Chapter 1: Information Systems and You

- **Information system (IS)**: a group of components that interact to produce information

The Five Components of an Information System

Hardware	Software	Data	Procedures	People

More difficult to change ----------→

- **Management information systems (MIS)**: the development and use of information systems that help businesses achieve their goals and objectives
- **Information technology (IT)**: the methods, inventions, standards and products; raw technology that concerns only hardware, software and data components of IS model
  - IT, by itself, does not help an organization achieve its goals and objectives; it must be embedded into an IS to become useful
- **Moore's Law**: the number of transistors per square inch on an integrated chip doubles every 18 months
  - Essentially, this means the speed of computer chips double every 18 months
  - As a result, the price/performance ratio of computers (and other IT products) has dramatically declined over the years

Chapter 2: Business Processes, Information, and Decision Making

- **Business process**: a network of activities, resources, facilities, and information that interact to achieve some business function (e.g., inventory management, manufacturing, sales and support, etc. – See Figure 2-1, p. 25)

Components of a Business Process

1. Activities: transform resources and information of one type into resources and information of another type (e.g., quantity received and shipping invoice information into a payment)
   - Can be manual, automated or both
2. Resources: Items of value
   - Includes suppliers and customers
3. Facilities: structures used within a business process (e.g., inventories, databases, equipment, etc.)
4. Information

- **data**: recorded facts or figures
- Definitions of **information**:
  - Knowledge derived from data (e.g., individual wages in a department– data → average wage in the department – information)
  - Data presented in a meaningful context (e.g. employee's wage – data → employee makes half the average wage in the department – information)
  - Processed data (e.g. data that has been summed, ordered, averaged, grouped, compared, etc.)
  - A difference that makes a difference

Characteristics of Good Information

- Accurate
- Timely
- Relevant…
  - To context
  - To subject
- Just barely sufficient: We only want enough information to make decisions and no more
- Worth its cost: Benefits > Costs

- Automated system: an activity in a business process where the work formerly done by people following procedures is now done by computers following instructions in software

Hardware	Software	Data	Procedures	People

←----------Work moves from human side to computer side

A mostly automated system

Hardware	Software	Data	Procedures	People

←----------→

A mostly manual system

Hardware	Software	Data	Procedures	People

←----------→

Decision Levels

- **Operational**: concern day-to-day activities (e.g., ordering inventory, extending credit, paying accounts payable, etc.)
  - Supported by **transaction processing systems (TPS)**
- **Managerial**: concern the allocation and utilization of resources (e.g., departmental budgeting, employee-project assignment, etc.)
  - Supported by **management information systems (MIS)** (NOTE: In this context, we are referring to an information system that supports managerial-level decision making, not the broader definition introduced in Chapter 1)
- **Strategic**: concern broader-scope, organizational issues (e.g. product line expansion, regional expansion, competitor acquisition, etc.)
  - Supported by **executive information systems (EIS)**

Decision Structures

- **Structured decision**: a decision for which there is an understood and accepted method for making the decision (e.g. inventory reordering in a just-in-time system)
- **Unstructured decision**: a decision for which there is no agreed-on decision making method (e.g. assessment of prospective employee suitability for job performance)
- Note: We are using the terms "structured" and "unstructured" in relation to the decision process, not the underlying subject. For example, weather forecasting is

a structured decision because standardized and agreed-upon methods are used by all meteorologists, but weather itself is unstructured.

Relationship between Decision Level and Decision Process

- See Figure 2-8, p. 33

Decision Making Steps

1. Intelligence gathering: What is to be decided, what the criteria for the decision will be, what data are available
2. Alternatives formulation: Determining the various alternatives
3. Choice: Analyzing the choices against the criteria using data, selecting an alternative
4. Implementation
5. Review: Evaluate results of decision, repeat process if necessary

Chapter 3: Organizational Strategy, Information Systems, and Competitive Advantage

- **Productivity paradox**: the lack of evidence of an increase in worker productivity associated with the massive increase in investment in IT
  - Difficulty in measuring productivity in increasingly service-based economy partly responsible
  - Intangible productivity benefits associated with IT
- Three ways through which the value of IT can be realized:
  1. Productivity increases: More output from the same inputs, better output, or faster output production
  2. Structure of competition: Altering the way corporations compete (e.g., when one corporation in an industry invests in IT, competing firms often do the same to not be at a competitive disadvantage)
  3. By the customer: Increased competition → productivity increases → reduced costs → savings passed on to customers

- Productivity in organizations can be increased through increased
  - Efficiency: Business processes accomplished more quickly or with fewer resources and facilities, or both – "doing things right"
  - Effectiveness: Changing business processes to deliver something new and improved – "doing the right things"

- **Value chain**: formalized by Michael Porter, a network of activities that improve effectiveness (or value) of a good or service (e.g., rubber harvested → shipped to manufacturer → tire designed → rubber manufactured into tire → tire packaged → tire sent to retailer → tire offered with warranty)
  - Each business process adds more and more value
  - In general, the more value a company adds to good/service, the higher the price it can charge
  - **Margin**: the difference between the price the customer is willing to pay and the cost the company incurs in moving the good or service through the value chain
- **Primary activities**: activities where value is added directly to the product (e.g., inbound logistics, operations, outbound logistics, marketing/sales, service, etc.)
- **Support activities**: activities that contribute indirectly to value creation (e.g., procurement, technology, human resources, company's infrastructure, etc.)

- **Porter's Five Forces Model**: five competitive forces determine industry profitability:

1. Bargaining power of customers
2. Threat of substitutions
3. Bargaining power of suppliers
4. Threat of new entrants
5. Rivalry among existing firms

- See Figure 3-4, p. 51

- **Competitive strategy**: the strategy an organization chooses to succeed in its industry

Porter's Four Competitive Strategies

	Cost	**Differentiation**
Industry-wide	Lowest cost across industry	Better product/service across industry
Focus	Lowest cost within industry segment	Better product/service within industry segment

Types of Technological Innovation

- **Sustaining technologies**: changes in technology that maintain the rate of improvement in customer value (e.g., improvements in production of rubber allowing the production of tires that perform better)
  - Help make processes more efficient (and often more effective) → create value for organizations
- **Disruptive technologies**: technologies that introduce a very new package of attributes to the accepted mainstream products (e.g., the change from cassette tapes and CDs to MP3 players)
  - When used to gain competitive advantage, can alter structure of the industry or even create a new industry
- IT can act as either type of technological innovation

Principles of Competitive Advantage

Product Implementations

1. Create a new product/service
2. Enhance products/services
3. Differentiate products/services

System Implementations

4. Lock in customers/buyers
5. Lock in suppliers

        - **Switching costs**: Costs incurred when switching from one company's products/services to another's (can be created by making it difficult to switch to competitors, or by making it easy to work with the organization)
    6. Establish alliances
        - Alliances establish standards, promote product awareness, develop market size, reduce purchase costs, etc.
    7. Reduce costs

- Because the effects of IT are easily seen, competing technologies are quickly developed and become readily available, and therefore it is difficult to sustain competitive advantage from IT
- When IT is integrated into an IS, different organizations will likely have largely different results
    - Long-term competitive advantage lies not with technology, but how an organization adopts technology
    - Requires organizations to find distinctive ways to compete

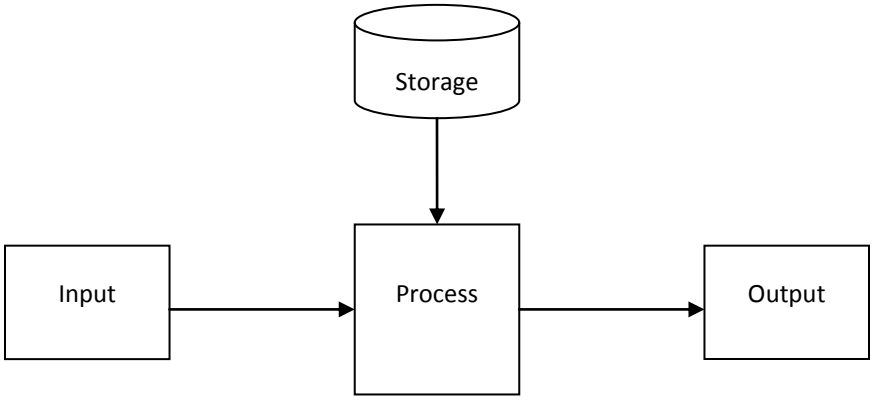
Chapter 4: Hardware and Software

History of Computers

- Early computers (1939-1952)
  - First digital computer: ENIAC
  - Could only run one program at a time
  - Housed in universities
- Mainframes (1952-Present)
  - **Mainframe**: first digital machines used in business and government
  - First-generation based on vacuum tubes; second generation built with transistors
  - Third-generation mainframes included operating systems and multiprocessing, but cost millions of dollars
- Microcomputers (1975-Present)
  - First microcomputer: MITS Altair 8800
  - Companies such as Microsoft began writing programming languages, programs and operating systems for use on microcomputers
  - Evolved into what we use today
- Networking Personal Computers (1985-Present)
  - Local Area Networks (LANs) using Ethernet to share data among microcomputers
  - 1990s: Commercialization of Wide Area Networks (WANs) such as the Internet

- **Hardware**: electronic components and related gadgetry that input, process, output, store and communicate data according to instructions encoded in computer programs or software
- **E-cycling**: the recycling of electronic hardware

Computer Hardware



- **Input hardware**: keyboard, mouse, document scanners, barcode scanners, microphones, webcams, tablets, etc.

- **Central processing unit (CPU)**: selects instructions, processes them, performs arithmetic and logical comparisons, and stores results of operations in memory (e.g., Intel Core 2 Duo/Quad, AMD Athlon 64/Phenom)
    - Performance factors:
        - Speed (clock rate): the rate at which a CPU can perform operations
        - **cache memory**: fast memory that stores frequently used instructions
            - This memory is **volatile**, which means its contents are lost when the computer is shut off
        - **Data bus/channel**: the means by which the CPU reads/writes instructions from/to main memory
        - data bus/channel speed: how fast instructions can be moved from main memory to the CPU
        - data bus/channel width: how many instructions can be transferred through the data bus at the same time
- **main memory (RAM)**: a set of cells in which each cell holds a byte of data or instructions; each cell has an address, and the CPU uses the addresses to identify particular data items
    - Also volatile
    - Performance factors
        - Size: the greater the quantity of memory, the more programs that can be run at the same time (or the same amount of programs more smoothly)
        - Speed
    - If a new program is opened or more data is created and not enough memory is available, the operating system, by a process known as

memory swapping, will remove existing programs/data from memory and place it temporarily on the hard drive to make room for the new program/data. This greatly reduces computer performance.

- **Special function cards**: add special functionality to a computer (e.g., video card for enhanced 3D capability; sound card to add/enhance audio; etc.)

- **Output hardware**: monitors (CRT, LCD), printers, speakers, projectors, etc.

- **Storage hardware**: saves data and programs
    - These are all **nonvolatile**, which means that the data are preserved when power is disconnected
    - Types of storage hardware:
        - Magnetic disk
            - Performance factors:
                - Size
                - Channel type and speed
                - Rotational speed
                - Seek time: the time it takes for the read head to get in position over the data on the disk
        - CD (700mb)
        - DVD (Single layer: 4.7GB, Dual Layer: 8.5GB)
        - Magnetic tape: usually only used for backup purposes

Computer Data

- **Binary digit (bit)**: how computers represent all data; a bit is either a 0 (off) or a 1 (closed)
- **Byte**: a group of 8 bits; represents one character

byte	8 bits
kilobyte (KB)	1024 bytes
megabyte (MB)	1024KB
gigabyte (GB)	1024MB
terabyte (TB)	1024GB

- Note: Hardware manufacturers often simplify these conversions so each unit is 1000 of the smaller unit (i.e., 1GB = 1000MB)

Difference between Clients and Servers

- **Client**: a computer that provides word processing, spreadsheets, database access, and usually a network connection
    - **Thin client**: a software application that requires nothing more than a browser and can be run only on the user's computer
    - **Thick client**: a software application that requires programs other than just the browser on a user's computer (i.e., requires code on both client and server computers)
        - Does not need network access to run
- **Server**: a computer that provides some type of service, such as hosting a database, publishing a website, etc.
    - Faster, larger and more powerful than client computers
    - **Server farm**: a large collection of server computers that coordinates the activities of the servers, usually for commercial purposes

Software

- **Operating system (OS)**: a program that controls the computer's resources
    - Manages contents of main memory, processes keystrokes and mouse movements, sends signals to the monitor, reads and writes files, and controls the processing of other programs
- **Instruction set**: the commands that a CPU can process
    - Operating systems only work with processors that conform to a certain instruction set (e.g., Windows on Intel/AMD instruction set, Mac OS on PowerPC instruction set)
- When purchasing software, you are not buying the software, you are buying a **license** to use the software
- **Application software**: programs that perform a business function (e.g., Word, Excel, QuickBooks, etc.)
    - **Horizontal-market application**: software that provides capabilities common across all organizations and industries (e.g., word processors, spreadsheets, graphics programs, etc.)
        - Purchased off-the-shelf
        - Generally little customization possible
    - **Vertical-market application**: software that serves the needs of a specific industry (e.g., dental office appointment/billing software, auto shop customer/car software, etc.)
        - Usually sold by developer
        - Generally customizable
    - **One-of-a-kind application**: software developed for a specific, unique need

- **Firmware**: computer software that is installed into devices like computer hardware, printers and various communication devices
    - Installed into special read-only memory (ROM)
    - Tells the device how to function
    - **Basic Input/Output System (BIOS)**: Firmware used when booting a computer; checks to make sure memory and input devices are working and then loads the OS

Operating Systems

- Windows
    - Current version: Vista
    - On 85% of world's computers, 95%+ of business computers
- Mac OS
    - Current version: OS X Leopard
    - Used primarily by graphic design/arts community, but its use is expanding
- Unix
    - Used primarily in scientific and engineering community
    - Very difficult for the average user to use
- Linux
    - A version of Unix developed by the **open source** (software in which the source code is published and open to modification) **community**
    - Free
    - Primarily used in software development industry and on servers due to stability

Security Issues

- **Virus**: a computer program that replicates itself
- **Payload**: the program code that causes unwanted activity (e.g., the code that deletes data)
- **Macro virus**: a virus that attaches itself to a Word, Excel or other type of document and when opened, places itself in the startup files of that application and infects every file that is subsequently created or processed by the application
- **Worm**: a virus that propagates using the internet or other computer network
- **Patch**: a group of fixes for high-priority failures that can be applied to existing copies of a particular product to fix security problems
- **Antivirus program**: software that detects and possibly eliminates viruses

Chapter 5: Database and Content Management

- **Intellectual property**: a form of creative endeavor that can be protected through a trademark, patent, copyright, industrial design, or integrated circuit topography
- Content varies by industry (e.g., commercials in advertising industry; accounting info in banking industry
- Challenge in content management is processing and storing the right content and getting the right content to the right person in the right format at the right time
- Content management can be split into
    - Data management: handled by database management systems (DBMS)
    - Presentation of content: more and more, handled by content management systems (CMS)

Databases

- Lists (most often Excel spreadsheets) are useful for keeping track of data on one theme (e.g., student marks)
    - They often become cumbersome to use when tracking more than one type of data (e.g., adding office visit info to the marks spreadsheet)
- Databases are much more efficient at keeping track of data that involve more than one theme (See Figure 5-2, p. 99)
- **Database**: a self-describing collection of integrated records
    - **Bytes** (a character of data) are grouped into…
    - **Fields** (or columns, e.g., Student Name, Assignment #1 Mark), which are grouped into…
    - **Records** (or rows), which describe a group of fields relating to one entity (e.g., Student 25's Assignment #1, Assignment #2 and Midterm marks), which make up…
    - A **table** (or file): a group of similar records
    - Databases must also include not only tables, but **relationships among the rows in those tables** and **metadata**

"Integrated": Relationships among Rows in a Table

- **key**: a column or group of columns that identifies a unique row in a table (e.g. Student number)
    - every table must have a key
    - used to relate rows in one table to rows in another table

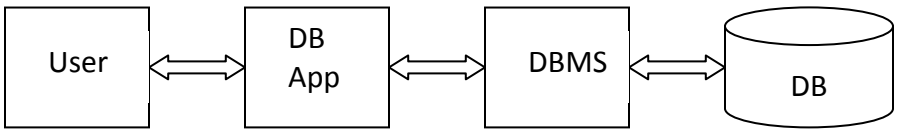
- When a key in one table (e.g., Student Number) is referenced in a second table (e.g., Office Visits), that key is a **foreign key** of the second table
- **Relational database**: a database that carries its data in the form of tables and that represent relationships using foreign keys

"Self-Describing": Metadata

- **Metadata**: data that describe data
- Explains the data in a database
- e.g., the field "EmailNum" is an automatically generated number which is the primary key of the Email table

Making Databases Useful

- **database management system (DBMS)**: a program used to create, process and administer a database (e.g., Microsoft Access and SQL Server, Oracle, MySQL)
    - Functions of the DBMS
        1. Creating the database and its structures (i.e., creating tables, relationships)
        2. Processing the database: Reading, inserting, modifying or deleting data
            - **Structured Query Language (SQL)** is the international standard language for database processing
        3. Administering the database: Managing security, permissions, user accounts, performance, etc.
- **Database application**: a collection of forms, reports, queries and application programs that process a database
    - **Data entry form:** used to read, insert modify and delete data
    - **Report:** show data in a structured context
    - **Query form**: used to find records quickly
    - other important database application programs process logic specific to given business needs (e.g., order processing) and allow for processing of the database over the internet



- **multiuser processing**: when multiple users process the database at the same time

- **lost update problem**: an issue in multiusers database processing in which two or more users try to make changes to the data, but the database cannot make all the changes because it was not design to process changes from multiple users
    - e.g., Two employees retrieve inventory data on the same item while processing a customer order. A value of 10 units is returned. Employee A files an order for 5 units, reducing the value in the database to 5. However, since Employee B has the outdated value of 10, when he files his order for 3, an incorrect value of 7 will be saved in the database.

- Two categories of DBMS products:
    - Enterprise DBMS: process large organizational and workgroup databases
        - Support thousands of users, 2/47 operation, databases spanning many hard drives
        - Includes IBM DB2, Microsoft SQL Server, Oracle
    - Personal DBMS: designed for smaller, simpler database applications
        - Usually supports less than 100 users
        - Only remaining personal DBMS is Microsoft Access
        - **NOTE**: For personal DBMS, application programs and the DBMS itself are packaged together

Chapter 6: Networks and Communications Technology

- **Global Positioning System (GPS)**: a collection of dozens of satellites orbiting the earth that transmit precise microwave signals
    - A GPS receiver can calculate its position by measuring the distance between itself and several of the satellites
- **Computer network**: a collection of computers that communicate with one another over transmission media
    - **Local area network (LAN)**: connections computers that reside in a single geographic location on the premises of a company that operates the LAN (generally connects two to several hundred computers)
    - **Wide area network (WAN)**: connects computers at different geographic locations
        - To create a WAN, a company must contract with a communications vendor to link the sites
    - **internet**: a network of networks (note the lower case "i")
    - **The Internet**: the collection of networks that you use when you send email or access the World Wide Web
- **Protocol**: a set of rules that two communicating devices follow
    - Different protocols uses for LANs, WANs, internets and the Internet, but two communicating devices must use the same protocol to communicate

Components of a LAN

- **Switch**: a special-purpose computer that receives and transmits messages on the LAN (e.g., a computer wanting to print has its data redirected to the printer)
- **Network interface card (NIC)**: a hardware component on each device on a network that connects the device's circuitry to the communications line
- **MAC (media access control) address**: a unique (physical) address assigned to every NIC when it is manufactured
- **Unshielded twisted pair (UTP) cable**: a type of cable used to connect devices on a LAN
- **Optical fiber cables**: a type of cable that uses light rays that are reflected inside the glass core of the cable to transmit data; used when large amounts of data are transmitted and/or over long distances
- **Ethernet (IEEE 802.3 protocol)**: specifies hardware characteristics and describes how messages are to be packaged and processed for transmissions over a LAN
    - **10/100/1000 Ethernet**: a type of Ethernet that conforms to IEEE 802.3 protocol and allows for transmission at a rate of 10, 100 or 1000 Mbps

- **Wireless NIC (WNIC)**: a device that enables connection to wireless networks by communicating with an access point
    - Most popular wireless network today is 802.11g (54Mbps); fastest is 802.11n (248Mbps)
- **Access point (AP)**: a point in a wireless network that facilitates communication among wireless devices and serves as a point of interconnection between wireless and wired networks
    - Processes messages according to both the 802.3 and 802.11 standards

Connecting to the Internet

- **Router**: a special-purpose computer that implements the protocol for WANs
    - Connects your computer to computers owned and operated by your ISP
- An **Internet Service Provider (ISP)** has three important functions:
    1. Provides your computer with a legitimate Internet address (an IP address)
    2. Serves as your gateway to the Internet (i.e., receives communications from your router and passes them on to the Internet and vice-versa)
    3. Helps pay for the Internet (collets money from customers to pay access fees and other charges)

- **Hypertext transfer protocol (HTTP)**: a protocol used to process web pages
- **Browser**: a program that implements HTTP protocol (e.g., Internet Explorer, Firefox)
- Note: The World Wide Web and the Internet are not the same thing. The web is a subset of the Internet consisting of sites and users that process HTTP, while the internet is a communication structure that supports protocols such as HTTP, FTP and SMTP.
- **Uniform Resource Locator (URL)**: a document's address on the Web (not its actual address)
    - The top-level domain in a URL is the last letters after the last period (e.g., .com, net., .org, .ca, etc.)
- **IP address**: a series of four dotted decimal numbers between 0 and 255 (e.g. 192.168.0.1)
    - On the internet, public IP addresses are assigned to ISPs and institutions
    - Private IP addresses are used within private networks and internets
    - Usually when you plug your computer into a LAN, your modem or sign onto a wireless network, a program called DHCP (Dynamic Host Configuration Protocol) running on a DHCP server will assign your computer an IP address
- **Domain Name Server (DNS)**: a system that converts user-friendly names into their IP addresses

- When you type a URL into your browser, a DNS server *resolves* the URL to convert it into its IP address

Internet Connections

- **Modem**: converts the computer's digital data into analog signals, which can be transmitted over telephone or cable lines
- **Dial-up modem**: a modem that performs the conversion between analog and digital in such a way that it the signal can be carried over a regular phone line (max speed: 56k – narrowband)
- **Digital subscriber line (DSL) modem**: operates on the same lines as voice telephones, but they operate so that their signals do not interfere with voice telephone service (speeds of over 256kbps – broadband)
    - **Asymmetric DSL (ADSL)**: slower upload speed than download speed (e.g., 1.5Mbps download and 512kbps upload)
    - **Symmetrical DSL (SDSL)**: same download and upload speeds
- **Cable modem**: a type of modem that provides high-speed data transmission using cable television lines (max speed: 10Mbps – broadband)
    - Shared bandwidth → speed depends on how many other users are using the Internet
- Wireless WANs (WWAN) use cellular networks to transfer data
    - Laptop with wireless WAN modem connects to base station on the wireless network via radio waves, which is carried to a mobile switching center, then onto the appropriate network
- **Firewall**: a computing device that prevents unauthorized network access
    - Can be a special-purpose computer, on a router, or software
    - **Port**: a number used to uniquely identify a transaction over a network (e.g., 80 for HTTP)
    - Firewalls can restrict access to ports, prohibiting certain traffic
    - **Intranet**: a private version of the Internet that is only available to employees within an organization who are behind a firewall
    - **Access control list (ACL)**: a firewall feature that keeps track of which IP addresses are allowed and which are to be prohibited access
    - **Packet-filtering firewall**: a firewall that examines each packet and determines whether to let the packet pass, depending on its source address, destination address and other data

How Does Email Actually Work?

- **Transmission Control Program/Internet Protocol (TCP/IP)** architecture

1. **Network Access Layer**: describes the equipment that is used for communication (e.g., UTP, fiber-optic cables), the signaling used (analog/digital) and the protocols used to communicate between machines
2. **Internet Layer**: Works with IP addresses to route messages across the Internet in the form of *packets* (i.e., segments with IP information attached), or reassemble them if the recipient
3. **Transport Layer**: Opens connections and maintains them; breaks apart large messages into *segments*; using TCP, ensures packets reach their destination
4. **Application Layer**: Data passed between programs

- Read Q6. How Does Email Actually Work? (p. 169-173) for full explanation of how data is transmitted over the Internet
- **Packet-switching network**: a system in which messages are first disassembled into small packets, then sent through the network and reassembled at the destination

Other Networking and Communications Technology

- **Virtual private network (VPN)**: a WAN connection alternative that uses the Internet or a private internet to create the appearance of private point-to-point connections
    - **Tunnel**: a virtual, private pathway over a public or shared network from the VPN client to the VPN server
    - Encryption is used to ensure secure transmission of data
- **Voice over Internet Protocol (VoIP)**: a technology that provides telephone communication over the Internet
    - Advantages: Free calling (through software), unlimited international calling, the ability to route calls to your VoIP phone regardless of where you're connected
    - Disadvantages: Reliability issues
- **Web crawler**: a software program that browses the web in a very methodical way
    - Collects URLs and sometimes even full text and images for search engines
    - Once URLs have been identified, they are organized by a process known as *search engine indexing* → allows for fast searching involving a large number of results