

## Computer

- a computer once meant a person doing math calculations; now it means a device that processes input into output

All computing devices contain common hardware:

- **Motherboard**
- **Central Processing Unit (CPU)**
- **Storage (RAM / Hard Drive)**
- **Video System**
- **Display Screen**

### BASIC COMPUTING CYCLE

- a four-step process devices use to handle instructions and tasks

#### STEPS

1. **Input** - Input is the first step of the cycle, where users (manually or automatically) give commands to the computer.
2. **Process** - the computer processes input using the CPU to calculate, think, or make decisions
  - > **Central Processing Unit**
    - executes instructions and processes data
3. **Storage** - computer keeps information and CPU relies on storage when handling large data
  - **Random Access Memory (RAM)**
    - short-term storage
  - **Hard Drive**
    - long-term storage

#### TYPES OF STORAGE

- **Volatile** - keep information as long as the device or computer has power
  - **Non-volatile** - keep information whether the device has power or not
4. **Output** - the computer outputs results through a screen, speakers, or print

## Computing Devices

### DEVICE TYPES

- **Desktop** - are larger PCs made to sit on a desk and are easy to upgrade
  - > **All-in-one** - combine hardware and display in one device but are harder to upgrade or repair
- **Notebook/Laptop** - are compact, lightweight, energy-efficient devices that run on AC power or batteries but are harder to repair or upgrade

- **Hybrid Laptop** - also called 2-in-one laptops can function as both laptops and tablets, with touchscreens and removable or built-in keyboards
- **Server** - are powerful computers with advanced CPUs, more RAM, and large storage, used to store data or provide network services
  - they differ from regular computers mainly by their operating system
- **Handheld** - tablets are battery-powered mobile devices with OS made for mobile apps
  - eReaders are similar but optimized for reading, with long battery life and large storage for books, though less powerful than tablets
- **Gaming Device** - gaming consoles are computers with powerful GPUs and fast RAM made for games
  - they reduce CPU workload and include built-in networking features

### INTERNET OF THINGS (IoT)

- IoT devices use sensors and software to connect and share data over networks, ranging from home gadgets to industrial systems

#### Examples of IoT Devices

- **Smart Camera**
- **Doorbell**
- **Smart speakers**
- **Smart TV**
- **Smartwatch**
- **Smart refrigerator**
- **Smart dog feeder**
- **Smart wearables**

#### IoT Functions

- for a device to be considered truly IoT, it must perform four functions

<b>Collect information using sensors</b>	<ul style="list-style-type: none"> <li>• Chemical sensors</li> <li>• Gas sensors</li> <li>• Gyroscope sensors</li> <li>• Humidity sensors</li> <li>• Image sensors</li> <li>• Infrared sensors</li> <li>• Light sensors</li> <li>• Magnetic sensors</li> <li>• Motion sensors</li> <li>• Pressure sensors</li> <li>• Proximity sensors</li> <li>• Sound sensors</li> <li>• Temperature sensors</li> <li>• Touch sensors</li> <li>• Vibration sensors</li> </ul>
<b>Process information sent by sensors</b>	IoT devices need network or Internet access to process data locally or send it to a server
<b>Store information</b>	IoT devices store information locally or in the cloud
<b>Output information</b>	IoT devices show information through apps or displays, letting users adjust settings or monitor data

Everyone who connects is a **Digital citizen**

### Different types of users

- **Personal Users** - create content, manage and organize information, and serves as a communication tool
- **IT Professionals** - develop applications, configure networks, secure networks, and troubleshoot
- **Animators** - make ideas come to life through graphic design, animation, video editing, vfx, develop games, etc.

### Digital Citizenship Guide

- **Digital Commerce**  
Be respectful and always have permission before you hit "buy"
- **Digital Downtime**  
Remember to digitally disconnect and spend time with others
- **Digital Etiquette**  
Apply real world behavioral standards to the digital world
- **Digital Health**  
Know when to stay connected and when to turn off devices
- **Digital Integrity**  
Examine the source of online information to determine credibility
- **Digital Literacy**  
Avoid suspicious emails, websites, and online advertisements
- **Digital Privacy**  
Review privacy settings, know what to share and with whom
- **Digital Responsibility**  
Report problems, abusive behavior, and inappropriate images or content
- **Digital Security**  
Make passwords easy to remember, but hard to guess

### Personal Identifiable Information (PII)

- data is information being processed or saved in digital form on a computer
- **Direct Personal Identifiable Information (PII)** - information that can identify an individual
  - **Full Name**
  - **Birthdate**
  - **Social Security Number**
  - **Passport Number**
- **Indirect Personal Identifiable Information** - information that is not unique to a single individual but is important to keep private
  - **Zip code**
  - **Gender**
  - **Race**
  - **Employer**
- **Threat Actor** - people or groups who use someone's personal information for harmful purposes
- **Identity Fraud** - when someone uses another person's information to pretend to be them and steal money, buy things, or get credit

### Data Collection

- companies often collect data legally for marketing, but some people or groups misuse PII for illegal purposes
- **Algorithm** - a step-by-step set of instructions that solves a problem by turning input into output
- **Analyzing Data** - algorithms analyze data from online activity to find patterns and insights, enabling large-scale analysis beyond human ability
- **Masking Data** - hides sensitive data to keep it private and secure from unauthorized access or exposure
- **Cookies** - cookies are data stored on a user's device by websites to remember logins, preferences, and activity, improving the browsing experience

- **Monetizing Data** - turning data into a business asset through sales, ads, licensing, or data-driven decisions
- **Data Broker** - businesses that collect, sort, organize, and sell information.

### HOW COMPANIES USE YOUR DATA

- **Targeted Marketing** - presenting content for a specific user based on interests and demographics
- **Data Brokering** - selling data to other companies

### COOKIES

- Store login credentials
- Remember user preferences
- Track user activity
- Build user profiles for targeted marketing

### BAD COOKIES

- Steal login credentials
- Add malicious scripts to trusted sites
- Track users across multiple sites and build profiles

### Privacy in Communications – Texting

- **Short Message Service (SMS) Protocol**
  - sent through cell service in plaintext
- **Instant Messaging (IM) Apps**
  - sent through the internet
  - some with end-to-end encryption

### Privacy in Communications – Email and FTP

- **Short Message Service (SMS) Protocol**
  - sends plaintext messages
  - allows for encryption, one email at a time
- **File Transfers – File Transfer Protocol (FTP)**
  - FTP: not secure
  - Use secure FTP (SFTP) for all file transfers

## Privacy in Artificial Intelligence (AI)

- internet as knowledge
- AI and PII

## Privacy Regulations

FEDERAL	STATE	EUROPEAN
<b>HIPPA</b> Medical records	<b>CCPA</b> California Consumer Privacy Act	<b>GDPR</b> General Data Protection Regulation
<b>FCT Act</b> Unfair or deceptive marketing	<b>New York SHIELD Act</b>	
<b>FERPA</b> Student records privacy		

## Social Media Privacy

- social media helps people stay connected and allows businesses to market products, but it also attracts malicious users
- understanding how to stay safe online is therefore essential

Safety Tips	Steps You Can Take
<b>Review your privacy settings</b>	limit profile visibility to friends or private, and adjust ad settings to reduce data use for targeted ads
<b>Be mindful of what you share</b>	don't share sensitive details, disable location services, and check that photos or videos don't reveal personal information or locations
<b>Clean up your friends list(s)</b>	remove individuals you no longer want to share information with.
<b>Be cautious of quizzes and games</b>	be cautious with apps like quizzes and games, as they may collect and access your personal data
<b>Understand a platform's privacy policy</b>	read and understand privacy policies to know how your personal data is collected, used, and shared before signing up
<b>Review your activity regularly</b>	regularly monitor your accounts for suspicious activity using the security tools provided by the sites

## Encrypting Data

### Encryption Methods

- **Symmetric** – uses one key to encrypt and decrypt
- **Asymmetric** – uses different keys to encrypt and decrypt

### Secure Protocols

- HTTPS
- SSL/TLS
- SSH I

### VPN

- Virtual private network
- Also called “tunneling”

## HOW DO YOU CREATE A STRONG PASSWORD?

### Authentication

- factor(s) that prove you are who you claim to be

### Authentication Factors

- something you know
- something you have
- something you are

### Passphrases

- long
- complex
- memorable

## HOW OFTEN SHOULD YOU CHANGE A PASSWORD?

### High-Security Accounts

- Every 60-90 days

### General Accounts

- Every 6-12 months

### Security Breach

- Immediately

### Employer Accounts

- Company policy

## Strong Passwords

- creating strong passwords is essential for protecting your online accounts from unauthorized access

Safety Tips	Steps You Can Take
Use a long password	use strong passwords with at least 12–16 characters for better security
Include a mix of characters	create passwords using a mix of uppercase and lowercase letters, numbers, and special characters
Avoid common words and phrases	avoid using easily guessed words, phrases, or patterns like "password" or "secretpassword"
Do not use personal information	don't use personal details like your name, birthdate, or address in passwords
Create a unique password for each account	create a different password for every account so a single breach doesn't put all your accounts at risk
Use passphrases	use a passphrase made of random words or a memorable sentence that's easy for you to recall but hard to guess
Avoid predictable patterns	Avoid predictable patterns like "abcd1234" or keyboard sequences such as "qwerty"
Regularly update passwords	update your passwords regularly, especially if you suspect an account has been compromised

## What is the Internet?

- a global network of connected computers and servers that exchange data using standard protocols, enabling activities like browsing, emailing, and streaming

### NO SINGLE ENTITY:

- Governs it
- Manages it
- Maintains it
- Grows it

## How did Internet start?

- began in the 1960s as a U.S. Department of Defense project to build a decentralized communication network
- DARPA worked with four universities to create ARPANET, the first packet-switching network and precursor to today's internet

## Basic Internet Terms

<b>Protocols</b>	the internet uses protocols, rules and standards that ensure data is transmitted accurately and efficiently
<ul style="list-style-type: none"> <li>• TCP/IP Protocols</li> <li>• TCP-Transmission control protocol</li> <li>• IP- Internet protocol</li> </ul>	TCP/IP protocols are the standard that enable different networks to connect and communicate, forming the foundation of the modern internet
<b>World Wide Web</b>	often mistaken for the internet, is a system of linked documents and resources accessed through browsers, using HTTP for communication between servers and clients
<b>Web Browser</b>	is software that lets users access and interact with content on the World Wide Web, such as websites and multimedia. (ex. Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, and Opera)
<b>Client</b>	a device or software that requests and uses resources or services from another device or application called a server
<b>Server</b>	a powerful computer or software that delivers services, resources, or data to other computers or applications called clients
<b>Client/Server Model</b>	a fundamental concept in networking, where clients and servers interact to perform various tasks Examples: <ul style="list-style-type: none"> <li>• A web browser (client) requests web pages from a web server.</li> <li>• An email client retrieves and sends emails through an email server.</li> <li>• A file transfer client uploads and downloads files from an FTP server.</li> </ul>

## Web Pages and Websites

- **World Wide Web** - web resources identified by Uniform Resource Locators (URLs)
- **Hypertext Markup Language (HTML)** - organizes everything you see on a web page
- **Hypertext Transfer Protocol (HTTP)** - the protocol that allows clients and servers to communicate
- **Web Server** - software and hardware that use HTTP to respond to client requests made over the internet

### WEB BROWSERS

- Applications used to access web content
- Uses HTTP and HTTPS protocols
- Interprets HTML, CSS, and JavaScript to display:
  - Text
  - Images
  - Multimedia
  - Interactive elements

## Using a Web Browser

- **Add Functionality** - extensions add specific capabilities or features
- **Privacy Concerns** - use caution with extensions that collect data
- **Download from Trusted Sites Only** - avoid downloading extensions from third-party sites

### MAINTAIN YOUR BROWSER

- Update your browser regularly
- Clear the cache and cookies
- Manage extensions and plugins
- Use strong, unique passwords
- Review your privacy settings regularly
- Backup bookmarks and settings
- Be cautious about downloads

## Think Before You Click

- a great tool for sharing and learning, but safe use requires caution and best practices always "think before you click"

- **Use trusted engines** - use trusted search engines like Google, Bing, or DuckDuckGo, as they offer strong security protections
- **Verify URLs** - check website URLs carefully for misspellings or odd domains to avoid phishing, and make sure the site uses HTTPS with a padlock icon for a secure connection
- **Avoid clicking on ads** - avoid clicking on ads or sponsored links since they may lead to malicious sites. Prefer organic search results and consider using an ad blocker for added safety
- **Enable safe search features** - enable the "Safe Search" feature on search engines to filter out explicit or harmful content for safer browsing
- **Hover to preview** - hover over links to preview their URL before clicking, and be cautious with shortened links like bit.ly, use URL expanders to reveal their full destination
- **Use trusted sources** - download files only from trusted websites, avoid unverified sources, and scan downloads with antivirus software before opening
- **Use strong passwords** - use long, complex passwords with upper and lower-case letters, numbers, and alternate characters
- **Keep browsers updated** - ensure your web browser is up to date with the latest security patches
- **Educate yourself** - keep up to date with the latest internet safety tips and best practices

### Internet Service Provider (ISP)

- a company that supplies internet access using infrastructure like cables, satellites, and servers, enabling individuals and businesses to connect online
- **ISPs offer subscription internet plans**
- **Plans differ based on bandwidth and speed**

- **ISPs provide:**
  - Internet access
  - IP addresses
  - Infrastructure
  - Customer premises equipment (CPE)

### EXAMPLES:

- Comcast (Xfinity): A major cable internet provider in the United States
- AT&T: Offers DSL, fiber-optic, and wireless internet services
- Verizon: Provides fiber-optic (Fios) and wireless internet services
- Spectrum: A cable internet provider serving various regions
- CenturyLink: Offers DSL and fiber-optic internet services
- BT (British Telecom): A major ISP in the United Kingdom

### Internet connection types

- **Dial-Up:** An older technology that uses telephone lines to connect to the internet. It is slow compared to modern options
- **DSL (Digital Subscriber Line):** Uses existing telephone lines to provide internet access. It's faster than dial-up but slower than fiber-optic connections

**Equipment:** Telephone wire, modem, router

**Speed:** 5 – 30 Mbps (Rarely up to 100 Mbps)

**Latency:** 20 – 50 ms

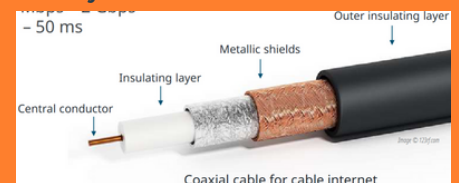


- **Cable:** Uses coaxial cable lines (the same used for cable TV) to provide high-speed internet access

**Equipment:** Coaxial cable, modem, router

**Speed:** 10 Mbps – 2 Gbps

**Latency:** 1 – 50 ms



- **Fiber-Optic:** Uses fiber-optic cables to deliver extremely high-speed internet. It offers the fastest and most reliable connection

**Equipment:** Fiber optic cable, router

**Speed:** 100 Mbps – 25 Gbps

**Latency:** 10 – 25 ms



## Internet connection types



Strand of fiber optic cable

- **Satellite:** Provides internet access via satellites. It is useful in remote or rural areas where other types of connections are unavailable

### Satellite Internet

- Satellite dish, modem, router
- Speed: 3 – 250 Mbps
- Latency: 100 ms and over
- Possible data caps
- Bad weather can affect the signal

### Fixed Wireless Internet

- Antenna, modem, router
- Speed: 1 – 30 Mbps
- Latency: 20 – 60 ms
- Direct line of sight of the cell tower
- Not affected by bad weather
- Cost may be higher

- **Wireless:** Includes mobile broadband (using cellular networks) and fixed wireless (using radio signals) to provide internet access

### Cable Internet

- Coaxial cable, modem, router
- Speed: 10 Mbps – 2 Gbps
- Latency: 1 – 30 ms
- Widely used in homes and small businesses
- Most popular way to connect to the internet

### DSL Internet

- Telephone line, modem, router
- Speed: 5 – 30 Mbps (Rarely up to 300 Mbps)
- Latency: 20 – 50 ms
- Modem may need to be near a window

### Fiber Internet

- Fiber optic cable, router
- Speed: 100 Mbps – 25 Gbps
- Latency: 10 – 25 ms
- Uses light to carry information
- EMI immunity
- Longer lifespan than wire cabling

### Wireless Internet

- Modem, router
- Downloads: 40 – 300 Mbps
- Uploads: 10 – 50 Mbps
- Latency: 1 – 30 ms
- Electrical outlet
- No cables
- Modem may need to be near a window

## Latency

the time it takes for data to travel across a network, affecting internet speed and responsiveness

## Bandwidth

the maximum data transfer rate of an internet connection, usually measured in Mbps or Gbps



## Cybersecurity

- the practice of protecting systems, networks, and data from attacks that aim to steal, alter, destroy information, extort money, or disrupt operations

## CIA Triad

- a core cybersecurity model that guides strategies to protect information and systems

## SECURITY STRATEGIES/SYSTEM

### CONFIDENTIALITY

- Definition: Ensuring that information is accessible only to those authorized to have access.
- Objective: Protect sensitive information from unauthorized access and disclosure.
- Methods: Encryption, access controls, authentication mechanisms, and data masking.

### INTEGRITY

- Definition: Ensuring the accuracy and completeness of data and that it has not been tampered with or altered.
- Objective: Maintain the trustworthiness and reliability of data.
- Methods: Hashing, digital signatures, checksums, and version control systems.

### AVAILABILITY

- Definition: Ensuring that information and resources are available to authorized users when needed.
- Objective: Ensure that systems and data are accessible and operational as required.
- Methods: Redundancy, failover mechanisms, regular maintenance, and robust disaster recovery plans.

### NON-REPUDIATION

## Key components of cybersecurity

Network security	protects data in transit
Information security	protects stored data
Application security	secures apps / software lifestyle
Operational security	processes for protecting data
End-user education	teaches users to avoid threats
Disaster recovery and business continuity	plans to restore after incidents

## Authentication

- the process of verifying the identity of a user, device, or entity to ensure only legitimate access, often using a username and password

## Multi-Factor Authentication

- enhances security by requiring two or more verification methods before granting access to a system, application, or data
  - Something You Know: password or PIN.
  - Something You Have: a smart card, security token, or mobile device.
  - Something You Are: fingerprints, facial recognition, or iris scans

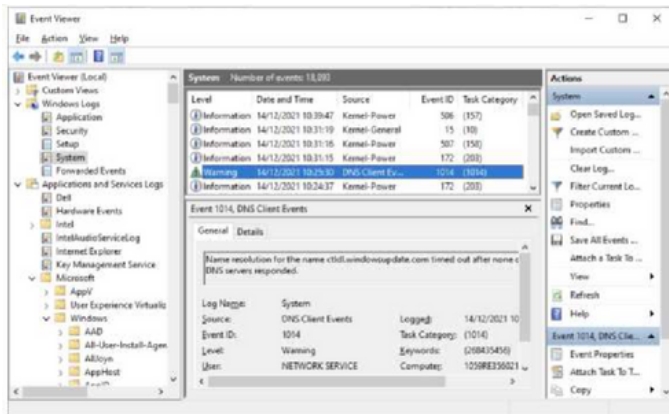
## Authorization Factors

### PERMISSIONS

Resource	Branch Manager	Broker or Salesperson	Customer Service Representative
Corporate financials	Read	Read	No permission
Customer deposits	Read Write	Read	Read Write

Software to tabulate cash transactions	Read Execute	No permission	No permission
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## Accounting and Tracking



## WINDOWS EVENT VIEWER

Shows:

- Multiple audit logs
- Thousands of events in this check-up

## Common Security Threats

- **Threat Actor** - person/group causing risk
- **Social Engineering** - tricks people to reveal info
- **Phishing** - fake emails steals data
- **Smishing** - phishing via SMS
- **Shoulder Surfing** - peeking at log in info
- **Tailgating** - sneaking in with employee
- **Lunchtime Attack** - using unattended device

## Malware

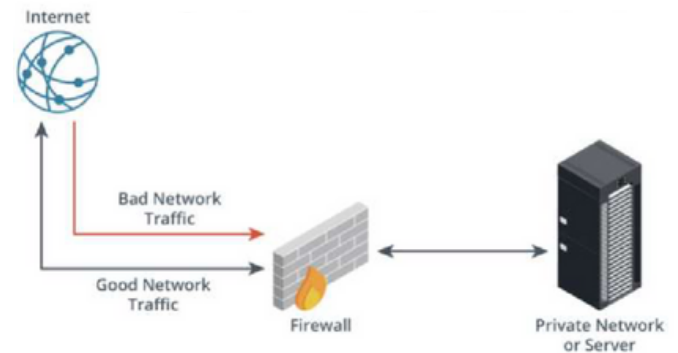
- is designed to harm computers or networks and often activates through user actions like clicking links, opening files, or email attachments

## MALWARE & SPYWARE

- **Viruses** - infects, spreads, damages
- **Worms** - self-replicates, spreads
- **Trojans** - disguised, tricks, installs
- **Ransomware** - encrypts, locks, demands
- **Backdoors** - hidden, bypasses, controls
- **Spyware** - monitors, steals, reports
- **Adware** - shows unwanted ads
- **Keylogger** - records keystrokes

## Security Tools & Software

- modern networks use advanced software and hardware security tools to protect against threats and maintain data CIA



- in cybersecurity, a firewall is a barrier between the Internet and your network

<b>Firewall</b>	filters traffic in and out
<b>Proxy Server</b>	hides user identity online
<b>Antivirus</b>	detects and removes malware
<b>Software Patches</b>	fix bugs and vulnerabilities

## Software Patching and Updates

- **Operating System Patching & Updates** - fixes, secures, improves
- **Application Patching & Updates** - updates, protects, enhances
- **Patch Management** - tracks, applies, verifies

## Number Systems

- when working with computer networks, it's important to understand the following number systems

- **Decimal:** Used to describe data flow speeds or the amount of data storage.
- **Binary:** The fundamental language of computers, it is used to encode data and instructions.
- **Hexadecimal:** Hexadecimal is used in computing because it provides a format that can be more understood by people to represent binary values.

## Binary vs The Decimal System

- Humans count in the Decimal System (numbers 0-9)
- Computers process, transmit, and store data using 1s and 0s
- 1s and 0s represent the Binary system
- A single binary digit is known as a bit

### BINARY BASICS

- It takes a lot of 1s and 0s (a lot of bits) to store or transmit data.
- There are 8 bits in one byte.
- It takes 1 byte to store one character (e.g., a letter, number, or symbol) on a computer.

### BINARY vs STORAGE

- **1024 bytes = 1 kilobyte (KB)** - spreadsheets and documents often measured in KB
- **1024 KB = 1 megabyte (MB)** - audio files like MP3 are often measured in MB
- **1024 MB = 1 gigabyte (GB)** - thumb drives are often measured in GB
- **1024 GB = 1 terabyte (TB)** - hard disk and solid state drives are often measured in TB

## Decimal System (Base 10)

- also called "base 10"
- it is built around ten unique digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10
- each digit can be 0 to 9

- values of the places or positions of the numbers are based on powers of 10
- each number position is 10 times the value to the right of it, thus the term base 10

### EXAMPLE: 10101010

Ten-million	One-million	Hundred-thousand	Ten-thousand	One-thousand	Hundred	Tens	Ones
$1 \times 10,000,000 = 10,000,000$	$0 \times 1,000,000 = 0$	$1 \times 100,000 = 100,000$	$0 \times 10,000 = 0$	$1 \times 1,000 = 1,000$	$0 \times 100 = 0$	$1 \times 10 = 10$	$0 \times 1 = 0$
Total Value ( $10,000,000 + 0 + 100,000 + 0 + 1,000 + 0 + 10 + 0$ )							10,101,010

## Binary System (Base 2)

- also called "base 2"
- it is built around two unique digits: 0 and 1
- each digit can only be a 0 to 1, depending on its place
- values of the places or positions of the numbers are based on powers of 2
- each number position is 2 times the value to the right of it, thus the term base 2

### CONVERT DECIMAL INTO BINARY

to convert decimal (base 10) into binary (base 2), insert it into this chart.

128	64	32	16	8	4	2	1
Digit x 128	Digit x 64	Digit x 32	Digit x 16	Digit x 8	Digit x 4	Digit x 2	Digit x 1

### EXAMPLE: 10101010 into decimal form

128	64	32	16	8	4	2	1
$1 \times 128 = 128$	$0 \times 64 = 0$	$1 \times 32 = 32$	$0 \times 16 = 0$	$1 \times 8 = 8$	$0 \times 4 = 0$	$1 \times 2 = 2$	$0 \times 1 = 0$
Decimal (Base 10) ( $128 + 0 + 32 + 0 + 8 + 0 + 2 + 0$ )							170

### EXAMPLE: To convert 172 into binary, you work left to right, subtracting each value.

128	64	32	16	8	4	2	1
1	0	1	0	1	1	0	0

- 128 could be deducted from 172, so a 1 is entered in the 128 place. ( $172 - 128 = 44$ )
- 64 cannot be deducted from 44, so a 0 is entered in the 64 place. (44)
- 32 can be deducted from 44, so a 1 is entered in the 32 place. ( $44 - 32 = 12$ )
- 16 cannot be deducted from 12, so a 0 is entered in the 16 place. (12)
- 8 can be deducted from 12, so a 1 is entered in the 8 place. ( $12 - 8 = 4$ )
- 4 can be deducted from 4, so a 1 is entered in the 4 place. ( $4 - 4 = 0$ )
- No value remains, so a 0 is entered in the 2 and the 1 places.

## Hexadecimal Numbers

### HEXADECIMAL (BASE -16) DIGITS:

- 0 - 9
- A - F

C3 AC P9 8F 50h 6G 8B R50 DE

## Why do we network computers?

- computer networks provide resource sharing and collaboration
- **Resource Sharing** - networks enable efficient sharing of information and resources like printers and data storage among multiple users
- **Collaboration** - networks support collaboration and communication among team members, whether they work remotely or in the same location

## What is a network?

- a computer network is made up of interconnected devices, or nodes, such as computers and servers, ranging from small local setups to large global systems

## What Does a Network Do?

- **Network Media** - pathways that connect computers
- **Network Interface** - the point where two different systems interact
- **Network Protocols** - a set of standards and protocols that serve as a common language

## Common Networking Terminology

<b>Node</b>	devices like computers, servers, and printers connected to the network
<b>Host</b>	a client computer or a server
<b>Transmission Media</b>	physical pathways in a network are the cables or connections that transmit data between devices

<b>Protocols</b>	Rules and standards that govern data transmission, such as TCP/IP (Transmission Control Protocol/ Internet Protocol).
<b>Local Area Network (LAN)</b>	a network that covers a small geographic area, such as a single building or campus
<b>Wide Area Network (WAN)</b>	a network that spans a large geographic area, often connecting multiple LANs
<b>Personal Area Network (PAN)</b>	a network for personal devices, often connected using Bluetooth, that is typically within a range of a few meters.
<b>Port numbers</b>	used to uniquely identify connection endpoints and differentiate services or processes on a device, such as port 80 for web servers

## NEW PORTS

- assign unique identifiers to different types of connection to keep interactions organized

Port Number	Name	Definition
21	File Transfer Protocol (FTP)	Standard protocol used for moving files between computers
22	Secure Shell (SSH)	Provides for secure communication between devices
23	Telnet	Provides for unsecure communication between devices
25	Simple Mail Transfer Protocol (SMTP)	Used for sending email. However, it has been deprecated in the last decade
53	Domain Name System (DNS)	Provides a translation between friendly domain names and IP addresses
80	Hypertext Transfer Protocol (HTTP)	Provides communication standards for clients and servers on the World Wide Web
110	Post Office Protocol version 3 (POP3)	Used by email programs for incoming email
143	Internet Message Access Protocol (IMAP)	Used most commonly for receiving email
443	Hypertext Transfer Protocol Secure (HTTPS)	Establishes encrypted communication between clients and servers on the World Wide Web
587	Simple Mail Transfer Protocol (SMTP)	Used for outgoing email

## Common Networking Devices

<b>Switches</b>	switches connect devices in a LAN and use MAC addresses to direct data
<b>Routers</b>	routers connect different networks and direct data between them, enabling internet access
<b>HUBs</b>	hubs connect multiple Ethernet devices into one network segment but are largely replaced by switches
<b>Modems</b>	modems convert digital and analog signals for data transmission over phone, cable, or satellite lines, allowing internet access
<b>Wireless Access Points (WAPs)</b>	devices that allow wireless devices to connect to a wired network using Wi-Fi

## Network Addresses

- **Ethernet** - as the foundational connection system, including physical components such as cables, network interface cards (NICs), and unique identifiers known as MAC addresses.
- **TCP/IP** - a suite of software protocols that enable devices to communicate seamlessly by speaking the same "language." IP addresses identify and route data between devices.
  - Logical address
  - IPv4
  - IPv6
- **MAC address**
  - Physical address
  - Burnt-in-address
- **Dynamic Host Configuration Protocol (DHCP)**
  - Auto configuration
  - Static configuration

## MAC and IP ADDRESS SPECIFICS

- **MAC Address (Media Access Control)**
  - a unique identifier assigned to a device's network adapter interface card (NIC)
  - it identifies devices within a local network
  - globally unique, no two devices share the same MAC address
  - 48 bits long, written as 12 hexadecimal digits
- **IP address**
  - a unique numerical identifier for devices on a network
  - it enables device identification and data routing across networks
  - it's a logical address, assigned by a network administrator
  - Two types: IPv4 (32-bit, decimal) & IPv6 (128-bit, hexadecimal)
  - unlike MAC addresses, IP addresses can be changed

## WHY DO WE NEED TWO ADDRESSES?

- MAC addresses handle accurate data delivery within a local network
- IP addresses route data between different networks for global communication
- together, they form a complete addressing system for local and worldwide data transfer
- analogy: MAC addresses are like the flight stops (Texas, Atlanta) that guide the journey, while the IP address is the final destination (New York)

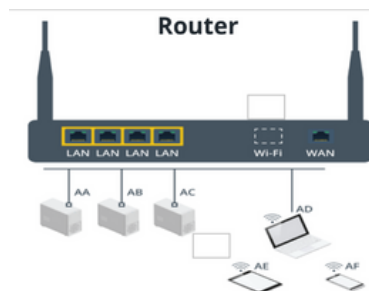
## How Networks Work

### Networking Models

- **Client-Server** - client requests information and server fulfills requests
- **Peer-to-Peer** - act as both a client and a server



### Local Area Networks (LAN)



- all devices have unique names or identifiers
- desktop computers connect directly to the router using cables
- mobile devices connect to the network with Wi-Fi

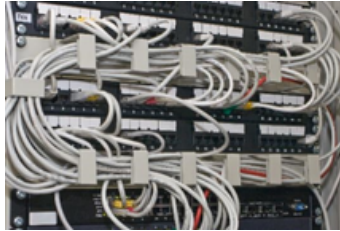
### Wide Area Network Types

- **WAN (Leased connection)**
  - Extends over a large geographical area
- **The internet**
  - Links millions of smaller networks
- **VPNs**
  - Secure connection between your device and the internet



**Networking Devices**

- **Modem**
  - Translates signals from an ISP to devices
- **Router**
  - Connects different networks
- **Switch**
  - Connects multiple devices
- **Firewall**
  - Monitors and controls network traffic

**Wired Network Connectors**

- **Twisted Pair**
  - Pairs of wires twisted together to minimize crosstalk
- **Standards**
  - 568A
  - 568B
- **JR45**
  - Standardized connector

**Wireless Network Connectors**

- **Wireless Access Point (WAP)**
  - Allows wireless devices to connect to a wired network
- **Wireless Local Area Network (WLAN)**
  - Uses wireless to connect devices within a limited area

**Small Wireless Network Specifications****Wireless Network Standards**

- **Modulation**
  - Data riding a carrier
- **802.11 Standards**
  - Compatibility
- **Wireless Security**
  - Encryption for data in transit

**Wireless Network Speed**

- **Latency**
  - Lag time or delay
- **Interference**
  - Other signals
  - Physical interference
- **Distance from WAP**
  - Attenuation

**Wireless Band Options**

- **2.4 GHz**
  - Longer range
  - Better through walls
- **5 GHz**
  - Higher data speeds
  - Less crowded
- **Hertz (Hz)**
  - Measurement of cycles per second (e.g., wave or signal)

**Virtualization on the Network****What is Virtualization?**

- **Virtualization**
  - Computers in computers
- **Virtualization Requirements**
  - Computer
  - Hypervisor or Virtual Machine (VM)
    - Type I hypervisor
    - Type II hypervisor
  - Guest Operating Systems

**Hypervisors and Guest Operating Systems**

- **Hypervisor**
  - Software that manages hardware
- **Type 1 Hypervisor**
  - Runs on Computer's hardware; bare metal installation
- **Type 2 Hypervisor**
  - Runs on top of host operating system; opposite of bare metal

**Hardware and Virtual Machines (VMS)**

- **Container Virtualization**
  - Portable software packages
  - Allows several apps to run simultaneously
- **Virtual Servers**
  - Software-based server
  - Allows multiple servers to run on a single physical machine

## Software

- software is a set of coded instructions that direct a computer to perform specific tasks

### Common Software Types

- **Web Browser** - it displays internet content such as text, images, links, and videos.
- **Email Software** - a way to send and receive digital messages over the internet using email addresses
- **Messaging Software** - a method for instantly sending and receiving text messages, photos, and files via mobile or internet
- **Productivity Software** - a type of software that helps create, edit, manage, and share documents, data, and presentations to improve productivity
- **Collaboration Software** - video conferencing enables real-time communication through video, while online storage allows saving and sharing files over the internet
- **Work Management Software** - a digital tool that helps manage tasks and projects through scheduling, tracking, collaboration, and reporting to boost productivity and efficiency
- **Remote Assistance Software** - software that lets users access and control a computer remotely over a network or the internet
- **Word Processing Software** - a type of application software designed for the creation, editing, formatting, and storing of data in tabular form
- **Spreadsheet Software** - a type of application software designed for organizing, analyzing, and storing data in tabular form
- **Presentation Software** - a type of application software used to create, edit, and display visual presentations
- **Diagramming and Graphics Software** - diagram applications create and edit diagrams, while image and video editors enhance and modify visual and audiovisual content

## Productivity Software

- Word Processing
- Spreadsheets
- Presentations

### Common Software Types

- **Video conferencing**
  - Real-time video and audio
- **File storage and sharing**
  - Google Drive
  - Microsoft One Drive
  - Apple iCloud

### Remote Assistance Software

- **Remote desktop software**
  - Remotely access and control another computer

### Diagramming and Editing Software

- **Diagramming**
  - Use for charts, diagrams, team brainstorming, and more
- **Image and Video Editing**
  - Photo and video editing and special effects
- **Audio Editing**
  - Noise removal, pitch correction, reverb effects

## Safely Managing Software

- **Trusted Site** - a trusted website or platform that offers safe, legal, and secure software downloads, protecting users from malware and threats
- **Reputable app stores** - trusted platforms like the Apple App Store, Google Play Store, and Microsoft Store ensure app safety through strict security checks and vetting
- **Software company sites**

### Software Licensing

- **End User License Agreement (EULA)** - a legal agreement between the software developer and the user that defines the terms, conditions, and restrictions of software use



- **Subscription Model** - where users pay a recurring (monthly or annual) fee to access and use the software
- **Open-Source vs Proprietary** - a software chosen based on organizational needs that offers freedom, transparency, and community-driven development, allowing users to modify and share it

### Software Installation

- **Installing Software** - the process of setting up software on a device to ensure it integrates with the operating system and functions properly
- **Removing Software** - the process of deleting a software application and its data from a device to free up resources and prevent system interference
- **Mobile Applications** - installing a mobile app is simple, though steps differ slightly between Android and iOS devices

### Installing and Uninstalling Software

INSTALLING	UNINSTALLING
1. Open the program download.	<b>MAC</b> 1. Find the program you don't need. 2. Drag it to the trash.
2. Read and agree to the license.	<b>Windows</b> 1. Go to Settings > Apps. 2. Find the program you don't need. 3. Click the three dots on the right. 4. Choose uninstall.
3. Decide where to install.	
4. Click to begin installation.	
5. You may need to restart.	

### The CompTIA Troubleshooting Methodology

1. Identify the problem
2. Establish a theory of probable cause
3. Test the theory
4. Establish a plan of action to resolve the issue
5. Implement the plan or escalate the issue
6. Confirm the solution works
7. Document findings

### Step 1: Identify the Problem

- Ask questions:
  - What isn't working?
  - When did it start?
- Check for error messages.
- Observe what happens when you try to use the computer.
  - Can you replicate the issue?

### Step 2: Establish a Theory of Probable Cause

- What might be causing the problem?
  - Even obvious causes like, "Is it plugged in?"
- Consider recent changes or updates.
- Make a list of possible causes.

### Step 3: Test the Theory

- Test your ideas one at a time.
- See if you can fix the issue.
  - Which might result from testing.
- If not, move to the next idea.

### Steps 4 and 5: Establish a Plan and Implement the Fix

- Create a plan with the steps to fix the issue.
- Get approval if needed.
- Back up important data.
- Fix the issue by implementing the plan or escalate the issue.

### Step 6: Confirm the Solution Works

- Confirm that the problem is really fixed.
- Test the computer to make sure everything works.
- Implement preventative measures if needed.
  - Keep the problem from reoccurring.

### Step 7: Document Your Findings

- Record the issue and describe how you fixed it.
  - This helps you and others in the future.
- Many companies maintain a knowledge base, where technicians document their work.

## Operating System

- a software that manages a computer's hardware and software resources, serving as a bridge between the user and the hardware

### Five Basic Functions of an OS

1. **Manage communication with hardware**
  - an OS uses driver software to communicate and control system hardware effectively
2. **Provide a user interface** - an OS provides an interface that allows users to interact with the computer and issue commands
3. **Provide a file system to store data** - the OS organizes files and directories, providing a structured way to store and retrieve data
4. **Provide a platform for applications** - an OS offers a stable platform that allows applications to run smoothly and consistently
5. **Offer system security for data** - the OS ensures security by managing user access, authentication, and permissions to prevent unauthorized use

### Types of Operating Systems

- **Mobile Operating Systems**
  - designed for smartphones and tablets
  - Examples: Android, iOS (iPhone and iPad)
- **Desktop Operating Systems**
  - used for personal computers and laptops
  - Examples: Windows, Linux, macOS
- **Server Operating Systems**
  - designed to manage and support multiple users, data, and network applications
  - Examples: Windows Server, Linux Server
- **Embedded Operating Systems**
  - manage hardware and software in specialized devices with limited functions
  - built for specialized devices with specific hardware and limited functions

- found in cars, planes, home devices, smartwatches, and cash registers
- designed for specific, resource-limited tasks

### Types of Operating System Software

- **Open-Source Operating System**
  - source code is freely available for anyone to view, modify, and distribute
- **Commercial Operating System**
  - sold and licensed for use; developed by companies for profit

### Common Operating Systems

- **Windows (Microsoft)**
  - provides two main types: Windows for PCs and Windows Server for servers
- **macOS (Apple)**
  - a graphical operating system developed and marketed by Apple for Macintosh computers
- **Linux**
  - includes various distributions (distros) combining the Linux kernel with other software and tools
  - tailored for specific needs and user preferences

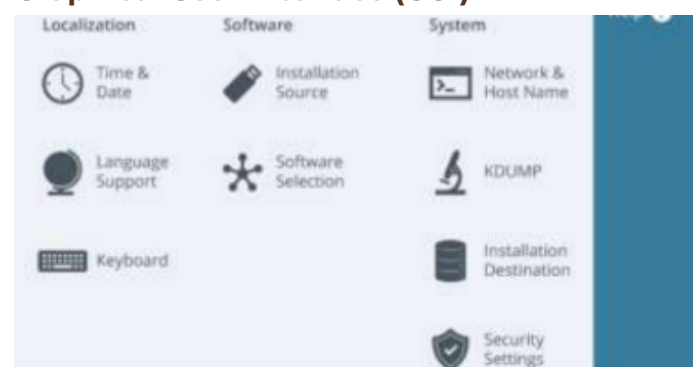
### Text-Based vs Visual Operating Systems

#### Text-Based Interface

```
student@fedora ~$ sudo systemctl status sshd
sshd.service - OpenSSH server daemon
Loaded: loaded (/usr/lib/systemd/system/ssh.service; disabled; vendor pre
Active: active (running) since Sat 2022-02-19 12:53:08 EST; 49s ago
Docs: man:sshd(8)
      man:sshd_config(5)
Main PID: 2639 (sshd)
Tasks: 1 (limit: 4638)
Memory: 1.0M
CPU: 11ms
CGroup: /system.slice/ssh.service
        └─2639 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Feb 19 12:53:08 fedora systemd[1]: sshd.service: Deactivated successfully.
Feb 19 12:53:08 fedora systemd[1]: Stopped OpenSSH server daemon.
Feb 19 12:53:08 fedora systemd[1]: Starting OpenSSH server daemon...
Feb 19 12:53:08 fedora sshd[2639]: Server listening on 0.0.0.0 port 22.
Feb 19 12:53:08 fedora sshd[2639]: Server listening on :: port 22.
Feb 19 12:53:08 fedora systemd[1]: Started OpenSSH server daemon.
student@fedora ~$ sudo system
```

#### Graphical User Interface (GUI)



### User Interface

- **Text-Based or Command Line Interface (CLI)** - allows precise system control using text commands and scripts for efficient task automation
- **Graphical User Interface** - easier to use with visual elements like icons and menus; commands are executed by selecting icons

### Software Installation

- **Installing Software** - the process of setting up software on a device to ensure it works properly with the operating system
- **Removing (Uninstalling) Software** - the process of deleting a software application and its data to free up system resources and prevent it from affecting performance
- **Mobile Applications** - installing a mobile app is simple, though steps may differ slightly between Android and iOS devices

### Key Functions of an Operating System

Manage Apps	Manage Tasks
<ul style="list-style-type: none"> <li>• Handles program downloads, installations, and uninstalls</li> <li>• Ensures apps are properly set up to run within the OS</li> </ul>	<ul style="list-style-type: none"> <li>• Monitors and manages running applications and background processes</li> <li>• Closes programs that use too much memory or affect system performance</li> <li>• Uses Task Management (Task Manager) to:               <ul style="list-style-type: none"> <li>◦ Provide details about performance</li> <li>◦ Display open applications, processes, and services</li> </ul> </li> </ul>

Manage Drivers	System Services
<ul style="list-style-type: none"> <li>• Communicates with hardware devices such as printers or external components</li> <li>• Uses Drivers, which are specialized software that:               <ul style="list-style-type: none"> <li>◦ Allow the OS to communicate with hardware devices</li> <li>◦ Convert generic OS commands into specific hardware instructions</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Manages essential background programs that support overall system operation</li> <li>• Examples include:               <ul style="list-style-type: none"> <li>◦ Bluetooth management</li> <li>◦ Virus software</li> </ul> </li> <li>• Provides System Services, which:               <ul style="list-style-type: none"> <li>◦ Run continuously in the background</li> <li>◦ Perform key functions that ensure smooth system and network operation</li> </ul> </li> </ul>
Device	Startup Applications
<ul style="list-style-type: none"> <li>• Any physical component that is part of or connected to a computer system</li> </ul>	<ul style="list-style-type: none"> <li>• Software programs configured to automatically launch when the system boots up</li> </ul>

### File Management

- **Window File Explorer** - a built-in Windows application that lets users access, manage, and organize files and folders through a GUI
- **Apple Finder** - the default macOS file manager that provides a GUI for accessing, managing, and organizing files, folders, and applications
- **File Fragmentation** - it is when a file is broken into pieces and stored in different locations on a disk, slowing down access and performance
- **File Defragmentation** - a process of recognizing fragmented files on a disk to store them in contiguous sections, improving access speed and performance

- **File System Root** - the starting point of the file system on a given drive, from which all other directories and files branch out
- **Files and Folders** - the way data is stored and organized on a computer

### Working with Files

- **Files can be:**
  - Encrypted
  - Compressed
  - Permission restricted

### Data Backup

- A copy of important files and information stored in a separate location to protect against data loss
- Prevents loss of personal, professional, or system data due to hardware failure, accidental deletion, or disasters

### Types of Files

- **Computer Personal Files**
  - Created and managed by individual users
  - Hold personal, professional, or sentimental value
  - Unique to each user
- **System Files**
  - Essential components of the operating system
  - Critical for the proper functioning and stability of the system
  - Part of the operating system

### What Data Should I Back Up?

- **System files**
  - Part of the operating system
- **Personal files**
  - Unique to each user
- **Corporate Data**

### Types of Backup / Storage Locations

- **Local Backup**
  - Data is stored on-site on a physical storage device such as an external hard drive, USB, or NAS
  - Example: External drive locked in a fireproof safe
  - Pros: Quick access and full control
  - Cons: Prone to theft, fire, or damage

- **Off-Site Backup**
  - Data is stored in a different physical location near the source
  - Ensures safety if the main site experiences damage or loss
- **Cloud Backup**
  - Data is stored online on remote servers managed by third-party providers
  - Examples: Google Drive, Microsoft OneDrive, Apple iCloud
  - Pros: Accessible anywhere, safe from local disasters, and automatically synced

## Hardware

- computer hardware refers to the physical parts of a computer, like the CPU, monitor, keyboard, and mouse

### Common Metric Prefixes

#### • BASE 10

- This chart uses Base 10, which is based on numbers 0-9 (10 numbers total) in the number system. Storage drive manufacturers often use Base 10 when listing storage capacity

TERM	Represents (units)	Example
Kilo (K)	$10^3$ or 1,000	1 Kilobyte (KB) = 1,000 bytes
Mega (M)	$10^6$ or 1,000,000	1 Megabyte (MB) = 1,000,000 bytes
Giga (G)	$10^9$ or 1,000,000,000	1 Gigabyte (GB) = 1,000,000,000 bytes
Tera (T)	$10^{12}$ or 1,000,000,000,000	1 Terabyte (TB) = 1,000,000,000,000 bytes
Peta (P)	$10^{15}$ or 1,000,000,000,000,000	1 Petabyte (PB) = 1,000,000,000,000,000 bytes

#### • BASE 2

- based on the binary numbering system of 1's and 0's. Base 2 uses powers of two (i.e., 2 to the power of 4 =  $2 \times 2 \times 2 \times 2 = 16$ , or 2 to the power 10 =  $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 1024$ )
- Operating Systems use Base 2 to calculate the size of data when it is stored on a disk or transmitted on a network

TERM	Represents (units)	Example
Kilo (K)	$2^{10}$ or 1,024	1 Kilobyte (KB) = 1,024 bytes

Mega (M)	$2^{20}$ or 1,048,576	1 Megabyte (MB) = 1,048,576 bytes
Giga (G)	$2^{30}$ or 1,073,741,824	1 Gigabyte (GB) = 1,073,741,824 bytes
Tera (T)	$2^{40}$ or 1,099,511,627,776	1 Terabyte (TB) = 1,099,511,627,776 bytes
Peta (P)	$2^{50}$ or 1,125,899,906,842,624	1 Petabyte (PB) = 1,125,899,906,842,624 bytes

## Units of Speed and Capacity

### Data at Rest

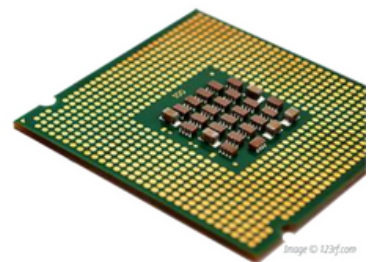
- **Stored data is measured in bytes**
  - 23 Kilobytes is written 23 KB
  - 4 megabytes is 4 MB

### Data in Transit

- **Data in transit is measured in bits per second**
  - 20 megabits per second is written 20 Mbps
  - 56 kilobits is written 56 Kbps

### Processing Speed

- The central processing unit (CPU) is the hardware responsible for running the system.



### Throughput and Speed

- **Bandwidth** - the maximum amount of data that can be transmitted over a network in a given time, measured in bps, Kbps, Mbps, or Gbps
- **Throughput** - the actual rate of successful data transfer over a network, measured in bps, Kbps, Mbps, or Gbps
- **Hertz** - a unit of measurement that indicates how many times something happens per second



## What's Inside a Computer?

### Computer Hardware

- **Form Factor**

- the shape and size of a device

- **Motherboard**

- also called the mainboard or system board
- acts as the central hub connecting all computer components, including the CPU, RAM, storage devices, and peripherals
- contains firmware such as BIOS (Basic Input/Output System) or UEFI (Unified Extensible Firmware Interface) stored on a chip
- BIOS/UEFI initializes and tests hardware during startup and provides runtime services for operating systems
- Form Factor: Refers to the shape and size of the motherboard or device

- **Firmware / BIOS / UEFI**

- Firmware: Software stored on a non-volatile chip in the motherboard
- BIOS/UEFI: Firmware that initializes hardware during boot-up and manages communication between the OS and hardware
- UEFI is a modern replacement for BIOS, offering more advanced features
- Stored in Read-Only Memory (ROM), which does not lose data when powered off

- **Central Processing Unit (CPU)**

- The main component that performs most of the computer's processing
- Executes instructions from programs and carries out arithmetic, logic, control, and I/O operations
- Gets hot during operation and requires cooling fans
- Major manufacturers: Intel, AMD, and Apple

- **Memory (RAM)**

- Also known as Random Access Memory (RAM)
- Stores data and instructions temporarily while the computer is running

- Provides fast access for the CPU to run programs efficiently
- Volatile memory: Data is lost when the computer is turned off



- **Graphics Processing Unit (GPU)**

- A specialized processor dedicated to rendering images, videos, and animations
- Enhances visual performance and graphical detail
- Works alongside the CPU to handle graphics-intensive tasks like gaming or video editing



- **Network Interface Card (NIC)**

- Enables a computer to connect to a network and communicate with other devices
- Supports wired (Ethernet) and wireless (Wi-Fi) connections
- For wired networks: requires an RJ-45 port and Ethernet cable
- For wireless networks: uses radio waves to connect to access points

- **Memory Types**

- **Volatile Memory:** Loses data when power is off (e.g., RAM).
- **Non-Volatile Memory:** Retains data when power is off (e.g., ROM, firmware).

### Computer Storage

- **Internal Storage**

- Refers to storage devices housed within the computer's main chassis

- Used to store and retrieve digital information such as the operating system, software, and user files
- Examples:
  - Magnetic Hard Drive (HDD)
  - Solid-State Drive (SSD)
- Common Interface: SATA
- **External Storage**
  - Any data storage device connected outside the computer's main body
  - Provides additional or portable storage capacity
  - Examples:
    - External Hard Drives (USB, eSATA, Thunderbolt)
    - USB Flash Drives
    - Memory Cards
- **Optical Storage**
  - Uses laser technology to read and write data on optical discs
  - Examples:
    - CD
    - DVD
    - Blu-ray Disc

### Computer Hardware

- **Storage Area Network (SAN)**
  - A specialized high-speed network providing access to large amounts of data storage
  - Commonly used in enterprise environments
  - Can fill an entire room with hundreds of hard drives
- **Network Attached Storage (NAS)**
  - A dedicated storage device connected to a network
  - Provides shared access for multiple users and devices
  - Typically a small box with 4–6 hard drives attached to the network
- **Cloud Storage**
  - A service-based storage solution that allows data to be saved and accessed via the Internet
  - Managed by third-party providers instead of being stored locally
  - Examples: Google Drive, Dropbox, OneDrive, iCloud

- **Outside Storage**

- Refers to data storage offered by service providers or external physical devices located outside the main computer
- Can overlap with cloud storage (internet-based) or external storage (physical and offline), depending on context

### Peripherals

- a "peripheral" in computer hardware refers to any external device that connects to and works with the computer to add functionality, such as a keyboard, mouse, printer, or external hard drive

#### Here is a list of common peripherals:

- **Keyboard**
- **Mouse**
- **Video Devices**
- **Sound Devices**
- **Printers**
- **Scanners**
- **Monitor**

### Uninterruptible Power Supply (UPS)

- A device that provides backup power to computers or electronic equipment during a power outage
- Ensures that the device continues to operate without interruption when power fails
- Contains a large internal battery to supply temporary power
- Allows users to save work and safely shut down equipment during outages
- Has a limited runtime on a single charge

### Installing Connected Devices

- **Plug-and-Play (PnP)**
  - Allows devices to connect and be recognized automatically without setup
  - Usually doesn't need extra software or drivers
  - Drivers may still be required if issues occur
  - Managed through Device Manager in Windows
- **Driver**
  - Software that lets the OS communicate with hardware
  - Translates system commands into hardware instructions
  - Required for non-plug-and-play or malfunctioning devices



## Databases

- a database is an organized storage system based on tables. Tables in a database can store any type of information such as:

- Names
- Dates
- Files
- Pictures
- Comments

### Database Characteristics

- **Centralized Access** - multiple users can get into or access the database at the same time
- **Security** - databases include security measures to ensure that only authorized users can access the data
- **Recovery** - databases are easy to back up, so database administrators (DBAs) can restore the data if something goes wrong
- **Scalability** - can easily handle a few records or millions of them

### Database vs Spreadsheet

Database	Spreadsheet
Quick access to billions of records	Simple structure
Data validation ensures accurate records	Great for small to medium datasets
Thousands or millions of concurrent users	Perfect for a single user or small group

### Working with Database/Location & Access

- **Import Records** - importing data means bringing information from another file into a database quickly and accurately
- **Queries** - a search of the database. They help you find the data you need
- **Reports** - a formatted summary of data used for analysis or presentation, often shown in tables, graphs, or charts
- **Offline Database** - works without the Internet and reduces cyber-attack risks
- **Online Database** - is accessible through the Internet, allowing users to access it from anywhere

- **Local Database** - stored on a company's local server and accessible to both on-site and remote employees
- **Cloud Database** - means putting the database and data online, hosted and managed by the cloud provider

### Database Structure

- **Structured Database**
  - data is organized in a fixed format, often in tables with rows and columns
  - easy to search and analyze

Name	Age	Grade
Alice	16	A
Bob	18	B
Charlie	17	A

- **Non-Structured Database**
  - data is stored in a format that doesn't follow a strict schema or structure, such as text, images, or videos
  - can still find what you need, but there is no order

SummerVacation.docx

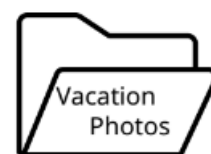


Photo1.jpg  
Photo2.jpg

SchoolPlay.mp4

- **Semi-Structured Database**
  - data is a mix of structured and non-structured data
  - doesn't fit neatly into tables but has some organizational properties, like tags or markers, to separate elements

Date	Sender	Recipient	Body
Mar 2	Alice	Bob	<ul style="list-style-type: none"> <li>• Text</li> <li>• SchoolPlay.mp4</li> </ul>
Mar 3	Alice	Charlie	<ul style="list-style-type: none"> <li>• Text</li> <li>• Photo1.jpg</li> <li>• Photo2.jpg</li> <li>• SummerVacation.docx</li> </ul>

## Types of Databases

• **Rational Database**

- stores and organizes data in tables
- uses relationships between tables to link data making it easy to retrieve and manage related information
- each table has rows and columns, like a spreadsheet

• **Non-Rational Databases**

- can organize and access the items based on their type or label, but there's no fixed structure like shelves or drawers
- stores and manages data that doesn't fit into strict fields
- also known as NoSQL, "not only SQL" database
- uses different query languages for the specific types of data they store

• **Key-Value Database**

- a type of non-relational database (NoSQL) that stores data as pairs of keys and values
- stores data with a unique key
- quick access to data for applications

Key	Value
Weight	100 pounds
Color	Red
Year of Release	1982

• **Document Database**

- a type of non-relational database
- stores data in flexible documents, like company inventory or blog posts
- can store multiple pieces of information in one field

Document Database



Image © 123rf.com

• **Database Schema**

- the architecture of the databases' structure and organization

▪ **Data Modeling**

- helps when designing schemas; shows how an entity's data flows

▪ **Data Models**

- conceptual, logical, or physical models

• **Concept Data Model**

- a simple way to organize and define the data needed for a system with no real technical details

• **Logical Data Models**

- more detailed and explains how to structure the data
- includes technical details like primary keys, foreign keys, entity names, entity relationships, and attributes
- doesn't show how to implement the database with a specific database management system

• **Physical Data Models**

- most detailed and shows exactly how to set up a database using a specific database management system
- includes technical details and performance needs for the hardware that will run the database

• **Tables in a Relational Database**

- tables form the structure of a database
- tables consist of records and fields

Columns = Fields

Employee Name	Employee ID	Manager Name	Title	Client	Training Status
Carson Miller	10000000753	Sam Watson	Business Unit	Barley 100	✓
Neil Smith	10000000045	Mary Smith	Marketing	Dark Industries	✗
Clara Miller	10000000002	Clarence Green	Marketing	Barley 100	?
Michael Smith	10000000008	Walter Bell	Client Services	Dark Industries	?
Michael Smith	10000000007	Anna Baker	Executive	Dark Industries	✓
Anna Baker	10000000005	Henry Baker	Executive	Dark Industries	✓
Walter Lee	10000000001	Alex Harris	Support	Barley 100	✗
Clara Miller	10000000004	Sam Watson	Marketing	Barley 100	✓
Michael Smith	10000000002	Walter Bell	Client Services	Dark Industries	?
Michael Miller	10000000004	Anna Baker	Executive	Dark Industries	✓

Rows = Records

• **Primary Keys**

- a special identifier that makes each record unique
- a social security number (SSN) can be a primary key, as no two SSNs are alike

• **Foreign Keys**

- helps link data from one table to another
- a Foreign key in one table references the primary key from a different table

## Relational Databases

## Schema in a Relational Database

## Coding

- coding is writing instructions for a computer to follow, like a recipe to bake a cake

### Programming Language

- is a way to write code that computers can understand and run
- have a strict syntax, or a set of rules for the language
- Examples of programming languages include C++, Python, Ruby, Basic, and Assembly Language

### Programming Language Terms

- **Machine Language**
  - most basic programming language
  - consisting of binary code (0s and 1s) that a CPU can directly execute
- **Syntax**
  - sets the rules for how to write the language
  - rules include statements, symbols, capitalization, punctuation, and comments
- **Compiled Languages**
  - a compiler translates the code to machine language all at once
  - programs are compiled for each computer type (Windows, Mac, etc.)
    - C, C++, Java
- **Interpreted Language**
  - interpreter program translates the code line by line as it runs
  - interpreted code can run on any computer
    - Python, Javascript
- **Assembly Language**
  - a human readable, and it can interact directly with computer hardware
  - also known as a low-level language, as no compiler or interpreter needed
  - hard to read, so it is not commonly used
- **Structured Query Language (SQL)**
  - used to interact with Databases
  - can be used to search, add, or remove data from a database

## Planning a Coding Project

- a great program or software application requires proper planning

### • Defining the Goals

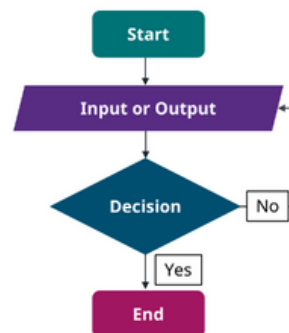
- What will the software do?
- How will the software use the hardware?
- How will users interact with the software?
- What will be displayed on the screen?

### • Flowchart

- programmers use flowcharts to design the flow of their code
- they use standard symbols that show how a program flows and branches

### • Flowchart Shapes

- **Oval:** the start or end of a program
- **Parallelogram:** input or output
- **Diamond:** decisions answered with a Yes or a No
- **Rectangle:** processes
- **Arrow:** the logical flow of the program



### • Pseudocode

- a way to describe how a computer program works using plain language instead of actual programming code
- it is writing down the steps to solve a problem in a way that is easy to understand

```

START
IF microwave is available THEN
  Open microwave door
ELSE
  Print "No microwave available"
END

IF popcorn bag is available THEN
  Place popcorn bag in the microwave
ELSE
  Print "No popcorn bag available"
END

Close microwave door
  
```

```

Set microwave timer to 2 minutes
Press the start button
  
```

```

WHILE microwave is running
  IF popping sound slows down THEN
    Stop the microwave
  END
END
  
```

```

Open microwave door
Carefully take out the popcorn bag
Print "Popcorn is ready"
END
  
```

## • Operators

- **==** mean "is equal to." this means it returns TRUE if both conditions are the same
  - for example, `5 == 5`
- **!=** means "is not equal to."
  - for example, true statement would be `"100 != 5."`
- **>** means "greater than."
  - for example, true statement would be `"100 > 5."`
- **<** means "less than."
  - for example, true statement would be `"5 < 100."`
- **>=** means "greater than or equal to."
  - for example, true statement would be either `"100 >= 100"` or `"100 >= 95."`
- **<=** means "less than or equal to."
  - for example, true statement would be either `"5 <= 5"` or `"5 <= 50."`

## Variables and Data Types

### • Variable

- container that can hold numbers, words, phrases, or other values
- value in a variable can vary or change

### • Variable Types

- Integers: positive or negative whole numbers such as 4, 33, -256
- Float: numbers with a decimal point such as 28.4, 231.28, 5.0
- Fixed-point: numbers with a fixed decimal point
  - for example, in finances, we use a fixed decimal point in the hundredths place such as \$1.99, or \$456.78
- Double: similar to a float, but can store larger float numbers, or "double the precision."
- Boolean: variable that stores only true or false
- String: a sequence of characters such as "Hello World" and "555-1212."
- Character: a single character from any key on the keyboard: a letter, symbol, or digit

- Array: a collection of variables of the same type, accessed with an index
  - for example, subjects in school = {Math, English, History, PE, Art, Science}

### • Array

- a special type of variable that holds many values at once

### • Vectors

- groups of the same type of variable

### • Boolean and Logic

- boolean operators compare if two values match, then, allow the computer to decide based on the outcome
- boolean operators include the following: AND, OR, XOR, and NOT

## Booleans and Logic

Boolean Operator	How It Works
<b>AND</b>	if two conditions are true, the whole statement is true Ex: <b>IF</b> it is raining <b>AND</b> it is cold <b>THEN</b> wear a jacket
<b>OR</b>	If either condition is true, the whole statement is true (either or both) Ex: <b>IF</b> it is raining <b>OR</b> it is cold <b>THEN</b> wear a jacket
<b>XOR</b>	If only one condition is true, the whole statement is true If both conditions are true, the statement is false (either/or, but not both) Ex: <b>IF</b> it is raining <b>OR</b> it is cold, <b>THEN</b> wear a jacket <b>IF</b> it is raining <b>AND</b> it is cold, <b>DON'T</b> wear a jacket
<b>NOT</b>	Inverts a condition, true becomes false, and false becomes true. Ex: <b>IF</b> it is <b>NOT</b> raining <b>THEN</b> go for a walk

## Coding Principles

### • Program Flow

- the order a computer runs code, but that order can change based on various conditions
- Computers follow a sequence, with conditions such as **IF/THEN** statements

- for example, **IF** the player collects 100 coins, **THEN** they get an extra life, **IF** the player collects all the coins, **THEN** proceed to next level
- **Loops**
  - programs can also have loops to repeat code WHILE a condition exists
    - for example, in a video game, a loop would look like this: **WHILE** lives>0 keep playing the game
  - **Sequence**
    - **IF** a player collects 100 coins, **THEN** they get an extra life
- **Call Functions**
  - a Function Call flow happens when a program gets a 'call' to go to another part of the program, run the code, and then return to where it was before
- **Code Documentation**
  - comments have a special symbol in front of them to let the computer know to ignore them
  - **#, ', or //** to let the computer know to ignore them
- **Branching**
  - code can branch off and run different sets of code depending on conditions
  - Pseudocode Branching
    - If hero finds the hidden key, reveal treasure room
- **For Loops**
  - repeats a block of code a specific number of times
  - includes a start point, end condition, and increment/decrement
    - for example, Loop runs 5 times to deal 5 cards in a game
- **While Loops**
  - repeats code while a condition is true
  - checks the condition before each loop
    - for example, Loops until the player has 5 cards
- **Functions**
  - a piece of code that does one specific job
  - usually takes in data, processes it, and then gives a result

- like a reusable toolkit: you call it whenever you need to perform a specific task, saving you from repeating the same steps over and over
  - for example, Function Call: Print("Hello World!")

## Object-Orientated Programming

- **Object-Oriented Programming (OOP)**
  - a modern approach to programming, where objects can represent real life things like cars, birds, etc.
  - OOP objects represent the specific model built from a Class (like a car or a bird)
  - objects can be programmed with variables, functions, or formulas
- **Classes**
  - like a blueprint or template for creating individual objects
  - have properties, which are attributes that objects can have
- **Objects**
  - the specific models built from a class
  - the data inside objects can be variables of different types, including numbers, strings of text, and functions or formulas that can manipulate other data

## Troubleshooting and Debugging

- humans can make mistakes in coding, both with typing correctly and creating the proper code flow
- troubleshooting code is running the program and fixing errors
- troubleshooting and fixing code is known as debugging
- the first step in fixing errors is finding and repeating the problem
- understanding the code is important, so the programmer can know what each part of the code is supposed to do
- this is why writing comments in the code is important for good programming
- there are also debugging tools that help programmers interact with and analyze how the program behaves

- a divide and conquer approach can help focus on the problem and eventually find a solution

### \*\*\* ADDITIONAL MODULE

#### The Future of Tech

- **Leading Technologies**
  - refers to tech that is either new, in development, or otherwise has a promising future, such as:
    - Artificial Intelligence
    - Quantum computing
    - Robotics
  - careers in leading technologies evolve as the tech industry evolves