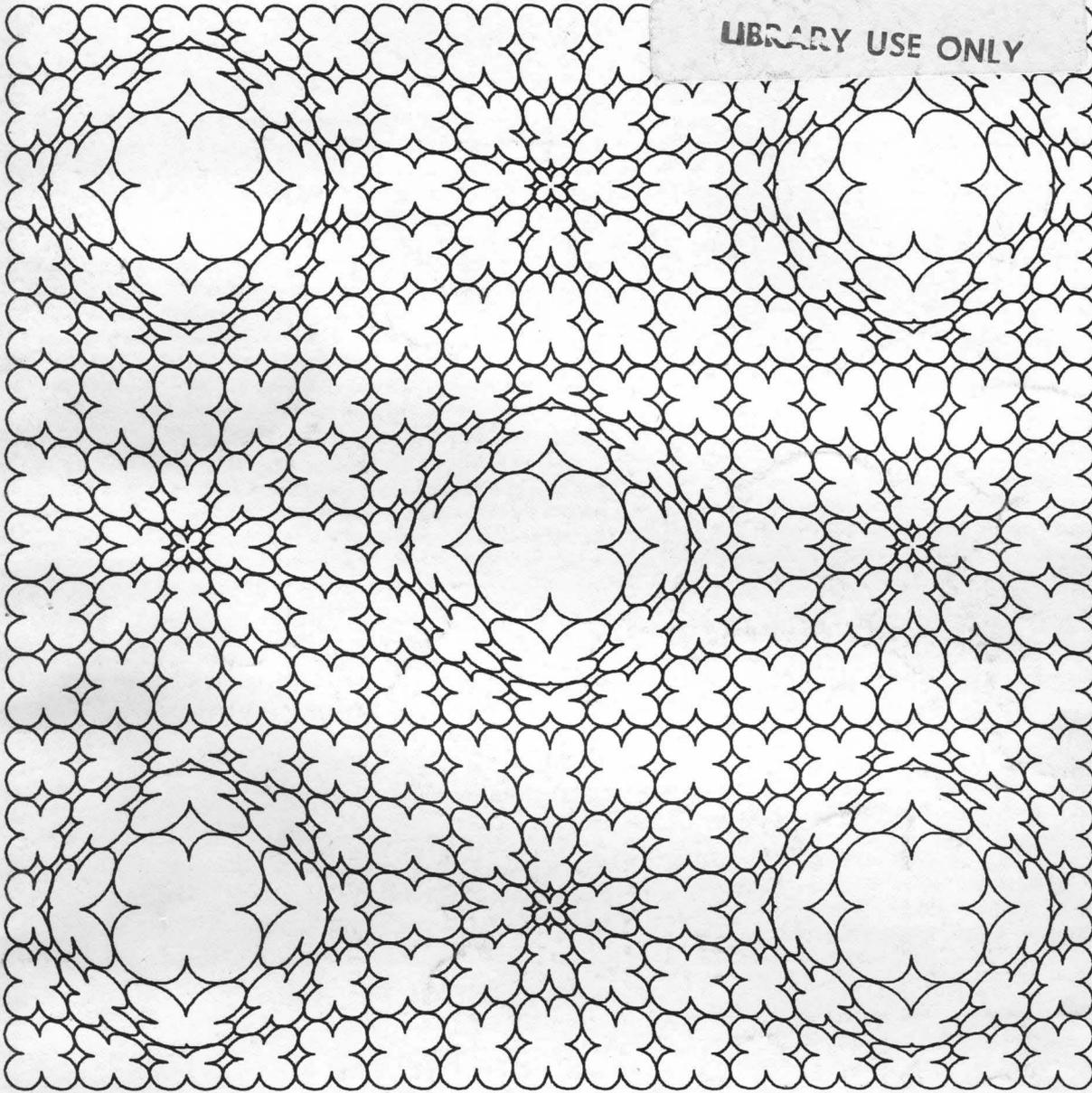


# computers and people

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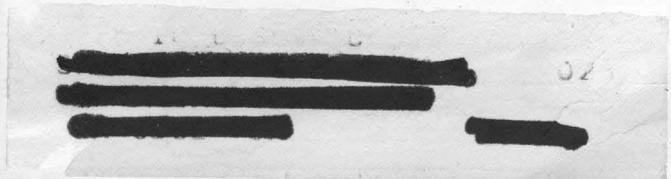
225 CHRISTMAS  
FLOWERS

by William  
Kolomyjec

*p. Kolomyjec '75*

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- The Universal Product Code
- Software Should Be Patentable
- Computer-Assisted Tutorials in College Mathematics
- Computers and Society: A Course at York University

- H. A. Peelle
- Thomas V. Sobczak
- ADAPSO
- J. L. Caldwell and Douglas Polley
- Larry J. Murphy



# "RIDE THE EAST WIND: Parables of Yesterday and Today"

by Edmund C. Berkeley, Author and Anthologist

Published by Quadrangle/The New York Times Book Co., 1974, 224 pp, \$6.95



## The Fly, the Spider, and the Hornet

Once a Fly, a Spider, and a Hornet were trapped inside a window screen in an attic. For several hours they walked up and down, left and right, here and there, all over the screen. They could look through the screen at the summer woods, feel the summer breezes, and smell the summer smells; but they could not find any hole to pass through the screen to the woods and fields so tantalizingly close, yet so far away.

Finally they decided to hold a conference on the problem of getting through the screen. The Fly spoke first, and said, "My Colleagues, . . .

## The Fox of Mt. Etna and the Grapes

Once there was a Fox who lived on the lower slopes of Mt. Etna, the great volcano in Sicily. These slopes are extremely fertile; the grapes that grow there may well be the most delicious in the world; and of all the farmers there, Farmer Mario was probably the best. And this Fox longed and longed for some of Farmer Mario's grapes. But they grew very high on arbors, and all the arbors were inside a vineyard with high walls, and the Fox had a problem. Of course, the Fox of Mt. Etna had utterly no use for his famous ancestor, who leaping for grapes that he could not reach, called them sour, and went away.

The Fox decided that what he needed was Engineering Technology. So he went to a retired Engineer who lived on the slopes of Mt. Etna, because he liked the balmy climate and the view of the Mediterranean Sea and the excitement of watching his instruments that measured the degree of sleeping or waking of Mt. Etna. The Fox put his problem before the Engineer . . .

## The Fire Squirrels

*Scene: Two squirrels, a young one named Quo, and an older one named Cra-Cra, are sitting by a small campfire in a field at the edge of a wood. Behind them hung on a low branch of a tree are two squirrel-size hammocks. Over each of the hammocks is a small canopy that can be lowered to keep out biting insects. It is a pleasant summer evening; the sun has just recently set, and the stars are coming out: —*

*Quo:* Cra-Cra, you know I don't believe the old myths any more. Tell me again how it really happened.

*Cra-Cra:* Just this: we received our chance because they dropped theirs. It is as simple as that.

*Quo:* In other words, they were the first animals to use tools, and we are the second?

*Cra-Cra:* Yes. There is a mode of surviving in the world . . .

## Missile Alarm from Grunelandt

Once upon a time there were two very large and strong countries called Bazunia and Vossnia. There were many great, important, and powerful leaders of Bazunia who carefully cultivated an enormous fear of Vossnia. Over and over again these important and powerful leaders of Bazunia would say to their fellow countrymen, "You can't trust the Vossnians." And in Vossnia there was a group of great, important, and powerful leaders who pointed out what dangerous military activities the Bazunians were carrying on, and how Vossnia had to be militarily strong to counteract them. The Bazunian leaders persuaded their countrymen to vote to give them enormous sums of money to construct something called the Ballistic Missile Early Warning System, and one of its stations was installed in a land called Grunelandt far to the north of Bazunia.

Now of course ballistic missiles with nuclear explosives can fly any kind of a path all around a spherical world, and they do not have to fly over northern regions. But this kind of reasoning had no influence on the leaders of Bazunia who wanted the money for building BMEWS. Nor did it have influence on their countrymen, who were always busy, trying to make money — in fact often too busy to think clearly . . .

---

52 parables (including fables, anecdotes, allegories)  
23 never published before  
27 authors  
18 full-page illustrations  
330 quotations and maxims

7 Parts: The Condition of Man / On Flattery and Persuasion / On Perseverance and Resourcefulness / Behavior — Moral and Otherwise / The Problem of Truth / On Common Sense / Problem Solving

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COMPUTERS and PEOPLE for December, 1975

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by Thomas V. Sobczak, Ph.D., Long Island City, NY 11101  
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### *The Computer Industry*

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A vigorous argument full of cogent reasons why computer programs should be patentable.

#### 10 Images and Reality in the Computer Field – A Discussion [F]

by the Editor and Jack Biddle, President, Computer Industry Association, Rosslyn, Va.  
Some of the things that IBM appears to do and actually does – in advertising, standards setting, entry into the computer peripherals market, and so on.

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by Howard A. Peelle, Director, Instructional Applications of Computers, University of Massachusetts, Amherst, Mass.

A black box that you can see into and can see how it works becomes a "glass box"; and this article describes how a true innovator in computer education is making algorithms and programming transparent to his students.

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by News Service, The University of Iowa, Iowa City, IA

*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.*

*Front Cover Picture*

“225 Christmas Flowers” is by William Kolomyjec, Instructor in the College of Engineering, Michigan State University, East Lansing, Michigan. It was drawn on a CalComp plotter driven by an IBM 1800, at the computer research facility of the College of Engineering.

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- 28 **“Computer Graphics and Art”** [F]  
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How should “Stuart University”, with given conditions and data, solve a set of problems about the use and applications of its computer?

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*Computers and the Understanding of Ordinary Language*

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MAXIMDIJ – Guessing a maxim expressed in digits.

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Statement of Circulation and Ownership:

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“The Computer Directory and Buyers’ Guide”, 21st annual edition, 1975:

Should be off press in December, 1975 – the delay is regretted.

*Key*

- [A] – Article
- [C] – Monthly Column
- [E] – Editorial
- [F] – Forum
- [N] – Newsletter
- [R] – Reference

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\*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. \*N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY.

## The Potential Understanding of Words by a Computer

There is no doubt that a computer can understand words -- especially if we stipulate as conditions "some words" and "some contexts". If I type into a computer with an appropriate program the five-lettered word "three", the computer can translate that both into the more customary "3" and the machine language for 3, and it can respond appropriately, as for example, by doing something three times, thus demonstrating at least some understanding. Evidence of successful communication is evidence of understanding.

When a computer program displays on a screen "Do you want to make any correction? (Yes, No)" and you then type in "No", the computer understands: it now accepts data previously labeled "Tentative", the item of knowledge that you do not want to make any correction; and the computer proceeds with the next step of its operations.

There is no doubt that you can play the game of Twenty Questions with a computer if it has an appropriate program inside of it, to respond to the "Yes" or "No" answers that you give it. For example, you can say to a computer that is appropriately programmed, "I am thinking of a number -- can you guess it?" The computer can then say, "Is it less than a million?"; and as soon as you are committed to answering "Yes" or "No" to appropriate questions that will pin the number down, the computer has won the game.

If you tell a computer "3 BUZZ 2 BANG 6" and "4 BUZZ 8 BANG 32", a computer with an appropriate program can promptly guess that BUZZ stands for TIMES and BANG stands for EQUALS.

Suppose you want to edit a computer program using a certain common type of on-line editor, and 14 is the line number of the line that needs correction. You can type 14L, for example, standing for "line 14, display", and line 14 is displayed in front of you. Then you type 14C, standing for "line 14, change"; the computer shifts from command mode into text mode; you retype the line with corrections; and when you press the appropriate keys, the computer returns from text mode to command mode. Then if you type 14L once more, the line will be displayed again in front of you, and you can satisfy yourself that the line as retyped is correct. (If not correct, repeat the process once more.)

More and more and more, the computer appropriately programmed will understand words in contexts; and eventually active, purposeful, and broad conversation with the computer will take place. In several

contexts this facility is already arriving:

- Diagnosis of disease, by conversational interaction between a doctor and the computer
- Taking of the medical history of a patient, by conversational interaction between a patient and the computer;
- Learning of a subject, by conversational interaction between a student and a computer program, as in computer-assisted instruction or computer-managed instruction.

In this issue, we publish one more article along this road to a land of riches: "Computer-Assisted Tutorials in College Mathematics" by J. L. Caldwell and Douglas Polley. The authors explore typical student mistakes in solving mathematical problems, diagnose the mistake, and then help the student correct precisely the mistake which he has made.

We can even imagine a time when one of the most interesting and congenial persons you can talk to is an appropriately programmed computer. It will know what you want to know. It will never be boring. It likes questions. It is unfailingly polite, patient, sympathetic, courteous, friendly, and tactful; it is programmed to be gently encouraging. If the computer is not quite sure what you mean, it will ask questions until it "knows" what you mean.

If you say "Don't overload my mind by telling me more than I can remember," then its replies to you will be condensed, and convey only the most important facts. It might even say "If you know these 5 things about the Bering Sea, then you know enough to begin with," or "If you know these 8 things about the Russian conquest of the Caucasus in the 1800's, then you know more than 10,000 people taken at random know."

The computer technology and the programming technology all exist. The selection of knowledge to be stored in the computer memory is a vast field for research and development -- and this field will it is hoped be cultivated well in the next twenty years.

*Edmund C. Berkeley*

Edmund C. Berkeley  
Editor

# The Universal Product Code: An Introduction to What It Means for Consumers

Thomas V. Sobczak, Ph.D.  
Long Island City, NY 11101

*"With the Universal Product Code, you pay more and know less — while supermarket profits change from 1% to 35%."*

The Universal Product Code is the group of lines or bars which have appeared on almost all items in the supermarket. The code is a planned system, developed by the Uniform Grocery Product Code Council, assigning an identification number to every manufacturer in the United States and to each of the manufacturers' products. When fully operative the system will enable every package to carry a unique UPC which will enable the product to be checked out at the retail store counter by a combination of accurate scanning and computer memory.

## Why Develop UPC

The Supermarket Industry had many good reasons, but they can be summed up in one word, "PROFIT."

1. Labor rates in the supermarket industry are expected to double by 1980. UPC can cut the store staff in half.
2. Industry profits, after taxes, are less than 1%. UPC studies indicate a possible 35% return on investment after taxes.
3. Misrings (an error made by the checkout clerk) are 25% of sales. UPC eliminates misrings and allows price changes on the computer faster than the time it takes you to walk from the shelf to the checkout stand.

## How Widespread is UPC

The concept of UPC is being marketed by Distribution Codes Inc. DCI is owned jointly by the Uniform Grocery Product Code Council and the National Association of Wholesalers/Distributors. NAW/D is an association of associations. Each association member is coordinating its activities through Distribution Codes Incorporated. At present, UPC exists under several names.

NAME	ABBREV.	SPONSORING DISTRIBUTOR ASSOCIATION
National Drug Code	(NDC)	National Wholesale Druggists
Health Related Items	(HRI)	National Wholesale Druggists
Publication Code	(UPC)	Council of Publication Distributors
Alcoholic Beverages	(UPC)	Wine and Spirits Wholesalers

Stationary & Business Supplies Code	(DC)	Business Records Assoc. Nat. Assoc. Writing Instrument Distributors Nat. Office Products Assn. Nat. School Supply & Equip. Assn. Paper, Stationary & Tablet Manuf. Assn. Wholesale Stationers Assn.
Electrical Supplies	(DC)	Nat. Assn. of Electrical Dist.
Air Conditioning	(DC)	A/C-Refrigeration Wholesalers
Plumbing	(DC)	Nat. Assn. Plumbing Wholesalers
Distribution Industries	(DC)	NIDA/SIDA (Nat. & Southern Industrial Distributions)

UPC is growing continually, under its many different names; therefore most people tend to underestimate its power. In the Grocery Industry the middlemen and supermarkets, who are staunch proponents of the UPC, want to eliminate price marking on the shelf items. Their lobby is so strong that:

- A Maryland bill requiring price marking died in a State Senate Committee.
- A price marking bill passed the Illinois House and Senate Committee only to lose on the Senate floor by seven votes.
- Virginia Legislators killed a price marking bill because they didn't feel Automated Checkout Systems had been given a fair chance.
- New York State's price marking measure got sidetracked until 1976.
- The President's Consumer Affairs advisor is favorable to UPC, so favorable she suggested that Congress leave the UPC alone.

Figure I shows the domino effect on industry as UPC moves from place to place. It started at Grocery (UPCC) but since Drugs and Health related items are sold in supermarkets, the Food and Drug Administration were convinced (lobbied?) to change the National Drug Code and the Health related item code to the

UPC format. Books are sold in supermarkets, as are magazines. The Publishers were the next to give in. Look at the UPC on the cover of "Family Circle". Recently the Alcoholic Beverage Commission was convinced to specify a UPC code. Remember, outside of New York State, alcoholic beverages are sold in supermarkets.

The trend continues with stationery and business supplies. The logic is the same. In time everything must be scanned mechanically.

The mass merchandising (Discount) stores are accepting UPC because it exists on products they buy. The Federal Department of Transportation is proposing to modify 49CFR577, the law controlling manufacturer marking of auto parts. This opens the door to UPC. It exists in wholesale electrical, air conditioning, refrigeration, and plumbing. UPC goes on and on and on without anyone realizing how quickly it grows or how much it affects their daily lives.

### What Does the UPC Symbol Mean

The symbol is the means by which a machine readable identification mark can be placed on a package. The code is actually eleven digits which are machine readable. The first digit for Grocery Products is the "0" centered before the first Printed Bar. It is called the Number System Character. It was added to allow integration of other industries into the Grocery field. As an example, Books, Drugs, and Health Related items are sold in Supermarkets as are Stationery items.

A look at the components of the symbol will help you to understand how it works in the scanning process. Figure 2 should be looked at after reading each paragraph to get full meaning. Let us read from left to right.

The first area, at the left, is a white space, identified as the "Left Light Margin." This space separates the symbol from other printed matter on the package. It tells the scanner that a UPC symbol is coming.

Next we have a double vertical dark bar separated by a light bar. This is called the "Left Hand Guard Bar." This pattern alerts the scanner to the start of data transmission.

The first character scanned is the "Number System Character" previously mentioned. The example (Figure 2) shows the bar pattern for a "zero" which means it is a grocery product. The "0" in the left light margin provides a human readable character if needed. Random weight items have a Number System Character of 2; Drugs and Health Related items use 3; Coupons use 5; Alcoholic Beverages will use 8.

The remainder of the left hand half of the symbol is occupied by the five characters making up the "Manufacturers Identification Number." As an example, Kraft foods code is 21000.

In the middle of the symbol is the "Center Bar Pattern". Its function is to separate left coded information from right coded information.

The right five characters are the Product/Part Code Number. This number is assigned by the manufacturer to uniquely identify each item he produces. As a point of interest the left side is constructed of a different combination of light and dark bars than is the right. This construction will be explained later.

Following the Product/Part Code Number is the Modulo Check Character. This provides the method by which the computer determines that what the scanning machine has read is accurate.

Finally, the scanner sees the Right Hand Guard Bar which tells the computer that the data collection cycle for this symbol is at an end.

A Right Light Margin again separates the symbol from any other printed matter.

### What's in a Bar

The symbol is designed so that the computer will know whether a particular character is on the left or on the right hand side of the Center Bar Pattern.

A Bar, or more technically a Character, is composed of 7 modulus which are series of light and dark bars. Each number from 0 to 9 has a different arrangement of the 7 light and dark bars which make up the character on either the left or right side of Center Bar Pattern.

Figure 3 shows a left hand "0" consisting of 7 modules 2 bars/2 spaces which is Binary encoded 0001101 where "0" equals light and 1 equals dark.

### How Does the Computer Check for Accuracy

From time to time the scanner will not be able to read the UPC symbol. This is because the Modulo Check Character printed on the symbol does not match the computer-calculated check character based on what the scanner read.

The Modulo Check Character is a mathematical technique through which the scanner-computer combination verifies each product to make sure the UPC will be rejected if it is read incorrectly.

It works as shown in Figure 4:

The complete coded symbol is shown at the top 021000 65883.

The middle line of boxes shows alternative odd numbers beginning with box 1 - 010683. This group of numbers is added equaling 18. Multiply the total by 3. The middle line total is 54.

The bottom line of boxes shows alternating even numbers beginning with box 2 - 20058. Added the total is 15.

The combined total of the middle and bottom line is 69. This is subtracted from the next highest multiple of 10. In our example that number is 70.

The result is a Modulo Check Character of 1, enabling the computer to instantaneously verify the accuracy of the scanner reading.

Mr. Alan Haberman, President of First National Stores, suggested that if consumers were really interested in having prices on merchandise, the supermarkets would be glad to supply grease pencils so the consumers could do the marking themselves. An activist consumer group with grease pencils could cause havoc by making vertical lines in the UPC symbol. The computer will not accept the scan (machine reading). Even more confusing is the potential of consumer activists to break the code and modify certain items of both the UPC and its resultant modulo check character. The computer would go berserk, leaving the checkout clerk and the store manager in chaos.

### Factors Affecting the UPC Symbol

The UPC symbol is fragile in its relationship to the scanner. It must be of a certain size. There must be sufficient contrast for the scanner to recognize light and dark bars. The symbol must be located in such a position as to provide enough room for the light margins, etc. The "UPC Symbol Location Guidelines" as prepared by Distribution Codes Incorporated are very precise.

In the store you might well find that a greasy or oily hand passed over the UPC symbol will prevent an accurate read. Crushed corners on boxes or dented cans may again prevent a positive scan. The stores equipped with scanner systems are in a minority now (less than 1% in 1975). The supermarkets while committed to UPC are approaching the transition slowly because the cost is very, very high.

#### Who Benefits from UPC

The winner with increased profits caused by UPC will be the supermarket operator and the wholesaler distributor. The McKinsey & Co. study, entitled "Phase I Report — Grocery Industry Ad Hoc Committee Universal Product Code", shows that it will cost (quantifiable) manufacturers \$37 million to gain a cost saving of zero. However Grocery Retailers (Supermarkets) and Wholesalers spend \$292 millions to a cost saving of \$444 million.

#### Who Loses if UPC is Accepted

The Consumer — McKinsey estimates it will cost between \$50,000 and \$1,500,000 for a manufacturer to convert to UPC. As the manufacturer's cost rises so does his price. Have you noticed any savings from other supermarket gimmicks? Again the increases will be passed down to the consumer. With the Universal Product Code, you pay more and know less — while supermarket profits go from 1% to 35%. UPC eliminates all price marking on packages. Suppose the house brand was priced higher than the so-called premium brand; without price marking how does the consumer know this. *No prices on shelves? including "unit pricing"?*

What will be the effect on price as marginal manufacturers drop out of competition? Could it be that the wheeler-dealers have an even bigger innovation planned — a seller's market? Supermarket 1984 is watching. Big Brother is small in comparison to what control of foodstuffs can do.

The Uniform Grocery Product Code Council, its love child, Distribution Codes Inc., and the National Association of Wholesalers/Distributors say, "Give the system a chance." Did you ever hear of a system, once started, that could be stopped for less than twice its startup cost? Do you really believe that those people investing \$292 million to gain a 35% return on investment after taxes will give up their profit? If you do, then you can believe in the tooth fairy.

National, State, and Local Government, and the consumers are being set up for the great rip-off: UPC for you and me.

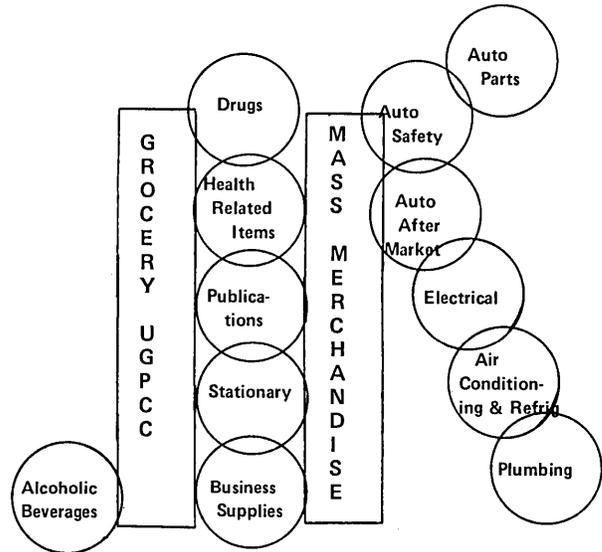


FIGURE 1

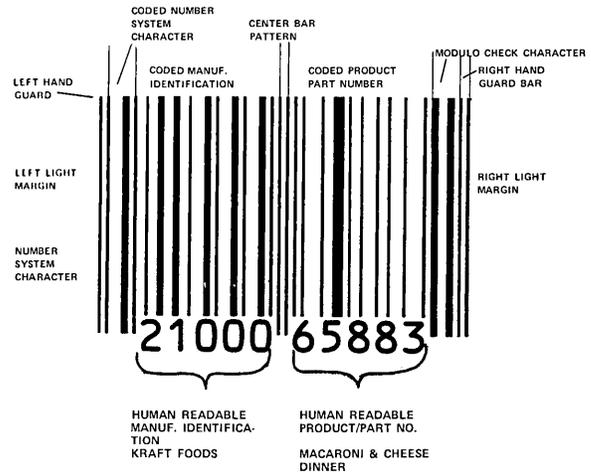


FIGURE 2

(please turn to page 20)

# MULTI-ACCESS FORUM

## COMPUTER GRAPHICS AND ART — OPEN LETTER

To: Subscribers and Intended Subscribers of  
COMPUTER GRAPHICS AND ART

Dear Colleagues in Graphics,

In our announcements we said we hoped to publish the first issue of COMPUTER GRAPHICS AND ART in January, 1976.

We now have to delay our original plan, due to a temporary illness and hospitalization of the editor. The first issue of COMPUTER GRAPHICS AND ART is now scheduled for February, 1976.

Our advisory board members and contributing editors to date include:

Dr. Al Bork, University of California, Irvine  
Dr. Charles Csuri, Ohio State University,  
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Washington, D.C.  
Dr. Joseph Raben, Editor, "Computers & the  
Humanities", Flushing, New York  
Prof. Erich Teicholz, Harvard Spatial Analysis  
Group, Cambridge, Mass.

The first issue is now being prepared. If you are interested in sending materials for this first issue, please do so immediately! If you wish to participate in other issues of this quarterly, we ask that you send your materials as early as possible for consideration. We look forward to working with you, to make this a significant and useful periodical for people in computer graphics and art. We need your help and your subscriptions.

If you have not yet paid for your subscription to COMPUTER GRAPHICS AND ART, please do so now. Or you may wish to enter a Library Subscription, whereby you and your colleagues may share this new quarterly.

May we hear from you soon?

Yours most cordially,

Grace C. Hertlein  
Editor, COMPUTER GRAPHICS & ART  
Berkeley Enterprises Inc. -  
Chico Branch  
555 Vallombrosa, #35  
Chico, Calif. 95926

## IMAGES AND REALITY IN THE COMPUTER FIELD — A DISCUSSION

### 1. From the Editor:

It seems to me that IBM, like the U.S. government and the advertising people on Madison Ave., has given us lessons in image making — the picturing of reality as something different from what it is.

For example, I have never seen an IBM ad or publicity release which admitted in any way the existence of any other computer companies than IBM or any other computer products except those produced by IBM. So if you read only IBM advertising and publicity, you would never realize that other companies besides IBM are in the computer field.

### 2. From Jack Biddle

President  
Computer Industry Association  
1911 N. Fort Meyer Dr., Suite 801  
Rosslyn, VA 22209

Why should IBM mention other companies in its ads? That's what an ad is for — advertising one company and its products.

I think it would be better to show:

- (1) How IBM argues that it has 36% of the market when their own studies and documents show their share to be 60 to 70%; or
- (2) How they participate in voluntary standards meeting to develop a communications protocol (SDLC) while simultaneously developing a different standard internally and spring their de facto standard on the world; or
- (3) Their contention before the courts that "the peripherals market is one big market because of the ease of developing interfaces," when their own internal studies showed that they couldn't enter the PCM market because of the difficulty and expense of the interface.

### THE PURPOSE OF FORUM

- To give you, our readers, an opportunity to discuss ideas, problems, and issues that seem to you important.
- To express comments, suggestions, and criticisms on what you find in this magazine.

# Computers and Society: A Course at York University

Larry J. Murphy  
Atkinson College  
York University  
4700 Keele St.  
Downsview, Ontario M3J 2R7  
Canada

*"I believe there is an urgent need to 'humanize' the computer science major, in fulfillment of C. P. Snow's efforts for a 'bridge between the two cultures'."*

The Natural Science Department of Atkinson College, York University, Toronto, Ontario has offered a "general education" course entitled "Computers and Society" (N. S. 178) for at least seven years. When I began to conduct the course five years ago, it had already been offered for at least two years by a mathematician who treated it much like a programming course. But since the original course outline described an essentially humanities' approach course on computers, there was little problem doing what I felt should have been done originally: offer a general education course on computers for both non-computer and computer majors.

I believe there is an urgent need to "humanize" the computer science major, in fulfillment of C. P. Snow's efforts for a "bridge between the two cultures". I believe no instructors should keep him back from the general history, the history of the theory, the literature (both fiction and non-fiction), and especially the ethics of his chosen field.

Over the past five years N. S. 178 has been offered seven times (including three summers); a total of about 400 students have completed the course (five classes of about 50 students, two of about 75). The course is a full year course as is customary in Canadian universities; it meets for three hours a week from September to May, for a total of about 70 class hours. The summer sessions cover the same material over the same number of class hours, but in half the number of months (May to August). Of the 400 students who have completed the course, approximately 8% were Computer Science majors. My experience has been that they were, overall, the most appreciative single group since when they began they had no idea there was a "history of computers," let alone such an extensive one. They also entered the class with a total lack of knowledge of: the "history of the theory of computers"; the literature on computers (except programming manuals); and most shockingly of all, any appreciation for ethical questions regarding computers and their applications! I believe this experience alone is enough to recommend courses in "Computers and Society" to all computer science majors and minors.

The readings books used in N. S. 178 are:

- Pylyshyn, Zenon W. (ed.): "Perspectives on the Computer Revolution", Englewood Cliffs, N. J.: Prentice-Hall, 1970.

- Lewis, Arthur O., Jr. (ed.): "Of Men and Machines", New York: E.P. Dutton & Co., 1963.
- Bowles, Edmund A. (ed.): "Computers in Humanistic Research", Englewood Cliffs, N.J.: Prentice Hall, 1967.

and either:

- Cress/Dirksen/Graham: "Fortran IV with Watfor and Watfiv", Englewood Cliffs, N.J.: Prentice Hall, 1970.

or:

- Smyth, J. Morgan: "York APL", Toronto: Ryerson Polytechnical Institute, 1972.

For those who feel they need extra support in the basic areas:

- IBM: "More About Computers," Armonk, N.Y.: IBM, 1971.
- Scientific American: "Information", San Francisco: W.H. Freeman & Co., 1966.

For those who wish to specialize in applications of computers:

- Kanter, Jerome: "The Computer and The Executive", Englewood Cliffs, N.J.: Prentice Hall, Inc., 1967.
- Sanders, Donald H.: "Computers in Business, An Introduction", (2nd Ed.), New York: McGraw-Hill, 1972.
- Shorter, Edward: "The Historian and the Computer", Englewood Cliffs, N.J.: Prentice Hall, 1971.

The course is divided into "lecture" sessions and "tutorial/seminar" sessions; the lecture session is used for guest lectures, films, and the general dissemination of information. Since I've come to computers through the history of technology — Hollerith and his electric data tabulating system — and most research in what might be called the "pre-history of computers" or "prerequisites of the computer" is in a very scattered primary literature, if even that, I can see no better alternative to the traditional lecture as the best method of sharing such background with the class. Certainly no adequate text or even readings book has yet appeared.

In the "tutorial/seminar" sessions the issues brought up by the lectures, the readings, and the students' research are discussed.

In addition to the "lectures" and the "tutorial/seminars", the student is required to do work outside of class which includes a minor programming project (relying on the York Computing Centre resource personnel), and two bibliographic projects (relying on the York Library resource personnel). These projects require the student to actually propose, flow-chart, programme, debug, and successfully run a programme on the computer, one that is useful in their area of interest. They may use either FORTRAN IV with WATFIV, (or COBOL if more relevant to their interest), or York APL (Iverson's A Programming Language). This is an interactive language developed at York as an alternative to the batch-mode FORTRAN IV with WATFIV. The projects also require the student to become familiar with the literature of and on computers; they require the student to perform (manually and/or on-line), two bibliographic searches at different levels on computer topics, to evaluate the retrieved articles, and ultimately to abstract selected articles.

Systems of three major computer manufacturers are visited by the students: IBM at York; Univac at the Metro Toronto Computer-Controlled Traffic Light Centre; and CDC at the Control Data Institute in Toronto.

Obviously, the structure of NS 178 is different from other proposed courses, but the content is very similar, as can be seen by comparing the outline below with that of other courses in Computers and Society.

I am much pleased that the U.S. computer community has been promoting courses in Computers and Society, since I feel NS 178 has been very valuable to most of the students who have completed it.

In closing, I wish to stress how important I believe it is not to restrict the courses in Computers and Society to non-computer majors or minors. In fact I strongly advocate that, if a university has any required courses, a course in Computers and Society be required of all computer majors and minors -- and perhaps not just of the students, but of faculty and practitioners of Computer Science as well. Perhaps even a national or international society of computer scientists could (or should) offer and promote such a course for all their members.

#### Course Outline:

#### First Half Year:

#### Period 1: Lectures

Brief history of western civilization as the history of science and technology.  
 Define "field."  
 "Computer Science": is it a science, or part of "Information Science"?  
 Computers allow "control" of information for the first time.  
 "Computer Revolution"? the 2nd Industrial Revolution.

#### Period 1: Tutorial/Seminars

Discussion/criticism of: Pylyshyn's "Perspectives on the Computer Revolution."

#### Period 1: Outside of Class

FORTRAN IV with WATFIV or York APL  
 Visit to York Computer Centre  
 Series of 12 1/2 hour video tapes on Fortran IV with WATFIV

#### Period 2: Lectures

Survey of "Pre-history" or "Prerequisites of the computer":

Information Storage and/or Retrieval Methods/ Devices: Language (words); writing (clay, papyrus); books (scrolls and codices, tape and cards); Hero(n) odometer; Vitruvius odometer; Danzig ribbon weaving loom; Wren and Hooke (1660s); Horse way-wisers; Falcon; Bouchon; Vancanson; Jacquard; Babbage; the Scheutzs; Ritty Brothers; Hollerith; Powers; Comrie; Aiken.

Mathematics, mathematical regularity: Language (numbers); counting; one-to-one correspondence; bases; arithmetic calculating or computing; place holder; zero; Leonardo da Pisa; number analysis (concerned with calculation); Stevin; Napier (logarithms); method of differences; Descartes; Leibniz (binary arithmetic); Boole; Babbage; Maxwell (formalization of the governor); number theory.

#### Period 2: Tutorial/Seminars

History (integration of lectures with Pylyshyn and general history of western civilization).

#### Period 2, 3: Outside of Class

Minor Programming Project

#### Period 3: Lectures

Logic, logic devices: Analysis of language (both words and numbers); Aristotle's logic (syllogism); Ramon Lull; Swift; Hobbes; Leibniz; Charles, the Third Earl of Stanhope; Boole; Venn; Jevons; Peirce; Marquand; Turing (Post), Shannon.

#### Period 3: Tutorial/Seminars

Theory: Algorithms, automata (mathematical), Cybernetics (Wiener, von Neumann)

#### Period 4: Lectures

Digital devices (counting devices: Fingers (toes); one-to-one representation; abacus; computing jetons; digital clocks; Napiers' bones/rods; Schickard; Pascal; Leibniz; Morland; Stern; De Colmar; Babbage; the Scheutzs; additional adding machines and the comptometer; Ritty Brothers; Bollee; Ludgate; Richardson (weather "forecast factory"); Shannon; Aiken (A.S.C.C.); Manchly & Eckert (ENIAC).  
 Analog devices (measuring devices): Stonehenge; ruler; "tape measure"; ancient Greek computer; Planetaria; analog clocks; astrolabs; Arab planetary computers; slide rules (circular and linear); Orreries; Big Horn Medicine Wheel; Amsler planimeter; Kelvin (tide predictor); Kelvin (differential equation solver); Michelson & Stratton (harmonic analyzer); Bush (differential analyzer).

#### Period 4: Tutorial/Seminars

History of the theory, way it came together.

**Period 4: Outside of Class**

Visit to outside computer facility.

**Period 5: Lectures**

Feedback devices; (C) or Ktesibus (waterclock); Hero(n) (wine dispenser); thermostats; windmill control mechanisms; Harrison's chronometer; Watt's steam engine governor; Babbage's bell; Claude Bernard; L.J. Henderson; Walter B. Cannon; Wiener (cybernetics); von Neumann.  
Automata: Mechanical regularity; Hero(n); Albertus Magnus; clocks-clockwork mechanisms; Orreries; Descartes; Newton (clockwork universe); Borelli; Vaucanson; Droz; La Mettrie; Industrial Revolution (automatic actions sophisticated); Babbage; "Turing Machine."

**Period 5: Tutorial/Seminars**

Artificial Intelligence

**Period 5: Outside of Class**

First Bibliographic Project (on computer literature in general)

**Period 6: Lectures**

Electricity, communications: Lodestone; atomic theories (Democritus & Lucretius); compass; Gilbert; 2 fluid theories of electricity; Franklin; electrical games; electrical medicine/psychology; Volta; Ampere; Faraday; Ohm; Henry; Morse (telegraph); Bell (telephone); Edison (Pearl Street station); AC/DC battle; Niagara Hydro; Marconi; Kettering; relays; vacuum tube (diode/triode); Shannon & Weaver; Bell labs; transistor.  
General integration of the 8 "strands" which come together to form the modern digital computer.  
Examples of combinations of "threads" prior to total combination.  
Arrival of modern digital computer: U.S. (A.S.C.C., ENIAC, UNIVAC); England (National Lab, Cambridge, Manchester); Canada (Saskatchewan); Rest of World (Zuse, etc.)  
Software/Hardware.  
Structure of a computer  
Changing Technology, futures re: technological limits.  
Example of subtraction unit.  
Computer languages (according to Jean Sammet, over 1500 languages), futures

**Period 6: Tutorial/Seminars**

Artificial Intelligence

**Period 6: Outside of Class**

First Bibliographic Project (on computer literature in general)

**Second Half of Course**

**Lectures**

Applications:  
Business/Commerce: Bookkeeping/accounting, etc.; Inventory control (guest lecturer from local bank)  
Industrial: Hybrid computers; Control of mfg. process; Examples  
Physical sciences: History of use; Exceptional use; Examples  
Social Sciences: History of use; Exceptional use; Examples (Guest lecturer from Traffic Planning Department of Toronto)

Humanities: Control of literature (umbrella); Art-graphics (film, examples); Music (listen to tapes, examples); Poetry (examples); Future. "Where's it all leading?": Leisure Ethic overtaking the Work Ethic.

**Tutorial/Seminars**

Discussion/criticism of Lewis, "Of Men and Machines" and latter part of Pylyshyn, especially questions/problems of ethics/privacy (Canada, Great Britain, U.S. hearings/legislation on data bank, etc.)  
Guarantee of privacy re: data banks  
Computer Crime  
"Computer as Friend"  
"Computer as Enemy"  
Futures  
Discussion/Criticism of Bowles "Computers in Humanistic Research": Comparison of humanistic applications with non-humanistic applications; Comparison of EDP and computer applications in scholarly research.

**Outside of Class**

Second Bibliographic Project (on the literature of computer applications, theory, history, in all 8 choices).

Visit to UNIVAC Computer facility.

Optional major research project (historical, theoretical or applied) in respect of interest of student (about 1/3 of the class). □

**WHO'S WHO IN COMPUTERS AND DATA PROCESSING**  
THE SIXTH CUMULATIVE EDITION

**WHO'S WHO ENTRY FORM**

(may be copied and expanded on any piece of paper)

1. Name (Please print) \_\_\_\_\_
2. Home Address (with Zip) \_\_\_\_\_
3. Organization \_\_\_\_\_
4. Its Address (with Zip) \_\_\_\_\_
5. Your Title \_\_\_\_\_
6. Your Main Interests:  
Applications ( ) Logic ( ) Sales ( )  
Business ( ) Management ( ) Systems ( )  
Construction ( ) Mathematics ( ) Other ( )  
Design ( ) Programming ( ) please specify: \_\_\_\_\_
7. Year of Birth \_\_\_\_\_
8. Education and Degrees \_\_\_\_\_
9. Year Entered Computer Field \_\_\_\_\_
10. Your Present Occupation \_\_\_\_\_
11. Publications, Honors, Memberships, and other Distinctions: \_\_\_\_\_
12. Do you have access to a computer? ( ) Yes ( ) No  
a. If yes, what kind: Manufacturer? \_\_\_\_\_  
Model? \_\_\_\_\_  
b. Where is it installed: Organization? \_\_\_\_\_  
Address? \_\_\_\_\_  
c. Is your access: Batch ( ) Time-Shared ( )  
Other ( ) Please explain \_\_\_\_\_
13. Do you subscribe: — to *Computers and People* (formerly *Computers and Automation*): ( ) Yes ( ) No  
— to *The New York Times*: ( ) Yes ( ) No
14. Associates or colleagues who should be sent Who's Who entry forms (name and address) \_\_\_\_\_

(attach paper if needed)

When completed, please send promptly to: Who's Who Editor, *Who's Who in Computers and Data Processing*, RFD, Box 177, Hampton, CT 06247

# Software Should Be Patentable

ADAPSO

[Association of Data Processing Services/  
Software Industry Association]

1420 Walnut St.

Philadelphia, Pa. 19102

*"Making clear that patents may be available for inventions in software would unleash enormous innovative talent."*

Association of Data Processing Service Organizations, Software Industry Association (hereinafter ADAPSO/SIA) is a nonprofit trade association of 62 companies in the computer field/1/, approximately 70% of whom concentrate their attention in the software products industry, and the remainder largely in the furnishing of varied software services to computer users and to hardware manufacturers.

ADAPSO/SIA presents its views to the Court because an inaccurate description of software technology and the software products industry has been set forth by Petitioner's Brief and the supporting brief of the hardware manufacturers' association, CBEMA.

ADAPSO/SIA companies are not "idea or think tanks." They are companies engaged in building and marketing machines for which profit-conscious companies will and do expend money. ADAPSO/SIA's members believe they are entitled to the same patent protection for their innovative products as that granted the hardware manufacturers.

## Nature of the Industry

### A. The Absence of Competition in Software

Whereas ADAPSO/SIA is an organization of relatively small companies, with no one company exerting dominance over all the others, CBEMA is an organization of relatively large companies, operating in a computer hardware industry "shaped and dominated by IBM."/2/ IBM's dominance is such that its 70% or better share of the computer hardware market is nearly ten times that of its nearest competitor, Sperry-Rand./3/ Other giant companies such as Honeywell, Burroughs, Control Data and National Cash Register are compelled to share the remaining portion of the market; General Electric and RCA found themselves forced to withdraw entirely from competition. Thus, it is IBM's voice and actions which have and which do dominate the computer industry.

In this case the Government remains silent while CBEMA distorts the history of the computer industry to assert that "the computer industry has developed in an atmosphere of free interchange of computer

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Based on a portion of the Brief Amicus Curiae No. 74-1033 for ADAPSO/SIA filed with the U.S. Supreme Court on October 16, 1975.

programs..."/4/ How "free" the atmosphere has been in the computer industry is best shown by the Government's pretrial brief in "United States of America v. International Business Machines Corporation."/5/

The Government in its antitrust action against IBM notes the development of the computer industry and finds that in "the earliest days of the development of the computer industry, there was nothing that could be identified as a software industry."/6/ This was in part because users design some of their own software and because the "computer systems manufacturers, following IBM's lead, provided [free] much of the software [that] users required."/7/

It was not until the late 1960's that "the independent software products market emerged, pioneered by the firm Applied Data Research, Inc.,"/8/ one of the amici herein. As the Government notes, "in light of the fact that IBM provided its customers with their software requirements as part of the IBM 'total systems solution,' independent software product firms had to market their offerings against products for which there was no identifiable price. As a result, only those companies which could offer products not available 'free' from IBM or which could demonstrate the technological superiority of their products in comparison to IBM's had any chance of survival."/9/ The result was that the independent software product firms lacked "a realistic opportunity to compete."/10/ That this was not an innocent case of cause and effect was shown by IBM internal memoranda which revealed that "the value of this exclusionary effect derived from bundled pricing [so-called free software]/11/ was fully appreciated by IBM.... The effect of IBM's ability to wield such exclusionary power has been felt most acutely...by those firms seeking to market software products."/12/

The Government has also noted that "IBM internal memoranda...reflect that from as early as 1965, IBM was aware of the marketing benefits derived from bundled pricing and the anticompetitive effect it had on software companies."/13/ The net effect was that "bundled pricing enabled IBM to exclude competition from independent software vendors."/14/

The Government concludes that its study of IBM documents "illustrate without ambiguity that its bundled pricing marketing approach was a practice known by IBM to be legally indefensible. Neverthe-

less, IBM consciously continued bundled pricing because of the competitive leverage it afforded IBM in maintaining its monopoly position."/15/

Software monopolies are also maintained by other hardware manufacturers through the use of bundling. A small software company has sued Sperry Rand, charging it with refusing to place a price on its bundled software and thereby making it impossible for the small company to sell its software in competition. /16/ Honeywell in bundling its software and hardware asserts that the software is "free." But when the hardware buyer attempts to transfer that software along with the hardware to another company, Honeywell claims that it owns the software and will control who can have possession./17/

#### B. The Resulting Poor-Quality Software

The CBEMA brief also boasts of "the tremendous growth of the computer software industry and the vast number of breakthroughs in the field of programming, which have occurred in the last two decades" (CBEMA Br. 12). How different the facts really are in the computer software field is made clear by the testimony of Dr. Ruty M. Davis, Director of the Center for Computer Services and Technology of the National Bureau of Standards/18/ characterizing the present condition of software as "poor-quality software," a condition which she described as the "crucial computer problem" confronting the nation today. Speaking on the "seriousness of the problems besetting both the consumers of computer products and services and the suppliers of these products and services" Dr. Davis stated:

The crippling problems are lining up in the software rather than in the hardware field. In particular, they fall under what we call the application-independent problem category ...these are the software problems which are common to many applications.

That the condition described by Dr. Davis in 1972 still holds true is seen by her warning at the CBEMA Spring meeting, May 29, 1974 that "the difficulty and cost of developing and maintaining quality software have become the single largest consideration in computer utilization and composes a serious limitation on the cost-effective use of computers."

Even IBM acknowledges that "the biggest problem facing programming today is the extreme difficulty and cost encountered in creating and maintaining large programming systems."/19/ At the National Computer Conference held early this year it was admitted by a leading hardware manufacturer that the "software dinosaur" has not "kept pace with the technical needs of the industry."/20/ As a result of the software users being at the mercy of the hardware manufacturers, the users are forced to make do with the "free," poor and technically inferior software./21/

The reason for the poor state of the development of software lies in the shackles IBM has placed upon free competition. History shows that it has been small technological companies and independent inventors, and not the vast financial combines such as IBM, which have been responsible for much of the innovation of this age. A recent government report has found that "studies of the sources of invention and innovation have shown that independent inventors and small technologically based companies are responsible for a remarkably high percentage of the important inventions and innovation of this century. /22/

#### C. The Small Company Potential for Competition

The small, mostly "young and struggling", companies who "surely possess excellent technical innovative capabilities" and "the principal technical capability...to work...on our critical computer problems"/23/ have been wrongfully denied the incentive of the patent system, which has been assured to the hardware manufacturers for products they sell. The patent incentive is both a form of recognition and a major aid in obtaining the necessary financing without which these companies face the prospect of shriveling and dying. It is no accident that the monopolistic and exclusionary practices of IBM have permitted only a small number of companies in the software products field to achieve a relative degree of success. As the Government states in its pretrial brief "operating systems continue to be part of IBM's bundled price structure. These continue to be bundled for the marketing leverage they afford IBM in terms of increasing the sale of IBM computer equipment and forestalling the growth of independent software companies."/24/

#### D. The Importance of Patent Incentives

A patent on a software program creates an economic toehold in the monopoly-dominated computer field. The software products company characterized by the Government as the pioneer in the independent software products market, Applied Data Research, Inc./25/ stands as proof of the importance of software patents./26/

To a large financial giant, the economic value of a patent may not loom large; to the small software companies upon which the future of the development of quality software depends, the financial value of the patent may spell the difference between life and death. To banks and financial institutions the existence of a patent or even the potentiality of obtaining one may well be a decisive factor in determining whether a loan should be granted. To prospective investors a patent or the possibility of obtaining one may be the principal element in the decision whether to invest.

Making clear that patents may be available for inventions in software would unleash enormous innovative talent. It would have the direct opposite effect forecast by IBM and the other hardware manufacturers -- it would enable competition with those companies and provide the needed incentive to stimulate innovation.

Patent protection would encourage the free dissemination of program innovations which is so necessary to stimulate technological progress. Disclosure is the statutory price paid by the inventor for patent protection. Without such protection inventors principally have to rely on the law of trade secrets in order to secure the economic value of their inventions, thereby excluding from the world-at-large disclosure of the invention.

When the Patent Office for its own convenience/27/ urges that inventors rely on trade secrets in lieu of patents, it is ignoring the mandate of the Patent Laws, and when it urges copyrights as another potential alternative, it is denying the inventiveness of an entire technology, thus abdicating its responsibility under the Patent Laws to grant patents for machines that "advance the Progress of the useful Arts."

Such computer programs as are freely disclosed in the trade literature of the computer industry

have little economic value or technological worth. All that this kind of "free exchange" has produced for the computer industry has been "crippling problems" and "poor quality software." The real strides forward in computer development occurred in hardware, an area fully protected by the patent laws. In a competitive economy, that which is given away for nothing tends to have the same value. Non-profit companies are non-existent in the computer industry. CBEMA favors its version of "free interchange of programs" because that has been one of its major techniques in excluding competition and in monopolizing the computer industry. It is profits and not "free interchange of programs" or "innovative software that CBEMA seeks."

The economic forces opposed to patent protection were clearly identified by Judge Rich in his dissenting opinion below. As he stated it:

On the one side...against patenting programs or software [were] collective forces of major hardware (i.e., computer) manufacturers and their representative associations who, for economic reasons, did not want patents granted on programs for their machines. (Emphasis in the original.)

This portion of Judge Rich's "dissent" (a dissent whose purpose was to provoke this Supreme Court review to obtain a ruling providing for software patents)/28/ is ignored by the Government as is the fact that Judge Rich reaffirmed his view as to the soundness of his previous opinions on computer technology.

When one knows that every action taken by IBM has been motivated by its monopolistic and exclusionary desires, one understands why IBM has led the legal fight against patents for software. It is not to strengthen the computer industry but only to strengthen IBM's stranglehold upon it that IBM postulates its legal theories in opposition to patents. Strange indeed is it that the Government despite its firsthand knowledge of IBM's efforts aimed at "forestalling the growth of independent software companies"/29/ joins hands herein with IBM in furtherance of IBM's monopolistic endeavors.

To arbitrarily deny patent coverage as urged herein by the Patent Office is to denigrate software technology and to cast a chilling effect upon inventiveness.

#### Summary of Argument

The writ of certiorari should be dismissed as improvidently granted. because of the inadequate record, the jurisdictional barrier to the reconsideration of a central factual issue, and the inappropriateness of the principal question for which certiorari was granted. To consider what the Patent Commissioner presents as the key issues in this case would require this Court to undertake a thorough inquiry into the complex technological issues of special-purpose computer construction, but the record does not provide the factual basis which would enable the Court to do so. The Supreme Court is not the appropriate forum for initial fact finding.

The most basic technological issue — the Board of Appeals' finding that programming a general-purpose computer restructures the computer into a different machine — is not jurisdictionally subject to review because 35 U.S.C. 141, et. seq. bind the Commissioner of Patents by Board determinations.

Since the Board is the alter ego of the commissioner, his attempt to appeal its finding is in essence a nonjusticiable intra-agency dispute. Moreover, the C.C.P.A. and the Board have considered the basic technological fact issue, each has special credentials of technological expertise and both have found in favor of the restructuring principle.

The broad question for which certiorari was granted — whether innovative machines which can be embodied in computer programs are patentable subject matter — is inappropriate for judicial resolution in this case because patentability depends on the structural nature of the specific invention not which of alternative types of construction was employed. The petitioner has conceded that the Court cannot formulate a rule of general applicability in its decision of this case and that the only other question presented — obviousness under 35 U.S.C. 103 — is not worthy of this Court's attention.

The petitioner's main legal arguments depend on a mischaracterization of computer program technology. An accurate picture of this technology reveals that a programmed general purpose computer is a different machine than the unprogrammed machine. The designer of software, like any engineer, builds machine structures, not methods of doing business; he develops machine solutions for machine problems. Computer innovations embodied with stored computer programs are legally entitled to the same patent protection as innovations embodied in wire-connected electronic circuits, for technologically "hardware" and "software" are equivalent.

The facts that a programmed computer (what respondent defines as his invention) is a machine and the innovative aspect of it is a machine structure cannot be overcome by petitioner's legal arguments. A machine is not a method of doing business. An innovative machine structure is not the mere embodiment of an abstract idea. Machines are patentable subject matter and respondent's only argument against software being patentable subject matter is the unsupported statement — appealing perhaps to a layman but universally rejected by the experts — that a program is not a machine but merely an idea, "new use," or "method of doing business."

Patent protection for software is vital to the health of the data processing industry. In a field dominated by IBM, the growth of the small independent software company has been stifled by the bundling practices of the hardware manufacturers which continue to this day in the systems programs area. Only through the availability of protection for their products can the software producers hope to bring competition to an industry that sorely needs it.

The absence of patent protection has forced reliance on trade secrecy and has had the negative effect of deterring disclosure of innovations. The availability of patents, with their public disclosure requirement, would "promote the progress of the useful Arts," in this most sophisticated, pervasive and vital area of technology.

Copyright protection is inadequate and inappropriate to protect innovative machine structures. Copyright of a particular set of computer language statements does not protect the novel machine structure that is the core of any software invention. The Constitution establishes innovation as the prerequisite for a grant of exclusive rights to machine structures; attempts to protect them via copyright  
(please turn to page 20)



10 20 DESIGN '//Δ@V\\'

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∇/∇∇Δ∇/∇/Δ\\//Δ/∇
\∇∇//∇@/∇\\//\∇\
∇/∇@/Δ/∇/\\//∇Δ∇∇
Δ∇\\∇∇Δ\∇/∇/Δ∇/\\
/∇@/Δ∇@//\\Δ/∇Δ∇∇
//Δ\∇/∇/∇/∇\\∇@/∇\
∇∇∇\∇\∇/Δ∇Δ∇ΔΔΔ/
\//∇∇∇Δ\∇/∇/∇\∇Δ\
∇@Δ\\∇∇\Δ∇\Δ\\Δ\Δ\

```

10 20 DESIGN '~ ~'

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~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~
~ ~ ~ ~

```

10 20 DESIGN '0 0 0 0 . '

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0 0 0 0
00 0 00 . 0 0
0 0 0 0 00 00 .
0 0000 0 0000
00 0000 0 0000
0 0 0 0 0000
.00 0 0 00 .0 0
. 0 00 0 0
00. 0 0
0 . . . . 0.

```

10 20 DESIGN '\* \* \* \*'

```

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```

These black and white "Computer hieroglyphics" may have dubious aesthetic appeal. But one can imagine — instead of these typed symbols — randomly generated swatches of color, perhaps displayed on a television-like screen.

Extensions of this approach to computer art include: (a) automating DESIGN, (b) weighting the selection of COLORS, (c) asking for human judgement (Do you like it or not?) in order to adjust weights on COLORS or other aesthetic factors, and (c) piecing together several computer-generated PICTURES into a montage.

Another approach to computer art involves viewing programs which simulate an artistic technique. For example, consider the program MONDRIAN below (named after the Dutch abstract painter).

∇ MONDRIAN

- [1] CANVAS ← 30 50p'
- [2] DAB: COLOR ← '0□'[?3]
- [3] SIZE ← 3 5 [ ?6 10
- [4] PICK: PLACE ← ?30 50-SIZE
- [5] OVERLAP ← +/+ /CANVAS[PLACE[1]+1SIZE[1]; PLACE[2]+1SIZE[2]]≠' .'
- [6] →PICK IF OVERLAP > 2
- [7] CANVAS[PLACE[1]+1SIZE[1];PLACE[2]+ 1SIZE[2]] ← COLOR
- [8] →DAB IF (PERCENT ' ' ON CANVAS) > 67
- [9] CANVAS

∇

MONDRIAN begins with a blank canvas (arbitrarily set at 30 by 50). Then the program chooses a random COLOR, SIZE and PLACE to DAB.

OVERLAP measures the extent of overlap with DABS already on the CANVAS.

IF OVERLAP is greater than 2, then it will PICK another PLACE. (This is tantamount to finding relatively open space on the CANVAS).

IF, however, OVERLAP is not too large, the COLOR is put on the CANVAS at the PLACE and in the SIZE selected.

The program continues to DAB IF the PERCENT of blank spaces ON the CANVAS is greater than 67. In other words, as soon as it is 1/3 filled up, CANVAS is displayed.

Note: MONDRIAN uses two simple sub-programs (mostly for readability). They are PERCENT and ON:

∇ HUNDREDTHS ← PERCENT N

- [1] HUNDREDTHS ← [ 0.5+100×N

∇

∇ DENSITY ← SYMBOL ON PICTURE

- [1] DENSITY ← ( +/+ /SYMBOL=PICTURE) ÷ ( ×/p PICTURE)

∇



MODULOS

may become considerably more sophisticated. Possible extensions include: (a) displaying pictorial feedback — like a "smiley face" for positive reinforcement or a "grouchy face" \*\*\*\*\*

```

*   o   o   *
*   v   *
*  \_/  *
*****
    
```

\*\*\*\*\*

```

*   x   x   *
*   Δ   *
*  /-\  *
*****
    
```

instead of 'NOPE. TRY AGAIN.', (b) presenting a pre-specified total number of problems, (c) limiting the number of allowable mistakes on individual problems (or all problems), (d) generalizing the multiplicands to create a more flexible range of problems (including negative numbers, decimals, etc.), (e) gathering performance data, (f) using performance criteria to make diagnoses, (g) automatically adapting level of difficulty based on diagnoses, (h) adding personalized instructions, and (i) building in timing components, jump-ahead options and hints.

Conclusion

These are but a few APL "glass box" programs designed to stimulate students to think about selected concepts. Each of the sample programs shown here can be used as is and, of course, can be extended in a myriad of directions. Other topics well-suited for this pedagogical approach include topics drawn from linguistics, statistics, mathematics, engineering, ecology, and physical sciences.

The challenge to educators, then, is to identify such topics suitable for embodiment as glass box programs, to search out the kernel concepts to be taught, and to lead students to better understandings of those concepts using a programming language.

Notes

/1/ A Programming Language (abbreviated APL) is a multi-purpose computer programming language developed by Kenneth Iverson of IBM. Originally conceived as a unifying mathematical notation, APL has since been used successfully in fields such as business, scientific research and education.

/2/ This program is similar to one written in a simplified FORTRAN by John Loehlin in "Computer Models of Personality", Random House, NY, 1968.

/3/ This question is treated as a theorem by Minsky and Papert in their book "Perceptrons," MIT Press, 1970.

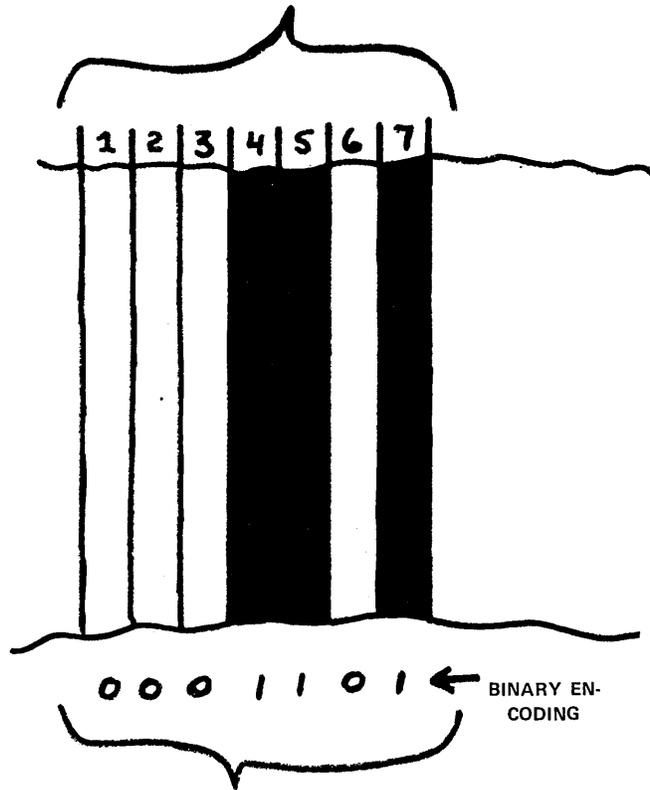
References

- (1) Papert, S. "Teaching Children Thinking", M.I.T. LOGO Memo #2, Oct. 1971.
- (2) Iverson, K.E. "APL in Exposition", IBM Tech. Report #320-3010, Jan. 1972.
- (3) Berry, P. et. al. "APL and Insight: The Use of Programs to Represent Concepts in Teaching", IBM Tech. Report #320-3020, March 1973.

ADAPSO - Continued from page 16

or registration run counter to this principle.

At stake in this case is equal patent treatment for the products of small software companies. The myth perpetuated by the Government and CBEMA -- that computer-program embodied inventions are not machine inventions -- has been exploded; there is now no justification for the denial of patent protection to software-embodied machines.



LEFT SIDE OF UPC SYMBOL ZERO

FIGURE 3

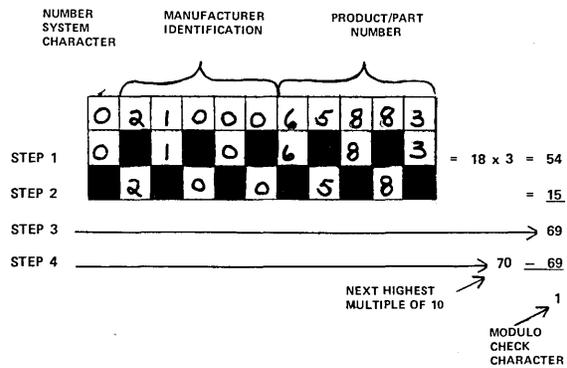


FIGURE 4

For the meaning of the 29 references and for the rest of the brief, please ask ADAPSO for a copy of the printed brief.

# Computers and People: Case 1 --

## "Stuart University"

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Stuart University\* was founded in the 1890s and has an enrollment of more than 10,000 full-time equivalent students and about 500 faculty members.

Administratively, the university consists of the board of trustees, the president, and vice presidents of academic affairs, research, financial affairs, student affairs, public relations, and planning. The various academic units are administered by deans and their assistants. Administration of Stuart, a private institution, has historically been relatively centralized and informal. Recently, there has been a gradual movement toward some decentralized decision-making as well as formalizing of policy and procedures. Long-range planning, budgeting, and institutional research are all receiving increased attention at Stuart. Overall, student enrollment has had some modest growth, but some specific educational programs have had serious declines in enrollment.

The data processing center began operating in the late 1950s, mostly for academic uses in the areas of mathematics and science. At that time, the center was administered on a part-time basis by a faculty member. In the 1960s, the data processing center was placed under the supervision of a full-time computer specialist who reported to the Vice President of planning. Several full-time computer programmers were hired. In a few years the major use of the computer was for administrative applications (e.g., payroll, accounting, students' grades, registration records) rather than for academic work. In the early 1970s, a university computer committee was established; the committee contained representatives from administration and academic departments. The committee recommended the establishment of an integrated information system for the university. A systems task force was designated to design and develop such a system. The head of the task force, a full-time systems analyst, also reported directly to the vice president of planning. Two goals were set for the task force: 1. The design and development of two data bases; a student file and a faculty file. These would constitute the beginning of an integrated information system. 2. An attempt to develop a university simulation model to be used as an aid in predictive planning for the university.

\*While based on an actual situation, the case material has been slightly modified to conceal the identity of the institution.

From time to time "Computers and People" presents a capsule case which illustrates practical problems and issues related to computer technology and its use in organizations. A case includes questions. Readers are invited to compose their answers to the questions and, if they wish, mail them to Dr. Tomeski before the 10th of the month following the month of publication. In a subsequent issue each case will be discussed and selected responses by readers will be printed, along with a proposed solution by Dr. Tomeski.

Recently, the use of the computer has been increasing in the academic areas for educational and research purposes. The data processing center, however, has a mandate to concentrate most of its time on administrative areas and the integrated information system. Consequently, there have been increasing complaints from faculty that educational technology is being neglected, and that such neglect harms the quality of the university education and research effort. Some professors use outside computers, because the university's computer is either inadequate for larger problems or the response time is poor. Because of the increase in operating costs (e.g., faculty salaries, fuel bills) and economic uncertainty, the university is operating under a very tight budget.

#### Questions:

1. From the information available, do you think the faculty complaints appear justified? What can the faculty do to alleviate the problem?
2. What are the dangers, to the university, if more computer power is not made available to academic and research users?
3. What is your assessment of the university computer committee and its role related to the data processing center? Can you reconcile the responsibilities of the vice president of planning, director of the data processing center, and the systems analyst who heads the systems task force?
4. What is the best way of balancing the center's service between the administrative and academic users of the university?
5. What actions would you take if you were the vice president of planning?

# Computer-Assisted Tutorials in College Mathematics

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*"While operating the programs, the students showed a most unusual enthusiasm for quadratic formula and line problems."*

Many uses of computers in mathematics education are well known. We believe that our approach differs in important aspects from most standard uses. It is hoped that this note will encourage others to experiment with techniques similar to the one presented.

## Analyzing Student Answers

The programs which the authors have designed and written were specifically intended to analyze the students' answers to computational problems. We call this approach tutorial (although this terminology is nonstandard) because the programs mimic the role of a tutor in the traditional sense. No new material is presented via the computer. We assume that the student has received instruction in basic formulae before using the programs. If the student responds incorrectly to problems generated by the program, the program analyzes the student's answers in an attempt to identify common errors.

The first programs deal with quadratic equations and equations of straight lines. A program dealing with sums of rational functions is under construction.

## Problems with Randomly Chosen Parameters

The format of all the programs is the same. The student, seated at a teletype, receives a problem with randomly chosen parameters. The student then solves the problem and enters his solution. If his solution agrees with the computer's solution, then another problem is presented. If the student's solution is incorrect, the computer then works the problem incorrectly in several different ways, each time checking its answer against the student's. If a match is obtained, then the computer suggests that the student has made a certain error and asks him to try again. If none of the incorrect answers match the student's answer, then the computer will check the student's work step by step. For example, in the case of the quadratic equation program, the student is first asked "What did you get for A, B, C?" and then later "What did you get for B -4AC?" Finally, if the student does not enter the correct answer, he receives a detailed solution. (For over 90% of the problems we have checked thus far, the student has eventually entered the correct answer.) If a student requires detailed solutions to several problems, he is asked to contact the instructor.

Reprinted with permission from the "American Mathematical Monthly", October, 1975

## Programming Languages

The programs were written in FORTRAN and implemented on a CDC 6400 computer, but other choices would serve well also. In particular, the size of the CDC 6400 is unnecessary because such programs are easily divided into subprograms. FORTRAN could be replaced, and in fact the programs are currently being translated into BASIC to permit their use on other time sharing systems. The use of an instructional dialogue language (IDL) would greatly facilitate the writing; but unfortunately the authors know of no IDL which has the capability of generating problems at random. Hopefully this void will soon be filled.

The principal use of the programs has been by precalculus and linear algebra students at the University of Wisconsin-River Falls and the Minneapolis and Morris campuses of the University of Minnesota. In addition, several other members of the Minnesota Educational Regional Interactive Time-Sharing System (MERITSS) have been involved.

Those readers desiring additional information about the programs are invited to write UWRF.

## Discovering the Source of a Student's Error

It was our intention to identify the source of a student's error as soon as possible with minimal interrogation of the student. This presents some interesting theoretical, as well as practical, questions. On the theoretical side, we may ask just how much can we tell about the source of the error based on our knowledge of the incorrect response, the correct response, and a knowledge of the technique being used. On the practical side, we have the considerations motivated by the following example of two incorrect solutions to the problem: "Find the equation of the line through the point (2, -3) with slope 2."

I	II
$y - 3 = 2(x - 2)$	$y + 3 = 2(x - 2)$
$y - 3 = 2x - 4$	$y + 3 = 2x - 4$
$y = 2x - 1$	$y = 2x - 1$

In I the mistake occurs in the first line, while in II the error is in the subtraction of the last line. In both cases the answer given is the same. Although the existence of the error can be readily identified, and it may be reasonable to assume that any incorrect answer of the form  $y=2x - 1$  is due to one of these methods, we still cannot tell which is the case. In programming the response to this situation we may issue a message of the form "I think you computed  $y - y$ , incorrectly, or perhaps you combined terms incorrectly." Alternatively, we may inquire "What did you get for  $y - y$ ?" While the latter choice is less ambiguous, it is more difficult to program because it involves additional decisions. In situations where the error is not among those errors deemed most likely to occur, it may be acceptable to respond in the former manner.

#### System Design Considerations

For those who want to develop a series of integrated tutorial programs there will be some additional system design considerations. One problem is how to allow a student to progress through problems of varying levels of difficulty. One possibility is to have a level indicator which determines the difficulty of the problem generated as well as the details of the interrogation of the student. In the case of a student who has made several mistakes we would assign a lower number and ask him to enter his work a step at a time. For a student who is not making many mistakes we would not ask for as many intermediate steps and give more opportunities to correct mistakes before we present the solution.

Another item of some import will be a series of software routines for such things as reading student input (e.g., polynomials) and extracting relevant data. Other such routines might include a means for comparing algebraic expressions to determine if they are equivalent (see Uttral [6]). Of course, once such routines have been written they can serve a large number of tutorial programs.

#### Immediate Individualized Help

We believe that this approach is a valid utilization of computer facilities because it offers immediate, individualized help to students in a manner that can be duplicated only by actual consultation with an instructor. The advantage to the student is a source of immediate feedback which might not be available if he had to compete with other students for help from the instructor. The advantage to the instructor is more time to deal with conceptual problems which are basically computational in nature.

#### Reduction in Teletype Time

We feel that this approach has advantages over the setting in which the entire course is presented via the computer. First there is a reduction in the teletype time required because the student first attends class or perhaps studies a programmed text, then comes to the computer to work problems. Even more teletype time can be saved if our system is modified by assigning to the students problems that are stored in the computer. Then the student would come to the computer only with problems he could not work. (Minimizing teletype time is important because it is often more scarce than computer time.) A second advantage is that tutorial programs are compatible with different presentations of the course material, thus leaving more control in the hands of the individual instructor.

#### Experience in Developing the Programs

Another benefit of a system of tutorial programs is the experience gained in developing them. The authors are currently having senior mathematics education students create additional programs because we believe that they will thus obtain a better understanding of the errors a student may make and also develop a facility in explaining the material. The student designer will, of course, learn much in the area of system programming.

#### Enthusiasm

Our experience with programs developed so far has indicated that there is considerable potential in this type of computer-assisted instruction, particularly at the college algebra level. The manipulative nature of many of the topics in college algebra (such as determinants, systems of equations, etc.) makes them suitable for the problem and answer analysis framework. Programs in this area would also provide review material for calculus students whose problem-solving techniques need improvement. In response to a questionnaire, students who have used existing programs indicated they considered the process most helpful and would recommend it to their fellow students. They also expressed a willingness to try new programs when they become available. While operating the programs, the students showed a most unusual enthusiasm for quadratic formula and line problems. It was most encouraging to see the students' satisfaction in obtaining the correct solutions with the assistance of the computer. For these reasons the authors hope that this approach will be expanded and improved.

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# Computing and Data Processing Newsletter

## COMPUTER "SCENARIOS" FOR THE APPLICATION OF PESTICIDES BEFORE THEY ARE APPLIED

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Biological and computer scientists at Michigan State University are going to attempt to head off ecological and environmental crises before they start. They will develop computer "scenarios" of the expected future effects of pesticide applications. They are funded by a \$360,000 grant from the federal Environmental Protection Agency. Under the general management of Pesticide Research Center at MSU, a research team of biologists, a group of systems scientists and pesticide experts will examine the environmental impact of 12 of the most commonly used "soft" pesticides. Dr. Erik Goodman, assistant professor of Electrical Engineering and Systems Science will head the group.

Soft pesticides — usually organic phosphorous and carbamate compounds — are generally considered safer by environmentalists because of their relatively rapid breakdown to nontoxic compounds. But in nature, things are rarely simple and loss of toxicity in the laboratory doesn't mean that a chemical will behave identically in the field. Even transient toxicity can have long-term detrimental effects in an ecological system. Temperature, humidity, or the activity of bacteria and fungi can drastically alter the persistence of a pesticide. To forecast the effects of an application, these and a number of other variables should be, but rarely are, taken into account.

The characteristics of an ecosystem — its geographic location, the kinds of animals and plants in it, its physical and chemical properties — all can have tremendous influence on the effects of a given pesticide. A chemical application having minimal side effects in a northern forest, could be disastrous to shellfish living in waters adjacent to a southern farm field. Because the ecological consequences of an improper chemical application can be severe, and because there are so many variables to consider, we need computer simulations to handle efficiently all the information relevant to rational decisions. With many scientist contributing information from many places, solving such a problem resembles working on a jigsaw puzzle without being sure of having all of the pieces. Computer models will help direct future research by putting available information in perspective, allowing scientists to identify information gaps and to establish relevant research goals.

## COMPUTER MONITORS PRESCRIPTIONS AND HELPS PREVENT ADVERSE DRUG REACTIONS

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Prescription drugs offer remedies for almost everything from circulatory disease to headaches, these same drugs can pose hazards if taken in the wrong combinations.

The average adult today consumes thousands of doses of medication a year. Tranquilizers, antacids, aspirin, antibiotics, cold remedies — the list is long and diverse.

We know of at least 17,000 documented drug interactions with other drugs, foods, miscellaneous substances, conditions and circumstances. Many of these interactions are harmless; others can produce symptoms requiring treatment, or even endanger life.

It costs an estimated \$2 billion a year to treat people in the United States suffering adverse drug reactions. Nearly 20 per cent of all hospital days in the nation are devoted to care of these patients.

To help prevent these mishaps, Group Health Cooperative has installed a computer system to monitor more than one million prescriptions issued yearly.

The Co-Op is a prepaid health care provider, and has more than 200,000 members in the Puget Sound area and a medical staff of 200. It operates a major hospital and ten neighborhood medical centers, each with its own pharmacy.

Patient profiles, listing the medication history, drug allergies and chronic illnesses of all GHC patients, are stored in a central computer. Another file lists all pharmaceuticals in stock, their chemical formulations, side-effects and interaction problems, if any.

This information is instantly accessible by means of remote TV-like computer terminals in the outlying pharmacies.

When a Co-Op member presents a new prescription, the pharmacist enters the patient's name and number into the system, which then scans the appropriate medication history. If the drug prescribed will react negatively with those the patient already is taking — including patent medicines — the computer automatically stops the process and indicates that the prescription should not be filled. If the pati-

ent's computer record shows an allergy to the medication, or one of its ingredients, the system displays this information on the remote terminal screen.

In either case, the pharmacist then contacts the prescribing physician and requests alternative therapy.

For example, if a person is allergic to penicillin, the doctor will prescribe a different type of antibiotic drug. But if this substitute should contain some form of penicillin, the computer will halt the prescription-filling process and alert the pharmacist.

The effects of certain antibiotics can be nullified if taken in combination with food or antacids. If a Group Health Cooperative member regularly takes antacids, this fact will be noted in his computer record. When this patient presents a prescription for an antibiotic, the computer will alert the pharmacist who then advises the patient how to avoid the interaction.

To deal with another situation, the computer system will reject a prescription for a sugar-based cough syrup, if that should be ordered inadvertently for a diabetic.

If no problems appear when the patient's profile is scanned, the new prescription is added to the record and a label is automatically printed.

The system does not replace the trained pharmacist or physician, but it serves as a major aid in dispensing the most effective and safe medications. At the same time, it reduces the tedious chores which pharmacists and their assistants would have to perform by hand.

All pharmacies in the State of Washington soon will be required to maintain medication profiles on regular consumers. The Cooperative's computer system will keep these records, ensuring compliance with the new ruling and conserving thousands of hours of pharmacists' time — time that would have been spent on maintaining manual records.

Another benefit of the system is that the computer is programmed to monitor the drug inventory. So the size of the inventory can be reduced, and costs cut, without fear of sudden exhaustion of stock. The system will generate reorders when quantities are low.

The newly-installed computer system will save money and, in addition, provide better service to the Co-Op members, making a larger contribution to their good health.

The computer used is an IBM System 370 Model 125.

## MINICOMPUTER HELPS CUT UNIVERSITY'S ELECTRIC BILLS

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Administrators at the University of California at Berkeley have installed a minicomputer system to monitor the use of about \$125,000 per month worth of electrical energy. The system is helping facility managers here discover exactly where and how power is consumed and how best to reduce the large monthly bill.

While itself consuming no more energy than a room air conditioner, the system monitors more than 20 megawatts of power used in 75 buildings on this campus. The Lawrence Berkeley Laboratory is separate electrically and accounts for another 20 megawatts.

The system includes a data acquisition and processing system containing a minicomputer and 31 transducers which sense voltage and current flow in the feeder circuits to all the campus buildings. The computer scans the transducers once per minute to take a new set of readings. These transducers are situated in the central, high voltage distribution cubicles, each of which supplies a single large building or several small buildings.

Signals from the transducers are conditioned by a scaling device. Then they travel over both campus and dedicated telephone company lines through an analog-to-digital converter and finally arrive at the computer. In real time, the computer generates displays of energy use in each of the 25 cubicles. The displays are monitored by a console in the plant engineer's office, and displayed data is also stored on one of two disc drives. Later, the displays are plotted offline on a digital plotter, and graphically display patterns of energy use over periods of a day, a week, or a month. A teletype is also available for producing data tabulations and for program development entries and output.

The Berkeley system is being used to examine the two main factors which go into the calculation of the institution's monthly bill — energy demand and energy usage. Demand represents how much energy the campus may require at any given moment, while the power or energy used is, of course, the summation for a given time period.

High demand peaks occur at the university when several experimental apparatus such as the main campus' wind tunnel, small nuclear reactors, and plasma experiments are turned on simultaneously and superimposed on the ordinary "background" loads such as lighting, heating, cooling and continuously-run experiments.

A high demand peak pays a heavy penalty. To help defray the costs of turbines, generators and transmission lines necessary to meet the highest peaks which may arise, no matter how short their duration, the Pacific Gas and Electric Company (PG & E) incorporates peak demand into the billing equation very significantly.

In charging for peaks in demand, PG & E employs what is called a "ratchet effect", whereby the highest peak occurring during any half-hour period for the month is carried forward in calculating the next 11 monthly bills, or until a new half-hour peak is registered in some succeeding month. This ratcheted peak is averaged-in with each month's actual peak.

As an example, suppose a three-megawatt peak over and above the normal demand for a half-hour period is recorded but never repeated again. At present demand costs — about \$1800 per megawatt — this amounts to \$5400 extra for the first month and \$2700 for the next 11 months for a total cost of \$35,100 for the year for that one peak.

Facility managers are taking aim at these costly peaks in demand. They are beginning to knock them down by a notch or two through using the minicomputer system to observe their occurrence.

A lamp removal program is underway to eliminate all unnecessary lamps while still providing illumination required for a practical environment. A program designed to upgrade lighting fixtures to diffuse light more efficiently has begun. Also, a scheduling program is being set up whereby experiments requiring substantial amounts of electricity are staggered, avoiding simultaneous use wherever possible and utilizing evening and weekend time periods when background loads are lowest.

A look at the pen plots generated by the computer for Moffitt Library demonstrates how revealing the detailed information on electrical demand can be. Analysis showed that most of Moffitt's load was the result of lighting rather than experimental equipments, machinery, or HVAC systems. Examination of the plots also revealed two unaccounted for and costly afternoon demand peaks, two weeks apart. A check of weather conditions (the weather bureau has a station on campus) showed these were exceptionally warm winter days and air conditioning units were turned on.

The 100 kw air conditioning units operate automatically for Moffitt from sensors located outdoors. The building's extensive fluorescent lighting provides all the heat necessary on most days. Facilities managers concluded that by turning off 50 percent of the lights on warm days, the air conditioners needn't be used as often. This was accomplished without impairing normal use of the building.

The monitoring of load peaking will have other benefits as well. The system functions as a maintenance tool for electricians. On the console, feeder lines can be identified and instantaneous readings of voltage and current can be taken. This permits electricians to find overloaded lines and switch loads, preventing individual transformers and cables from taking the brunt of the load, which shortens their productive lives.

The system installation was very inexpensive. The transducers cost about \$30 each; there was little special wiring necessary. Each of the 31 monitoring points cost about \$150 to install completely. The monitoring system should pay for itself in two years. If so, the saving in monthly electric bill would be more than 10 percent.

## PROMOTING THE USE OF A COMPUTER IN TEACHING

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The University of Iowa has received a National Science Foundation grant of \$375,000 so that it can serve as a center for the review, testing and dissemination of selected computer-based materials for college science courses. The project is being carried out by CONDUIT, a consortium of eight educational computer networks directed by James W. Johnson of The University of Iowa Computer Center.

The main objective of CONDUIT is to improve education by providing for instructors and students alternative ways of learning concepts and methods. Because of the newness of the use of computer technology in education, structures to effectively disseminate innovations do not now exist.

The 15-month grant will provide support for the CONDUIT central office on the U of I campus to re-

view, test, evaluate, and distribute the best available computer-based materials for classroom use in the physical and social sciences. This activity will require establishing quality standards for materials; it also requires the development of mechanisms for delivering materials to instructors.

The grant is from the Technological Innovations in Education Group of the National Science Foundation; it will enable CONDUIT to continue work on the development of procedures, techniques, standards and systems for disseminating complex computer-based instructional packages.

In addition, CONDUIT will assemble panels of experts to provide state-of-the-art reports on instructional computing in the fields of chemistry, physics, economics, biology, mathematics, sociology, geography, political science, business and psychology.

CONDUIT was founded in 1972 to study and promote the exchange of computer-based instructional materials. The original members of the CONDUIT consortium were Dartmouth College, North Carolina Educational Computing Service, Oregon State University, The University of Iowa, and the University of Texas, Austin. The project will be expanded this year with the inclusion of 10 new members in the consortium.

The use of the computer to provide new and exciting techniques for learning has become much more feasible because of dramatic decreases in equipment costs. But the real effectiveness of the new technology depends on the dissemination of ideas on the use of computers in education. The main job of CONDUIT is to assure that the best ideas, some of which currently pass unnoticed, are widely disseminated and adopted. □

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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 the programming of 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*.

## NAYMANDIJ

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") and 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 displays some kind of evident, systematic, rational order and completely removes some kind of randomness; the operation must be expressible in not more than four English words. (But Man can use more words to express it and still win.)

### NAYMANDIJ 7512

```

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

## MAXIMDIJ

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 for them. To compress any extra letters into the 10 digits, the encipherer may use puns, minor misspellings, equivalents like CS or KS for X or vice versa, etc. But the spaces between words are kept.

### MAXIMDIJ 7512

```

⊕ ✕ ⊙ * # * ⊕
⊕ * ⊕ ■ △ ✕ ⊙ # * ⊕
⊕ # # ■ ⊙ * △
    
```

## 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, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns, or deliberate (but evident) misspellings, or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

### NUMBLE 7512

```

           H E
        x  W H O
           T E W
           S L L
           S W T
           -----
        =  O M K T W
    90685 36549 06851 3254
    
```

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

## SOLUTIONS

**NAYMANDIJ 7511:** Make row 3 even.

**MAXIMDIJ 7511:** If it is different, it is rong.

**NUMBLE 7511:** People learn by losing and losing.

Our thanks to the following individuals for sending us their solutions to – **MAXIMDIJ 7510:** T. P. Finn, Indianapolis, Ind. – **NUMBLE 7510:** T. P. Finn, Indianapolis, Ind.; Abraham Schwartz, Jamaica, N. Y.

Announcing plans for a new quarterly magazine:

# COMPUTER GRAPHICS AND ART

To all persons interested in:

Applied Arts and Graphics  
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Cartography Systems  
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Computer Assisted Instruction  
in Computer Graphics

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Chemistry, Mathematics, and  
Other Sciences  
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Arts, and Other Fields

Computer Graphics in Business,  
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.....

Dear Colleague,

At the present time we are exploring the possibility of publishing a new magazine on interdisciplinary computer graphics and computer art aimed at the college level. We need your feedback concerning the graphic interests that you have and that you know of. We want this magazine to be useful to you and your colleagues.

Accordingly, this is your invitation to submit material and to begin subscribing (or indicate your intention of subscribing) to

## COMPUTER GRAPHICS AND ART

a new quarterly to be published starting probably early in 1976, and for which I have been asked to be the editor.

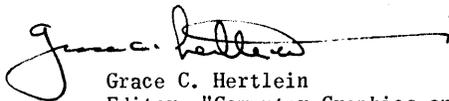
At the present time an advisory board of distinguished people and a group of contributing editors well known in graphic fields are being assembled. Your suggestions and nominations will be welcome.

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Cordially,



Grace C. Hertlein  
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Associate Professor  
Department of Computer Science  
California State University, Chico  
Chico, Calif. 95926

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