

16th Edition

Understanding Computers

Today and Tomorrow

Comprehensive

Chapter 1

Introduction to the World of Technology

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Overview

- This chapter is an overview
- In Computer Science we often introduce topics and later in subsequent chapters and courses, we go deeper and deeper into detail and understanding => less and less abstraction
 - *Abstraction - the process of removing physical, spatial, or temporal details or attributes in the study of objects or systems in order to focus attention on details of higher importance, it is also very similar in nature to the process of generalization;*



Abstraction & Representation

- Of course cannot put a car into a computer to run a traffic simulation so we must represent it
 - => Digitally & Virtually
- We abstract the object and model and represent its properties



What Is a Computer and What Does It Do?

- A **computer** is a programmable, electronic device that accepts data, performs operations on that data, and stores the data
 - Its instructions, called programs, determine the tasks the computer will perform
 - Basic operations (the IPOS cycle)
 - **Input**: Entering data into the computer
 - **Processing**: Performing operations on the data
 - **Output**: Presenting the results
 - **Storage**: Saving data, programs, or output for future use
 - Not included in all textbooks as many texts define computing just as Input, Processing and Output as Storage can be a type of Output as is Communications below
 - **Communications**: Sending or receiving data
- ➔ IPOS Definition scales from device up to Information System



Data vs. Information

- Data
 - Raw, unorganized facts
 - Can be in the form of text, graphics, audio, or video
- Information
 - Data that has been processed into a meaningful form
- Information processing
 - Converting data into information



Data

012569856

Does this mean anything to anyone?



Information

SSN

012569856

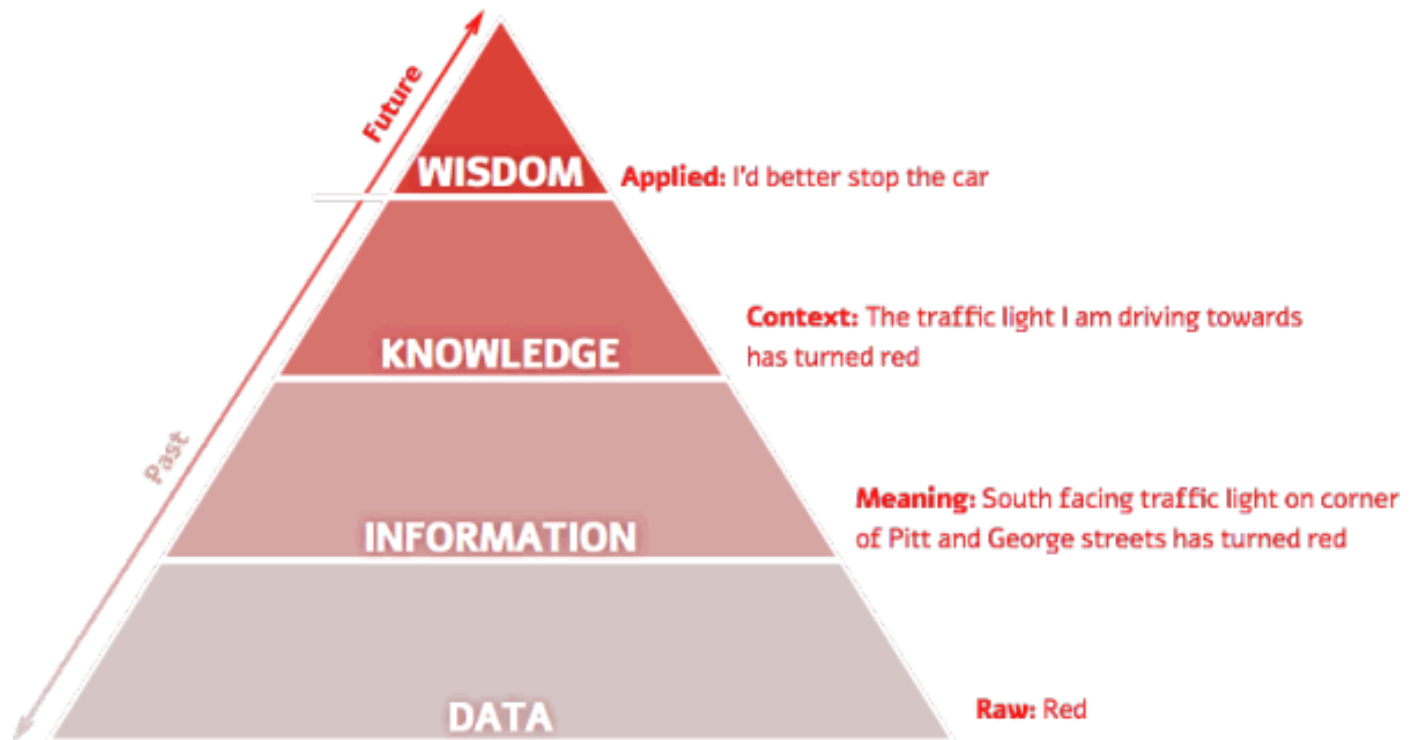
Now did this add context?

Now what is a SSN?

SSN - Unique text (not number)
corresponds 1 to 1 with an individual
=> This corresponds to Knowledge

Information Hierachy

Stop Light Example





Computers Then and Now: Precomputers and Early Computers

- The computer as we know it is a fairly recent invention
- The history of computers is often referred to in terms of generations
- Each new generation is characterized by a major technological development
 - Note there were corresponding generational advances in both Operating Systems (OS) and Programming Languages
- Precomputers and early computers (before approx. 1946)
 - Abacus, slide rule, mechanical calculator
 - Punch Card Tabulating Machine and Sorter



Computers Then and Now: First and Second Generation Computers

- First-generation computers (1946-1957)
 - Enormous and powered by vacuum tubes
 - Used a great deal of electricity and generated a lot of heat
 - ENIAC and UNIVAC
- Second-generation computers (1958-1963)
 - Used transistors
 - Computers were smaller, more powerful, cheaper, more energy-efficient, and more reliable
 - Punch cards and magnetic tape were used for input
 - Punch cards and paper were used for output
 - Magnetic tape was used for storage



Computers Then and Now: Third and Fourth Generation Computers

- Third-generation computers (approximately 1964–1970)
 - Used integrated circuits (ICs), which consist of transistors and electronic circuits on a single tiny silicon chip
 - Keyboards were used for input; monitors for output
 - Hard drives were used for storage
- Fourth-generation computers (approximately 1971–present)
 - Use microprocessors, which contain the core processing of an entire computer on a single chip
 - Keyboards and mice are used for input; monitors and printers for output; hard drives, flash memory media, and optical discs for storage
 - Networks and the Internet were developed

Computers Then and Now: Fifth Generation Computers

- Fifth-generation (now and the future)
 - Most commonly defined as being based on artificial intelligence (AI)
 - Some aspects like voice and touch input are used today
 - Future computers may be different, such as:
 - Optical computers
 - Tiny computers that utilize nanotechnology
 - General-purpose computers built into everyday devices



FIFTH-GENERATION COMPUTERS

Some aspects of fifth-generation computers, such as the natural language input and artificial intelligence used by the IBM Watson computer shown competing on *Jeopardy!* here, already exist.

Source: IBM Corporate Archives, U.S. Army; IBM Corporation


FIGURE 1-7

A brief look at computer generations.



Contemporary Computing

- Pervasive computing
 - Also known as ubiquitous computing
- Convergence
 - Electronic devices are converging into single units with multiple capabilities
 - => Convergence can be disruptive
 - => Business-IT-Society Triangle



Hardware (full chapters on these topics)

- **Hardware** is the physical parts of a computer
 - Internal hardware
 - Located inside the main box (system unit) of the computer
 - External hardware
 - Located outside the system unit
 - Connect to the computer via a wired or wireless connection
 - Hardware devices are associated with all five computer operations



Input, Processing and Output Devices

- Input devices
 - Used to input data into the computer
 - Include keyboards, mice, scanners, cameras, microphones, pens, touch pads, touch screens, fingerprint readers, etc.
 - Missing sensors for Internet of Things
- Processing devices
 - Includes the central processing unit (CPU), which performs calculations and controls the computer's operation
 - Also includes additional processors, such as the graphics processing unit (GPU), and memory
- Output devices
 - Present results to the user
 - Includes monitors, printers, speakers, headphones, etc.
 - Missing haptics



Storage and Communications Devices

- Storage devices
 - Used to store data on or access data from storage media
 - Include hard drives, CD/DVD discs and drives, USB flash drives, etc.
- Communications devices
 - Allow users to communicate with others and to electronically access remote information
 - Includes modems, network adapters, routers, etc.



Software

- **Software** is the program or instructions used to tell the computer hardware what to do
 - System software allows the computer to operate
 - Includes the **operating system**, which starts up the computer and controls its operation
 - Without an operating system, a computer cannot function



Operating System (System)

- The operating system **boots** the computer and launches programs at the user's direction
 - Unified Extensible Firmware Interface (UEFI)
 - NVRAM / EEPROM
 - please research the Boot Process located here:
http://www.webopedia.com/DidYouKnow/Hardware_Software/2004/BootProcess.asp
- Most OS use graphical objects to interact with the user via icons, buttons, tiles, etc.
 - Includes Windows, OS X, Linux, Android, iOS, etc.
 - The **desktop** is the work area for PCs
- We will explore Command Line Interface (CLI) in Linux



Application Software (Apps)

- **Application software (apps)** perform specific tasks or applications
 - Creating letters, budgets, etc.
 - Managing inventory and customer databases
 - Editing photographs
 - Scheduling appointments
 - Viewing Web pages
 - Exchanging e-mail
 - Burning DVDs
 - Designing homes
 - Playing games, watching videos, listening to music
 - Writing computer programs and creating Web pages



Computer Users and Professionals

- Computer users (end users) use a computer to perform tasks or to obtain information
- Computer professionals include:
 - Programmers
 - Write programs that computers use
 - Systems analysts
 - Design computer systems
 - Computer operations personnel
 - Manage day-to-day computer operations
 - Security specialists
 - Secure computers and networks against hackers



Computers To Fit Every Need

- Six basic categories of computers:
 - Embedded computers
 - Mobile devices
 - Personal computers
 - Servers
 - Mainframe computers
 - Supercomputers

Embedded Computers

- An **embedded computer** is designed to perform specific tasks or functions for the product in which it is embedded
 - Household appliances
 - Thermostats
 - Sewing machines
 - Treadmills
 - Answering machines
 - Cars
 - Self-driving cars
 - => IoT



Source: Google Inc.

FIGURE 1-12
Google's self-driving car prototype.

Mobile Devices

- A **mobile device** is a very small device with some type of built-in computing or Internet capability
 - Typically has a small screen and keyboard
 - Many use voice or touch input
 - Can perform Internet searches, pay for products, and view documents
 - Include **smartphones**, handheld gaming devices, **tablets**, and smart watches



FIGURE 1-13
Mobile devices.



Portable Computers

- A **portable computer** is designed to be carried around easily
 - **Notebook (laptop) computers**
 - Typically use a clamshell design
 - **Tablet computers**
 - Usually use a digital pen/stylus or touch screen
 - No physical keyboard; on-screen or attached keyboard
 - **Hybrid notebook-tablet computers**
 - Can function as either a notebook or a tablet
 - **Netbooks**
 - Smaller; designed for accessing Internet resources



Thin Client and Internet Appliances

- A **thin client** is designed to utilize a network for much of its processing
 - Advantages include lower cost, increased security, and easier maintenance
 - Disadvantages include limited or no local storage and the inability to function if the network is down
 - => Enterprise Servers typically backed up, have generator backup up and in VDI can support ubiquitous computing allowing users to relocate and continue their work.
- An **Internet appliance** is an ordinary device that can be used for accessing the Internet
 - Some use apps to deliver news, sports scores, weather, music, and other Web-based information
 - Include smart TVs, refrigerators, and other appliances

Servers

- A **server** is a midrange computer used to host programs and data for a small network
 - Users connect via a network with a computer, thin client, or dumb terminal
 - **Virtualization** refers to creating virtual rather than actual server environments
 - Used to share a server for increased efficiency
 - Desktop virtualization delivers a user's desktop to his or her current device

FIGURE 1-17

Servers. Are used to host data and programs, such as for a school computer lab or medical office network.

The user connects to the server using a computer, thin client, or dumb terminal.



The server is typically stored in a nearby closet or other out-of-the-way place.



Mainframe Computers

- A **mainframe computer** is a powerful computer used by many large organizations to manage large amounts of centralized data
 - Often used in hospitals, universities, large businesses, banks, government offices, etc.
 - Located in climate-controlled data centers and connected to the rest of the company computers via a network
 - Runs programs to meet the needs of a wide variety of users, as well as large processing tasks during off hours
 - Often uses virtualization; used for new and emerging needs such as processing data from smart meters and running social networks
 - Also called high-end servers or enterprise-class servers



Supercomputers

- A **supercomputer** is the fastest, most expensive, most powerful type of computer
 - Generally run one program at a time, as fast as possible
 - New applications include hosting extremely complex Web sites and three-dimensional applications
 - Can cost several million dollars each
 - Tend to be very large and contain a large number of processors
 - Example: Titan is one of the fastest computers in the world
 - Contains more than 300,000 processors
 - Peak speed is 27,000 calculations per second



Computer Networks and the Internet

- A **computer network** is a collection of hardware and other devices that are connected together
 - Users can share hardware, software, and data
 - Users can communicate with each other
 - Users can share an Internet connection
 - Most computers and mobile devices today connect to a computer network
 - Examples include small and large business networks, school networks, home networks, public wireless networks, and mobile telephone networks



What Are the Internet and the World Wide Web?

- The **Internet** is the largest/most well-known computer network in the world
 - Individuals connect using an **Internet service provider (ISP)**
 - ISPs connect to regional networks, which connect to backbone networks, which connect to form the Internet
- The **World Wide Web (Web)** is one resource (a vast collection of **Web pages**) available through the Internet
 - Web pages typically contain **hyperlinks**
 - **Web sites** contain Web pages stored on **Web servers**
 - Web pages are viewed using a **Web browser** (Edge, Internet Explorer (IE), Chrome, Safari, Firefox, Opera, etc.)
 - Web pages offer a wide variety of information and uses



Accessing a Network or the Internet

- Need a network adapter to connect
- Many networks require a username and password
- Internet connections can be:
 - Direct (always-on) connections
 - Dial-up connections
- **Internet addresses** access resources on the Internet
 - The most common types of Internet addresses:
 - IP addresses and domain names (to identify computers)
 - Uniform Resource Locator (URL) identifies Web pages
 - E-mail addresses (username) identifies person)

IP Addresses and Domain Names

- An **IP (Internet Protocol) address** is a numeric address that identifies computers (such as 134.170.185.46)
 - IPV4 above is 4 bytes => 32bits
 - IPV6 => 128 bits
- A **domain name** is a name (such as microsoft.com) that corresponds to an IP address
 - The top-level domain (TLD) is the far right part of the name and identifies the type of the organization or its location

FIGURE 1-22
Sample top-level domains (TLDs).

ORIGINAL TLDS	INTENDED USE
<i>.com</i>	Commercial businesses
<i>.edu</i>	Educational institutions
<i>.gov</i>	Government organizations
<i>.int</i>	International treaty organizations
<i>.mil</i>	Military organizations
<i>.net</i>	Network providers and ISPs
<i>.org</i>	Noncommercial organizations

NEWER TLDS	INTENDED USE
<i>.aero</i>	Aviation industry
<i>.biz</i>	Entrepreneurs and growing businesses
<i>.expert</i>	Individuals branding themselves as an expert
<i>.fr</i>	French businesses
<i>.info</i>	Resource sites
<i>.jobs</i>	Employment sites
<i>.name</i>	Individuals (personal branding)
<i>.nyc</i>	New York City businesses
<i>.us</i>	United States businesses



Uniform Resource Locators (URLs)

- A **Uniform Resource Locator (URL)** uniquely identifies a Web page
 - It indicates:
 - The protocol or standard being used, such as:
 - http:// for Web pages
 - https:// for secure Web pages
 - ftp:// for some file transfers
 - The Web server hosting the page
 - The names of the folders in which the Web page file is stored
 - The Web page's filename



E-Mail Addresses

- An **e-mail address** consists of:
 - A **username**
 - An identifying name (unique within a domain name)
 - The @ symbol
 - The domain name for the computer that will be handling the person's e-mail (mail server)
- Pronouncing Internet addresses

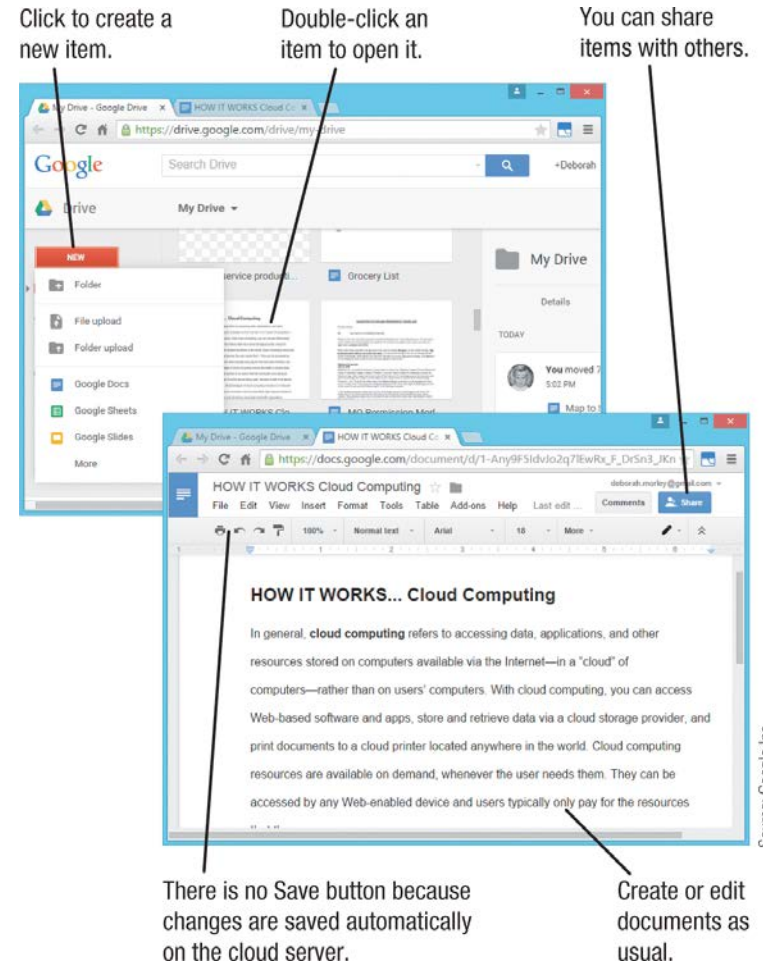
TYPE OF ADDRESS	SAMPLE ADDRESS	PRONUNCIATION
Domain name	berkeley.edu	berkeley dot e d u
URL	irs.gov/freefile	i r s dot gov slash free file
E-mail address	president@whitehouse.gov	president at white house dot gov

FIGURE 1-24
Pronouncing
Internet addresses.

How It Works

Cloud Computing

- Resources stored on computers in a “cloud” of computers rather than on users’ computers
- Resources are available on demand, accessible to any Web-enabled device
- Cloud data is safe if the device is lost, stolen, or damaged
 - Google Docs and Google Drive are shown here



Google Drive and Docs.



Surfing the Web

- A Web browser is used to display Web pages
- The browser's starting page or home page is the first page displayed when the browser is opened
 - Users can change their browser's home page
 - From the home page, other Web pages can be accessed
- To view a Web page:
 - Type a URL in the Address bar
 - Click a hyperlink (graphics or text linked to other Web pages) located on a Web page
 - Choose a Web page saved as a **Favorite/bookmark** or a Web page from the History List

Searching the Web

- A search site is a Web page that help you locate Web pages and other resources
 - Typically search using keywords
- Reference sites are designed to let you look up addresses, telephone numbers, ZIP codes, maps, and other reference information
 - You can find reference sites using a search site

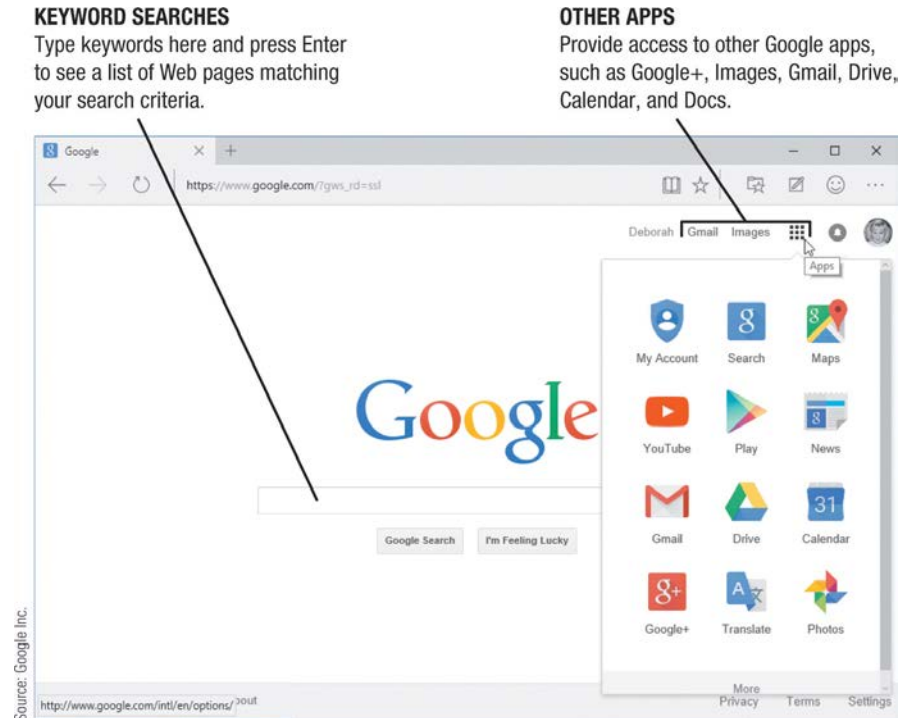


FIGURE 1-26
Google displayed in the Edge browser.



E-Mail

- **Electronic mail (e-mail)** is the process of exchanging electronic messages between individuals over a network
 - One of the most widely used Internet applications
 - Can be sent and received via an installed e-mail program, or a Web mail service or app
 - Conventional
 - Microsoft Outlook
 - OS X Mail
 - Web-Based
 - Gmail
 - Outlook.com
- Can contain photos and other attached files
- Mobile e-mail may be charged against data usage
- Other types of mobile communications include text messages and multimedia messages



Technology and Society: Benefits

- The vast improvements in technology over the past decade have had a distinct impact on daily life, at home, and at work
- Benefits of a technology-oriented society include:
 - Design before construction leads to safer products
 - Earlier medical diagnoses and more effective treatment
 - Devices that allow physically and/or visually challenged individuals to perform job tasks
 - Documents e-mailed or faxed in moments
 - Download information, music, movies, and more on demand



Technology and Society: Risks

- Risks of a technology-oriented society include:
 - Stress and health concerns
 - Security issues
 - Computer viruses and malware
 - Identity theft and phishing
 - Privacy issues
 - Spam
 - How collected data is used
 - How secure the collected data is



Technology and Society: Online Communications

- Differences in online communications
 - Less formal than traditional communications
 - Netiquette
 - Be polite and considerate of others
 - Refrain from offensive remarks
 - Abbreviations (acronyms) and emoticons are often used
 - Acronyms, such as BTW (by the way)
 - Emoticons (typically illustrations of faces), such as 😊

Technology and Society: Netiquette

RULE	EXPLANATION
Use descriptive subject lines	Use short, descriptive subject lines for e-mail messages and online posts. For example, "Question regarding your online classes" is much better than a vague title, such as "Question."
Don't shout	SHOUTING REFERS TO TYPING YOUR ENTIRE E-MAIL MESSAGE OR ONLINE POST USING CAPITAL LETTERS. Use capital letters only when it is grammatically correct to do so or for emphasizing a few words.
Watch what you say	Things that you say or write online can be interpreted as being sexist, racist, or in just general bad taste. Also check spelling and grammar—typos look unprofessional and nobody likes wading through poorly written materials.
Don't spam your contacts	Don't hit <i>Reply All</i> to an e-mail when a simple <i>Reply</i> will do. The same goes for forwarding e-mail chain letters, reposting every joke you run across, or sending every funny YouTube video you find—to everyone you know.
Be cautious	Don't give out personal information—such as your real name, telephone number, or credit card information—to people you meet online.
Think before you send or post	Once you send an e-mail or text message or post something online, you lose control of it. Don't include content (such as compromising photos of yourself) that you would not want shared with others, and don't tag people in photos that are unflattering to them. In addition, don't e-mail or post anything if emotions are running high—wait until you calm down.

FIGURE 1-30
Netiquette. Use these netiquette guidelines and common sense when communicating online.



Technology and Society: Anonymity and Integrity

- The anonymity factor
 - Online communications can be anonymous
 - Anonymity gives many individuals a sense of freedom
 - Online anonymity can also be abused
- Information integrity
 - Use common sense when evaluating online content
 - Check your sources—not all information on the Internet is accurate
 - Double-check information before using it or passing it on to others