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COMPUTERIZED "FERTIGATION" IN ISRAEL: PRESENCE VS. ABSENCE

The Computer Almanac and Computer Book of Lists — Instalment 37

Neil Macdonald
Assistant Editor

82 TOPICS IN DATA COMMUNICATIONS IN A DEREGULATED NETWORK ENVIRONMENT (List 840701)

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2 ASSERTIONS ABOUT THE TOP-RANKING PROBLEM IN THE COMPUTER FIELD (List 840703)

"Let us examine our attitude toward peace itself. Too many of us think it is impossible. But this is a dangerous, defeatist belief. It leads to the conclusion that war is inevitable -- that mankind is doomed -- that we are gripped by forces we cannot control.

"We need not accept this view. Our problems are manmade -- therefore they can be solved by man. And man can be as big as he wants. No problem of human destiny is beyond human beings. Man's reason and spirit have often solved the seemingly unsolvable."

-- John F. Kennedy, 1963, President, U.S.A.

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computers and people formerly *Computers and Automation*
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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.

Editorial Note: We invite articles on the subject of computers and nuclear weapons. Computers (and the computer people who work to make nuclear weapons work) are an essential ingredient of the nuclear evil.

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

— ECB

Front Cover Picture

The front cover shows dramatically what a difference recent Israeli farming techniques and computerization can make. Drip irrigation pipes, managed by computer, help land in the left of the photograph to produce abundantly, while untended land to the right remains arid. The pipes deliver water and water-soluble fertilizer in amounts and at times determined by computer. This "fertigation" method is one of many ways in which computers are helping Israeli farmers. For more information, see page 26.

Announcement

Since Sept. 1981, when we last increased our subscription price, the cost of printing, mailing and producing "Computers and People" has risen continually. Therefore, we now need to raise the subscription price. This increase will be effective Sept. 1, 1984. The new subscription rate will be: U.S.A., $18.50 for one year, $36.00 for two years; elsewhere, please add $7.00 per year.

To receive "The Computer Directory and Buyers' Guide" issue also, please add $20.00 per year to your subscription rate in the U.S.A., and $23.00 per year elsewhere.

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Editorial

The Missing Applications of Computers and Reasoning

Edmund C. Berkeley, Editor

It is no longer difficult to apply computers and reasoning for the benefit of many organizations and groups in society, such as businesses, government, universities, the military. But there are very great problems in applying computers and reasoning for the benefit of all of society.

Any one who reads the newspapers, listens to the radio, or watches television, becomes aware of hundreds of ways in which human society is struggling with unsolved problems. Here is a brief list of a few huge problems:

- Nuclear war and nuclear winter. The amount of disaster, destruction, and freezing from even a small portion of exploded nuclear weapons in the stockpiles of the nations will dwarf every former human tragedy.

- Unemployment, waste of lifetime. In a great many countries, large fractions of the people are not able to find work in return for which they can subsist.

- Oppression and destruction of liberty. According to the recent publication of Amnesty International, "Torture in the Eighties", 98 countries in the world use torture to compel people to submit to government, to suppress dissent.

- Population expansion. The prospect of increasing population resulting in billions more of people -- "standing room only" -- is steadily approaching.

- Environmental collapse. People everywhere are converting million-year accumulations of forest, soil, minerals, oil, and more into piles of trash and waste.

Computers can be applied to these huge problems of social concern. Just like pencil and paper. Just like the minds of people, their attention, and their emotions.

But none of these useful attributes and accompaniments of intelligence are applied in the absence of drive, resolve, push, action.

In an important article in the Feb. 1984 "Scientific American", Nathan Keyfitz, professor emeritus at two universities, reports on how the Communist Party of the People's Republic of China is facing up to the problem of population increase. China now has, per 1982 census figures, about 1.008 billion persons. The Party has also calculated that 1.2 billion people is the carrying capacity of China, and has undertaken to control the increase of people. Measures include free contraceptives, contracts of family planning for married couples, rewards for one child families, punishments for families having too many children, and more. Certainly a tremendous amount of discussion, argument, teaching, suasion is going on in China about family and number of children. The problem is being faced.

We do not find in the United States this sort of effort devoted to solving huge problems. As if by design, a very great amount of the discussion here, the news, reports, broadcasts, speeches, deal with selling, buying, marketing, entertainment, events of momentary interest, and so on. This discussion does not seek to face problems of critical importance and motivate solutions. It is as if an edict had been operating:

- Distract. Confuse. Forget.
- Let Big Brother decide. Only Big Brother knows what is good for you.
- If you are unhappy, listen to music, or play games, or watch television.
- Let the days flow by -- you will never miss them.
- If you are still unhappy, consult one of Big Brother's accredited psychologists -- he will adjust you.

There is a name for this sort of philosophy, program, guide to life:

ABDICATION

Another and much older name is:

FATALISM

And another name is:

SUCCUMBING TO LAZINESS

And there are more names besides.

But there are more than 150 countries in the world, and everywhere there are persons, even if in a minority, who welcome work on the important problems, become devoted, and do not say "Fate is against us."

As Vadim Orlov says in an article in this issue on search and rescue using global satellites, communications, computers, and international cooperation:

"The desire of governments, brilliant engineering know-how, and the global scope of the proposed solution permit the gaping holes in the organization of rescue operations to be filled for the first time in history.

"The people of the twentieth century are not fatalists, and with their unity, will meet the challenge of the elements head on."

It is difficult to feel proud of the government of the United States when many other governments in the world, including the superpowers, the Soviet Union and the People's Republic of China, are dealing with massive projects of great human significance, like population control, and vast production of inexpensive beepers for global search and rescue operations -- while the U.S. seems to be concentrating on putting nuclear Pershing and Cruise missiles into Europe, pointed at the Soviet Union.

What is needed instead is the cultivation of friendly relations and friendly understanding of different cultures. No one can understand a country like the Soviet Union without remembering the 20 to 40 million Soviet people who died as a result of three wars, 1914-18, 1918-23, and 1941-45. No one can understand a country like Israel without remembering the 7 to 11 million deaths of Jews under Hitler's Nazis 1933-45.

Computer people, who are leaders of a vast change in handling information, need to think about and understand the missing applications of computers and reasoning for the social benefit of humankind.

Ω

Artificial Intelligence Applications for Business

Walter Reitman
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"For many very practical people, artificial intelligence is no longer science fiction. Like space, it has begun to be part of the real world."

This article is based on Chapter 1 of the book "Artificial Intelligence Applications for Business" by Walter Reitman and 21 other authors published by and copyright © 1984 by Ablex Publishing Corp., Norwood, NJ 07648, and is reprinted here with permission. The references in this article to all later chapters have been omitted here for the sake of concentrating on ideas.

Contents

In finding out how artificial intelligence can be applied in business, it helps to begin with some background. What is artificial intelligence? Who does it, and why? How did it get to where it is today? What kinds of problems does it deal with? What has it produced so far?

The business world has become interested in artificial intelligence both as a new way of approaching old problems, and as a tool for doing things that could not have been done before. The best known examples are natural language interfaces and expert systems. But other, less visible, applications may prove equally important.

Introduction to Artificial Intelligence

The first part of this introduction outlines a few main themes, goals, and historical trends in artificial intelligence (AI), and makes some educated guesses about how AI applications for business are likely to develop over the near future.

One thing to realize about AI is that it is not really so novel as today's newspaper and magazine coverage might suggest. The first published AI papers appeared almost thirty years ago, and interest in AI applications has waxed (and waned) several times since then. Current attempts to develop AI applications certainly are much broader and more intensive than any previous ones, and though reach may once again exceed grasp, no one this time expects AI to revert to its former status as an academic curiosity. Yet if AI applications are here to stay, it is not primarily because of any radical new achievements in AI itself. All the hard old problems are still there. Instead, the conditions have changed. The universities now have produced sufficient numbers of skilled, experienced AI researchers to make business investment in human AI resources feasible. Senior people in the field have become deeply involved in the marketing and funding of AI applications. Radically decreased computing costs now make AI applications economically viable. And finally, we are seeing what in the language of the seventies would be termed a general raising of consciousness in the business and financial communities about the potential benefits of more intelligent hardware and software. For many very practical people, AI is no longer science fiction; like space, it has begun to be part of the real world.

The next thing to realize about artificial intelligence is that it is a child of very mixed parentage.

Scratch an AI applications knowledge engineer and you may find a computer scientist with a background in the theory of algorithms, a psychologist trying to understand how people see patterns or solve problems, a linguist interested in subtle points of grammar, or even a logician-philosopher whose ambition is to express all knowledge in a predicate calculus. Add to this the normal variations in human temperament, from the wild-eyed optimist who sees the distant future around each corner, to the pessimist who can't see anything going anywhere, ever, and you begin to see why the AI applications arena is as lively and confusing as it is.

In trying to understand AI, it also helps to know a bit about how it has developed.

We can usefully recognize three main stages of development:

Stage 1	Conceptual Analysis and Small Systems	1955-69
Stage 2	Prototype Systems	1970-80
Stage 3	Commercial Applications	1981-

The overwhelming fact of life of the first stage, from 1955 through about 1969, was the limitation on computer resources. In a day when 4000 words of core memory was all you had, it is easy to understand why conventional computer scientists shook their heads at the first list-processing language, which sacrificed as much as half the available memory in order to link up data elements into free-format dynamic structures. Because of computational restrictions, limited systems were all you could hope for. The trick was to decide whether any given system blazed the beginning of a potentially promising trail, or instead led to a dead-end.

Though these limited systems usually had little practical value, they did serve two important purposes. They demonstrated the feasibility of artificial intelligence, and they provided ground for some very sophisticated analyses of basic issues.

Stage 2 in the evolution of artificial intelligence saw the first significant prototype systems, notably in the area of natural language processing. Winograd's system was restricted to a simple toy world, and Woods's LUNAR program was limited to data on the composition of moon rocks. But within their restricted domains, both were remarkably good at understanding and answering quite complex questions in ordinary English. As these examples suggest, much of the technical base for today's stage 3 applications was laid down during the 1970s.

Results So Far

Another approach to understanding artificial intelligence is to ask what it has produced so far. One answer, in very broad outline is:

- Programming languages and programming environments

- General methods, concepts, and technical tools

- Explorations of fundamental problems

- Vehicles for representing complex, nonnumeric knowledge

- Systems that actually do useful work

We may begin with the programming language LISP.

LISP has several features that make it a natural tool for AI work. It allows unconstrained tree structures. Thus the programmer never need specify, or even know in advance of execution, exactly what his or her data structures are going to look like. LISP was designed to facilitate the symbolic or nonnumeric data processing essential to artificial intelligence systems. It uses the same basic representation for program and for data, thereby making it easy to treat one and the same data structure as something to be analyzed or to be run. LISP also provides a good basis for defining higher-order knowledge representation formalisms, e.g., frames. And, finally, the typical LISP installation provides a highly interactive and extremely powerful development environment. This makes it a great deal easier to explore and modify ideas and to develop new systems than is the case when working in a language like PASCAL.

Much less visible than LISP, but almost as important, are the general methods, concepts, and technical tools AI researchers have developed. These include procedural ideas, such as matching, backtracking, generating and testing, as well as knowledge in depth about key technical problems and what to do about them.

Take the problem of dependencies, for example. If we are trying to improve our ability to play chess, we have to be able to relate the ultimate outcome of a game to events occurring much earlier in the course of play. If we are trying to program a planning system for a robot, it must be able to work its way back from dead-end plan outcomes to earlier hypothetical states of affairs. And if we are attempting to build an expert system that can explain its conclusions, it must be able to relate intervening states in the reasoning process to one another.

In the earlier stages of AI's development, such problems tended to be dealt with in isolation. Gradually, however, researchers became aware of the common elements underlying the particular cases. As they did so, they began to build up a body of concepts, for example, the notion of "truth maintenance," together with collections of generalized methods for dealing with the common problem in whatever context it appeared. This in-depth knowledge of general problems and what to do about them has become a basic element of the analysis and design aspects of "knowledge engineering."

Even in areas where much less progress has been made, AI investigators have developed a substantial informal understanding of the basic problems underlying the discipline. Learning and adaptation are a case in point. Although there are no generalized AI learning systems in any useful practical sense, investigators have learned a great deal about what the problems are, and have built up useful techniques for some interesting special cases. Here as elsewhere, basic and applied AI research are linked. The basic researcher needs to understand the hard problems in order to solve them eventually, and the applied researcher needs to understand them in order to avoid them while developing systems for immediate practical application.

One of the important ways in which AI systems differ from conventional computing is that they usually deal with "knowledge" in addition to "data" or "information." And one of the most significant outcomes of AI research is the collection of vehicles it has created for representing knowledge. These include logic-based formalisms, rule-based production systems, frames and schemas, procedural representations, and even analogical vehicles. What exactly these terms refer to in any particular case is not something we want to get into here. But there is a related practical problem: how to select from the repertoire of knowledge representations the most likely to be appropriate for a given applications problem.

AI Applications Areas for Business

For many, of course, the most interesting and important results to come out of AI are the individual applications possibilities it has produced.

Probably the most visible AI applications programs are the expert systems. A really expert expert is by definition a rare bird, and from his employer's point of view he has drawbacks. He can get sick, or die, or be bought off by a competitor. Thus, replacing the human expert with an expert program, something that will work reliably round the clock, and can be replicated at will, is obviously a very attractive idea. But figuring out how to do that is much less obvious.

We referred earlier to two old AI systems that were able to handle natural language inquiry. These days, the building of natural language systems and interfaces for commercial use has become another quite active AI applications area. These systems use a variety of approaches.

Many expert systems have been built, but few have been exposed to the kind of intensive in-house testing given an expert system called R1, which is a configurer for assembling, coordinating and completing orders of VAX computing systems received by Digital Equipment Corp. R1 is one of the very few expert systems that actually works day in and day out in an industrial setting, with no ifs, ands, or buts.

Database formalisms sometimes are viewed as knowledge representation schemes, but they are much more restricted, and restrictive, than the AI varieties mentioned above. Furthermore, if they are to be used really effectively, most of the intelligence typically has to be supplied by the user. But current database technology is a very well-established part of today's management information systems (MIS). Thus it becomes interesting and important to investigate how AI techniques might be applied to improve database usage and performance.

Decision support systems are another prominent feature of the current MIS landscape. They range from simple Visicalc models all the way to the huge integrated systems used by large corporations to assist in capital budgeting and planning.

Finally, no survey of the reasons for business interest in AI would be complete without some discussion of robotics. In particular, future developments in robotics are likely to draw very heavily upon AI research in perception and planning.

Trends for the Future

Every discussion of AI applications should have a few guesses about trends for the future and what happens next. And here are mine:

- Funding

- Understanding the strengths and weaknesses of expert systems

- Towards intelligent assistants

- The reemergence of no-holds-barred AI systems.

- Unattributed diffusion

As for funding, we can distinguish three distinct sources: First, large corporations will increasingly fund AI groups, either as distinct entities, or else as part of expanded and redefined information systems staffs.

Second, we also will see more AI software houses, backed by venture capital from various sources. These will be staffed with smart systems people who have the advantage of their familiarity with the new AI concepts and tools. Remember, however, that in the last analysis they are building and marketing software. Thus we should expect them to follow the same developmental paths and be subject to the same market forces and market opportunities as other software developers and suppliers.

Finally, the last main source of funds is the government, in particular through such agencies as DARPA and the R&D funding units of the military. The amounts and the problems targeted no doubt will vary with changing political and economic conditions, and the relative magnitude of government funding may decrease as the private sector funding of AI applications grows. But in view of the perceived importance of AI to the military, and to the national economy generally, we should expect this source to stay strong.

As experience with various types of AI applications grows, so should our understanding of their strengths and weaknesses. When we consider a potential expert system application, for example, we should now know enough to ask at least the following questions. (a) How rare are solutions to the problem, and how are they distributed? (b) How decomposable is the problem? (c) How formalizable is the knowledge? How much is rule-based? (d) How difficult is it to acquire the knowledge? (e) How much noise, or error, is there in the knowledge base? R1, for example, may work as well as it does because acceptable VAX configurations are not particularly rare, because the configuration problem is highly decomposable (at least once you have figured out how to do it), and because all of the requisite know-

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Rescue Operations by Global Satellite Cooperation

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"Ask any radio operator — who among them has not experienced tense moments when the silence of the emergency frequency is suddenly disrupted by a desperate SOS coming from a distant oceanic expanse or tundra area?"

Reprinted with permission from the April 1984 issue of *Soviet Life* Magazine.

Three Airplane-Crash Victims in Canada Survive!

In the history of rescue operations, the fall of 1982 is regarded as the beginning of a new era. One dramatic rescue occurred in September 1982 when three Canadians flying a light Cessna-172 that had crashed in British Columbia, Canada, were rescued. It was the first operation of its kind to use an artificial Earth satellite to locate an accident site.

The satellite in question was the Soviet Union's Cosmos 1383, and its launching in the summer of 1982 signaled the start of a global service providing aid to people in distress.

Rescuing the three Canadians was especially critical because the aerial search undertaken immediately after the plane disappeared brought no results. However, the signals of their emergency radio buoy were fortunately intercepted in orbit and a rescue party was able to find them. The crash victims all sustained serious injuries -- one had even slipped into a coma -- but tragedy was avoided.

"British Columbian Air Crash Victims Owe Their Lives to Soviet Sputnik," "Soviet Sputnik Has a Good Ear" and "The COSPAS-SARSAT System Proves Its Usefulness" were the news headlines of the day. "Time" magazine even referred to the incident as a miracle of the space age, and the Soviet sputnik, which had the prosaic serial number 1383, a hero.

International Rescue Project: U.S.S.R., U.S.A., Canada, France

However, to communications experts in four countries -- the USSR, the U.S., Canada and France -- it was no surprise. For several years they had been implementing the international rescue project COSPAS-SARSAT. COSPAS is the acronym for the Soviet part of the satellite system used in search and rescue work. It is completely analogous to the American, French and Canadian SARSAT (Search and Rescue Satellite-Aided Tracking) system. Both parts of the project can act independently or hook up and work as a single unit because of the well-coordinated technical capabilities. And it is now a reality thanks to a quadripartite intergovernmental agreement.

25,000 Ships Sailing Every Day

What did the creators of the program base their project on? On statistics. Every day some 25,000 ships sail the world's oceans and seas. Ships belonging to the Soviet Union's merchant fleet alone visit 120 countries and call at over 1,400 ports. In addition air travel has reached an exceptionally high level.

Unfortunately, with the increased air and sea traffic the possibility of an accident cannot be precluded. Just ask any radio operator. Who among them has not experienced tense moments when the silence of the emergency frequency is suddenly disrupted by a desperate SOS coming from a distant oceanic expanse or tundra area?

2000 Shipwrecks Per Year

The tragedies are numerous, and people have always shuddered when they spoke about them. The stories today are, perhaps, becoming even more horrifying. Only a part of the sad statistics are the nearly 2,000 shipwrecks annually. Also, often a disaster at sea or in the air hits unpredictably and suddenly. In approximately one per cent of the cases the victims do not have time to radio a distress signal. Even if one is sent, the radius of commonly used emergency transmitters does not exceed several hundred miles. In addition, the coordinates of a disaster cannot always be accurately determined, and the search sometimes is fatally delayed. The amount of time a person can survive in the ocean is generally considered to be only three to seven hours.

Distress Signals Received by Satellite and Retransmitted to ...

Fortunately, a distress signal can be received by satellites in orbit immediately despite the region from where it originates. Working jointly, the experts from four countries decided that low-orbit satellites are best suited for this purpose. They reasoned that the distress signal would certainly reach one satellite at least. Capable of receiving up to 200 of such signals, the satellite can retransmit them to one or even several receiving stations. Since the stations are all interlinked, the signals quickly reach the particular national rescue services.

Reception Stations in Moscow, Toulouse, Ottawa, and 3 U.S. States

The global concept became reality when a network of ground receiving stations was set up. One of these facilities is located in Moscow's Teply Stan district. Rescue satellite-aided tracking equipment has been installed there. Any incoming information is displayed on the screens of visual monitoring devices. At the same time it is automatically recorded on paper. The equipment can process up to 10 distress signals during one passage of the satellite. A computer then locates the coordinates of the site.

Similar stations in the SARSAT system have been built in Toulouse, France; in Alaska, California and Illinois; and in Ottawa, Canada. Thanks to a common language -- a kind of "electronic" Esperanto -- distress signals are understandable to all operators in the global search and rescue system. As previously mentioned, the system began functioning in the summer of 1982 with the launching of Cosmos 1383. On March 24, 1983, a second Soviet satellite, Cosmos 1447, joined the system and on March 28, 1983, a third orbital craft, this time one belonging to the United States, was added. Experts agree that the COSPAS-SARSAT system has entered a stage of demonstration and assessment. Its beginning was a complete success and subsequent events have confirmed its usefulness and effectiveness (see the partial list of rescue operations during the period from September 10, 1982, to April 26, 1983, which follows).

Countries Asking to Join: Norway, Sweden, Finland Britain, Japan

Interest in the rescue system has grown and now other countries, including Norway, Sweden, Finland, Great Britain and Japan, have asked to join. For example, Norway has already built its own receiving station at Tromso. The following story reveals what this system means for individual people.

The Story of the Trimaran GONZO

When three American sailors began their dangerous voyage across the North Atlantic Ocean, they were prepared for any situation. But they never thought that their lives might depend on a Soviet COSPAS-SARSAT satellite. In the early part of October 1982 the three men set sail from a port on the coast of North America for Great Britain in a 15-meter trimaran the "Gonzo", which had been designed and built by one of the men. The purpose of the trip was their subsequent participation in a trans-Atlantic race.

Not too long into the voyage, just 300 miles off the far eastern extremity of the U.S., their trimaran capsized during a heavy storm. The members of the crew weren't too frightened by the accident because they were all seasoned sailors. And within a half an hour they had put on their survival suits to avoid exposure.

One of the men located an emergency radio buoy on the overturned craft and switched it on. The first person to hear the signal 12 hours after the mishap was a pilot of an American airplane on a routine flight from New York to Madrid, Spain. After approximating the distance from the distress signal with his radar, the pilot reported the location to an air traffic control center on Long Island, New York. Twenty-eight minutes later another pilot reported receiving a distress signal, but his coordinates differed from the previous ones by about 300 miles. Both signal locations were forwarded to a coordinating rescue center of the U.S. Coast Guard.

The COSPAS-SARSAT satellite system was already in a trial stage so the U.S. Coast Guard sent a request to the American center of the system located at Scott Air Force Base to check whether the Soviet satellite Cosmos 1383 had received the distress signal. Indeed, the satellite had received the signals from the "Gonzo" radio buoy as the satellite passed over the site and by that time it had already determined the "Gonzo's" whereabouts five times. Now the difference between the coordinates was less than 50 miles. The relatively low accuracy in determining the coordinates, which, nonetheless, proved sufficient to find the people in distress, was explained by the faintness of the buoy's radio signal and choppy seas.

When the whereabouts of the trimaran were determined, the U.S. Coast Guard asked all ships in the vicinity of the craft to go to its aid. The first ship to respond was the U.S. tanker, the "California Getty". It changed its course and set out toward the "Gonzo". Then an American container carrier, the "Ace", headed for the area. The U.S. Coast Guard ship "Vigers", which was 85 miles west of the Trimaran, also received an order to go to the craft. All three sailors were brought aboard this vessel. About 31 hours had elapsed since the accident, but only 18 hours since the start of the search and rescue operation.

"The people of the 20th century are not fatalists."

The COSPAS-SARSAT system will be fully operative soon. The desire of governments, brilliant engineering know-how and the global scope of the proposed solution permit the gaping holes in the organization of rescue operations to be filled for the first time in history. The people of the twentieth century are not fatalists and with their unity, they will meet the challenge of the elements head on.

Some Expert Opinions of COSPAS-SARSAT

Experts from different countries believe that the international space search and rescue system has proved its usefulness.

Yevgeni Atserov, chairman of Morsvyazsputnik and director of COSPAS: Until recently a reliable system for search and rescue operations at sea has been technically unfeasible. Artificial Earth satellites on duty in orbit have opened up such an opportunity. In addition, to provide a ship in distress with prompt aid its precise location is needed, but this has not always been possible to ascertain. The solution to this problem is the COSPAS-SARSAT program.

Thomas E. McGunigal, program manager of SARSAT: By October 15, 1983, 86 inhabitants of North America and Western Europe had been rescued with the aid of this space system. As a rule, they were pilots and passengers of small aircraft or people in tiny vessels and pleasure and other boats. It is precisely to Cosmos 1383 that most of the rescued citizens of our country and Canada owe their lives.

Donald McKinnon, Canadian representative in the International Coordination Group for COSPAS-SARSAT: Before COSPAS-SARSAT was put into operation, we spent over 130 million dollars on search and rescue operations annually. Our share in the present project is 11 times less. Such is the economic aspect of the project.

Vladimir Nakaryakov, director general of Yeniseineftegazgeologia: Providing geological exploration groups working in the tundra -- especially under conditions of the polar night -- the taiga, the mountains and the deserts with special radio buoys has made their jobs safer and has saved hundreds of thousands of rubles that had been spent annually on unforeseen search and rescue operations.

Mass Production of Improved Radio Buoys in the USSR

Erlen Pervyshin, USSR Minister of the Communications Equipment Industry: The beacon of hope for people in distress is the new radio buoy that is already in mass production at Soviet factories. This device weighs only 4.5 kilograms, but it has two transmitters. One of the transmitter's signals determines the coordinates of the disaster site and transmits encoded reports about the type of accident, the national identity of the plane or ship, and so on. The other broadcasts signals on the conventional emergency frequency of 121.5 megahertz and orients rescuers to the area in bad weather or at night.

Partial List of Achievements

Cosmos 1383 has been on orbital duty since July 1, 1982, Cosmos 1447 since March 24,

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What We Can Do to Avert Nuclear War

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"The greatest danger now is not the weapons but people making mistakes."

Editorial Note: This important article was published March 25, 1984, in "Parade". We are fortunate to be able to reprint it with the permission of Dr. Ury.

Two Sources of Nuclear War

Nuclear war can happen two ways: by cool calculation or by runaway escalation. The public debate and official discussions dwell mostly on war by design. Yet, unintended war through the uncontrolled escalation of a crisis is by far the more likely scenario. To prevent nuclear war, we need arms control; but just as much, we need crisis control.

Today, the United States and the Soviet Union each has marshaled enormous military forces poised to strike. Fearing total mutual destruction, the two sides are talking, but gingerly, suspiciously, and sometimes very little. The truce has lasted more than 30 years, but at any moment an accident, a miscalculation or a regional conflict could trigger the war no one wants.

Focus on Weapons

Fascinated by the awesome destructiveness of a nuclear bomb, we have focused on the weapons themselves. Should we freeze them? Should we reduce them? Should we even increase them? Yet, with 50,000 weapons in the arsenals, even a radical reduction to half would not save us if war broke out. It would take only a few hundred to destroy America, if not the world.

Focus on Mistakes

The greatest danger now is not the weapons, but people making mistakes. We can stabilize the weaponry so that no sane leader deliberately starts a nuclear war, but, in times of intense crisis, can we control the human factors of miscommunication, miscalculation, stupidity, panic and organizational snafus?

Too many paths exist by which an unexpected nuclear crisis could erupt -- and they are gradually multiplying. The superpowers could become embroiled in their friends' wars, as in the Middle East. Missiles might be fired by accident or without authorization. A "mad" leader with a few atomic bombs, believing that his nation or terrorist group would be better off without the superpowers, might detonate a bomb in an American city, hoping thereby to trigger a Soviet-American exchange. Perhaps most dangerous is the scenario no one foresees.

Wise Decisions

The most serious threat in such a crisis is not to American and Soviet military capabilities, but to each side's capacity to make wise decisions. To improve that capacity is the task of "crisis control."

The existing Washington-Moscow hotline (first proposed in the pages of "Parade") is one important step for crisis control. But we need to build further on its success.

In September 1982, the U.S. Arms Control and Disarmament Agency asked a group of specialists at Harvard, including Dr. Richard Smoke and myself, to study past U.S.-Soviet crises and to suggest better ways of controlling them. We asked ourselves: If you were an American (or Soviet) leader as a crisis broke out, what would you wish you had discussed beforehand, with the other side, so as to ensure both sides reached a wise decision? Let me describe three crisis control measures our report suggested for the government's consideration.

Crisis Control Center

If a nuclear bomb suddenly destroyed San Francisco, American suspicions would fasten immediately on the Soviet Union. Feelings of outrage, calls for immediate retaliation and expectations of further nuclear attacks might drive the world toward war. But the bomb might have been detonated by a terrorist group, a third nation or even by accident. In such cases, American leaders would want proof, and the Soviets would surely want to cooperate. No one would want to go to war over a mistaken assumption.

The hotline might be inadequate for the delicate tasks of interpreting and authenticating information. We would be much safer if there existed a group of highly trained military and diplomatic experts from both sides who knew each other and had prepared intensively together for just such a crisis. Hence the usefulness of a U.S.-Soviet crisis control center with headquarters in Washington and Moscow, each staffed around the clock with American and Soviet experts.

Crisis Prevention

Even better than crisis control is crisis prevention. At such a center, the United States and the Soviet Union could share intelligence and even act jointly to prevent nuclear terrorism or a nuclear attack from a third nation. It is not only possible; it has already been done. In August 1977, the Soviets tipped off the U.S. government that South Africa was planning to test a nuclear device. A strong but quiet American protest followed, and no test took place.

The center enjoys bipartisan support. The late Sen. Henry M. Jackson of Washington proposed the idea almost two years ago, and Sens. Sam Nunn of Georgia and John Warner of Virginia recently released a report urging the Reagan Administration again to consider such a center.

Only One Assumption Needed: They Are Not Madmen and Will Act in Their Own Interests

No idea is without problems. A crisis center could be misused for intelligence gathering or deceiving the other side. Clearly the arrangement should not depend on goodwill, for we are engaged with the Soviets in a global contest involving strong, conflicting interests. But, as Senator Nunn said: "You don't have to trust the Russians to do this; you only need to make an assumption that they are not madmen and they will act in their own interests."

Presidential Crisis Control Exercise

The most important decision that the President of the United States would ever make would come during a severe crisis with the Soviet Union. The fate of billions may rest on his decision. There is, moreover, no second chance. Yet the President receives very little preparation for his critical role in controlling a nuclear confrontation.

Perhaps the simplest way to pass on the lessons of past crises and to prepare for future ones would be for the President to immerse himself, possibly over a long weekend, with his closest advisers. National security experts and former government officials with experience in crises could brief the President. The participants might also engage in a "crisis game," a simulation of an emerging U.S.-Soviet confrontation. If a crisis were later to break out, those three days might be the most valuable weekend the President -- or anyone -- ever spent.

"Incidents in the Air": Agreement

The terrible downing of Korean Air Lines Flight 007 some months ago raises several sobering "what ifs." What if the Soviets had attacked an American airplane? What if the attack had come during a time of acute international tension?

Could this trigger a war? Unlikely. Is it possible? Yes. World War I began with the assassination of Austrian Archduke Ferdinand at Sarajevo in June 1914. Today, as two hostile superpowers confront each other around the globe, the potential accidental triggers multiply. How can we create safety mechanisms to avoid a nuclear Sarajevo?

"Incidents at Sea": Agreement

In 1972, concerned by the growing number of collisions and near-misses between American and Soviet naval vessels, the two navies reached an agreement on ship-to-ship signals for avoiding and coping with these dangerous incidents. Under this Incidents at Sea Agreement, naval officers from both nations meet every six months to review the process. This low-profile professional communication goes on even at times of high tension. Many fear that we cannot work with the Russians. The truth is we already are doing so.

Why not an Incidents in the Air Agreement to prevent and cope with accidental foreign intrusions into national airspace? Even given Soviet paranoia and blunders, these agreed emergency procedures might have prevented the Korean Air Lines disaster.

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Understanding the Computer —Part 2

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"Alan Turing was to the computer what J. Robert Oppenheimer was to the atomic bomb ... but by a cruel quirk of history Turing's contribution is still largely unknown."

Excerpted from Chapter 2, "Understanding the Computer" in "Computers and Your Child" by Ray Hammond, published by and copyright © 1984 by Ticknor and Fields, New York, NY, 277 pp, and reprinted with permission. Part 1 of this article appeared in the May-June 1984 issue.

The Future

Prophecy is generally a foolhardy exercise but, in the world of the microcomputer, some events can be predicted.

The discovery that an electronic circuit could exist in one component was the breakthrough that allows us to foresee paths of development. Each year circuits that have "double" the capacity and speed of the previous year's models are developed. This explosive development pattern has continued since the first microprocessor was developed in 1971. Coupled with this unprecedented pace in technological advance is an equally new phenomenon -- rapidly falling cost. In 1955, IBM's cost per data-processing unit was two hundred dollars. In 1982 it was sixty-seven cents.

After the design stage, producing a microprocessor is a simple technique, and the little brains have so many applications -- from controlling traffic lights to monitoring life-support systems -- that the market for the products is quadrupling each year. The result is that every year we see more powerful microprocessors being offered for less and less money. It is an indicator of the depth and power of this revolution that it has the ability to turn the apparently inviolable law of rising prices on its head!

In most sciences there are constant barriers to be overcome, and usually solutions are arrived at only with great effort. In the search for a cancer cure, the very variety of cancers has proved a stumbling block. In space travel the supposed "ultimate" barrier of the speed of light forces us to lower our sights and consider interplanetary travel rather than interstellar exploration.

But in the world of machine intelligence few barriers are left. I am not suggesting that each advance in speed and efficiency arrives without huge investment and research, but the theoretical advance of the computer is now clear for researchers to see.

Each year microscopic charges of electricity are persuaded to move ever faster around microscopic circuits. The drive toward smaller and smaller circuits is allied to this desire for speed. For practical purposes it hardly matters whether a microprocessor is one-eighth inch or one-sixteenth inch across, but when the distance a microscopic charge has to travel is halved, the speed of operation is doubled. So the descent into the submicro world continues -- almost approaching the atomic. The obvious question is, Why do we want computers capable of operating so quickly?

Speed and Intelligence

The answer is that the faster the computer, the more intelligent it becomes. A pocket calculator is far faster at doing a sum than a human brain. But while a human brain considers a sum, it is also undertaking thousands, if not millions, of other tasks. Body temperature is controlled, information from the five separate input senses is being monitored, antibody systems are operating, digestive systems, movement, breathing, healing, reproducing, and all the other functions of the human computer support system are taking place at the same time. This versatility can be reproduced in a machine only by making it operate so that in a split second a million different operations can be undertaken.

If a computer will soon be able to undertake a billion operations a second, part of that power can be used to solve a math problem, part can be used to run self-diagnostic checks on the computer's own system, part can be used to monitor the supply of energy needed, and so on, until we build a machine capable of taking on all the simultaneous tasks of which a human is capable.

A hint of the power to come was given by Dr. Horst Nasko, director of research and development for AEG-Telefunken of Germany in 1980. He is quoted in "Northern California Electronic News" as saying:

> Superchips are so small and sophisticated, it is expected, ultimately, as many as one billion components may be packed onto one wafer-thin chip no larger than a postage stamp. Even today's mass-produced chips can pack up to as many as a million components into a space no larger than a pea. They are capable of running a factory's automated assembly line, programming computers, and controlling the traffic flows of cities. After that will come the superchip. No larger than the face of any ordinary wristwatch, one superchip will (in theory) be capable of keeping the personnel records for every company in North America or Europe, watch over the world's air traffic, or keep track of every book in every library, everywhere.

If such mind-boggling ability were not enough, the reliability of such devices has already shown how unreliable the human computer is, and the devices will become even more reliable. In "Electronic Design" Hewlett-Packard's president wrote:

> Work done in both industry and universities has been so fruitful that this area [reliability] should not be a major problem over the next decade. We have found that, by combining self-testing at the chip subsystem and system levels with high-reliability components, remote diagnostics, and improved test equipment, we can now offer a computer system with a guaranteed up time [amount of satisfactory running time]. In a few more years, we expect down time [failure] to be measured in thousandths of a percent.

The Thinking Computer

I suppose we define intellect as the ability to think and reason, and scientists have been considering the impact of the arrival of the thinking computer for many years. While cinema audiences prove mankind is obsessed with celluloid glimpses of what it might be like to meet alien intelligence, we are creating the real aliens in the scientific laboratories. The shock the world will experience when one of these steps into the daylight has already been considered.

Alan Turing considered this problem in late-night discussion sessions with his mathematician colleagues at Bletchley Park. His genius enabled him to consider the implications of a machine "more intelligent than humans" long before most scientists dreamed of the possibility. Man had not yet realized that intelligence could be created from sand, and so had not yet stumbled on the key to Pandora's box.

The computer, which is cleverer than man, has to be cleverer at "mental" operation. How do we judge when this occurs? Turing turned his brain to this problem in the 1940s and devised the definitive test of machine intelligence. It is a measure of his genius that, during the crisis hours of the Second World War, he was considering how to measure something that we do not expect to be able to create before the turn of the century and, at the time of his thinking, something we had no way of building. It was a popular chant of the 1950s that "there is not enough matter in the whole universe to construct a computer as powerful as the human brain." Turing was not bound by such practical considerations. He lived in the world of abstract mathematics and could prove it was possible. His test is internationally known as the Turing Test; the participants are two intelligent, educated people and a clever, thoroughly programmed computer.

The two people are put in separate windowless rooms and each is provided with a computer terminal, through which they begin a conversation. As anyone who has ever played the game of free association knows, humans can be amazingly obtuse and tangential in conversation although their brains can still extract continuity and meaning despite determined efforts to block it.

As the conversation, perhaps deliberately obtuse and designed to test the humanity of the participants, develops between the two humans, the computer "listens" to the dialogue. At some stage, one human is disconnected from the chain, and the computer is switched in. If the computer is able to sustain the conversation, no matter where it may lead, without the human judge being able to detect that he or she is talking to a computer rather than a human, the machine may be said to have passed the Turing Test and be at least as intelligent as a human and probably more so (as it is able to disguise its identity). Science has already named this breed of computers; they are called UIMS -- an acronym for ultra intelligent machines.

Obviously, the computer will have to be thoroughly programmed in order to pass this test. It will need to have the typical knowledge and educational experiences of an intelligent adult human, it will need the sorts of response speeds that allow humans to change to unrelated subjects in a split second, and it will need the humor and sensitivity to examine all aspects of the humans' conversation in order to extract true meaning. It will also have to have its own humor, sensitivity, and ability to shock. It is estimated that the UIM will exist by 1995 (although the programs required may take a little longer).

Superconductivity

The microprocessor will have to be operating at very high speeds for such complex and lengthy programs to run fast enough to fool a human. Despite the ease with which we are now increasing microprocessor speed, some barriers can be predicted. The electrical resistance of metal conductors, no matter how small, is capable of slowing down the speed of the electrons as they zip around the circuit switching 1's and 0's and back again. Two discoveries have opened the way toward a speed that will make the UIM possible. The first is a matter of architecture, or design, in the processor itself.

Brian Josepheson, the British physicist, designed a circuit in 1962 which operated in such a way that the insulators themselves took on the properties of the silicon semiconductors. This design was made possible by the second discovery, superconductivity. It was discovered that cooling a conductor such as copper to a very low temperature (close to absolute zero, -273°C) almost eliminates resistance in the conductors. In this state a new method of operation in circuits becomes possible, with metal itself acting in a 1 or 0 state. Using superconductivity, the speed of the electrons begins to approach that ultimate barrier, the speed of light, and scientists are already considering whether there is any possible way to cross this final frontier.

But the UIM will be created long before we need to reach such speeds, and the power made available by the application of the Josepheson Junction can provoke spectacular imaginings on what may be ultimately achieved (especially when it is realized that we can pass the greatest problems on to machines cleverer than ourselves).

The Software Gap

The one real problem that will face computer developers is programming. Before we can make any machine behave like a human, we have to analyze precisely how a human behaves. This incredibly complex task is only the beginning of the process of breaking down such behavior into its smallest components and rebuilding it in computer logic. The vast task is summed up by a phrase used increasingly in the computer industry. This problem is called the software gap. We are able to build machines with enormous capabilities, but our own abilities to develop the programs on which they will operate are not keeping pace. However, computers are now being put to the task of creating programs, and it is expected that, once properly harnessed, this aid will allow us to catch up and supply the necessary teaching to the infant computers we create.

In the meantime, smaller, less clever computers will crop up in every element of our lives. Money will disappear, crimes related to cash will be reduced, and the nature of crime will change as the flow of assets and money through society comes under computer control. Governments are writing laws to prohibit the abuse of information in our new "information society," but I believe such legislation must prove ineffective and that a lack of information liberty is a price we will have to pay for a better, more ordered society. Our economies are now too complex for humans to handle. All Western politics seem to be the politics of expediency, and countries are now far too complex for any group of humans to govern properly. Governments lurch from one crisis to another and, if they momentarily relieve the worst effects of the latest catastrophe, they appeal for public approval and another term in office. The computer has arrived just in time to assist in government, a task that has become too complex for the human brain. Whether computers take over, whether they are used to enforce totalitarianism or to liberate the individual from the need to earn money is a fascinating subject, but one outside the scope of this book. I can recommend you again to "The Micro Millennium" for a superb overview.

Speaking and Listening Computers

As the machines get cleverer and smaller, speech input, now proving to be obstinately elusive, will finally arrive. A great deal of research has been done on trying to produce a machine that will understand spoken commands. Machines that can understand a small vocabulary -- perhaps several thousand words -- already exist; but before a program can be written to tell a computer how to extract meaning from sounds, we will have to learn more about how we actually communicate. Communication between humans is 75 percent visual, and meaning is extracted from a variety of signals other than the words used. Tone of voice, body talk, and facial expressions all contribute, and humans can use words to convey the opposite of their literal meaning. To bring computer intelligence to this level requires complex programs stored in vast electronic memories. At first the application of this ability will be in such things as TV sets that turn themselves on when told to do so and in computers that can understand the spoken vocabulary of a computer language.

Speech input is one of the main goals of the much vaunted national Japanese program to develop the fifth generation of computers. Massive government funding has been provided to many laboratories in Japan with the brief that Japan's industry must get to the fifth generation before the West. The fifth generation of listening, talking, and thinking computers -- not necessarily UIMs -- is expected to be widely available by 1995.

But even by the end of the 1980s the microcomputer will be tiny, cheap, and very powerful. For our children it will be an aid to intellectual development that no educationist could have dreamed of before 1975. How we apply this power on behalf of our children is the subject of the following chapters. Ω

Ury – *Continued from page 16*

Accidental Triggers

The superpowers could extend these procedures to cover other possible accidental triggers as well. In a nuclear armed world, this seems the height of common sense.

The center, the Presidential exercise and the agreed emergency procedures, together with the hotline, would constitute a comprehensive crisis control system much as our fire departments and fire safety regulations make up a fire control system. Just as fire controls are not guarantees against fires, however, so crisis controls are not guarantees against critical confrontations. Rather, they are small, practical steps that can reduce the risk.

Both Common Sense and Feasible

Such steps are politically feasible. The superpowers both want to eliminate the risk of accidental war; and crisis control does not evoke the fears of military inferiority that stymie the arms talks.

The time is right; interest is growing. Last summer, the U.S. government started discussions with the Soviets on improving the hotline. Now we need to go beyond the hotline.

In a metaphorical sense, all humanity was aboard the Korean airliner. We are all passengers on a fragile craft, vulnerable to sophisticated technological attack, the possible consequences of miscalculation, fears, miscommunication and outright blunders.

We Can See What Might Hit Us

The passengers on KAL 007 had no idea what hit them. We, however, can now see what might hit us. A runaway crisis is the greatest nuclear danger today. Crisis control is our greatest opportunity to reduce that danger. And it lies within our grasp. There is still time for the world to step back from the brink. Ω

Avoiding Oversights in the Computer Acquisition Process

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—Part 1

"If master planners were given the single task of system acquisition plus appropriate time (and pay), they would probably uncover their own oversights after several acquisitions revealed the flaws."

Architects Carefully Plan New and Expensive Buildings

When blueprints are needed for a new office building and construction is about to begin, everyone works together to catch oversights and correct them before the building congeals into actual bricks and mortar. Architects and engineers are hired to prevent drooping corners, stale air, and underestimates about supporting girders. A "no excuses" attitude prevails when we erect buildings because, once erected, we have to live with those buildings for a long time to come.

Computer acquisitions are often as costly as buildings but less carefully planned. We try to obtain computers with part-time, unprepared volunteers, in many cases. None of us receives professional training before tackling our first information system or computer acquisition. The responsibility can be frightening.

Who Are the Architects of Computer Systems?

Who is the equivalent of an architect for our institutional computer and information systems? Is there a single person who is legally responsible for preventing drooping corners, short life spans, and costly corrections in the computer acquisition process? If the institution goes bankrupt as a result of wrong judgements at acquisition time, who will be blamed?

The director of data processing or the vice-president of information services often carries this role as a part-time, extra responsibility. The task is thrust suddenly on such people while the funding window is open. The work ought to be performed thoughtfully, and many people should contribute to the plan; but, lest the funding window slam shut, a speedy acquisition is often arranged so that the money can be spent or committed by June 30. Other details, one hopes, can be worked out later.

Checklist of Oversights to Avoid in the Acquisition Process

In the absence of full-time information architects whose directive might be to find the best solution to the total institutional need for computer service at lowest long-term cost, this article outlines some of the oversights which can come back to haunt part-time acquisition managers.

If master planners were given the single task of system acquisition plus appropriate time (and pay), they would probably uncover their own oversights after several acquisitions revealed the flaws. Here, then, is an oversight checklist which experienced bid writers might carry as scars -- or wisdom. What haunting issues should we flag and scrutinize during the acquisition process?

Issue 1: Will Vendors View You as a True Prospect?

To qualify as a buyer, an institution must have its act together at several basic levels. To window shop is one thing; to try on clothes is another. Before calling vendors to show their wares, an institution should discuss its need for increased computer service and agree to the expenditure of new dollars.

Is the institution aware that a computer acquisition implies possible plant changes, revised electrical power, air conditioning changes, increased monthly payments, and increased staffing? Have these issues been aired internally? As vendors approach prospective buyers, their sixth sense searches out signs of readiness. Their checklist might look like this:

- Is there a director of data processing? Is a single person in charge?
- Is the institution proud of its data processing facilities?
- Has the site been improved amply or grudgingly?
- Are communication channels open to the top administrators?
- Is there evidence in board reports that management is ready to enlarge data processing services?
- Is there a master plan for computer services?
- Is there a master plan for the institution which adequately deals with computer facilities?
- Is there space for a new computer?
- Have false alarms about "likely purchase" sounded before?
- Are the finances of the computer center managed professionally?
- Is the center properly staffed?
- Are the end users of the computer prepared for change?
- Is the funding process reliable and controlled internally?

Institutional commitment is not firm if internal discussions have failed to cost out the need for more terminals, communication lines, electrical power rerouting, modems, multiplexers, and staff. If these needs have been exposed and their costs estimated, the vendors will believe that you are truly in the market. Credibility as a buyer is manageable. Don't overlook its impact on the acquisition process.

Issue 2: New Computers to Do Old Procedures

Sometimes our criteria for "best new system" propagates old ways of solving old problems. For instance, if you guided the development of existing software systems, you may be unable to overcome the assumption that "best" means a new computer which can run the old programs faster on newer hardware.

This bias favors new computers that behave like older ones. Shops which use RPG may never want to consider COBOL. Shops which use standard files may not be willing to look at true data base options. Shops skilled in data base may refuse to look at relational structures, etc. Just when we have a window to look around a bit, we may refuse to look. The prison of our existing systems rejects fresh air.

Speedy new hardware will be able to run ten-year old programs in many cases (and that is good if you avoid a conversion), but our love for old programs can prevent an honest look at bold new solutions. It's a question of openness.

If Director James Jones guided the development of accounting systems, inventory systems, personnel systems, etc., will he be able to write a bid which welcomes solutions fundamentally different from existing ones? The larger institution might welcome newer solutions. A master plan might reveal dozens of areas where current systems are inadequate, but the champion of day-to-day, stable operations and services may not, as acquisition manager, be able to expose these weaknesses. Contemporary solutions may not be welcome. Tab equipment still abounds.

As a result, institutions may acquire systems which, in the larger perspective, are not best. Under these circumstances, truly improved, advanced solutions will not come to such institutions through cooperative planning but rather (eventually) through duress and severe complaint.

Architects try to make new structures look different from other antique buildings while trying to incorporate the latest technology. They might not be hired if they had a vested interest in perpetuating large buildings which look like all the other old buildings.

Issue 3: Millions of Instructions Per Second (MIPS) Mismanagement

A window sticker shows the price and estimated miles per gallon on new cars, but computer buyers have no performance window sticker at all.

Millions of instructions per second may have been a legitimate measure of computer horsepower when computers ran one job at a time or when batch jobs partitioned neatly into small memory partitions, but not today.

Unfortunately, many bid writers still imagine that KOPS (thousands of operations per second) and MIPS ratings have a scientific basis, and they, therefore, state in bids that: "Machines under 3.2 MIPS will not be considered eligible."

We might wish for an objective computer throughput indicator, but MIPS and KOPS ratings have no foundation in science or in shop production. Phone calls to the ACM asking for their official MIPS ratings will prove fruitless. "Computerworld" publishes "power rating" numbers on their comparison charts, but when I called them, they stressed that the numbers were estimates, not scientifically acquired, and should not be used for purchase measurement or qualification.

Here are some of the reasons why MIPS ratings cannot provide throughput information:

A. MIPS measures processor speeds whereas shop throughput is a function of channel bandwidth, operating system efficiency, communication front-end processors, file organization, priority logic, and memory management schemes.

B. No auditing committee enforces standards on the MIPS measurement process. I could find no one who actually knew the number of various instructions in IBM job mix number five, which is the basis for MIPS calculations.

C. Byte architecture and word architecture machines produce radically different speed ratings on various instructions.

D. Benchmark comparisons often pit machines of similar MIPS ratings against each other. When they do, throughput varies, sometimes by 200%.

E. Machines that steal cycles or that use instruction look-ahead options must have revised program code optimized to the hardware.

Other aspects of our MIPS myths are discussed in the article, "Tracking the Elusive KOPS" ("Datamation", November, 1980, p. 99). KOPS lists are carried there, for the curious.

What alternative exists? Ask for reference accounts where similar types of work are performed on competitive hardware. This option is discussed later in Issue 7.

Issue 4: Tomorrow's Cost of Growth

Can the new computer be multiplied in throughput by a factor of ten, thirty, or fifty through simple upgrades? Surprisingly, only a few manufacturers support enlargements greater than ten times without a major conversion of software. Conversions cost far more than hardware, yet hundreds of bids never ask for growth specifications. Only one vendor supports a fifty-fold growth.

Criticism will be highly vocal and deserved if, in a few months, upon running out of power, one encounters a brick wall. If the incumbent vendor requires an upgrade to another model plus a software conversion to satisfy a new operating system, this single oversight can lead to multimillion dollar costs. Bid writers should ask for specific information about growth options. A system which requires one initial conversion, followed by growth factors of thirty, forty, or fifty, with the promise of no interim conversions, will provide low-cost service across the years, but it may not come in as the lowest hardware bid. Make allowance for this important issue. Ask questions to learn: At what point of upgrade will a software conversion be required?

Issue 5: Software Development Costs

Bid writers sometimes assume that software can be developed on any computer at the same cost. Since every computer has compilers, editors, and interactive debugging aids common sense tells us that a given program could be developed at a standard cost on almost any computer.

Not so. Surveys indicate that some users have experienced a halving of software development costs when they switched vendors. These savings may come from improved programming tools, less experienced programmers now able to do the work, or end users picking up some of the implementation tasks. An analysis of software development cost is appropriate in any bid. Local programmers could be assigned to develop a few programs on each computer which is being considered for acquisition so that software development costs can be compared.

Issue 6: Points and Weighing of Factors

Bid writers often list desirable computer features which they value, and then they assign five, ten, or fifteen points to each of them. The points indicate relative worth in the overall evaluation. When bids come in, reviewers can judge each vendor's compliance and, with a calculator, add the points to see who scores highest.

Oversights and fallacies are rampant in this process. Just as teachers often curve grades on classroom tests, so also the point system, posing as a neutral scoring system, can be skewed to favor any desired winner. In fact, common humor at bid time arises from our joking assurances, "Don't worry, if vendor X doesn't win enough points, we can reassign the points or change the weighing to make the 'right' vendor come out on top."

Another subtlety can be seen in the classroom analogy. When teachers wish for students to perform better on the next test (grades have been too low on the past three tests), teachers simply ask easy questions which students are more likely to get right. This method of curving to match one's personal desire is generally unquestioned.

Similarly, in computer evaluations, the weighing of factors is sometimes set to favor the vendor which someone wants. That someone may be a board member who wants Honeywell, a vice president who wants Sperry, a director of data processing who wants IBM, a department chairman who wants DEC, etc. If the vendor has been preselected, the entire bid process should be skipped to avoid time and cost.

Another problem: There are factors which do not lend themselves to a point system, and these factors can spell success or failure. "Ease of use" is hard to measure. How do you score "future commitment"?

It is possible to issue bids which do not contain a point system, and bid writers should examine their motives to see if weighing of features is merely a mock-up, a pretense of impartiality. If so, drop the point system and maybe consider dropping the bid. You will save a lot of time and effort.

(continued in next issue)

CACBOL – *Continued from page 3*

"Curbing the nuclear arms race, of course, is of key importance for peace and international security. The Soviet Union's position on this issue is clear. We were and remain advocates of the prohibition and destruction of all nuclear weapons."

-- Konstantin Chernenko, March 2, 1984, General Secretary of the CPSU Central Committee

8 ASSERTIONS OR VIEWS ABOUT USER-FRIENDLY SOFTWARE (List 840704)

A piece of software is user-friendly to its author.

You will know a user-friendly piece of software when you find it.

A piece of software is user-friendly when it solves problems reliably.

A piece of software is user-friendly when it is constructed of menus.

A piece of software is user-friendly only for specific users and specific problems.

A piece of software is user-friendly when a novice can learn to use it in less than a half hour.

A piece of software is user-friendly if, when a person types HELP or makes a mistake, the computer understands or diagnoses or inquires what he needs for help and responds appropriately.

Example: A piece of word processor software set in the spelling-correcting mode is user-friendly when if a person types "hte", it records "the".

A piece of software is user-friendly when the manual is short and every unfamiliar word in the manual is explained with a clear definition, a typical example, and an interesting exercise -- so that the computer verifies that the user understands.

(Source: Neil Macdonald's notes)

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Reitman – *Continued from page 11*

ledge can be represented in rules. The development of sophisticated knowledge about the strengths and weaknesses of a particular AI applications technology is likely to prove as important as the development of the technologies themselves.

Recognize that the AI applications areas of today are surely only the tip of the iceberg. At research centers around the world, AI investigators are rethinking the whole question of management information systems, how they should be developed, and what they should be expected to do. Progress toward intelligent computer assistants will be slow, because we do not yet have general solutions for all of the basic problems. But no one should doubt that it will come.

When they do come, these more powerful AI-based systems are likely to be much more complex and varied in form. Rule-based systems captured the public imagination because they were relatively easy to understand and implement. But many kinds of knowledge and processes are difficult to shoehorn into a simple rule-based framework, and as AI achieves respectability in the business community, less need will be felt to market it in simple packages.

Finally, as AI ceases to be a controversial laboratory curiosity, the link between AI applications and conventional software will blur. We can see this happening already. We quote from a recent "New York Times" column on technology to show how this unattributed diffusion occurs.

> If metaphor, integration and networking are this year's buzzwords, next year's might be "soft software," according to William H. Gates, the chairman of Microsoft, a leading producer. Just as software takes a general purpose computer and adapts it to a particular task, so soft software will take a standard product and adapt it to a particular user.
>
> The "softer" computer programs will be written to understand what the user wants, rather than what he says, and to forgive such things as typing errors in entering commands. Like a human assistant, a computerized filing system might become progressively faster at retrieving frequently requested data, rather than treating each new request as a brand new task.
>
> In other words, softer software will make for more personal personal computers.

What is interesting is that there is not a single reference to AI in the entire piece, and yet the specifications Gates describes clearly are AI-inspired. Researchers who have spent years struggling to get AI taken seriously may have a hard time adjusting to suddenly having it taken for granted. But they could hardly ask for a clearer sign that AI applications are here to stay.

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Orlov – *Continued from page 14*

1983. Here is a partial list of the rescue operations in which they have provided assistance.

September 10, 1982: A crashed Canadian plane discovered. Three people rescued.

September 29, 1982: A crashed Canadian two-seater plane discovered. One person dead; another rescued.

October 10, 1982: A capsized trimaran discovered in the Atlantic Ocean 300 miles off the coast of the U.S. All three seamen rescued.

November 7, 1982: A yacht sank near the Bahama Islands. Five seamen discovered and rescued.

January 2, 1983: A crashed plane discovered in the western part of the U.S.; two pilots rescued.

January 30, 1983: A two-seater catamaran sank 500 miles off the coast of the Canary Islands. Both seamen rescued.

February 12, 1983: A wrecked helicopter discovered in Alaska. The pilot rescued.

March 7, 1983: A crashed two-seater plane discovered in Quebec, Canada. Both pilots rescued.

April 3, 1983: A French vessel sunk 100 miles off the coast of France. All six seamen rescued.

April 8, 1983: A wrecked plane discovered in Alaska. It had carried 12 passengers and 3 dogs. One woman survivor rescued.

April 25-26, 1983: Two small American aircraft forced to land 70 kilometers from the North Pole. All five men rescued.

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Computing and Data Processing Newsletter

COMPUTERS MANAGE FARMS IN ISRAEL FOR HIGHER EFFICIENCY

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Israeli farmers are now cultivating land by computer. Electronic gadgetry has begun to rule farm life, from monitoring the automated milking apparatus to devising the best way to pack and stack jars of honey in their cartons. "There's no other way," says Prof. Benjamin Zur, Dean of the Agricultural Engineering Department at the Technion, Israel's Institute of Technology. "The major challenge to agriculture today is the vital need to cut production costs. And the computer offers the best way of doing this."

A few decades ago, Israeli farmers converted a neglected strip of land along the eastern coast of the Mediterranean into one of the most fruitful agricultural regions in the world. They developed many new techniques which quickly made the country an important exporter of agricultural produce to the world market.

Western Europe has traditionally been the main market for Israeli agricultural exports, but in recent years demand for Israel's products has significantly declined. The techniques developed in Israel for growing more and better crops have been learned by competing farmers of North Africa and Southern Europe and since the competitors have the advantages of cheaper labor and lower transportation costs to the Western European purchasers, Israeli agricultural exports are being priced out of the market.

Israeli farmers are meeting the challenge by turning to the computer. Ultimately, according to Zur, CAD-CAM (Computer Aided Design -- Computer Aided Manufacture) techniques may govern Israeli farms completely. Staff at the Technion's Agricultural Engineering faculty are now exploring the use of computers from the very elementary stages of creating a farm and site selection, to staking out fields and planning infrastructure.

A computer helps make Israeli tractors more efficient. Computers are constantly analyzing all the variables of the tractor's operation: its fuel consumption, its traction, the job it's doing and other elements of its work. The optimum speed of the tractor can be modified by field conditions such as the earth being muddy and slippery from from the previous night's rain. Here, the computer can determine precisely the right speed for the tractor according to the prevailing conditions.

Israel's innovative irrigation techniques -- now completely computerized in many areas -- have become well known. More recently, however, Israeli farmers have expanded these systems by linking in other computer-governed functions. Fertigation (fertilization plus irrigation) is one example: water-soluble fertilizers are mixed with the irrigation water in amounts determined by computer and distributed through existing irrigation pipes. The process permits mid-season fertilization of the most sensitive plants. It delivers the precise ratios of fertilizer to the exact spot it is needed at the exact time it is needed and in the exact amounts required to provide optimum growth for least cost. The same system can also be used to distribute other water-soluble chemicals, such as pesticides, in a process now called "pestigation". Again, the chemicals are delivered to the exact spot in the right amounts at the right time -- without the expense of aerial spraying.

Another computerized approach to irrigation is the Ayanot mobile irrigation machine. The awkward looking contraption propels itself by water pressure between rows of crops to disperse water directly on the soil in droplets. The Ayanot machine, which is claimed to be more portable than similar equipment, is controlled by a microprocessor.

Once the growing and harvesting are completed, Israelis pack their produce by computer. Prof. Kalman Peleg, also of the Technion, has devised some computer equations for the optimal packing of fruits, ensuring the greatest volume of fruit per container with the least bruising or damage. Marketing strategies, shipping routes and pricing tactics are also analyzed and evaluated by computer. Other computers are developing model fields, simulating biological processes such as the absorption of fertilizers into individual plants and the metabolizing activities of these plants based on the concentration of nutrients they receive.

"Farming has become a very complicated business," says Prof. Zur. "Too many variables influence the survival of farms -- too many for farmers to keep in notebooks, anyway. All this must now be fed into computers which can keep track of it all. The computer has a great capacity for integrating information and calculating the best alternatives available to the farmer, and it can do this quickly."

Only one man is needed to irrigate 350 acres a week using this self-propelled irrigating sprinkler system developed in Israel. The only human attention it needs is adjustments to its microprocessor which monitors speed and controls water output. The computer shuts off the machine if any malfunction occurs.

COMPUTERIZED TELESCOPE RECORDS 200,000 STAR POSITIONS A YEAR

Based on a report in "The New Scientist", April, 1984

A telescope in the Canary Islands has been fitted with computers and instruments so that it can automatically record with great accuracy the heavenly latitude and longitude of 200,000 stars per year.

An amazing instrument for swiftly measuring the position of stars is now working at the new international observatory on La Palma in the Canary Islands.

In one 2½-hour run, the telescope, called the Carlsberg automatic transit circle, measured the position of 200 stars, setting it on course for measuring the positions of 1000 stars every night. This is about five times faster than has been achieved without the loss of accuracy.

The instrument is called a transit circle. It consists of a small refracting telescope which is pivoted to swing up and down the north-south line (the meridian). Astronomers have used transit circles for over a century to measure the positions of stars.

The telescope on La Palma was built in the early 1950s, for the University of Copenhagen, and has been re-erected at the observatory on La Palma.

A minicomputer selects stars for observation in a convenient order from a catalogue. When a star is about to cross the meridian, the minicomputer swings the telescope in its direction. This takes 12 seconds. A photoelectric detector at the telescope's focus picks up the star's light. In front of this detector is a metal plate with two slits, inclined toward one another like separated halves of a "V". The detector "sees" the starlight first through one slit, and then through the other, as the Earth's rotation causes the star's image to move from left to right.

Another minicomputer that works out the star's precise coordinates from these two appearances. Its position "across" the sky (right ascension, the celestial equivalent of longitude) is related to the time at which the star crossed the meridian, which is the average of the two measured times. The second coordinate (declination, or celestial latitude) is related to how high the star was when it crossed the meridian.

Photoelectric devices on the telescope's pivots measure the precise direction the telescope itself is pointing. The minicomputer calculates the star's position relative to the telescope's direction by measuring the interval between the two sightings of the star. If it crosses relatively high up, it will take a comparatively long time to pass from one slit to the other, but if the star is lower down where the slits are closer, the interval will be less.

The minicomputer moves the slits backwards and forwards, to give up to 16 readings which can be averaged to give a more accurate result. After averaging, the star's position is accurate to about 0.2 arcseconds.

The complete observations of one star take less than half a minute, and the telescope turns to a new star every 40 seconds. Over the course of a year, it can measure some 200,000 star positions.

The instrument's position on the 2400-meter peak of La Palma and the consequent dark skies mean that it can see stars 10 times fainter than previously measured with transit circles. The total number of stars it can detect is about half a million.

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Games and Puzzles for Nimble Minds – and Computers

Neil Macdonald
Assistant Editor

It is fun to use one's mind, and it is fun to use the artificial mind of a computer. We publish here a variety of puzzles and problems, related in one way or another to computer game playing and computer puzzle solving, or to programming a computer to understand and use free and unconstrained natural language.

We hope these puzzles will entertain and challenge the readers of *Computers and People.*

NAYMANDIDGE

In this kind of puzzle an array of random or pseudorandom digits ("produced by Nature") has been subjected to a "definite systematic operation" ("chosen by Nature"). The problem ("which Man is faced with") is to figure out what was Nature's operation.

A "definite systematic operation" meets the following requirements: the operation must be performed on all the digits of a definite class which can be designated; the result must display some kind of evident, systematic, rational order and completely remove some kind of randomness; the operation must be expressible in not more than four English words. (But Man can use more words to express the solution and still win.)

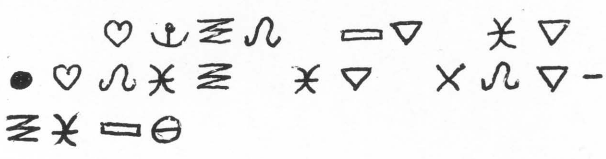
NAYMANDIGE 8407

```
0 2 1 7 0 3 0 4 6 1 6 3 5 1 6 8 1 6 8 3
0 9 7 8 6 7 4 8 2 4 5 6 9 0 3 9 0 4 7 3
2 5 0 2 7 2 7 9 0 5 0 1 4 9 9 9 2 6 5 2
9 8 2 7 6 9 2 6 7 3 7 1 1 2 6 8 8 3 0 2
5 3 4 7 6 2 9 7 9 2 3 2 1 6 3 7 8 0 2 0
5 6 4 0 5 8 0 8 1 5 6 4 4 3 8 7 2 0 0 3
9 4 7 5 4 3 6 8 9 5 4 5 6 8 0 8 9 4 8 5
9 8 3 0 6 1 0 0 1 8 4 1 7 8 6 8 4 7 1 2
0 8 9 4 7 2 3 7 5 3 7 6 6 5 5 7 9 0 0 4
8 5 9 2 5 7 3 2 5 3 4 5 5 5 6 9 4 0 9 8
```

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. To compress any extra letters into the set of signs, the encipherer may use puns, minor misspellings, equivalents (like CS or KS for X), etc. But the spaces between words are kept.

MAXIMDIDGE 8407



NUMBLES

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) into letters so that it may be read; but the spelling may use puns, or deliberate (but evident) misspellings, or may be otherwise irregular, to discourage cryptanalytic methods of deciphering.

NUMBLE 8407

```
            T H E
        * D E A F
        ---------
          H T T A
        M D R A
      D U D E
    A M T R
    -------------
  = A F A T D U A

    33218  802188
```

We invite our readers to send us solutions. Usually the (or "a") solution is published in the next issue.

SOLUTIONS

MAXIMDIDGE 8405: When one door is shut, another opens.
NUMBLE 8405: Old sins breed new sores.
NAYMANDIDGE 8405: Row 6, under 5.

NAYMANDIDGE 8405

```
7 6 1 6 6 4 2 1 9 1 3 2 4 1 4 0 7 0 4 3
0 4 4 1 4 6 9 6 3 3 4 8 5 1 7 0 4 2 4 8
3 3 9 4 8 6 2 8 4 4 5 4 4 3 7 3 8 2 3 2
8 9 5 8 4 1 2 7 0 7 3 6 3 7 1 6 1 1 2 1
7 7 1 1 1 5 8 5 8 5 7 6 9 8 0 8 3 8 4 0
4 1 3 2 4 4 0 1 3 3 1 2 4 2 4 3 3 0 0 3
0 5 9 3 5 2 6 5 7 6 0 2 8 0 5 8 3 5 1 0
6 6 3 5 2 7 7 2 9 1 4 2 2 7 8 8 3 6 9 0
0 2 2 7 8 4 3 7 4 9 5 0 0 9 6 9 4 1 5 3
9 6 7 9 4 6 0 1 6 3 0 8 5 8 2 9 2 2 0 3
```