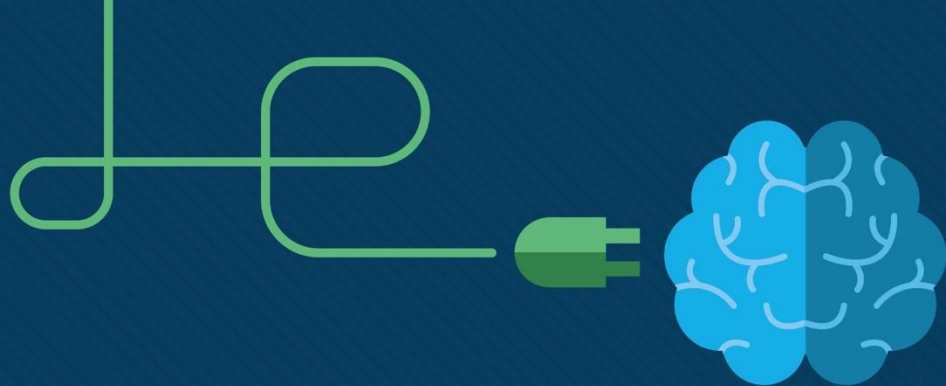


Chapter 1: Introduction to Personal Computer Hardware



Chapter 1 - Sections & Objectives

- 1.1 Personal Computers
 - Explain how to keep personal computer components safe.
 - Explain components in a computer.
 - Explain electrical and ESD safety.
- 1.2 PC Components
 - Explain the features and functions of computer components.
 - Describe cases and power supplies.
 - Describe motherboards.
 - Describe CPUs.
 - Explain types of memory.
 - Describe adapter cards and expansion slots.
 - Describe hard disk drives and SSDs.

Chapter 1 - Sections & Objectives (Cont.)

- 1.2 PC Components (Cont.)
 - Describe optical storage devices.
 - Describe ports, cables and adapters.
 - Describe input devices.
 - Describe output devices.
- 1.3 Disassemble a PC
 - Explain the features and functions of each component in the tool kit.
 - Disassemble a computer.

1.1 Personal Computer

Video Explanation – What is in a computer?

Video Explanation: What is in a Computer?

In this video explanation, you will learn the components that make up a computer:

- Input devices
- Output devices
- Internal components



Personal Computers

Electrical Safety

- Electrical devices have certain power requirements.
- AC adapters are manufactured for specific laptops.
 - Exchanging AC adapters with a different type of laptop or device may cause damage to both the AC adapter and the laptop.
- Some printer parts, such as power supplies, contain high voltage. Check the printer manual for the location of high-voltage components.



Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities.

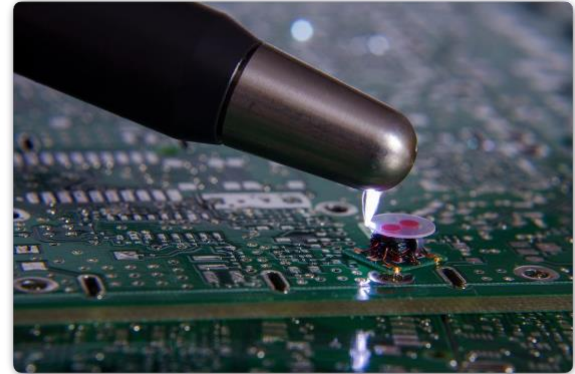
Electrical and ESD Safety

ESD

- Electrostatic discharge (ESD) can occur when there is a buildup of an electric charge that exists on a surface which comes into contact with another differently charged surface.
- ESD can cause damage to computer equipment if not discharged properly.
- At least 3,000 volts of static electricity must build up before a person can feel ESD.

Follow these recommendations to help prevent ESD damage:

- Keep all components in antistatic bags until you are ready to install them.
- Use grounded mats on workbenches.
- Use grounded floor mats in work areas.
- Use antistatic wrist straps when working inside computers.



1.2 PC Components

PC Components

Cases

- The case houses the internal components such as the power supply, motherboard, central processing unit (CPU), memory, disk drives, and assorted adapter cards.
- The term **form factor** refers to the physical design and look of a case. Common desktop computers are available in form factors including:
 - Horizontal case
 - Full-Size Tower
 - Compact Tower
 - All-in-one

Many case manufacturers may have their own naming conventions, including super tower, full tower, mid tower, mini tower, cube case, and more.



PC Components

Power Supplies

- Computers use a power supply to convert AC power into a lower voltage DC power required by internal components.
- Desktop computer power supply form factors include:
 - **Advanced Technology (AT)** – original power supply for legacy computer systems
 - **AT Extended (ATX)** – updated version of the AT
 - **ATX12V** – the most common power supply on the market today
 - **EPS12V** – originally designed for network servers but is now commonly used in high-end desktop models.



PC Components

Connectors



- A power supply includes several different connectors. They are used to power various internal components such as the motherboard and disk drives.
- Some examples are:
 - 20-pin or 24-pin slotted connector
 - SATA keyed connector
 - Molex keyed connector
 - Berg keyed connector
 - 4-pin to 8-pin auxiliary power connector
 - 6/8-pin PCIe power connector

Power Supply Voltage

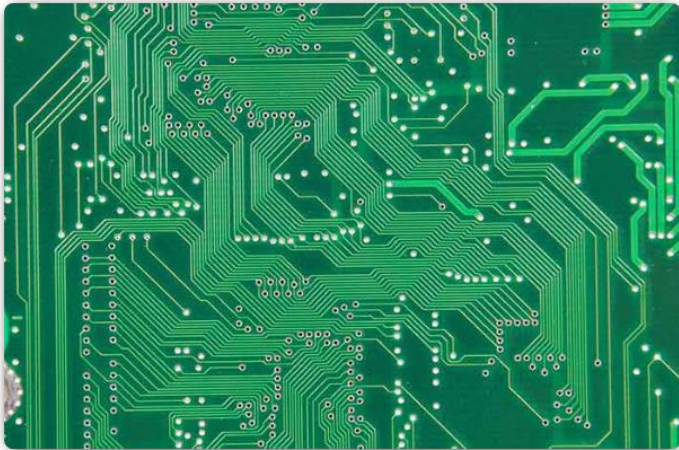
- The different connectors in a power supply also provide different voltages.
- The most common voltages supplied are 3.3 volts, 5 volts, and 12 volts.
- The 3.3 volt and 5 volt supplies are typically used by digital circuits, while the 12 volt supply is used to run motors in disk drives and fans.
 - Power supplies can also be single rail, dual rail, or multi rail.
 - A rail is the printed circuit board (PCB) inside the power supply to which the external cables are connected.

A computer can tolerate slight fluctuations in power, but a significant deviation can cause the power supply to fail.



PC Components

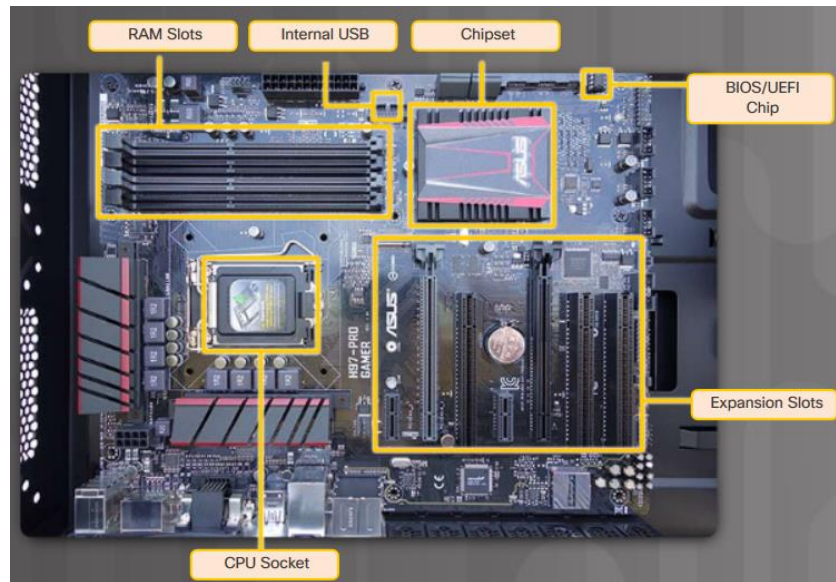
Motherboards



- The motherboard is the backbone of the computer.
- It is a printed circuit board (PCB) that contains buses, or electrical pathways, that interconnect electronic components.
- These components may be soldered directly to the motherboard, or added using sockets, expansion slots, and ports.

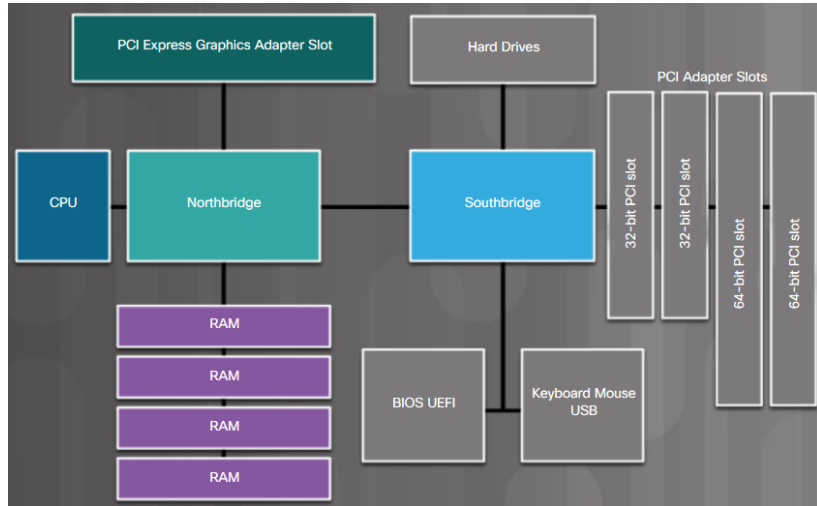
Motherboard Components

- Major components on a motherboard include:
 - Central Processing Unit (CPU)
 - Random Access Memory (RAM)
 - Expansion slots
 - Chipset
 - Basic input/output system (BIOS) chip and Unified Extensible Firmware Interface (UEFI) chip
 - SATA connectors
 - Internal USB connector



PC Components

Motherboard Chipset



- **Chipset** consists of the integrated circuits on the motherboard that control how system hardware interacts with the CPU and motherboard.
- Most chipsets consist of the following two types:
 - **Northbridge** – Controls high speed access to the RAM and video card.
 - **Southbridge** – Allows the CPU to communicate with slower speed devices including hard drives, Universal Serial Bus (USB) ports, and expansion slots.

Motherboard Form Factors

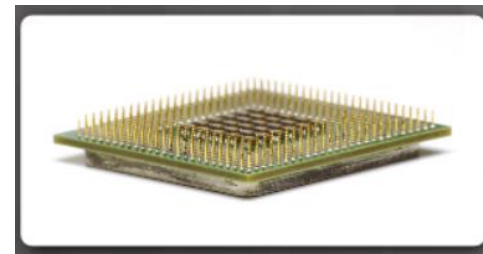
- The form factor of motherboards pertains to the size and shape of the board.
- There are three common motherboard form factors: **Advanced Technology eXtended (ATX)**, **Micro-ATX**, and **ITX**.

Form Factor	Description
ATX	<ul style="list-style-type: none">• Advanced Technology eXtended• Most popular form factor• 12 in X 9.6 in (30.5 cm X 24.4 cm)
Micro-ATX	<ul style="list-style-type: none">• Smaller footprint than the ATX• Popular in desktop and small form factor computers• 9.6 in X 9.6 in (24.4 cm X 24.4 cm)
Mini-ITX	<ul style="list-style-type: none">• Designed for small devices such as thin clients and set-top boxes• 6.7in X 6.7 in (17cm X 17 cm)
ITX	<ul style="list-style-type: none">• Comparable form factor to Micro-ATX• 8.5 in X 7.5 in (21.5 cm X 19.1 cm)

The choice of motherboard form factor determines how individual components attach to it, the type of power supply required, and the shape of the computer case.

What is CPU?

- The central processing unit (CPU) is responsible for interpreting and executing commands.
- The CPU is a small microchip that resides within a CPU package.
- The CPU socket is the connection between the motherboard and the processor.
- Modern CPU sockets and processor packages are built in following architectures:
 - **Pin Grid Array (PGA)** - the pins are on the underside of the processor package and is inserted into the motherboard CPU socket.
 - **Land Grid Array (LGA)** - the pins are in the socket instead of on the processor.



PC Components

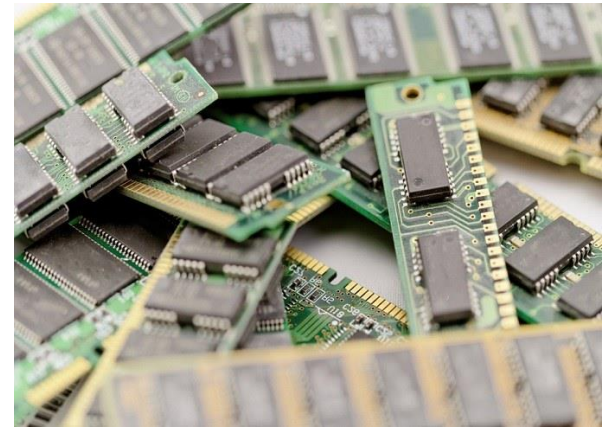
Cooling Systems

- Computer components perform better when kept cool.
- Computers are kept cool using active and passive cooling solutions.
- Active solutions require power while passive solutions do not.
- Passive solutions for cooling usually involve reducing the speed at which a component is operating or adding heat sinks to computer chips.
- A case fan is considered as active cooling.



Types of Memory

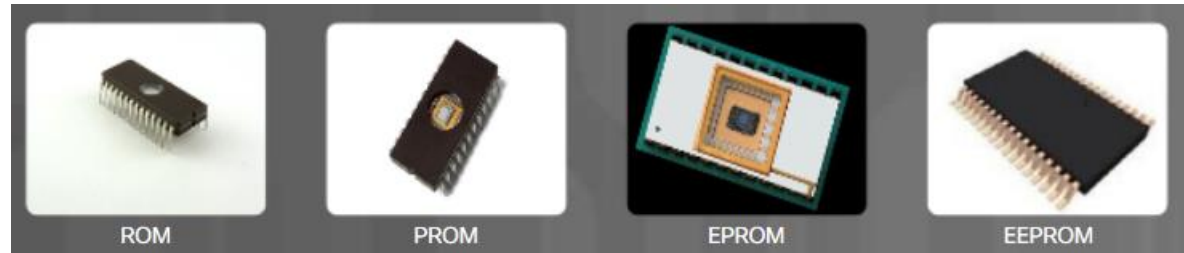
- A computer might use different types of memory chips.
- All memory chips store data in the form of bytes.
 - A byte is a block of eight bits stored as either 0 or 1 in the memory chip.
- **Read-Only Memory (ROM)** – such as ROM chip.
- **Random Access Memory (RAM)** is the temporary working storage for data and programs that are being accessed by the CPU. RAM is volatile memory.
- Adding more RAM in a computer enhances the system performance. However, the maximum amount of RAM that can be installed is limited by the motherboard.



PC Components

Types of ROM

- Types of Read-only Memory (ROM) include:
 - ROM chips.
 - PROM chips.
 - EPROM chips
 - EEPROM chips.



Types of RAM

- Types of Random Access Memory (RAM) include:
 - Dynamic RAM (DRAM)
 - Static RAM (SRAM)
 - Synchronous Dynamic RAM (SDRAM)
 - Double Data Rate Synchronous Dynamic RAM (DDR SDRAM)
 - DDR2 Synchronous Dynamic RAM (DDR2 SDRAM)
 - DDR3 Synchronous Dynamic RAM (DDR3 SDRAM)
 - DDR4 Synchronous Dynamic RAM (DDR4 SDRAM)
 - GDDR Synchronous Dynamic RAM (GDDR SDRAM)

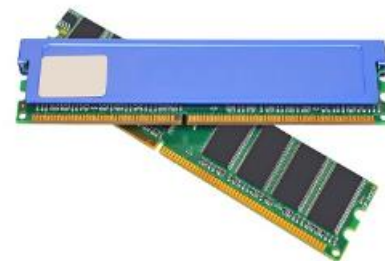
Memory Modules

- Memory chips are soldered to a circuit board to create a memory module which is placed into a memory slot on the motherboard.
- Different types of memory modules include: **DIP**, **SIMM**, **DIMM memory**, and **SODIMM**.
- The speed of memory has a direct impact on how much data a processor can process in a given period of time.
- The fastest memory is typically static RAM (SRAM) which is used as cache memory



Memory Modules (Cont.)

- The speed of memory has a direct impact on how much data a processor can process in a given period of time.
- The fastest memory is typically static RAM (SRAM) which is used as cache memory for storing the most recently used data and instructions by the CPU.
- The three most common types of cache memory are:
 - L1 cache – integrated into the CPU
 - L2 cache – was original mounted on the motherboard, but now integrated into the CPU
 - L3 cache – used some high-end workstations and server CPUs

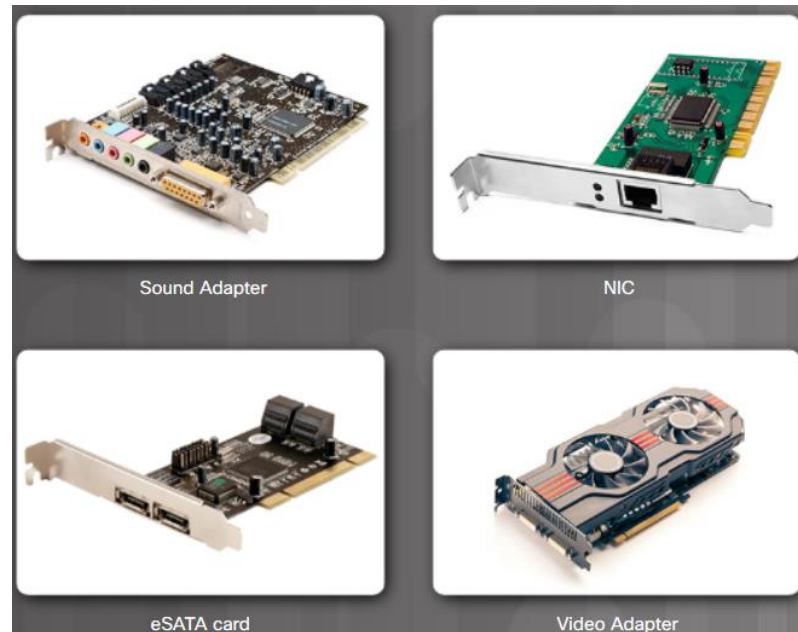


Memory Modules (Cont.)

- Memory errors occur when the data is not stored correctly in the memory chips. The computer uses different methods to detect and correct data errors in memory.
- Different types of error checking methods include:
 - **Nonparity** – Nonparity memory does not check errors in memory.
 - **Parity** – Parity memory contains 8 bits for data and 1 bit for error checking.
 - **ECC** – Error Correction Code memory can detect multiple bit errors in memory and correct single bit errors in memory

Adapter Cards

- Adapter cards increase the functionality of a computer by adding controllers for specific devices or by replacing malfunctioning ports.
- Common adapter cards include:
 - Sound adapter
 - Network Interface Card (NIC)
 - Wireless NIC
 - Video adapter or display adapter
 - Capture card
 - TV tuner card
 - Universal Serial Bus (USB) controller card
 - eSATA card



Adapter Cards (Cont.)

- Computers have expansion slots on the motherboard to install adapter cards.
- The type of adapter card connector must match the expansion slot.
- Common expansion slots include:
 - Peripheral Component Interconnect (PCI)
 - Mini-PCI
 - PCI eXtended (PCI-X)
 - PCI Express (PCIe)
 - Riser card
 - Accelerated Graphics Port (AGP)



Types of Storage Devices

- Data drives provide non-volatile storage of data.
- Some drives have fixed media, and other drives have removable media.



Hard Disk Drive



Optical Drive



Solid State Drive



Tape Drive

- Data storage devices can be classified according to the media on which the data is stored:
 - Magnetic – like hard disk drive and tape drive
 - Solid state – like solid state drive
 - Optical – like CD and DVD

Storage Device Interfaces

- Storage devices inside a computer connect to the motherboard using Serial AT Attachment (SATA) connections. The legacy interface is Parallel ATA (EIDE).
- The interface standards define the way that data is transferred, the transfer rates, and physical characteristics of the cables and connectors.
- There are three main versions of the SATA standard: SATA 1, SATA 2, and SATA 3.
- The cables and connectors are the same, but the data transfer speeds are different.

ATA	Parallel (PATA)	IDE	8.3 Mb/s
		EIDE	16.6 Mb/s
	Serial (SATA)	SATA 1	1.5 Gb/s
		SATA 2	3.0 Gb/s
		SATA 3	6.0 Gb/s

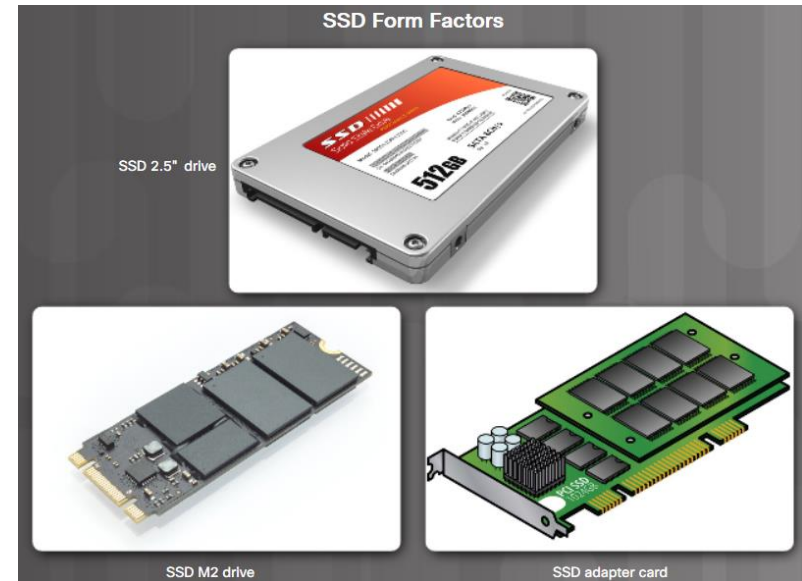
Magnetic Media Storage

- This type of storage represents binary values as magnetized or non-magnetized physical areas of magnetic media.
- Common types of magnetic media storage drives:
 - Hard Disk Drive (HDD) – the traditional magnetic disk devices with storage capacity ranging from gigabytes (GBs) to terabytes (TBs).
 - Tape Drive – most often used for archiving data.
 - Tape drives use a magnetic read/write head and removable tape cartridge.
 - Common tape storage capacities vary between a few GBs to many TBs.



Semiconductor Storage

- Solid-state drives (SSD) store data as electrical charges in semiconductor flash memory. This makes SSDs much faster than magnetic HDDs.
- SSDs have no moving parts, make no noise, are more energy efficient, and produce less heat than HDDs.
- SSDs come in three form factors:
 - Disc drive form factor – similar to an HDD
 - Expansion cards – plugs directly into the motherboard and mounts in the computer case like other expansion cards
 - mSata or M.2 modules – these packages may use a special socket. **M.2** is a standard for computer expansion cards.



Semiconductor Storage (Cont.)

- The Non-Volatile Memory Express (**NVMe**) specification was developed specifically to allow computers to take greater advantage of the features of SSDs by providing a standard interface between SSDs, the PCIe bus, and operating systems.
- NVMe allows compliant SSD drives to attach to the PCIe bus without requiring special drivers.
- Solid State Hybrid Drives (**SSHDs**) are a compromise between a magnetic HDD and an SSD.
 - They are faster than an HDD but less expensive than an SSD.
 - They combine a magnetic HDD with onboard flash memory serving as a non-volatile cache.

Types of Optical Storage Devices

- Optical drives are removable media storage devices that use lasers to read and write data on optical media.
- They were developed to overcome the storage capacity limitations of removable magnetic media such as floppy discs.
 - There are three types of optical drives:
 - Compact Disc (CD) - audio and data
 - Digital Versatile Disc (DVD) - digital video and data
 - Blu-ray Disc (BD) - HD digital video and data



Types of Optical Storage Devices (Cont.)

- CD, DVD, and BD media can be pre-recorded (read only), recordable (write once), or re-recordable (read and write multiple times).
- DVD and BD media can also be single layer (SL) or dual layer (DL). Dual layer media roughly doubles the capacity of a single disc.

Optical Media	Description	Storage Capacity
CD-ROM	CD read-only memory media that is pre-recorded	700 MB
CD-R	CD recordable media that can be recorded one time	
CD-RW	CD rewritable media that can be recorded, erased, and re-recorded	
DVD-ROM	DVD read-only memory media that is pre-recorded	4.7 GB (Single-Layer)
DVD-RAM	DVD rewritable media that can be recorded, erased, and re-recorded	8.5 GB (Dual-Layer)
DVD+/-R	DVD recordable media that can be recorded one time	4.7 GB (Single-Layer) 8.5 GB (Dual-Layer)
DVD+/-RW	DVD rewritable media that can be recorded, erased, and re-recorded	
BD-ROM	Blu-ray read-only media that is pre-recorded with movies, games, or software	
BD-R	Blu-ray recordable media that can be recorded one time	25 GB (Single-Layer) 50 GB (Dual-Layer)
BD-RE	Blu-ray rewritable media that can be recorded, erased, and re-recorded	

Video Ports and Cables

- A video port connects a monitor to a computer using a cable.
- Video ports and monitor cables transfer analog signals, digital signals, or both.
- Video ports and cables include:
 - Digital Visual Interface (DVI)
 - DisplayPort
 - High-Definition Multimedia Interface (HDMI)
 - Thunderbolt 1 or 2
 - Thunderbolt 3
 - Video Graphics Array (VGA)
 - Radio Corporation of America (RCA)



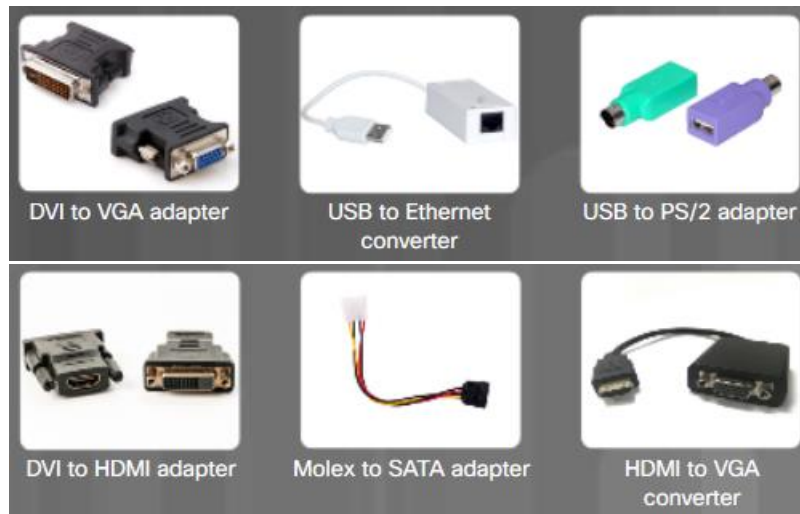
Other Ports and Cables

- Input/output (I/O) ports on a computer connect peripheral devices, such as printers, scanners, and portable drives.
- A computer may have other ports:
 - Personal System 2 (PS/2)
 - Audio and game port
 - Network
 - Serial AT Attachment (SATA)
 - Integrated Drive Electronics (IDE)
 - The Universal Serial Bus (USB)



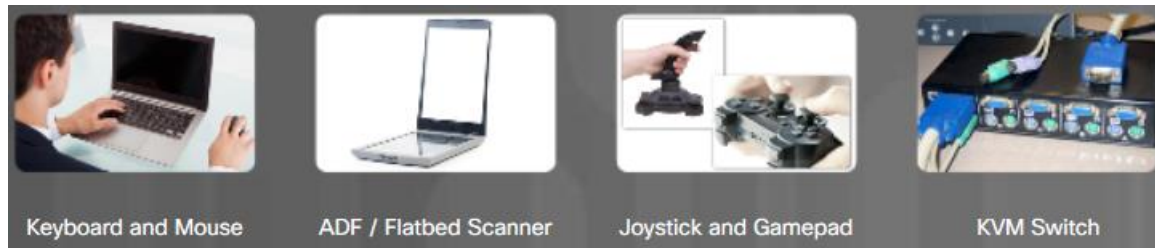
Adapters and Converters

- There are many connection standards in use today. These components are called adapters and converters:
 - **Converter** – performing the same function as an adapter but also translates the signals from one technology to the other.
 - **Adapter** – physically connecting one technology to another
 - Example of adapters include:
 - DVI to VGA Adapter
 - USB to Ethernet adapter
 - USB to PS/2 adapter
 - DVI to HDMI adapter
 - Molex to SATA adapter
 - HDMI to VGA converter



The Original Input Devices

- Input devices allow the user to communicate with a computer.
- Some of the first input devices include:
 - Keyboard and Mouse – these are the two most commonly used input devices
 - ADF / Flatbed Scanner – these devices digitize an image or document
 - Joystick and Gamepad – these devices are used for playing games
 - KVM Switch – a hardware device that can be used to control more than one computer while using a single keyboard, monitor, and mouse



New Input Devices

- Some new input devices include touch screen, stylus, magnetic strip reader, and barcode scanner:
 - **Touch screen** – input devices with touch or pressure sensitive screens
 - **Stylus** – a type of digitizer that allows a designer or artist to create artwork by using a pen-like tool
 - **Magnetic strip reader** – a device that reads information magnetically encoded on the back of plastic cards
 - **Barcode scanner** – a device that reads the information contained in the barcodes affixed to products



More New Input Devices

- A few newer input devices:
 - **Digital camera** – devices that capture digital images and videos
 - **Webcams** – video cameras that can be integrated into a computer
 - **Signature pad**– a device that electronically captures a person's signature
 - **Smart card reader** – a device used on a computer to authenticate the user. A smart card may be the size of a credit card with an embedded microprocessor that is typically under a gold contact pad on one side of the card.
 - **Microphone** – a device that allows a user to speak into a computer and have their voice digitized



Most Recent Input Devices

- The newest input devices include NFC devices and terminals, facial recognition scanners, fingerprint scanners, voice recognition scanners, and virtual reality headsets:
 - **NFC devices and terminals** – Near Field Communication (NFC) tap to pay devices
 - **Facial recognition scanners** – devices identifying a user based on unique facial features
 - **Fingerprint scanners** – devices identifying a user based on unique fingerprint
 - **Voice recognition scanners** – devices identifying a user based on unique voice
 - **Virtual reality headset** – used with computer games, simulators, and training applications with virtual reality functionalities.



What are Output Devices?

- An output device takes binary information from the computer and converts it into a form that is easily understood by the user.
- Examples of output devices include monitors, projectors, VR headsets, printers, speakers, and headphones.



Monitor



Projector



VR Headset



Printer



Speakers



Headphones

Monitors and Projectors

- Most monitors use one of three types of technology:

- Liquid crystal display (LCD)
- Light-emitting diode (LED)
- Organic LED (OLED)



Monitor

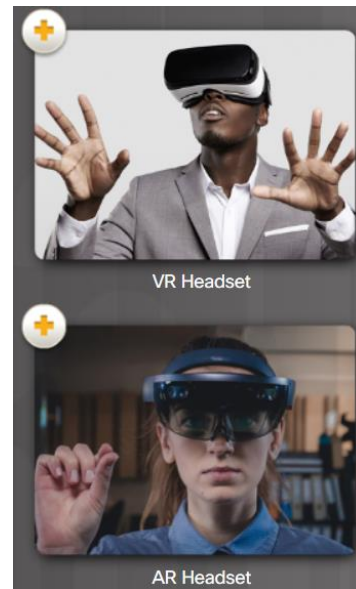


Projector

- Most video projectors use LCD or DLP technology.
 - DLP stands for Digital Light Processing
 - Different projectors have different numbers of lumens, which affects the level of brightness of the projected image.

VR and AR Headsets

- **Virtual Reality (VR)** uses computer technology to create a simulated, three-dimensional environment.
- A VR headset completely encases the upper portion of users' faces, not allowing in any ambient light from their surroundings.
- **Augmented Reality (AR)** uses similar technology but superimposes images and audio over the real world in real time.
- AR can provide users with immediate access to information about their real surroundings.
- An AR headset usually does not close off ambient light to users, allowing them to see their real life surroundings.



PC Components

Printers

- Printers are output devices that create hard copies of files.
- A hard copy might be on a sheet of paper. It could also be a plastic form created from a 3D printer.
- Different types of printers:
 - Inkjet, impact, thermal, laser, and 3D printers
 - Printers use wired or wireless connections
 - All printers require printing material (such as ink, toner, liquid plastic, etc.)
 - Printers use a driver to communicate with OS



Inkjet Printer



Impact Printer



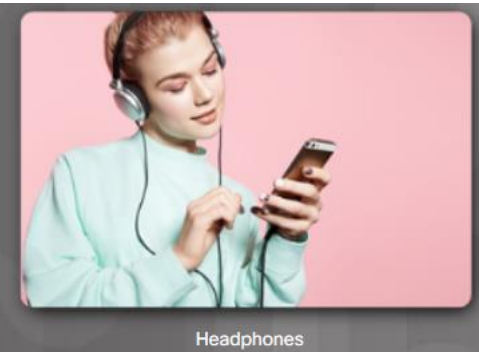
3D Printer



Thermal Printer

PC Components

Speakers and Headphones



- **Speakers** are a type of auditory output device.
- Most computers and mobile devices have audio support either integrated into the motherboard or on an adapter card.
- **Headphones**, earbuds, and the earphones found in headsets are all auditory output devices.
- These may be wired or wireless. Some are Wi-Fi or Bluetooth-enabled.

1.3 Computer Disassembly

Video Explanation – Technician's Toolkit

Video Explanation: Technician's Toolkit

In this video explanation, you will learn about the basic tools in a technician's toolkit:

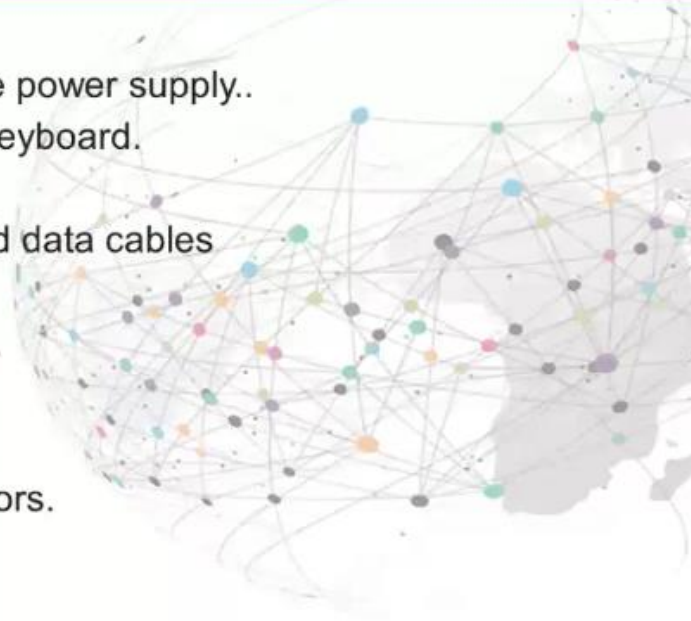
- Anti-static Wrist Strap and Mat
- Compressed Air
- Extraction Tool
- Phillips Head Screwdriver
- Torque Screwdriver
- Cable Tester
- Crimpers



Video Demonstration – Computer Disassembly

Video Demonstration: Disassemble a computer

- **Step 1:** Power off and disconnect the power supply..
- **Step 2:** Disconnect the mouse and keyboard.
- **Step 3:** Remove the case screws.
- **Step 4:** Remove the SATA power and data cables
- **Step 5:** Remove the hard drive.
- **Step 6:** Remove the optical drive.
- **Step 7:** Remove the adapter card.
- **Step 8:** Remove the power supply.
- **Step 9:** Remove front panel connectors.
- **Step 10:** Remove the RAM.



Lab – Disassemble a Computer

In this lab, you will disassemble a computer using safe lab procedures and the proper tools. Use extreme care and follow all safety procedures. Familiarize yourself with the tools you will be using in this lab.

Note: If you cannot locate or remove the correct component, ask your instructor for help.

1.4 Chapter Summary

Chapter 1: Introduction to Personal Computer Hardware

- Explain how to keep personal computer components safe.
- Explain the features and functions of computer components.
- Disassemble a computer.

