The Assumptions of Computing

James K. Huggins
EECS Department, University of Michigan, Ann Arbor, MI, 48109-2122, USA
huggins@umich.edu

Abstract

The use of computers, like any technological activity, is not content-neutral. Users of computers constantly interact with assumptions regarding worthwhile activity which are embedded in any computing system. Directly questioning these assumptions in the context of computing allows us to develop an understanding of responsible computing.

1 Technology and Society

For what purposes should computers be used in our society? This question is a special case of a more general one. How should we conduct any technological activity?

To begin to address this question, one must start with a definition of technology. We will use the following [5]:

> We can define technology as a distinct human cultural activity in which human beings exercise freedom and responsibility in response to God by forming and transforming the natural creation, with the aid of tools and procedures, for practical ends or purposes.

This definition is not completely applicable in the context of computing systems. It requires that technology transform the natural creation. Thus, software practitioners, who pursue practical purposes by manipulating bits and bytes instead of metal and bone, would not be technologists under this definition.

However, this definition does emphasize several important aspects of technology. Technology is an activity; it is not an object like a CPU or a program, which are more properly termed technological products or artifacts. As an activity, technology can be judged against a standard of conduct (in the definition above, the standards of God). Those engaged in technology utilize tools and procedures: technology is an intentional activity, and allows for the development of skills and expertise. Technology is used for practical ends or purposes – this distinguishes technology from other activities such as the arts.

This definition is also an inclusive one. The participants in technology are not just those of us who produce technological products. Any person who uses tools and procedures to perform practical work participates in technology. And thus, when we begin to question the proper place for technology in society, our discussion need not be limited to the professionals who produce the artifacts, but may freely include the "amateurs" who use them.

1.1 Reactions to Technology

There are generally two types of fallacious attitudes which people may hold toward technology: total rejection and total acceptance.

1.1.1 Total Rejection

Total rejection is the less common error. This attitude calls for the complete removal of technological artifacts from our lives and a return to a simpler lifestyle. Most of us at one time or another have shared this desire for simpler lives, in which most of the technology in which we participate daily is eliminated, along with its consequent complications. And certainly most of our lives could stand to be simplified in some manner.

Those who call for total rejection are often chastised as "Luddites". The term is usually used in a perjorative manner, characterizing the target as cowardly and unsophisticated. In reality, the original Luddites were honorable textile workers who destroyed their equipment as a last defense against the onslaught of oppressive labor laws [6].

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But the total rejection of all that is produced by technology is not desirable. Those who would reject all that technology produces neglect to consider the benefits that technology has provided in education, literature, science, medicine, and many other fields. While some technology may harm the world around us, other technology can help us to care for our world and preserve it. Most of us can identify ways in which technological activity has improved their lives, whether at work or play, and so this point need not be belabored here.

1.1.2 Total Acceptance

The opposite (and more common) error is that of total acceptance; the belief that all technology is valuable. This has been described as "technicism:" the pursuit of technology and the production of technological artifacts for their own sake [5]. For the technicist, any technology is a valuable activity. The argument usually proceeds as follows: "If I can produce a better mousetrap, why shouldn't I? The better mousetrap, however I may define 'better', will have value simply because it is better. And if I don't produce it, someone else will. After all, you can't stop progress."

The problem with this view is that it assumes that technology is a neutral activity. But technology is not neutral. Technology may have both helpful and harmful effects, but those effects may not cancel one another out like debits and credits to a ledger. We must examine this idea more closely.

1.2 Technology Is Not Neutral

Technology often has unforeseen effects upon the world in which it is practiced. This is a truth recognized long ago by Plato [6]. In his *Phaedrus*, Plato describes a dialogue between King Thamus, the ruler of a great Egyptian city, and the god Theuth, who is bringing many new inventions to Thamus. Plato writes:

> When it came to writing, Theuth declared, "Here is an accomplishment, my lord the King, which will improve both the wisdom and the memory of the Egyptians. I have discovered a sure receipt for memory and wisdom." To this, Thamus replied, "Theuth, my paragon of inventors, the discover of an art is not the best judge of the good or harm which will accrue to those who practice it. So it is in this; you, who are the father of writing, have out of fondness for your off-spring attributed to it quite the opposite of its real function. Those who acquire it will cease to exercise their memory and become forgetful; they will rely on writing to bring things to their remembrance by external signs instead of by their own internal resources. What you have discovered is a receipt for recollection, not for memory.

For a modern example of the same idea, consider the proliferation of electronic calculators in Western society, and the accompanying increase in the number of people who cannot perform simple mathematics without one (or worse, cannot recognize when their calculators are malfunctioning).

Often, the source of these unforeseen effects is embedded within the technology itself. Technology is laden with assumptions about what is and is not valuable. These hidden assumptions can lead to unexpected effects when placed in new settings. For example, the introduction of matches into an African society dramatically affected its sexual behavior [6]. In this society, it was customary to start a new fire in the fireplace after each act of sexual intercourse. Thus, after intercourse, someone had to travel to a neighbor's dwelling to obtain a burning stick, making sexual intercourse a public event – and adultery difficult to conceal. Consequently, adultery was rather rare.

Consider the effect of the introduction of matches into this society. Those who use matches assume that it is desirable to be able to create fire quickly without needing another fire nearby. With a match, an adulterous couple did not need to announce every act of intercourse to the entire community. With secrecy easier to preserve, the incidence of adultery increased. And so the assumptions embedded in a technology helped to alter a society in (most would argue) an undesirable manner.

Another example of the effects of technology's assumptions can be seen in the automatic cotton picker [7]. The automatic cotton picker was a great boon to agriculture, particularly in the southern United States. One embedded assumption at work in the cotton picker is that machines can pick cotton better than people can. Thus, those who once picked cotton are now freed for other types of work (presumably, work which they are better at performing than machines).

One effect of the introduction of the cotton picker was widespread unemployment amongst farm workers who formerly picked cotton, mostly African Americans. With few other opportunities available to them, many of these workers migrated to the cities, and sought employment in the industrial centers of Atlanta, Birmingham, Memphis, Chicago, and Detroit. While the link is certainly not direct, it is perhaps not coincidental that the civil rights movement blossomed into being around this time, as Black workers displaced by technology demanded their rightful place in American society. And so the assumption embedded in the cotton picker may have indirectly helped the struggle for racial equality in the United States.

Thus technology may have both good and bad effects, sometimes at the same time. In order to understand how to deal with these effects, we need to develop an understanding of "responsible technology" [5]. We must ask "What are the assumptions laden in this technology?" and "What are the effects – good and bad – of these assumptions?" Our responses will give us the tools to better practice responsible technology.

2 Computers and Technology

What, then, are the assumptions embedded in computing?

2.1 Power

One assumption is that power — having control or influence over other people or objects — is valuable. Developing computer hardware and software that can control formerly uncontrollable (or even dangerous) situations is often valuable, and makes a worthwhile contribution to our society.

But power has its drawbacks. Power is often intoxicating; those who have power often become enamored with it, and are willing to claim that much more can be achieved than is actually possible. This is certainly true in computing; consider the number of times that promised software or hardware introductions have been delayed when the promised power of the new product could not be provided on schedule. Even academia has its examples: consider MIT's Marvin Minsky, who stated in 1967 that "within a generation the problem of creating 'artificial intelligence' will be substantially solved." [2]

Intoxication with power may also lead one to apply computers to perceived problems not because the computer can help solve the problem, but because a "computerized" solution is by definition more valuable than a "manual" one. For example, electronic mail and computer conferencing systems are often promoted as a way to help improve communication between groups of people. But while computers can help improve the exchange of information between groups, communication and information exchange are not synonymous. Information exchange is necessary for communication, but is hardly sufficient.

Power is also addictive. For example, consider the following (paraphrased) description of a familiar scene:

> By eleven o'clock, there remain there only the desperate ones, the real ones, the ones for whom nothing else exists ... who know nothing of what is going on around them and take no interest in any matters outside, but only continue from morning till night, and would gladly continue all 'round the clock if it were permitted. These people are always annoyed when midnight comes, and they must go home, because the center is closing. And when the chief, about 12 o'clock, just before closing calls out, ..., these men are ready to stake all they have on those last few moments, and it is certain that it is just then that these people lose most.

The description sounds like that of a college computer center (at least, before many went into 24-hour operation). The irony is that this is not a description of late-night computer programmers, but Dostoevski's description of men addicted to roulette [7].

In the world of computing, programmers create their own little worlds, worlds which respond to their creator's commands instantly and faithfully. The joy of the programmer who has just eliminated the last error from his program has been compared to the joy of God shown in Genesis 1, who upon finishing his creation, saw that it was good [1]. It seems natural that people, being created as creatures in the image of God (Gen. 1) might share in the joy of creation as well.

But it is all too easy, like Dostoevski's roulette players, to become caught up in our own creations. The stereotype of the computer "geek" who prefers to spend time with the computer he understands rather than the complicated people around him that he can never understand is all too real. These people often become social misfits, wondering why the people around them cannot react more "logically" and respond as predictably as their computers [3]. And in a world where electronic communication is becoming more and more common, it becomes easy to forget that a person is at the other end of that wire, resulting in an increasingly impersonal (and perhaps impolite) world.

Computers bring power to users. But with power comes the temptation to apply that power in inappropriate ways, along with the temptation to become lost in worlds of our own creation. Participants in the technology of computing must continually ask questions like "Will this computer system help to solve this problem?" and "What is real?" to keep the assumption of power in computing under control.

2.2 Speed

Another assumption embedded in computing is that speed is valuable. The power of a computer is often measured solely in terms of its speed. Since speed can enhance productivity, many tasks in our society have become more productive as computers have been incorporated into their performance, and as the machines involved have become faster.

But speed can be a harsh taskmaster. Because a task can be performed quickly, we often are expected

to perform it at that speed. Consider the everyday activity of professional correspondence. Responding to the inquiries of colleagues may have been a leisurely activity in the past, since postal mail systems measured message delivery times in days. Overnight mail services were a novelty used only for important parcels that "absolutely, positively had to be there overnight." Today, with faxes and electronic mail, message delivery times can be measured in seconds, and overnight often isn't fast enough.

Those who cannot keep up with the increasing speed of our society are left behind, at a competitive disadvantage. Those who can keep up are forced to improve their performance simply to maintain position. And if we are able to do the tasks we do now with greater speed, what shall we do with the time we have saved? More of the same? Or something new? We need to ask "What is worth doing?" to keep the assumption of speed in computing in check.

2.3 Information

A third assumption embedded in the world of computing is that access to information is a good thing. "The truth shall make you free" (Jn. 8:32) has been shown to be true in our modern age; for example, the attempted military coup in the former Soviet Union was overthrown in part because the military could not (or chose not to) close all communications between the Soviet Union and the rest of the world. While television and radio stations were taken over, fax machines and electronic mail messages kept information flowing freely within the Soviet Union and to the rest of the world.

But with the Information Age comes other problems. While more and more information is being made available to more and more people, little is known about how to manage this increasing volume of information. It is easy to become overwhelmed by the sheer volume of data that one can amass on a particular subject. Hence, our modern world has created the technology of bureaucracy, whose purpose is to control the onslaught of information. (After all, what else is a standardized form but a method for defining what information is relevant for a particular task? [6])

Questions of substance also arise. When information itself is valuable, and computerized information more so, it becomes easy to disguise misleading or false information as truth. During the Vietnam War, when the decision was made to conceal from the U.S. Congress the facts regarding the United States' bombings of Cambodia, Pentagon computers were "fixed" to report all strike reports regarding Cambodian attacks as strikes against Vietnam [7]. And so while high Congressional officials were given private access to the Pentagon's own computer reports, what they saw as "authentic" accounts were purely fabrications. Computing professionals have talked about GIGO ("garbage in, garbage out") for years. Yet many around us have not heard the message.

There is also the danger that the information-handling abilities of the computer leads to viewing all important information as computer-acceptable data. An old adage asserts that "To one with a hammer, everything looks like a nail;" in the computer age, one might assert that "To one with a computer, everything looks like data." [6] One may come to view reality only in terms of its representation as computerized data (essentially, numbers). But how does one quantify the beauty of a poem into a set of numbers? Or how does the nature of warfare change when those who direct military attacks, such as in Operation Desert Storm, only see the war through the numbers on their computer screen?

To combat this onslaught of information, we must have a clear sense of what is worth doing to guide us. We must continually ask "What is true?" in order to identify the G in GIGO. And when reality becomes abstracted as a set of data, we must continue to ask ourselves "What is real?".

2.4 Logical Reasoning

Finally, computer technology assumes that symbolic (or "logical") reasoning is valuable. This is a central belief of the artificial intelligence community, where some of its practitioners claim that the essence of intelligence is rational thought. And understanding how humans reason has helped us learn how to build systems with the same capabilities.

But this assumption can lead to an unhealthy conclusion: the idea that intelligence is solely symbolic computation. In this world, there is no room for intuition, for emotion, for much of what makes human discourse different from that of computer discourse. We think of "playing a hunch" as intelligent behavior, although it follows no logical course; and often, when we pursue a logical course, we fail. Are we valuable as people only because we are rational? Or is there another basis for our worth?

3 Responsible Computing

The use of computers in society raises a number of questions. Does this system help to solve my problem? What is real? What is worth doing? What is true? Why are we valuable?

These questions form the core of what cultural specialists call a "world view" [4]: essentially, the core set of assumptions about life to which every culture develops answers, even if the questions are not asked explicitly. The answers to these questions in turn control every aspect of cultural behavior.

If we are to develop a responsible technology of computing, we must address these questions directly; not only since they are questions we must answer in all of our activities, but because these answers will guide us in our decisions regarding technology. And since these questions are not restricted to the field of computer science, we may freely turn to other disciplines — sociology, anthropology, religion, or others — to develop useful answers to these questions.

As technical experts in computing, we can help those around us to see how these questions interact with our discipline. And with the help of those around us, we can together develop a methodology for responsibly using computers in our society.

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