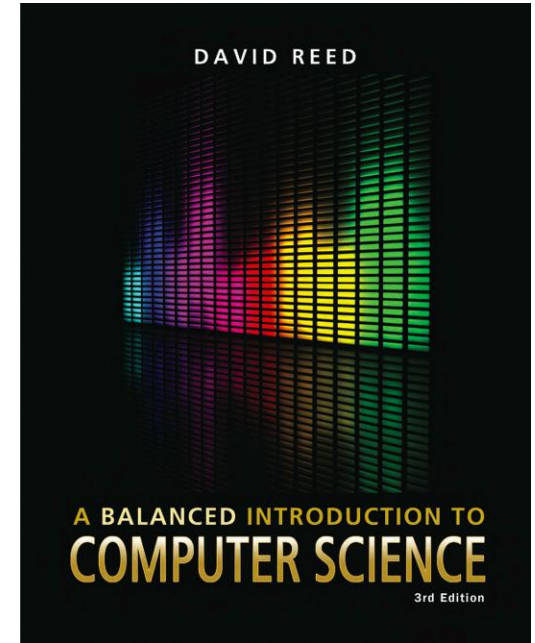# A Balanced Introduction to Computer Science, 3/E

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Chapter 18
Computers and Society

Positive Impact of Technology

historian Larry Gormley ranked technological developments according to their impact on modern life

- do you agree with his list?

	Invention	Year	The Greatest Inventions in the Past 1000 Years[1] Inventor	Notes
1	Printing Press	1450	Johannes Gutenberg	allowed literacy to greatly expand
2	Electric Light	1879	Thomas Edison	powered countless social changes
3	Automobile	1885	Karl Benz	increased personal mobility and freedom
4	Telephone	1876	Alexander Graham Bell	spread communication across wide areas
5	Radio and Television	1895 & 1926	Guglielmo Marconi and John Baird	made the world smaller
6	Vaccination	1796	Edward Jenner	protected people from disease
7	Computer	1939	John Atanasoff et al.	transformed business world; predecessor to the Internet
8	Airplane	1903	Orville and Wilbur Wright	allowed people and products to quickly move across wide areas
9	Gas-powered Tractor	1892	John Froelich	started agricultural mechanization
10	Anesthesia	1844	Horace Wells	provided a great leap forward for medicine

(Gormley, Larry. "The Greatest Inventions in the Past 1000 Years." eHistory.com, 2003.)

Positive Impact of Technology

more than any other invention, computer technology is still evolving, which means that it continues to impact society in new ways

- the first electronic computers made significant contributions in the 1940's
    - COLOSSUS – used for code breaking in World War II
    - ENIAC – performed calculations and simulations that led to the development of nuclear technology and Cold War science
- currently, we live in an "information economy", with computers central to business and innovation

technology has become so pervasive in daily life, it is difficult to imagine life without it

e.g., monetary transactions

- cash is frequently being replaced with credit or debit cards
- computerized banking networks enable the immediate electronic transfer of funds
- ATM machines allow people to access their money around the clock from any location
- all this has discouraged traditional theft, but has inspired new forms of illegal activity

Computers in Everyday Tasks

modern life also depends on thousands of less obvious, hidden computer applications

embedded processors are computer chips that are built into appliances and machinery to control their workings

- they account for more than 90% of all computer processors

- modern homes contain hundreds of embedded processors
  - in ovens, television remote controls, cordless phones, automatic thermostats, …

- automobiles employ embedded processors to control a wide variety of components

Microprocessors in Automobiles[3]		
speech technology	high-intensity discharge lamps	lighting system
electronic-memory seat	electric windows	mirror control
premium audio system	door module	climate control
digital radio	transmission control	navigation/GPS
immobilization	alarm systems	trip computer
head-up display	one-way data pager	right-of-cluster display
cruise control	Internet access	integrated cell phone
central body controllers	rain sensor	engine controller
vehicle-to-roadside communications	central locking and remote keyless entry	analog and digital instrumentation

(Webb,Warren."Embedded Technology Transforms the Automobile." EDN Magazine, 1999.)

Computers in Everyday Tasks

society has also been affected by the availability of personal computers and easy-to-use software

- software can enable people to accomplish tasks previously reserved for highly trained professionals, e.g.,
    - word processing and desktop publishing software
    - video editing software
    - tax preparation software

smart phones and hand-held computers have driven the development of mobile apps

- in June 2010, Apple's app store offered more than 225,000 apps for iPhone/iPad
- Amazon's Kindle & Sony's Reader enable downloading and reading electronic books

Internet/Web for Information

many users utilize the Internet/Web as an information source

online resources are quickly replacing (or complementing) traditional sources of information
- Web sites can be updated 24 hours a day allowing publishers to report stories as soon as they break
- text can be integrated with other types of media
- the immediacy of online delivery system is especially appealing

in order to compete, many newspapers and magazines have expanded their offerings to include online versions
- e.g., www.nytimes.com, www.washingtonpost.com, www.time.com

Internet/Web for Information

traditional media have approached the Internet in a variety of ways

- some provide limited services online for free
  - e.g., cnn.com, weather.com
- others provide full services with a fee
  - e.g., Encyclopedia Britannica sells access over the Web

independent media organizations have utilized the Web to present stories and opinions that might not otherwise reach a mainstream audience

Internet/Web for Information

the majority of Web pages are unique resources created by individuals and private organizations

- you can find Web content on virtually any topic
- to help navigate the vast sea of information, *search engines* automatically catalog Web pages and allow users to search for data by topic or keywords

Internet/Web for Communication

many users were originally drawn to the Internet by the availability of electronic mail and newsgroups

- in 2006, 91% of all Internet users communicated via email
    - 171 billion email messages were sent and received each day
    - 70% of those emails were *spam*

Internet Service Providers (ISPs) manage email accounts with other services

- e.g., AOL, msn, Microsoft Hotmail, Yahoo! Mail
- programs such as Microsoft Outlook provide an intuitive user interface for sending and receiving email messages
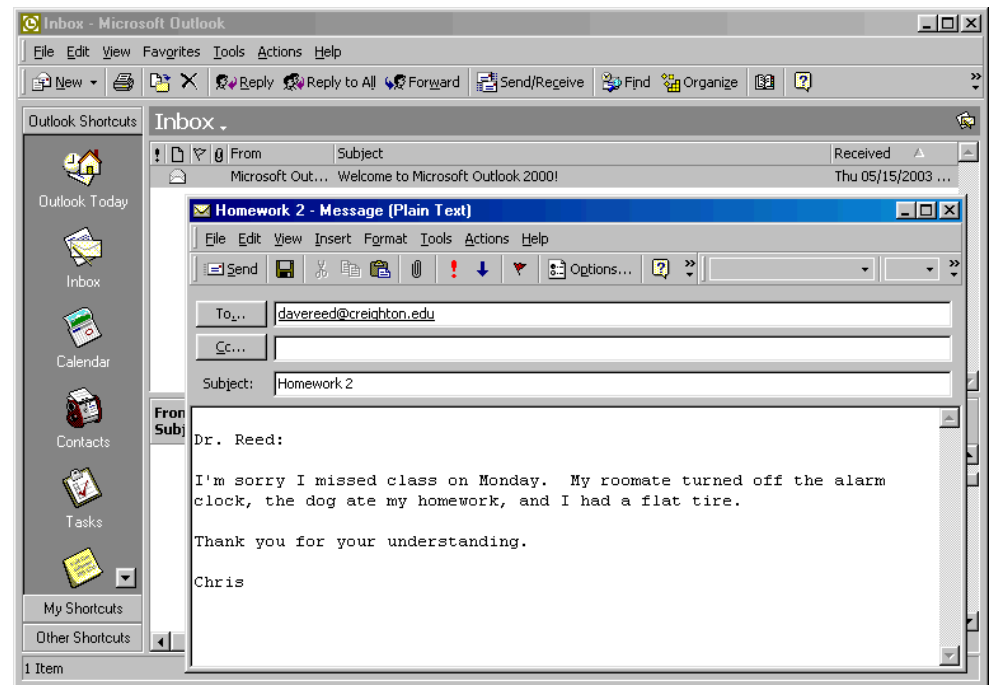
Internet/Web for Communication

increasingly, the Internet is being used for social networking

- *instant messaging*, or *chat*, applications enable virtual conversations
- *text messaging*, or *texting*, applications enable users to send short messages via cell phones
    - by 2008, text messages (357/month) exceeded cell calls (204/month)
    - for teens, even more pronounced: 1,742 texts/month vs. 231 calls/month

Twitter served more than 100 million users in 2008

Facebook served more than 400 million users in 2008

Internet/Web for Commerce

another popular function of the Web is to facilitate *electronic commerce*, or *e-commerce*

- businesses have recognized the Web's potential as an advertising medium, and as a tool for reaching new customers
- some business sites are information-based (providing background on the company or product descriptions)
- other business sites are transaction-based (allowing customers to purchase products or services directly)

online shopping has numerous advantages for the consumer

- you can make purchases from your home at any time
- it is easy to comparison shop
- many online retailers, such as Amazon.com, allow consumers to research products as well as purchase them

Internet/Web for Commerce

total online sales in 2008: $133 billion

many of the most successful sites are online offshoots of traditional retailers

- Barnes & Noble, Sears, Circuit City

companies that are strictly Internet ventures have added risks due to their lack of other revenue streams for startup and development

- many of these companies fail early on, however, some are very successful
- Amazon.com: $19.1 billion in sales in 2008

Internet/Web for Commerce

the Web has provided a new advertising channel for businesses and organizations

- e-commerce sites charge fees for hosting advertising banners on web pages
  - *banner ads* are clickable images that promote a particular company's product or service
  - users who click on a banner ad are typically directed to the company's Web site, where they can make purchases or review product-related information
- the Web's structure allows for a direct connection between ads and related purchasing interfaces

in addition, the Internet is extensively used for communication and information exchanges within and among businesses

- business-to-business (B2B) transactions allow companies to manage inventory more dynamically
- can improve efficiency by linking various data channels (e.g., sales & marketing)
- businesses may form partnerships based on sharing resources and information

Potential Dangers

in conjunction with the benefits we have mentioned, the widespread adoption of technology also introduces the potential for abuses and undesirable consequences

potential dangers to individuals, businesses, and society at large include

- an over-reliance on complex, perhaps poorly-understood, systems
- information overload
- privacy and security violations
- the Digital Divide

Reliance on Complex Systems

as society becomes dependent on complex, computer-based products and services, the effects of errors or system failures become far-reaching

computer-system bugs can produce dire consequences
- between 1985 and 1987, six cancer patients received massive radiation overdoses due to equipment malfunction, resulting in four deaths (the malfunction was traced to a single coding error)
- in 1991, 28 soldiers were killed by a Scud missile because a software error caused the Patriot missile to miss its target
- in 1999, NASA's Mars Climate Orbiter went off course and was destroyed in the Martian atmosphere (the problem was due to software inconsistencies which used different measurement conversions, e.g., English vs. Metric)
- in 2007, 17,000 planes were grounded at LAX for more than 8 hours due to a Customs agency software bug
- in 2010, Toyota recalled more than 400,000 hybrid due to faulty anti-lock brake software (estimated cost exceeds $6 billion)

to avoid errors, various software design and testing methodologies are used
- however, as the size and complexity of the software grows, design and testing become exponentially more difficult
- Windows 2000 – 35 million lines of code, 63,000 known bugs

Information Overload

the impressive range of information available online can be viewed as a strength, but it is also one of the greatest weaknesses
- often, data is not well organized
- finding a single piece of specific information can be very difficult
- as of 2009, Web size estimated at more than 50 billion pages

search engines are helpful in narrowing down Internet searches, but users must be careful in selecting search criteria
- a Google search for "JavaScript" produced 525 million matches
- a more refined search for "JavaScript alert function" produced 2.6 million matches

even after a user locates a Web page related to the desired topic, judging reliability is not always easy
- the Web is neither monitored or censored
- authors may provide incomplete, uninformed, or biased answers

Information Overload

since most Internet/Web content lacks editorial review, it is up to the user to evaluate its credibility

  ■ common criteria for evaluating credibility include:

Author Reputation	Is the author well known or well regarded in his field? If this information is not apparent, try to access biographical information or related works that reference the author to determine credibility.
Author Objectivity	Is there reason to believe that the author is objective? If the author has a political agenda or personal history with the topic, there is a greater danger of bias.
Content Review	Has the page been edited or reviewed by other parties? If so, there is more reason to trust its accuracy. Even the reputation of the organization hosting the page can be considered as supporting evidence, because a reputable organization will exert some control over content to protect the organization's integrity.
Content Verifiability	Does the author demonstrate scholarship and knowledge of the field by properly referencing other works? If evidence is strictly anecdotal or sources are untraceable, the content may reflect personal opinions that are not supported by the facts.
Content Timeliness	Is the information provided in the material timely? If the sources are old or are not accompanied by explicit dates, then the content may be out of date or contradictory to current practices.

Privacy and Security

when using credit cards or shopping online, consumers sacrifice privacy for the sake of convenience

- companies maintain records of consumer purchases
- private details can be inferred from shopping patterns
- companies often sell customer profiles to marketing firms

Web users can limit exploitation by interacting only with reputable online businesses with privacy policies

- such policies will explain what information is collected by the business and how that information is to be used (and shared)

Privacy and Security

email also raises privacy concerns

- when a message is received it is commonly stored in a file on the recipient's computer
- there is a danger that unauthorized users might get access to that file
- few laws apply directly to electronic privacy
  - courts overwhelmingly favor employers over employees in privacy suits
  - unless explicitly stated, it is generally accepted that employers may access any content on company-owned machines
- in 2008, 5 million users were victims of *phishing* attacks, in which they are fooled into surrendering sensitive information via email

privacy is closely linked with security

- email messages travel through numerous routers, and each router represents a security risk, because someone could gain access to a router and eavesdrop on a relayed message
- with online transactions, credit card numbers or other personal information can be intercepted and subsequently result in identity theft
- encryption methods are commonly used to secure information transmissions, but online fraud is still a continuing problem ($4 billion lost in 2008)

The Digital Divide

an especially troubling aspect of recent technological developments is that the benefits associated with computers are not shared by all

- Americans with minority ancestry, lower incomes, and less education are far less likely to be online

How Internet Access Has Changed in America[13] The percentage of each group with Internet access.					
By Gender	**2000**	**2009**	**By Race**	**2000**	**2009**
Men	51%	74%	Whites	50%	76%
Women	46%	74%	Blacks	34%	70%
			Hispanics	43%	64%
By Age	**2000**	**2009**	**By Household Income**	**2000**	**2009**
18–29	69%	93%	less than $30,000	31%	60%
30–49	60%	81%	$30,000–$50,000	52%	76%
50–64	45%	70%	$50,000–$75,000	67%	83%
64 +	14%	38%	$75,000 and above	78%	94%
By Education	**2000**	**2009**			
Did not graduate high school	17%	39%			
High school grad	34%	63%			
Some college	63%	87%			
College +	75%	94%			

(Pew Internet and American Life Project: Latest Trends. Pew Research Center, Dec 2009.)

The Digital Divide

addressing the digital divide

- during the Clinton administration, public schools received government funding for computer technology and Internet service
    - by 2003, nearly all public schools were connected to the Internet, as compared to 35% in 1994
    - most public libraries and community centers provide Internet-enabled computers
- organizations such as TechSoup Global supply Internet access and technical assistance to minority groups and low income individuals
- the digital divide is still a problem for Americans, but there is no doubt that conditions have improved

the digital divide also exists on a global scale

- America, Western Europe, and certain Asian countries have much greater Internet connectivity than other parts of the world
- lack of Internet access places less developed nations at a significant disadvantage, and compounds other economic problems
- the United Nations, World Economic Forum, and other organizations are working to address the global digital divide
- the One Laptop Per Child program has distributed more than 1.5 million low-cost, low-power laptops to school children around the world

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