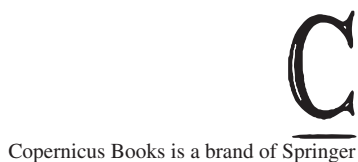# Living with Computers

James W. Cortada

Living with Computers

The Digital World of Today and Tomorrow

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Preface

For well over half the human race, it has become nearly impossible to go through a full day without encountering computers. Most other humans, too, are subject to the same reality, just that they might not realize it. Three-fourths of the world is now connected (or has access if they want) to the Internet. In many societies, we see most people between the ages of 12 and 60 clutching smartphones, which are really computers that also happen to be telephones. It is not uncommon in the United States for 3- and 4-year-olds to have their favorite websites. Surveillance technologies track and identify people walking the streets of cities all over the world, while GPS records where people are 24 hours a day. All of this happened so fast—essentially in less than one generation—yet *incrementally* with new dependencies on computing technology introduced into our lives literally almost on a monthly or yearly basis that we forget how much changed. It happened so fast that we have not had an opportunity to step back to understand what computing means to humanity's existence and yet humans are an introspective species that likes to think about things.

If you are between the ages of, say, 25 and 50, this is a survival guide for you. If you are between the ages of 51 and roughly 75, it is a fun read and useful for giving you meaning that enhances your sense of self-worth, if older, a glimpse at what your grandchildren are about to experience, a peek at the arc of your family's future—it is why you want to be old enough to dance at your granddaughter's wedding. If you are under 25, well, this is about your future, but I realize you will probably only read this if a professor, older relative, or your manager puts it in front of you and insists that you devote a couple of hours meeting your future. Nobody will be more affected by what is in this book than your generation.

I did not want to write this book. I have other research that I am pursuing as a business and technology historian that are both interesting and I think relevant. But, as I entered my 70th decade of life, having observed what was happening with computers for forty years, computing, information technology, or whatever else you wish to call it, I concluded that too many people were too focused on the widgets, their smartphones and tablets as individuals, and corporations on hybrid cloud applications and supply chain management processes. If we stepped back just a few steps for just a little while, we can see that computing is a far bigger deal, one that

transcends narrower issues. It involves privacy, an issue I am concerned with, role of computers in shaping or eliminating jobs, and effects on my grandchildren who hover so much over tablets. It concerns the future in which we have to ask who controls what: the computer us or we the computer? The bigger questions are about who runs the planet and how humans as a species evolve. These sound like mega issues, and they are, and I believe individuals have a role to play in how people evolve, precisely because of their access to computing. The issue of the role of computing on Earth is right up there, nearly with breathing air to sustain life, the existence and role of God in human values, and the evolution of climate change and its effects on life. This is pretty heady stuff if you are trying to pay bills every month, worrying about whether some company is going to lay you off because a computer can do your job or someone in a faraway country is less expensive.

I think humanity, as a species, does not understand how important computing is to its survival and success. That is why I set aside more mundane projects, shared my thinking, and offered my nearly half century of observations for whatever they are worth. I hope others do the same, as I have learned that I do not always have the right answers. I am confident, however, that I know many of the issues to raise, what alarm bells to ring. I also offer up for your consideration some "connecting the dots" insights.

Raising issues is important, because most people reasonably do not sit around and think about the nature of current and future computing or of the technology's possible implications. But they should, so this book is for them, but also for the experts in computing and artificial intelligence (AI) and the vendors who sell us those wonderfully magical digital toys that clutter our lives with fun and work. I have calibrated to the best of my ability what level of detail we mortals need to get about our lives as parents, employees, managers, leaders, Luddites, social creatures, and thoughtful, even piously decent people. It is difficult to address what over seven billion people should know, and I realize this is a hopeless objective. Or is it? Go back to how I began this preface, reporting how many people engage with computing, whether they like it or not. We don't get to vote on that; it is our reality, so we need to know enough to do enough to make life happy and productive enough. So how should we proceed?

I believe this book has to be more essay than tome to ponder the influence of computing on humans. It is an exercise in thinking about digital things in a big picture way. How humanity developed, encountered, and used computers is a large topic, so to do the job right should reasonably require a very fat book, which is exactly what this is not. For one thing, to make the subject accessible to people with too little time to read and yet an important topic to consider, a short book is in order. For another, to truly understand a subject, humans need clarity—the elevator answer when properly expressed—in order to understand the important issues, the touch points, of a topic that they can further track and dig into. We are discovering this fact about how humans learn, which is why many scholarly presses now publish really short books on big topics that boil an issue down to its essence on which a reader can add on as much detail as they want. Starting with a fat book simply can confuse or add too many facts and thus risk hiding clarity and wisdom. That is why this is a

short book about when humans used computers back in the twentieth and early twenty-first centuries and what that experience possibly means for our future.

It is based, however, on my encounters with computing. It is simply one person's point of view, a reflection of how computing's events of the late twentieth century affected one of its users. Critics may complain that I should have included discourses on all manner of sidebar issues involving information technology (IT) and its physical forms, that I should have engaged with specific authors about the evolution of computer science, artificial intelligences, the "singularity" when people and machines become one, theological implications (Do we need God if we all evolve into computers?), today's parents fretting over their children spending too much time engaging with their screens, and so forth. When you write a short book, all of that vast literature—and by my estimation, it consists of over 100,000 books and millions of articles—has to be subsumed under the covers of the short conversation. Priorities and hard decisions have to be made.

However, as any diligent student of a topic can attest, one can examine a great deal of material in nearly a half century—thousands of books and articles—speak to and listen at hundreds of conferences, engage colleagues at work, and interact with the materials at hand. That is what I have done. After all that activity, what does it mean? What insights have tumbled around in my mind to be explained? This book—the extended essay—addresses such questions. My experience suggests others have the same questions about their own personal encounters with computing, so this book can be seen as a journey taken together to form opinions about the meaning and role of computers in our lives. As a result, numerous footnotes, lengthy quotes, and bibliographic eye candy that so normally grace any serious books are missing here. We will travel light on this exploratory trip through information, information technology, and the widgets that so clutter our lives. For those not acknowledged in this text, my apologies, but you are not ignored, just added into the soup of tacit knowledge accumulated over time.

More specifically, our purpose is to argue the case for several ideas. Computers are important additions to the human tool kit. Many people believe we live in some sort of Information or Computer Age—although I argue that we really don't—but for the time being, let's agree that we occupy a period enveloped by all manner of computing, both good and bad, large and small, difficult and simple to use. Computers are also *temporary* because of their ability to be shaped and be used in so many ways—what experts call a "general-purpose technology" as stand-alone devices: large mainframes (servers), laptops and PCs, and handheld smartphones that soon will seem as large mementos emblematic of our time just as cars with big fins bespoke 1950s–1960s. These technologies are increasingly becoming part of the Earth's environment, of the world we live in at work and at home, as part of any device we use. These already have arrived; think about our programmable coffee makers or fancy video doorbells that tells our smartphone who is calling us or the digital sensors that instruct our home furnaces when to turn on.

In time, computing's capabilities will be a part of our social and physical DNA. As a reminder of the obvious, our DNA and that of every living creature are the true databases and software that made life possible through the ages. Our

existence as humans is based on DNA, and if computing contributes to that, then we can argue that computers will increasingly be one of the most important influences affecting the nature of humanity's form and way of functioning over the next several centuries. This would be a development ranked up there with climate conditions and living on other planets. That computing/DNA nexus is a powerful idea whose possibility no longer can be ignored, even if it feels more like science fiction than real science. However, increasingly today, sociologists, political scientists, media experts, and historians are viewing society as a massive information ecosystem, almost as an extended living creature in which the Internet contributes to this worldview. So the idea is already out of the bottle.

A second idea we explore is that today's computing that is made up of hardware, plastic, rubber, metal, and software (the latter also comprising of electrons, magnetized physical objects, and electricity) may someday be integrated into our physical beings, be part of our bodies and possibly of other life forms. If this technology makes the leap from metal and plastic to biological mass, which is possible as it compresses to the level of atoms, that turn of events would represent a fundamental leap in the evolution in how living creatures continue to adapt to their ever-changing environment. In such a scenario, computers become an intimate part of their environment, just as do trees, oxygen, and sunshine. It would be right up there with humans gaining the capacity to think consciously, speak, and walk upright. We do not fully understand the implications, let alone have consensus, but the potential for rapid transformation is there. But, humans have already proven they can adapt their bodies to fundamentally new conditions in a matter of a few generations. They are not finished transforming.

Will computing then help shape life in living creatures? What influence do we have on the features of that capability? While we do not know the answers to those two questions, we can at least begin to ponder them. That we dare ask them already suggests how important computing is to humanity. Often fundamental questions of human existence never are satisfactorily answered but take a half millennium or more to understand. For one thing, we can begin to appreciate that our human-centered view of so much—what theologians and scientists often describe as our anthropomorphic view of the world—will be challenged. As life and the world we live in change, thanks to computing embedded in "everything," will our reality be replaced or be rivaled by another paradigmatic lens, not seen through the eyes of humans?

To illustrate the point, a human-centered view of religion has a divine God who, according to Christian, Islamic, and Judaic faiths, is largely a man; children are shown pictures of an elderly vigorous older gentleman with a white beard or a kindly looking young man—Jesus—who also has a mother (Mary a female human), even an earthly human father (Joseph), and a heavenly father (the same elder with white beard). Buddha is pictured in humanlike form. And so it goes throughout much religion. The issue of the possible decline of our anthropomorphic perspective is more than just a loss of intellectual power and dominance over ideas and observations. It possibly signals the emergence of some other world view stimulated by ever-smarter computers which, again thinking anthropomorphically, computer

scientists and AI experts believe will be as smart (or more) than humans in the second half of the twenty-first century. Hmm? What can all that mean?

So there is much to think about that goes far beyond discourses about blockchains and bitcoins, children's screen times, AI in global supply chains, the Internet of Things (IoT), how to download an app to our smartphones and to stream a TV program to whatever device we favor, or what privacy issues have ensnared Facebook or Google. Computing is increasingly becoming central to the existence of humans.

I propose to start discussing crucial topics through the medium of several short chapters. Following our human modern way of thinking, an introduction sets the table, by explaining our collective already considerable expertise in computing, yes about you dear reader. Then Chapter 1 defines what computing is today, while Chapter 2 will be the world's shortest history lesson on how we got to where we are now. Spoiler Alert: I will offend many hundreds of historians, technologists, and journalists who have done wonderful research on this topic as I purposefully fail to acknowledge them by name and oversimplify their work, since we don't have time to do more than wave at them as we jog through nearly a century of computer history.

Chapters 3 and 4 move into the issues of human-centered views of computing: computing as comparable to or replacement of the human brain. This is where we converse about AI. It is when we discuss the part machines and sensors play as physical parts of our global information ecosystem. Chapter 5 speculates—ponders—how we might see the end of the Information Age as we humans understand it, as everything has embedded in it computing first developed by people, but latter by who knows what. Computing as part of all life's DNA would represent both a novel development in life forms and a return to business as usual in the evolutionary schemes of things. Chapter 6 comes full circle to begin answering a simple but powerful question: So what? What implications can we draw from our discussions in prior chapters? Chapter 7 continues that discussion, setting us up for the last chapter which proposes a reshaping of our definition of our species and how we interact with computing. It also provides specific advice on how to keep up with this ever-changing technology.

The questions and issues raised can be discomforting, especially the possibility that computing morphs into the natural world, although we are a ways off from such a transformation. It could also possibly never happen. That we dare raise such issues, however, suggests that computing itself and its effects on human life right now gives this technology a gravitas we would not have dared to impose before the wide diffusion of the Internet, beginning in the mid-1990s. The concerns and issues that we must engage with transcend generations. Aging baby boomers and millennials share the same concerns, questions, and destinies as co-members of the same species occupying the same planet. Differentiating among generations misses the point. What I think and do as a boomer affects my children and grandchildren, just as what my children do impacts my life and that of their children. It's time for a more comprehensive species-wide view of what is happening.

I would like to thank my publisher for publishing this book, and particularly my editor, Wayne Wheeler, who has been a long-serving enthusiastic supporter of my

investigations into information and computing. The production team at Copernicus has done its job well. Two experts on computing—Jeffrey Yost and Gerard Alberts— were instrumental in supporting this project when it came to my editor. You, I, and all three and their colleagues have traveled a long journey across decades to an understanding of computing, happily converging on this project. My views are my own, however, and do not necessary reflect those of my publisher or the Charles Babbage Institute at the University of Minnesota.

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Introduction: Why Listen to Me? Why You Should Take Seriously Your Own Knowledge of Computers

I am not a theologian, philosopher, or computer scientist. I have struggled with Microsoft software, laptops, and my Apple computer just like the rest of you. I still cannot keep up with all the functionality of my smartphone, which I still think is a really dumb device, and I prefer paper books to e-books. But I am a product of the twentieth and early twenty-first centuries, just like you. I have been around computers for a long time and have had to explain to many people what they do and their effects. I encountered my first computer system in the basement of a dorm in college in the mid-1960s—an IBM 1400 system comprising of multiple machines—and it looked the part we all think of: lots of devices the size of big kitchen refrigerators, made noisy by whirling components and tapes and all made out of metal. I played Hangman and Baseball on it. After college, it was off to graduate school where I picked up a Ph.D. in Modern History.

That turned out to be only a momentary escape from computers, because I then began a long career at IBM, where for nearly four decades and for between 50 and 70 hour workweeks, I observed how companies in over a dozen industries deployed computers through my roles in sales and consulting, explaining to hundreds of executives and even more managers and their employees what these machines could do and the possible consequences of their deployment. Along the way, I studied, wrote, and spoke about the history of computing and their current applications. I sometimes felt like the mid-nineteenth-century rebel Lutheran theologian/philosopher, Søren Kierkegaard, who struggled with what Christianity was all about by writing extensively almost every day of his adult life about it. In my case, I was trying to understand the technology while implementing it and watching it change form and impact in real time. Like the Lutheran, I ended up having written a shelf full of books about the use and history of computing before I even retired from IBM.

Computers changed me. For one thing, after being at IBM for two decades, I began to realize that we—IBM, its customers, and scholars—were spending too much time fixated on the hardware, the machines, and not enough on the software, ignoring the ultimate purpose of computers: their production and use of information. It was always about the answers these technologies pumped out. It took my writing a three-volume history of how computers changed the work of entire

industries for me to tumble onto—understand—the central task of computers: they augmented the work of humans by taking over some of their work. Talk to a help desk at one's telephone company, and you are handled by a computer; do the same when inquiring about when a package is going to be delivered, and again, another conversation with a computer, while a third one is deciding whether you qualify for a home mortgage or a new credit card. Today, if you look up a product, for days, you will be inundated with advertisements for it on your Facebook account. You have encountered more computers that have made decisions about you. Facebook routinely collects thousands of pieces of data about you. Evidence is mounting that up to 60 percent of what we read on the Internet was written by a piece of software, not a person. In short, we have come full circle from when computers were first created, when they were invented for one primary purpose: to create and help manage the use of information.

Upon leaving IBM at the end of 2012, I turned my energy to studying how people used information, treating computers as support actors—tools if you wish—but with information always the central player. More articles, talks, and books were my way, like the Danish theologian, to sort out what computing was about, its importance and role. To be in the arena tangling with the central technology of our time was relevant, important, and, in the end, fascinating. Like you and especially those engaged with computers or lived during their arrival and diffusion, much changed, all incrementally, but quickly.

For one thing, when I was a teenager in the early 1960s, there were only an estimated 6,000 to 7,000 computers worldwide; today, there are so many that we do not know how many exist. You may have a hundred in your home if you have digital alarm clocks, TVs, a microwave oven, two cars in the garage, a lawn mower, plus the usual digital devices, such as smartphones, laptops, and iPads. They shrank from being the size of refrigerators to devices capable of being injected into your bloodstream. There is even "smart dust," other computers with the ability to store and manipulate data in tiny sensors, and intelligent drones that look like small insects. Add in magnetizable liquids and tiny communications with the ability to store data in individual atoms, and you have humankind on the verge of being able to track every step and action taken by every human being (plus many animals) for their entire lives.

Let me turn to the second part of this introduction's title—Why You Should Take Seriously Your Own Knowledge of Computers—because my experience is not unique. For one thing, tens of thousands of people have written books and articles and have made presentations at technical conferences; millions attended such sessions, and tens of millions of you work in the world of information technology as computer scientists, programmers, and machine operators and still others manufacturing devices and hundreds of millions using them as central features of their daily work. No country is isolated from these realities. Go to a Benedictine monastery atop some European mountain and you will encounter laptops, smartphones, and online library catalogs; visit a village in India that recently gained access to electricity and you will see tablets and smartphones. London's officials have been complaining for well over a decade that computers are consuming so much electricity

that the city runs the risk of not having enough of this kind of energy with which to operate. The movement of some computing out of London to the continent as a result of Brexit concerns does not end the concern. The point is most people under the age of 65 know a great deal about computers, and as one of them, you should acknowledge that fact.

Yes, you know more about computers or, more accurately, about computing than you probably give yourself credit for, which is one reason this book already should resonate with you. This also means that you can read it with the critical eye of an expert. Your collective biography goes something like this. As a species, you began to hear about these new devices in the 1950s and 1960s, most did not encounter them at work in the 1970s (except for a few million), but then by the end of the 1980s had. Personal computers flooded the world by tens of millions in the 1980s. Their appearance forced you to learn, first conceptually, what was a computer; second, what it could be used for; third, how to use it; and fourth, why. You learned incrementally about this technology and by the end of that decade had formed opinions about it based on personal "hands-on" experience. Some of you, in addition, did too through the use of large mainframes and interacting with these through terminals that almost looked like PCs, but were not. You called them "dumb terminals," or "green screens," while PCs soon displayed colored images and could be used in so many new ways.

You learned new words and concepts: "computer chips," "operating systems," "programming languages," "online," "spread sheets," and "e-mail." Games took on a new meaning, no longer flat pieces of cardboard with plastic pieces to move about on them; you now could simulate being a pilot in some of the most popular online games of the 1980s–1990s. Your children and, for some, grandchildren made online gaming one of the most widely used forms of computing after 2010.

You also learned how to judge the value and functions of new devices that had computing in them, and you did this with confidence: digital cameras, programmable television sets, use of the Internet for information searches and then to make purchases, and so forth. How do we know you had confidence? Because economists and entire industries tracked how quickly you embraced new forms of computing. They learned that every time a new form of computing came along, you acquired these faster than the previous generation of information technology. That is how we can largely explain the success of properly run companies offering these new devices, such as Apple, and services too, such as e-Bay, Amazon, and Google.

Many experts like to argue that the behavior of different generations varies in their use of computing. They will argue that really old people use these devices far less than really young people. That certainly was true in the late 1990s and the first decade of the new century. But it is an old paradigm that no longer makes as much sense as before. I knew a 103-year-old who used an Apple tablet because it afforded her the ability to project larger print versions of her local newspaper. Nursing homes are full of PCs, tablets, and smartphones. Most of their residents have been around computers for decades, in fact many for longer than their 20's something grandchildren. True, each new generation was exposed to computing at an earlier age and to more portable varieties, offering more functions than their predecessors, but we

have reached a point where differentiating between generations is increasingly mis-leading. People in their 70s use their smartphones for the same purposes as others in their 30s. Both generations look up information, play games, watch TV pro-grams, place orders, and engage with friends and family using Facebook and other social media. All adult generations reinforce his or her political views with fake and real news, and everyone seems to check the weather.

Older users have the experience over younger ones of having seen the technology evolve. Along the way, they saw devices shrink in size and cost, while designers massively increased their ability to collect, store, sort, present, and analyze informa-tion for and about you. All that happened in one lifetime. Talk to computer scientists and they enthusiastically tell you that they see no end in sight to the continued evo-lution of this general-purpose technology or its miniaturization while expanding its ability to collect and process ever-increasing amounts of data.

In short, you are more expert about the technology than you might have thought, especially about how best to use it. Yet, if you are bewildered by all of this and con-cerned about what it means, especially after I hinted that perhaps the human race would evolve again because of this technology, then imagine how I feel being close up confronting these machines for a half century. But even more to the point, it's due to your prior experience that you are entitled to feel bewildered, because you know enough that you should be puzzled. Acting like an expert, you appreciate the need to understand the context of what you are experiencing.

I referred earlier to the idea that millions of people were learning new computer-oriented words; your latest are probably "AI" and "cloud," maybe even "5G." But I have some bad news: just as the technology kept changing over the past half century, so too did the vocabulary that we used to describe it. Old fat printed dictionaries of computer terms had to be replaced with new ones, of course, while writers had to update their lingo. Remember when we spoke about *computers*? Now they are called *servers*. My first book had EDP (electronic data processing) in its title when published in 1980, its sequel a few years later spoke of management information systems (MIS) in 1984, in yet another in 2001, about "the new digital economy," then in a later one in 2015, I had to speak about "information ecosystems." This constant churn in how you and I speak about computers is not going to end any time soon.

Take, for example, the word *machine*. It may soon no longer reflect what these are. Today, the vast cost for computing and for their "care and feeding" is not for hardware (computers and other devices) and their electricity, rather for their soft-ware—something you and I have never seen—as these are largely electrical impulses traveling through our world with only their output made visible to humans on screens and as reports. Increasingly, sensors, which gather more data than humans do and travel through the Internet, don't bother to deal with such living beings. People just get in the way and are too slow to handle the volume of information, so they "talk" to other sensors and computers as they go about their work.

Welcome to your future, to that of every descendant you will ever have. Now you understand why I argue that nothing matches computing except perhaps life itself and the physical environment we live in. No human invention since the discovery of

fire, or the wheel, and the development of our ability to think and talk is perhaps as important as the computer. Let us begin with a frustration: the word *computer* may also no longer suffice to explain what we are talking about, yet I have not seen a better term. Even my clever colleagues at IBM who have been dealing with computers since the 1940s have not come up with a better one. "A tool for modern times" may have been the closest they got to in the 1980s when describing personal computers. "Artificial intelligence" is very much off the mark if, as I am thinking, computing's "intelligence" becomes integrated in life forms it no longer is artificial. "Cognitive computing" is borderline incomprehensible except that it does clearly suggest that computers learn from their data and experiences—a hugely important evolution in computing that gets them closer to becoming part of living creatures. What makes computing artificial is that we think of it in anthropomorphic terms outside our bodies, even if augmenting what our brains do.

If you think, perhaps, that we are not so innocent as to think of computers as almost humanlike, I present as Exhibit A our recently available devices that we talk to. Let me introduce you to two things who are already close intimates to millions: Alexa and her cohort, Siri. Alexa is the name given to an Amazon device that responds to human voice queries and commands to look up information on the Internet or, if programmed to communicate with household devices, to turn on and off lights, television sets, and play music. It has a friendly, non-threatening non-judgmental female voice. We think of this device as anthropomorphic—a female. Siri is Apple's version of Alexa, except "she" can talk to you from your smartphone and like Alexa has increased "her" ability to engage in humanlike conversations. They are not alone. GPS-based voice-activated driving instructions are also humanlike. What automobile driver today doesn't ask such questions as, "What does she say to do next?" "Where does she want us to turn?" These driving systems also come in male voices, in many languages, speaking with different accents. We shall see many more such devices before too long. Developers of computing are shaping them into humanlike creatures, and already some are remaking themselves—the cognitive computers with AI mentioned above. So, humans let's confront our possible destiny.

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