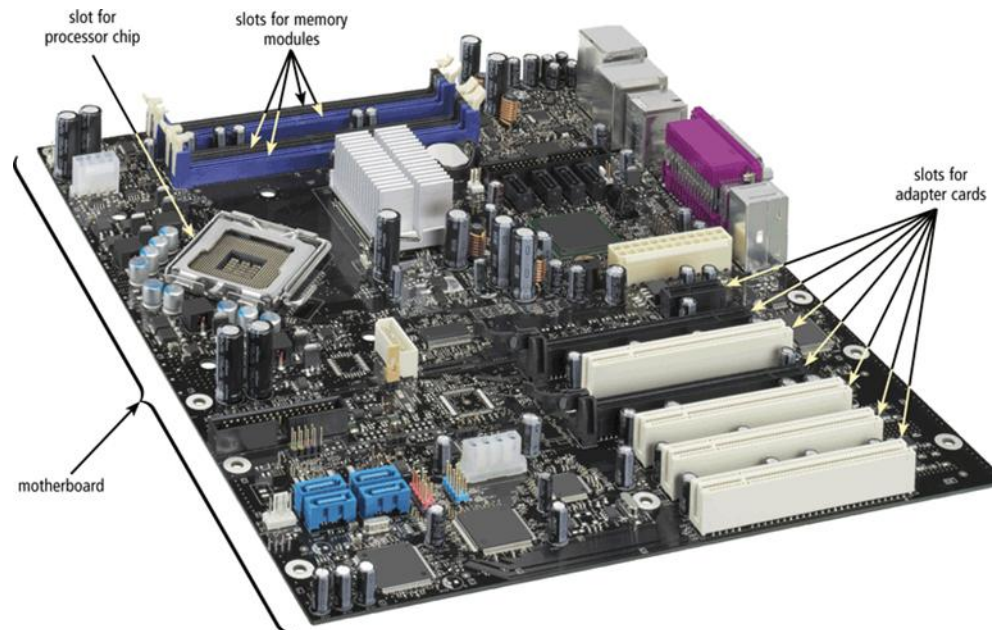
The Motherboard

- Also called the system board, is the main circuit board of the system unit.
- Many electronic components attach to the motherboard and others are built into it.

The Motherboard

- Slots for adapter cards, the processor, and memory.

The Motherboard

- Computer chips are small pieces of semi-conducting material, usually silicon, on which integrated circuits are etched.
    - IC's contain may microscopic pathways capable of carrying an electric current.
    - They contain components such as resistors, capacitors, and transistors.
- Manufacturers package chips to be attached to a circuit board, such at the motherboard or adapter cards.

Processor

- Also called the central processing unit (CPU), interprets and carries out the basic instructions that operate a computer.

- Impacts overall computing power and manages most of the computer's operations.

Processor

Processor

- Most processor chips manufacturers offer multi-core processors, single chips with two or more separate processor cores.
  - Dual-core: 2 cores
  - Quad-core: 4 cores
- Each core runs at a slower clock speed than a single core processor, but still increase the overall performance.
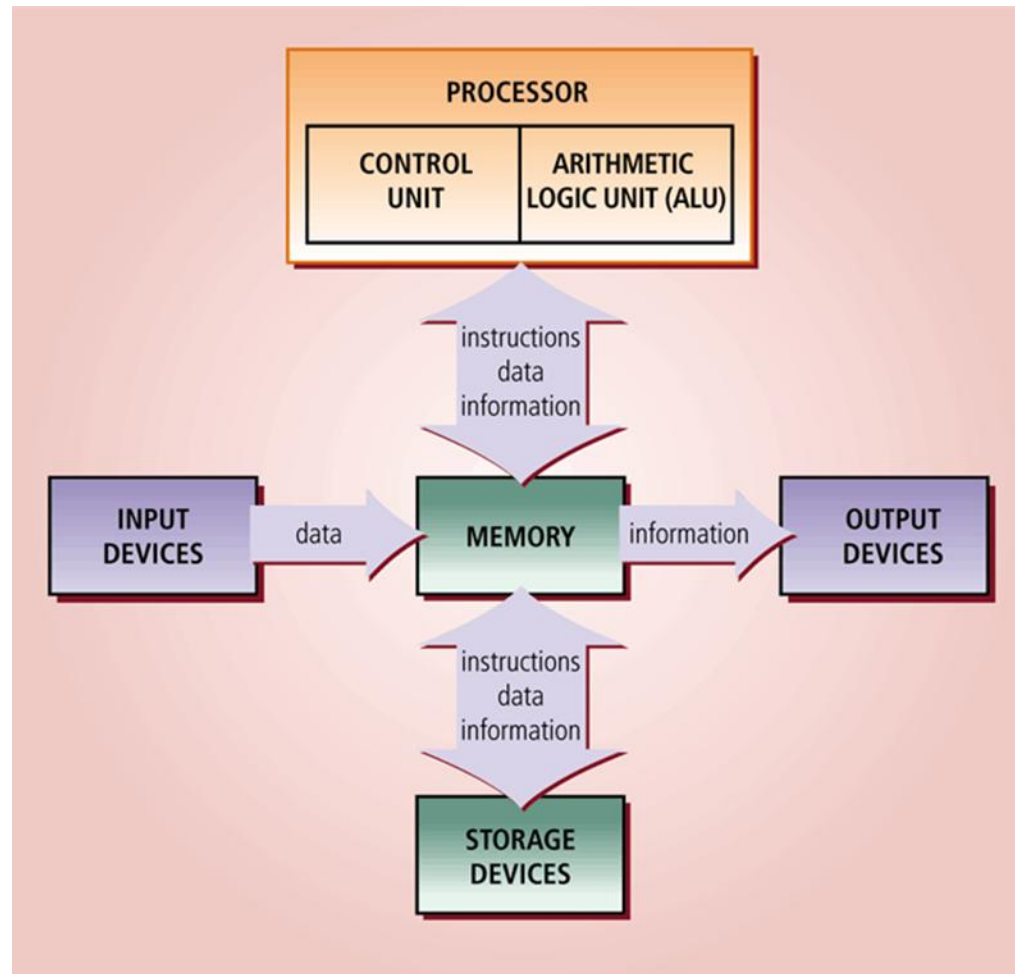
Processor
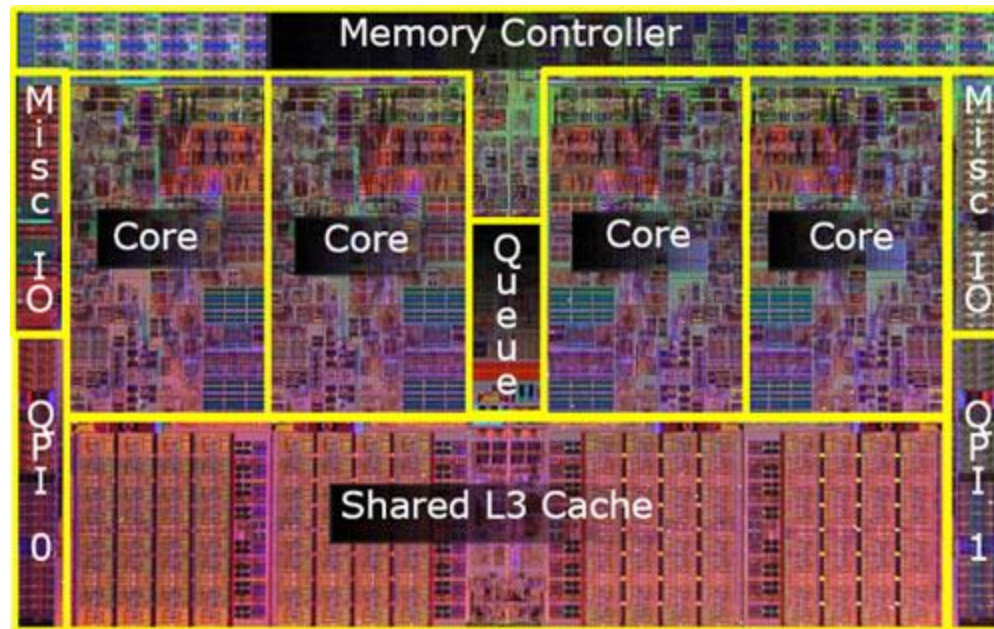
Processor

- Contain a control unit and an arithmetic logic unit (ALU)
  - Control Unit: Component of the processor that directs and coordinates most of the operations in the computer.
  - Arithmetic Logic Unit: Component of the processor that performs arithmetic, comparison, and other operations.

Processor

Machine Cycle

- For every instruction, a processor repeats a set of four basic operations, which comprise a machine cycle

Machine Cycle

- Fetching: Process of obtaining a program instruction or data item from memory.
- Decoding: Process of translating the instruction into signals the computer can execute.
- Executing: Process of carrying out the commands.
- Storing: Writing results to memory.

Machine Cycle

The Steps in a Machine Cycle
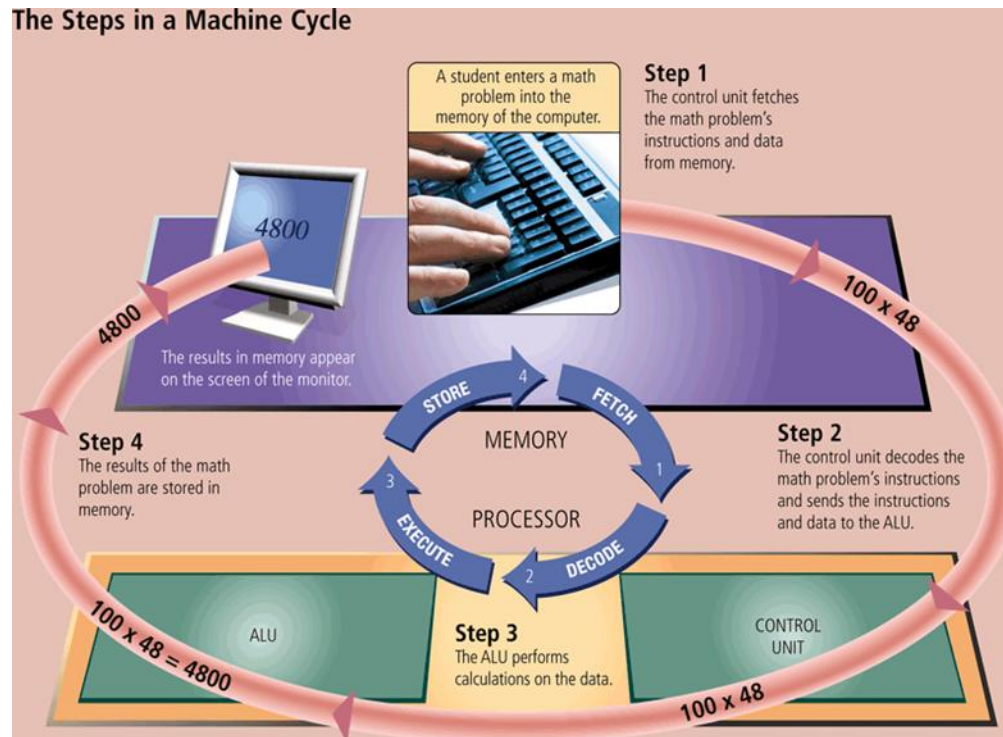
Machine Cycle

- With pipelining, the processor begins fetching a second instruction before it completes the machine cycle for the first.

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				
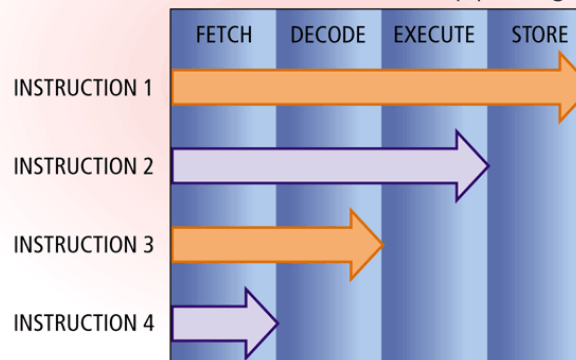
Registers

- Small, high-speed storage locations that temporarily hold data and instructions.
- A part of the processor, itself.

The System Clock

- A small quartz crystal circuit used to control the timing of all computer operations.
- Each tick equates to a clock cycle.
- Today, processors are superscalar, which means they can execute more than one instruction per clock cycle.

The System Clock

- Clock speed is the pace of the system clock and is measured by the numbers of ticks per second.

- Current personal computers have clock speeds in the gigahertz range.

- One gigahertz (GHz) equals one billion ticks of the system clock per second.

Comparison of Personal Computer Processors

- Intel
  - Core family for high-performance.
  - Pentium or Celeron for basic computers.
  - Xeon or Itanium for workstations and low-end servers.
- AMD
  - Intel compatible processors, structured similar to Intel, perform same functions, can be as powerful, often are less expensive.

Comparison of Personal Computer Processors

Comparison of Currently Available Personal Computer Processors

	Name	Multi-Core Availability	Manufacturer
SERVER PROCESSORS	Xeon	Quad Core, Dual Core	Intel
	Itanium	Dual Core	Intel
	Opteron	Quad Core, Dual Core	AMD
	UltraSPARC	8 Core, Dual Core	AMD
DESKTOP PERSONAL COMPUTER PROCESSORS	Core 2 Extreme	Quad Core, Dual Core	Intel
	Core 2	Quad Core, Dual Core	Intel
	Pentium Dual-Core	Dual Core	Intel
	Celeron	Dual Core	Intel
	Phenom	Quad Core, Triple Core	AMD
	Athlon	Quad Core, Dual Core	AMD
	Sempron		AMD
NOTEBOOK COMPUTER PROCESSORS	Core 2 Extreme	Quad Core	Intel
	Core 2	Quad Core, Dual Core	Intel
	Turion	Dual Core	AMD
	Athlon	Dual Core	AMD
	Sempron		AMD

Buying a Personal Computer

## Guidelines for Selecting a Personal Computer Processor

USE

- Power users with workstations
- Low-end servers on a network

Itanium 2 Xeon Opteron UltraSPARC

- Power users or users who design professional drawings, produce and edit videos, record and edit music, participate in video conferences, create professional Web sites, play graphic-intensive multiplayer Internet games
- Users who design professional documents containing graphics such as newsletters or number-intensive spreadsheets, produce multimedia presentations, use the Web as an intensive research tool, send documents and graphics via the Web, watch videos, play graphic-intensive games on optical discs, create personal Web sites

Core 2 Quad Core 2 Extreme

- Home users who manage personal nances, create basic documents with word processing and spreadsheet software, edit photos, communicate with others on the Web via e-mail, chat rooms, and discussions, shop on the Web, create basic Web pages, use the computer as a digital entertainment unit

Phenom Athlon FX Athlon X2 Dual-Core

- Home users who manage personal nances, create basic documents with word processing and spreadsheet software, edit photos, make greeting cards and calendars, use educational or entertainment CDs, communicate with others on the Web via e-mail, chat rooms, and discussions

Core 2 Duo Celeron Dual-Core Sempron

- Users with notebook computers

Core 2 Extreme Turion X2

Processor Cooling

- Processors generate heat which could cause the chip to burn up.
- The computer fans generate airflow, but the processor requires additional cooling.
- Heat sinks/pipes and liquid cooling are often used to dissipate processor heat.

Processor Cooling

- A heat sink is a small ceramic or metal component with fins to absorb and disperse heat.

- Liquid Cooling Technology uses a flow of fluid to transfer heated fluid away from the processor, gets cooled, and returns to the processor, continuously.

heat sink fan

heat sink
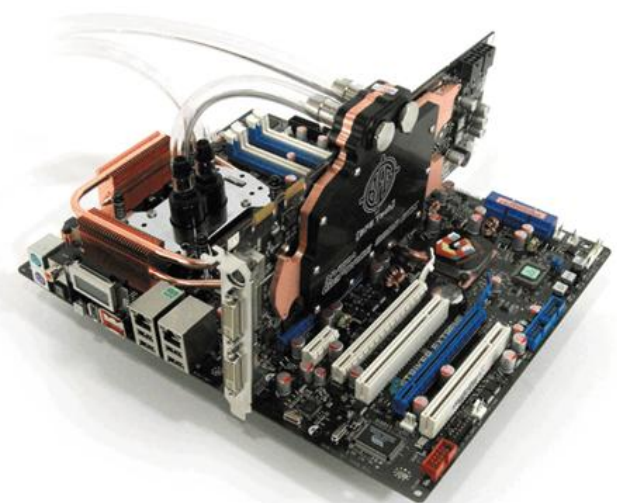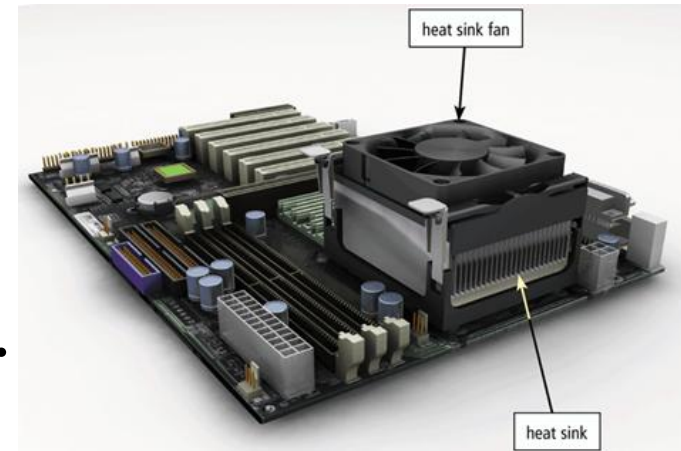
Parallel Processing

- A method that uses multiple processors simultaneously to execute a single program or task.
- A single problem is divided into portions and multiple processors work on their assigned portion at the same time.
- Special software is needed to divide the problem and bring the results back together again.
- Super computers use massive parallel processing for applications such as artificial intelligence and weather forecasting.

Data Representation

- Most computers are digital, meaning they recognize two discrete states: on and off.
- This is due to the two states of electrical switches.
- Two digits, 0 and 1, represent off and on respectively, which is the basis for the binary system.

Data Representation

- The binary system is a number system that has just two unique digits, 0 and 1, called bits.

- A bit is the smallest unit of data the computer can process.

- A byte is 8 bits grouped together as a unit, totally 256 unique combinations.

Data Representation

- Binary that represents characters are defined by patterns called coding schemes.
- ASCII (American Standard Code for Information Interchange) is the most widely used coding scheme.

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

- Unicode is a 16-bit coding scheme that has the capacity of representing more than 65,000 characters.

- It is large enough to fit almost all of the world's current written language as well as classic languages, even reserving 30,000 codes for future expansion.

Data Representation

- ASCII and Unicode standards make it possible for components in computers to communicate.

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.

Auto Care
ON-SITE CLEANING

T

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.

- Memory usually consists of one or more chips on the motherboard or some other circuit board on the computer.

Bytes and Addressable Memory

- A byte is the basic storage unit in memory.
- The instructions and data exist in memory as bytes.
- An address is a location in memory where each byte resides temporarily.

Memory Sizes

- Manufacturers state the size of memory and storage devices in terms of the number of bytes of available storage.

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

Types of Memory

- Two types of memory:
  - Volatile memory: Memory that loses its contents when the power is turned off.
    - RAM
  - Nonvolatile memory: Memory that does not lose its contents when the power is turned off.
   - ROM, flash memory, and CMOS

RAM

- Users typically are referring to RAM when discussing computer memory.

- RAM (random access memory), or main memory, consists of memory chips that can be read from and written to by the processor and other devices.

- When the computer is powered up, the RAM is initially populated with operating system files from a storage devices, such as a hard disk.

RAM

- The processor interprets and executes instructions while the program is in RAM.
- Most RAM is volatile, so it will lose its contents when the power is removed.
- RAM chips usually reside on a memory module, which is a small circuit board.
- Memory slots on the motherboard hold the memory modules.

RAM

memory chip

dual inline
memory module

memory slot
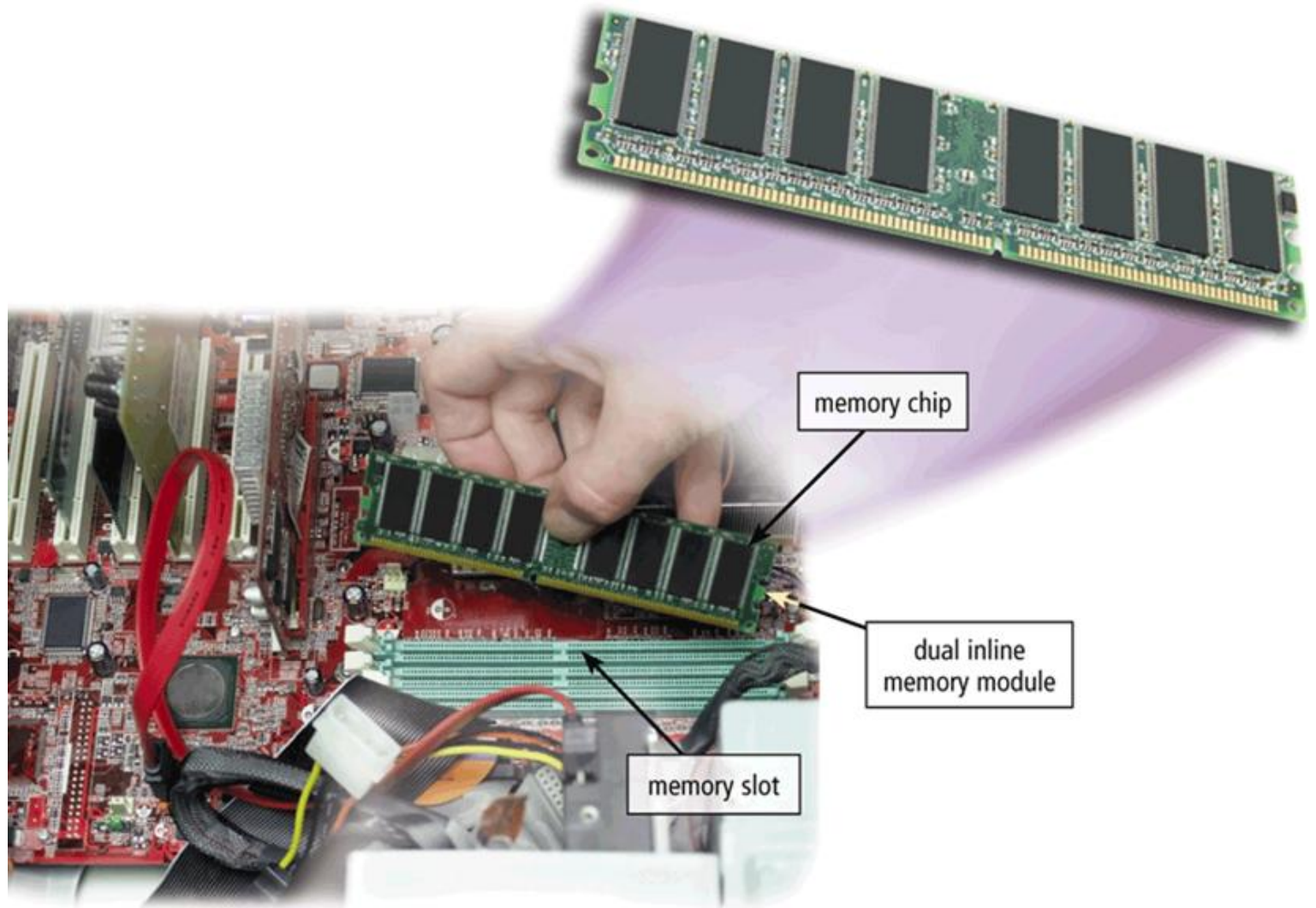
RAM Configurations

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

- Retail software typically indicates the minimum amount of RAM it requires.

Cache

- Pronounced "cash," helps improve processing times.
- Memory cache stores frequently used instructions and data.
- L1 cache: built directly into processor chip, usually small (8-128 KB)
- L2 cache: slightly slower than L1 with larger capacity (64KB-16MB)
- L3 cache: on the motherboard, often up to 8MB

Cache

- When the processor needs an instruction or data, it searches memory in this order: L1, L2, L3, then RAM, with a greater delay in processing for each level of memory it must search.

ROM

- ROM (Read-only memory) refers to memory chips storing permanent data and instructions.
- The data cannot be modified on most ROM chips and is nonvolatile.
- ROM chips called firmware contain permanently written data, instructions, or information.
- PROM is a programmable ROM on which a programmer can write permanently.
- EEPROM is an electrically erasable PROM.

Flash Memory

- A type of nonvolatile memory that can be erased electronically and rewritten, similar to EEPROM.

- It allows computers to store startup instructions and is easy to update contents.

- They store data and programs for many mobile computers and devices such as smart phones, portable media players, and digital cameras.

CMOS

- Some RAM chips. Flash memory chips, and other memory chips use complementary metal-oxide semiconductors (CMOS) technology because it provides high speeds and consumes little power.
- Battery backed CMOS chips keep the date and time even when the computer is turned off.

Memory Access Time

- Access time is the amount of time it takes the processor to read data, instructions, and information from memory.

- Directly affects how fast the computer processes data.

- Accessing data in memory can be more than 200,000 times faster than accessing data on a hard disk because of the mechanical motion of the hard disk.

Memory Access Time

- Access times can be given in terms of fractional seconds, such as nanoseconds (one billionth of a second) or in terms of Hz.

- The higher the hertz (MHz, GHz) the faster the access time; conversely, the lower the nanoseconds, the faster the access time.

Expansion Slots and Adapter Cards

- An expansion slot is a socket on the motherboard that can hold an adapter card.
- An adapter card, or expansion card, is a circuit board that enhances functions of a component of the system unit and/or provides connections to peripherals.
- Peripherals are devices that connect to the system unit and is controlled by the processor in the computer.
  - Modems, disk drives, printers, scanners, keyboards.

Expansion Slots and Adapter Cards

- Sound cards enhance the sound-generating capabilities of a personal computer.
- Video cards, or graphics cards, convert computer output into a video signal that is sent to the monitor to be displayed.
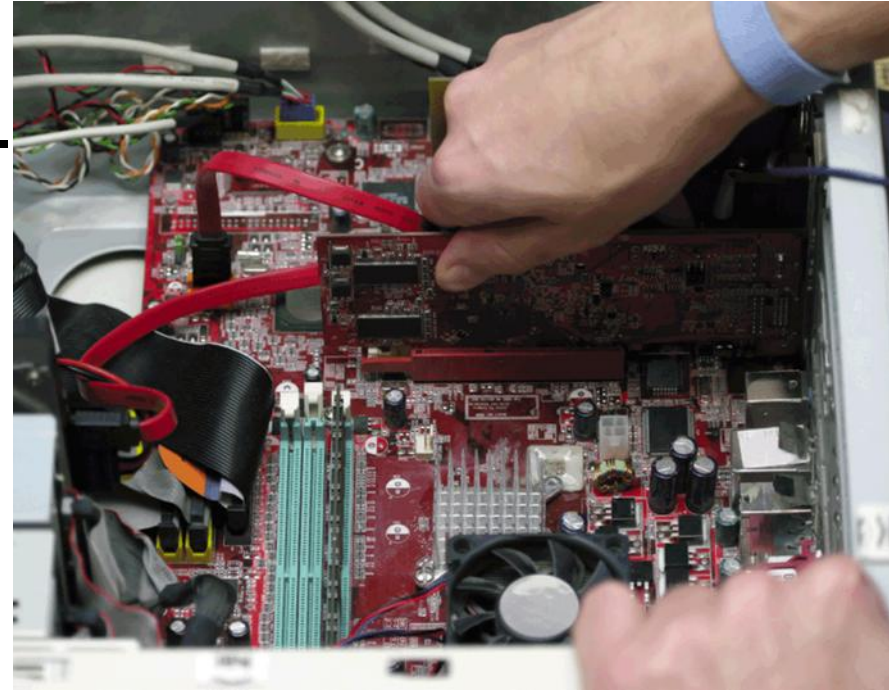
Expansion Slots and Adapter Cards

- Plug and Ply (PnP) support allows the computer to automatically configure adapter cards and other peripherals as you install them.

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 or cable television lines
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 2.0	Connects to USB 2.0 devices
Video	Connects a monitor
Video capture	Connects an analog video camera or VCR

Removable Flash Memory

- With hot plugging, flash memory devices can be changed without shutting down or restarting the computer.
- A memory card is a removable flash memory device that you can insert and remove from a slot in a personal computer, game console, mobile device, or card reader/writer.
- A USB flash drive is a flash memory storage device that plugs in a USB port.

Ports and Connectors

- A port is the point at which a peripheral attaches to or communicates with a system unit so that the peripheral can send data to or receive information from the computer.

- A connector joins a cable to a port.

Ports and Connectors

Port Types

Type	Picture	Type	Picture	Type	Picture
Audio in		HDMI port		Serial	
Cable TV		Headphones		Side surround sound	
Center surround sound/subwoofer		Keyboard		S/PDIF in	
Composite video in		Microphone		S/PDIF out	
Digital Video Interface (DVI)		Monitor		Speaker	
eSATA port		Mouse		S-video	
FireWire		Network		Telephone line in	
FM reception		Rear surround sound		USB	

Ports and Connectors

- USB port, or universal serial bus port, can connect up to 127 different peripherals with a single connector.
- FireWire port, similar to USB, used for connecting devices that require faster data transmission, such as video cameras.

Other Ports

- Bluetooth uses radio waves to transmit data between two devices.
- SCSI port is a special high-speed parallel port for peripherals.
- eSATA port, IrDA Port, Serial Ports, MIDI Port.

Buses

- Bits transfer internally within the circuitry of a computer along electrical channels, called buses, which allow for various devices, both inside and attached to the system unit, to communicate with each other.
- The size of the bus, called bus width, determines the number of bits that the computer can transmit at one time.
- In conjunction with the bus width, many computer professionals refer to a computer's word size, which is the number of bits the processor can interpret and execute at a given time.

Expansion Bus

- Some peripherals outside the system unit connect to a port on an adapter card inserted in an expansion slot which connects to the expansion bus.

- The most common types are: PCI bus, PCI Express bus, AGP bus, USB, FireWire bus, and PC Card bus.

Bays

- A bay is an opening inside the system unit in which you can install additional equipment.
- A drive bay is a rectangular opening that typically holds disk drives.
- An external bay allows a user to access openings in the bay from outside the system unit, like optical disc drives.

Power Supply

- The component of the system unit that converts the wall outlet AC power into DC power, which the computer can use.
- Different motherboards and computers require different wattages.