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## The Computers Are Coming

Almost since its invention, the power and versatility of the digital computer have fascinated both computer professionals and laymen. Primarily designed for large scale numerical problems in the 1950s and 1960s, computers of the time were cumbersome, expensive machines. For almost twenty years, the trend was toward even larger and more costly machines. With their reliability so strongly affected by temperature and humidity, however, these machines required pristine, air-conditioned environments in order to function effectively. Such limitations tarnished the dream of computer power made readily accessible and available. To facilitate rationing among those who wanted computer time, institutions simply sought an even bigger and faster machine. A few lucky places had the funds to purchase several. However, computers proved to be similar to highways. No sooner did more computing power become available than people found new innovative ways to use these larger, complex computers.

The next scheme to broaden the base of computer users, and provide ample rationing, was time-sharing. A large computer used for a single problem, did not always utilize the machine's full capacity; at other times, during the input and output of information, parts of the machine might not be used at all. Time-sharing could provide a number of users with access to the same machine while the machine allocated its functions as they became available. Depending upon the machine's size and speed, as well as the particular demands on its functions, many users were afforded simultaneous access provided each user had his own terminal. Furthering efficiency, each person with a terminal could enjoy access to the computer without leaving his own work location. Special trips to the computer room could be

greatly reduced and the computer made to fit into a work schedule—rather than have the work schedule tailored to the computer's availability. During the 1970s great strides were made in implementing this concept, and the large time-shared computer came to be the standard in the field. However, despite the best efforts of computer scientists, time-sharing bred its own limitations. As the number of computer users grew so did difficulties of gaining access to the machine. Speed of response slowed. If someone required the machine's full power, that computer might be unavailable to other users for lengthy periods of time. So, while the concept of time-sharing did make computing power more available and accessible, it failed to solve the problem completely.

Even as computer scientists were grappling with these problems, a major technological advance—semi-conductor development—was beginning radically to transform computer usage. As it became possible to manufacture and place larger and larger numbers of complex electronic circuits on tiny silicon chips, the trend toward bigger, more costly computers slowly ebbed, then reversed. Computers were now *reducing* in size, then in cost. This reduction in cost—underway, in fact, since the early 1950s—as well as the reduction in size of computers made possible by microelectronics, gave rise to a truly revolutionary third solution aimed at making computer power widely available. No longer did the computer professional require an office terminal for access to a large general purpose computer; he could use his *own* machine. The day of the personal computer had dawned.

Officially, the era of the personal computer can be traced to 1975, the year that Steve Jobs and Steve Wozniak developed the Apple Computer. These two young men, one a technician at Atari, the other an employee of Hewlett-Packard, created what few



*The personal computer, here a product of the Apple Computer, Inc., can play an integral role in the business environment. Storing important information in its memory and flashing relevant facts on call, the personal computer can greatly increase the efficiency of many businesses.*

had ever dreamed so immediately feasible: a small, reasonably powerful computer so modestly priced, under \$5,000, that small businesses and even individuals could imagine owning one. With Jobs' and Wozniak's personal computer setting the trend, other companies quickly entered the market. The Tandy Corporation's TRS-80 model 1 was introduced in 1977. In 1979 Atari introduced a model priced under \$1,000. IBM entered the personal computer market in 1981 and rapidly began shipping units. In 1982 Digital Equipment Corporation, another major manufacturer of computers, joined the variety of firms producing personal computers. Spurred on by this brisk competition, micro-electronic technology has been applied to make personal computers smaller, more powerful, and cheaper. Current prices go from \$5,000 to as low as \$100, and within this range are products developed for home use, for small businesses, and for scientific tasks. Thanks to this wide variety in price and usage, it is now possible to say that almost anyone who can afford a television set may also be tempted to purchase a personal computer. During 1982, an estimated one million personal computers will be sold to consumers.

While both the computer hobbyist and professional may wish to write their own programs, many people who purchase personal computers prefer to use them without learning a programming language or acquiring programming skill. A large number simply intend their computers for game-playing, financial calculations, budgeting, or educational purposes. To meet these needs, a broad and varied industry is springing up to provide pre-programmed "software" that allows the computer to be used almost immediately as a versatile tool. A recent ad in *The New York Times*, for example, listed approximately one thousand programs that are available for use with the Apple Com-

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puter: programs that ranged from accounting and business functions to agriculture, education, foreign languages, games, mail list and label processing, time management and scheduling, and word processing. In fact, those listed programs represented only a fraction of a much larger number of available Apple programs. With each new computer market entry, such as IBM's, the software industry quickly adapts to bring out new products compatible with all the hardware.

A final factor spurring the growth of the personal computer industry is the popularity of the home-video game. Just a few years ago, Atari and other companies showed that it was possible to convert the home television set into a screen for video games. With these games priced at anywhere from \$75 to \$200, and individual cartridges available for about \$20, video games have proven enormously popular, and are partially responsible for the changing perception of the traditional family television set. No longer simply a receiver of broadcasts, the TV set has become increasingly viewed as a home display screen for a variety of entertainment and information.

Looking into the next decade, there is every expectation that the personal computer market will continue its explosive growth. Competition and techniques for mass production will surely lower the unit cost of personal computers. Added to these efficiencies of manufacture is the enormously important factor of advancing computer technology—increasing computer speed and diminishing computer size. The software base for the personal computer market is expanding rapidly. As personal computers become more widely available and more sophisticated, there is little doubt that additional software will become available, making the personal computer ever more versatile and more attractive to individual purchasers of all types. Many of these purchasers will

be today's school children—a generation quickly acquiring ease and familiarity with computers. For them, the purchase of a computer is likely to be as natural as purchasing a TV set is for their parents. Less easy to envision, but equally important in the long run, are the horizons that are bound to enlarge as the population of personal computer owners explodes.

Let us remember that the personal computer is also a communications device. Attached to the television set and communicating with other computers over telephone lines, the personal computer may well catalyze the development of a new inter-home communications environment, a network that will merge functions of the telephone, the personal computer and the television set. Already, over 95% of American households have television sets and telephones. The personal computer may not be far behind. The hand held calculator that I use in my office is a Hewlett-Packard, Model 70, purchased six years ago for \$275. The latest comparable Hewlett-Packard costs about \$110 and boasts approximately 2-3 times the capability of the one I own. Taking account of inflation, I can now buy six times as much calculator power per dollar as I could six years ago. And the analogous situation is taking place in the personal computer industry. Experts anticipate that every three years the amount of computer power purchasable per dollar will double, and that this trend will continue unabated perhaps till the end of the century.

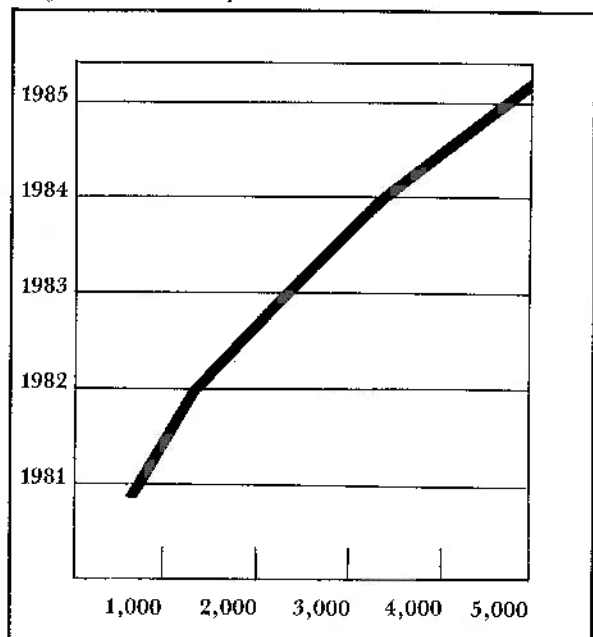
Viewed by the computer professional, of course, today's personal computer is relatively uninteresting. It lacks the memory, speed, and versatility necessary to make it a compellingly usable product. Instead, the computer professional expends his time and attention on a machine that might cost upwards of \$30,000. But remember: today's professional-model \$30,000 dream-machine

is likely to be the \$3,000 home machine of tomorrow. So fast is technology improving the product—in terms of functionality, availability and accessibility—that it seems unlikely that anyone who buys a personal computer will be able to assume his purchase final. Changes in technology and function are likely to make a new purchase desirable approximately every five years. The computer tasks that exist today in the realm of blue-sky oddities—control of the home energy environment, control of home security by computer, shopping, purchasing, transfer of funds and banking at home—are destined to be widespread realities by 1990.

### Self-Communication

A personal computer, like any computer, is a device which can receive information, manipulate and transform that data, then display the results. Information can be received in a variety of ways—from a keyboard, a magnetic tape, over telephone lines, via cable. The “personal” in personal computing refers to the size of the computer, or to the idea that such a computer can be the property of an individual. One way to define personal computers is to include any computer that sells for under \$5,000 (although some people might prefer a definition of any sub-\$2,500 price or even one under \$1,000). But there is another sense in which such a computer can be personal: self-communication. Most of us keep some kind of notes, or perhaps we write in a daily diary. We maintain calendars with lists of appointments, or as means to plan future activities. In little black books we jot down important telephone numbers and addresses. Many of these paper and pencil devices are ways of enhancing our fragile, fallible memories. The personal computer can be an important addition to these techniques, for paramount in the computer’s repertoire of functions is its memory. In one sense, of course, the

*Projected home computers in the U.S.*



Source: International Data Corporation

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computer is merely replacing paper and pencil with electronics; in another sense, however, it is doing so in an orderly and centralized way. Notes, calendars, diaries, lists of numbers, need to be planned carefully and kept up to date to be of maximum use. The computer can prove an invaluable aid by filing this data in easily retrievable fashion, in a centralized place, and by providing better and more uniform organization than many of us do on our own.

Yet another key mental function that can be enhanced by the use of a personal computer is planning. Planning involves making a set of assumptions and then anticipating the outcome based on a variety of possible conditions. For example, to develop a financial plan for next year, it will be necessary to make some assumptions about anticipated earnings, expenditures, amount of money intended to be borrowed, likely interest, plus major purchases and bills like college tuition. These and many more factors, interrelated in a personal financial plan, may be somewhat awkward to assemble and resolve, for if one assumption or condition is changed, the entire plan needs to be altered. Though an exercise of financial planning can be a highly valuable exercise, it can also be tedious and time-consuming. Here the personal computer comes to the rescue. In fact, one of the most popular personal computer programs, "VisiCalc," is an electronic worksheet designed to simplify the creative play involved in the planning process. On the electronic worksheet, if one condition or assumption is changed, the computer automatically brings the rest of the plan into conformity. Much of the drudgery is thus removed from the planning process.

Undoubtedly, one of the most popular uses of personal computers will be in the area of word processing. Like many non-professional writers, I find that the process of setting words down on paper and making the necessary revisions is a laborious and

time-consuming task. (I imagine even professional writers occasionally get frustrated.) My handwriting can be a problem; most people can't read it. In fact, sometimes I can't even read my own handwriting a few days later. If I am writing for distribution, my secretary will ordinarily type a first draft and then the work will go through several more drafts and revisions before I tire of my labor and pronounce it finished. Used as a word processor, the computer can race through many of these tasks. In fact, this is the last annual report essay I intend to write in the old-fashioned way. According to my plans, next year I will be composing this essay electronically on a word processor.

Numerous advantages await the user of a word processor. Material typed into the computer is immediately displayed on the screen and can then be read and revised before it is printed. In addition, there are a number of devices to facilitate revision and editing. Several word processing systems include a capability to check automatically the spelling of most frequently-used words and then advise the writer if a word or phrase seems misspelled or incorrect. In some cases, the word processing system will even suggest alternatives to the word actually displayed. If a word, phrase, sentence or paragraph needs to be changed or deleted, a new word or paragraph can be typed in and automatically substituted for the old deleted portion. One need never rewrite the entire body of the material. The word processor allows the writer to interchange sentences, or shift part of an essay from one page to the next and can then store the old material should it ever require retrieval. With an amplitude of functions, sophisticated word processing systems are designed to ease the writer's task, to simplify and automate the process of editing and revision, and finally to print out a clean copy of the author's product. In time it is likely that word processing systems—used by personal computer enthus-

<b>now!</b>		HARSH WORDS ON LIBYAN CONFLICT 1	
KCET'S ELECTRONIC NEWSMAGAZINE		BASEBALL SAVES ITS GOOD NAME 15	
August 20		SPECIAL REPORT IS YOUR CAR SAFE? 25	
NEWS	1	GUIDE TO LA	33
WEATHER	14	STAGE & SCREEN	40
SPORTS	15	KCET TONIGHT	50
SCOREBOARD	18	KID'S MAGAZINE	60
FINANCE	20	CRISIS PHONES	95
GAMES	30	MASTHEAD	99

<b>STAGE AND SCREEN</b>	
<p><b>CUE</b> The Tony award-winning play "Children of a Lesser God" begins a seven-week run at the Huntington Hartford on August 26.</p>	
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*Text services delivering information to the home are proliferating. Databases such as The Source and CompuServe can be accessed through a personal computer. Above, the Los Angeles public TV station KCET's teletext service "Now!" delivers text to the home on a television signal. "Now!" is a forerunner of videotex services accessible by personal computer.*

ists and professional writers—will increasingly come to replace that increasingly obsolescent machine: the typewriter.

## Communicating with Other People

The "personal" in personal computer is not just self-referential: computers can also communicate with each other. Equipped with a small device called a modem, a computer can use standard telephone lines to transmit information to another modem-equipped computer with the resulting information displayed on a screen or printed out as necessary. "Smart" modems can dial other computers at pre-set times and answer a ringing telephone. With sufficiently high usage, computers may transmit over their own telephone lines, rather than using the dial system. Already numerous universities, branches of government and many businesses are computer-linked in such networks. And what is now common in business, science, and the military may soon become a widespread phenomenon among individual computer users. Compared to the cost of a computer, the price of a modem is relatively low—often around \$100. For the personal computer owner who wants to avail himself of inter-computer linkages, cost will not be much of a barrier.

As computers are linked together, one fascinating dream may soon become a reality: electronic mail. The hobbyist and computer buff will want to make use of electronic mail simply for the sheer fun. More widespread use of computer networks for electronic mail will ultimately depend upon cost comparisons between computerized mail and regular mail, as well as their comparative speed, ease of use, and flexibility. Regular mail, of course, provides a written record; so does computer mail if printed out. Regular mail may take anywhere from one to several days for delivery depending upon points of origination and receipt; computer mail takes only

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as long as it takes to complete a telephone call. When and if the volume of computer mail becomes heavy, suggesting nighttime transmission when telephone rates are cheaper, normal delivery time may be overnight. Cost comparisons are not easy to make. A twenty cent stamp carries a letter from any point in the United States to any other point. The cost of telephone usage, however, varies with the distance over which the call travels, and few long-distance calls cost as little as twenty cents. On the other hand, while the costs of regular mail are clearly rising, long-distance telephone rates have been dropping. If computer mail does become popular, there is no reason why extremely attractive rates could not be afforded electronic mail delivered overnight when telephone lines are used only minimally.

An extension of electronic mail is the use of the computer to send messages to specialized networks of people, where the message does not simply pass from person to person, but among designated people with shared interests. These specialized networks have already sprung up on college campuses and in the scientific and military communities. A comment or question on a recent astronomical event, say, would simply be typed into the computer and then automatically routed to all other people interested in astronomy. A similar process would take place among jazz buffs or skiing enthusiasts. With such instantly accessible networks, the computer clearly begins to gain over the use of regular mail. If I had wanted to make a comment on an astronomical event, I would probably not think it worthwhile to send it to my colleagues by conventional mail—unless my message were of extreme importance or of considerable length. Then it would be necessary to type a letter, make copies, and mail the several copies to those people I thought might be interested. With a computer network, I would simply sit down,

type out a few questions or sentences, then have the computer dispatch the message automatically. Because of such spontaneity, computer networks can actually encourage communication—rather than making the communication more artificial.

In a further extension of computer use people can form a conference network. In a sense, simply an elaboration of the telephone conference call, the computer conference offers certain advantages, like permanent records of the proceedings which any participant in a computer conference can periodically review and respond to. Those who have tried computer conferencing, find it convenient for groups for whom physical meetings are impractical. Several small companies already sell computer conference software, for example, Infomedia Corporation of San Bruno, California. (Thirty groups currently employ its system.) As personal computers and computer conferencing become popular, many companies will probably offer conference abilities to the individual consumer.

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### Communicating with Intelligence

Whether taking notes, keeping a calendar, financial planning, or conferencing—a computer, unlike a book, changes depending on its use. It has no specific content, but rather organizes and processes information. As time goes on, though, a computer's value in communications will increasingly depend on pre-packaged content. Like a book, the computer's memory can be thought of as a means of preserving intelligence. Unlike a book, a computer's memory can be flexibly accessed, searched, and readily restructured.

For centuries the library has been civilization's memory—our main way to preserve communal intelligence. Libraries have grown in size and complexity until they threaten to outgrow our ability to house or pay for them. To mine the infinite resources

*Computer games enjoy great popularity among children across the country. At the Sesame Place in both Irving, Texas, and Langhorne, Pennsylvania, families with children of ages 3 to 13 play educational computer games in a learning environment.*



of the great libraries, a good reference librarian is invaluable. Someone with questions to pose needs guidance to frame meaningful questions. Only a reference librarian knows how to exploit a modern library's vast store of information. Unfortunately, these people are scarce. Also, since there are so many demands on the reference librarian, finding time to serve each individual client adequately is difficult.

But there may be a solution—computerized databases accessed through a personal computer. Already there are hundreds of databases containing information ranging from the highly technical, such as nuclear science references, to general consumer information like airline schedules.\* The use of these databases can be relatively cheap or expensive—from five dollars an hour to several hundred dollars an hour, depending, of course, on the nature of the material.

In the past, libraries were stationary collections of books, periodicals, standard reference materials such as dictionaries, great works of literature, encyclopedias, and so on. Each library is unique, but its quality depends on the size and organization of its collection. Computerized databases will revolutionize these traditions. A person can gain access to a database using his own computer and a telephone, thus databases need not be housed in any particular location. In fact, as the system evolves, we will find this unnecessary, although some individual organizations with specialized goals may require their own databases. Personal computers and the telephone system are leading us to the concept of a vast, distributed library of information with virtually limitless access. The specter of ever growing collections of books and periodicals housed in ever larger libraries will fade away as the computer revolution becomes more widespread.

\*Cuadra Associates: *Directory of Online Databases*.  
Gale Research: *Encyclopedia of Information Systems and Services*.



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Textbooks by nature are inflexible and expose all students to the same learning process, even though their needs differ, as do the types of help they require. Sophisticated teaching programs can give us the benefits of the skill and intelligence of the master teacher. The great advantage of the computer, in addition to its unlimited patience, is that it can adapt to the needs of individual students. Just as the master teacher diagnoses a student's needs and provides appropriate instruction, so can the best computer programs adapt—providing drill and practice where necessary, remedial instruction if required, or new material at the appropriate level.

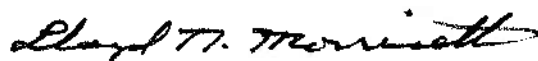
If much of today's teaching is stodgy and makes little use of the computer's exciting potential, a few programs show what is possible. Utilizing the computer for effective teaching is not easy. As personal computers become more widespread and are used more in learning, many effective teaching systems will no doubt follow. Such systems will require expert knowledge of the teaching and learning process, as well as skill in computer programming.

One of the long-term goals of computer professionals has been to endow the computer with human intelligence. In the 1950s, the theory was that if computers could someday solve the same kinds of problems that humans solve, artificial intelligence would become a reality. Some of the first tasks used to demonstrate artificial intelligence were games like checkers and chess that require "human" planning, problem-solving, and strategy. Although in the 50s computer programs could play acceptable checkers and chess, they couldn't compete effectively against skilled players. Now, however, a computer can compete and beat very good players of these games.

As these programs become more and more successful, the goals of artificial intelligence have grown. Now researchers are

attempting to design computer programs to converse with the computer operator and to solve a variety of problems. In fact, a number of small companies are beginning to apply the techniques of artificial intelligence to real problems. Roger Shank and his colleagues at Yale University have formed a company called Cognitive Systems, Incorporated. One of their first projects is to provide easy access to the huge databases used by oil companies. As computers improve, they will be adapted to increasingly intelligent functions. In ten or twenty years time, owning a personal computer will mean having a flexible, highly intelligent instructor and problem-solver who converses in ordinary English.

Computers are transforming our way of life, though the process may seem slow. From the standpoint of a ten or twenty year period however, it's clear that enormous changes are afoot. The cost of computing has diminished while the power of computers has grown. For little more than the price of a standard television set an individual can buy a personal computer with substantial capacity, and within ten years that computer will equal the power and sophistication of more advanced laboratory models. As these computers link up via telephone, a mass communications system of unprecedented capability and versatility will evolve. At the moment, most of us think of television, telephone and computers as separate media. In the future, a single, interconnected system will form a communications network unlike anything previously known to mankind. For the future, individual choices in entertainment, education and information will be as boundless as the technological imagination that masterminded the new age in communications.



Lloyd N. Morrisett