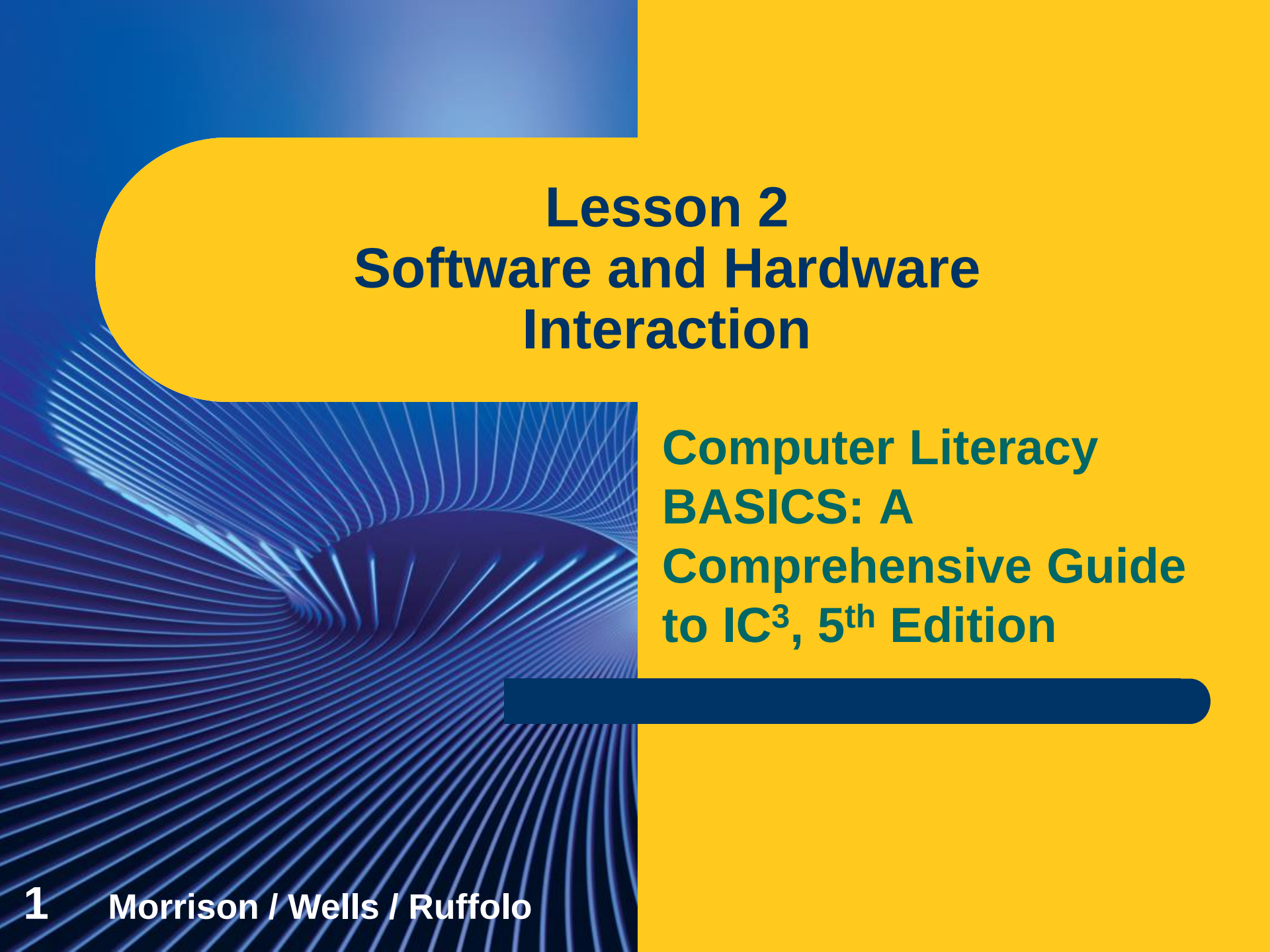




Lesson 2

Software and Hardware Interaction

**Computer Literacy
BASICS: A
Comprehensive Guide
to IC³, 5th Edition**

Objectives

- Identify hardware components that affect computer performance.
- Explain how the central processing unit (CPU) processes software instructions.
- Describe types of computer memory.
- Explain how to use system requirements.
- Explain the purpose of software updates.
- Use Windows Update to keep the operating system up to date.

Words to Know

- arithmetic/logic unit (ALU)
- byte
- cache
- central processing unit (CPU)
- circuit board
- clock speed
- control unit
- execution cycle (E-cycle)
- gigahertz (GHz)
- instruction cycle (I-cycle)
- machine cycle
- megahertz (MHz)

Words to Know (continued)

- motherboard
- multicore processor
- multiprocessing
- multithreading
- nonvolatile memory
- read-only memory (ROM)
- register
- system unit
- thrashing
- volatile memory

Identifying Hardware Components in a Computer

- How efficiently hardware and software complete tasks is called ***performance***.
- The ***system unit*** is the case that contains a computer's main system components.
- The computer's main circuit board is called the ***motherboard***.
- A ***circuit board*** is a thin metal plate with an extensive electronic circuit.
- All of the essential chips and the circuitry that connects them are on the motherboard.

Identifying Hardware Components in a Computer (continued)

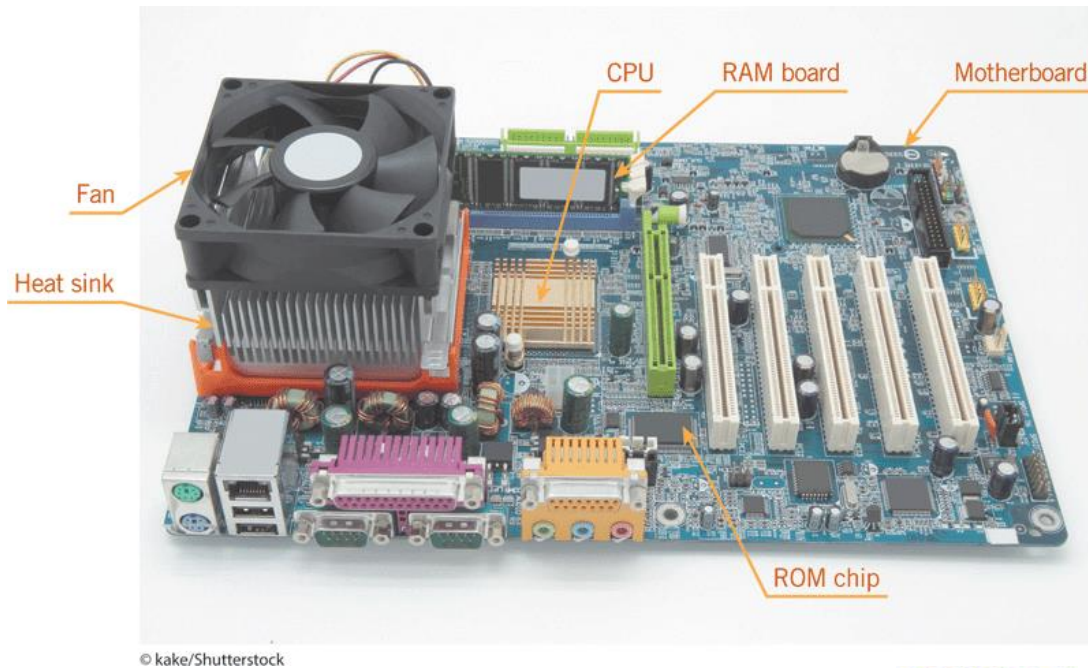


FIGURE 2-1

Identifying Hardware Components in a Computer (continued)

- Central Processing Unit
- The *central processing unit (CPU)* is a single computer chip that contains all the electronic circuitry a computer needs to process data.
- A *chip* is a small, thin piece of silicon containing electronic circuits, which is why a chip is called an integrated circuit (IC).



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FIGURE 2-2

Identifying Hardware Components in a Computer (continued)

- **Parts of a CPU**
- The ***arithmetic/logic unit (ALU)*** performs arithmetic calculations and logical operations.
- The ***control unit*** coordinates all the processor's activities and manages the flow of information through the processor.
- ***Registers*** are memory cells for temporarily storing data needed by the ALU to perform its calculations.

Identifying Hardware Components in a Computer (continued)

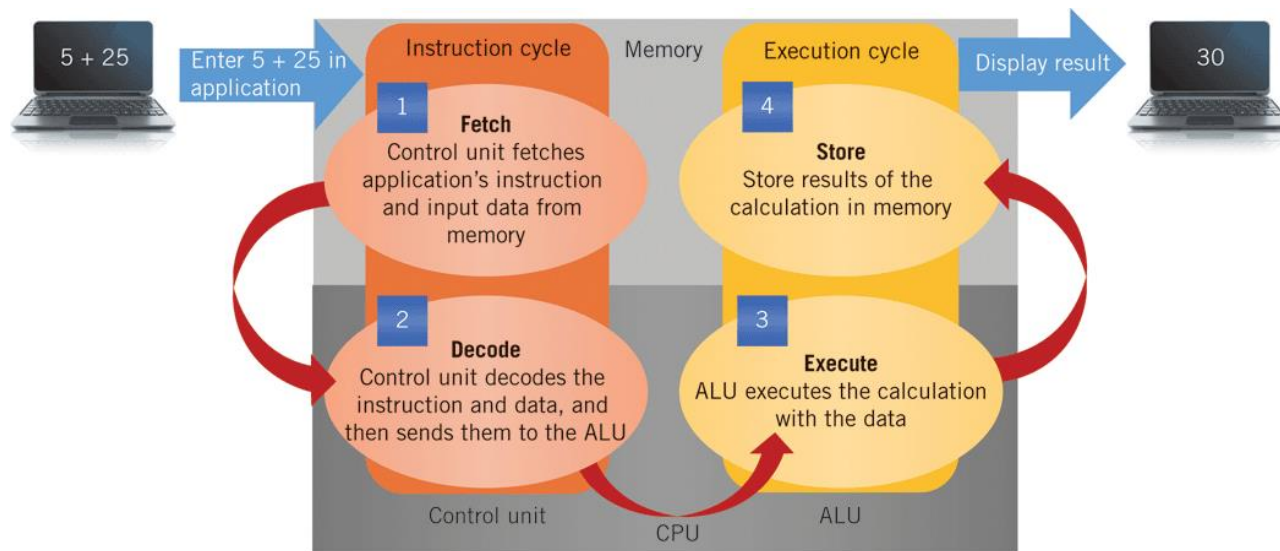
- **Machine Cycle**
- The CPU carries out software instructions by repeating four basic operations in the ***machine cycle***.
- Fetching and decoding make up the ***instruction cycle (I-cycle)***.
 - Fetching retrieves an instruction or a data item from memory.
 - Decoding translates the instruction into a form the computer can execute.

Identifying Hardware Components in a Computer (continued)

- Machine Cycle (continued)
- Executing and storing make up the *execution cycle (E-cycle)*.
 - Executing carries out the commands in the instruction.
 - Storing writes the result to memory (not to a storage medium).

Identifying Hardware Components in a Computer (continued)

- Machine Cycle (continued)



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FIGURE 2-3

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Clock Speed**
- Machine cycles are measured in microseconds, nanoseconds, and even picoseconds.
- The faster the machine cycle, the faster your computer processes data.
- The speed of the processor directly influences the speed of the machine cycle.
- The processor's speed is also called the ***clock speed***, which is the number of instructions the CPU can process per second.

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Clock Speed (continued)**
- The computer has a system clock that generates a regular electronic beat to set the pace and timing of system operations.
- Each beat of the system clock is called a cycle.
- Clock speed is stated in ***megahertz (MHz)***, which is a million cycles per second, and ***gigahertz (GHz)***, which is a billion cycles per second. (A *hertz* is one cycle per second.)

Identifying Hardware Components in a Computer (continued)

- **Bit Size**
- Another measure of CPU performance is ***bit size***, which is how many bytes of data the CPU can retrieve from RAM at once.
- A ***byte*** of data is roughly equivalent to one character.
 - An 8-bit CPU can process 1 byte at a time.
 - A 16-bit CPU can process 2 bytes at a time.
 - A 32-bit CPU can process 4 bytes at once.
 - A 64-bit CPU can process 8 bytes at once.

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Types of Processors**
- A ***multicore processor*** is a single chip that contains more than one processor.
- If a computer contains a multicore processor, the operating system can use multiprocessing to split tasks among the processors.
- Each processor can work on a different task at the same time.

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Types of Processors (continued)**
- A single-core processor can enhance performance using multitasking and multithreading.
- Multitasking can run more than one program at the same time.
- With ***multithreading***, the operating system handles many parts, or threads, of a single program.

Identifying Hardware Components in a Computer (continued)

- **Types of Processors (continued)**
- With a multicore processor, the operating system can use multiprocessing, multitasking, and multithreading to improve performance.
- With a single-core processor, the operating system can use only multitasking and multithreading.

Identifying Hardware Components in a Computer (continued)

- Types of Processors (continued)

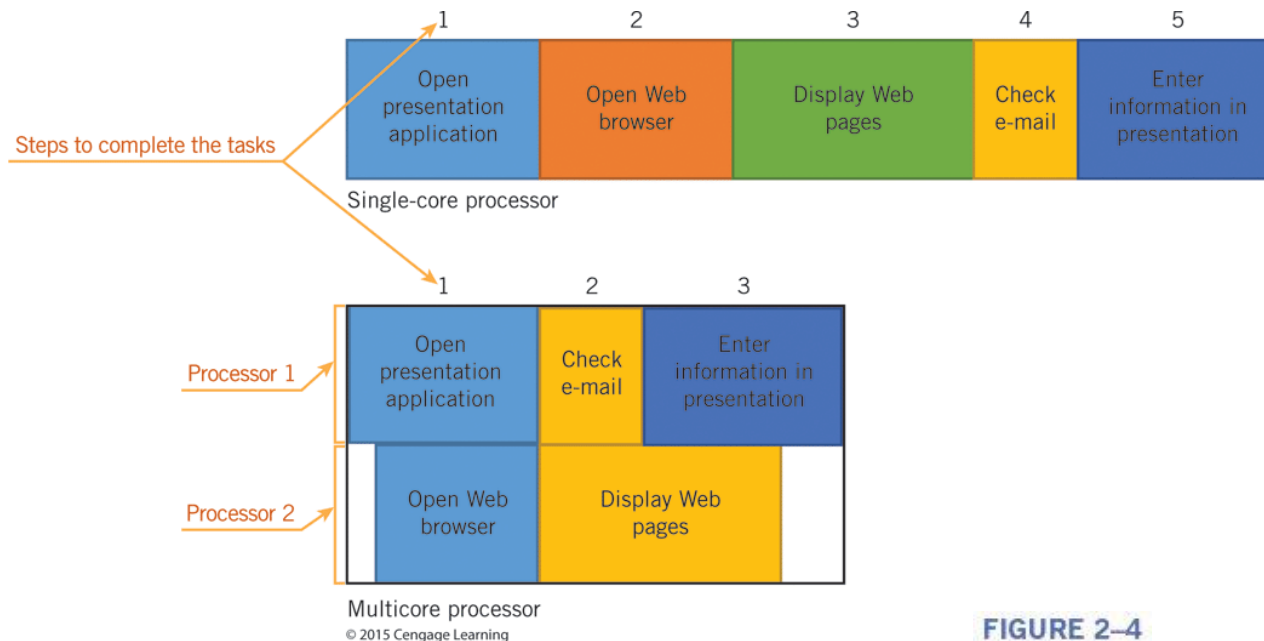


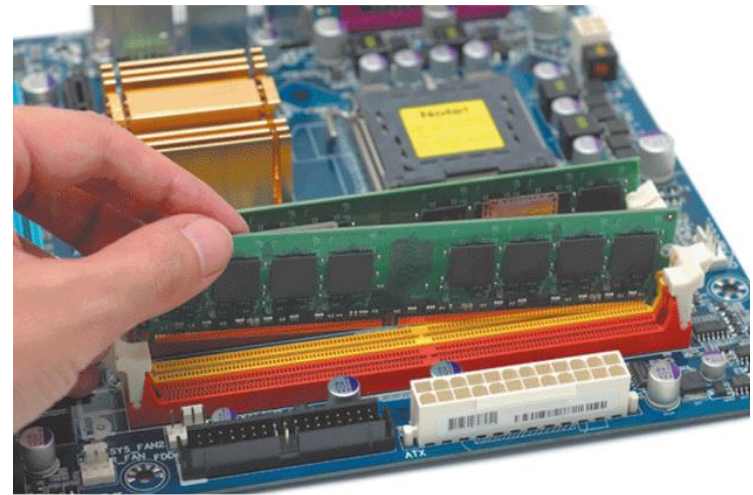
FIGURE 2-4

Identifying Hardware Components in a Computer (continued)

- **Memory**
- The CPU, operating systems, and applications use memory (chips inside the system unit) to store data and instructions.
- A computer has two types of memory: volatile and nonvolatile.
- RAM is ***volatile memory*** that loses its contents when you turn off the computer.
- ROM is ***nonvolatile memory*** because it is permanent; it does not lose its contents when you turn off the computer.

Identifying Hardware Components in a Computer (continued)

- **RAM**
- Data, information, and instructions from applications and the operating system are stored temporarily in RAM.
- RAM usually consists of several chips on a circuit board called a memory module, which is plugged into the motherboard.



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FIGURE 2-5

Identifying Hardware Components in a Computer (continued)

- **RAM (continued)**
- RAM has a significant effect on performance.
- Without enough RAM, the operating system must move data in and out of RAM frequently, slowing performance.
- ***Thrashing*** means the operating system spends more time swapping data than running software.

Identifying Hardware Components in a Computer (continued)

- ROM
- ROM is *read-only memory* stored on a single chip on the motherboard.
- The operating system retrieves data or programs in ROM when it needs them.
- The operating system does not write over the contents of ROM.

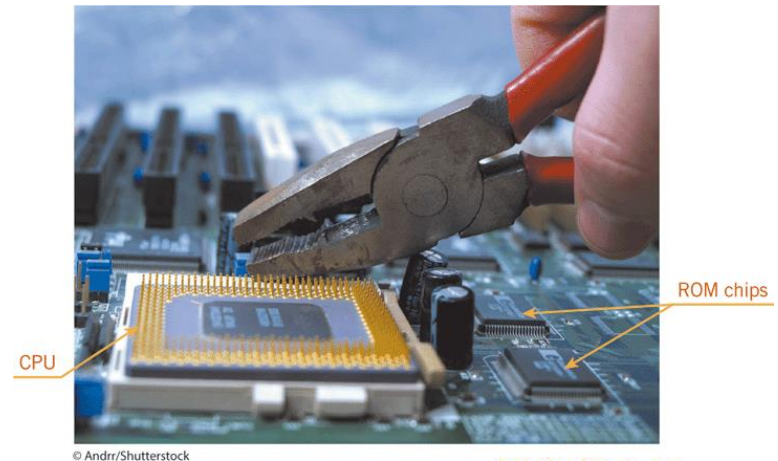


FIGURE 2-6

Identifying Hardware Components in a Computer (continued)

- ROM (continued)
- *Electrically erasable programmable read-only memory (EEPROM)* is a type of ROM that is nonvolatile, but can be modified.
- *Flash memory* is a type of ROM that can be updated much more quickly than EEPROM and has largely replaced ROM.
- Flash memory is now being used on mobile computers and peripheral devices.

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Caches**
- In addition to RAM, the CPU accesses memory ***caches*** to speed processing.
- ***Level 1 cache*** memory is a small amount of memory stored on the CPU itself, apart from the registers, where it is almost instantly available.
- ***Level 2 cache*** memory is a larger amount of memory that can reside on the CPU or on a chip that has a direct connection to the CPU.

Identifying Hardware Components in a Computer (continued)

- **Caches (continued)**
- The closer instructions and data are to the CPU, the faster the CPU can process them.

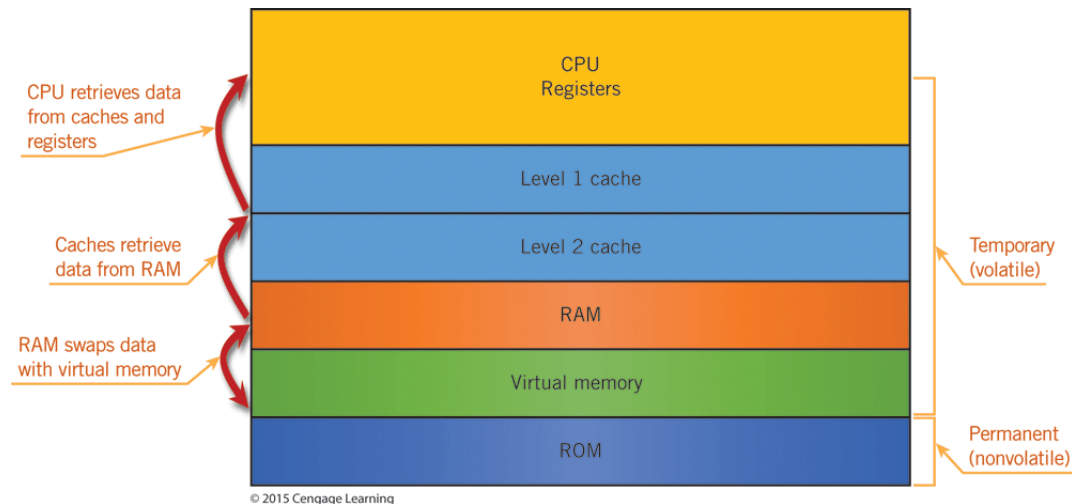


FIGURE 2-7

Identifying Hardware Components in a Computer (continued)

- **Heat Sinks and Fans**
- Processors in laptops, desktops, and servers generate a lot of heat.
- As the temperature increases, the system slows down to avoid overheating, which severely impairs performance.
- To prevent overheating, one or more fans in the system unit draw cooler air into the case from the outside and expel warm air from the inside.
- The fan moves air across a **heat sink**, which collects heat from an electronic component so the fan can cool it quickly.

Identifying Hardware Components in a Computer (continued)

Lesson 2

- **Performance Indicators**
- You can tell how efficiently a computer is working by tracking its CPU and RAM usage.
- You can track the CPU and RAM usage in Windows by using Task Manager.
- Task Manager gives you a behind-the-scenes glimpse at how Windows is interacting with hardware resources and other software.

Identifying Hardware Components in a Computer (continued)

- Performance Indicators (continued)

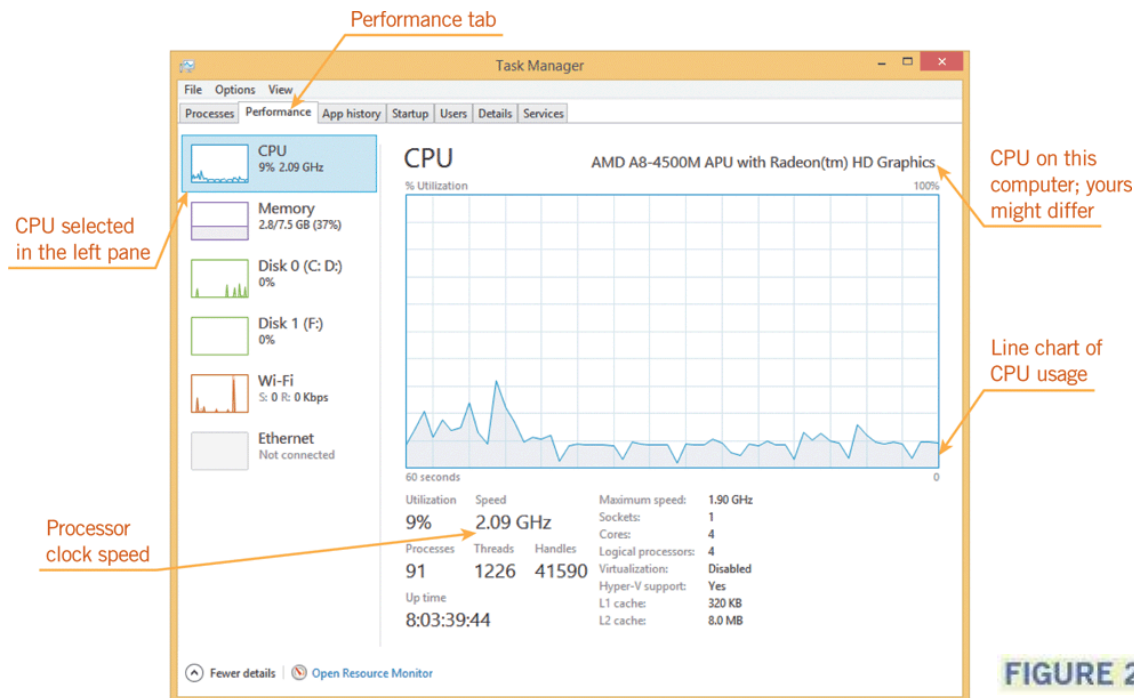


FIGURE 2-11

Understanding System Requirements

- **System requirements** are hardware characteristics such as the amount of memory and the processor speed.
- An application lists these hardware specifications on the product's box or Web site.

Office Home & Student 2013

COMPONENT	REQUIREMENT
Computer and processor	1 gigahertz (GHz) or faster x86-bit or x64-bit processor with SSE2
Memory	1 GB RAM (32-bit); 2 GB RAM (64-bit)
Hard disk	3.0 GB available disk space
Display	1366 x 768 screen resolution
Graphics	Graphics hardware acceleration requires a DirectX 10 graphics card.
Operating system	Windows 7, Windows 8, Windows Server 2008 R2, or Windows Server 2012
Browser	Supported browsers for Office 2013 and Office 365 (includes browser requirements for using Apps for Office and Word video playback)
Other	Internet functionality requires an Internet connection. Fees may apply.
	Multi-touch features require a touch-enabled device. All features and functionality are always available by using a keyboard, mouse, or other standard or accessible input device. New touch features are optimized for use with Windows 8.
	Certain online functionality requires a Microsoft account.
	Certain features require a Skype account.

Processor speed and bit size

Amount of RAM

Product functionality and graphics may vary based on your system configuration. Some features may require additional or advanced hardware or server connectivity: www.office.com/products.

FIGURE 2-13

Understanding System Requirements (continued)

- **Optional Hardware Requirements**
- Some applications include features designed for particular hardware.
- Many popular applications now include features that accept input from touchscreens so you can use a fingertip to select commands or handwrite text input. These are optional hardware requirements.
- You can use the software without the hardware, but having the hardware extends the features of the software.

Updating Software

- Application software is constantly changing to keep up with hardware developments and user requests.
- Software is also revised to address problems.
- If you purchased the original version of the software, you can download a **patch**, an **update**, or a **service pack** from the Internet.

TABLE 2-1

TYPE	DESCRIPTION
Patch	Small program that corrects or enhances existing software
Update	Collection of files (larger than a patch) that revises software to fix problems or provide enhancements
Service pack	Collection of updates, fixes, or enhancements to software delivered as a single file

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Updating Software (continued)

- Software developers use version numbers to keep track of the software they release.
- The original software is assigned version 1.0.
- When developers make major improvements, add new features, or change the software design, the new versions are called ***upgrades*** and are numbered 2.0, 3.0, and so on.

Updating Software (continued)

- ***Installing*** means to move a copy of the software from its distribution location (such as a Web site) to your computer.
- System and application software often include tools for managing updates.
- An ***automatic update*** feature checks for updates and then downloads them when they are available.
- When performing a ***manual update***, you download and install the updates yourself.

Updating Software (continued)

- **Updating Operating Systems**
- Personal and mobile operating systems provide tools to keep the operating systems up to date by contacting a server and then downloading the files containing the updates.
- The tools let you select settings for how and when to update the operating system.

Updating Software (continued)

- **Updating Operating Systems (continued)**
- In Windows, you use Windows Update to check for the latest updates to Windows and to review your update settings.
- Windows Update can download three types of updates.

TABLE 2-2

TYPE	DESCRIPTION
Important	Updates you should install to maintain the security and reliability of Windows
Recommended	Updates that enhance your computing experience or repair problems that are not considered critical
Optional	Updates that are not critical and do not apply to all Windows users

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Summary

In this lesson, you learned:

- The characteristics and capabilities of a computer's internal hardware components directly influence computer performance.
- The system unit is the case that contains a computer's main system components, including the motherboard, the processor, and memory. All of the essential chips and the circuitry that connects them are on the motherboard.

Summary (continued)

- The internal hardware that processes data is the processor, also called the microprocessor and the central processing unit (CPU), which is a single computer chip that contains all the electronic circuitry for performing a personal computer's processing tasks.
- The processor has a significant effect on a computer's performance and computing power.

Summary (continued)

- The CPU has two primary sections: the arithmetic/logic unit (ALU) and the control unit.
- The ALU performs arithmetic calculations and logical operations.
- The control unit coordinates all of the processor's activities and manages the flow of information through the processor.

Summary (continued)

- The CPU carries out each instruction it receives from software by repeating four basic operations, which constitute the machine cycle: fetching, decoding, executing, and storing.
- The fetching and decoding operations make up the instruction cycle.
- The executing and storing operations make up the execution cycle.

Summary (continued)

- The clock speed indicates the number of instructions the CPU can process per second. It directly influences the speed of the machine cycle, and, therefore, the overall performance of the computer.
- The type of processor in a computer affects how quickly the computer can accept and carry out instructions from software.
- A multicore processor is a single chip that contains more than one processor, such as dual-core processors and quad-core processors.

Summary (continued)

- If a computer has a multicore processor, the operating system can use multiprocessing to split tasks among the processors. With multiprocessing, each processor can work on a different task at the same time.
- On a computer with a single-core processor, the operating system can use multitasking and multithreading. A multitasking operating system can run more than one program at the same time. A multithreading operating system handles many parts, or threads, of a single program.

Summary (continued)

- To store data and instructions, the CPU, operating system, and applications use memory, which consists of chips inside the system unit.
- A computer has two major types of memory: volatile memory such as RAM, and nonvolatile memory such as ROM.
- Volatile memory loses its contents when you turn off the power to the computer, while nonvolatile memory is permanent and does not lose its contents when you turn off the power to the computer.

Summary (continued)

- The amount of RAM in your computer has a significant effect on performance. If you do not have enough RAM, the operating system must move data in and out of RAM frequently, which slows performance.
- If the operating system spends more time swapping data between RAM and virtual memory than running software, it is said to be thrashing, which makes the computer sluggish or completely unresponsive.

Summary (continued)

- ROM is stored on single chips attached to the motherboard. The operating system retrieves the data or programs stored in ROM when it needs them, such as when the computer starts up.
- ROM is read-only memory because the operating system does not regularly write over its contents.
- EEPROM and flash memory are types of ROM that are non-volatile, but can be modified.

Summary (continued)

- If you change system components on your computer, by adding RAM, for example, the BIOS stored on a ROM chip must be updated to take these configuration changes into account.
- In addition to RAM, the CPU accesses memory caches to speed processing. The small amount of memory stored on the CPU itself, apart from the registers, is called level 1 cache memory. Level 2 cache memory is a larger amount of memory that can reside on the CPU or on a chip that has a direct connection to the CPU.

Summary (continued)

- You can tell how efficiently a computer is working by tracking its CPU and RAM usage. The lower the usage, the more efficiently the operating system is performing tasks. In Windows, you use Task Manager to track CPU and RAM usage.
- Applications have system requirements, which are hardware specifications such as the amount of memory and the speed of the processor. If your computer does not meet the application's system requirements, the application will not be able to run or will run ineffectively.

Summary (continued)

- Some applications include features designed for special hardware such as touchscreens, which allow you to use a fingertip to select commands or handwrite text input. Microsoft Word includes a button that lets you switch to Touch Mode, which adapts the Ribbon for touchscreen users.
- Software developers are constantly updating system and application software to keep up with hardware innovations and changes, user requests, and security threats. They release updated software as a patch, an update, or a service pack.

Summary (continued)

- When developers make major improvements to software, add new features, or change the design, the new version is called an upgrade. The first upgrade is assigned version 2.0, the next is version 3.0, and so on.
- You can download software, including new versions and updates, and installation instructions from a Web site. When you install software, you move a copy from its distribution location to your computer. During installation, the operating system changes its settings to make sure the software runs with your hardware.

Summary (continued)

- To update system and application software, you can use the software's automatic update feature, which automatically checks for software updates and then downloads them when they are available; or you can perform a manual update, where you download and install the updates yourself.
- You use Windows Update to check for the latest updates to Windows and to review your update settings. Windows Update can download important, recommended, and optional updates.
- Windows Update is a tool provided in the Control Panel, which is a window containing specialized tools you use to change the way Windows looks and behaves.