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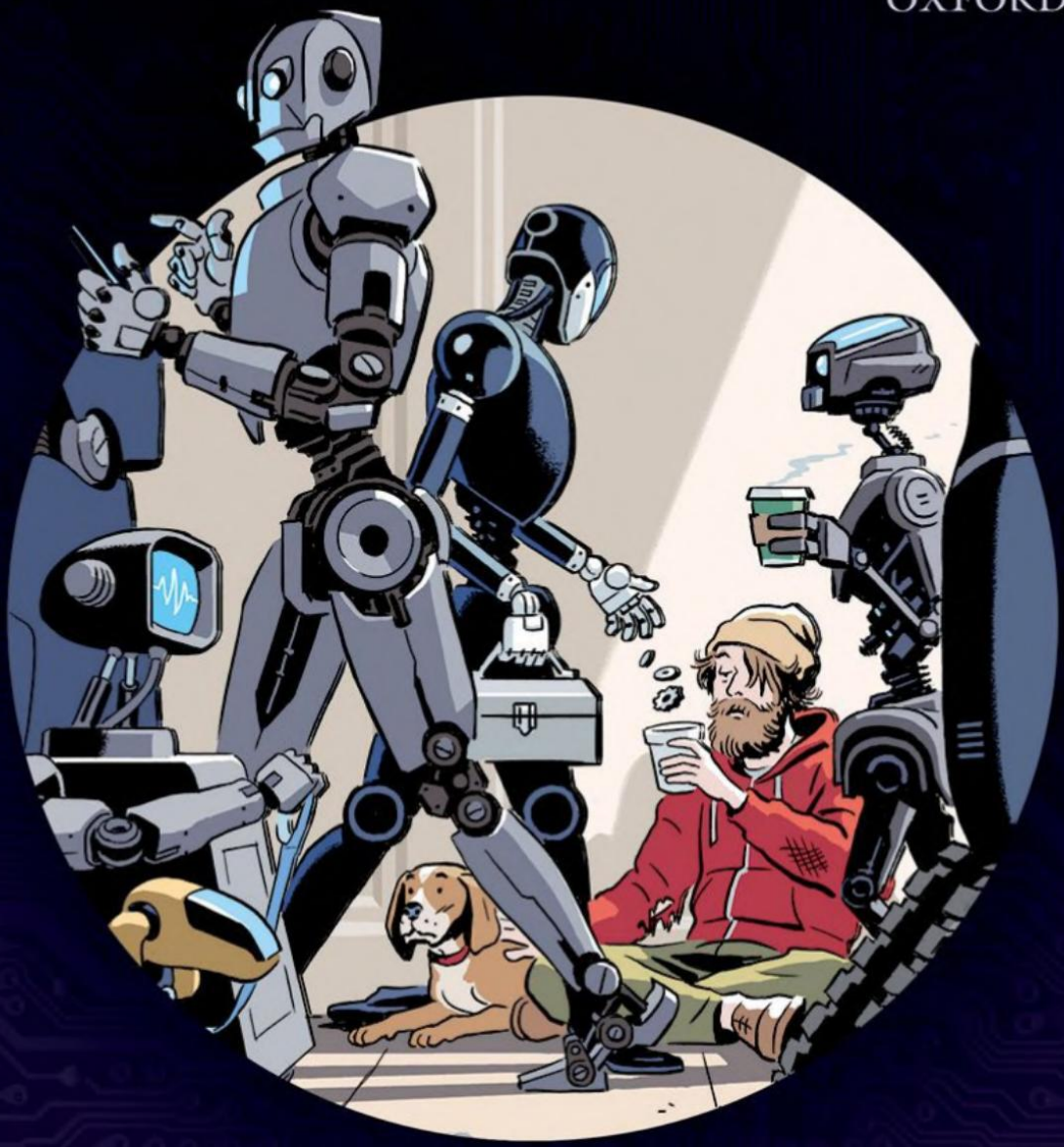

COMPUTERS AND SOCIETY

Modern Perspectives

RONALD M. BAECKER

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Prologue

I wrote this book because I could not find a concise but comprehensive, current, affordable, and globally focused treatment of key issues to use in teaching a Computers and Society seminar to University of Toronto undergraduates in the autumn of 2017. I had taught my first Computers and Society class in 1972, so I had a good sense of what I wanted.

The text needed to be succinct to allow instructors to tailor and add other course readings based on their passions and on student interests. This approach would also encourage students to think and develop ideas and solutions, and not to memorize canned answers. It was important to provide an imaginative set of exercises for individual students or student teams. The rapid pace of technological change and societal responses to these developments made 'comprehensive' and 'current' key requirements. I had to avoid discussing only US situations, cases, and laws; an international and culturally diverse overview of technology and its uses and implications worldwide was needed. Finally, the text needed to be affordable and offer good value.

I worked hard on the title. Each of the four key words is significant.

Computers was interpreted in the broadest sense, at various scales—large-scale computational engines, corporate networks, desktop and laptop computers, the internet, tablets, and mobile phones. I also included the 'internet of things' and 'ubiquitous computing', where computers are invisible to the naked eye. I stressed the amazing progress as well as the both encouraging and discouraging consequences of our achievements.

By *society* I included not only social issues, but also political choices, legal responses, and moral and ethical dilemmas. Ethical choices are brought up in many of the exercises and are highlighted in one case study in each chapter.

Many of the current textbooks have chapter-level tables of contents that have changed little since 2000. They focus primarily on the classical 'big six' topics of Computers and Society courses—intellectual property, free speech, privacy, security, safety, and automation. While these topics are still important, my book approaches them in a more *modern*, livelier way, and ranges broadly over issues not covered in the other books.

Finally, I also tried with all topics to present a variety of *perspectives*. Many issues raised are troubling ones, with no obvious 'right' answers. It is vital that those addressing the issues be able to see that there are several plausible answers and opinions to every question.

Although mainly targeted at upper-level undergraduate students, the book can be used with mature freshmen or sophomores, and at a graduate level. It may also be used in courses dealing with digital technologies in disciplines such as politics, government, philosophy, sociology, psychology, education, or medicine.

In the words of my friend Leslie Mezei, who also has followed developments for over fifty years, this book needed to convey 'the awe and the terror of it all'. I hope that I have done so.

This Prologue begins with historical context—both the history of computing and my own fifty-plus years in the field. Chapters are organized into three sections, the first dealing with *applications* of computers and telecommunications, where the dominant theme is *opportunity*; the second focusing on critical *threats* posed by computerization, where the dominant theme is *risk*; and the third analysing *issues* that have loomed large in the last decade, and grow more important each year, where the dominant theme is *choice*. To establish context, chapters begin with a description of visions that have motivated many of the developments, or summaries of relevant history, or reminders of science fiction novels or films that have foreshadowed the issues.

I conclude the Prologue by discussing how topics are typically presented and ways in which this book may be used. A great variety of engaging individual or group assignments appear within each chapter just after the relevant section. I also briefly mention other valuable books, journals, websites, and videos. More resources are cited in a section at the end of the text before the Index. All URLs of documents, videos, and other resources were checked between May and August 2018.

0.1 Background

I am an Emeritus Professor of Computer Science. My first introduction to programming, writing programs in the MAD 'high-level language', and submitting them on punched cards in the inhuman process called 'batch processing', was hardly inspiring. Yet happily, in the following year, 1962 to 1963, I was able to write programs in assembly language and submit them on paper tape to one of the first PDP-1 minicomputers. This was indeed a *personal computer*, because I had little competition for the machine at night. The long nights became palatable through occasional spurts of playing Space War on an early cathode ray tube (CRT) display. I derived a good sense of what interactive computing could be like.

This experience deepened during my doctoral work on computer animation.[1] Several people could concurrently do interactive graphics under a time-sharing operating system on the TX-2 computer—an important experimental machine best known for hosting the influential Sketchpad PhD thesis of Ivan Sutherland,[2] which launched the field of computer graphics. In the five decades since completing my PhD, I have been an active research participant and keen observer of applications of computing to education and learning, medicine and health, the arts, digital media, collaborative work and learning, and as enhancements to the life of senior citizens.

A high-level, optimistic vision of the power of human creativity coupled to machine capability had already been provided in 1960 by the influential 'man–machine symbiosis' paper of scientist and computer technology research leader J. C. R. Licklider:[3]

> The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.

Other thinkers and pioneers amplified this optimism. A far-seeing 1945 paper by engineer and inventor Vannevar Bush,[4] who had led the US scientific research and development (R&D) effort during the Second World War, postulated a device called the Memex, conceived to transform the ways in which we explore information and create knowledge. In 1962, engineer and inventor Doug Engelbart described the potential of digital technologies for augmenting human intellect and facilitating team collaboration.[5] Soon thereafter, in 1965, generalist Ted Nelson sketched early concepts of hypertext and hypermedia.[6] Computer scientist Alan Kay then anticipated the personal computer and personal dynamic media,[7] a topic to which we shall return in Chapter 2.

Yet others had fears for the future. Early concerns were expressed about issues such as privacy, automation and work, and the goals of and limits to artificial intelligence (AI). The 1960s and 1970s saw some of the first books on computers and society. University of Toronto computer science professors Kelly Gottlieb and Allan Borodin contributed an early textbook.[8] Law professor Alan Westin wrote a scholarly treatise on privacy.[9] Computer scientist Joseph Weizenbaum reflected on the dangers of relying on computer programs that no human being understood anymore and the effect of programmers' personality and lifestyle on the work they create.[10] Mathematician and AI guru Seymour Papert and philosopher Hubert Dreyfus engaged in a debate about the potential of AI,[11] issues we shall revisit more knowledgeably in Chapter 11.

Computer speed was then a fraction of what it is now. Moore's Law predicted continuous miniaturization and impacts of this on computer power and memory.[12] Indeed, the number of logic components one could place on a silicon chip was projected to double approximately every two years. For example, the first Macintosh computer, announced on 1 January 1984, had 128 KB (128,000 bytes) of memory. A 'Mac' purchased in 2016 (thirty-two years or sixteen two-year periods later) had 16 GB (16 billion bytes). Moore's Law would predict that it could have 32 GB of memory, a very accurate forecast indeed. There have been similar increases in processor chip count and speed—amazing advances in digital technology!

This progress has enabled the digitization of communication, the internet, the web, mobile phones, and advances in AI and machine learning, which rely upon massive processor power and memory. The speed of hardware and software developments has emboldened many pioneers to articulate visions of a grand and glorious future; we shall highlight some of these. We shall also mention visions of despair and nightmares of plausible totalitarian control aided by technology.

Technological change has produced a complex set of issues for individuals, society, and government. Concerns about privacy and automation's effects on work and jobs continue. There are new opportunities and challenges in the areas of digital inclusion, intellectual property, security, and safety. We also see ways in which computing impacts learning, health, politics and government, and war and peace. A discussion of safety will also highlight concerns about the environment. Trust of automated systems and robots is now a major issue. There are also legitimate concerns about the 'tech-centric' lifestyle we have adopted, and the phenomenon of increasing corporate concentration. We shall address all these themes in this volume.

0.2 Opportunities: computer applications

I first discuss applications of computers and telecommunications, areas in which digital technologies have changed our lives, and will likely do so even more profoundly in the future.

If we are optimistic about the ways in which widespread computerization improves our life, then we must be concerned when digital technology is not meaningfully available to some sectors of society. Such gaps are known as 'digital divides'. In Chapter 1, we examine the goal of removing digital divides, between rich and poor, individuals in Western societies and those in 'Third World countries', young and old, men and women, and those who are able-bodied and those who have sensory, motor, cognitive, or reading challenges. This goal is now often termed *digital inclusion*. We shall consider a challenge to this goal in the battle over *net neutrality*, and present several notable examples of digital inclusion, including the formation of online communities and the widespread availability of knowledge and information in over 40 million Wikipedia articles in over 250 different languages. This development is all the more remarkable because it has engaged over 30 million individuals in its creation and upkeep.

Wikipedia demonstrates the power of *digital media*; there are many other examples from the arts and sciences. Chapter 2 discusses the explosion of digital media, the role and value of *intellectual property* (IP), and the intellectual property of digital media. Writers, musicians, artists, and inventors have historically viewed their creations as protected by IP regulations, enabling them to profit from and control the use of their writings, music, art, and inventions. We shall discuss digitized music, motion pictures, mash-ups of fragments of audio and visual media, digital textbooks, and research literature. In all cases, there are questions about what represents *fair use* and what may be considered inappropriate use, often termed 'piracy' or 'stealing'. We then discuss the concept of *open access*, as applied to textbooks and research journals, and also the *open source* software movement. We close with the important *Creative Commons* method of licensing creations, which provides us an opportunity to bridge the divide between *proprietary* (uses focused on ensuring credit and earning compensation for work) and *open*, shared culture.

Chapter 3 begins by reviewing influential visions of how computers could revolutionize *education* and *learning*. We then discuss real developments: tutorials, drill-and-practice exercises, simulations and gaming, enhanced presentations, smart classrooms, flipped classrooms, intelligent tutoring, online learning, and massive open online classrooms (MOOCs). The current ubiquity of online learning has transformed traditional 'classrooms' in post-secondary and continuing education. Due to the success of these developments, school administrators and school systems now struggle to wisely apply digital technology in the schools, and to control the extent to which resources should be allocated to computers. One specific case is a dilemma now prevalent in secondary schools—the issue of when and how to allow or restrict the use of mobile phones and other mobile devices in classrooms.

We begin our discussion of applications to *medicine* and *health* in Chapter 4 with influential early visions of possible roles for computers. We consider the effect of online health

information sources found on the internet and online forums where individuals share their health experiences with others. We examine the care improvements promised by personal health and electronic medical records, technology for documenting adverse drug reactions and interactions, and the use of big data for infectious disease surveillance. Digitization also extends to the human body; patient simulators are now widely used in medical education. Artificial body parts are increasingly embedded in real humans, likely resulting in *bionic people* or *androids* in the future. Recent advances in understanding the human genome point to exciting opportunities for *precision medicine*, using genetics to better target treatments to the specifics of each patient. These advances also allow future parents to have what some term as *designer babies*, a vision that brings delight to some and chills to others. Finally, we look at two current topics of particular interest to older adults: *neuroplasticity* and *brain training exercises*, and robotic companions and caregivers for seniors, especially for those with degenerative diseases.

Free speech, *politics*, and *government* are other aspects of our lives that have undergone dramatic change. This is the topic of Chapter 5. Visions have primarily been negative, expressed in several influential literary dystopias. We consider the cultural and legal framework governing speech and other forms of expression on the internet, the universal right of free speech, and incentives governments have to restrict speech that they view as pornographic, hateful, threatening, treasonous, or supporting terrorism. Troubling new issues have also arisen in recent years with social media 'speech' that is actually *fake news*. This came to the foreground during the 2016 US presidential election, but has also affected politics in other parts of the world. We focus on emerging trends in e-democracy, including the roles of social media in enabling political protest and the application of social media to political campaigning, including the use of surveys and big data to target potential voters. We conclude the chapter with a discussion of e-government, the use of technology and social media in governance, including the bizarre and painful US case of the current 'tweetocracy' of President Donald J. Trump.

Some of the earliest computers were developed for military applications during the Second World War. The effects of computerization and worldwide telecommunications on *law and order*, *war and peace* is the theme of Chapter 6. After highlighting android policemen and soldiers from science fiction novels and films, we review the use of social media by police, and by citizens in their interactions with police. We discuss technology-aided surveillance by police and by government. Then, looking beyond the borders on an individual country, we examine how computer hacking may be used by one nation against the other, for example, to interfere with elections, a prominent topic after the 2016 American election, and one that has continued to arise in various parts of the world in 2017 and 2018. We discuss societies that repress and forbid free access to the internet, as well as methods of combatting this repression, which often is done from nations outside the repressive society. We then expand our view of hacking as an agent of international politics, via *cyberespionage*, *cyberterrorism*, or more generally, *cyberwarfare*. Modern warfare technology has also changed: there is an increasing use of drones and other self-guided weapons as tools of combat, or *semi-autonomous weapons*, and the future possibility of *robot soldiers*.

0.3 Risks: technological threats

In Chapters 7, 8, and 9, we focus on major issues that often arise in the uses of the digital technologies discussed in previous chapters.

Security is the attribute of a computer system that ensures that it can continue to function as it normally does and as it is supposed to function. We begin Chapter 7 by explaining some of the major ways in which computer systems may be insecure and therefore subject to invasion. *Hackers*—individuals who seek to exploit the weaknesses of a system— and *cybercriminals* exploit system vulnerabilities in order to break in or disrupt the system. Such intrusions can interrupt the computational and communication capabilities of an institution or a society and have the ability to wreak great damage. Hackers with political motivations have already been discussed in the preceding chapter. In Chapter 7, we continue our discussion of large-scale system intrusions, typically done for financial gain, and then look at three specific ways in which digital society is vulnerable to sabotage—*identity theft*, often via *phishing*; break-ins into our digital worlds, including our phones and our homes; and the security of electronic voting. We close with a discussion of legal responses to safeguard security.

Safety of a system is similar to but not identical to security and is the topic of Chapter 8. A system that is secure may not be safe, if its normal operation can result in damage to individuals or societies. For example, intractable user interfaces can cause frustration, anger, and even rage. Damage may be done to younger people by *cyberbullying* and through the use of *revenge porn*. There are also daily threats to our safety because pedestrians, bike riders, and drivers are immersed in their mobile devices. We then widen our scope from the individual to society. Our inability to predict the complexity and control the costs of large-scale *information technology* (IT) implementations threatens safety because it undermines our ability to plan an orderly progression for a government or an organization. Even more serious are incomprehensible large-scale software systems that are no longer understood, even by their creators; controlling them is essential for society to function. We also look at safety in electronic medical devices, industrial accidents such as with nuclear reactors, and the recent interest in self-driving cars. We close by examining ways in which IT contributes to improving the planet's environment, and ways that it contributes greenhouse gases and waste that further jeopardize our planet's safety.

Concerns about *privacy*, the topic of Chapter 9, have long been manifested in dystopian literature, and have been discussed within computer science since the early years. Data storage is now virtually limitless and free, so governments and corporations can keep and access records on almost all aspects of our lives. Hardly a week goes by when we do not hear of a significant data breach that exposes people's personal financial or health information. There are also new risks from new technologies—*social media* where we ourselves expose personal information, location tracking, video surveillance, and embedded devices. For example, the privacy intrusions via inappropriate use of Facebook data by Cambridge Analytica illustrated in 2018 the malicious use of our social media information. Government itself is not safe—the 2016 revelations of Hillary Clinton's emails raised the

question of whether or not politicians and statesmen can count on private communications in the internet age. The 2013 news of the widespread US surveillance of American citizens and other individuals unleashed anger at the covert data collection, and support for or anger at *whistle-blowers* such as Edward Snowden who exposed the practice. We close the chapter with a discussion of legal responses to safeguard privacy.

0.4 Choices: challenges for society

The topics of Chapters 10, 11, and 12 are not new, but have increased in urgency due to technical developments over the past two decades.

The effect of *automation* on *work* and *jobs* has engaged thoughtful computer scientists and economists since the earliest days of computing. Discussions often invoked movements such as the Luddites during the British Industrial Revolution. We examine in Chapter 10 how computers are used to enable more efficient processing of job applicants and employee selection, and how they are also used to monitor job performance. Not only is there dramatic change in our jobs, there are changes in how we do some of this work. Examples are found in *on-demand services* and in methods of job tasking and sharing that are enabled by internet communication. We then discuss how computers are doing both manual labour and mental labour, and investigate its effects on various sectors of the economy—agriculture, manufacturing, service industries, and the professions. We end with an overview of current data and projections on unemployment caused by automation, visions of the future of work and leisure, and the choices that we as a society will face as we struggle with the economic and psychic impact of many or most human jobs becoming obsolete due to technological advances. For example, will we need to institute *guaranteed annual incomes*?

Since the 1960s, advances in AI have made us ask whether we will soon no longer be the species with the greatest ability to think, and the consequences we will face in ceding critical, even life and death, decisions to intelligent machines. Chapter 11 discusses many important questions. What kinds of artificial intelligence are there? What is the difference between *good old-fashioned AI* (GOFAI) and the modern approaches to *machine learning*? What are the capabilities and limitations of smart programs? Should programs be treated anthropomorphically, as if they were people? Can machines exhibit *empathy*? How do we know what a machine knows or does not know? Can we understand the logic behind its decisions or actions, in other words, are they *explainable*? Under what circumstances do we trust people and traditional machines, and under what circumstances should we *trust* computers? Who or what is *responsible* if errors are made or life is lost? Furthermore, since our digital records, whether accurate and complete or not, stand for us in situations where it is essential that there are no errors, there are concerns about *fairness* and *justice*, for example, how big data can be used to characterize unfairly and limit the opportunities of some individuals.

The widespread use of the internet for purposes such as social media has led to dramatic changes in our *lifestyle*. In Chapter 12, we discuss the internet and social media's

enabling of interconnectedness of people to friends, acquaintances, and communities, in terms of what it allows, and also what a surfeit of connectedness means for our lives. We look at the phenomenon of addiction to computers or social media. We consider the effect of ubiquitous digital media, the impact of the Internet of Things on work and home life, and the rapidly improving capabilities of *virtual reality* and *augmented reality*. We look at online dating, and, as robots become more lifelike, the future of sex robots. We examine how financial transactions are changing, and the future of cash in a world with digital finance infrastructures such as *blockchain*. As some IT firms have developed monopolistic positions and expanded their focus to allow them to dominate numerous other sectors of the economy, we close with the topic of corporate concentration.

In the Epilogue, we summarize social, legal and policy, and ethical issues and questions. Following the Epilogue, there is an Afterword that summarizes developments in autumn 2018.

What kind of society would we like? How should we address the tension between proprietary and open approaches to digital media? To what extent will we use computers in education and medicine, and should we impose limits? Will we still drive, or will we yield driving to smart cars in the interests of safety or efficiency? What happens when smart technology fails or is compromised? Will we allow ourselves to enjoy states of solitude disconnected from technology, or can we no longer imagine being offline?

To what extent, and how, should governmental policies and laws control the ways in which computers are used? How important is digital inclusion, and how do we increase it? What kinds of speech should governments or the monolithic firms that control the internet forbid? How can we control the proliferation of fake news? Will governments be able to deal with cyberattacks on their sovereignty? Will there be no limits on surveillance in the service of security? How can we ensure that some privacy remains?

What ethical choices do we face as we live in societies where there are fewer and fewer limits to what digital technologies can do? Will we use precision medicine to order babies with certain characteristics? Will we allow an arms race in cyberweapons? Will there be limits to what work can be automated? How will we ensure dignity and economic security to those who can no longer find work? Are there limits to what we will trust machines to do? How will we decide when not to convey trust and responsibility? What do educated citizens, as well as those active in technology professions, do when faced with conflicts between their beliefs and what is happening?

0.5 How to use this book

Typically, we motivate the treatment of each topic with an engaging and specific case study that illustrates the topic to be presented and the themes to be discussed. Where needed, we include a layperson's discussion of the computer science developments that have enabled the topic to be relevant and interesting. We sketch the extent to which and how computer capability is affecting or is likely to affect society in the foreseeable future. We summarize how some individuals can view these developments and impacts as

positive and others can see them as negative. We expand the discussion to consider policy decisions that have been made or could be made by various branches of governments, and ethical dilemmas that may be perceived and acted on by individuals and organizations. We highlight different points of view about most issues. Where possible, we enrich the discussion by explaining how various aspects of the same issue have manifested themselves and been dealt with in different cultures, societies, or nations.

Tech Support

Gracing this book's cover is a brilliant editorial cartoon that originally was the cover art of the 23 October 2017 issue of the *New Yorker* magazine—'The Money Issue'. It was created by the cartoonist and illustrator R. Kikuo Johnson,[13] and was given the title 'Tech support'.

Figure 0.1 The cover of a recent issue of *The New Yorker* magazine: "Tech Support"[14]

It is eye-catching, and also illuminates several themes that I will discuss primarily in Chapters 10 and 11. What are the limits to AI? Will robots take our jobs? What jobs will they not take? What physical forms will robots assume? Will they learn our habits? Will they drink coffee and text while walking? What will become of us? How will we sustain ourselves if we can no longer get paying jobs?

My short treatments of each theme and topic do not give 'all the answers'. The text points the way for students to go out and read literature that is cited, and to find and organize more literature that responds to specific research questions that they themselves may investigate. Many references to additional literature that appear in the electronic version of the text may be clicked to access online versions of the cited papers. There is a section called Notes that includes asll the endnotes that elaborate on arguments made in the text and provide the references for citations. There also is a section called Resources which lists websites that have huge amounts of relevant, useful, and current material.

Students are encouraged to formulate and debate their own opinions about social, policy, and ethical issues.

Each chapter contains interesting assignments and projects. Others may be obtained by morphing an assignment of one category into a similar one from another category, or by modifying the topic straightforwardly, such as by substituting one country for another. The ten categories are:

1. Scholarly *research* paper
2. *Concept* definition as a new Wikipedia article, or as improvements of an existing one
3. *Debate* topic, realized in various forms that involve two competing individuals or teams
4. *Policy* brief, presenting facts, opinions, and arguments for a politician or candidate
5. Text of a proposed *law*, on an issue of importance, in the context of a specific country
6. *Jury* deliberation, by a small group on a hypothetical violation of a real or postulated law
7. *Field work*, understanding technology use via interviews, questionnaires, observation
8. *Book report*, on a relatively recent book related to material discussed in the course
9. *Technology review*, comparing and contrasting several comparable products
10. Dilemma regarding *ethics*, in some cases for an individual working in the computer field, in other cases for an organization or society.

Assignments encourage students or teams of students to research and synthesize material that goes beyond what is discussed in the text.

A word about terminology. Although my title is 'Computers and Society', the word 'computer' was used because that term typically appears in the titles of courses dealing with the subject matter of this book. Two phrases are more descriptive. Using the phrase *digital technologies* makes it clear that we typically are speaking of a variety of devices, only some of which look like computers, such as mobile phones and fitness measurement devices. *Information and communication technologies* (ICT) makes it clear that we are speaking of systems of devices and connections that communicate and process information. We shall typically simply just say *information technology* (IT).

This book will primarily be read in academia, but the subject matter is not just of academic interest. Many who engage with the topics experience life-changing insights into how vital the issues are. Many build careers trying to ensure that technology is used to make the world a better place. In May 2018, I attended a conference called RightsCon.[15] It was the seventh such conference, attended by over 2,000 passionate and articulate individuals from 115 countries. RightsCon describes itself as:[15]

> [a] conference on human rights in the digital age…bring[ing] together business leaders, policy makers, general counsels, government representatives, technologists, and human rights defenders…to tackle pressing issues at the intersection of human rights and digital technology.

Events since 2016 illustrate how digital technologies are exacerbating worldwide human rights issues such as disinformation, authoritarian control, divisiveness, hatred, and conflict.

If this book engages your imagination and your social conscience, there is much for you to do!

0.6 A note to instructors

This book is shorter than a traditional Computers and Society text, and can therefore be used differently. Each of the chapter topics could form the basis of several weeks to a half-semester of presentations and discussion. Instructors are encouraged to tailor their course organization to match their interests and those of their students. They can profitably assign the core readings from the text, and supplement it with references provided in the text, or with additional readings that they or the students may choose. Or there need be no additional readings; the material presented can provide the basis for organizing classes and for designing assignments and projects that will engage students mightily over a term, or even over a year.

A course focused on the traditional Computers and Society topics would use Chapters 2, 5, 7, 8, 9, and 10, with selections from some of the other topics. There are of course many more options.

The assignments and projects can be tailored by instructors as individual or team assignments. Most can have both written and oral components. The assignments are grouped at the end of the discussion of each topic (a section within a chapter) to enrich the preceding discussion.

Ethical discussions are best led by the instructor, with additional readings assigned according to his or her tastes and beliefs. This can be done in four different ways: applying an Ethical Theory; applying a Code of Ethics and Professional Conduct; focusing on the Ethics Case Studies in this text or assigning papers from other sources that present ethical analyses; or reading and discussing issues that emerge in literature such as science fiction.

Ethical theories

One or several ethical theories may be taught. Here are some options:[16]

Ethical theory	Key idea
Deontological ethics	The morality of an action is based on rules of behaviour. For example, act in accordance with universal laws of how humans should behave that may be derived through rational thought. (Immanuel Kant)
Act Utilitarianism	Act in a given situation so as to produce 'the greatest happiness for the greatest number' (Jeremy Bentham).
Rule Utilitarianism	Act in accordance with rules that lead to the greatest good. (John Stuart Mill)
Social Contract	Act in accordance with rules that have been agreed upon by individuals so that they can live together in a society. (Thomas Hobbes, John Locke, Jean-Jacques Rousseau, and recently by John Rawls, who expressed this in terms of a theory of justice.)
Virtue Ethics	Act according to virtues, character traits of good human beings who behave virtuously. (Philosophy grounded in writings of Plato and Aristotle.)

The instructor may frame ethical discussions in terms of the code of ethics of a professional society. The Association for Computing Machinery (ACM), the society of computer science research and teaching, has had a code of ethics and professional conduct since 1992. It was updated in 2018.[17] Its preamble explains its methodology and how it is to be used:

> The Code includes principles formulated as statements of responsibility, based on the understanding that the public good is always the primary consideration. Each principle is supplemented by guidelines, which provide explanations to assist computing professionals in understanding and applying the principle.

Another relevant framework is the code of ethics of the software engineering community.[18]

Analysis and discussion may also focus on examples highlighted in this text's Ethics Case Studies. Or one might assign some additional readings on topics that highlight ethical issues. Three books are good sources. Since 1985, Deborah G. Johnson has authored a compact and excellent text called *Computer Ethics*, now in its fourth edition.[19] The book's second chapter, 'Ethics and Information Technology', is a useful introduction to the ethical theories mentioned above. Johnson also motivates ethical thinking beautifully:

> Our deliberations about how to act and what to choose often involve moral notions (right and wrong, loyalty, duty, justice, responsibility), ethical principles (do no harm, tell the truth, keep your promises), and ideas about what makes for a full and meaningful life (concern for others, community, friendship).

A wonderful and broad compendium of classic papers is *Computers, Ethics, & Social Values* by Deborah G. Johnson and Helen Nissenbaum,[20] published in 1995. In this volume, Prof. Terry Winograd's essay on social responsibility and the third chapter, on software ownership,

focus insightfully on ethical questions. Kenneth Einar Himma and Herman T. Tavani's *The Handbook of Information and Computer Ethics* provides broad coverage of ethical and policy issues raised by widespread computerization,[21] for example, Prof. Dorothy Denning's chapter on the ethics of cyberconflict.

Finally, students may be highly motivated by reading and discussing issues that arise in literature such as science fiction. [22]

Some other books may be helpful to instructors with respect to certain topics.

Sara Baase's *A Gift of Fire: Social, Legal, and Ethical Issues for Computing Technology* is now in its fifth edition.[23] It covers a subset of the topics covered in my book, and pulls out 'Freedom of Speech', 'Crime', 'Evaluating and Controlling Technology', and 'Errors, Failures, and Risks' explicitly as chapters. A valuable feature is a set of sections at the end of each chapter listing important books and articles, and organizations and websites. References are included in comprehensive notes which amplify the text and set the references in context.

Michael J. Quinn's *Ethics for the Information Age* is now in its seventh edition.[24] Its topic list is similar to that of Baase's book. A notable feature is its presentation of eight different ethical theories, its selection of five of these as most relevant and useful, and its use of these theories to frame and discuss topics that appear under the themes of networked communications, intellectual property, information privacy, privacy, security, reliability, professional ethics, and work and wealth.

Computers and Society: Modern Perspectives differs from the two aforementioned textbooks in several ways. My text is much more current, yet more concise, as the goal was to frame topics in broad outline rather than to present them in as much detail as the other texts. My outlook is more global, with less of an American emphasis. This text's treatment of the themes of digital inclusion, learning, health, safety, AI, work and leisure, politics, war and peace, and lifestyles goes far beyond that found in the two other books. Finally, unlike Quinn, I do not discuss ethical dilemmas using specific codes of ethics, leaving that to instructors to present as they think best.

Here are four other useful books. Still impressive is Rob Kling's *Computerization and Controversy: Value Conflicts and Social* Choices.[25] Its 1996 second edition includes valuable writing by the author as well as many classic papers. Three volumes have a narrower focus. *Reinventing Technology, Rediscovering Community: Critical Explorations of Computing as a Social* Practice,[26] by Philip Agre and Douglas Schuler, focuses on ontological questions about computers and software as well as the application of networks to support community. Batya Friedman's *Human Values and the Design of Computer Technology* proposes a methodology known as value-sensitive design.[27] A new volume discussing this approach is being published in 2019. A useful volume that is somewhat current with robot technology and applications is *Robot Ethics: The Ethical and Social Implications of Robotics* by Patrick Lin, Keith Abney, and George Bekey.[28]

You may also want to refer students to the following publications:

- *Communications of the ACM*, ACM
- *Computer Law and Security Review*, Springer
- *Ethics and Information Technology*, Springer

- *IEEE Computer Magazine*, IEEE
- *Interactions*, ACM
- *Journal of Information, Communication and Ethics in Society*, Emerald
- *Science, Technology, & Human Values*, Sage
- *Technology in Society*, Springer
- *MIT Technology Review*, MIT Press
- University law journals, especially Duke, George Washington University, Harvard, Stanford, University of California at Berkeley, University of Chicago, and the University of North Carolina

Part I

Opportunities

1

Digital inclusion

J. C. R. Licklider, Vannevar Bush, Doug Engelbart, Ted Nelson, and Alan Kay optimistically and exuberantly imagined how computers could better the lives of people. Much of this has come to pass. The Internet supports learning by 'students' at all levels. Information on laws, procedures, diseases, and medical care may be found on the web. The Internet now provides the easiest, or in some cases the only, way to pay bills or order items such as books, groceries, and even clothing. It is a means of communication with family, friends, individuals one would like to meet, individuals with whom one could share insights, and potential employers. Music, films, and other means of entertainment stream to our digital devices.

This implies that those for whom digital technology is not available are at a disadvantage. The gap between the technology-haves and the technology-have-nots became known in the 1990s as a *digital divide*.[1] The concept is nuanced; we can speak of availability or scarcity of hardware, such as personal computers (PCs) and mobile phones; of infrastructure such as cellular networks; of communications bandwidth that enables a smooth media viewing experience; of expertise in using the technology; of commitment to its use; and of engagement in the process. Some only consume information; others contribute their ideas via methods such as blogging and tweeting.

Yet a better way to describe digital technology widely accessible is the goal of *social inclusion*,[2] to allow all individuals, regardless of socio-economic status, location, race, gender, or ability or disability, to take advantage of the benefits of modern computing and telecommunications. To have terminology that is even more evocative, we shall use the more modern and descriptive term of *digital inclusion*.[3] This has been defined by the International Telecommunications Union as 'empowering people through information and communication technologies (ICTs)'. The term 'people' is meant here to imply all people throughout the world.[4]

This chapter will first examine the digital divide between the haves and the have-nots (often the rich and the poor) within several nations. Examples of the benefits of digital inclusion will be cited. We shall also discuss the threat to digital inclusion within the USA posed by the recent US government decision to abandon the policy of *net neutrality*.

We examine ways to digitally include not just individuals in developed societies but also people in 'developing countries'. We discuss the impact technology can have in such contexts, and also the damage that can be done in any nation when the Internet is shut down for political reasons.

We then introduce the concept of the *inclusive design* of technology and examine how the failure to provide inclusive technology often leads to a divide between those who are able-bodied and those who have sensory, motor, or cognitive challenges. We conclude the chapter with two interesting special cases of digital inclusion—the divides between male and female and between young and old—and the ways in which gender and age play a significant role in digital inclusion.

Do digital divides still exist? What are the benefits of solving the problem of digital inclusion? What are the challenges that must be met?

1.1 Pioneers and visionaries

The vision of digital inclusion has motivated individuals and societies to close digital divides. We shall first highlight the work of two individuals with early far-reaching dreams about digital inclusion for people with disabilities. We shall then celebrate the achievement of an entrepreneur committed to making quality information available to all internet users.

The British scientist Alan Newell began work on technology for deaf and non-speaking people in the UK in the late 1960s.[5] His first inventions were a voice-operated typewriter using Morse code for people who could not type and a talking brooch, a wearable communication aid for people who could not speak. His research then moved to what became known as Augmentative and Alternative Communication (AAC) for people with severe disabilities such as Amyotrophic Lateral Sclerosis (ALS). Newell coined the phrase 'ordinary and extra-ordinary human–computer interaction'; he believed that one could understand how *people with disabilities in ordinary environments* could cope by understanding the functioning of *people without disabilities in severe environments*. Examples of this concept are how heavy fog makes it hard to see long distances and how loud noises make it difficult to hear. A more recent innovation has been the use of theatre enactments to raise awareness of the lives of individuals with disabilities and senior citizens. This proved especially helpful in thinking about needs and possible technology solutions for senior citizens, some of which are discussed later in this chapter and also in Chapter 4.

The American scientist Elliot Cole began work on treatments for Traumatic Brain Injury (TBI) in the early 1980s.[6] In the USA, 1.7 million people who have experienced a TBI are seen in a hospital each year. The increased survival rate of soldiers returning from war zones has meant the prevalence of TBIs has grown. Cole's major concern was enabling people to do normal everyday activities that had been routine before their injuries: tasks such as remembering names, making lists, checking completed items off a list, and making one's lunch. His solution, developed and tested with over 100 patients over three decades, was 'user-friendly' software delivered on PCs that functioned as *cognitive prostheses*. Cole also pioneered *tele-rehabilitation*, working with patients using telecommunications, thereby enabling the patient to be in his or her natural environment, supported by a therapist who could be located remotely. He sometimes described his work as identifying and fostering 'islands of abilities in seas of deficits'.

Both Newell and Cole employed digital technologies to aid individuals with disabilities: in one case, primarily sensory and motor, and in the other case, cognitive. Yet computers and telecommunication technologies aid us all in many ways, often as a source of information and knowledge at one's fingertips on the web. A dramatic vision of this was created by Jimmy Wales, the co-founder of Wikipedia.

Wikipedia

Wikipedia is a free online encyclopaedia that has become a remarkable success in the past fifteen years.[7] There are now over 40 million articles, 5 million of them in English, in over 250 languages. It is accessed by nearly 500 million unique viewers each month. It is now the dominant general encyclopaedic resource in the world.

Wikipedia's content is created by its community of users and readers. There are now 30 million 'registered editors' and over 100,000 active editors. Most of the content creators do not have credentials, but are just ordinary people. Although the original goal of allowing text to be entered by anyone has had to be modified due to disputes over accuracy and occasionally even vandalism, various scholarly analyses have given Wikipedia high marks for quality.[8]

Co-founder and leader of the project, Jimmy Wales, sought to create 'a world in which every single person on the planet was given free access to the sum of all human knowledge'.[9] Wikipedia has dealt reasonably well with the problem that there are sometimes passionate disagreements as to what is the truth and what is knowledge and what is neither. We aim 'not for the truth with a capital T, but for consensus', said Wales,[10] in which people who disagree can at least reach a consensus on the essence of their dispute.

Figure 1.1 The Wikipedia page describing Wikipedia
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There have been recent developments related to Wikipedia. One good one has been Google's Knowledge Graph,[11] which aids the instantaneous access to knowledge. It provides summaries of facts in response to searches right on the search results page. One then need not dig deeper into websites, online encyclopaedias, or other sources of information. A negative development has been the censoring of access to Wikipedia by over a dozen countries including China, Cuba, Iran, Russia, Syria, and Turkey,[12] a topic to which we shall return in Chapter 5.

Research: Identify, illustrate, discuss, and analyse Wikipedia mechanisms for the resolution of disputes over what constitutes the truth and what is the knowledge that should be recorded on Wikipedia.

Debate: Resolved: Despite occasional inaccuracies, Wikipedia contributes hugely to our knowledge and wisdom.

1.2 Access to the Internet

Although Wikipedia was created only in 2001, the value of the Internet for all citizens was recognized by governments earlier. For example, in the USA, the Clinton administration's High Performance Computing Act of 1991 proposed the creation of what was called a 'national information infrastructure'.[13] In January 1994, then US Vice President Al Gore spoke about 'connect[ing] and empower[ing]…citizens…through broadband, interactive communication'. Internet access equality was explored in detail in four US National Telecommunications and Information Administration reports between 1995 and 2000.[14] A grand political vision accompanied these developments:[15] the digital divide must be overcome to give everyone the ability to compete in a 'New Economy'. One can question whether or not this is a realistic goal, although being competitive is certainly desirable for individuals and businesses.

Since then, there have been countless recitations of ways in which computer and communication technologies benefit many people but are disproportionately available to individuals based on categories such as household income, educational attainment, race, ethnicity, gender, age, community type (urban, suburban, rural), disability status, and language preference.

Inequities in access are still to some degree prevalent within the USA.

Table 1.1 Characteristics of internet users in the USA at two recent points in time[16]

	2000	2015
All American adults (18 and above)	52%	84%
Household income less than $30K	34%	74%
Household income greater than $75K	81%	97%
Less than high school	19%	66%
At least a college degree	78%	95%
18–29	70%	96%
Over 65	14%	58%
Female	50%	84%
Male	54%	85%
Black, non-Hispanic	38%	78%
White, non-Hispanic	53%	85%

We can see that the digital divide in the USA has narrowed, but not completely.

Net neutrality

This rapid growth of internet use was fuelled in part by visionary US government policies. A small but significant factor leading to the Internet's success has been the pricing of telecommunications. The phrase *net neutrality* refers to a telecommunications policy in which: (1) all users, corporations, and individuals pay the same amount, regardless of the volume of data used; (2) all data is treated the same, regardless of purpose of use; and (3) there are no fast lanes for special customers or data or purposes. These rules guaranteed equal treatment, similar to the transmission of electricity for telephone calls. In 2018, Federal Communications Commission (FCC) chairman Ajit Pai abandoned this policy and allowed telecommunication companies to charge differentially, an action that was greeted with a flurry of lawsuits from state attorney generals and public interest groups.[17]

Although it is too early to know the impact, many worry that US telecommunication companies will increasingly tilt internet pricing and policies in favour of big business and special interests. Among the groups that have expressed concern are artists and activists,[18] who convey their creativity and their message using social media such as YouTube, Facebook, and Twitter; small businesses, 500 of whom protested because their firms increasingly rely upon the economics of e-commerce; and start-ups, 200 of whom spoke up for the same reasons.

Digital inclusion or exclusion must not be viewed as a binary variable,[19] with groups or nations characterized either as 'haves', that is, technologically 'rich'; or 'have-nots', that is, technologically 'poor'. Unfortunately, individuals with wealth and education are more likely to have the 'digital skills' which with to make good use of the Internet. In a bad case of negative feedback, use of the net can in turn increase inequalities in knowledge and skill.[20] Yet factors that can increase digital inclusion, such as low-cost broadband, low-cost computers, public-access computing centres, and relevant digital literacy training are essential but insufficiently unimplemented.[21] Digital media content in appropriate languages, human resources to promote learning and literacy, and social resources, that is, support from committed institutions and community partners,[22] are vital to bridge the divide. Finally, it is critical that prospective internet users have the motivation to make effective and meaningful use of the technology, and that their uses be 'situationally relevant', that is, it must support meaningful goals for them such as pursuing social connections, engaging in commerce or political activity, or consuming goods and services.[23]

Does digital inclusion better the lives of citizens? In Chapters 2, 3, and 4, we will give examples via developments in technologically enhanced media, education, and health. In this chapter, we shall present one other example: digital communications to support community.

Beginning in the early 1990s, community networks across the world used the Internet to create community cohesion, inform citizens, provide access to educational resources, and strengthen democracy.[24] Most were situated in urban areas, although some linked

individuals across rural spaces. The Berkeley Community Memory project was an outstanding early example of creating a 'virtual people's park'. Principles underlying such systems included access, service, democracy, and world community. They anticipated today's Internet and its mechanisms such as websites, forums, list servers, and blogs, which enable individuals worldwide to stay in touch with friends and acquaintances, enlarge the circle with whom they interact, and enrich their lives with instantaneous access to online sources of knowledge and information. We shall return to this topic in Chapter 5, where we will discuss the role of community networks in terms of enabling greater participation in the political process.

Research: Research and analyse the digital divide for your country or country of origin.

Research: Identify and discuss cases of countries other than the USA where the issue of net neutrality has come up and what policies were put in place.

Concept: Write a Wikipedia article, 'digital inclusion'.

Book report: Jan van Dijk and Alexander van Deursen (2014). *Digital Skills: Unlocking the Information Society*. Palgrave Macmillan.

Ethics: Your town is planning a major expenditure on providing free and excellent bandwidth throughout the area. At the same time, it needs to raise taxes significantly, because there are other pressing demands for cash, especially for road repair. Your expertise as a computer professional is sought. What do you advise? How do you compare and judge the importance of physical and virtual highways?

1.3 Internet access across the world

Globally, access to computing and telecommunications is distributed unevenly.

Table 1.2 Global internet penetration in 2013

Ranking	Country	% of population with internet access
1st	Iceland	96.5%
2nd	Bermuda	95.3%
3rd	Norway	95.1%
	…	
15th	Canada	85.8%
18th	USA	84.2%
	…	
86th	China	45.8%
139th	India	15.1%
	…	

Ranking	Country	% of population with internet access
178th	Myanmar	1.2%
179th	Timor-Leste	1.1%
180th	Eritrea	0.9%

As Table 1.2 shows, there are vast regions of the world with little digital inclusion.[25] Inequalities are even greater when one considers availability of bandwidth and not just subscriptions to services.[26,27]

The growth of internet use in Canada, Europe, China, and India has been similar to the USA, with the latter two countries starting somewhat later.

Table 1.3 Digital inclusion (individuals who used the Internet at least occasionally in 2013) in several countries

		Age			Education			Income		
Country	Total %	18–34%	35+%	Diff.	Less %	More %	Diff.	Less %	More %	Diff.
USA	89%	99%	85%	−14%	80%	95%	+15%	84%	97%	+13%
Canada	90%	100%	87%	−13%	81%	95%	+14%	85%	99%	+14%
China	65%	93%	49%	−44%	48%	91%	+43%	56%	80%	+24%
India	22%	34%	12%	−22%	9%	38%	+29%	11%	28%	+17%
Pakistan	15%	20%	10%	−10%	6%	33%	+27%	8%	20%	+12%
Ethiopia	8%	12%	4%	−8%	5%	43%	+38%	5%	23%	+18%

In Table 1.3 we can see the differences in digital inclusion as a function of age, education, and socio-economic variables within each nation, as well as differences between the countries.[26]

China is interesting because of its growing influence in world politics and trade. The digital divide there is rapidly shrinking, driven by increases in mobile connections, which had risen to 890 million by the end of 2015.[28] The country is now a major world player in digital media,[29] despite its extreme government internet censorship.[30] We shall return to this topic in Chapter 5.

One dramatic digital inclusion success is Digital Green.

Digital Green

Rikin Gandhi has been the driving force behind this project.[31] Gandhi had started with a concept that was not working—creating village knowledge centres in small villages throughout India. After working at length with farmers, he modified the concept. He focused on training farmers and employed them along with other villagers to create and endorse

Continued on next page

educational digital videos made with local talent. In a thirteen-month controlled trial involving 1,470 households in sixteen villages, Digital Green increased the adoption of desired agricultural practices by a factor of seven; Gandhi's process was ten times more cost-effective than a classical agricultural extension approach.

Figure 1.2 Screenshot from a video overview of Digital Green

Key to success was the organization's human element, especially Gandhi himself, and the means used to engage the participation and enthusiasm of farmers. The Digital Green Foundation has grown and seems to be thriving.[32] As of June 2016, its 4,400 videos had reached over 1 million individuals in over 13,000 villages in India and other nations in Asia and Africa. Its approach has also been adopted—with promising early results—in nutrition education.[33]

Not every project has been as successful. One ambitious effort was the One Laptop Per Child (OLPC) project of Nicholas Negroponte,[34] founder of the MIT Media Lab. The mission was 'to empower the world's poorest children through education'. The goals of the project were:

> to provide each child with a rugged, low-cost, low-power, connected laptop… [and] hardware, content and software for collaborative, joyful, and self-empowered learning. With access to this type of tool, children are engaged in their own education, and learn, share, and create together. They become connected to each other, to the world and to a brighter future.

Founded in 2005, its original goal was building and shipping 100 to 200 million US $100 machines per year within two years.[35] By 2014, the project had only shipped devices at a price closer to US $200 to approximately 2.4 million children.[36]

These results were insufficient to enable sustainability, and the head office shut down that year.[37] There have been several thoughtful analyses of how and why OLPC achieved

what it did, and why it did not do more.[38] The OLPC failed to anticipate and deal with the complexities of a developing country environment and the response by computer hardware industry players such as Intel to develop competitive low-cost laptops. Other challenges included a lack of electricity, hardware unreliability, repair problems, insufficient teacher expertise, insufficient budget for repairs and training, technology rushed to market, and disagreements among key OLPC executives. Nonetheless, the OLPC staff reported findings from various sites that were 'largely positive in nature', including improvements in school attendance and engagement.[39]

The largest deployments of the OLPC concept were in Peru (860,000 laptops) and Uruguay (570,000 laptops). The number of computers per student increased in 319 rural Peru primary schools from 0.12 to 1.18.[40] Yet only about 40 per cent of the students took the computers home due to concerns about theft and machine breakage. No significant effect was found on test scores in maths or language, although a significant positive effect was seen in one cognitive skills measure.

The deployment in Uruguay was studied extensively.[41] Devices were distributed to students in every public school and many secondary schools. The secondary schools were brought on board because of enthusiasm about results at the primary level. The result was an impressive reduction in the digital divide, both in terms of income level and geography. Yet advances in digital inclusion were not ideal; for example, only one-fourth of students reported that their parents also made use of the laptops. No impact on test scores in reading and maths was found. Laptop use declined over time; only 4.1 per cent of the students reported using the machines 'every' or 'almost every' day by 2012. Machines were used mainly for downloading, web surfing, and game playing. There was no effect on the self-perceived ability to carry out educationally significant tasks.

The need to enhance teacher training and to transform education is a theme to which we shall return in Chapter 3. We shall also address the value of standardized testing in assessing the impact of educational technological innovations that seek outcomes not in line with accepted standardized outcomes. Do standardized tests capture what one has learned? If not, how does one articulate the value of innovations that do not result in better student test scores?

The desire for worldwide digital inclusion, as well as expanded markets for technology, continued into the 2010s. In 2013, founder and CEO of Facebook, Mark Zuckerberg, asserted in a white paper that (internet) connectivity is a 'human right'.[42] He went further in a keynote speech to the Mobile World Congress:[43]

> [a] Deloitte study . . . showed that if you increase the number of people in emerging markets that have Internet access you could easily create more than a hundred million jobs and bring that many people or more out of poverty and you could decrease the child mortality rate by up to 7% and save millions of lives by giving people access to that information.

The report,[44] actually released a year later, did not say that, but did assert:

> This study analyses how Facebook stimulates economic activity and jobs through three broad effects: as a tool for the biggest and smallest of marketers; as a platform for app development; and as a catalyst for connectivity. It estimates that through these channels Facebook enabled

> $227 billion of economic impact and 4.5 million jobs globally in 2014. These effects accrue to third parties that operate in Facebook's ecosystem, and exclude the operations of the company itself.

Unfortunately, the report's intricate research methodology shed little light on how Deloitte justified the claims of substantial economic impact and job creation that Facebook has 'enabled'.

Yet Facebook does bring value to many people and businesses. To bring greater connectivity to developing countries, and ultimately secure new customers, in August 2013 Facebook established an organization called 'Free Basics'. By November 2016, it had connected 40 million people to the Internet.[45] Yet its technologies and policies resulted in great controversy, most notably in India.[46] Little of the Internet's full potential was exposed as the site favoured Facebook, violating net neutrality. Many individuals perceived Facebook's ulterior motive to be securing a higher market position rather than improving the life of citizens in developing countries. Because of this perception, Facebook withdrew Free Basics from India in 2016.

Kentaro Toyama, founding assistant managing director of Microsoft Research India (MSR India), provided his analysis of the problems encountered in using technology to promote social change around the world.[47] He described his disappointment that ten different promising educational technology projects at MSR India did not seem to make a difference, always floundering because of the lack of good teachers and academic administrators. Based on his observations of over fifty projects, he argued that real impact results from the dedication of the researchers to create concrete social impact, the commitment and capacity of partner organizations, and the desire and ability of the intended beneficiaries to utilize the technology.

In other words, designing with knowledge of the human element and context is more significant than creating any specific technological features. This was illustrated by the Digital Green project mentioned—its success is due primarily to its community and to the commitment of individuals. Two other examples are research projects, which we shall now describe.

The first is research done in Sierra Leone by Steven Sam.[48] The research literature on digital inclusion falls into three categories: papers that suggest that mobile phones are 'panaceas for ameliorating the problems of poor people'; others that suggest that they 'widen existing socio-economic disparities'; and a third group that views the mobile phone as 'a means to achieve the development of human well-being'. As a research contribution of the latter kind, Sam carried out participant observation, in-depth interviews, informant interviews, and focus group discussions with almost one hundred 'marginalized' people between 18 and 35 years old in two small towns (one urban, one rural) near Freetown, the capital of Sierra Leone. Marginalization was defined in terms of lack of schooling and regular formal employment. The study found that mobile phones were used to organize family affairs, especially financial; keep in touch with family; coordinate activities for small businesses; and participate in politics. Despite the value of digital telecommunications to empower participants, Sam found no evidence that they were 'completely emancipated from their marginality' due to their technological ability. He concluded that political decision-making remains in the hands of 'political

elites' and that political input via telecommunications is 'unnoticed in national development policy'.

A second example addressed the issue of enabling individuals in developing countries with low literacy to use mobile phones.[49] Professor Ishtiaque Ahmed's research team worked with a group of rickshaw pullers in Dhaka, Bangladesh. None could read or write a complete sentence in any language. A six-month ethnographic study helped the researchers design an interface that allowed low-literate pullers to get remote assistance in placing calls from members of their community who were more literate. This collaborative use model proved effective in a second study, in which the interface was tested with ten pullers over six weeks. Yet, like so many research studies, it is an open question whether the benefits are sustainable and scalable.

Research: Research the case of Free Basics and discuss if and how the result could have been different had Facebook done things differently.

Debate: Resolved: Resources in the developing world should be spent on upgrading health and core literacy as opposed to information technology.

Book report: Walter Bender, Charles Kane, Jody Cornish, and Neal Donahue (2012). *Learning to Change the World: The Social Impact of One Laptop Per Child*. Palgrave Macmillan.

Book report: Kentaro Toyama (2015). *Geek Heresy: Rescuing Social Change from the Cult of Technology*. Public Affairs, Perseus Books Group.

1.4 Internet shutdowns

We have seen that the Internet can enhance literacy and empower individuals. As we shall discuss in detail in Chapter 5, it is also a vehicle for free speech and the expression of ideas. These ideas are not always popular with governments, so they sometimes try to suppress dissent by shutting down the Internet. This has been happening increasingly throughout the world.

Internet shutdowns do not just occur under totalitarian regimes. Between 1995 and 2010, there were growing numbers of shutdowns. Forty-five per cent of the 606 incidents spread across ninety-nine countries happened in democratic regimes or in emerging democracies.[50] India has suffered the largest number of shutdowns; Chinese access has been limited by what is known as the 'great Chinese firewall', and there have been numerous incidents in Africa and the Middle East.[51]

By 2015, this was costing countries a conservative estimate of $2.4 billion in lost productivity, not counting impacts such as reduced tax revenues and loss of consumer confidence.[50] Special damage is sustained by emergency service workers and journalists. Also affected are human rights advocates, who have been outspoken in their attempts to fight internet shutdowns.[52] In 2016, the United Nations passed a resolution on behalf of human rights on the Internet.[53]

We shall return to these issues in both Chapters 5 and 6. Next, we shall discuss how internet access, even if unhampered by governments, is not equally accessible by all.

1.5 Inclusive design of technology

The Inclusive Design Research Centre of Canada's OCAD University defines inclusive design as 'design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference'.[54] The researchers note that inclusive design processes must 'recognize diversity and uniqueness', use an 'inclusive process and tools', and do so while keeping in mind the work's 'broader beneficial impact'. We do not have the space to elaborate further on the design process but will focus on specific disabilities that present challenges for digital inclusion: vision, hearing, and cognition.

The World Health Organization (WHO) estimated that 246 million have poor vision, 285 million people worldwide are *visually impaired*, and 39 million are blind.[55] Roughly 90 per cent live in low-income settings; 82 per cent of the blind are 50 years old or older. Because vision is the primary modality we use in interacting with computers and mobiles, poor vision is a serious obstacle; zero vision is a grave one. Despite recent genetic, stem cell, and bionic advances to end blindness,[56] the digital divide between those with and without adequate vision is wide.

A variety of technological aids have been developed to help those with low vision access computers. First, there are screen magnifiers which enlarge what is displayed on a screen. More interesting, however, are *screen readers*.[57] Screen readers take the text from the screen and convert it into voice or into Braille or other haptic feedback. Effective design of screen readers takes into account the frustrations that blind users experience in interacting with the web,[58] as well as thoughtful design guidelines to ameliorate these issues.[59] A key element is the order in which sections of the screen are vocalized. There are intrinsic problems that will always remain, for example, assisting those with poor or no vision in navigating complex paths among various internet pages, or relationships among complex charts and tables; and enabling the 'seeing' of material which cannot be completely described in text, such as diagrams, photos, and videos. But what about navigating the world, and not just the screen?

Navigation aids for the blind and visually impaired

BlindSquare,[60] created in 2017, is an accessible app which announces interesting features of an environment to the visually challenged. Outdoors, it works by retrieving information using the global position system (GPS), and then announcing street intersections and plausible points of interest to the user. Indoors, it can work if the environment has been instrumented with iBeacons: low-energy Bluetooth devices sending out signals describing the area that can be received by smartphones.

Figure 1.3 Screenshot from a video introduction to BlindSquare

Recently, WHO estimated that 360 million people worldwide have *disabling hearing loss*.[61] This disproportionately affects the elderly—over one-third of individuals 65 years old or older suffer from hearing impairments. Hearing difficulties do not significantly impede computer and internet use; in fact, technology could be used to deliver hearing loss tests, information, and interventions to the hearing challenged.[62] Furthermore, where information is communicated in sound, there are well-understood techniques such as *closed captioning* for videos and movies. For mobiles, the situation is different, as hearing is typically as or more essential than vision and touch for effective use.

Recent research projects suggest promising directions, including an app for recognizing sounds in the environment and turning them into visual or vibro-tactile alerts on a mobile phone,[63] and SignWriting,[64] a method for communicating on mobiles via static visual signs. Much effort has gone into supporting the dynamic American Sign Language (ASL) under restricted bandwidth conditions on mobile phones,[65] although increasing bandwidth will soon make this easier.

Cognitive challenges are extremely diverse. Cognitive disabilities can include autism, dementia, Down syndrome, and TBI, among many others.[66] One can also speak about functional diagnoses of challenges such as attention span, executive function, language, naming, memory, and visuospatial ability. As all of these are needed to use digital technology, cognitive disabilities are serious impediments to the use of digital devices.

Significant work has been done in the area of autism. A systematic and comprehensive review of *interactive technologies* for autism noted that individuals with autism are often well disposed to use technology, which they find less stressful than interacting with people.[67] Eight components of interactive technology platforms for autism have been identified: PCs and the web, video and multimedia, mobile technologies, shared active surfaces, virtual

and augmented reality, sensor-based and wearable technologies, robotics, and natural user interfaces.

There has also been work done specifically on technologies relevant to children with other special needs,[68] and on software architectures to ease the incorporation of inclusive internet interfaces into mainstream software.[69]

It is important to note that innovations designed for people with special needs often benefit the rest of us. Curb cuts, introduced to help people in wheelchairs move between the sidewalk and the street, also work for individuals with baby carriages and bicycles. Closed captioning, originally intended for the hard of hearing, also help us in noisy sports bars, where everyone becomes hard of hearing. Vocalizations of information for the visually impaired are useful for anyone surrounded by a dense fog.

Research: Research if and how people who cannot read are Internet-disadvantaged.

Research: Technologies for working with ASL.

Concept: Write a Wikipedia article on Alan Newell, pioneer in inclusive design.

Concept: Write a Wikipedia article on Elliot Cole, pioneer in cognitive prosthetics.

Policy: Write a brief for a politician who is planning to speak about digital inclusion for blind and visually impaired people at a conference of politically active citizens.

Law: Requiring libraries to provide internet access technology for blind patrons.

Technology review: Identify and evaluate several new solutions to navigation assistance for the visually impaired. Refer to issues raised in this chapter.

Ethics: Your software firm is delivering products that are not accessible by people with disabilities such as poor vision. You raise the issue. The CEO insists that the firm cannot afford to develop such features and that they would be detrimental to users with normal vision. How do you deal with this? How do you debate ideals versus economics? What options can you identify? How far will you go to protest the decision?

1.6 Gender issues

Statistically, women and girls have now achieved parity in internet use with men and boys, at least in the Western world, but it is helpful to examine their use more carefully. Early hopes for *computer-mediated communication* (CMC) were that the absence of visual gender clues online would lead to more equal and equitable participation on conversations. Yet research has uncovered significant gender differences in the style of one's digital participation.[70] Susan Herring and her colleagues analysed the discourse of participants in online discussion forums and responses to surveys about 'netiquette'. They found that men and women participated unequally and in different ways; men tended to dominate conversations, often being argumentative and confrontational, while women said less and

tended to be polite, supportive, and encourage negotiation and agreement. They concluded that this was in part due to different values and approaches to conversation. Although differences in participation volume and style have reduced over the years, their recent synthesis was that the research results 'run counter to the claim that gender is invisible or irrelevant in CMC, or that CMC equalizes gender-based power and status differentials'. Differences also vary by country; a survey found greater gender differences within a British group of university students than among a Chinese cohort.[71]

Ethics

Gender portrayal in video games: Gender has also been a significant variable in video games. Analyses of video games by researchers concerned about gender equality have focused on three major issues: (1) the extent to which female characters are present in the games; (2) the ways in which women and girls are portrayed; and (3) the degree to which video games present experiences that are enjoyable for females and are consistent with their learning, work, and play styles. A review of 150 games across nine gaming platforms found that only 10 per cent of the primary characters were female and overall only 15 per cent of the characters were female.[72]

Figure 1.4 Typical portrayals of women in video games, as illustrated by characters in *Mortal Kombat*

Reproduced with permission from D.Williams, et al. The virtual census: representations of gender, race and age in video games. *New Media & Society*,11(5): 815-834.Copyright © 2009, SAGE Publications. https://doi.org/10.1177/1461444809105354.

A study of the portrayal of women in thirty-three popular Nintendo and Sega Genesis video games found that there were no female characters in 41 per cent of the games with avatars.[73] Female characters were portrayed as sex objects 28 per cent of the time and had violence directed against them 21 per cent of the time. Women were rarely featured as heroes or as action characters, but more typically cast as victims or damsels in distress—like the

Continued on next page

popular character of Princess Peach, the female lead in the Nintendo Mario franchise. A study of German female gamers found that they disliked video games because of the lack of meaningful social interaction, the extent of violent content directed towards women, the female gender role stereotyping just discussed, and the focus on competition rather than collaboration.[74]

Even if this style of video game design and development is still good business strategy—an assertion that should be questioned—designers and developers need to consider the ethics of perpetuating misogyny in their games.

Could video games be this way because most of them are designed by men? Since the late 1990s, concerns have been raised about the degree to which women and girls are underrepresented as programmers and computer scientists.[75] The percentage of women working in computing has declined steadily from 35 per cent in the early 1990s to a current (2018) level of 25 per cent.[76] Reasons given for this decline include the image of the profession, the lack of emphasis in secondary schools on STEM (science, technology, engineering, and maths) education for girls, and the relative scarcity of successful female role models in technology fields.

Yet this development is paradoxical. In 1843, Ada Lovelace, daughter of the English poet Lord Byron, wrote what is thought to be the first computer program. It was designed for Charles Babbage's machine called the Analytical Engine, which was never built. Historian Nathan Ensmenger recounted that computer programming was a desirable and welcoming profession for women in the 1960s, with good opportunities for upward mobility into management.[77] Only later did computing begin to be viewed as a 'masculine discipline' where 'people skills' are unimportant.[78]

The underrepresentation of women in computing is caused in part by similar phenomena in higher education. In 1985, only 37 per cent of computer science university and college degrees went to women;[79] by 2014, that percentage had dropped to 18 per cent. To remedy this, institutions like Carnegie Mellon University (CMU) have mounted a concerted effort to raise the percentage of women entering the computer science undergrad program; they have succeeded, as the number has grown from 7 per cent in 1995 to 42 per cent in 2000.[80]

Another good example is small California-based Harvey Mudd College. It educates prospective engineers, scientists, and mathematicians using a broad curriculum that includes the humanities and the social sciences.[81] The percentage of female computer science majors was 10 per cent in 2005; it rose to between 37 and 50 per cent early in the 2010s. President Maria Klawe, a respected computer scientist, demonstrated the importance of strong role models and female leadership to encourage women in STEM fields. There were also three major innovations: (1) the department changed the introductory programming course to focus on problem solving with computational approaches, the broad scope of computer sciences applications, and its impact on society, very different from the typical introduction to programming course content; (2) they made it possible for each female first-year student, regardless of major, to attend the Grace Hopper Celebration of Women in Computing;[82] and (3) they created large numbers of on-campus summer research opportunities for first-year students who had completed Introductory Computer Science.


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1.7 Technology for seniors

Digital inclusion for seniors is an active area of research, development, and technology adoption. Here is a quote from AGE-WELL, a leading R&D site:[89]

> AGE-WELL NCE (Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life NCE Inc.) is Canada's technology and aging network… dedicated to the creation of technologies and services that benefit older adults and caregivers… to help older Canadians maintain their independence, health and quality of life, [and to] increase their safety and security, support their independent living, and enhance their social participation.

Such work is particularly relevant because the world's population continues to age at a rapid rate. Especially noteworthy is the rate of growth of the 'oldest old', that is, those over 80 years of age.

Table 1.4 Aging of the world's population

	2015	2030	2050
People in the world aged 60 and over	901 million	1.4 billion	2.1 billion
People aged 80 and over	125 million	*	434 million

Note: * no data available

Demographic data indicate that seniors are going online in increasing numbers.[90] Yet the digital divide between seniors and other adults still exists. By 2017, almost all Americans were going online; the percentage for individuals 65 and over was roughly two-thirds. The good news is that the gap between seniors and everyone else has been narrowing. Only 14 per cent of seniors were going online in 2000; the percentage grew to 59 per cent by 2013. The bad news is the extent to which technology use declines as seniors get older and become the oldest old.

Table 1.5 Technology use as a function of age

Tech use at different ages	65–69	70–74	75–79	80+
Uses the Internet	82%	75%	60%	44%
Has home broadband	66%	61%	41%	28%
Owns a smartphone	59%	49%	31%	17%

Older adults experience more vulnerability with respect to new technology,[91] as 73 per cent of seniors say that they need help to understand and navigate new electronic devices.[92] In Chapter 8, we shall return to other kinds of harmful emotions seniors often experience with digital technology—frustration, anger, and even rage.

Assisting older adults in staying connected

An important use of seniors' technology is for connectedness with family and friends. Social isolation is a critical problem for older adults in many societies. For example, varying estimates of social isolation in Canada's seniors range from 19 to 30 per cent.[93] A recent US study found that 43 per cent of seniors reported feeling lonely;[94] loneliness was associated with declines in activities in daily living and mobility, and an increased risk of death. Since the Internet enables worldwide electronic communication that is synchronous (e.g., real-time video conferencing), and asynchronous (e.g., text and audio-visual email), there have been many solutions proposed for facilitating connectivity and combatting seniors' social isolation and loneliness.[95]

Figure 1.5 A prototype that focuses on enabling seniors' communication in text, voice, photos, and videos

Another application for seniors' technology is fall detection, often called Personal Emergency Response Systems (PERS).[96] From the classic 'I've fallen and I can't get up' technology, which required a senior needing help to call for it, newer designs are apps for wearables which detect falling and/or lack of motion automatically to alert emergency response personnel immediately.

More generally, the challenge of digital inclusion for older adults can be viewed in two ways. The simpler problem is that of designing technologies and interfaces that are easy for seniors to use, assuming they are committed to this use. The more challenging problem is that of motivating and supporting seniors to use technologies if they are not certain that they want to so at all, or if they are positively reluctant to do so.

Several authors have proposed design principles or guidelines to aid the invention of technology and interfaces that support use by older adults. These typically focus on


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ultimately loss of control over bodily functions can make the use of technology more and more challenging.[102]

On the one hand, if computer use is satisfying, resulting in enhanced sense of worth, independence, and social connectedness, one can overcome these problems. On the other, if computer use is a challenge, it is likely to result in frustration, failure, and anger; poor health makes this even more likely. We shall return to this again in our discussion of safety in Chapter 8.

Research: Challenges in computer and mobile phone use faced by seniors who have dementia.

Research: Compare and contrast the out-of-box experience with three or four new mobile phones.

Concept: Write a Wikipedia article entitled 'seniors' technology'.

Debate: Resolved: It is essential that your grandparents become computer-literate.

Debate: Resolved: Designing technology specifically for seniors will not be necessary in thirty years when all are computer-literate. (Or will seniors' deteriorating vision, hearing, motor control, cognition, and self-confidence always cause problems? For a discussion of this proposition, see the Aging in Place Technology Watch.[103])

Jury: John Smith is on trial for identity theft and taking $20,000 from the life savings of 85-year-old Herman. He claims he is innocent, as Herman willingly gave his banking and personal information to him. Is John guilty and, if so, what penalty should you administer? Depending on the country and legal system within which the trial takes place, what protections are offered to Herman?

Field study: Explore how seniors in a care facility (retirement home, long-term care/nursing home, etc.) learn and use, or fear and avoid, technology.

1.8 Summary

We have addressed the goal of digital inclusion, which ideally means empowering all people everywhere through ICTs. Some of the earliest goals of this kind were articulated by Alan Newell and Elliot Cole, who imagined and dedicated their research careers to using technology to assist individuals with sensory, motor, and cognitive disabilities. Entrepreneur Jimmy Wales envisioned comprehensive information available online to everyone and was able to make this happen with Wikipedia. Wikipedia is a particularly compelling form of digital inclusion, because so many people read the articles and there are also numerous writers.

We began by examining at the digital divide in specific countries. Data suggests that these divides are narrowing, yet there are often political challenges, such as those currently posed in the USA by the proposal to abolish net neutrality. We discussed typical

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