**CSIS 2200:**

**Slide 01: Information System an Overview**

**Computer literacy:**

Skill in using productivity software, as well as having a basic knowledge of hardware and software, the internet, and collaboration tools and technologies.

**Information Literacy:**

Understanding the role of information in generating and using business intelligence (BI). Provides historical, current and predictive views of business operations and environments and gives organizations a competitive advantage in the marketplace.

**Transaction-Processing Systems (TPS):**

* Focus on data collection and processing.
* Used for cost reduction.
* Applied to structured task.
* Require minimal human involvement when automated.

**Management Information System (MIS):**

* Organized integration of hardware and software technologies, data, processes, and human elements.
* Designed to produced timely, integrated, relevant, accurate, and useful information for decision-making.
* Designing tasks
  + Define the system’s objectives
  + Collect and analyze data
  + Provide information in a useful format for decision-making purposes.
* MIS applications
  + Used in both private and public sectors.

**Components of an Information System:**

*Data | Database | Process | Information*

1. Data:
   1. Considered the input of a system.
   2. Sources of data:
      1. Internal: records.
      2. External: customers, suppliers, government agencies, labor…
   3. Has a time orientation:
      1. Past data: performance reports.
      2. Current data: operational reports.
   4. Can be collected in different forms:
      1. Disaggregated data: helps analyze sales by product, territory, or salesperson.
      2. Aggregated data: useful for reporting overall performance during a sales quarter.
2. Database:
   1. Collection of relevant data organized in a series of integrated files.
      1. Essential for the success of any information system.
   2. Database management System (DBMS)
      1. Used to create, organize, and manage databases
      2. Reduces personnel time needed to gather, process, and interpret data manually.
3. Process:
   1. Generates the most useful type of information for making decisions
      1. Transaction-processing reports.
      2. Models for decision analysis that can be built into the system or accessed from external sources.
4. Information:
   1. Consists of facts analyzed by the process component and is an output of an information system.
      1. Usefulness qualities
         1. Timelines
         2. Integration with other data and information
         3. Consistency and accuracy
         4. Relevance
   2. Needs to provide either a base for users to explore different options or insight into tasks.
   3. Usefulness is affected by the information system’s user interface.
      1. Graphical user interfaces (GUIs) are used because they are flexible and easy.
   4. Systems should produce information in different formats, including graphics, tables and exception reports.
      1. Increases likelihood of users understanding and being able to use the information.
   5. Users need to be able to make use of informal information when solving problems.

**Information technologies:**

* The internet.
* Computer networks.
* Database systems.
* Point-of-sale (POS) systems.
* Radio-frequency-identification (RFID)

**Importance of Information Systems:**

* Timely, relevant, and accurate information is a critical tool.
  + Enhance competitive position in the marketplace.
* Manage the four Ms of resources:
  + Manpower
  + Machinery
  + Materials
  + Money
* Personal Information System (PIS) or Human Resource Information System (HRIS)
  + Designed to provide information that helps decision makers in personnel carry out tasks effectively.
* Logistic Information System (LIS)
  + Designed to reduce the cost of transporting materials while maintaining safe and reliable delivery.
* Manufacturing information system (MIS)
  + Used to manage manufacturing resources.
  + Reduce manufacturing costs.
  + Increase product quality.
  + Improve inventory decisions.
* Financial information system (FIS)
  + Used to provide information to financial executives in a timely manner.
* Marketing information system (MKIS)
  + Used to improve marketing decisions.
  + Provides timely, accurate, and integrated information about the marketing mix.
  + Price, promotion, place and product.
* Marketing technology tools
  + Business, web, and mobile analytics
  + E-mail marketing
  + Search engine marketing
  + Mobile technologies
  + Marketing automation

**Using Information Technologies for a Competitive Advantage:**

* Michael Porter: Three strategies for successfully competing in the marketplace.
  + Overall cost leadership.
  + Differentiation.
  + Focus.
* Information systems
  + Help organizations reduce the cost of products and services.
  + Help bottom-line and top-line strategies.
  + Use enterprise systems to create an efficient and effective link between suppliers and consumers.
* Differentiation strategies
  + Making products and services different from competitors.
* Focus strategies
  + Focusing on specific market segments to achieve a cost or differentiation advantage.

**Porter’s Five Forces Model: Understanding the Business Environment**

* Analyzes a firm’s position in the marketplace and how information systems can make it more competitive.
  + Five forces
    - Buyer power.
      * **High** when customers have **many** choices.
      * **Low** when customers have **few** choices.
    - Supplier power.
      * **High** when customers have **fewer** options
      * **Low** when customers have **more** options
    - Threat of substitute products or services.
      * **High** when **many alternatives** to an organization’s products and services are available.
    - Threat of new entrants.
      * **Low** when duplicating a company’s product or service is difficult.
      * **Focus** strategies are used to ensure that the threat remains low.
    - Rivalry among existing competitors.
      * **High** when competitors occupy the same marketplace position.
      * **Low** when there are few competitors.

This image depicts the five forces model. There is rectangular box positioned at the center of the image, and four boxes have been positioned around this box. The box on the left is labeled suppliers, the box on the right is labeled buyers, the box at the top is labeled potential entrants, and the box at the bottom is labeled substitutes.  
The box at the center contains two points that read industry competitors and rivalry among existing competitors. A U-shaped arrow has been positioned between these points. The arrowhead points at the first point. 
An arrow arises from the right side of the box labeled suppliers that is positioned on the left and points at the box at the center of the image. This arrow is labeled bargaining power of suppliers. 
An arrow arises from the left side of the box labeled buyers that is positioned on the right and points at the box at the center of the image. This arrow is labeled bargaining power of buyers. 
An arrow arises from the bottom of the box labeled potential errants that is positioned at the top and points at the box at the center of the image. This arrow is labeled threats of new entrants. 
An arrow arises from the top of the box labeled substitutes that is positioned at the bottom and points at the box at the center of the image. This arrow is labeled threat of substitute products or services.  

**The IT Job Market**

* Operations and help desk.
* Programming.
* Systems design.
* Web design and web hosting.
* Network design and maintenance.
* Database design and maintenance.
* Robotics and artificial intelligence.
* Chief of Technology Officer (CTO) / Chief of Information Officer (CIO)
  + Oversees long-range planning and monitors new developments that can affects a company’s success.
* Chief Privacy Officer (CPO)
  + Responsible for managing risks and business impacts of privacy laws and policies.
* Manager of information systems services
  + Responsible for managing hardware, software, and personnel in the information systems department.
* Systems analyst
  + Responsible for the design and implementation of information systems.
  + Should have a sound understanding of business systems and functional areas within a business organization.
* Network administrator
  + Oversees a company’s internal and external network systems.
  + Provides network and cybersecurity.
* Database administrator (DBA)
  + Responsible for database design and implementation.
  + Required to have knowledge and understanding of data warehouses and data-mining tools.
* Computer programmer
  + Writes programs or software segments that allow the information system to perform a specific task.
* Webmaster
  + Designs and maintain the organization’s web site.
  + Have been in high demand owing to the popularity of e-commerce applications.

**Outlook for the Future**

* Hardware and software costs will decline
* Artificial intelligence and related technologies will improve and expand.
* Computer literacy and networking technology will improve.
* Personal computer will improve in power and quality.
* Internet growth will continue.
* Computer criminals will become more sophisticated.
* Protecting personal information will become more difficult.
* Ubiquitous computing and the Internet of Things (IoT).
* 3D printing, pervasive analytics, context aware computing, smart machines and devices, and cloud computing.
* Software defined applications and infrastructures.
* Security.
* Increased applications of augmented and virtual reality.

Check computer: Core, ram, cache, # of usb port

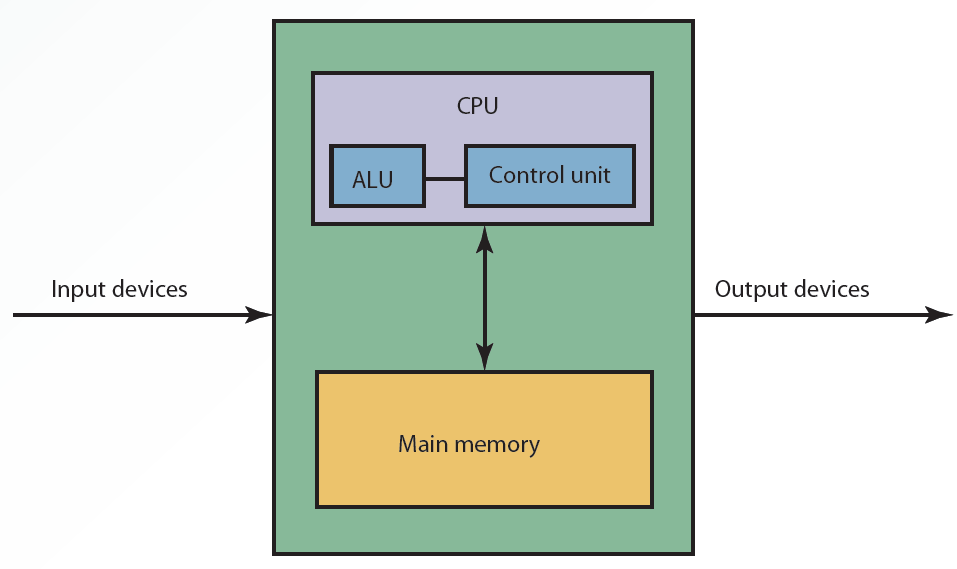
**Slide 02: Computers: The Machines Behind Computing**

**Defining a Computer:**

* A computer is a machine that:
  + Accept data as input.
  + Processes data without human intervention using stored instructions.
  + Outputs information.
* Instructions:
  + Step-by-step directions for performing a specific task.
  + Written in a language the computer can understand.
* Garbage in, garbage out (GIGO):
  + If the input data is erroneous, the information provided by the computer is also erroneous.
* Writing a computer program:
  + Identify what needs to be done.
  + Write the algorithm to achieve the goal.
  + Select a programming language for it. (depends on the problem and the computer)
* A program is also called a source code (a sequence of 0’s and 1’s).

**Components of a Computer System:**

* Hardware: physical devices such as keyboard, monitors, processing units.
* Software: programs written in computer languages.
* Central Processing Unit (CPU): the heart of the computer
  + Arithmetic Logic Unit (ALU): perform the arithmetic operations.
  + Control Unit: tells the computer what to do such as instructing the computer which device to read or send output to.
* Computers can have a single processor or multiple ones (two or more CPUs).



* Bus: link between devices connected to the computer.
  + Parallel or serial.
  + Internal (local) or external.
* Disk drive: peripheral device for recording, storing, and retrieving information.
* CPU case: enclosure containing the computers main components (computer chassis or tower).
* Motherboard: main circuit board containing connectors for attaching additional boards.

**Hardware Generations:**

**Table

Description automatically generated**

**The Power of Computers:**

* Speed.
  + Measured by the number of instructions executed per fractions of a second:
    - Millisecond: 1/1,000
    - Microsecond: 1/1,000,000
    - Nanosecond: 1/1,000,000,000
    - Picosecond: 1/1,000,000,000,000
* Accuracy.
* Storage and retrieval capabilities.
  + Save data in computer memory.
  + Access data from memory.
  + Data stored in bits.
  + American Standard Code for Information Interchange (ASCII).
    - Defines up to 128 characters.

Table

Description automatically generated

**Computer Operations:**

* Computer functions:
  + Three basics tasks:
    - Arithmetic operations.
    - Logical operations.
    - Storage and retrieval operations.
  + Input, Output and Memory
  + Main Memory:
    - Volatile and nonvolatile.
    - Random Access Memory (RAM).
    - Cache RAM: stores recently accessed memory.
      * Resides on the processor.
      * Made of silicon.
    - ROM (Read-only Memory).
      * Nonvolatile memory.
      * Data cannot be written to it.
      * Includes BIOS information and the computer system’s clock.
      * Programable read-only memory (PROM).
      * Erasable Programable read-only memory (EPROM).
  + Secondary Memory:
    - Magnetic disks.
      * Made of Mylar or metal.
      * Used for random-access processing.
    - Magnetic tape:
      * Made of a plastic material.
      * Stores data sequentially.
    - Optical disks:
      * Use lasers beams to access and store data.
      * CD-ROMs, WORM discs, and DVDs.
      * Include hard disks, USB flash drives, and memory cards.
    - Redundant Array of Independent Disks (RAID):
      * Collection of disk drives used for fault tolerance and improved performance.
      * Found in large network systems.
    - Cloud storage:
      * Involves multiple virtual servers that are hosted by third parties.

Table

Description automatically generated

* Storage Area Network:
  + Dedicated high-speed network consisting of both hardware and software.
  + Connect and manage shared storage devices
  + Disk arrays, tape libraries, and optical storage devices.
* Network-Attached Storage (NAS)
  + Network-connected computer dedicated to provide file based data storage services to other network devices.

**Classes of Computer:**

* Based on cost, amount of memory, speed and sophistication.
* Subnotebooks and notebooks
* Personal and minicomputers
* Mainframes
* Supercomputers

**Server Platforms: An Overview**

* Server: computer and all the software for managing network resources and offering services to a network.
* Available server platforms: applications servers, database servers, disk servers, fax servers, file servers, mail servers, print servers, remote access servers (RAS), and web servers.

**What is a Software?**

* Programs that run a computer system.
* Classification:
  + System software: work in the background and takes care of tasks, such as deleting waste files.
  + Application software: performs specialized tasks.

**Operating System Software:**

* Set of programs controlling and managing computer hardware and software.
  + Provides an interface between a computer and the user.
  + Increases computer efficiency by helping users share computer resources and performing repetitive tasks for users.
  + Increases computer efficiency by helping users share computer resources and performing repetitive tasks for users.
* Consists of control programs to manage hardware and resources by performing:
  + Job management.
  + Resource allocation.
  + Data management
  + Communication
* Supervisor program (i.e., the Kernel)
  + Responsible for controlling all other programs in th OS.
* Application Software:
  + Commercial software or software developed in house; used t perform variety of tasks on a personal computer.
    - Word processing, spreadsheet, database, presentation and graphics.
    - Desktop publishing.
    - Financial planning and accounting.
    - Computer-aided design (CAD).
* Computer Languages:
  + Machine Language:
    - First generation of computer languages.
    - Consists of a series of 0s and 1s representing data or instructions.
    - Dependent on the machine.
    - Time-consuming to write a program.
  + Assembly language:
    - Second generation of computer languages.
    - Machine dependent and a higher-level language than machine language.
    - Uses a series of short codes, or mnemonics, to represent data or instructions.
  + High-level languages:
    - Third generation of computer languages.
    - Machine independent and self-documenting.
    - Used for web development and internet applications.
  + Fourth-generation languages (4GLs):
    - Commands are powerful and easy to learn.
    - Use macro codes that can take the place of several lines of programming.
  + Fifth-generation languages:
    - Used artificial intelligence technologies.
    - Knowledge-based systems, natural language processing (NLP), visual programming, and a graphical approach to programming.
    - Designed to facilitate natural conversations between an individual and the computer.

**Slide 03: Database Systems, Database Workers and Data Marts**

**Databases:**

* Database:
  + Collection of related data that is stored in a central location or in multiple locations.
* Data Hierarchy:
  + Structure and organization of data, which involves fields, records, and files.
* Database Management System (DBMS)
  + Software for creating, storing, maintaining, and accessing database files.
  + Makes using databases more efficient.

**Interaction between the User, DBMS, and Databases:**

This illustration depicts the interaction between the User, DBMS, and Database. 
A rectangular box has been positioned at the center of the illustration. This box is labeled D B M S.
A circle has been placed on the left side of the illustration. This circle is labeled user. An arrow arises from the right side of this circle and points at the box labeled D B M S. A rectangular box has been aligned on the top of this arrow, and it contains text that reads user makes a request for information. An arrow arises from the left side of the box labeled D B M S and points at the circle. A rectangular box has been aligned at the bottom of this arrow, and it contains text that reads D B M S returns information to the user. 
A cylinder has been placed on the right side of the illustration. This cylinder is labeled database. An arrow arises from the right side of the box labeled D B M S and points at the cylinder. A rectangular box has been aligned on the top of this arrow, and it contains text that reads D B M S searches the database. An arrow arises from the left side of the cylinder and points at the box labeled D B M S. A rectangular box has been aligned at the bottom of this arrow, and it contains text that reads D B M S retrieves the information. 

**Types of Databases:**

* Internal data:
  + Collected from within an organization.
  + Stored in the organization’s internal databases and can be used by functional information systems.
* External data:
  + Comes from a variety of sources.
  + Stored in a data warehouse.

**Methods for Accessing Files**

* Sequential access file structure:
  + Records in files are organized and processed in numerical or sequential order.
  + Records are organized based on a primary key (e.g., Social Security numbers or Account numbers).
  + Used for backup and archive files because they rarely need updating.
* Random Access File Structure
  + Records can be accessed in any order, regardless of their physical locations in storage media.
  + Fast and very effective when a small number of records need to be processed daily or weekly.
  + Records are stored on magnetic disks to achieve speed.
* Indexed Sequential Access Method (ISAM)
  + Records accessed sequentially or randomly, depending on the number accessed.

**Random access** is used for a **small amount of data**. While the **sequential access** is used for a **larger set of data**. Indexed sequential one uses an index structure with two parts: index value and a pointer to the disk location of the record matching the indexed value.

**Logical Database Design**

* Information is viewed in a database in two ways
  + Physical view: how data is stored on and retrieved from storage media.
  + Logical view: how information appears to users and how it can be organized and retrieved.
    - Depending on the user, there can be more than one logical view of data.
* Data model determines how data is created, represented, organized, and maintained
  + Data structure.
  + Operations.
  + Integrity rules.
* Hierarchical model:
  + Relationships between records form treelike structure.
  + Records are called nodes, and relationships between records are called branches.

This flowchart depicts an example of a hierarchical model. It is divided into four levels. The content against the second, third, and fourth levels reads siblings.
A box has been positioned at the top center of the flowchart, and this box is labeled supplier A. Three lines arise from the bottom of this box and lead downward to three different boxes, which have been positioned horizontally. All three boxes have been labeled product line. 
Two lines arise from the bottom of the first box labeled product line. These lines lead downward to two different boxes. The first box is labeled P1, and the second box is labeled P2. Two lines arise from the bottom of the box labeled P1 and lead downward to two boxes, which are labeled A and B. Four lines arise from the bottom of the box labeled P2 and leads downward to four boxes, which are labeled C, D, E, and F. 
Three lines arise from the bottom of the second box labeled product line. These lines lead downward to three different boxes. The first box is labeled P3, the second box is labeled P4, and the third box is labeled P5. Two lines arise from the bottom of the box labeled P3 and lead downward to two boxes, which are labeled G and H. Three lines arise from the bottom of the box labeled P4 and lead downward to three boxes, which are labeled I, J, and K. Three lines arise from the bottom of the box labeled P5 and lead downward to three boxes, which are labeled L, M, and N. 
Two lines arise from the bottom of the third box labeled product line. These lines lead downward to two different boxes. The first box is labeled P6, and the second box is labeled P7. Four lines arise from the bottom of the box labeled P6 and lead downward to four boxes, which are labeled O, P, Q, and R. Three lines arise from the bottom of the box labeled P7 and lead downward to three boxes, which are labeled S, T, and U. 

* Network model:
  + Similar to the hierarchical model but records are organized differently.
  + Each record can have multiple parent and child records.

This flowchart depicts the network model in the form of a flowchart. It is divided into three levels. The content against the first level reads customer number. The content against the second level reads invoice number. The content against the third level reads method of payment. 
Three boxes have been positioned horizontally at the top of the flowchart. These boxes are labeled 2000, 3000, and 9000.  A line arises from the box labeled 2000 and leads downward to a box labeled 111. Two lines arise from the box labeled 3000 and lead downward to two different boxes, which are labeled 222 and 333. Two lines arise from the box labeled 9000 and lead downward to two different boxes, which are labeled 444 and 555. 
Three lines arise from each of the boxes labeled 111, 333, and 444 and lead downward to a box that is labeled cash. Two lines arise from each of the boxes labeled 222 and 555 and lead downward to a box that is labeled credit. 

**The Relational Model**

* Uses a two-dimensional table of rows and columns of data:
  + Rows are records (i.e., tuples)
  + Columns are fields (i.e., attributes)
* Data dictionary:
  + Stores definitions, such as data types for fields, default values, and validation rules for data in each field.
* Primary key:
  + Uniquely identifies every record in a relational database.
* Foreign key:
  + Field in a relational table that matches the primary key column of another table.
  + Used to cross-reference tables.
* Normalization:
  + Used to improve database efficiency.
    - Eliminates redundant data.
    - Ensures only related data is stored in a table.
  + Goes through different stages, from the first normal form (1NF) to the fifth normal form (5NF).
* Operations:
  + Help retrieve data from tables.
  + Common operations: select, project, join, intersect, union, and difference.

**Components of a DBMS**

* DBMS software components:
  + Database engine
  + Data definition
  + Data manipulation
  + Application generation
  + Data administration
* Database engine:
  + Responsible for data storage, manipulation and retrieval.
  + Interacts with other components of the DBMS to convert logical requests from the users into their physical equivalents.
* Data definition:
  + Used to create and maintain the data dictionary and define database file structure.
  + Makes changes to a database’s structure.
* Data manipulation:
  + Used to add, delete, modify, and retrieve records from a database.
  + Uses a query language, such as Structured Query Language (SQL).
* Application Generation:
  + Designs elements of an application using a database.
  + Used by IT professionals and database administrators.
* Data Administration:
  + Used for tasks such as backup and recovery, security, and change management.
  + Used to determine who has permission to perform certain functions, summarized as create, read, update, and delete (CRUD)
* Database Administrators (DBAs)
  + Handle database design and management.

**Recent Trends in Database Design and Use**

* Data-driven web sites.
* Natural language processing.
* Distributed databases.
* Object-oriented databases.
* Advances in artificial intelligence.

**Data-Driven Web Sites**

* Acts as an interface to a database
  + Retrieves data and allows users to enter data in the database.
* Improves access to information:
  + Reduces support and overhead needed to maintain static web sites.
  + Gives users more current information from a variety of data sources.

**Distributed Databases**

* Distributed Database Management System (DDBMS)
  + Stores data on multiple servers throughout an organization.
  + Several advantages:
    - Design better reflects the firm’s structure.
    - Local data storage reduces response time.
    - Minimizes effects of computer failure.
    - Cost advantage.
    - Not limited by physical location of the data.
* Approaches to setting up a DDBMS:
  + Fragmentation: addresses how tables are divided among multiple locations.
  + Replication: each site stores a copy of the data in the organization’s database.
  + Allocation: combines fragmentation and replication.
* Object-Oriented Databases:
  + Data and their relationships are contained in a single object.
    - Object consists of attributes and methods that can be performed on the object’s data.
      * Encapsulation: grouping objects along with their attributes and methods into a class.
      * Inheritance: new objects can be created faster and more easily by entering new data in attributes.
  + Advantages of object-oriented database:
    - Supports more complex data management.
    - Handles storing and manipulating all types of multimedia as well as numbers and characters.

**Data Warehouses**

* Collection of data from a variety of sources.
  + Support decision-making applications.
  + Generate business intelligence.
* Called hypercubes because they can store multidimensional data.
* Characteristics of data in a warehouse
  + Subject oriented.
  + Comes from a variety of sources.
  + Categorized based on time.
  + Captures aggregated data.
  + Used for analytical purposes.

**Data Warehouses Configuration**

* Input:
  + Different data sources provide the input for a data warehouse to perform analyses and generate reports
    - External data sources, databases, and transaction files.
    - Enterprise resources planning (ERP) systems.
    - Customer relationship management (CRM) systems.

This image depicts the configuration of a data warehouse and highlights its components. Four cylinders have been positioned vertically, one below the other, on the left side of the image. From the top to the bottom, these boxes are labeled databases, transaction files, enterprise resource planning systems, and customer relationship management systems. Another cylinder has been positioned at the top of the image. This cylinder is labeled external data sources. 
Arrows arise from the right side of each of the four cylinders positioned on the left side and from the bottom of the cylinder positioned at the top of the image. These arrows point at a rectangular box positioned vertically at the center of the image. This box is labeled extraction, transforming, and loading. An arrow arises from the right side of the box at the center and leads to another long, vertically-positioned cylinder. This cylinder is labeled raw data, summary data, and metadata. 
Three arrows arise from the right side of the vertically-positioned, long cylinder. The first arrow points at content that reads O L A P analysis. The second arrow points at content that reads data-mining analysis. The third arrow points at content that reads decision-making reports.

* Extraction, Transformation, and Loading (ETL):
  + Processes used in a data warehouse.
    - Collecting data from a variety of sources.
    - Converting data into a format that can be used in transformation processing.
    - Loading data into the data warehouse.
* Storage:
  + Collected information is organized in a date warehouse as:
    - Raw data: information in its original form.
    - Summary data: gives users subtotals of various categories.
    - Metadata: information about data’s content, quality, condition, origin, and other characteristics.
* Output:
  + Data warehouses use the following to generate reports:
    - Online analytical processing (OLAP)
      * Uses multiple sources of information and provides multidimensional analysis.
      * Generates business intelligence.
    - Data mining analysis
      * Used to discover patterns and relationships.
  + Benefits of data warehouses:
    - Cross-reference segments of an organization’s operations for comparison.
    - Generate complex queries and reports faster than when using databases.
    - Generate reports efficiently using data from a variety of sources.
    - Find patterns and trends that cannot be found with databases.
    - Analyze large amounts of historical data quickly.
    - Assist management in a making well-informed business decisions.
    - Manage a high demand for information from many users with different needs and decision-making styles.

**Data Marts**

* Smaller version of a data warehouse used by a single department or function.
  + Advantages over warehouses:
    - Faster access to data owing to its smaller size.
    - Improved response time for users.
    - Easier to create because of its size and simplicity
    - Less expensive.
    - Effective targeting of users.
  + Disadvantages:
    - Limited scope.
    - Difficulty in consolidating information from different departments or functional areas.

**Business Analytics**

* Uses data and statistical methods.
  + Gains insight into the data.
  + Provides decision makers with information to act on.
* Methods:
  + Descriptive
  + Predictive
  + Prescriptive
  + Descriptive Analytics:
    - Reactive strategy
    - Reviews past events, analyzes the data, and provides a report indicating:
      * What happened in a given period of time?
      * How to prepare for the future.
  + Predictive analytics:
    - Proactive strategy
    - Prepares decision makers for future events
  + Prescriptive analytics
    - Recommends a course of action that decision makers should follow.
    - Shows the likely outcome of each decision.

**The Big Data Era**

* Voluminous data
  + Conventional computing methods are unable to efficiently process and manage it.
* Involves five dimensions:
  + Volume
  + Variety
  + Velocity
  + Veracity
  + Value
* Provides competitive advantage in many areas
  + Retail, financial services, advertising and public relations, government, manufacturing, healthcare, etc.
* Many technologies and applications have contributed to growth and popularity
  + Mobile and wireless technology, the popularity of social networks, etc.
* Executives should guard against privacy risks
  + Discrimination, privacy breaches and embarrassments, unethical actions based on interpretations, loss of anonymity, etc.

**Database Marketing**

* Uses an organization’s database of customers and potential customers to promote products or services
  + Main goal: use information within the database to implement marketing strategies.
    - Increase profits.
    - Enhance competitiveness.
  + Transforms marketing from a reactive to a proactive process
    - Multivariate analysis
    - Data segmentation
    - Automated tools
  + Tasks performed by successful database marketing campaigns
    - Calculating customer lifetime value (CLTV)
    - Conducting recency, frequency, and monetary analysis (RFM)
    - Using different techniques to communicate effectively with customers
    - Using different techniques to monitor customer behavior across a number of retail channels.

**Relationship Diagrams Review**

Table is in 1NF if the table satisfies the following five conditions:

1. There’s not top-to-bottom ordering to the rows.
2. There’s no left-to-right ordering to the columns.
3. There are no duplicate rows.
4. Every row-and-column intersection contains exactly one value from the applicable domain (and nothing else).
5. All columns are regular [i.e. rows have no hidden components such as row IDs, object IDs, or hidden timestamps.]

Table

Description automatically generated

This table is not on the 1NF. Because you can observe the same information being repeated in the same row.

**One to Many Relationship**

One-to-many (1:M) – is used to relate one record in the table A with many records in the table B. A record in table A can have many matching in table B, and a record in table B can have one matching record in table A. In a one-to-many relationship, each row in one table can be related to many rows in the others table.

Graphical user interface

Description automatically generated with medium confidence

**Modelling a one-to-many relationship**

Step 01: Create individual tables with associated primary keys.

Step 02: Take the primary key from the table whose multiplicity is 1 and add it in table with multiplicity M.

Step 03: Create the relationship.

**Slide 04: Personal, Legal, Ethical, and Organizational Issues of Information Systems**

**Privacy Issues**

* Employers search social networking sites for background information on applicants.
* Monitoring systems are adopted by employers to check employee performance.
* Healthcare organizations, financial institutions, legal firms, and online-ordering firms gather personal data and enter it in databases.
* Information about every aspect of people’s lives is stored on various databases.
  + Many practices of government agencies, credit agencies, and marketing companies using databases would represent an invasion of privacy.
* Several federal laws regulate the collecting and using of information on people and corporations.
  + Narrow in scope and contain loopholes.
* Concepts of the web and network privacy
  + Acceptable use policy: set of rules specifying legal and ethical use of a system and consequences of noncompliance.
  + Accountability: issues involving both the user’s and the organization’s responsibilities and liabilities.
  + Nonrepudiation: method for binding all the parties to a contract.
* Guidelines to minimize the invasion of privacy.
  + Conduct business only with Web sites that have private policies.
  + Limit access to personal to those with authorization information.
  + Ensures data’s reliability and take precautions to prevent misuse of the data.
  + Make sure data collection has a stated purpose.
  + Identify ways to prevent personal information gathered from being disclosed without consent.
  + Use verification procedures to ensure data accuracy.
  + Ensure records kept on an individual are accurate and up to date.
  + Review records and correct any inaccuracies.
  + Do not keep record-keeping systems that store personal data a secret.
  + Take all necessary measures to prevent unauthorized access to data and misuse of data.
* Federal data protection laws.
  + Health Insurance Portability and Accountability Act (HIPAA).
  + Fair and Accurate Credit Transaction Act (FACTA).
  + Children’s Online Privacy Protection Act (COPPA).

**Email**

* Spam: unsolicited e-mail sent for advertising purposes.
  + Sent in bulk using automated mailing software.
* Ease of access  
  + Individuals should assume that others have access to their messages.
  + Any e-mail sent on company-owned computers are the property of an organization.

**Data Collection on the Web**

* Number of people shopping online is increasing rapidly because of convenience, the array of choices, and lower prices.
  + Reluctant to make online purchases because of concerns about hackers.
* Information provided on the Web can be combined with other information and technologies to produce new information.
* Cookies: small text files with unique ID tags that are embedded in a Web browser and saved on the user’s hard drive.
  + Help Web sites customize pages for users.
    - Considered an invasion of privacy when user’s information is used without prior consent.
    - Installing cookie manager helps users disable cookies.
* Log files record a user’s actions on a Web site
  + Generated by Web server software.
  + Help in identifying cases of identity misrepresentation on Web sites.

**Ethical Issues of Information Technologies**

* Information technology offers opportunities for unethical behavior because of the ease of collecting and disseminating information.
  + Increase in cybercrime, cyberfraud, identity theft, and intellectual property theft.
* Organizations can reduce unethical behavior of employees by developing enforcing codes of ethics.

**Censorship**

* Types of Information on the Web.
  + Public information is posted by an organization or public agency.
    - Censored for public policy reasons.
    - Censored if the content is deemed offensive to a political, religious, or cultural group.
  + Private information is posted by a person.
    - Uncensored because of constitutional freedom of expression
* Restricting access to the Web.
  + Countries such as China, Myanmar (Burma), and Singapore restrict or forbid their citizen’s access to the Web.
    - Internet neutrality: Internet service providers (ISPs) and government agencies should treat all data on the Internet equally.
  + Parents use programs such as CyberPatrol, CyberSitter, Net Nanny, and SafeSurf to prevent children’s access to Web sites.

**Intellectual Property**

* Legal umbrella covering protection that involve copyrights, trademarks, trade secrets, and patents developed by people or businesses.
* Categories of intellectual property:
  + Industrial property: inventions, trademarks, logos, and industrial designs.
  + Copyrighted material: literary and artistic works.  
    - Online materials such as Web pages, HTML code, and computer graphics.
    - Fair Use Doctrine: exception to the copyright law that allows the use of copyrighted material for certain purposes.
  + Intellectual property protections
    - Trademark: protects product names and identifying marks.
    - Patent: protects new processes
      * Advantages of patents to organizations
        + Generates revenue by licensing the patent.
        + Attracts funding for research and development.
        + Keeps competitors from entering certain market segments.
  + 1980 revisions to the Copyright Act of 1976 include computer programs.
    - Both people and organizations can be held liable for unauthorized duplication and use of copyrighted programs.
  + Laws covering legal issues related to information technologies in the U.S.
    - Telecommunications Act of 1996.
    - Communications Decency Act (ADA).
    - Laws against spamming.
  + Cybersquatting
    - Registering, selling, or using a domain name to profit from someone else’s trademark.
  + Typosquatting
    - Relies on typographical errors made by Web users when typing a Web site address into a Web browser.
      * Variation of cybersquatting.
      * Called URL hijacking.

**Social Divisions and the Digital Divide**

* Digital divide: created between the information rich and the information poor by information technology and the internet.
  + Computers still are not affordable for many people.
  + Increasing funding for computers at schools and public places helps offset the divide.

**The Impact of Information Technology in the Workplace**

* Increased consumer’s purchasing power.
  + Results in a stronger economy by reducing production costs.
* Information technologies have a direct effect on the nature of jobs.
  + Telecommunicating enables people to perform their jobs from home.
  + Organizations can use the best human resources in a large geographical region.
* Job deskilling: occurs when skilled labor is eliminated by high technology.
* Virtual organizations: networks of independent companies, suppliers, customers, and manufacturers connected via information technologies.
  + Share skills and cost.
  + Have access to each other’s markets.

**Telecommuting**

Table

Description automatically generated

Graphical user interface, text, application, email

Description automatically generated

**Information Technology and Health Issues**

* Increasing popularity of touchscreens
  + Results in stress-related injuries of the users’ hands, arms, back, and eyes.
* Health problems related to computer equipment.
  + Vision problems.
  + Musculoskeletal problems.
  + Skin problems.
  + Reproductive problems.
  + Stress-related problems.

**Green Computing**

* Promotes a sustainable environment and consumes the least amount of energy.
  + Involves design, manufacture, use, and disposal of computers, servers, and computing devices with minimal impact on the environment.
  + Requires cooperation of both private and public sectors.
* Ways to achieve green computing
  + Designing products that last longer and are modular in design.
    - Parts can be upgraded without replacing the entire system.
  + Designing search engines and computing routines that are faster and consume less energy.
  + Replacing underutilized smaller servers with one large server using a virtualization technique.
  + Using computing devices that consumes less energy and are biodegradable.
  + Allowing certain employees to work from their homes.
  + Conducting meetings over computer networks to reduce business travel.
  + Using cloud computing.
  + Turning off idle PCs and recycling compute-related materials.

**Slide 05: Protecting Information Resources**

**Risks Associated with Information Technologies**

* Information technologies can be misused to invade user’s privacy and commit computer crimes.
  + You can minimize or prevent many of these kids by installing operating systems updates regularly, using antivirus and antispyware software, and using e-mail security features.

**The Costs of Cyber Crime to the U.S. Economy**

* Stolen identities, intellectual property, and the trade secrets.
* Damage done to companies’ and individuals’ reputations.
* Expense of enhancing and upgrading a company’s network security after an attack.
* Opportunity costs associated with downtime and lost trust and loss of sensitive business information.

**The Costs of Cyber Crime to the U.S. Economy**

* Spyware:

* + Software that secretly gathers information about users while they browse the Web.
  + Prevented by installing antivirus or antispyware software.
* Adware:
  + Spyware that collects information about the user to determine advertisements to display.
  + Prevented by installing an ad-blocking feature in the Web browser.

**Phishing, Pharming, Baiting, Quid Pro Quo, SMiShing, and Vishing**

* Phishing: sending fraudulent emails that seem to come from legitimate sources.
* Pharming: internet users are directed to fraudulent Web sites with the intention of stealing their personal information.
* Baiting: similar to phishing attacks; baiter gives recipient a promise.
* Quid Pro Quo: involves a hacker requesting the exchange of critical data or login information in exchange for a service or prize.
* SMiShing (SMS phishing): technique tricks a user to download a malware.
* Vishing (voice or VoIP phishing): technique tricks a user to reveal important financial re personal information to unauthorized entities.

**Keystroke Loggers**

* Monitor and record keystrokes.
* Can be software or hardware devices.
* Used by companies to track employees’ use of email and the internet.
* Used for malicious purposes.
* Prevented by some antivirus and antispyware programs.

**Sniffing and Spoofing**

* Sniffing:
  + Capturing and recording network traffic.
  + Used by hackers to intercept information.
* Spoofing:
  + Attempting to gain access to a network by posing as an authorized user in order to find sensitive information.
  + Also happens when an illegitimate program poses as a legitimate one.

**Computer Crime and Fraud**

* A computer fraud is a unauthorized use of computer for personal gain.
* A computer crime can be identified has one of the following:
  + Denial-of-service attacks.
  + Identify theft and software piracy.
  + Distributing child pornography.
  + E-mail spamming.
  + Writing or spreading malicious codes.
  + Stealing files for industrial espionage.
  + Changing computer records illegally.
  + Virus hoaxes.
  + Sabotage.
  + Holding a firm’s critical data for ransom. i.e., ransomware.

**Computer and Network Security: Basic Safeguard**

* Comprehensive security system
  + Protects an organization’s resources.
  + Collectively protect information resources and keep intruders and hackers at bay.
    - Hardware
    - Software
    - Procedures
    - Personnel
* Important aspects of computer and network security: CIA triangle.
  + Confidentiality
  + Integrity
  + Availability
* McCumber cube
  + Framework for evaluating information security.
  + Represented as a three-dimensional cube.
  + Defines nine characteristics of information security.
  + Includes different states in which information can exist in a system.
  + Transmission, storage, and processing.

This image depicts the McCumber cube. The image is that of a three-dimensional cube.
The top side of the cube contains three labels that read transmission, storage, and processing. 
The right side of the cube contains three labels that read human factors, policy and practices, and technology. 
The left side of the cube contains three labels that read confidentiality, integrity, and availability. 

* Levels of network security:
  + Level 1: front-end servers protected against unauthorized access.
  + Level 2: back-end systems protected to ensure data confidentiality, accuracy, and integrity.
  + Level 3: corporate network protected against intrusion, denial-of-service attacks, and unauthorized access.
  + Planning a comprehensive security system: designing fault-tolerant systems
    - Ensure availability in the event of a system failure y using a combination of hardware and software.
    - Commonly used methods:
      * Uninterruptible power supply (UPS).
      * Redundant array of independent disks (RAID).
      * Mirror disks.

**Intentional Threats**

* Viruses and worms.
* Trojan programs
* Logic bombs
* Backdoors
* Blended threats.
* Rootkits.
* Denial-of-service attacks.
* Social engineering.

**Viruses**

* Consists of self-propagating program code that is triggered by a specific time or event.
* Attaches itself to other files, and the cycle continues when the program or operating system containing the virus is used.
* Transmitted through a network or e-mail attachments, or message boards.
* Prevented by installing and updating an antivirus program.

**Worms**

* Independent programs that can spread themselves without having to be attached to a host program.
* Replicate into a full-blown version that could end up eating computing resources.
* Examples: Code Red, Melissa, and Sasser.

**Trojan Programs**

* Contain code intended to disrupt a computer, network, or Web site.
* Hidden inside a popular program.

**Logic Bombs**

* Type of Trojan program used to release a virus, worm, or other destructive code.
* Triggered at a certain time of by a specific event.

**Backdoors**

* Programming routine built into a system by its designer or programmer.
* Enables the designer or programmer to bypass security and sneak back into the system later to access programs or files.

**Blended Threats**

* Combines characteristics of viruses, worms, and malicious codes with vulnerabilities on networks.
* Search for vulnerabilities in computer networks and take advantage of them.
* Embedding malicious codes in the server’s HTML files.
* Sending unauthorized e-mails from compromised severs with a worm attachment.

**Denial-of-Service Attacks**

* Flood a network or server with requests to prevent legitimate user’s access to the system.
* Distributed denial-of-service (DDoS) attack: thousands of computers work together to bombard a Web site with thousands of requests in a short period, causing it to grind to a halt.
* Botnet: network of computers and IoT devices: infected with malicious software and controlled as a group without owners’ knowledge.
* TDoS (Telephony denial of service) attacks: use high volumes of automated calls to tie up a target phone system, halting incoming and outgoing calls.

**Social Engineering**

* Using “people skills” to trick others into revealing private information.
* Commonly used social-engineering techniques.
  + Dumpster diving
  + Shoulder surfing
  + Tailgating
  + Scareware
  + Pretexting

**Security Measures and Enforcement: An Overview**

* Components of a comprehensive security system.
  + Biometric, nonbiometric, and physical security measures.
  + Access controls.
  + Virtual private networks.
  + Data encryption.
  + E-commerce transaction security measures.
  + Computer Emergency Response Team (CERT)
* Use a physiological element unique to a person that cannot be stolen, lost, copied, or passed on to others.
  + Biometric devices and measures.
    - Facial recognition, fingerprints, hand geometry, iris analysis, palm prints, retinal scanning, signature analysis, vein analysis, and voice recognition.

**Nonbiometric Security Measures**

* Three main nonbiometric security measures.
  + Callback modems.
    - Verify whether a user’s access is valid
    - Done by logging the user off and then calling the user back at a predetermined number.
    - Useful when many employees work off-site and need to connect to the network from remote locations.
  + Firewalls.
    - Combinations of hardware and software that acts as a filter between a private network and external networks.
      * Network administrator defines rules for access, and all other data transmissions are blocked.
      * Types: packet-filtering firewalls, application filtering firewalls, and proxy servers.

This image depicts the basic configuration of a firewall. It contains three rectangular boxes that have been positioned horizontally. 
Starting from the left, the first box is labeled private network. An arrow arises from the right side of this box and points at the second box, which is labeled firewall. The arrow is labeled outgoing data. An arrow arises from the right side of the second box and points at the third box, which is labeled Internet. 
An arrow arises from the left side of the third box and points at the second box. This arrow is labeled incoming data. An arrow arises from the left side of the second box and points at the first box. 

* + Introduction detection systems (IDS)
    - Protects against external and internal access.
    - Placed in front of a firewall.
    - Identifies attack signatures, traces patterns, and generates alarms for the network administrator.
    - Causes routers to terminate connections with suspicious sources.
    - Prevents DoS attacks.

**Proxy Server**

**This image depicts a proxy server.
There is a cloud on the left side of the image. This cloud is labeled Internet. A wave arises from the right side of this cloud and ends against a vertically-positioned line. On the right side of this line, there is a rectangular box that is labeled proxy. A line arises from this box and leads to an oval that is labeled L A N. Seven lines arise from the circumference of this oval and lead to seven different boxes with curved edges. In a clockwise manner of appearance, these boxes are labeled Web server, P C, file server, P C, database server, P C, and application server. 
**

**Physical Security Measures**

* Control access to computers and networks.
  + Include devices for securing computers and peripherals from theft.
  + Cable shielding and room shielding.
  + Corner bolts and steel encasements.
  + Electronic trackers, identification (ID) badges, and proximity-release door openers.

**Access Controls**

* Designed to protect systems from unauthorized access in order to preserve data integrity.
* Terminal resource security erases the screen and signs the user off automatically after a specified length of inactivity.
* Passwords: combination of numbers, characters, and symbols that is entered to allow access to a system.

**Virtual Private Network**

* Provides a secure tunnel through the internet for transmitting messages and data via a private network.
  + Gives a remote user have a secure connection to the organization’s network.
  + Provides security of extranets.
* Data is encrypted before it is sent with a protocol.
  + Layer two tunneling protocol (L2TP)
  + Internet Protocol Security (IPSec)
* Advantages:
  + Set-up costs are low
* Disadvantages:
  + Slow transmission speed.
  + Lack of standardization.

**Data Encryption**

* Transforms data, called plaintext or cleartext, into a scrambled form called ciphertext that cannot be read by others.
  + Receiver unscrambles data using a decryption key.
* Rules for encryption
  + Knows as the encryption algorithm
  + Determine how simple or complex the transformation process should be.
* Commonly used encryption protocols
  + Secure Sockets Layer (SSL): Manages transmission security on the internet.
  + Transport Layer Security (TLS): Cryptographic protocol that ensures data security and integrity over public networks, such as the Internet.
* Asymmetric encryption uses two leys
  + Public key known to everyone.
  + Encrypted message can be decrypted only with the same algorithm used by the public key and enquires the recipient’s private key.
  + Private or secret key known only to recipient.
  + Drawback: slow and requires a large amount of processing power.
* Symmetric (secret key) encryption: same key is used to encrypt and decrypt the message.
  + Sender and receiver must agree on the key and keep it secret.
  + Can be used to create digital signatures.
  + Drawback: sharing the key over the internet is difficult.

**E-Commerce Transaction Security Measures**

* Concerned with several issues.
  + Confidentiality
  + Authentication
  + Integrity
  + Nonrepudiation of origin
  + Nonrepudiation of receipt

**Computer Emergency Response Team**

* Developed by the Defense Advanced Research Projects Agency.
  + Focuses on security breaches and DoS attacks.
  + Offers guidelines on handling and preventing attacks.
  + Conducts publics awareness campaigns and research Internet security vulnerabilities.

**Guidelines for a Comprehensive Security System**

* Before establishing a security program, organizations should:
  + Understand the principles of the Sarbanes-Oxley Act 2002.
  + Conduct a basic risk analysis, which makes use of financial and budgeting techniques.
  + Information obtained helps organizations weight the cost of a security system.
* Steps when developing a comprehensive security plan.
  + Set up a security committee.
  + Post security policy in a visible place.
  + Raise employee awareness.
  + Ise strong passwords.
  + Install software patches and updates.
  + Revoke terminated employees’ passwords and ID badges immediately.
  + Keep sensitive data locked in secured locations.
  + Exit programs and systems promptly.
  + Limit computer access to authorized personnel.
  + Compare communication logs with communication billings periodically.
  + Install antivirus programs, firewalls, and intrusion detection systems.
  + Use only licensed software.
  + Ensure fire protection systems and alarms are up to date and test them regularly.
  + Check environmental factors.
    - Temperature and humidity levels.
  + Use physical security measures
    - Corner bolts on workstations, ID badges, and door locks.

**Business Continuity Planning**

* Outlines procedures for keeping a firm operational in the event of a natural disaster or network attack.
  + Disaster recovery plan lists the tasks that must be performed to restore damaged data and equipment and steps to prepare for disaster.
* Steps to follow when disaster strikes
  + Put together a management crisis team.
  + Contact the insurance company
  + Restore phone communication systems
  + Notify all affected people that recovery is underway
  + Set up a help desk to assist affected people
  + Document all actions taken

**Slide 06: Data Communication: Delivering Information Anywhere and Anytime**

**Data Communication**

* Electronic transfer of data from one location to another.
  + Enables information system to deliver information.
  + Improves the flexibility of data collection and transmission.
  + Improves the flexibility of data collection and transmission.
  + Basis of virtual organizations.
  + Provides e-collaboration.

**Why Managers Need to Know about Data Communication**

* Enhances decisions maker’s efficiency and effectiveness.
* Enable organizations to use email and electronic file transfer to improve efficiency and productivity.
* Effects of data communication technologies
  + Online training for employees can be provided via virtual classrooms.
  + Internet searches for information keep employees up to date.
  + The internet and data communication systems facilitate lifelong learning.
  + Boundaries between work and personal life are less clear-cut data communication is more available in both homes and business.
  + Web and video conferencing are easier.

**Basic Concepts of a Data Communication System**

* Bandwidth: amount of data that can be transferred from one point to another in a certain time period.
* Attenuation: loss of power in a signal as it travels from the sending device to the receiving device.
* Broadband: Multiple pieces of data are sent simultaneously to increase the transmission rate.
* Narrowband: Voice-grade transmission channel capable of transmitting a maximum of 56,000 bps, so only a limited amount of information can be transferred.
* Protocols:
  + Rules that govern data communication
  + Error detection, message length, and transmission speed.

**Sender and Receiver Devices**

* Input/output device, or thin client
  + Used only for sending or receiving information.
  + No processing power.
* Smart terminal: performs certain processing tasks but it is not a full-featured computer.
* Intelligent terminal, workstation, or personal computer
  + Performs certain processing tasks without the main computer’s support.
* Netbook computer:
  + Low-cost, diskless computer used to connect to the internet or a LAN.
  + Runs software off servers and saves data to servers.
* Minicomputers, mainframes, and supercomputers:
  + Process data and send it to the other devices.
  + Receive data that has been processed elsewhere, process it, and then transmit it to other devices.
* Smart mobile phones, MP3 players, and PDAs: advanced capabilities, with a built-in keyboard or an external USB keyboard.
* Video game console receives instructions from a game player and produces a video display signal on a television screen or monitor.

**Modems**

* Devices that connect a user to the Internet
  + Short for modulator-demodulator.
  + Not required for all Internet connections.
* Dial-up: analog modem is necessary to convert a computer’s digital signals to analog signals.
* Digital subscriber line (DSL): high speed service that uses ordinary phone lines.
* Cable modems: use the same cable that connects to TVs for internet connections.

**Communication Media**

* Connect sender and receiver devices
  + Can be conducted (wired or guided) or radiated (wireless).
  + Can be a point-to-point or a multipoint system.

**Types of Communication Media**

This figure illustrates a flowchart on the types of communication media. At the top, the first box reads transmission media. It has arrows connecting it to two more boxes. The first box reads conducted media, which is wired. The second box reads radiated media, which is wireless. The box labeled conducted media is connected to two boxes. The first box reads electrical conductors and leads to two other boxes. The first box reads wires, which consist of STP and UTP, and the second box reads coaxial cable. The second box reads light conductors. It connects to another box that reads fiber optics.
The box labeled radiated media is connected to two boxes. The first box reads radio frequency. The second box reads light frequency. Under radio frequency, there are five more boxes. The first box reads broadcast. The second box reads spread spectrum. The third box reads cellular. The fourth box reads microwave. The fifth box reads satellite.
The box that reads light frequency connects to another box that reads infrared.

**Processing Configurations**

* Data communication systems can be used in several different configurations: depending on users’ needs, types of applications, and responsiveness of the system.
* During the past 60 years, three types of process configurations have merged: centralized, decentralized, and distributed.
* Centralized processing:
  + Processing is done at one central computer.
  + Used in early days of computer technology.
  + Data-processing personnel were in short supply.
  + Hardware and software were expensive.
  + Advantage: ability to excise tight control on system operations and applications.
  + Disadvantage: lack of responsiveness to users’ needs.
* Decentralized processing:
  + Each user, department, or vision has its own computer for performing processing tasks.
  + Advantage: responsive to users.
  + Disadvantages:
    - Lack of coordination among organizational units.
    - High contrast of having many systems.
    - Duplication of efforts.
* Distributed processing:
  + Maintains centralized control and decentralized operations
  + Advantages:
    - Accessing unused processing power.
    - Computer can be added or removed.
    - Distance and location are not limiting.
    - More compatible with growth.
    - Fault tolerance is improved.
    - Resources can be shared to reduce costs.
  + Disadvantages:
    - More security and privacy challenges.
    - Incompatibility between various pieces of equipment.
    - Managing the network is challenging.