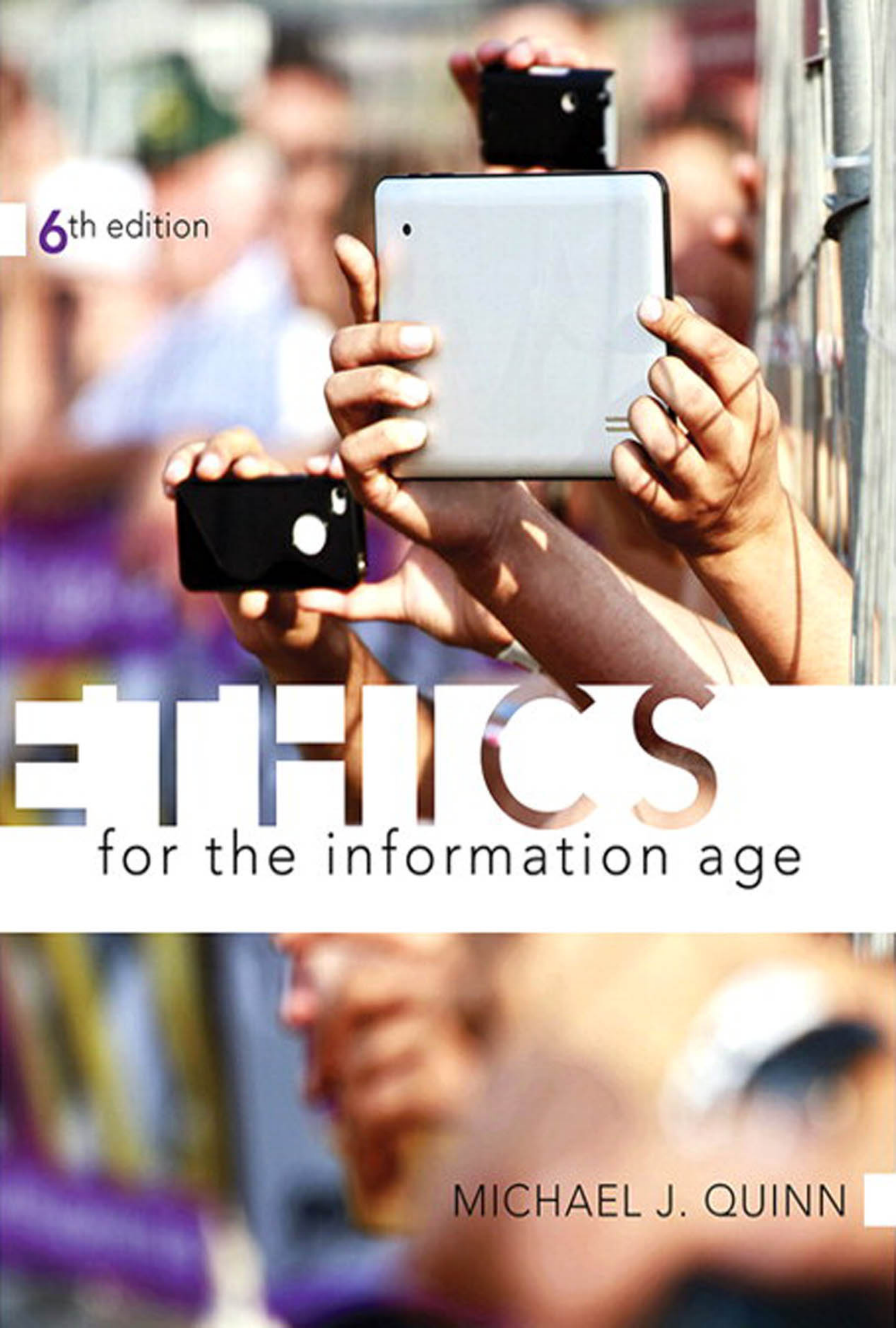
6th edition
ETHICS
for the information age
MICHAEL J. QUINN

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for the information age

MICHAEL J. QUINN
Seattle University

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Preface

Computers and high-speed communication networks are transforming our world. These technologies have brought us many benefits, but they have also raised many social and ethical concerns. My view is that we ought to approach every new technology in a thoughtful manner, considering not just its short-term benefits, but also how its long-term use will affect our lives. A thoughtful response to information technology requires a basic understanding of its history, an awareness of current information-technology-related issues, and a familiarity with ethics. I have written *Ethics for the Information Age* with these ends in mind.

Ethics for the Information Age is suitable for college students at all levels. The only prerequisite is some experience using computers and the Internet. The book is appropriate for a stand-alone "computers and society" or "computer ethics" course offered by a computer science, business, or philosophy department. It can also be used as a supplemental textbook in a technical course that devotes some time to social and ethical issues related to computing.

As students discuss controversial issues related to information technology, they have the opportunity to learn from one other and improve their critical thinking skills. The provocative questions raised at the end of every chapter, together with dozens of in-class exercises, provide many opportunities for students to express their viewpoints. My hope is that they will get better at evaluating complex issues and defending their conclusions with facts, sound values, and rational arguments.

WHAT'S NEW IN THE SIXTH EDITION

The most significant change in the sixth edition is the new emphasis on virtue ethics. I have written a completely new section on virtue ethics that appears in Chapter 2, replacing the description of virtue ethics that formerly appeared in the chapter on professional ethics. In addition, I have included analyses from the perspective of virtue ethics to the case studies appearing in Chapters 3, 5, and 7.

To increase the relevance and value of the "Further Reading and Viewing" sections, I have eliminated the references to scholarly tomes. They have been replaced by lists of recent magazine and newspaper articles, television interviews, documentaries, and other videos available on the Internet. Most of the videos are only a few minutes long and can fuel interesting classroom discussions.

In response to a suggestion from one of the reviewers, I have added a table to Chapter 7 that provides students with practical tips about how to choose good passwords.

The sixth edition references many important recent developments; among them are:

- Edward Snowden's revelations of longstanding National Security Agency access to telephone metadata, email messages, and live communications;
- the privacy implications of Twitter, Foursquare, Instagram, and other apps gathering information from address books stored on smartphones;
- the controversy surrounding Microsoft's proposal for digital rights management on the Xbox One;
- the activities of the "hacktivist" group Anonymous;
- benefits and harms of tracking the movement of people through their smartphones;
- the debate over the use of drones by police departments;
- retailers using information collected from online sales to differentiate between customers and offer different prices to different people;
- retailers using targeted direct marketing to win new customers;
- the use of "crowdsourcing" by companies to improve products and services;
- coverage of how cell phones are changing lives in developing countries;
- predictive policing based on data mining;
- massive open online courses (MOOCs) and implications for students from different socio-economic groups; and
- the "Internet of Things"—Internet-connected devices that can be controlled remotely.

Finally, I have updated facts and figures throughout the book.

ORGANIZATION OF THE BOOK

The book is divided into ten chapters. Chapter 1 has three objectives: to get the reader thinking about the process of technological change; to present a brief history of computing, networking, and information storage and retrieval; and to provide examples of moral problems brought about by the introduction of information technology.

Chapter 2 is an introduction to ethics. It presents nine different theories of ethical decision-making, weighing the pros and cons of each one. Five of these theories—Kantianism, act utilitarianism, rule utilitarianism, social contract theory, and virtue ethics—are deemed the most appropriate "tools" for analyzing moral problems in the remaining chapters.

Chapters 3–10 discuss a wide variety of issues related to the introduction of information technology into society. I think of these chapters as forming concentric rings around a particular computer user.

Chapter 3 is the innermost ring, dealing with what can happen when people communicate over the Internet using the Web, email, and Twitter. Issues such as the increase in spam, easy access to pornography, cyberbullying, and Internet addiction raise important questions related to quality of life, free speech, and censorship.

The next ring, Chapter 4, deals with the creation and exchange of intellectual property. It discusses intellectual property rights, legal safeguards for intellectual property, the definition of fair use, digital rights management, abuses of peer-to-peer networks, the rise of the open-source movement, and the legitimacy of intellectual property protection for software.

Chapter 5 focuses on information privacy. What is privacy exactly? Is there a natural right to privacy? How do others learn so much about us? The chapter describes the electronic trail that people leave behind when they use a cell phone, make credit card purchases, open a bank account, go to a physician, or apply for a loan.

Chapter 6 focuses on privacy and the US government. Using Daniel Solove's taxonomy of privacy as our organizing principle, we look at how the government has steered between the competing interests of personal privacy and public safety. We consider US legislation to restrict information collection and government surveillance; government regulation of private databases and abuses of large government databases; legislation to reduce the dissemination of information and legislation that has had the opposite effect; and finally government actions to prevent the invasion of privacy as well as invasive government actions. Along the way, we discuss the implications of the USA PATRIOT Act and the debate over the REAL ID Act to establish a de facto national identification card.

Chapter 7 focuses on the vulnerabilities of networked computers. A case study focuses on the release of the Firesheep extension to the Firefox Web browser. A section on malware discusses rootkits, spyware, cross-site scripting, and drive-by downloads. We discuss common Internet-based attacks—phishing, spear-phishing, SQL injection, denial-of-service attacks, and distributed denial-of-service attacks—and how they are used for cyber crime, cyber espionage, and cyber attacks. We conclude with a discussion of the risks associated with online voting.

Computerized system failures have led to lost business, the destruction of property, human suffering, and even death. Chapter 8 describes some notable software system failures, including the story of the Therac-25 radiation therapy system. It also discusses the reliability of computer simulations, the emergence of software engineering as a distinct discipline, and the validity of software warranties.

Chapter 9 is particularly relevant for those readers who plan to take jobs in the computer industry. The chapter presents a professional code related to computing, the Software Engineering Code of Ethics and Professional Practice, followed by an analysis of the code. Several case studies illustrate how to use the Software Engineering Code of Ethics and Professional Practice to evaluate moral problems related to the use of computers. The chapter concludes with an ethical evaluation of whistle-blowing, an extreme example of organizational dissent.

Chapter 10 raises a wide variety of issues related to how information technology has impacted work and wealth. Topics include workplace monitoring, telecommuting, and globalization. Does automation increase unemployment? Is there a "digital divide" separating society into "haves" and "have nots"? Is information technology widening the gap between rich and poor? These are just a few of the important questions the chapter addresses.

Unit	*Name*	*Chapter(s)*
SP1	History of computing	1
SP2	Social context of computing	1, 3, 10
SP3	Methods and tools of analysis	2–10
SP4	Professional and ethical responsibilities	9
SP5	Risks and liabilities of computer-based systems	8
SP6	Intellectual property	4
SP7	Privacy and civil liberties	5, 6
SP8	Computer crime	3, 7
SP9	Economic issues in computing	10
SP10	Philosophical frameworks	2

Table 1 Mapping between the units of the Social and Professional Issues course in *Computing Curricula 2001* and the chapters of this book.

NOTE TO INSTRUCTORS

In December 2001, a joint task force of the IEEE Computer Society and the Association for Computing Machinery released the final draft of *Computing Curricula 2001* (www.computer.org/education/cc2001/final). The report recommends that every undergraduate computer science degree program incorporate 40 hours of instruction related to social and professional issues related to computing. For those departments that choose to dedicate an entire course to these issues, the report provides a model syllabus for CS 280T, Social and Professional Issues. *Ethics for the Information Age* covers all of the major topics listed in the syllabus. Table 1 shows the mapping between the 10 units of CS 280T and the chapters of this book.

The organization of the book makes it easy to adapt to your particular needs. If your syllabus does not include the history of information technology, you can skip the middle three sections of Chapter 1 and still expose your students to examples motivating the formal study of ethics in Chapter 2. After Chapter 2, you may cover the remaining chapters in any order you choose, because Chapters 3–10 do not depend on one other.

Many departments choose to incorporate discussions of social and ethical issues throughout the undergraduate curriculum. The independence of Chapters 3–10 makes it convenient to use *Ethics for the Information Age* as a supplementary textbook. You can simply assign readings from the chapters most closely related to the course topic.

SUPPLEMENTS

The following supplements are available to qualified instructors on Pearson's Instructor Resource Center. Please contact your local Pearson sales representative or visit www.pearsonhighered.com/educator to access this material.

- An instructor's manual provides tips for teaching a course in computer ethics. It also contains answers to all of the review questions.

- A test bank contains more than 300 multiple-choice, fill-in-the-blank, and essay questions that you can use for quizzes, midterms, and final examinations.
- A set of PowerPoint lecture slides outlines the material covered in every chapter.

FEEDBACK

Ethics for the Information Age cites hundreds of sources and includes dozens of ethical analyses. Despite my best efforts and those of many reviewers, the book is bound to contain errors. I appreciate getting comments (both positive and negative), corrections, and suggestions from readers. Please send them to quinnm@seattleu.edu or Michael J. Quinn, Seattle University, College of Science and Engineering, 901 12th Avenue, Seattle, WA 98122.

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Finally, I am indebted to my wife Victoria for her support and encouragement. You are a wonderful helpmate. Thanks for everything.

Michael J. Quinn
Seattle, Washington

We never know how high we are
Till we are called to rise;
And then, if we are true to plan,
Our statures touch the skies.

The heroism we recite
Would be a daily thing,
Did not ourselves the cubits warp
For fear to be a king.

—Emily Dickinson, *Aspiration*

I dedicate this book to my children: *Shauna, Brandon,* and *Courtney.*

Know that my love goes with you, wherever your aspirations may lead you.

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CHAPTER

1 Catalysts for Change

A tourist came in from Orbitville,
parked in the air, and said:

The creatures of this star
are made of metal and glass.

Through the transparent parts
you can see their guts.

Their feet are round and roll
on diagrams of long

measuring tapes, dark
with white lines.

They have four eyes.
The two in back are red.

Sometimes you can see a five-eyed
one, with a red eye turning

on the top of his head.
He must be special—

the others respect him
and go slow

when he passes, winding
among them from behind.

They all hiss as they glide,
like inches, down the marked

tapes. Those soft shapes,
shadowy inside

the hard bodies—are they
their guts or their brains?

—May Swenson, "Southbound on the Freeway"[1]

1.1 Introduction

MOST OF US TAKE TECHNOLOGICAL CHANGE FOR GRANTED. In the past two decades alone, we have witnessed the emergence of exciting new technologies, including smartphones, MP3 players, digital photography, email, and the World Wide Web. There is good reason to say we are living in the Information Age. Never before have so many people had such easy access to information. The two principal catalysts for the Information Age have been low-cost computers and high-speed communication networks (Figure 1.1). Even in a society accustomed to change, the rate at which computers and communication networks have transformed our lives is breathtaking.

In 1950 there were no more than a handful of electronic digital computers in the world. Today we are surrounded by devices containing embedded computers. We rely upon microprocessors to control our heating and cooling systems, microwaves, smartphones, elevators, and a multitude of other devices we use every day. Thanks to microprocessors, our automobiles get better gas mileage and produce less pollution. On the other hand, the days of the do-it-yourself tune-up are gone. It takes a mechanic with computerized diagnostic equipment to work on a modern engine.

FIGURE 1.1 Low-cost computers and high-speed communication networks make possible the products of the Information Age, such as the Samsung Galaxy S4. It functions as a phone, email client, Web browser, camera, video recorder, digital compass, and more. (Marian Stanca/Alamy)

In 1990 few people other than college professors used email. Today more than a billion people around the world have email accounts. Email messages are routed instantaneously for very low cost, which can be both a blessing and a curse. Business communications have never been so efficient, but it's not unusual to hear businesspeople complain that they can never get caught up with their email.

The World Wide Web was still being designed in 1990; today it contains more than a trillion pages and makes possible extraordinarily valuable information retrieval systems. Even grade school children are expected to gather information from the Web when writing their reports. However, many parents worry that their Web-surfing children may be exposed to pornographic images or other inappropriate material.

May Swenson has vividly described our ambivalent feelings toward technology. In her poem "Southbound on the Freeway," an alien hovers above an expressway and watches the cars move along [1]. The alien notes "soft shapes" inside the automobiles and wonders, "are they their guts or their brains?" It's fair to ask: Do we drive technology, or does technology drive us?

Our relationship with technology is complicated. We create technology and choose to adopt it. However, once we have adopted a technological device, it can transform us and how we relate to other people and our environment.

Some of the transformations are physical. The neural pathways and synapses in our brains literally change with our experiences. One well-known brain study focused on London taxi drivers. In order to get a license, aspiring London taxi drivers must spend two to four years memorizing the complicated road network of 25,000 streets within 10 kilometers of the Charing Cross train station, as well as the locations of thousands of tourist destinations. The hippocampus is the region of the brain responsible for long-term memory and spatial navigation. Neuroscientists at University College London found that the brains of London taxi drivers have larger-than-average hippocampi and that the hippocampi of aspiring taxi drivers grow as they learn the road network [2].

Stronger longer-term memory and spatial navigation skills are great outcomes of mental exercise, but sometimes the physical effects of our mental exertions are more insidious. For example, studies with macaque monkeys suggest that when we satisfy our hunger for quick access to information through our use of Web browsers, Twitter, and texting, neurons inside our brains release dopamine, producing a desire to seek out additional information, causing further releases of dopamine, and so on, which may explain why we find it difficult to break away from these activities [3, 4].

Adopting a technology can change our perceptions, too. More than 90 percent of cell phone users report that having a cell phone makes them feel safer, but once people get used to carrying a cell phone, losing the phone may make them feel more vulnerable than they ever did before they began carrying one. A Rutgers University professor asked his students to go without their cell phones for 48 hours. Some students couldn't do it. A female student reported to the student newspaper, "I felt like I was going to get raped if I didn't have my cell phone in my hand." Some parents purchase cell phones for their children so that a child may call a family member in an emergency. However, parents who provide a cell phone "lifeline" may be implicitly communicating to their children the idea that people in trouble cannot expect help from strangers [5].

FIGURE 1.2 The Amish carefully evaluate new technologies, choosing those that enhance family and community solidarity. (AP photo/*The Indianapolis Star and News,* Mike Fender)

The Amish understand that the adoption of a new technology can affect the way people relate to each other (Figure 1.2). Amish bishops meet twice a year to discuss matters of importance to the church, including whether any new technologies should be allowed. Their discussion about a new technology is driven by the question, "Does it bring us together, or draw us apart?" You can visit an "Old Order" Amish home and find a gas barbecue on the front porch but no telephone inside, because they believe gas barbecues bring people together while telephones interfere with face-to-face conversations [6].

New technologies are adopted to solve problems, but they often create problems, too. The automobile has given people the ability to travel where they want, when they want. On the other hand, millions of people spend an hour or more each day stuck in traffic commuting between home and work. Refrigerators make it possible for us to keep food fresh for long periods of time. We save time because we don't have to go grocery shopping every day. Unfortunately, Freon leaking from refrigerators has contributed to the depletion of the ozone layer that protects us from harmful ultraviolet rays. New communication technologies have made it possible for us to get access to news and entertainment from around the world. However, the same technologies have enabled major software companies to move thousands of jobs to India, China, and Vietnam, putting downward pressure on the salaries of computer programmers in the United States [7].

We may not be able to prevent a new technology from being invented, but we do have control over whether to adopt it. Nuclear power is a case in point. Nuclear power plants create electricity without producing carbon dioxide emissions, but they also produce radioactive waste products that must be safely stored for 100,000 years.

Although nuclear power technology is available, no new nuclear power plants were built in the United States for more than 25 years after the accident at Three Mile Island in 1979 [8].

Finally, we *can* influence the rate at which new technologies are developed. Some societies, such as the United States, have a history of nurturing and exploiting new inventions. Congress has passed intellectual property laws that allow people to make money from their creative work, and the federal income tax structure allows individuals to accumulate great wealth.

Most of us appreciate the many beneficial changes that technology has brought into our lives. In health care alone, computed tomography (CT) and magnetic resonance imaging (MRI) scanners have greatly improved our ability to diagnose major illnesses; new vaccines and pharmaceuticals have eradicated some deadly diseases and brought others under control; and pacemakers, hearing aids, and artificial joints have improved the physical well-being of millions.

To sum up, societies develop new technologies to solve problems or make life better, but the use of new technologies changes social conditions and may create new problems. That doesn't mean we should never adopt a new technology, but it does give us a good reason why we should be making informed decisions, weighing the benefits and potential harms associated with the use of new devices. To that end, this book will help you gain a better understanding of contemporary ethical issues related to the use of information technology.

This chapter sets the stage for the remainder of the book. Electronic digital computers and high-performance communication networks are central to contemporary information technology. While the impact of these inventions has been dramatic in the past few decades, their roots go back hundreds of years. Section 1.2 tells the story of the development of computers, showing how they evolved from simple manual calculation aids to complex microprocessors. In Section 1.3 we describe two centuries of progress in networking technology, starting with the semaphore telegraph and culminating in the creation of an email system connecting over a billion users. Section 1.4 shows how information storage and retrieval evolved from the creation of the Greek alphabet to Google. Finally, Section 1.5 discusses some of the moral issues that have arisen from the deployment of information technology.

1.2 Milestones in Computing

Calculating devices have supported the development of commercial enterprises, governments, science, and weapons. As you will see in this section, the introduction of new technologies has often had a social impact.

1.2.1 Aids to Manual Calculating

Adding and subtracting are as old as commerce and taxes. Fingers and toes are handy calculation aids, but to manipulate numbers above 20, people need more than their own digits. The tablet, the abacus, and mathematical tables are three important aids to manual calculating [9].

Simply having a tablet to write down the numbers being manipulated is a great help. In ancient times, erasable clay and wax tablets served this purpose. By the late Middle Ages, Europeans often used erasable slates. Paper tablets became common in the nineteenth century, and they are still popular today.

An **abacus** is a computing aid in which a person performs arithmetic operations by sliding counters along rods, wires, or lines. The first abacus was probably developed in the Middle East more than two thousand years ago. In a Chinese, Japanese, or Russian abacus, counters move along rods or wires held in a rectangular frame. Beginning in medieval Europe, merchants performed their calculations by sliding wooden or metal counters along lines drawn in a wooden counting board (Figure 1.3). Eventually the word "counter" came to mean not only the disk being manipulated but also the place in a store where transactions take place [9].

Mathematical tables have been another important aid to manual computing for about two thousand years. A great breakthrough occurred in the early seventeenth century, when John Napier and Johannes Kepler published tables of logarithms. These tables were tremendous time savers to anyone doing complicated math because they allowed them to multiply two numbers by simply adding their logarithms. Many other useful tables were created as well. For example, businesspeople consulted tables to compute interest and convert between currencies. Today, people who compute their income taxes "by hand" make use of tax tables to determine how much they owe.

Even with tablets, abacuses, and mathematical tables, manual calculating is slow, tedious, and error-prone. To make matters worse, mathematical tables prepared centuries ago usually contained errors. That's because somebody had to compute each table entry and somebody had to typeset each entry, and errors could occur in either of these steps. Advances in science, engineering, and business in the post-Renaissance period motivated European inventors to create new devices to make calculations faster and more reliable and to automate the printing of mathematical tables.

1.2.2 Mechanical Calculators

Blaise Pascal had a weak physique but a powerful mind. When he got tired of summing by hand long columns of numbers given him by his father, a French tax collector, he constructed a mechanical calculator to speed the chore. Pascal's calculator, built in 1640, was capable of adding whole numbers containing up to six digits. Inspired by Pascal's invention, the German Gottfried Leibniz constructed a more sophisticated calculator that could add, subtract, multiply, and divide whole numbers. The hand-cranked machine, which he called the Step Reckoner, performed multiplications and divisions through repeated additions and subtractions, respectively. The calculators of Pascal and Leibniz were not reliable, however, and did not enjoy commercial success.

In the nineteenth century, advances in machine tools and mass-production methods, combined with larger markets, made possible the creation of practical calculating machines. Frenchman Charles Thomas de Colmar utilized the stepped drum gear mech-

Figure 1.3 This illustration from Gregor Reisch's *Margarita Philosophica*, published in 1503, shows two aids to manual calculating. The person on the left is using a tablet; the person on the right is adding numbers using a counting board, a type of abacus. (Heritage Images/Corbis)

anism invented by Leibniz to create the Arithmometer, the first commercially successful calculator. Many insurance companies purchased Arithmometers to help their actuaries compute rate tables more rapidly [9].

Swedish publisher Georg Scheutz was intimately familiar with printing errors associated with the production of mathematical tables. He resolved to build a machine capable of automatically calculating and typesetting table values. Scheutz knew about the earlier work of English mathematician Charles Babbage, who had demonstrated how a machine could compute the values of polynomial functions through the method of differences. Despite promising early results, Babbage's efforts to construct a full-scale Difference Engine had been unsuccessful. In contrast, Georg Scheutz and his son Edvard, who developed their own designs, completed the world's first printing calculator: a machine capable of calculating mathematical tables and typesetting the values onto molds. The Dudley Observatory in Albany, New York, purchased the Scheutz difference engine in 1856. With support from the US Nautical Almanac Office, astronomers used the machine to help them compute the motion of Mars and the refraction of starlight. Difference engines were never widely used; the technology was eclipsed by the emergence of simpler and less expensive calculating machines [9].

America in the late 1800s was fertile ground for the development of new calculating technologies. This period of American history, commonly known as the Gilded Age, was characterized by rapid industrialization, economic expansion, and a concentration of corporate power. Corporations merged to increase efficiency and profits, but the new, larger corporate organizations had multiple layers of management and multiple locations. In order for middle- and upper-level managers to monitor and improve performance, they needed access to up-to-date, comprehensive, reliable, and affordable information. All these requirements could not be met by bookkeepers and accountants using pen and paper to sum long columns of transactions by hand [10].

To meet this demand, many entrepreneurs began producing adding and calculating machines. One of these inventors was William Burroughs, a former bank clerk who had spent long days adding columns of figures. Burroughs devised a practical adding machine and offered it for sale. He found himself in a cutthroat market; companies competed fiercely to reduce the size of their machines and make them faster and easier to use. Burroughs distinguished himself from his competitors by putting together first-class manufacturing and marketing organizations, and by the 1890s the Burroughs Adding Machine Company led the industry. Calculating machines were entrenched in the offices of large American corporations by the turn of the century [10].

The adoption of mechanical calculators led to the "de-skilling" and "feminization" of bookkeeping (Figure 1.4). Before the introduction of calculating machines, offices were a male bastion, and men who could rapidly compute sums by hand were at a premium. Calculators leveled the playing field, making people of average ability quite productive. In fact, a 1909 Burroughs study concluded that a clerk using a calculator was six times faster than a clerk adding the same column of figures by hand [11]. As managers introduced mechanical calculators into offices, they replaced male bookkeepers with female bookkeepers and lowered wages. In 1880 only 5.7 percent of bookkeepers, cashiers, and accountants were women, but by 1910 the number of women in these jobs had risen to 38.5 percent [12].

1.2.3 Cash Register

Store owners in the late 1800s faced challenges related to accounting and embezzlement. Keeping accurate sales records was becoming more difficult as smaller stores evolved into "department stores" with several departments and many clerks. Preventing embezzlement was tricky when clerks could steal cash simply by not creating receipts for some sales.

Figure 1.4 Mechanical calculators led to the “de-skilling” and “feminization” of book-keeping. (Underwood Archives/Getty Images)

While on a European holiday in 1878, Ohio restaurateur James Ritty saw a mechanical counter connected to the propeller shaft of his ship. A year later he and his brother John used that concept to construct the first cash register, essentially an adding machine capable of expressing values in dollars and cents. Enhancements followed rapidly, and by the early 1900s the cash register had become an important information-processing device (Figure 1.5). Cash registers created printed, itemized receipts for customers, maintained printed logs of transactions, and performed other accounting functions that provided store owners with the detailed sales records they needed.

Cash registers also made embezzlement by clerks more difficult. The bell made it impossible for clerks to sneak money from the cash drawer and helped ensure that every sale was “rung up.” Printed logs made it easy for department store owners to compare cash on hand against sales receipts [10].

1.2.4 Punched-Card Tabulation

As corporations and governmental organizations grew larger in the late 1800s, they needed to handle greater volumes of information. One of these agencies was the US Bureau of the Census, which collected and analyzed information on tens of millions of residents every decade. Aware of the tedium and errors associated with clerks manually copying and tallying figures, several Census Bureau employees developed mechanical