computers and people

July—August, 1986
Vol. 35, Nos. 7-8

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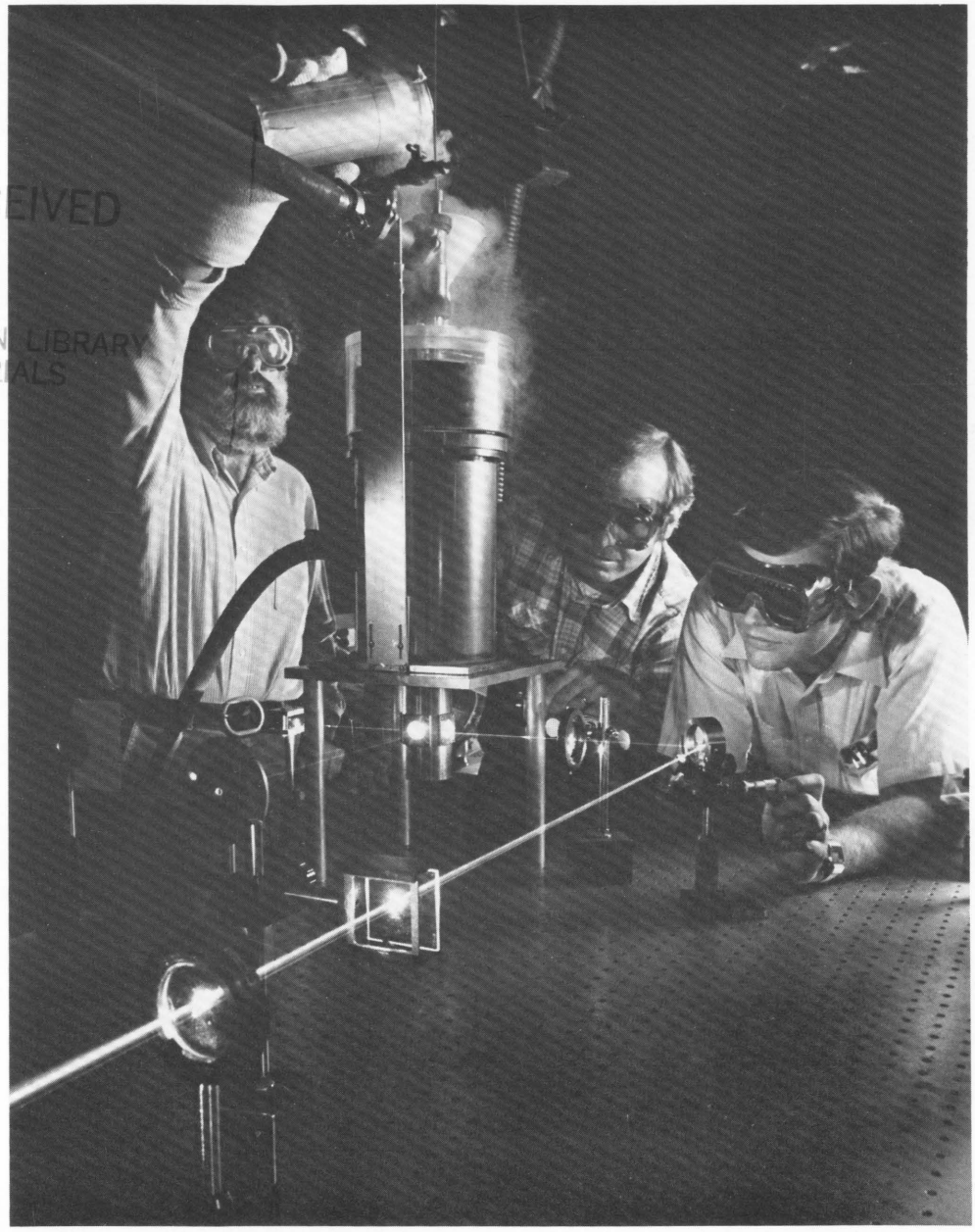

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38 SUBDIVISIONS OF COMPUTER SCIENCE RECOGNIZED IN ACM CURRICULUM (List 860701)

A. For Bachelor's Degrees in Computer Science:

CS 1 Computer Programming I

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CS 6 Operating Systems and Computer Architecture I

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CS 8 Organization of Programming Languages

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CS 13 Algorithms

CS 14 Software Design and Development

CS 15 Theory of Programming Languages

CS 16 Automata, Computability, and Formal Languages

CS 17 Numerical Mathematics: Analysis

CS 18 Numerical Mathematics: Linear Algebra

B. For Master's Degrees in Computer Science:

CS 19 Compiler Construction

CS 20 Formal Methods in Programming Languages

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CS 22 Performance Evaluation

CS 23 Analytical Models for Operating Systems

CS 24 Computer Communication Networks and Distributed Processing

CS 25 High Level Language and Computer Architecture

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CS 28 Microcomputer Systems and Local Networks

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CS 38 Introduction to Symbolic and Algebraic Manipulation

(Source: "Communications of the ACM", March, 1981, published by the Association for Computing Machinery (ACM), 11 West 42 St., New York, NY 10017)

8 APHORISMS (List 860702)

- Happiness is a talent we develop, not an object to be sought.

- Some people are crushed by misfortune. Others grow because of it.

- Lucky breaks in life are less important than what we do with them.

- People don't wear out. But they often rust out.

- Skillful pilots gain their reputation from storms and tempests.

- Continual success shows only one side of life. We are never forced to stretch and grow.

- The most massive characters are covered with scars.

- Prosperity is a great teacher. But adversity is a greater one.

(Source: excerpts from an advertisement publicizing the Patricia Neal Rehabilitation Center, Knoxville, TN, appearing in the "Wall St. Journal", May 14, 1986, inserted by Panhandle Eastern Corp., P.O. Box 1642, Houston, TX 77251; slightly edited)

10 APHORISMS (List 860703)

- "It is difficult to take pride in work that is neither seen nor appreciated."
  - William

- "The idle mistress makes the idle servant."
  - Dona St. Columb

- "I have always served faithfully the people I love, my lady."
  - William

- "My late master talked to me long and often, my lady; many of my ideas and much of my philosophy are borrowed from him."
  - William

- "I have made a practice of observing people."
  - William

- "It seems you have been spying on my ship," he said. "On the contrary," she said, "it seems your men have been trespassing upon my land."
  - Jean-Benoit Aubéry, and Dona St. Columb

- "Approve and disapprove are two words that are not in my vocabulary, my lady."
  - William

- "Your master is right - we are all cogs in a wheel."
  - Dona St. Columb

- "The difference between happiness and contentment is not easy to put into words. Contentment is a state of mind and body when the two work in harmony, and there is no friction. Happiness is elusive, and approaches ecstasy."
  - Jean-Benoit Aubéry

- "It happens you reflect upon your face what is passing through your mind, which is exactly what an artist desires."
  - Jean-Benoit Aubéry

(Source: "Frenchmen's Creek", a best selling and intensely powerful novel by Daphne du Maurier, published by and copyright by Doubleday and Co., Inc., New York, NY, 1941, 216 pp; slightly edited)

Ω

Shore – *Continued from page 11*

as "overflow." Most CPUs operate on a fixed number of bits at a time - usually 8,16, or 32 bits - and this puts a practical limit on the magnitude of the largest number that the CPU can handle in routine arithmetic operations. If an instruction attempts to generate a number that exceeds this maximum value - for example, by dividing any number by zero, or by multiplying two numbers that are both close to the maximum - the CPU register containing the result is said to "overflow", and this fact is reported to the computer system's software. The user might get a message like

```
FATAL ERROR...REGISTER OVERFLOW AT AF45
712 547 234 232
777 234 342 455
209 487 439 332
```

More often than not, overflows result from bugs or invalid usage rather than from hardware errors.

(Continued in next issue. Please see page 27 for more information from Viking Penguin, Inc. about this interesting book.)

computers and people

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NOTES & ANNOUNCEMENTS

by E.C.B.

Front Cover Picture

The front cover shows scientists and laser apparatus in a laboratory where an experimental technique for high-density data storage is being developed. The technique is called "frequency domain optical storage." It uses thousands of colors, or frequencies of light, to record, store, or refer to computer data. The potential is 100 thousand million characters of information per square inch. The lab is at IBM Corp. in San Jose, CA.

Nuclear Weapons

We invite articles on the subject of computers and nuclear weapons. Computers, and computer people who work to make nuclear weapons work, are an essential ingredient of the nuclear evil. Such work is ethically wrong, morbid, and fiendish.

Computer Field → Zero

There will be zero computer field and zero people if the nuclear holocaust and the nuclear winter occur. Every city in the United States and in the Soviet Union is a multiply computerized target. Thought, discussion, and action to prevent this holocaust is an ethical imperative. Learning to live together is a biological imperative.

Storage Crunch

We have to reduce the storage space we are occupying. Back copies for 1985 and prior years back to to 1980 are available. The special price per copy (so long as the excess lasts) will be $2.50 (instead of the usual price $4.00) for each copy, applying to orders received in our office before August 15, 1986.

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Puzzles for Nimble Minds

We have a large supply of many types of puzzles, games, and tests (easy or hard), for computers, people and situations.

If you are interested, write us and ask for some you might like. Many are designed by a good chess player. Many are far simpler than chess but nevertheless entertaining, and requiring thought not chance.

"The Gritty Interface"

The Real World and Information Systems: The Gritty Interface will soon be published by Berkeley Enterprises, Inc., in newsletter style, 6 issues a year, 4 to 6 pages each issue.

We plan that the first issue will be published in July, 1986, and go to all subscribers of *C&P* FREE. Starting November 1, 1986, the cost will be $30 a year.

Back Copies

For issues 1951 through 1979, only microfilm copies of *Computers and People* (formerly *Computers and Automation*) are available from University Microfilms International, 300 North Zeeb Rd., Ann Arbor, MI 48106. For issues 1980 to the present, only back copies are available from Berkeley Enterprises, Inc., 815 Washington St., Newtonville, MA 02160. The cost of these back copies is $4.00 each, plus postage and handling. Since we are not a technical journal, we do not supply free reprints of articles.

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computers and people

The magazine of the design, applications, and implications of information processing systems — and the pursuit of truth in input, output, and processing for the benefit of people.

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Can Americans Put Their Faith in Failure?

Robert Kahn, Certified Management Consultant, Editor of "Retailing Today"
Robert Kahn and Associates, Business Counselors
P.O. Box 249
Lafayette, CA 94549

Virtually every reader of "Retailing Today" works with a computer in his own company -- and with computer systems in other companies or governmental agencies.

I won't repeat the disastrous impacts on a business when a computer system fails. There are too many such stories. Nor do I need to repeat the stories of supposedly tested and proven systems that had bugs in them.

The Internal Revenue Service has used computers for over 25 years; yet they spent most of 1985 apologizing to the public and answering questions directed to them from Congress about the complete breakdowns in several offices. Tax returns were lost. Forms were sent to taxpayers saying they would receive a reply to their question in 90 days -- and later a second letter, again computer prepared, that it would take another 60 days. The government paid large amounts of interest because refunds were not mailed promptly.

We had one great bastion of confidence in computers -- National Aeronautics and Space Administration (NASA) and the space program. 26 successful flights. Minor bugs could be handled from the ground. When something went wrong, Control in Houston was able to identify the cause almost immediately.

On the 27th flight, the "Challenger" exploded within two minutes of takeoff destroying 7 people, a $2 billion vehicle and, I hope, the too easily given confidence in the miracles of computers. (If not by this disaster, then by two successive failures of unmanned rockets.)

The investigation of the "Challenger" disaster has disclosed human failures (importance of schedule over safety questions), inadequate design (certain factors were not under control), lack of communications (the astronauts were not told of the dangers to which they were exposed) and stonewalling (that is still an institutional response). The early testimony before the Commission was less than frank and truthful although the speaker would later explain that he answered the question asked -- and not the one that he knew was the intended question but which could not be properly phrased.

There are those who say -- 26 out of 27 is pretty good. 96.2962962% (it is fun having a 10-place calculator) is pretty darned good. Call it 96.3%. "You can't expect perfection."

But the Strategic Defense Initiative (SDI or Star Wars) as now being proposed will allow more than 3.7% of the Russian missiles to get through -- enough to assure destruction of most of the United States.

Can we assume that SDI will be 100% effective when no other massive computer system (all of which still involve humans) has ever been 100% effective?

Reprinted with permission from *Retailing Today*, May 1986, Vol. 21, No. 5, published by Robert Kahn and Associates, P.O. Box 249, Lafayette, CA 94549.

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Conversation With a Computer —Part 1

John Shore
c/o Viking Penguin Inc.
40 West 23rd St.
New York, NY 10010

"It is ironic but true that the computer's strict obedience to instructions is a constant source of frustration; it contributes to anxiety in the novice and anger in the veteran."

This article is based on Chapter 6 of *The Sachertorte Algorithm* by John Shore, copyright 1985 by John Shore, published by Viking Penguin Inc., 40 West 23rd St., New York, NY 10010; it is reprinted with permission.

Computers and Understanding

As an indicator of intellect, language can be misleading. Many small children pick up sophisticated phrases and use them in exactly the right context without the slightest idea of what they mean; their felicity can be confused with wisdom. Many foreign visitors speak halting English; their infelicity can be confused with stupidity.

So it is with computers. Many computer users encounter facile communications and they misjudge the underlying level of understanding. They are quick to attribute intellectual capabilities to the computer that it doesn't have and can't have. Other users find it enormously difficult to get a computer to do their bidding -- communicating is a constant struggle, which they lose as often as they win. They conclude that the computer's reputation as an effective tool is undeserved. "Computers are supposed to be so capable, but this one acts so dumb! " These two extreme reactions are both inappropriate for today's computers. The reactions result from expectations formed in conversations with people, expectations that make it harder to cope with computer anxiety and harder to use computers effectively.

When you use a computer to analyze a budget or write a report, you're engaged in a conversation of sorts, a conversation that takes place across a user-interface. But the language of that conversation is extremely limited, and the limitations can be a constant source of struggle and frustration. The limitations reflect technical and economic constraints, such as the speed of the CPU, the speed of the memory, the size of the memory, and the amount of effort devoted to user-interface design and software development. The limitations also reflect a lack of knowledge -- regardless of other constraints, we don't know how to program computers to interact in all of the ways that might be convenient and effective.

If you understand these limitations, you're better able to deal with them. Understanding can also head off some of the frustrations, especially those caused by expectations that carry over from conversations among people. Here is another case where anthropomorphic attitudes cause problems.

ELIZA Does Little

A computer program called ELIZA is perhaps the most famous example of misleadingly facile communication between people and computers. ELIZA was written in 1966 by the American computer scientist Joseph Weizenbaum. Weizenbaum was studying the use of natural languages like English in user-interfaces, and he wrote ELIZA to show that a relatively simple procedure can give the appearance of understanding. ELIZA mimics Rogerian psychoanalysts -- those who make their couch-resident patients do most of the talking. ELIZA can be pretty convincing, especially if you're receptive, and it quickly became popular. It's still popular. Versions of ELIZA and ELIZA-like programs abound (DOCTOR is another common name).

Naturally, when I was drafting these paragraphs I couldn't resist generating an example. So I had a few "conversations" with a version of ELIZA. The first three were pretty dumb -- few would find them convincing, I hope -- but I started falling for the fourth

one. Here is the transcript, exactly as it appeared on my terminal screen. The lines in the transcript alternate between my inputs and the progam's responses. The responses have no capitalization and no terminal punctuation marks, but the omissions aren't too distracting. I prefer to show it to you as I saw it. The transcript begins with my first input to the program:

My book is getting to be a major problem.

please continue, this may be interesting

It's all because of my problem with procrastination.

have you any other problems you wish to discuss

Well, of course I want people to like the book.

i am not sure i understand you fully

Well, I would just die if people think it's a stupid book.

do you think it's likely that people think it's a stupid book

I don't really know. But if they do, it would be agonizing.

do you wish that they do

Of course not! Do you think I'm a masochist?

we were discussing you – not me

Oh yeah ... I'm even more worried that I won't even finish.

please go on

It's the procrastination – I can't seem to control it.

what does that suggest to you

Perhaps I don't want to finish the book.

And so on.

ELIZA is a relatively simple program, without any pretensions of understanding either input or output, yet it can participate in some surprisingly cogent exchanges. It works by recognizing certain key words in the input sentence -- words like "problem," "if," and "you" -- performing some simple transformations on the sentence, and printing out the result or some stock sentence like "i am not sure i understand you fully." The program has some ability to remember special words or phrases that appear in the input. If it gets stuck later, this stored information enables it to stimulate further conversation with something like "tell me more about your mother."

ELIZA showed clearly that one can mimic intelligent responses without understanding the ongoing conversation. This wasn't really a surprise; as I mentioned already, we know that children can do it. Grown-ups do it too -- for example, to cover up during inattentive telephone conversations. Yet it was interesting to see that the behavior could be captured in a computer program -- often, writing a computer program serves to verify that we understand what has been automated. Besides, some of ELIZA's more effective conversations were surprisingly long.

Responses of Form without Content

The real surprise, however, was in people's reactions to ELIZA. People became emotionally involved -- Weizenbaum's secretary, engrossed in a conversation with ELIZA and feeling the need for privacy, once asked him to leave the room. Some people believed that ELIZA demonstrated a general solution to the problem of understanding English with a computer. And some psychologists even believed that the program could evolve into automatedd psychotherapy. These reactions to style without substance and form without content remind me of the Peter Sellers movie "Being There", in which society exalts the cryptic utterances of a well-dressed, elegant moron. The worst part about the reactions to ELIZA is that they occurred despite Weizenbaum's repeated explanations of the program's purpose and methods.

One can speculate at length about people's reactions to programs like ELIZA. Plausible explanations could be based on the psychology of conversation, on the urge to trust machines, and on the urge to anthropomorphize computers. Perhaps ELIZA attracts people by the technological aura of machine-dispensed wisdom. Whatever the reasons, ELIZA exemplifies the kind of facile communication that can mislead the novice user.

Do What I Mean, Not What I Say

Unlike children, dandelions, and cockroaches, computers do exactly what they're told. This may sound like a good thing, especially to those who are about to use computers for the first time. But a bit of experience, with computers or even with children, is enough to demonstrate otherwise. Having a child do exactly what you say is

not the same thing as having a child do exactly what you want. Most of us have experienced impish children who respond to instructions by choosing the most literal interpretation. You tell them to jump into bed and they do, nearly breaking the springs. You ask them whether they're happy or sad, and they say "yes." The first few times a child does this sort of thing, it's cute. Thereafter, it's annoying and frustrating. With a computer it's almost the same, the difference being that it's not cute even the first time.

It is ironic but true that the computer's strict obedience to instructions is a constant source of frustration; it contributes to anxiety in the novice and anger in the veteran. The main reason is that, while you may think you're instructing the computer properly, it's easy to get confused and issue either "illegal" instructions or legal instructions that do something other than what you really want. In short, your instructions don't always correspond to your intentions, but the computer goes right ahead and follows your instructions exactly. The result? Perhaps a cryptic error message, perhaps damaged information, perhaps a system crash.

Such problems plague all users, but novices are especially susceptible. They're ill-equipped to avoid trouble, and ill-equipped to get out of it. And when they encounter trouble, they tend to blame themselves; they interpret the designer's failures, the programmer's failures, and the computer's failures as their own. Veterans know more, and they can use that knowledge to avoid trouble and get out of trouble. Moreover, when they do encounter trouble, their egos are less likely to be damaged than their files. They remain secure because they understand how various failures can lead to trouble, and because they often understand what happened in a particular case. To the veteran, the trouble was predictable, at least in retrospect. To the novice, however, the predictable appears capricious.

Computers follow instructions, whether or not the instructions correspond to intentions. This fact is summarized by the following ditty, said to have appeared on the bulletin board in a room full of computer terminals:

> I really hate this damn machine,
> I wish that they would sell it.
> It never does quite what I want,
> But only what I tell it.

Courting Disaster and Winning

A large number of discrepancies between intentions and results are caused by confusion on the part of the user. Here's an example: I sometimes use a text-editing program that interprets what you type depending on which of two modes it's in at the time. When the program is in "insert mode," almost everything you type is interpreted as text to be inserted into your document. When the program is in "command mode," almost everything you type is interpreted as a sequence of commands for manipulating the text that is already in the document. My trouble is that I often forget that the program is in command mode, and I start typing some text I want added to my document. The program interprets every character as a command, with predictable but definitely unwanted results. Suppose, for example, that I move the cursor to a position between two particular words and type in 'deep', thinking that the word "deep" will be inserted into my document. Instead, the 'd' (in command mode) means to start deleting text; the 'e' means to move to the end of the next word; the 'p' means to put back in the last piece of text that was deleted. The result is to exchange the position of two words. Instead of inserting the word "deep", I reverse the order in which two words appear in my document.

It can get much worse. There is a story, probably apocryphal, told about another text-editing program that has separate input and command modes. According to this story, a hapless user wanted to type the word "edit" into his document. Unfortunately, the program was in command mode when he started typing -- the 'e' selected everything currently in the document; the 'd' deleted everything that was selected; the 'i' caused the program to enter insert mode; and the 't' inserted the letter "t". The result: the entire story was replaced by the letter "t". Sorry.

Easy Ways to Cause Catastrophe

The story may be apocryphal, but it isn't misleading. Computer systems abound with easy ways to cause catastrophic results. A famous example concerns a popular computer operating system (control program) called UNIX. Like any complete operating system, UNIX provides a way to delete files (without it, you would eventually run out of space). The command is called "rm" (for remove); to delete a file called "bookone", for example, you would type in the command 'rm bookone'; to delete the two files "bookone" and "booktwo", you would type in the command 'rm bookone booktwo'; and so on (the

file names are separated from each other by one or more spaces). If many files are involved, this can get tedious, so you're likely to take a shortcut and make use of UNIX's ability to accept a "wild card" -- a special character, in this case the asterisk (*), which stands for any possible sequence of characters. Thus, the command 'rm book*' deletes all of the files that have names beginning with the four characters "book." Unfortunately, people sometimes mistype commands like this and include an inadvertent space, for example 'rm book *'. This too is a meaningful command -- too meaningful. UNIX responds first by deleting the file "book" (if it exists) and then by deleting all of the files whose names match the wild card, i.e., every single file.

This really happens. UNIX is the operating system on one of the computers I use at the Naval Research Laboratory. The system manager told me recently that at least five people had come to him for help during the past year after inadvertently deleting all of their files in this way. Because he regularly makes backup copies of every file in the system, he had been able to restore many of the lost files. But some work was usually lost, and the experience was always annoying. Novice users find such experiences to be not just annoying, but unnerving.

Does the Punishment Fit the Crime?

If all your files are deleted because you type an extra space, then it's your own fault. But does the punishment fit the crime? The situation is somewhat analogous to that in a military aircraft cockpit where the bomb-release switch is placed, without a safety catch, next to the landing-gear switch. Similarly, if you forget the current mode of that text editor and scramble or delete existing text instead of inserting new text, that's your fault, too. But the mistake is a likely one, and you should be fair to share the blame with whoever designed the program to use separate input and command modes.

In fairness, let me mention that the designer of the text-editing program was responding to a built-in constraint -- the lack of special function keys on a standard keyboard. (Indeed, the disadvantages of modes are among the reasons why many word processors use keyboards with extra function keys or augment the keyboard with screen menus and a pointing device like a mouse.) The designers of UNIX were likewise responding to constraints -- they were striving for a small, simple but powerful operating system that doesn't protect users as much as it allows users to protect themselves. They succeeded, and the widespread popularity of UNIX is well-deserved.

In both cases, however, the user-interfaces make it easy to damage or destroy information. There are compensating advantages for veteran users. But the disadvantages can overwhelm the novice user, who is more likely to make mistakes and less likely to understand that the programs are just doing what they're told.

Obeying the Bugs

It was the eve of my mother's birthday, and we were on our way to a dinner party that my father was holding in her honor. Our destination was a restaurant in New Jersey to which we had never been before. My friend Susan and I were surprise guests, so it was important that we arrive before everyone else. We weren't worried about finding the restaurant, however, because we possessed typewritten instructions sufficient for a cretin leaving from the North Pole. You wouldn't believe how detailed these instructions were unless you either saw them or knew my father, who had written them. Reports on my father as a youth vary, but through some combination of predisposition, Czechoslovakian law school, and the British Army, he became a meticulous planner (psychologists have less flattering terms). When he writes down instructions, they tend to be complete, precise, and unambiguous. We make fun of his instructions, but we follow them.

On this particular night the unexpected happened: we turned right onto Route 9W, as instructed; we proceeded to the second light, as instructed; and we started to turn left, as instructed, onto what was supposed to be East Clinton Avenue. Only it wasn't East Clinton Avenue.

We did what anyone would do under the circumstances: we considered what the likely errors might be (Dad had either counted the lights wrong or gotten the street name wrong, more likely the first); we considered the obvious alternatives to getting back on track (turn left anyway and see if the instructions made sense without the street being East Clinton Avenue, or continue on 9W and see if East Clinton Avenue turned up soon); and we starting trying these alternatives. In particular, we continued on 9W and found East Clinton Avenue at the next light, where we turned left. From that point

on the instructions made sense again. My mother was pleasantly surprised, and we all had a good time.

The Computer Behaves According to Its Instructions

Had we behaved like a typical computer, however, we probably wouldn't have found the restaurant. We might have executed the left turn as instructed and continued to interpret the instructions as best we could regardless of where they took us until we either crashed, ran out of gas, or came to the end of the instructions at the wrong building. Or we might have stopped immediately at the offending intersection and put a white handkerchief on the car. Or we might have returned to Washington, D.C. -- our starting place -- and tried again. Had we been in an unfriendly mood, we would have driven to the nearest phone booth, called my father, screamed

JOB ABORTED ... FATAL REDUNDANCY CHECK

and hung up.

Like my father's instructions for finding the restaurant, computer programs don't always express what we want them to. The resulting behavior may be surprising, but it's predictable from the programs; like the examples in which there were discrepancies between users' intentions and their instructions, the computer's behavior is exactly in accordance with its instructions. Even when an error occurs because the computer hardware malfunctions, the resulting behavior is often just as predictable.

Unfortunately, although the result may be predictable, it can seem capricious. Moreover, the cause can be hard to see. Suppose that you try to print a document, perhaps with some printing options you haven't used before, and the system crashes, taking your document with it. Whom do you blame first? Chances are it's not your fault, but it takes self-confidence to question the validity of a slick user's manual. It may also be hard to pin down the blame. If you take the time to re-create the problem and try to understand what happened, you may fail because it's easy to overlook some of the circumstances that were involved. Something you or someone else did ten minutes ago may be relevant, but you don't realize it.

Checking for Errors Using Redundant Information

We got to the restaurant because we were able to detect and handle the bug in my father's instructions. Unfortunately, computer systems are not as adept as people at detecting, handling, and reporting the problems that arise from erroneous or misinterpreted instructions. There are really two issues here: first, detecting that something is wrong; and second, doing something about it. Error detection is accomplished in almost all cases by consistency checks that exploit redundant information. My father's instructions, for example, were redundant. Instead of telling us just to turn left at the second light on Route 9W, he added the name of the street and it was this redundancy that made us notice the error. The same approach is used in computer systems to detect both software bugs and hardware malfunctions.

Redundancy is used, for example, to detect malfunctions of computer memories. In a typical malfunction, some of the memory locations can become unreliable -- when the bit patterns are read from these locations, they may be different from the patterns that were written there. In effect, a number stored in the faulty location may change to a different number, or an instruction stored there may change to a different instruction. Analogous problems could have arisen with my father's instructions had I misread them or spilled coffee on them. Such memory errors are often detected using extra bits that store redundant information. In some computer systems, every 8-bit byte of the memory is accompanied by one more bit, called a parity bit, which is set to one or zero depending on whether the number of ones in the byte is odd or even. Whenever a byte is read from memory, so is its parity bit. If the byte is inconsistent with its parity bit, one of the two has changed, most likely the byte, and the computer system's software is so informed. Typically, the program then running is stopped and its user gets a message like

MEMORY VIOLATION ... PARITY ERROR AT A3F2

Finding Errors Through "Overflow"

Parity bits help to detect memory failures but not program bugs. Other hardware consistency checks, however, can pick up bugs. One example is the phenomenon known

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Remarks On US—USSR Trade

Mikhail S. Gorbachyov
General Secretary, Central Committee,
Communist Party, Soviet Union
Kremlin
Moscow, U.S.S.R.
December 10, 1985

"Both of us will survive without each other, since there is no lack of trading partners in the world today. But is it normal from a political standpoint? My answer is emphatically no. We simply cannot afford to neglect trade, economic, scientific, and technological ties."

Editorial Note: This is an off-the-trail article for *Computers and People* since it does not specifically say the word "computer" and since like many utterances of heads of states it may contain ambiguities. But so long as the U.S. government prohibits certain kinds of computer information and products from being easily marketed abroad and sold to any customer worldwide who can pay for them, and thereby detracts from IBM's long famous and truthful slogan "World Peace through World Trade", it is worthwhile to study important statements by important persons who are not subject to the U.S. government. The real world is a whole planet and a whole biosphere, and whether we like it or not, we have to live together. This is the reason why this statement, in English as issued by the U.S.S.R. Embassy in Canada, is printed here. We are very grateful for the exact text (not including the centered headings inserted by us) received from the U.S.S.R. Embassy in Canada.
– ECB

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"Statement by Mikhail Gorbachyov at Dinner to Honour the Participants in the Ninth Annual Meeting of the US-USSR Trade and Economic Council," December 10, 1985.

Ladies and Gentlemen, Comrades,

I am pleased to welcome in the Kremlin the participants in the annual meeting of the US-USSR Trade and Economic Council. We value the extensive activities in which the council has been engaged for ten years now in promoting contacts between American companies and Soviet foreign trade organizations. We value that fact particularly since, as you know, those were not easy years.

I also would like to address words of welcome to United States Secretary of Commerce, Mr. Baldridge. We appreciate his presence here.

Developing Cooperation

The current meeting provides another confirmation that it is quite possible -- and today, I would say indispensable -- to develop cooperation among people, nations and states having different social systems and different ideologies.

Whether we like each other or not, we will have to live on this planet together. Hence our most important task -- of which I spoke both in Geneva and afterwards -- is to master the art of getting along together. And since this situation will be around for quite a while, we have to learn to live side by side in a civilized manner, as befits human beings.

Ties

This brings me to the question of commercial and economic, as well as scientific and technological ties between the Soviet Union and the United States, or, put in more general terms, between East and West. We view those ties above all from a political standpoint. First this is because politics is the field where we tackle the main question of our relationship, namely, the question of war and peace. All other aspects of our relations, trade and economic ties including, should serve this overriding objective. Secondly, this is because our two countries are economic giants fully able to live and develop without any trade with each other whatsoever.

This, in effect, is the way things are right now. Look at the facts. In our trade exchanges the United States, the largest trade power in the world, ranks thirteenth, lagging far behind Finland, Belgium and Austria. We ourselves are in sixteenth place among US foreign trade partners. The volume of US imports from the USSR is roughly equal to what your country imports from the Republic of Ivory Coast.

Survival Without Each Other

I regard this as no economic tragedy at all. Both of us will survive without each other, particularly since there is no lack of trade partners in the world today.

But is it normal from a political standpoint? My answer is definitely and emphatically no. In our dangerous world we simply cannot afford to neglect -- nor have we the right to do so -- the stabilizing factors in relations such as trade and economic, scientific and technological ties. If we are to have a genuinely stable and enduring relationship capable of ensuring lasting peace, they should be based, among other things, on well-developed business relations.

Independence

In this day and age each country and nation -- the smallest as well as the big ones -- regard independence as their highest value and spare no effort to defend it. And yet we witness the growing interdependence of states. This is an objective consequence of the development of world economy today, and at the same time an important factor for international stability. Such interdependence is to be welcomed. It can become a powerful incentive in building stable, normal and, I would even venture to say, friendly relations.

The Dangerous Influence of Military Business

We are fully conscious of the complexity of the tasks facing all of us. I know that there are among you senior executives of companies that are prominent in American military business. Let me say frankly: We believe that military business exerts a dangerous influence on politics. In fact, we are not alone in thinking so. The very concept of the military-industrial complex was not formulated by Marxists, but by a conservative Rebublican, President Dwight D. Eisenhower of the United States, who warned the American people of the negative role that can be played by that complex.

The Common Sense of Some Members of the Military Business

I am not saying this to reproach those of our guests who have contracts with the Pentagon. They have come to Moscow, and we welcome that fact, which, as I see it, testifies to the common sense of some representatives of military business. It would appear to me that some of them, as well as the U.S. business community as a whole, cannot remain indifferent to the economic and financial consequences for the country of the excessive military expenditures as well as the consequences of a one-sided development of the economy caused by militarization.

As to the Soviet leadership, we are deeply convinced that cessation of the arms race serves the genuine vital interests of not only

the Soviet Union but also the United States -- if, of course, we are to address the crux of the issue rather than be guided only by the benefits of the moment accruing from any particular contract.

Learning to Live in Peace

Learning to live in peace -- and this, I believe, is the preeminent interest common to both of us -- means not only to refrain from making war. The difference between living in the genuine sense of that word and languishing in fear implies the development of varied contracts and cooperation, including trade.

Another reason why I believe that the development of trade and economic ties between our two countries is a political problem is that the main obstacles in their way are political rather than economic.

Most-Favored Nation Treatment

The first such obstacle is that the Soviet Union does not enjoy the so-called most-favoured-nation treatment. The term itself may be misleading, the impression being that it implies a particularly favourable attitude on the part of the United States to those granted such treatment. However, American businessmen know full well that this is not so. In practice the MFN treatment is no more than the absence of discrimination, primarily in custom tariffs. I have been told that about 120 countries enjoy the MFN treatment in the United States.

The Soviet Union is being denied that treatment. And this, of course, creates obstacles in the way of our exporting many kinds of products to the United States, making it impossible for us to earn the money needed to purchase American products. After all, we cannot endlessly earn foreign currency, let us say, in Western Europe while spending it in the United States; for our trade partners will simply not appreciate that.

The second problem is the obstacles we have to face in the United States as regards credits. I don't have to prove to you, experienced businessmen, that there can be no serious trade without credits.

Export Controls

The third obstacle is the so-called "export controls", i.e. bans on export of numerous products under the pretext that they can help in Soviet military production and thus prejudice U.S. security.

There is a wealth of speculation on that score.

I would like first of all to say this: the allegation that the Soviet Union's defense potential is based almost entirely on purchased Western technology and that it cannot develop without it is complete nonsense. Those who come up with that allegation simply forget what kind of country they are dealing with; they forget -- or want to make others forget -- that the Soviet Union is a country of big science and advanced technology, a country of outstanding scientists and engineers and highly skilled workers.

International Science and Technology

Admittedly, like any other country, we rely -- in military as well as civilian industries -- on both our own and international scientific and technological achievements and international production know-how. That's life; it is inevitable, as demonstrated by the example of the United States itself. It is no secret that, for instance, a leading role in the development of nuclear weapons and missiles was played, not by American science and scientists, but by European, including Russian and Soviet scientists.

The real facts of today, as well as the lessons of history, should not be forgotten. To put things in true perspective, let me recall some of those facts here.

It is a fact that the theoretical foundations of rocket technology were discovered and formulated by the outstanding Russian scientist Tsiolkovsky, that the basic theory of multistage rockets originated in our country and that the first experimental rockets and, finally, the first artificial satellite were launched by our country, too, to say nothing of the first manned space flight.

One can speak at great length about the contributions made by Russian and Soviet scientists -- from Mendeleyev to our time -- to the development of modern chemistry. Let me just mention the fact that of the transuranic elements identified since 1950, a half were discovered by Soviet researchers.

The major, and in many respects decisive, contribution of Soviet scientists to the development of chain reaction theory, light and radiowaves theory and the discovery of lasers, is also beyond dispute. Modern aerodynamics, very low temperature and very high pressure technologies, and almost all the technologies used in present-day metallurgy would be in-

conceivable without what has been done by the Soviet scientists.

For all that, we are not saying that American corporations operate on technologies stolen from the Soviet Union.

Development of Cooperation

Just like you, we are interested in the development of scientific and technological ties and cooperation, which is quite normal and legitimate. I want all of you in the United States to understand that the Soviet Union will not become a market for obsolete products, that we are going to buy only those items that meet high world standards. If the United States persists in its current policy, we will produce what we need on our own or buy it elsewhere.

Broken Trade Contracts

Another obstacle to the development of our trade and economic ties is the policy of boycotts, embargoes, "punishments" and broken trade contracts that has become a habit with the United States. You know what the results are: no particular harm has been done to the Soviet Union, while the commercial reputation of U.S. business and therefore its competitive position in the Soviet market have been seriously damaged. Our economic managers have lost confidence in the U.S. partners and therefore increasingly prefer other partners.

This is what happened with large contracts for the delivery of pipe-laying equipment and equipment for the Novolipetsk Iron and Steel Integrated Works and an aluminum plant in Siberia, to say nothing of oil and gas drilling and prospecting equipment, where the U.S. share in our purchase has currently fallen to less than half a percentage point. And, being better informed than I am of the existing situation in the world markets, you are aware of the fact that competition there is bound to become even more intensive in the foreseeable future.

No Independent Nation Desires to Beg

I will be absolutely frank with you: so long as those obstacles exist, there will be no normal development of Soviet-U.S. trade and other economic ties on a large scale. This is regrettable but we are not going to beg the United States for anything.

Should, however, those political obstacles be removed, then, I am sure, broad prospects would be open to us. We are not competing with you in the world market or in the United States itself; in this respect you have more problems with your own allies than with us. But we can become partners -- natural partners, who, I can assure you, will be honest and reliable.

New Forms of Factory Production can be Found

That will, naturally, require work on both sides, including better knowledge of each other's markets and an improved mechanism for economic cooperation. I am aware that we are not without fault here either. The USSR government takes a fairly critical view of our foreign trade organizations, too. We believe that new forms of production and scientific and technological cooperation can be found.

We are now engaged in a major effort in that regard with the socialist countries. We view greater economic integration with them as a most important task. We also intend to expand trade and other forms of economic cooperation with Western Europe, Japan, and the developing countries.

We would not want our economic relations with the United States to be left out of that process -- both for political reasons that I have referred to and for economic reasons as well. We have great plans for our economic, scientific and technological development. And for that we would like to make the fullest possible use of the additional opportunities inherent in international cooperation, including that with the United States. One can contemplate major long-term projects and numerous medium-size and even small business deals, which would be of interest both to giant corporations and to small and medium-size businesses. Provided that the situation is normalized and a sound political and contractual basis is established for the development of trade and economic relations, we shall have both what to buy from you and what to sell to you.

Sectors: Energy, Machine Tools, Agro-Industrial ...

We might suggest that US companies and businesses participate in our programmes of further developing the energy sector of our economy. We could also consider the possibility of giving American businesses and companies a share in our major effort to radically modernize machine-tool-building and other machine-building industries. Should American companies find it worthwhile, they might, perhaps, become involved in the work which is

under way in our country in the agro-industrial complex, in chemistry and petro-chemistry and in the production of sets of machines and equipment to introduce intensive technologies in land cultivation and stock-breeding.

All that, however, requires a display of political will. Economic relations have to be built on a long-term basis. Guarantees are needed that some political windchill will not once again begin to erode business ties.

The Wind Chill Factor in Politics, and Political Wind Chills

And now let me go back to politics.

This session of the US-USSR Trade and Economic Council is taking place just three weeks after the Soviet-American meeting in Geneva. This fact makes the current session quite special. As I see it, its purpose is to analyze potentialities for trade and economic cooperation between the Soviet Union and the United States and to see what should be done in the best interests of both Soviet and American peoples.

Geneva Meeting of Reagan and Gorbachyov

The realization of the fact that the present state of Soviet-US relations is unsatisfactory and dangerous was the main reason that brought President Reagan and myself to Geneva for our meeting and negotiations. I am sure that the President of the United States felt, as I did, that during those days the eyes of hundreds of millions of men and women, and even children, in our two countries and, in fact, in all other countries were focused on Geneva. And those eyes expressed both hope and anxiety.

I can tell you frankly that feeling all that was not an easy experience. However, neither myself, nor, I believe, the President thought it possible to shirk that enormous burden of human concerns and aspirations.

Bearing in mind how difficult the road to Geneva was, it may be said that some success was achieved there. It is, however, only a first step. And every step that may follow will require still greater effort, a greater readiness to listen, greater willingness and ability to understand and accommodate each other. And, what is most important, a willingness to learn the most difficult art of reaching agreements on an equal and mutually acceptable basis, without which we will never be able to solve any serious problem.

Putting American-Soviet Relations on an Even Keel

In other words, we have entered a particularly crucial period, when words, intentions and political statements should be translated into concrete decisions and action. What I have in mind, as you understand, are such decisions and such actions as would contribute to putting Soviet-American relations on an even keel and to general improvement in the world political climate.

Many US businessmen are known for their well-developed spirit of enterprise, a knack for innovation and an ability to identify untapped growth opportunities. I am convinced that today the best, genuinely promising possibilities of that kind are to be found not in pursuit of destruction and death but in the quest for peace and in a joint effort for the sake of equal and mutually beneficial cooperation among all countries and peoples. This is the essence of life, and benefits to be derived from it are indisputable.

Allow me to wish the US-USSR Trade and Economic Council success in its useful activities.

Thank you all for your attention. Ω

Newsletter – *Continued from page 27*

ing the current recession. It can cost a company between US$1m and US$2m to develop and implement an expert system.

Singapore's Minister of Communications Dr. Yeo sums up the dilemma of Singapore, and other small countries, when he says that the "biggest barrier we face is the lack of availability of AI users" which could create a demand for products and justify the expense of training people to supply them.

Consequently, David Waltz, senior scientist at Thinking Machines Corporation, one of the new American AI ventures, says that despite Singapore's advances in AI research full commercial exploitation is three or four years down the road.

Ω

Star Wars: A Paradox for Our Time

Les Allen
Deputy Rector
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London, England

"The biggest paradox of all ... is that of the image of Reagan as a peacenik. It was precisely Reagan's fear of the peace movement that led him to hijack its rhetoric and present his initiative in terms of defence and the abolition of nuclear weapons."

Reprinted with permission from *The New Scientist* of 1 May, 1986, published by IPC Magazines Ltd., London, England. This issue of *The New Scientist* is remarkably important for several valuable British scientific reports on the Chernobyl disaster and nuclear implications.

Paradox and Deceit

The world of disarmament, some would say politics as a whole, is full of paradox if not deceit. Even those who believe in the concept of deterrence agree that a few hundred nuclear warheads on each side would be sufficient to achieve it; yet both great powers possess tens of thousands of them. Most nuclear disarmers, let alone those inclined to pacifism, view the idea that nuclear weapons are there to keep the peace with a good deal more than a pinch of salt. As the graffiti has it, it is like copulating to preserve virginity.

A Speech that Came from Reagan's Heart

Yet star wars seems especially worthy of an award for the creative use of paradox. President Reagan's celebrated Strategic Defense Initiative (SDI) in March 1983, probably made against the wishes of most of his advisors except Edward Teller, was claimed to be precisely that: an initiative. George Keyworth, presidential science adviser, called it "...a top-down speech. A speech that came from the President's heart."

Reagan himself, speaking to schoolchildren in Baltimore, said "the hand of providence" inspired the speech. Yet within two years the programme was being presented not as anything new but as a response to years of Soviet activity and consequently a necessity if the US was to stand any chance of catching up. Yet no one on either side had ever claimed, as would have been entirely logical if such a programme were known to exist, that the USSR was making an initiative for peace, or, indeed, mounting a threat. The fact that Reagan has also spoken of giving the technology to the USSR when it is complete is just one more element of the paradox.

Essentially Unstable Deterrence

Many people have tried to rationalise star wars since Reagan's speech. They argue, for example, that deterrence is unstable and that opponents of star wars are really ingenuous proponents of deterrence who refuse to recognise that this is so. The essentially unstable nature of deterrence is not in doubt but, as any degree of deployment of star wars would be totally destabilising, the paradox of replacing a measure of instability with total instability is not an engaging one.

"A Leaky First Strike Invites Horrible Retribution"

Nor is that a full measure of the paradox. The initiative was to render "nuclear weapons obsolete" by providing a totally impenetrable umbrella. Yet by June 1985 Keyworth was saying that a "leaky dome...is more than effective enough as a deterrent against first strike -- which is our goal", and that "a first strike can only succeed if it destroys essentially all the enemy's retaliatory capability. Otherwise first strike invites horrible retribution." In other words, star wars does not replace unstable deterrence; it will allow deterrence to work. Yet deterrence is supposed to have kept the peace for 40 years and star wars was devised to replace it as a policy.

Although star wars is often presented as defensive, any system which could absorb a measure of first strike and then retaliate lends itself, as even Geoffrey Howe, Britain's

Foreign Secretary, has realised, to being seen as offensive. The USSR recognises that star-wars technology would enable the US to make a first strike and then rather effectively mop up "ragged retaliation" from intercontinental ballistic missiles launched from silos or submarines missed in the onslaught. Yet Reagan, in his original speech, said, even more paradoxically, "If defensive systems were paired with offensive systems they could be regarded as fostering an aggressive policy, and nobody really wants that."

Capturing the Imagination of the American Public

Reagan's speech, of course, captured the imagination of the American public. The idea of ridding the world of nuclear weapons and of enabling the US to "intercept and destroy strategic ballistic missiles before they reach our own soil" was, and is, immensely appealing. Jerome Grossman, president of the Council for a Liveable World, a group of scientists opposed to nuclear weapons, says that all public opinion polls give positive support for Reagan's stated goals. Americans are inclined to support star wars when it is described as a defensive system. "The US public prefers assured defence to mutually assured destruction, but even more it prefers an agreement which would ban nuclear weapons from space."

Margaret Thatcher has argued that Reagan gave her satisfactory undertakings concerning the SDI at their meeting in December 1984. However, although it was already clear that the US administration had no intention of honouring three out of four undertakings, Thatcher jumped the gun on her European allies not only by endorsing the programme but by offering to put British scientists at its disposal.

Caspar Weinberger's Contribution

In particular, Reagan undertook that the deployment of a system related to the SDI would have to be a matter for negotiation with the Soviet Union as a signatory of the antiballistic missile (ABM) treaty. But on 6 November last year he said that, if the Soviet Union did not agree to amend the ABM treaty to permit the deployment of a space-based defence system, he would go ahead and deploy it anyway. Caspar Weinberger, the US secretary for defence, has said: "I am ruling out the possibility of giving up on strategic defence either in the research stage or if it becomes feasible in the deployment stage."

For its part, the British government claims that it wants to maintain the ABM treaty and objects to work by the Soviet Union on the Krasnoyarsk phased-array radar system. Meanwhile, it allows Fylingdales to be developed and argues that the treaty permits research. Distinguished lawyers, such as Abraham Chayse of Harvard, argue that it does not.

The early promise that European industry would benefit greatly from research for the SDI shows little sign of realisation. This is not too surprising: as Grossman has written ("The Politics of Star Wars," Council for a Liveable World, 1986): "Western Europeans may not be bamboozled much longer with promises of lucrative contracts for star-wars technology. Since this is a weapons project, it is by necessity classified and, as Lieutenant-General James Abrahamson [chief of the SDI programme] has said, the allies will only be able to do unclassified work."

Another paradox comes from the argument, very prevalent in the US last summer, that a defensive umbrella will allow a negotiated reduction of nuclear arms. Yet the SDI programme was the major obstacle to progress at the summit meeting in Geneva last November. In any case, as Lawrence Freedman, professor of war studies at King's College, London, has said: "It would be easier to get Soviet agreement on a straightforward arms reduction than to the construction of a complicated new balance between offensive and defensive systems."

Scientific Paradoxes

The paradoxes are not all political: the world of science plays its part too. The scientific lobby against star wars got off to a good start in the US, with many distinguished scientists being associated with it. Unhappily, though, Pitt-River's maxim of 1888 -- "This is an age of science and we should listen to the voice of the scientific men; they are our instructors. They see the affairs of the world from a higher standpoint than political men who are merely wire-pullers and self-interested partisans" -- does not stand up very well.

Physicist and science writer Jeremy Bernstein, reviewing William Broad's book "Star Warriors" (Simon and Schuster, 1985) in "The New York Times", said that Broad was "not able to find a single scientist" who would say that a leakproof nuclear umbrella could be built. That matches my own perception, except that I do know some who believe that

it is necessary to carry out a research programme and who have no worries about whether or not research is allowed under the ABM treaty. Yet Abrahamson claims that opposition to star wars among scientists is confined to a "few diehards". In fact, some 2500 members of science faculties, in the US have signed petitions opposing the initiative.

Ten Million Times Heavier

A trivial, even banal, paradox in the circumstances is that a prime contender in star wars is an X-ray laser powered by a nuclear explosion. The idea is that the laser could contribute to an invulnerable system as it could be thrown into space only when the need arose. Words of caution in "Science" last November tried to suggest that tests on the laser had not been as successful as was first thought. But this did not stop Gerold Yonas, chief scientist of the SDI, trying to get additional funds for the project. Nor did this come as any great surprise because, without a nuclear device to provide the energy for the laser, the payload that would have to be "popped" into space would be ten million times heavier. The world might in some way be said to be rid of nuclear weapons, but the same can hardly be said for space or for the upper atmosphere.

Almost amusing in the context of scientific debate is that, a year or so ago, computer scientists were arguing that it would be intrinsically impossible to construct a testable, workable, computercode for a defensive missile umbrella. My fear has always been that individual devices, particularly laser devices and especially nuclear-pumped ones, could be made to work. But others have argued that this did not much matter as, given dodging, non-cooperating, decoy proliferating, hardened, fast burn-out boosters, a sustainable defence system would not be achievable. Indeed, Ashton Carter, who prepared a report for Congress's Office of Technology Assessment in April 1984, helped by every official organisation in the US, concluded: "The prospect that emerging star-wars technology, when further developed, will provide a perfect or near-perfect defense system...is so remote that it should not serve as the basis of public expectation or national policy about ballistic missile defense."

"The Whole is More Reliable than Its Parts" ???

Last December, however, Charles Seitz and Soloman Buchsbaum, of AT&T Bell Labs, and Danny Cohen, of the University of Southern California, turned the argument on its head. Buchsbaum argued that the network as a whole is more reliable than its individual components. To be fair, he did not claim that a totally leak-proof missile-defence system could be built, but he did think that it would be possible to design a system that would be "reliable, robust, and resilient". By building in redundancy, a system could be designed that would, "like the telecommunications network", be much more reliable than its components. Seitz, meanwhile, said that although he would not sign a statement opposing or favouring star wars he would sign a statement saying that adequate computer software could be designed.

This is not the place for a critical analysis of the rapid way in which the betting odds on the technological options for star wars have changed over the past two years. Space-based chemical and excimer lasers, for example, considered hot-favourites a year or so ago, are thought to have blown their followers' money in the ante-post stakes. But, in the spirit of paradox, it is worth quoting William Sweet, of "Physics Today", who made the following remark on the development of an antisatellite weapons system (ASAT): "It would be quite an irony if the weapons type that was generally thought of as the nation's future ASAT -- infrared homing vehicles based on Earth -- instead turned out to be based in space as the nation's principal ABM system, and the technology that was generally thought of as the basis for star wars -- lasers based in space -- turned out to be based on Earth as the nation's principal ASAT."

The Most Savage Paradox

Perhaps the most savage paradox is that those who argue that research is necessary and permissible, but who oppose deployment, may not be able to do anything to stop deployment if the research is successful. If that happens, the ABM treaty will be in ribbons and destabilisation inevitable. As Grossman puts it: "Anyone who has studied the ineffectual effects of Leo Szilard, James Franck and Albert Einstein to prevent the atomic bombing of Hiroshima can have little hope that a decisive weapon that works will not be deployed." Yet quite a number of government scientists in the US take the inconsistent view that a workable system is not possible, but that research should be carried out while deployment should not be allowed. I was a good deal less than popular when I attacked this standpoint as naive at a Pugwash Symposium last December.

(please turn to page 22)

Computer Language and Mystique

Ellen Pate
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"The mystique around computers borders on the taboo ... and is perpetuated by the exclusive use of computer language when talking with one another."

Teaching Lawyers, Nurses, and Drop-Outs

I used to teach adults how to read and write. Now I teach them how to use computers. I teach lawyers, nurses and high school drop-outs how to enter data, run specific software and program in BASIC. I've come to see myself as a translator, or liaison between computer specialists and non-specialists. It surprises me that lawyers, nurses and people with extensive nonacademic experience need a translator for something as simple and straightforward as computers, but they do for several reasons.

Intimidation

The mystique around computers borders on the taboo. I have seen numerous competent people say, "I'm just afraid to touch the thing for fear I'll do something wrong." This timidity is repeated at each new perceived barrier, i.e., "I'm afraid to hit enter until I know I've done everything right" or, especially, "I'm afraid to turn it off for fear that I'll lose everything I've done." Fear of the new and unknown accounts for some of this awe and hesitance, but having gotten to know these people pretty well in the course of several weeks association, I would wager that when they learned to drive, went to college or graduate school, if they did, got married, had children, started or changed jobs, they did not do so in such a coy or timorous manner. Something more than newness and the unknown is intimidating these people.

Outlandish Jargon

The mystique of computers is perpetuated -- to whose advantage? -- by our exclusive use of computer language when talking with one another and with those who specialize in other fields. When I say computer language, I do not mean Cobol, Fortran or Assembler. I am talking about words like "boot," "bite," "chip," and "peripheral" -- words which are particularly difficult for novices because they know these words from other contexts. I am talking about the alphabet soup of abbreviations like DOS, I/O, CRT, CPU, ASCII, ROM, and RAM. And I'm talking about computer specific words like "modem," "baud," "dot matrix," or "hard and floppy disks."

Computer specialists who recognize the rudeness of speaking quickly or in slang before novices to the English language, or who feel embarrassed by those who do not accommodate to the hearing-impaired, often do not seem to recognize the similar exclusivity of their specialized form of communication, their outlandish jargon. To put the issue in their own language, even documentation specialists, manual writers and trainers have an interfacing problem. If these same people received an error message for every blank look or a "file not found" for every shrug of the shoulders of non-specialists, they would devote vast amounts of time, energy and concentration to improving their program or completing their network. But because these statements are in polite human language rather than in any language of a CRT, computer specialists at best ignore them and, much worse, treat such responses as uninformed, unenlightened and vague.

Tone

The purpose of the information revolution is to make an immense amount of information available and comprehensible to people who had not had access to it before. However, many of the communications experts are a bottleneck in this process. If pressed to respond to these accusations, computer

specialists might offer two truthful observations: 1) what they are saying is very clear to them and to those with whom they work most extensively, and 2) what they are saying is too complex to be comprehensible to novices. These are "User Friendly Fictions," which are soothing to their speakers, but which evade the issue at hand -- the failure of specialists to communicate well with non-specialists. These hypothetical observations explain, to some extent, the tone that non-specialists have sensed again and again from manuals and documentation of all sorts.

Tone, in the Thirties, meant a writer's or speaker's attitude toward the audience. In the more alienated Eighties, tone has come to mean the writer's or speaker's attitude toward the subject of the work. In the former sense of tone, computer specialists, whether programmers, engineers, documentation specialists, sales people or technical support teams, often do not seem to have focused on their audience at all. It is part of the stereotype of the computer specialist that he or she has poor social skills, not technical skills or grammar skills, or organizational skills, but social skills. In the more contemporary sense of tone, the people charged with explaining computer use and potential often end up explaining the computer or the software itself, usually because they find it more interesting and easier to explain. To most end users, how something happens or why is of little use and may only be overwhelming. What happens and the uses it can be put to outside the computer are much more tangible and pertinent to them.

Debugging Human Communication

How can busy, well intentioned, well informed, computer-literate people debug their human networking programs? For some, debugging is mainly a matter of empathy, remembering their own early days of learning the customs of the ADP tribe. To others -- those for whom learning computers was easier than drinking a glass of water -- empathy would have to be rooted in remembering a situation where learning something was more arduous.

Slowing down the Baud Rate

A simple thing to do to improve networking skills is to check and adjust baud rates. Apparently, humans learn at a slower baud rate than that in which they converse or compose or state information they already understand. We have to have time and sometimes repetition to let something "sink in" as if into the quicksand of our consciousness. Slowing down without being impatient or condescending can be difficult for busy, top-down, get-done people. But, if your goal is really communicating computer capabilities to the point where the user becomes fairly self sufficient, then slowing down, establishing an atmosphere where people are not afraid to try to articulate what they do and do not understand can, in the long run, be the most efficient use of time.

Learning from Hands-On Mistakes

Learn to appreciate the pedagogical benefits of letting those with whom you are working make their own mistakes in asking questions or learning hard or soft ware. Don't jump in to "fix" something without being asked to by the user. Half of what they have to learn is how to recognize problems as they are occurring. The other half is how to fix the problems themselves. Of course I am not suggesting that trainers stand by while novices frustrate themselves unto violence. I am saying that repeated interruption of the learning process damages concentration and impairs confidence. In fact, this kind of hovering involvement can foster a permanent dependence on trainers when trainers' obvious goal should be their own obsolescence. Reaching over a keyboard to "just do this quickly for you," shifts the user's intake of information from a tactile level to the less effective visual level. What the trainer knows to be an easy three key sequence, the user may only be able to see as near magic. Hands-on training has to be the user's hands, not the trainer's.

Answering the Intent of the Question

Questions are difficult for computer novices to ask. They aren't sure if what they are inquiring about has to do with the software, the input, the hardware or the operating system and often they only vaguely understand the implications and overlaps of each of these. They are not sure what they are asking but they are sure they are asking it in a language they don't comprehend well. It is at the critical juncture of answering customers', students', or users' questions that computer specialists have gotten their worst reputations. We tend at this point to answer their questions with the same mindless literalism the CPU uses on our programs, good or bad. Especially if we are unfamiliar with the contexts in which our programs, manuals, hard or soft ware are being used, we must learn to listen between the lines. We

must learn to hear a variety of implications, depending on who is talking, in words and phrases we know too concretely to be able to use flexibly ourselves.

Often at this same critical point of answering questions we perceive to be vague or poorly stated, we err on the side of information overload in order to cover everything in the general area of the topic of the question. Few end users and almost no novices are as fascinated by future possible applications of design capabilities as specialists. This is unfortunate for the end user and makes the specialist's job of designing, altering, and communicating technical options and potential particularly difficult, but it is, by and large, a fact of human networking life. In my ten years of teaching thousands of people, I am finally convinced that there is no such thing as a stupid question. There are poorly worded questions, vague questions, and unwittingly repetitious questions, but the fear in people of asking a dumb question is so overwhelming that most people truly believe that they are doing the best they can with a topic before they will risk asking a question. When someone is struggling to ask what seems to them a complicated or difficult question, the very worst thing we can do is respond with too much information. When people feel overwhelmed, they lose the ground from which to ask even simple questions.

"The Public is a Frustrating Beast"

One of the main symptoms of the relatively new syndrome called Technostress is the tendency to feel much more at ease "conversing" with a computer or word processor than with actual people. We all have days when this is true because the public is and always has been a frustrating beast. The individuals who make up the public are often idiosyncratic, preoccupied by their own business, and unwilling to focus the kind of attention it takes to communicate clearly about the issues at hand. But we also make up the public and so share these same often unattractive traits. What we must remember at all times, especially the most frustrating times in improving our human networking program, is what the situation looks like to the non-specialists, i.e. what files are available to them in their role as learner/user. Any time we attempt to build on information that is unavailable or inaccessible to the situation, we guarantee ourselves more of the stereotype of the computer specialist who can't speak English.

Usability from the Customer's Point of View

Efforts to improve communication and encourage confidence in end users are especially cost effective as the ADP market weathers another of its down cycles. John Young, President and CEO of Hewlett Packard, said in the March-April issue of "Computers and People","...the challenge remains for all of us to translate increasing hardware power into usability from the customer's point of view. It's a task of immense proportions." Fortunately for all of us in our past and for those of us who spend noticeable amounts of time trying to communicate about computers, the excitement and empowerment that comes with gaining new knowledge and new skills with computers is contagious. The energy of the successful human interface situation, whether in marketing, administration or technical support, is at least as satisfying as the clean efficiency of a successful program or project. It is worth the effort to debug your human interfacing programs.

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Allen – *Continued from page 19*

Reagan's Fear of the Peace Movement Led Him to Hijack its Rhetoric

The biggest paradox of all, however, is that of the image of Reagan as a peacenik. It was precisely Reagan's fear of the peace movement that led him to hijack its rhetoric and present his initiative in terms of defence and the abolition of nuclear weapons. Sadly, nothing that has come out of it since has been of much value to the real peace lobby, let alone the prospect of arms reduction as a route to peace.

Patrick Wall, the MP for Beverley, contributed to the debate about star wars in the House of Commons in February. He spoke of "a small nuclear generator which produces the laser" and of "radar particle beams". In the first case, he meant a nuclear explosion, while in the second case he was talking about scientific hogwash. The paradox here, or do I mean irony, is that I know a lot about lasers, and have followed the star wars issue closely since its inception, but did not speak in the debate because I got wiped out by Nicholas Soames when I stood as a Labour candidate for Crawley at the last general election. A rotten world, the world of paradox.

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Computing and Data Processing Newsletter

"STAR WARS" FACES A STRUGGLE FOR CREDIBILITY

Based on a report by Fred Kaplan
The "Boston Globe"
135 Morrissey Blvd.
Boston, MA 02107
May 18, 1986

WASHINGTON - The Reagan Administration's Strategic Defense Initiative, the missile-defense program widely known as "star wars" is facing deep trouble in the area where it needs the biggest boost -- credibility.

Last week, the quicksand thickened, as a petition was presented to Congress containing the names of more than 6,500 scientists -- 3,700 professors and senior researchers, 2,800 graduate students and junior researchers -- who have pledged not to accept money for SDI research and, furthermore, to "encourage" their colleagues to follow their steps.

Shortly afterward a private survey was released, indicating that 92 percent of the members of the National Academy of Sciences are opposed to SDI, and that 98 percent do not believe an SDI system would provide an effective shield against a Soviet nuclear attack.

Official reaction to this skepticism has only burrowed the administration into a slightly deeper hole. Donald Hicks, under-secretary of defense for research and engineering and thus the man in charge of dispensing $42 billion in research and development funds next year, threatened -- in an interview in "Science" magazine -- to cut off all defense money to SDI foes.

"If they want to go out and use their roles as professors to make statements, that's fine, it's a free country," Hicks said. But "freedom works both ways. They're free to keep their mouths shut...I'm also free not to give the money."

"Tough time with disloyalty"

Hicks, a former vice president of Northrop, one of the top weapons manufacturers, continued, "I have a tough time with disloyalty...My money is overall specified to be given to people who feel the same kind of urgency that I feel...When a guy stands up and gives an interview and goes on television (in opposition), somehow he's not one of us... I don't see why I should make his life easier."

Scientists at universities, who pride themselves on their independence, tend to rankle at this sort of pressure, and become still more rancorous in their dissent.

Hicks is not the first high-ranking official who has threatened to take away research contracts from universities housing critics of controversial weapons programs.

In the early 1970s, under remarkably similar circumstances, President Nixon, trying to push the Safeguard Anti-Ballistic Missile system, was frustrated by a group of highly regarded scientists who told Congress and the public that the system would not work. In response, Nixon tried to take defense-research money away from the Massachusetts Institute of Technology because several of the scientists opposed to the missile system resided there.

Nixon's wishes were never implemented, partly because too many officials in the Pentagon were opposed to the notion and partly because the director of the budget office at the time -- George P. Schultz, presently President Reagan's secretary of state -- simply ignored the order, which came down through Nixon's henchmen, Robert Haldeman and John Ehrlichman.

Nevertheless, the pressure was felt. Recalls Jerome Wiesner, then-president of MIT and one of the leaders of the scientists against the ABM, "Many people at MIT felt very threatened. Many people were muted in their protest of the ABM because of that. And several asked me to tone down my protest as well."

Pressure might grow

The pressures might grow still stronger under the Reagan Administration because of three factors. First, the Office of Management and Budget now tends to be more pliant

to military requests. Second, the chieftains of the Pentagon, men like Donald Hicks and Defense Secretary Caspar Weinberger, are very keen on SDI -- to the point where, for nearly three years now, internal criticism of the basic mission of the program has been explicitly banished.

Third, from the beginning, the managers of the SDI program have viewed public relations as a vital element of their success, and they have viewed the prospect of scientists hopping on the bandwagon to be a vital element of their public relations.

Last year, the SDI managers established an Office of Innovative Science and Technology, the mission of which would be to involve universities and small businesses in exploring basic research needed for the breakthroughs that an SDI system would require. The director of this new office, James Ionson, said at the time, "This office is trying to sell something to Congress. If we can say that this fellow at MIT will get money to do such and such research, it's something real to sell."

Ionson's publicly uttered thoughts on this strategy were all too clear. "People go where the bucks are," he said. "There is a lot of money involved here...Even if someone is not an [SDI] advocate, there's still a lot to be gained -- a lot of good science and the opportunity to perform that science."

A bold statement

But Ionson got too bold for his own good. In May 1985, a press statement he released announced that MIT and the California Institute of Technology had joined a consortium of universities working on SDI. The presidents of both institutes denied the claim. It turned out that some faculty at MIT and Cal Tech had individually received contracts, but Ionson was suggesting the schools themselves had endorsed SDI -- and that bristled.

Ionson remained undeterred in his enthusiasm, however, and told "The New York Times" in July, "Virtually everyone on every campus, wants to get involved."

It was these sorts of remarks that galvanized physicists, initially at Cornell University and the University of Illinois at Urbana-Champaign, to organize a campaign of explicit dissociation from the SDI program and its policies -- and that led to the petition of 6,500 last week.

When Ionson was asked whether he thought the boycott by some of the nation's first-rate scientists would impede progress of the SDI program, he reportedly replied, "Two second-rate scientists are as good as one first-rate scientist."

QUESTIONS AND ANSWERS ON OPPOSITION TO "STAR WARS"

Based on a report by Fred Kaplan
The "Boston Globe"
135 Morrissey Blvd.
Boston, MA 02107
May 14, 1986

Here is a Globe interview with James R. Melcher, professor of electrical engineering and director for the Laboratory for Electromagnetic and Electronic Systems at Massachusetts Institute of Technology. Melcher was one of four scientists at a Washington news conference yesterday presenting a petition signed by more than 3,700 senior science professors and senior researchers pledging to do no research on the strategic defense initiative program.

Q: How did you come to sign the petition?

A: It didn't come all that easily. As a lab director, I was very concerned about the relationship between myself and my colleagues. I signed it personally because the SDI is clearly a political thing, an escalation in the arms race, the pretext for elevating weapons in space. I am not a unilateral-disarmament type. I am very aware that there is in Russia a group of people that have to be dealt with realistically.

Q: Does your lab have other defense contracts?

A: My lab has a total [annual] gross of $3-$4 million. Department of Defense funding is about 15 percent. I should say, back in the Vietnam War period, I was prowar. I truly came from a conservative background. I would regard myself yet as a conservative. I just don't buy crazy people. The word crazy means you cannot distinguish fact from fantasy. That's what [the SDI program] is.

Q: The administration says it's just a research program, to see if building a shield to protect the population from nuclear weapons is feasible. What's wrong with that?

A: Well, this is pushing the notion of research. They're building things.

Q: But what if it has a chance of succeeding?

A: There is no chance whatever. That has to be very clear. Because if you put up in space a mirror like they're talking about [to bounce and direct laser beams to their targets] and then all [the Russians] have to do [to destroy it] is throw up a bucket of sand in a retrograde orbit -- I mean, what's the point in that? It is so destabilizing it's unbelievable, that you'd depend on something that's that easily wiped out."

Q: Labs often get lots of money for projects that go nowhere. Why do you so object to taking money for SDI?

A: If something is never going to be built, it's not engineering. What a blind alley. What a horrible thing to work on. It's not engineering. The well-educated engineer is somebody who understands that human factor, the human need. Certainly it is not [someone who] goes through some exercise where he develops and makes something, and even puts it into orbit, that never serves any purpose ...

[Someone in the lab] is working on integrating rotating machines-motors. He has the state-of-the-art motor for making robots. He's doing it for a small company that's so thin that they use this professor to develop their machines. He has infinite opportunity [to work on SDI], but he won't.

Q: So the SDI office is being deprived of someone who might really, at least on a gadget level, help them along?

A: I just can't begin to see it in those terms. I see it the other way. Do you realize what it would mean for the motors in your washing machine, your dryer and your dishwasher to be sold to us by the Japanese? There are more than 100 of these [types of motors] in every home. [US companies] buy them from the Japanese now. A student who came back the other day from [General Electric] was telling me about the semiconductors, a computer, a motor, an integrated machine. And I said, "Where are you going to get your rotating machines?" He said, "The euphemism is 'offshore'" -- meaning Japan. A buddy of his just quit GE and went into teaching out of disgust. He'd been offered a 20 percent raise to go to GE's new [SDI] rail-gun facility. A facility for this, drawing on the same pool of resources which they've told everybody clearly they're going to get from the Japanese now. This is GE.

Q: In other words, they could have used their resources to set up a facility to build a better motor instead?

A: Yes, if they wanted to take a hard route. Profits wouldn't be so large. SDI is the pied piper for industry. But without the larger picture -- improving our competitive position in the world, industrially -- they're going to die.

Q: What kinds of things does your lab do that could be applied to SDI if you wanted?

A: Pulse power supply. It can be used as a high electric energy storage element for driving a laser -- a weapon. Or it can be used to make a better transformer.

Part of my lab is the high-voltage laboratory developed by John Trump. John over a period of three decades would be approached by people of all sorts because he could make megavolt beams of ions and electrons -- death rays. What did he do with it? Cancer research, sterilizing sludge out there at Deer Island, all sorts of wondrous things. He didn't touch the [weapons] stuff.

Q: What's your main reason for objecting to SDI? Do you think it doesn't work, that it's immoral, diverts from your vision of socially productive work?

A: Yes, all of that. I saw the other day that it would cost $100,000 for a computer that could tell you what organs were available across the country. We don't have one. So a woman's child died for lack of that. There's no money for it. Somehow that doesn't come through to the public in this country. We in our culture think we have resources that are infinitely rich, so we squander them away. It's beyond our experience to understand there is a limitation, and it's going to come to a grinding halt. Unless we tighten up and go straight, we're going to see it.

SINGAPORE PUTS BRAINPOWER BEHIND THINKING MACHINES

Based on a report by Stephanie Yanchinski
"The Financial Times"
10 Cannon Street
London, E-C-4 England
April, 1986

Singapore has set out on an ambitious course to become a world-class centre for research into artificial intelligence (AI). But it faces a number of barriers if it is to achieve its goal.

The country has wide-ranging plans to upgrade its computer expertise from mainly parts assembly to the design of "thinking machines" at the very forefront of computer technology.

Central to this strategy is Singapore's new S$21.5m Information Technology Institute, due to be completed in October. This will serve as a centre for applied research and development in all aspects of information technology. It will closely collaborate with industry, and artificial intelligence rates as a top priority, with its own special laboratory.

ITI will also gather together research groups currently scattered throughout government agencies. In addition it is planned to launch new undergraduate programmes for AI training, and strengthen postgraduate research by inviting the best of foreign experts to teach.

The aim is to turn Singapore into a first rate centre for computer software design and win a share of the lucrative market in computer programs. At the same time Singapore mandarins see AI as a tool for boosting industrial competitiveness, and a key to its cherished aim of becoming a "knowledge centre" for south-east Asia.

Dr. Yeo Ning Hong, Minister for Communications and Information and himself an expert in AI, told a recent gathering of AI experts that artificial intelligence "is essential to our role as a knowledge broker."

Artificial intelligence involves the application of the principles of human thought to computers. This converts simple "number crunchers" into thinking machines capable of matching or even bettering the best human experts in certain narrow areas.

Sales of AI hardware and software topped US$700m, in 1984, according to a new study by merchant bankers Rothschild. The new found commercial success of AI is largely due to innovations in software called expert systems. These sophisticated software programs endow computers with the ability to mimic human thought.

Expert systems are not "free" thinkers. They work to set "rules," compiled from interviewing human experts about how they think. However, the mechanical boffins also depend on "heuristic" reasoning, sometimes called the art of good guessing.

Like human beings, the thinking computer builds up knowledge through experience. This enables it to tackle complex problems which cannot be solved using conventional computing.

Artificial intelligence is further advanced in the West and in Japan, where these expert computers help treat cancer, search for mineral and oil deposits, and help run steel mills and petrochemical refineries.

In the business world financiers are beginning to rely on expert systems in a variety of ways, from planning long-term capital investments, to making snap decisions on equality dealing. One prototype program even assesses the political risks attached to international investment projects for wary insurance underwriters and international loan merchants.

However, artificial intelligence could be equally important to newly industrialised countries (NICS) rimming the Pacific Ocean, such as Singapore.

The "NICs" see it as one way to compete against bigger industrialised countries, by carving out special market niches. Prof. Edward Feigenbaum, computer scientist at Stanford University and keynote speaker at the recent meeting of AI experts in Singapore, said: "Artificial intelligence is ideal for a small nation such as Singapore. It requires no imports, as it is based on people's knowledge."

The Information Technology Institute will initially have a pool of 40 computer professionals who will be transferred from the existing Joint Software Engineering Programme between the National Computer Board and the Ministry of Defence. There will also be an advisory panel of international authorities.

The final programme remains to be worked out. But it is likely that ITI scientists will apply AI to solving practical problems in established industries such as shipping, transportation and financial servicing, as well as the growing telecommunications business.

Expert systems would be able to organise container loading and storing at Singapore's busy port more efficiently, for example, and save many thousands of dollars a day.

Singapore also hopes to win its share of the future market for AI equipment and

software which the American consultancy firm Arthur D. Little predicts will jump to US $200bn by the end of the century.

The Joint Software Programme has already brought one expert system, POSE, close to commercialisation. Picture Oriented Software Environment is a tool for systems analysis, which can be taught in an hour.

The most lucrative application involves developed generic "shells" which could be tailored to fit a variety of industrial applications. At the moment it costs between US$60,000 and US$80,000 to purchase a single copy of AI software.

For instance, Rubicon, another product of Singapore's AI research under development, is a generic product for automating the production of expert systems for many industries including transportation and financial servicing.

Singapore is also eyeing the huge untapped market for Chinese language programmes. At the ultra-modern Institute for Systems Science, IBM's Dr. Ifay Chang is leading a small team which is close to perfecting a Chinese version of Prolog, a popular AI software, which will find applications in designing Chinese expert systems.

However, China itself offers strong competition, says Edward Feigenbaum, as interest in artificial intelligence increases. Two years ago the Chinese Association of Artificial Intelligence boasted over 1,000 members.

Singapore faces other hurdles in developing AI into a fully-fledged business. Dr. Don Walker, a computer scientist at Bell Communications Research, points out that there is such a world wide shortage of AI experts that American industry "has had to resort to inhouse training. Singapore will have even greater difficulties in finding the right people."

Dr. Vincent Yip, head of the Singapore Science Council, disagrees, saying that the foundation for AI training has already been laid through joint research projects between Singapore research institutes and IBM, Britain's ICL and the Japanese company NEC.

Another problem, that of where Singapore will find a market for its AI products, may be more intractable, however. The region is not ready to use AI, and local industry, with the exception of aerospace, is suffering dur-

(please turn to page 16)

The Sachertorte Algorithm

And Other Antidotes to Computer Anxiety

by John Shore

John Shore offers the perfect "recipe" (based on his aunt's famous sachertorte) for the fear, anxiety and suspicion that computers inspire in almost everyone. With wit, style and vision, Shore explains the workings and wonders of new machines – from the basic to the unimaginably complex.

"A humane and sensible book ... a highly lucid illustration for the benefit of the intended lay reader." – Los Angeles Times

"One of the very few books which I would recommend to the interested layman. It is full of information and ... wisdom about computers. Above all, it is intellectually honest – a rare phenomenon." – Joseph Weizenbaum, author of *Computer Power and Human Reason*

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Opportunities for Information Systems

– Instalment 4

SOUND TO SPELLING

Edmund C. Berkeley, Editor

Every person must learn in one (or more than one) language how to recognize each sound (or phoneme) that carries meaning in that language. We must also learn how to spell those sounds in each of the languages that we need to use.

For example, in English we need to learn the sound "f" as in "fat" or "muffin" or "if", and we need to learn the spellings of the sound, which can be "f" or "ff" or "ph" as in "physics" or "gh" as in "cough".

I remember as a kid having no clear understanding of the difference in the French sound "e" as in "le" (with lips relaxed) meaning "the", and "eu" as in "leur" (with lips poked forward) meaning "their". My French-speaking mother made me pronounce a great many French words correctly; but I did not acquire the underlying idea until as a teenager in college I found out about phonemes in general.

Also I remember the shock I felt when finding an American boy 10 years old to whom I had to teach the difference between the sound of "e" as in "bed" or "set" and the sound of "i" as in "bid" or "sit". He had never been taught by his teachers in public school to listen to and catch this sound difference, and he had spent SIX years from kindergarten to 5th grade without noticing it or his teachers noticing it! This was the result of the "look-say" method of teaching reading that has prevailed in public schools in the United States for more than 40 years, as a result of which the United States is now 49th in literacy, and sinking lower and lower. This drop has created a "Pentagon" of bureaucracy, consultants, and businesses in remedial reading.

A great many parents and teachers want their kids to enjoy reading, writing, books, literature, history, and the world of thoughts, designs, and ideas. For this objective there can be a very simple machine. The machine is programmed to speak sounds (the 43 in English or the 16 in Hawaiian or the 40 in Russian) one by one. The machine has a keyboard of letters. When the machine utters the sound "s", the keyboard is frozen except for the letter "s" which when the kid presses it types the letter "s". This is the beginning problem for the kid, and then the machine and the kid take off, for the other sounds and letters. A loving teacher or parent should be at hand to help in possible confusions; but the great bulk of the chores of one-on-one teaching of reading and spelling can be accomplished by such a machine. Many, many variations of such a machine would be possible, sensible, and marketable.

The market for such machines should be in the billions of dollars all over the world. Ω

Games and Puzzles for Nimble Minds and Computers

Neil Macdonald
Assistant Editor

NUMBLE

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away, and a second one in the digit cipher. The problem is to solve for the digits. Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, expressed in numerical digits, is to be translated using the same key, and possibly puns or other simple tricks.

NUMBLE 8607

```
      N A T -
*     U R E
  -----------
    L L L U
  N N D N
L U A E
-----------
= L T S R D U
```

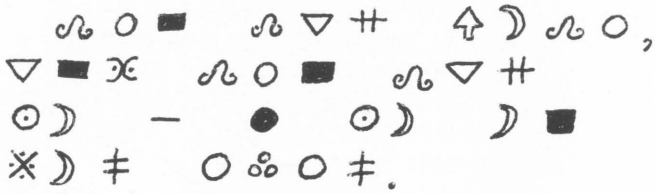
TW = HU

1 1 4 2 3 0 9 9 4 6 7 4

MAXIMDIDGE

In this kind of puzzle, a maxim (common saying, proverb, some good advice, etc.) using 14 or fewer different letters is enciphered (using a simple substitution cipher) into the 10 decimal digits or equivalent signs, plus a few more signs. The spaces between words are kept. Puns or other simple tricks (like KS for X) may be used.

MAXIMDIDGE 8603



SOLUTIONS

MAXIMDIDGE 8605: In hell there are no fans.
NUMBLE 8605: Old saws tell truth.

Our thanks to the following persons for sending us solutions: Leon Davidson, White Plains, NY – Maximdidge 8605; T.P. Finn, Indianapolis, IN – Numble 8603, Maximdidge 8603. Ω