Working with Computers 1960 to 2012

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Computers were integral to my work from 1960 when I was a graduate student at Stanford until I closed down my business and retired in 2012. Over that span of 43 years computers changed dramatically. I wrote software = more particularly I wrote software for use by those who were not experts with computers.

This is a tale of my work with computers, an effort to illustrate how computing used to be, and a rebuttal to those who insist that we have to put up with the shortcomings of the current state of computing: the malware that threatens our current computer systems, the planned obsolescence that costs us all time and money, and the frustration of dealing with poorly designed and written software.

When I was at Reed College in Portland, Oregon, the mathematics faculty argued vehemently, and successfully, against having a computer on campus. They said it would only distract from academic pursuits. That was from 1955 to 1959.

As a graduate student in the Statistics department at Stanford, I worked part time. The work involved calculations for statistical tables. As I remember it, the work began using desk top calculators that would add, subtract, multiply and divide. They were noisy and slow. By the end of the academic year I was using a Burroughs 220 computer to do the work. That required learning how to write programs.

Following graduate school, I worked at SRI and was involved with large Burroughs machines. By the time I left SRI in 1976 there were minicomputers on the market from DEC, HP and others. I started my own business working almost entirely with the HP3000 minicomputer. When I shut down the business and retired, HP had retired the HP3000 and was selling personal computers. Over the span of my time working with computers the field moved from only very large, very expensive machines to personal computers that cost very little and had far greater storage and computing capacity.

The B220 computer was built with vacuum tubes. The memory and processing components were in cabinets with the tubes mounted on gates that could swing out. Vacuum tubes fail – and when they are failing they go through a spell of intermediate functioning and failing. When the computer was sporadically non-functional, the repair people had to find the bad tube. Their process involved opening the cabinet, swinging a gate with the tubes mounted on it, and whacking the end of the gate with a baseball bat or large board. When the gate with the bad tube was whacked, the machine stopped.

SRI had three large computers, referred to as “mainframes,” for much of the time I was there. A machine made by IBM was used primarily for accounting; it shared the ground floor computer room with the Burroughs system. A machine made by CDC lived in the basement and was used mainly for scientific calculations – including a lot of classified work. I was involved with the Burroughs installation.

A computer room housed one, or more, mainframes. The computer room had raised flooring with panels about two feet square; large cables connecting the pieces of the computer ran under

the floor, the panels could be lifted up to provide access to the cables. The computer room had its own air conditioning system to keep the temperature below 72° and it had an electrical panel to provide power from PG&E and separate from the power to the rest of the building.

Today moving information to or from a computer is done electronically. It may be over a wire, a phone line, the internet, or the data may be moved to/from a memory stick. With the computer systems in this discussion, data transferring was done with punch cards, magnetic tape, paper tape or by typing on a computer terminal.

Large data files were stored on 12 inch reels of magnetic tape. The computer would have as many as eight, or more, tape drives. Programs for the computer, and data that was not originated on the computer came on punch cards. The computer system had a card reader and a card punch . Output from the computer for people to read came on a line printer that used continuous feed paper. As a group these units were referred to as "peripherals" and any of them could breakdown or jam easily.

The computer had memory for use by the running programs as well as a disk that held programs, including the operating system and some data. The disks were physically large – but compared to current disk capacities extremely small. However, multiple disk units could be attached to one computer giving a reasonably large total data storage capacity.

Running a job on the computer generally involved starting with a stack of punch cards containing the instructions for the job and a program to be compiled. The punch cards were loaded in the card reader and the operator's console was used to start the process.

Typically, a programmer would write a program out on coding sheets; the keypunch shop would take the sheets and punch the cards. The punch cards were then loaded into the card reader and the job was started from the operator's console. Typically, there were errors, some punch cards had to be tossed and corrections inserted and the job had to be run again.

Every programmer that I knew had at least one experience of putting the program cards through the compiler on the computer, getting the printout showing errors, going through the card deck and punching new cards to replace the cards with mistakes, then putting the erroneous cards back in the deck and throwing out the corrections. And everyone thought that they must be the first one to make such a foolish mistake.

One Saturday, I came in to run a program I had been working on. The card reader jammed. I spent hours taking the reader apart, cleaning it out, and putting it back together. What was going to be about a 30-minute time on the computer turned into about 4 hours.

An important innovation sometime in the 1960's allowed communication between the computer and a terminal connected over a direct wire or over a phone line. Programing could then be done at a terminal, programmers could work at home, and there was significantly less need for punch cards. ("Work at home" was generally in addition to the time spent in the office, not instead of coming in to work.) At the beginning the terminals were teletype machines with a top speed of 10 characters/second. By 1976 the speed and variety of terminals had significantly increased.

The computers were used for computation and accounting – there was no word or document processing capability. By 1976 the computers had grown significantly in speed, capacity, and cost. Computers still used punch cards and magnetic tapes for most data transfer.

Programming at SRI in those days involved working with a researcher to decide how collected data would be punched onto cards and processed by a program written specifically for the purpose to generate the analysis required.

Generally, any project using a computer required custom programming. However, there were many projects/problems that would not. Development of a general-purpose statistical regression program would be of value to SRI. The first version was available in January 1966, I have a copy of the revised manual dated June 1968.

In 1966 it was highly unusual for a researcher to use a computer without engaging the services of a programmer. The revised version of the Regression Program User Manual points out: "It is worthy of note that the Regression Program has enjoyed wide use by non-programmers over the past year." The manual is written to be friendly to non-programmers and to encourage them to try it out. The program is not what would now be called "user-friendly" – there are strict formatting requirements for the input. But the explanations are complete.

The program was written for a Burroughs computer – it first ran on the B220, then on the B5500. It was then translated for use on SRI's CDC computer. (The tech support staff for the CDC machine did not think it could be moved to that platform; I had a couple of staff people with some experience on the CDC machine – so I asked them to convert the program, neglecting to tell them it might not be possible. They did it.)

Mountain View High School had an "opportunity class" around 1973. The principal described it as the class for kids who should be out stealing hubcaps. At that time Mountain View High was on Castro Street in downtown Mountain View.

I knew the teacher of the class and suggested to her that we teach her kids how to write a computer program. This was a time when computers were still relatively new. No one at the school had computer experience. For the 1973-74 school year, the Mountain View High School budget included funds to pay for the computer time used on SRI machines as well as some money for personnel time. All other time put in by me or my staff was done on our own time.

I borrowed a couple of teletype terminals from SRI, got help from a couple of the computer room people, and someone arranged for phone lines in the classroom. Either I or someone from my group came to the class every day for a while. We taught the "opportunity class" how to write programs in BASIC – with an emphasis on writing a program that would do your math homework.

One of the students in that class was hired as a computer operator at SRI. Members of the staff worked with him, and he earned his high school equivalency certificate within a year of hiring on. Some ten years later, he was still working at SRI (long after I was gone!).

The administration at the high school as well as the Superintendent of the district showed interest in the program and in the student who became a computer operator at SRI. The district superintendent visited SRI to see our computer room operation. A few years later, Mountain View had a new principal; he called and invited me to meet him at the school. He proceeded to tell me how he had transformed the program I had started into a program for the MGM (Mentally Gifted Minors) students. He never understood why I found that so abhorrent!

In 1969 IBM was facing charges of monopolist business practices. Their lawyers came to SRI to discuss the issue. I was invited to join the meeting along with members of the SRI legal staff. The President of SRI was constantly lobbying for an IBM machine because IBM salespeople told him that every large operation except SRI had some IBM equipment, thus there was something wrong at SRI. In my opinion that was a clear indication of monopolistic business practice.

Another factor influencing my opinion of IBM was their 360 series of computers. IBM advertised that the 360 series was innovative because: programs written for one computer in the series would run on all machines in the series; the machines could run several programs simultaneously (referred to as "time sharing"); and the operating system made use of the disk as virtual memory. Each of those features were present on the Burroughs computers that we had been using for years.

In 1974 knowledge of computers, even among research personnel, was minimal. In May 1974, I proposed a series of computer classes for SRI personnel. Each of twelve topics would be covered in a series of 3 to 5 one-hour sessions. Topics included: Introduction to Computers, Programming Languages, Computers at SRI, Graphics, Networking, and Text Handling.

In September there was a report on interest in the classes showed: 530 employees were interested with 2,755 topic requests. The most popular topic was "Computers at SRI" with 356 requests; the least popular was "Networks" with only 184. My notes indicate that 42 sessions began on November 4 with the last session given on December 17. Fourteen speakers, including me, participated.

SRI had a contract to evaluate the Follow Through and Head Start educational programs. The data processing for that project – and for most data intensive projects of that time – was quite different from what one might expect today. Coding specifications were written to dictate how information was to be punched onto cards. Punch cards were fixed size of 80 characters. Once the data was punched onto cards, an editing program read the cards, flagged errors, and wrote the data onto magnetic tape. The tapes were written, and read, on reel-to-reel tape decks connected to the computer. A typical computer configuration did not have the disc space to store an entire reel of tape for one of several projects using the computer.

SRI also had a contract to evaluate income maintenance experiments in Denver and Seattle. The Seattle-Denver Income Maintenance Experiment (SIME/DIME) was the last in a series of four, large-scale income maintenance experiments undertaken in the late 1960s and early 1970s to measure the disincentive effects of cash transfers on the working hours of recipients of the cash.

There were 2,042 households enrolled in Seattle and 2,758 in Denver. The project involved long face-to-face interviews three times a year. Interviews included detailed questions on every aspect of labor force participation, earnings, and job change. Interviews were variable in length depending on the number of people in the household and their characteristics. The interviews were going to pose a significant data processing problem.

A set of programs to encode and process interview data was proposed. They would run on the Burroughs computer at SRI – but we hoped to have hardware "soon" that would let interviewers go in the field with a gadget that would gather the data. This is years before there were laptop computers or iPads or anything similar.

Ninety days later we had a pair of programs that proved the concept. It was clear that we could have the system working within another 90 days.

The software was called **The Electric Interview System**. It served to gather and edit data from all the SIME-DIME interviews for the duration of the project. The Electric Interview System also generated significant interest from other organizations in the business of interviewing. None of them used it – as far as I know. Had we been able to get hardware that would have allowed the use of the software in the field I expect it would have gained much more acceptance.

A marketing brochure describing the software says "More than one hundred thousand interviews, averaging over five hundred questions each, have now been processed with the system."

Data processing for projects evaluating SIME/DIME and Follow Through involved problems vastly different from what might be faced today. The desktop PC that I am using to write this has more memory space and more disk space than were available on the large computers used at that time.

The Burroughs computers were easier to program than other machines on the market; they worked well with database operations, and, they were compatible from one version of the operating system to another and from one model of the computer to another. Programs written for a B5000 computer would run without change on a B6700 machine five years later. Most important, especially for the SIME/DIME work, the Burroughs machines worked in a time-sharing mode.

Time sharing meant that many users could connect to the computer with a terminal at the same time to enter data, write programs, or run jobs. Data entry for SIME/DIME was done in Seattle and Denver over leased phone lines.

In order, to connect multiple terminals in Seattle or Denver with the computer in Menlo Park we needed communication equipment that could combine the data streams from several terminals, pass the combined stream over the phone line, then unscramble them at the other end. Then the computer center had to deal with multiple vendors – the phone company, the terminal company, and the company supplying the gear to combine the signals. When something went wrong there was always an expert demonstration of finger pointing.

During this time the terminals used to connect with the computer had no processing power. All of the computing capability was in the main frame computer. A user could type on the terminal and have the material transmitted to the computer, the computer could respond back to the terminal.

At the start of this work, the terminals were communicating at a speed of 10 characters per second – that is way slower than most people can type; by the end of my time at SRI terminal speeds of 30 characters/second and higher were becoming standard.

If a line of text has 80 characters (spaces count); and a page has 6 lines to the inch for 10 inches; that would come to 4,800 characters on the page. At 10 characters per second it would take 480 seconds or 8 minutes to type the page; at 30 characters per second the time drops to 2.7 minutes per page. Compare that to the printers we use now that print 20-40 pages per minute.

Computers also had a line printer that lived in the computer room and was used to print longer documents. Those printers measured their speed in lines per minute and the speeds could go as high as 1,200 lines per minute.

In the Fall of 1972, we had two B5700 mainframe computers and Burroughs introduced a larger, more powerful machine – the B6700. Lease cost for the new machine would be less than that of the two older ones and the computing capacity would be far greater. SRI ordered a B6700 with the knowledge that program would not have to be rewritten for the new machine.

SRI accounting work was being done on an IBM 360. The accounting work could be handled on the B6700 without impacting other work on that machine. That would allow SRI to get rid of the IBM 360 and its cost. The accounting people agreed, and that work was added to the B6700 and the IBM 360 was out the door – after a significant amount of programming work to move processing from the IBM to the Burroughs

SRI sought a computer system to manage the air conditioning and heating equipment at SRI. One machine was made by DEC, the other by IBM. They were functionally the same; the IBM system was more expensive. I recommended the IBM noting that it would do no harm and that the additional cost would be recovered in the time saved by not having to explain to management why we had no IBM computers at SRI. The recipient of my note added his comment: “I agree” to the memo and passed it along.

In 1976 I left SRI and, with a partner, started the business that would be LARC Computing.

HP was in process of promoting their relatively new computer – the HP3000. They had arranged for demonstrations at SRI before we left there. It was an impression machine - a mini-computer that took up about 30 square feet of floor space and required minimal air conditioning. Access to the computer was through terminals that were wired directly to the machine or over phone lines that connected to modems wired to the computer. Most important, the operating system design was very similar to that of the Burroughs computers.

LARC arranged to use an HP3000 installed at a Mountain View company; we set up a dedicated, leased, phone line between our offices and theirs. We purchased an HP terminal for use in our

office – the cost in 1976 was $5,679. (By contrast I bought a new car about the same time for $3,000.)

In 1976, and for several years after that, Hewlett-Packard maintained a sales office in Santa Clara to cover the entire Bay Area. A staff of sales representatives made calls on businesses interested in doing business with HP. Their emphasis was on companies that had, or were interested in buying, HP3000 computers.

The salesman for our area came by the LARC office with a proposition: HP wanted to sell computers to offices and small companies; it would be a great advantage if there was word processing software on the HP3000. There were companies selling systems that only did word processing. (Wang is the only name I can remember.) HP could compete if it had a word processing application. HP proposed to help us get started on the software and, if we were able to produce a product, to promote that product with the nationwide HP salesforce.

HP provided source code for a text editor written by HP and licensed for our use at no cost as well as source code for a formatter that was in the public domain – but it did not work very well.

We were successful in enhancing the two programs –they were essentially entirely re-written. The two were marketed as *Editor/Scribe* and came with documentation and telephone support. On-site training sessions were also offered.

LARC offered support contracts and most clients stayed on contract. Our arrangement was that any user was entitled to telephone support for the life of their use of the product. If the site was on a support contract, they also got updates. Those not on support did not get the updates.

One of our early customers was Hewlett-Packard's Sales Office. Where proposals used to be typed from scratch for every new prospect, with this system they could write big chunks of "boilerplate" and include them in a proposal without retyping. The White House bought a copy of the software to use for presidential letter writing

HP, on our behalf, sold the software to the State of South Dakota. (They sold them an HP3000 system at the same time.) One of the reasons the State bought the system was for "real time" word processing: the Governor addressed the legislature without a prepared text. With the HP3000 and our software, his secretary listened to the speech over a wire in her office and typed as the governor spoke. At the end of the speech, she printed copies and had them available by the time the press got from the legislative chamber to her office.

In 1980, HP bought rights to the word processing software and contracted with LARC to provide support. HP's support procedure involved a staff that received all problem reports; assessed the effort required to fix the problem; and recommended a course of action. We did not argue with their procedure but insisted that the information be sent to LARC at the same time. Over the course of our contract with HP we consistently fixed problems in less time than it took for their analysis. That experience provides one example of how bureaucracy has gotten in the way of good user service in the computer industry.

HP introduced the first laser printer for IBM PC compatible personal computers in May 1984. It was an eight page per minute printer that sold for $3,495. It printed in a variety of character fonts and sizes. The formatting software required became more complex as it had to handle a table of character weights for each font and the weights had to be scaled to the font size; the user needed to be able to specify the font and the size.

Originally, HP did not market laser printers for use with the HP3000 nor did it support their use with that system. LARC developed formatting software and worked out how to connect the printers to the HP3000.

The HP3000 was first introduced in 1972, the last models reached end-of-life in 2010, making it among the longest-lived machines of its generation.

Earlier this year (2022) I got an email message from a user of the LARC software on the HP3000 saying that they were about to decommission the computer. He was sorry to see the system leave. Some of the software he had been running were written at LARC more than 30 years before. They had continued to function properly over changes to the hardware and software. They had not been forced to pay upgrade fees or support fees for many years; yet they had been able to ask questions and receive phone or email support for the product. LARC Computing was a successful business with those policies; we had satisfied clients.

There is no technological reason that computer systems cannot be upward compatible. There is no technological reason for forcing users to pay upgrade fees as they get new hardware or as the operating systems are upgraded. Marketing decisions, perceived profit maximization, and poor programming decisions force inconvenience on users.