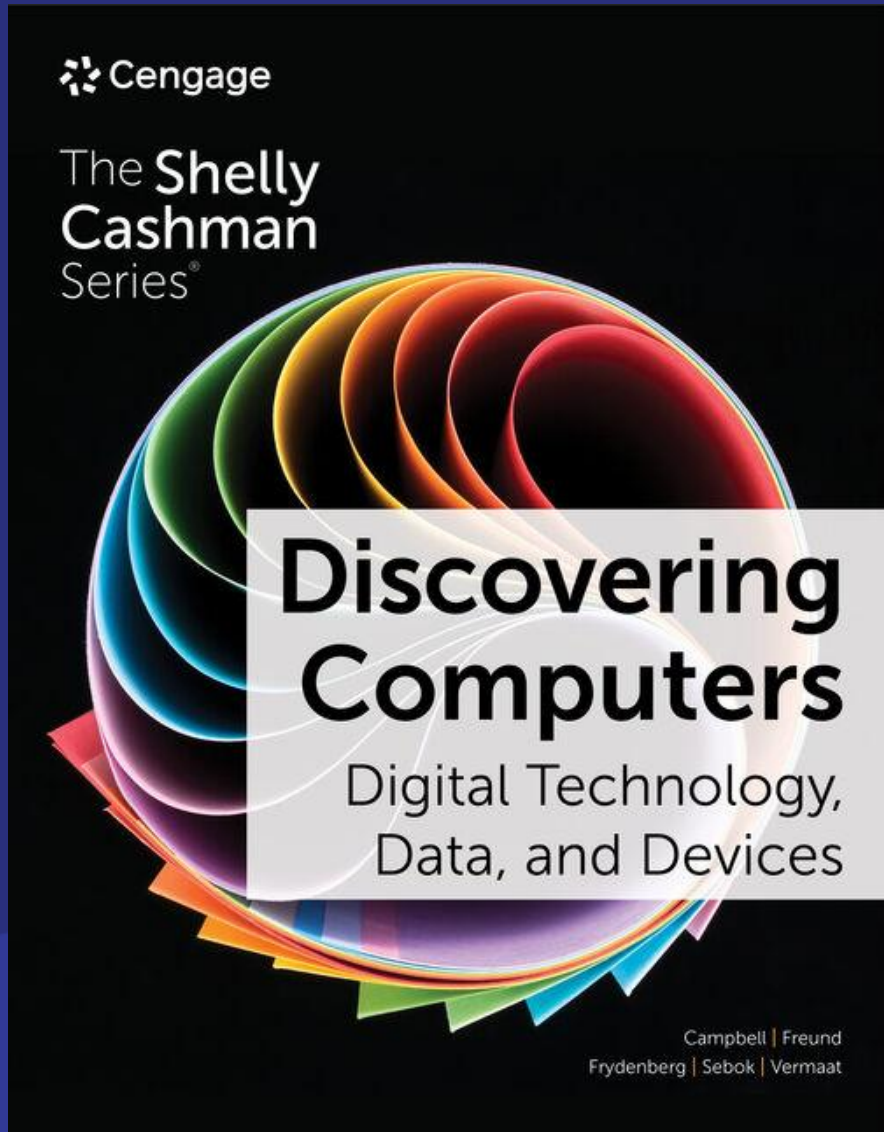# CS 110 – Introduction To Computing

Module 2: Computer Hardware (Evaluating Hardware: For Home and Work)

Module Objectives

By the end of this module, you should be able to:

- Explain considerations when purchasing technology devices

- Describe the characteristics and uses of input and output devices

- Evaluate hardware

- Prevent and troubleshoot hardware theft or failure

- Distinguish among internal, external, and cloud-based storage

- Describe network hardware

- Explain the uses of cases, motherboard components, system clock, processor cooling, the arithmetic logic unit, the machine cycle, and registers

- Discuss ways to prevent health-related injuries and disorders caused by technology use

- Identify responsible e-waste and technology disposal techniques

Considering Computer Operating Systems (1 of 6)

- **Hardware** refers to the device itself and its components, such as wires, cases, switches, and electronic circuits.

- **Components** of computer hardware contain various types of hardware:

  - ✓ Memory

  - ✓ Storage devices

  - ✓ CPU

  - ✓ Input and output devices

  - ✓ Communication devices

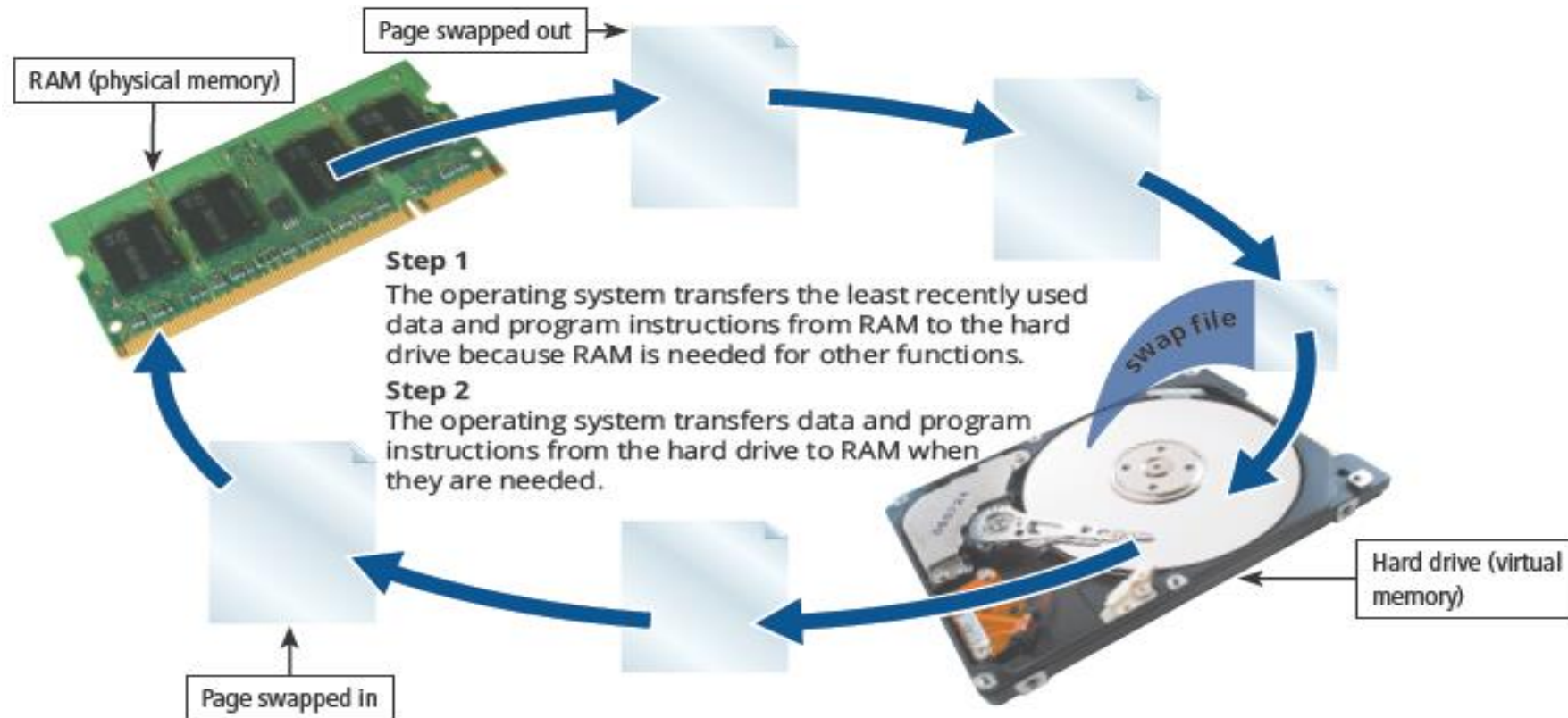# Considering Computer Operating Systems (2 of 6)

Figure 3-2 How a computer might use virtual memory.

Considering Computer Operating Systems (3 of 6)

- A **processor core** is a unit on the processor with the circuitry necessary to execute instructions.

- Processors with more cores perform better.

- A processor with multiple cores is a **multi-core processor**.

- **Computer memory** is responsible for holding data and programs as they are being processed by the CPU.

- An **operating system** and other apps require a certain amount of **RAM** to function properly.

- When more apps run simultaneously, more RAM will be required.

- The area of the hard drive temporarily used to store data that cannot fit in RAM is called a **swap file**, or **paging file**.

- Using virtual memory may decrease your computer's performance.

Considering Computer Operating Systems (4 of 6)

RAM

- It is the **temporary** storage location.

- It is stored on one or more chips connected to the main circuit board of the computer (**the motherboard**).

- It is **volatile memory**.

- The **motherboard** is a circuit board inside a computer that contains the microprocessor, the computer memory, and other internal devices.

ROM

- It is the **permanent** storage location.

- It is stored on a chip that contains **BIOS** connected to the main circuit board of the computer (**the motherboard**).

- It is **non-volatile memory**.

- Computer manufacturers update the instructions on the ROM chip, which are referred to as **firmware**.

Considering Computer Operating Systems (5 of 6)

Table 3-1 Types of RAM.

Type of RAM	Description	Volatile or Nonvolatile
Dynamic RAM (DRAM)	Memory needs to be constantly recharged or contents will be erased.	Volatile
Static RAM	Memory can be recharged less frequently than DRAM but can be more expensive than DRAM.	Volatile
Magneto-resistive RAM	Memory uses magnetic charges to store contents and can retain its contents in the absence of power.	Non volatile
Flash memory	Fast type of memory that is typically less expensive than some other types of RAM and can retain its contents in the absence of power.	Non volatile

Considering Computer Operating Systems (6 of 6)

Table 3-2 Factors to consider in buying a computer.

Consideration	Questions
Platform	• Do I need to use software that requires a specific platform? • Does the computer need to be compatible with other devices I own that use a particular platform?
Hardware	• Do I require specific hardware to perform my intended tasks? • How much data and information do I plan to store on the computer?
Hardware specifications	• Will the tasks I perform or software I want to run require certain hardware specifications?
Form factor	• Will I be using this computer in one location, or will I need to be mobile?
Add-on devices	• What additional devices will I need to perform my intended tasks?

Which Type of Computer Is Right For You? (1 of 2)

Table 3-3 Evaluating system requirements.

Specification	Recommended Solution
Different processor requirements	Identify the program or app with the greater processor requirement and select a computer with a processor that meets or exceeds the requirement.
Different memory requirements	Identify the program or app with the greater memory requirement and select a computer with a memory type and capacity that meets or exceeds this requirement. Computers with as little as 4 GB of memory are great for basic web browsing and very basic productivity tasks, while computers with as much as 32 GB are often used for virtual reality applications, high-end gaming, and other intensive tasks.
Different storage requirements	Add the storage requirements for each program or app you want to use, and select a computer with a storage capacity that exceeds the sum of all storage requirements.
Other differing hardware requirements	In most cases, identify the program or app with the greater requirement and select a computer that at least meets or exceeds this requirement.

Which Type of Computer Is Right For You? (2 of 2)

- The **form factor** refers to the shape and size of the computer.

- **Various types** of computers exist, including desktop computers, all-in-one computers, laptops, tablets, and other mobile devices.

- A **desktop computer** typically consists of the system unit, monitor, keyboard, and mouse which remain in a stationary location under a desk or table.

- An **all-in-one computer** has a monitor and system unit housed together.

Selecting The Right Device (1 of 2)

A **laptop** is a compact communicating device with

- **input devices**, keyboard, touchpad, and webcam

- **output devices**, screens, and speakers

- one or more **storage devices**, such as a hard drive

Ultrathin laptops

- Light weight and more expensive

- Less powerful

- Thin device with fewer parts

- Longer battery life

Figure 3-7 Laptop form factors.

Traditional laptop

MacBook Air

Ultrathin laptop

Selecting The Right Device (2 of 2)

- Two popular **form factors of tablets** are slate and convertible.

- A **slate tablet** resembles a letter-sized pad and does not contain a physical keyboard.

- A **convertible tablet** is a tablet that has a screen on its lid and a keyboard on its base.

Magnetic keyboard cover

Slate tablet in stand

Stylus

Convertible tablet

Figure 3-8 Slate and convertible tablets.

Input and Output Devices (1 of 3)

- A **scanner** is an input device that converts an existing paper image into an electronic file that you can open and work with on your computer.

- **3-D scanners** can scan three-dimensional objects.

- **Scanner** can be used to scan a printed document to edit it using an app on your computer.

- A **printer** creates hard copy output on paper, film, and other media.

- A printer can be linked to a computer wirelessly, over a network, or with a cable.

Input and Output Devices (2 of 3)

Table 3-4 Types of printers.

Type of Printer	Description
Inkjet printer	Prints by spraying small dots of ink onto paper
Laser printer	Uses a laser beam and toner to print on paper
Multifunction device	Also called an all-in-one printer; can serve as an input device by copying and scanning as well as an output device by faxing and printing
Mobile printer	Small, lightweight printer that is built into or attached to a mobile device for mobile printing
Plotter	Large-format printer that uses charged wires to produce high-quality drawings for professional applications such as architectural blueprints; plotters draw continuous lines on large rolls of paper
3–D printer	Creates objects based on computer models using special plastics and other materials

Input and Output Devices (3 of 3)

- Computers can also provide voice output. A **voice synthesizer** converts text to speech.

- Some apps and operating systems have a built-in voice synthesizer.

- It is convenient for some and helpful for those with visual impairments.

- **Projectors** can display output from a computer on a large surface, such as a wall or screen.

- These are wired or wirelessly connected to one another.

- It is an exact replica of the computer monitor.

Figure 3-20 Projector and screen.

Install and Evaluate Hardware (1 of 3)

Before you turn on your computer or device for the first time, make sure that:

- All necessary components are included and free from damage.

- Read the manual to ensure you are following the setup instructions.

- Carefully unpack all components from the box and in case of laptop, charge the battery completely before use.

- Connect all components and accessories.

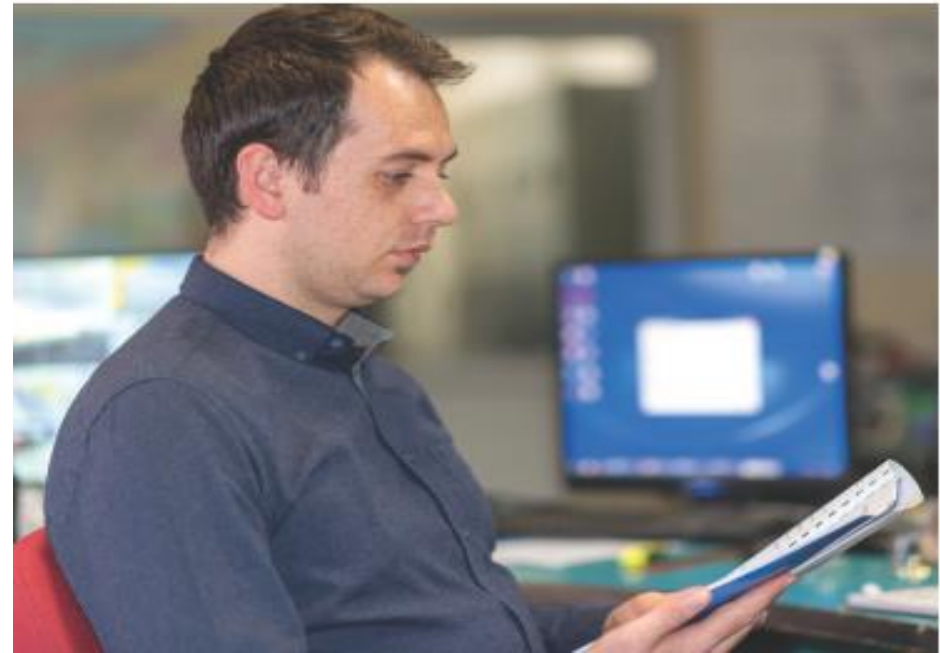- Turn on the computer or device and follow all the remaining steps on the screen.

Figure 3-21 User manuals provide safe setup instructions.

Install and Evaluate Hardware (2 of 3)

- **Peripheral devices** over the wireless network need installation directly to your device through a port.

- Some devices, called **Plug-and-Play** devices, will begin functioning properly as soon as they are connected to your computer.

- A **device driver** is a program that allows your computer or device to issue controls to a separate device, such as a printer, monitor, or video card.

- To connect a **wireless device** to your computer, follow the installation instructions that come with the device.

Install and Evaluate Hardware (3 of 3)

- The processor's **clock speed** measures the speed at which it can execute instructions.

- A **cycle** is the smallest unit of time a process can measure.

- The efficiency of a CPU is measured by **instructions per cycle**.

- The **bus width** determines the speed at which data travels and is also referred to as the **word size**.

- A **benchmark** is a test run by a laboratory or other organization to determine processor speed and other performance factors.

Secure IT: Reducing Hardware Risks (1 of 5)

Avoid Hardware Theft

- Known for their mobility, devices can be stolen

- Keep data accessible in case of theft or destruction of the device

- To prevent laptops from being stolen, use a **cable lock**.

- Keep mobile devices out of sight when traveling in a high-crime area.

- Minimize the use of headphones and be aware of your surroundings.

Figure 3-22 Laptop cable lock.

Secure IT: Reducing Hardware Risks

- Use a damp cloth to clean the screen gently.

- Use a can of compressed air to clean the keyboard of any dirt and debris.

- Extreme temperatures or humidity can damage electronics.

- An **uninterruptible power supply** is a device that maintains power to computer equipment in the event of an interruption in the primary electrical source.

- A **surge suppressor** is a device that prevents power fluctuations from damaging electronic components.

Figure 3-23 Uninterruptible power supply.

Secure IT: Reducing Hardware Risks (3 of 5)

Protecting a computer from a cyber attack is important, but its damage by dropping it or by a lightning strike is also of prime importance.

Table 3-5 Electrical changes.

Electrical Change	Explanation
Blackout	Total loss of power
Brownout	Drop in voltage lasting minutes or hours
Spike	Very short duration of voltage increase
Surge	Short duration of voltage increase
Noise	Unwanted high-frequency energy

Secure IT: Reducing Hardware Risks (4 of 5)

- **Restoring** an operating system means reverting all settings to their default or migrating back to the operating system's previous version.

- To restore the operating system, review the help documentation and follow the specified steps.

- Data backups can protect against hardware malfunctions, user errors, software corruption, and natural disasters.

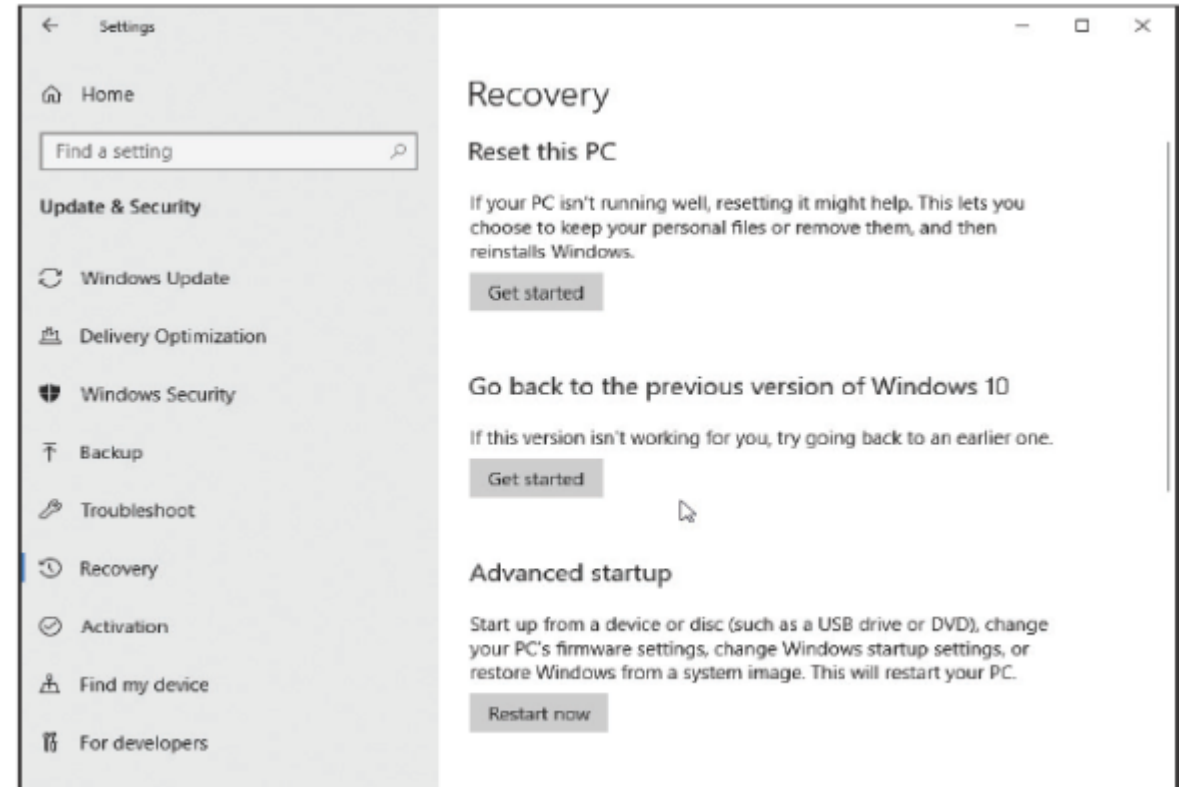- They can also protect against cyber attacks.

Figure 3-24 Windows includes a feature to restore your operating system.

Secure IT: Reducing Hardware Risks (5 of 5)

- The central connection devices for a home-based Wi-Fi network are called **wireless routers.**

- **Wi-Fi networks are vulnerable to several risks, such as:**

  ✓ Reading wireless transmissions

  ✓ Viewing or stealing computer data

  ✓ Injecting malware

  ✓ Downloading harmful content

Figure 3-25 Wireless router.

Internal, External, and Cloud-Based Storage Solutions (1 of 3)

- When using a computer, the most common storage medium is the internal **hard drive** and can either store data magnetically or use solid state storage.

- Internal hard drives are installed on the computer you are using.

- An **external hard drive** can add storage capacity to your computer.

- Magnetic hard disk drives (HDDs) typically have greater storage capacity.

- A **solid-state drive** (**SSD**) is faster and more durable than magnetic drives.

Figure 3-26 Hard disk drive.

Internal, External, and Cloud-Based Storage Solutions (2 of 3)

- **Optical media** use laser technology for storage and playback and include CDs, DVDs, and Blu-ray discs.

- Optical media were once widely used to distribute installation files for programs and apps, but saving files to optical media requires special software or capabilities within the operating system.

- Instead of optical discs, USB flash drives, external hard drives, and cloud storage are now more commonly used to transport files.

Internal, External, and Cloud-Based Storage Solutions (3 of 3)

- **Cloud storage** involves storing electronic files on a remote server connected to the Internet, not on a local computer, and is called **storing data** on the cloud.

- It enables the storage of files remotely on servers that could be any part of the world.

- Storing files on and retrieving files from cloud storage requires only a computer or mobile device with an Internet connection.

- Cloud storage companies host and maintain the servers and provide access to your files.

Figure 3-28 Cloud storage.

Network Hardware (1 of 3)

- All **networks** have the same basic characteristics and hardware.

- **Networks** allow computers to share resources, such as hardware, software, data, and information.

- A network requires a combination of **hardware** and **software** to operate.

- **Smaller networks** usually require simple hardware and can rely on the operating system's features while **larger networks** typically require more sophisticated hardware and software.

Cengage

Network Hardware (2 of 3)

- Devices on a network, also called **nodes**, include computers, tablets, mobile phones, printers, game consoles, and smart home devices.

- Most networks also include additional components, such as **hubs**, **switches**, and **routers**.

- A **hub** is a device that provides a central point for cables in a network and transfers all data to all devices.

- A **switch** is similar to a hub in that it provides a central point for cables in a network.

- A **router** is a device that connects two or more networks and directs, or routes, the flow of information along the networks.

- A **modem** is a communications device that connects a communications channel, such as the Internet, to a sending or receiving device, such as a computer.

- For a computer to connect to a network, it should have a **network interface card**.

- Most of today's modems are digital, which means that they send and receive data to and from a digital line.

- **Cable** and **DSL** (digital subscriber line) are two common types of digital modems.

- The type of modem required for your network will depend on your Internet service provider.

- A cable modem sends and receives digital data over a cable TV connection.

- A DSL modem uses existing standard copper telephone wiring to send and receive digital data.

Figure 3-29 Modems can connect many devices to the Internet.

Inside the Case (1 of 5)

- **Processor chips** for laptops, desktops, and servers can generate quite a bit of heat, which could cause the chip to malfunction or fail.

- Heat sinks, liquid cooling technologies, and cooling pads are used to help further dissipate processor heat.

- A **heat sink** is a small ceramic or metal component with fins on its surface that absorbs and disperses heat produced.

- **Liquid cooling technology** uses a continuous flow of fluid, such as water and glycol, in a process that transfers the heated fluid away.

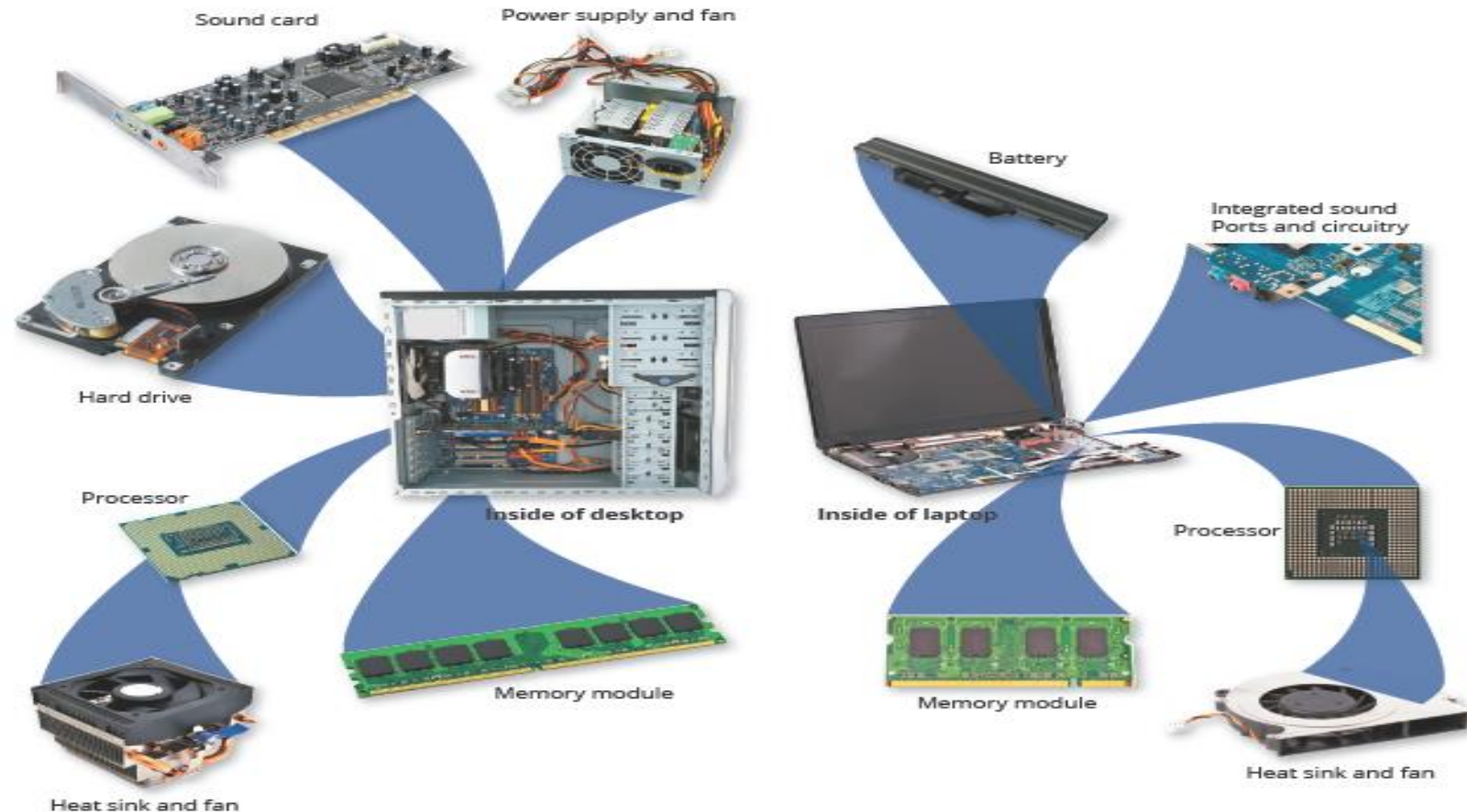- A **cooling pad** rests below a laptop and protects the computer from overheating.

Figure 3-30 Typical components of a higher-end desktop and laptop.

Inside the Case (3 of 5)

- Many electronic components, such as the processor and memory, attach to the **motherboard**; others are built into it.

- On desktop and laptop computers, the circuitry for the processor, memory, and other components resides on a **computer chip.**

- A computer chip is a small piece of semiconducting material, usually silicon, on which integrated circuits are etched.

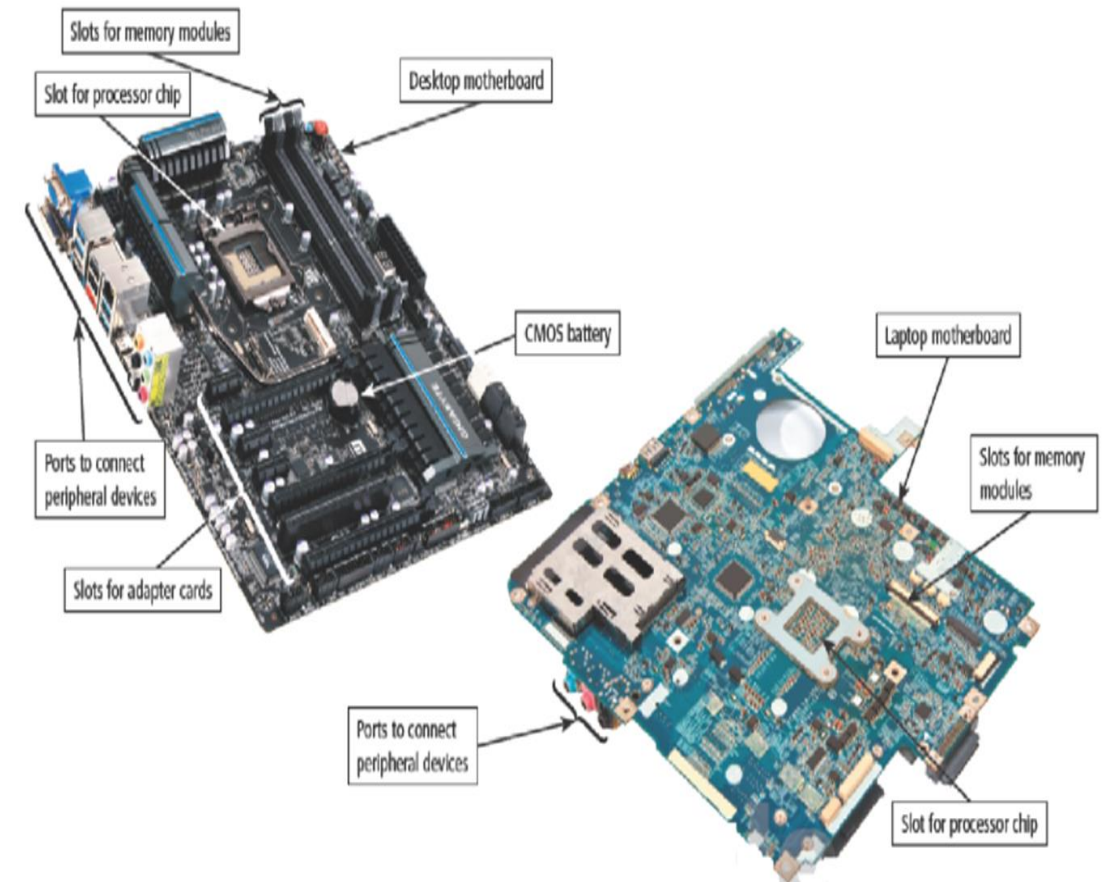- An integrated circuit contains many microscopic pathways capable of carrying electrical current.

Slots for memory modules

Slot for processor chip

Desktop motherboard

CMOS battery

Ports to connect peripheral devices

Slots for adapter cards

Laptop motherboard

Slots for memory modules

Ports to connect peripheral devices

Slot for processor chip

Figure 3-31 A desktop and laptop motherboard.

Inside the Case (4 of 5)

A processor repeats a set of four basic operations, which comprise a **machine cycle.**

- **Fetching** is the process of obtaining a program or an application instruction or data item from memory.

- **Decoding** refers to the process of translating the instructions into signals the computer can execute.

- **Executing** is the process of carrying out the commands.

- **Storing**, in this context, "writing" means writing the result to memory (not to a storage medium).
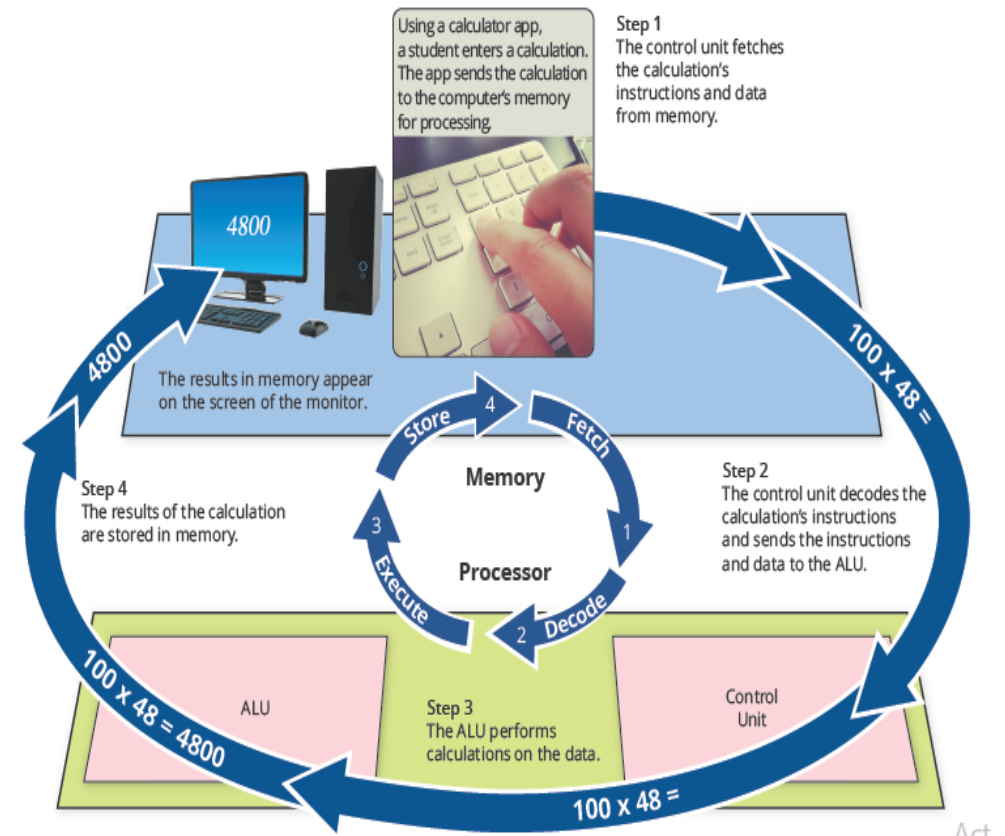

Figure 3-32 The steps in the machine cycle.

Inside the Case (5 of 5)

- A processor contains small, high-speed storage locations, called **registers**, that temporarily hold data and instructions.

- **Registers** are part of the processor not part of memory or a permanent storage device.

- Register functions include storing the location from where instruction was fetched, storing an instruction while the control unit decodes it, storing data while the ALU calculates it, and storing the results of a calculation.

- The hazard of technology is your physical health as well as your behavioral and social well-being.

- Many users of technological devices report aches and pains associated with repeated and long-term usage of the devices, known as **repetitive strain injury (RSI)**.

How To: Protect Yourself When Using Devices (5 of 5)

- **RSI** impacts your muscles, nerves, tendons, and ligaments. RSI most often affects the upper parts of the body, including elbows, forearms, hands, neck, shoulders, and wrists

- RSI has a variety of symptoms:

  - ✓ Aching
  - ✓ Cramp
  - ✓ Numbness
  - ✓ Pain
  - ✓ Stiffness

  - ✓ Tenderness
  - ✓ Throbbing
  - ✓ Tingling
  - ✓ Weakness

How To: Protect Yourself When Using Devices (1 of 4)

RSI most often is caused by three factors:

Table 3-6 Causes and examples of RSI.

Cause	Description	Example
Repetitive activity	Repeating the same activity over a lengthy time period	Typing on a keyboard for multiple hours every day over several years
Improper technique	Using the wrong procedure or posture	Slouching in a chair
Uninterrupted intensity	Performing the same high-level activity without frequent periods of rest	Working at a computer all day with no breaks

How To: Protect Yourself When Using Devices

Ergonomics is an applied science that specifies the design and arrangement of items that you use so that you and the items interact efficiently and safely.

This shows the correct ergonomic posture and techniques for sitting while working on a computer.
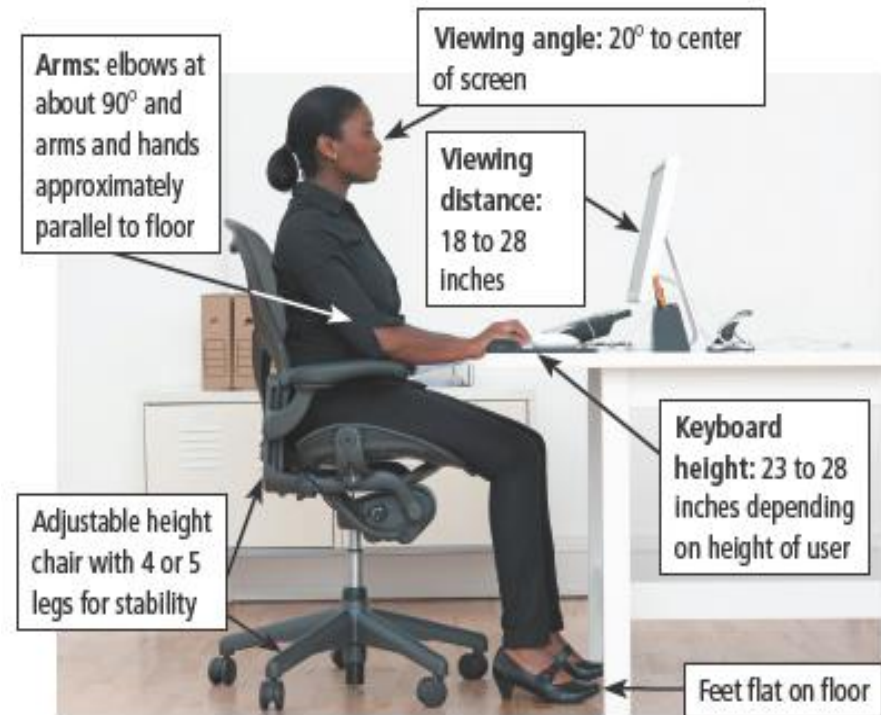

Figure 3-33 Ergonomic sitting setup.

How To: Protect Yourself When Using Devices (3 of 4)

- One behavioral hazard is **technology addiction**, which occurs when a user is obsessed with using a technology device.

- Apart from technology addiction, other behavioral risks are:
  - ✓ Sedentary lifestyle
  - ✓ Psychological development
  - ✓ Social interaction

- One negative impact that can result in serious emotional harm is cyber-bullying.

- **Doxing** is a form of cyber-bullying in which documents (dox) are shared digitally that give private or personal information about a person.

- **Cyber-stalking** involves the use of technology to stalk another person through email, text messages, phone calls, and other forms of communication.

How To: Protect Yourself When Using Devices (4 of 4)

Table 3-7 Harmful features of cyberbullying.

Feature	Bullying	Cyberbullying
Seems to never end	A child may be bullied at school, but once the child goes home the bullying ceases.	Because cyberbullying comments posted online are visible all the time to the victim the bullying never ends.
Everyone knows about it	Mean-spirited words spoken to a victim may be heard only by those who are nearby.	A cyberbully can post comments online that can be read by everyone.
May follow for a lifetime	Bullying usually stops when the person or victim leaves.	Posted cyberbullying comments may remain visible online for years and even follow the victim through life, impacting college admissions and employment.

Ethics and Issues: Dispose of Hardware Responsibly (1 of 2)

- **E-waste** is electronic waste from discarded digital devices.

- It often contains toxic metals, like lead and mercury which contaminate the ground and water supply, causing harm to the environment.

- Three responsible methods for disposing of e-waste:

  - ✓ Send it to a recycling facility

  - ✓ Donate it to a charity or other nonprofit organization

  - ✓ Bring it to a technology store or firm

Figure 3-35 Electronic recycling center.

Ethics and Issues: Dispose of Hardware Responsibly (2 of 2)

An initiative called **Sustainable Electronics Management** (SEM) promotes the reduction of e-waste.

Table 3-8 SEM action steps.

Step	Action	Description
1	Buy Green	When purchasing new electronic equipment, buy only products that have been designed sustainably
2	Donate	Donate used but still functional equipment to a school, charity, or nonprofit organization
3	Recycle	Send equipment to a verified used electronics recycling center