February 1981
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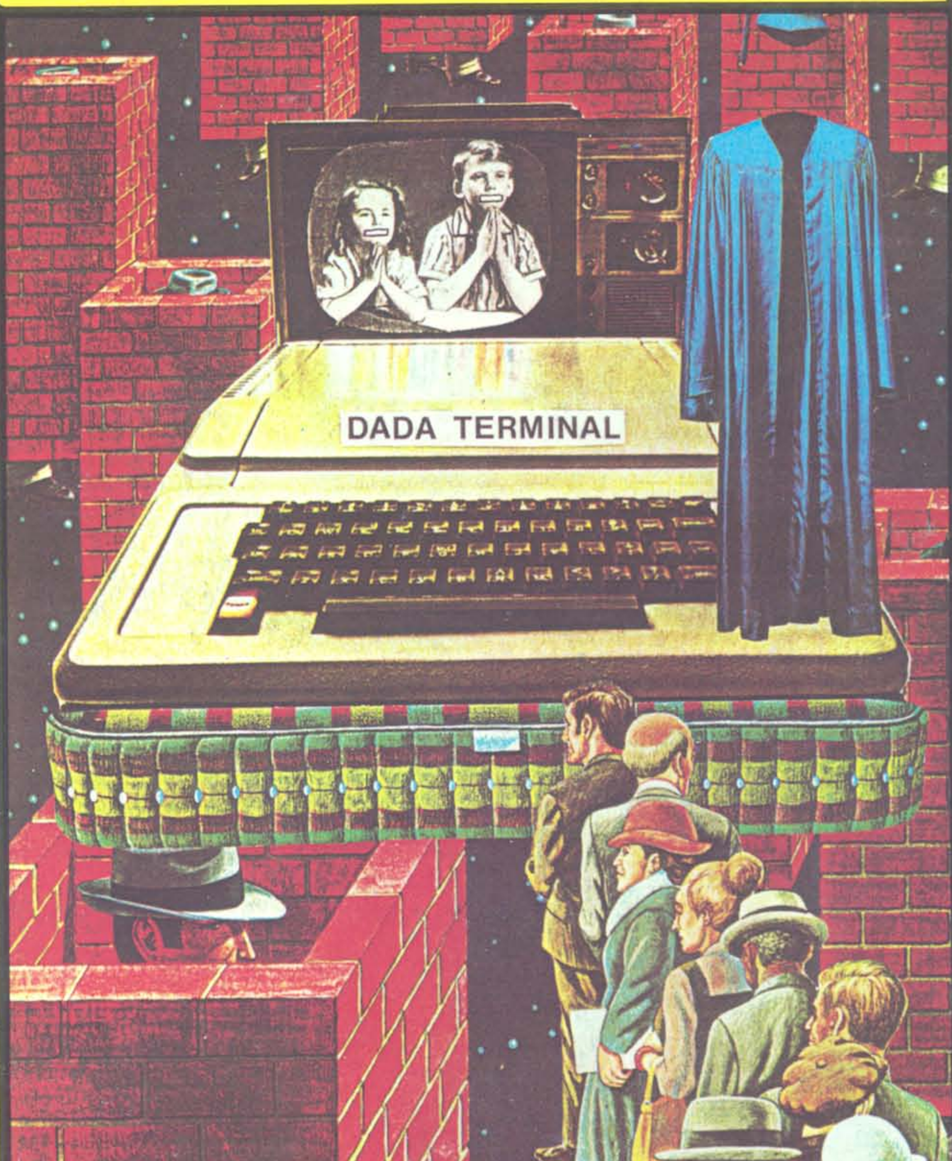

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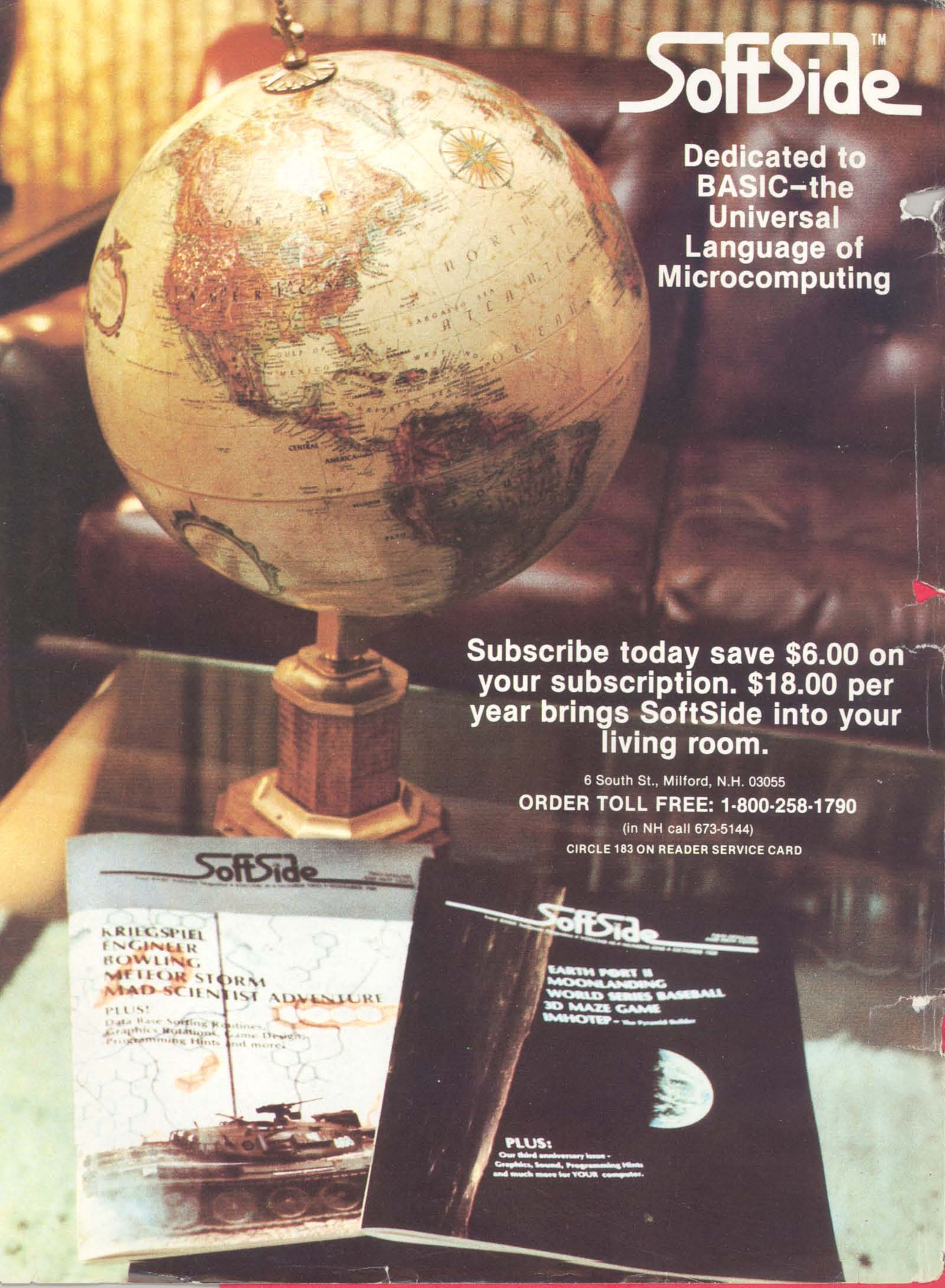
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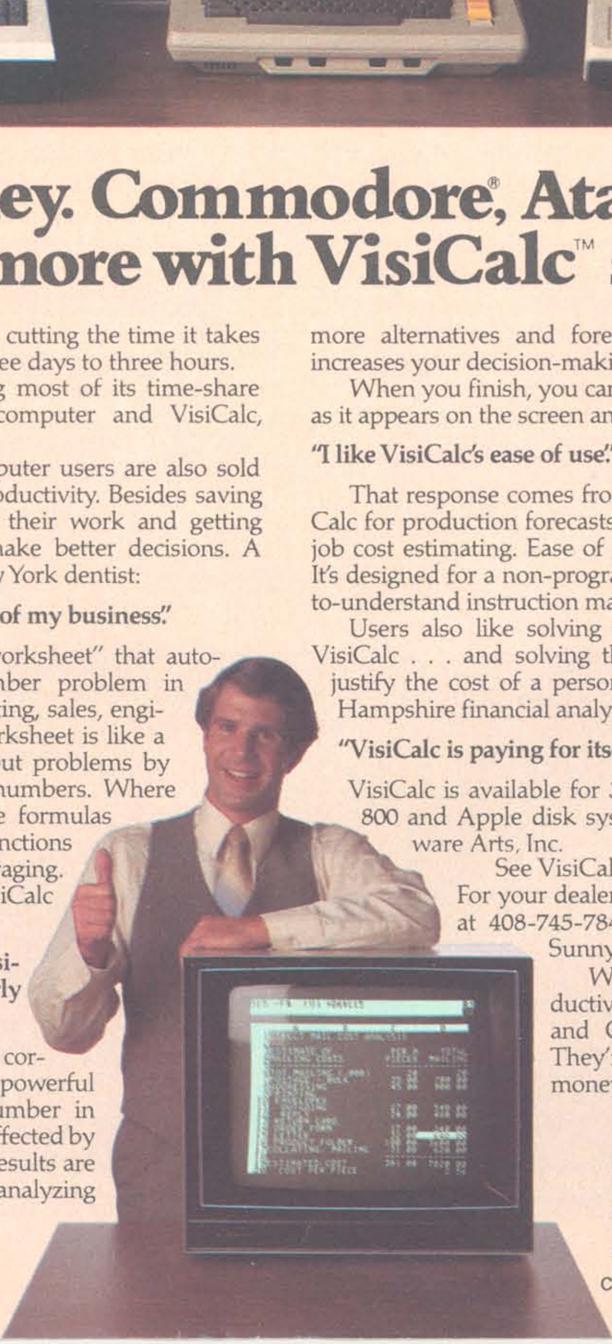

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et cetera
et cetera

Congratulations!

We have two winners! In September, we announced a competition for the best transportation simulation and the best simulation in a freestyle category.

Kenneth Murray of Grand Rapids, Michigan wrote an amazing simulation, "Streets of the City." The user has goals of completing street and Interstate highway construction, improving street repair, improving traffic safety, upgrading the bus fleet, increasing ridership and improving on-schedule performance. It will be published in its entirety in the April or May issue of *Creative Computing*. Ken received an Ohio Scientific Challenger 1P for his simulation.

Richard Galbraith of Tempe, Arizona also wrote an exceptional simulation, "Trucker." The program simulates coast-to-coast trips by an independent trucker hauling different types of cargo. The primary objective is to improve the user's understanding of reasonable risk-taking and the costs involved in freighting. It succeeds very well. It will be published in the March or April issue. Richard received an Interact computer and software for his efforts.

Getting Bigger and Growing Stronger

Getting Bigger

Some months ago when we had a company luncheon at Victoria Station, we needed their largest private room to hold all 60 of us. Such is the time for reflections and one person recalled that two and a half years ago the company would have fit in one large booth (8 people).

We're still growing. Our newest division headed by Larry Koss will provide extension and adult educational courses in cooperation with school districts and colleges throughout Northern New Jersey. Of course, there are also our new magazines, *Microsystems*, and *Sync*. These and several other new ventures will be described in an upcoming Random Ramblings column.

However, we're not ignoring our established divisions. *Creative Computing* magazine is growing at a rapid clip. Indeed, within a few months you'll be seeing ads for it on TV in certain parts of the country. You've probably already seen ads for it in *Popular Science*, *Scientific American*, *The Wall Street Journal* and scores of other places.

Recently too, *Creative Computing* has received editorial mention in *The New York Times*, *New Jersey Monthly*, *The Christian Science Monitor* as well as on CBS-TV.

Growing Stronger

All this growth would not be possible if we didn't have quality products. And quality in this business means people, none in the publishing business being more important than the editorial people.

Hence, it is with great delight that we welcome **George Blank** to our staff as Editorial Director. George comes to us from The Software Exchange where he was editor of *Softside*. Readers of *Creative* should be familiar with George as the author of our Atari column. We feel that George will be a tremendous addition to our editorial department. His responsibility includes management of all magazine, book and software publishing of Creative Computing.

The "new" editor of *Creative Computing* is **Elizabeth Staples**. No newcomer to these pages, Betsy has been doing the new products column and generally one or two pieces per issue for the past year and a half. This was done on top of her regular duties as Business Manager where she oversaw the entire order processing, subscription fulfillment, retail sales, financial and accounting operations of the corporation.

Ted Nelson will occupy the newly-created position of editor-at-large. In this position he will have the freedom to explore new and interesting concepts, carry on with his personal research projects, philosophize and give us outpourings from his fertile mind.

We expect these changes to have a very positive effect on both the editorial content of the magazine and our dealings with outside contributors. Speaking of contributors, if you haven't seen the editorial on effective writing by Chris Morgan in the December issue *Byte*, I urge you to read it. He says many things that I've been saying for ages, but he does it in a succinct and entertaining fashion.

Credit Due to Personal Computer World

In the December issue, we published an in-depth review of the Sinclair ZX80 by David Tebbutt. We also noted that the review was reprinted from *Personal Computer World*. However, we probably should have given you a bit more background

Personal Computer World is a British magazine and, in some loose sense, is our sister publication in the U.K. We both run David Levy's Intelligent Computer Games column, for example. Also, we occasionally reprint a piece from *PCW* and vice versa.

We feel that some important developments are emerging from the U.K., such as the Sinclair ZX80, Acorn Atom and Tuscan S100 on the hardware front. In addition, companies such as Thorn/EMI are developing outstanding software. Short of frequent trips to Britain, we keep tuned to the latest developments through the magazines.

A one-year subscription to *PCW* costs 22 (approx. $50) via air mail. Write Personal Computer World, 14 Rathbone Place, London W1P 1DE, England.

Personal Computing for the Handicapped (National Contest)

Johns Hopkins University will be conducting the First National Search/Contest on the Application of Personal Computing to Aid the Handicapped starting in November 1980 and lasting to June 1981.

Major objectives of the contest are to:

1) Focus the power of computing technology on the urgent needs of millions of handicapped citizens.

2) Harness individual innovation and creativity on a national basis.

National Computer Problem Solving Contest

The University of Wisconsin—Parkside extends an invitation to schools everywhere to participate in its fifth annual computer problem solving contest. Complete rules and a copy of last year's problems with solution, appear on p. 82 of this issue.

Corrections

In the December 1980 "Apple Cart," the price of RADCOM PLUS was given as $190,000. The correct price is $190. Also, the software was referred to as *Integer Basic*. This is not the name of the program, just the language it runs under.

The Program for "Out of Sorts" (December 1980, page 14) has a line missing. The line is:
205 LET I=I-Y

On page 67 of the December 1980 issue the price of the CBM 2022 printer was incorrectly listed as $995. The printer sells for $795.

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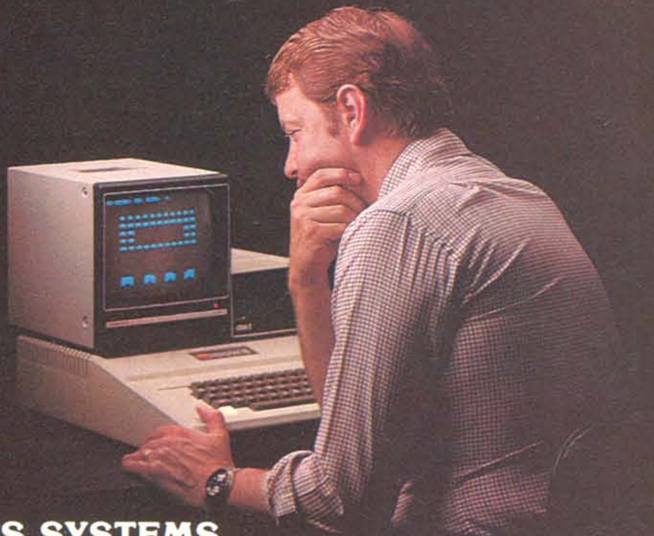

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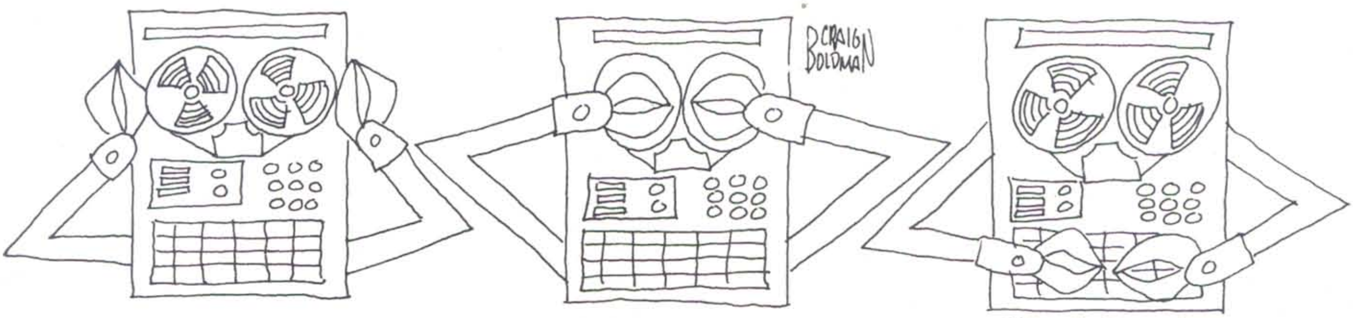

Business as Usual

Dear Editor:

I would like to comment on the article written by Mr. Paul F. Doering, entitled, "The Bleak Future of Small Business Computing," in the November, 1980 issue of *Creative Computing*.

First, I certainly agree that there are both good and bad business programs available. However, to condemn all business programs as being poorly written is like throwing the baby out with the bath water.

While some of the problems mentioned in Mr. Doering's article are real, he has missed a very critical point. That is, the whole area of business application of small computers is very new. As in a fledgling industry, it takes time to mature and shake out the marginal operators.

A suggestion we use, in our firm, to ascertain the quality of a program is to ask for the documentation before purchasing. This costs a firm little and does a reasonable job in protecting it from poorly written programs or programs with inadequate documentation.

Also, another thing a prospective purchaser of business programs should inquire about are the qualifications of the programmer. It is very critical to have a programmer that understands the application as well as having programming skill. For example, frequently I have seen programs written to compute asset depreciation schedules — only to find out that they use the general guidelines method of depreciation. This method was outmoded by the ADR (Asset Depreciation Range schedule) which offers significantly greater tax shield to the firm.

Our firm has been in business for two years now — dedicated to promoting quality business software. To our knowledge, we have never had any complaint about our products. I only mention this to show that there are good business software houses.

Jerome S. Osteryoung, Ph.D.
Management Systems Software, Inc.
2912 Brandemere Drive
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Bleak House

Dear Editor:

I couldn't agree more with the observations of Mr. Doering in his article "The Bleak Future of Small-Business Computing" (November 1980). Clearly he makes many fine points regarding the sometimes immoral schemes foisted upon the innocent (and sometimes naive) small businessman.

I regularly run up against businessmen who are so eager to "get into computers" that they just can't reason straight. When an effort is made to explain such things as the need for backup, maintenance, audit trails and the like, they conclude that such things are merely an attempt to "milk" them for more money. They are bound and determined to get a complete computer system for the least amount of money. Therefore, they invite Mr. Doerings kitchen-table amateur (KTA) in with open arms! Is it any wonder that such businessmen fail?

At the same time though, I question the conclusion of Mr. Doering that a bleak future is ahead for small business computing. Regardless of the reasons why the situation has reached its current state of affairs, I don't think it is a terminal ailment. The mystique which has long surrounded computers is quickly crumbling, thanks to the home computer craze. Businessmen worth their salt have gone and talked to others about the problems associated with installing a computer system. Most of them are smarter than we computer professionals may be willing to give them credit for.

No doubt the problems mentioned in the article have contributed toward the go-slow attitude we have seen among businessmen in general. And remember too, there have been successes. Those competent commercial programmers (CCP's) responsible for such successes are going to be in high demand. They will be around for a long time. Meanwhile, the kitchen-table amateur who is out to make a quick buck is liable to move along to some other get-rich-quick scheme. While new ones will come along from time to time, I think we will see a stabilizing which will be beneficial for all.

The situation reminds me of the fledgling personal computer marketplace that existed just a few years ago. Then the urge was to market a product that was insufficiently

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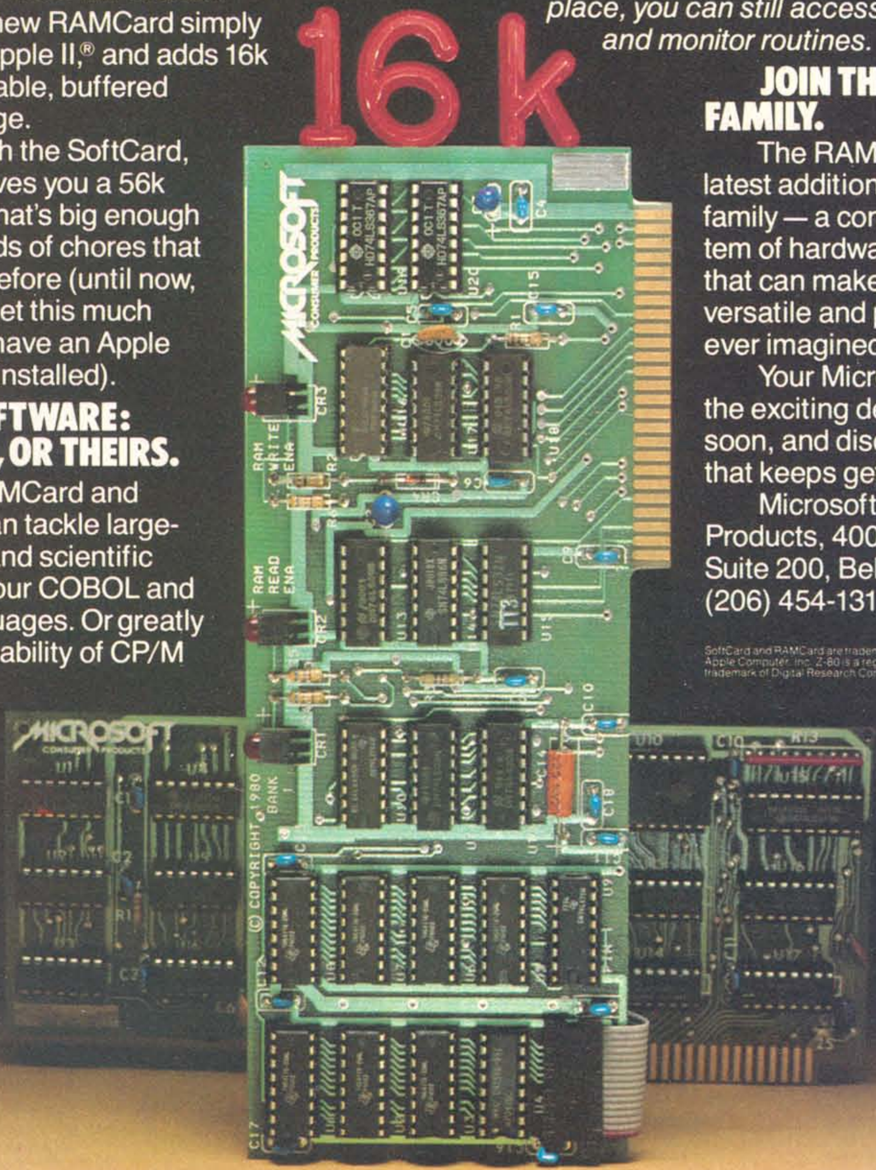

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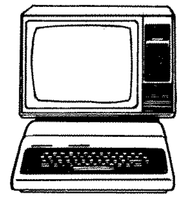

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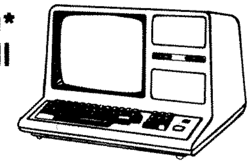

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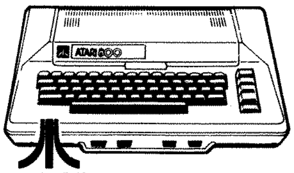

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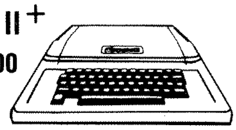

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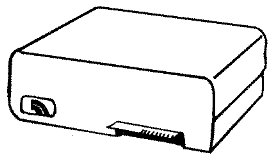

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Daryl A. Frame, President
Discreet Computer Service, Inc.
69 Victor Herbert Drive
Ventura, CA 93003

Lonely Parts Club

Dear Editor:

I would like to help form or join a Video Brain user's group. My little orphan was purchased for $78 with three ROM cartridges, but I have been unable to obtain a Basic ROM so far, so it's just games for now. I would like to get in touch somehow with other users, and most of all obtain a Basic cartridge. Can you help me?

John Starrett
7115 E 14th Ave.
Denver, CO 80220

P.S. I also own a ZX80 and would like to see some articles about it and correspond with other users.

We did run something on the Video Brain in the September 1980 issue, p. 38.

As for the ZX80, try our new magazine, **Sync,** *$10 a year.* — *TN*

Vote of Confidence

Dear Editor:

I found Stephen Kimmel's "Election Prediction by Computer" in the October 1980 *Creative Computing* and used it with great pleasure this week.

In fact, at about 6:45 p.m. on November 4th, my TRS-80 predicted a Reagan landslide with only Kentucky and Indiana — but then who believes a "computer knut" that early in the evening? (Actually not even the knut.)

Anyway, the program was well written, it worked on first input, and the article presenting was also good reading. I am not a subscriber but I scan all the appropriate magazines at the University Library.

Thank you and congratulations for a most enjoyable evening.

Eli C. Hall
Resident Manager
University of Kentucky
Carnahan House Conference Center
Lexington, KY 40511

Peak Performance

Dear Editor:

It seems that the people who "yell" the loudest in the world are those who feel they have been wronged. Computer journals are filled with letters telling of the incredible suffering and horrors of trying to do business with various computer oriented companies. Unfortunately there is little said about the companies with whom we have dealings which are especially pleasant.

I have been a computer hobbyist for quite some time, and as such I have experienced much of the frustration and dissatisfaction of purchasing hard & software from numerous vendors. Over the past few months I have had the absolutely incredible experience of dealing with Mountain Computer, Inc.

Mountain Computer manufactures a line of peripherals mainly for the Apple Computer. As the owner of three of their products, I can say without fear of contradiction that their products are second to none. Their hardware, software, documentation and even the packaging of their products is superb.

Mountain Computer has an incredible attitude towards its customers. I have had a few occasions to correspond with the company to request information. I was slightly amazed (in a field in which companies seem to neglect answering their mail) to receive immediate, informative and friendly replies to my requests. In one instance they actually called me via telephone to give me a personal and timely reply to my request.

I once telephoned them to ask if it would be possible to send a representative to our local Apple Users Group (note: we are in New Jersey; they are in California) to demonstrate their product line. I really expected a negative answer, but much to my joy and surprise they answered in the affirmative and even set a date with me immediately.

I can go on and on about this outstanding company. If you are looking for an Apple peripheral, give this company a look, because if they happen to manufacture what you are looking for, you will be hard pressed to find a superior product.

S. D. Sadowsky
17 Round Hill Road
Scotch Plains, NJ 07076

Waiting for Baudot

Dear Editor:

As your November issue points out, being a deaf dancer really IS something. Being able to communicate with her friends, relatives and emergency services via telephone is something else. I would like to enlist your help in providing some information which may be important to this young dancer.

As you may know, the deaf can use teletypewriters to communicate with their friends and a small number of public agencies which have installed TTYs. Because the origin of this network resulted from cast-off Western Union hardware, their standard for communication is the BAUDOT code. I have been trying to track down a reasonably priced modem which would be switchable from ASCII to BAUDOT. If such a device exists or if its development could be encouraged, it would have several commercial and human benefits:

- The deaf could be integrated into the home-computer communication network to the benefit of all.
- The deaf could use home-computers rather than the single-purpose devices they now must buy which cost as much.
- Businesses would be in instant compliance with Federal laws which require them to have non-discriminatory communicative access, through interface with existing ASCII hardware or typewriter interface.
- Everyone could communicate with and market telecommunication devices internationally. (Is BAUDOT translation not a problem?)

If you have any specific information, leads or general thoughts about making the computer revolution work for ALL of us, I would be glad to share them with some of the young deaf dancers of the world.

David V. Williams, Ph.D.
5 Wildflower Drive
Ithaca, NY 14850

In Addition

Dear Editor:

Your October, 1980 issue carried a letter in the Compendium section by a Susan J. Wilkins wherein an accountant or equally uncreative type was required to be browbeaten by the programmer in determining a listing program.

In acquiring my first cassette computer system in 1973, I too was advised that the computer could not add sideways.

When I pointed to my purchase order and said that it was part of the agreement; that if no such program could be accomplished that I would not pay for the system and the factory could pick up the equipment, then:

Very quickly not only could the computer add sideways but the program allowed for an error column and a provision for correcting errors, the computer could add down, *and* both sets of columnar totals would balance against each other and indicate any errors in balance differences.

Two years ago when I went to a hard disk system, Wang's people gave me the same runaround (which cost them a sale) but Century Computer's staff found no problem in providing the application.

When programmers realize they are here to provide what a user requires or wants, not what a programmer feels the user could use, then perhaps more systems would be acquired resulting in uncreative types of programmers becoming human beings.

Sully Sudin
Public Accountant
730 East Washington Street
Marina Del Rey, CA 90291

Summing it Up

Dear Editor:

I am not too often moved to write rebuttals to publications but in reference to Susan J. Watkins' "A Short Episode" in the October Compendium, Page 12, I have been moved.

One of the great differences between a GOOD programmer and just another programmer is that person's knowledge of now to make the program do what the customer wants it to do. It is, admittedly, sometimes difficult for us customers to convey to the programmer what we want done.

The image of the programmer locked up in the back room with his chocolate bars and root beer is not helped much by Ms. Wilkins' programmer friend. It sounds like he falls into this image very well. He is not sharp, he is just not a programmer.

I am no programmer but once in a while I do convince my computer to do what I want it to do. One of those things is to add *BOTH* row and column totals. It is not difficult and certainly should be within the capabilities of any programmer.

Maybe my assumptions are wrong. Maybe both Ms. Wilkins and *Creative Computing* were looking for Halloween stories since her story appeared in your October issue.

R. W. Russell
418 Louisiana, S.E., Suite 8
Albuquerque, NM 87108

For the Record

Dear Editor:

We are writing this letter in regard to Mr. Yob's evaluation of the MTU music system and song data in the November 1980 PET column ("about going too far").

Mr. Yob seems to have missed the overall point of the system (which is to produce high quality music at a low cost). For some reason he complains that the program pushes the PET to its limits in order to obtain the best possible results (would he prefer a lower quality music, to make it "easier" on the PET?)!

In his evaluation, Mr. Yob recommends the use of additional hardware, which costs considerably more than $1000 (whereas the MTU system requires only a $50 digital-to-analog converter, which can be used for other purposes besides music, and a $25 software package).

The major advantage of computer generated music is the ability to control instrument definitions, alter pitch, and envelope & timber. We personally don't know of any $7.00 record that can be played with several different variations and control.

Granted, there are some limitations in the system, but not enough to condemn it to the point of abstinence simply because it can't compare to album quality (kind of like cutting your nose off to spite your face).

Matt Ganis & Fred Covitz

Constant Comment

Dear Editor:

In a recent article (August 1980) entitled "Translating into Apple Integer Basic," the author, Jordan Mechner, spoke of some limitations of integer arithmetic. I would like to pass along some tips developed in the olden days (i.e., 1970, 4K Nova computer, no model number, just a Nova) for dealing with fractions using integers.

We used a "precision constant" to give us the desired fractional accuracy in our computations. You multiply your number by a precision constant before an operation which would produce a fraction. For example, (5-10)/2 = 25. You can output the precision constant and result (10,25) and know the answer is really 2.5. Using this method you can get any desired degree of precision. Usually one or two decimal places is all that is required. The concept of significant digits is relevant here. Thus, square root and Mugwumps is possible with Apple integer Basic contrary to Mechner's article.

You must be careful using this method. Some very large numbers can result, and the user must watch out for overflow. Also note $\sqrt{X} = \sqrt{10X}$. For square root applications use 100 or 10,000 as the precision constant.

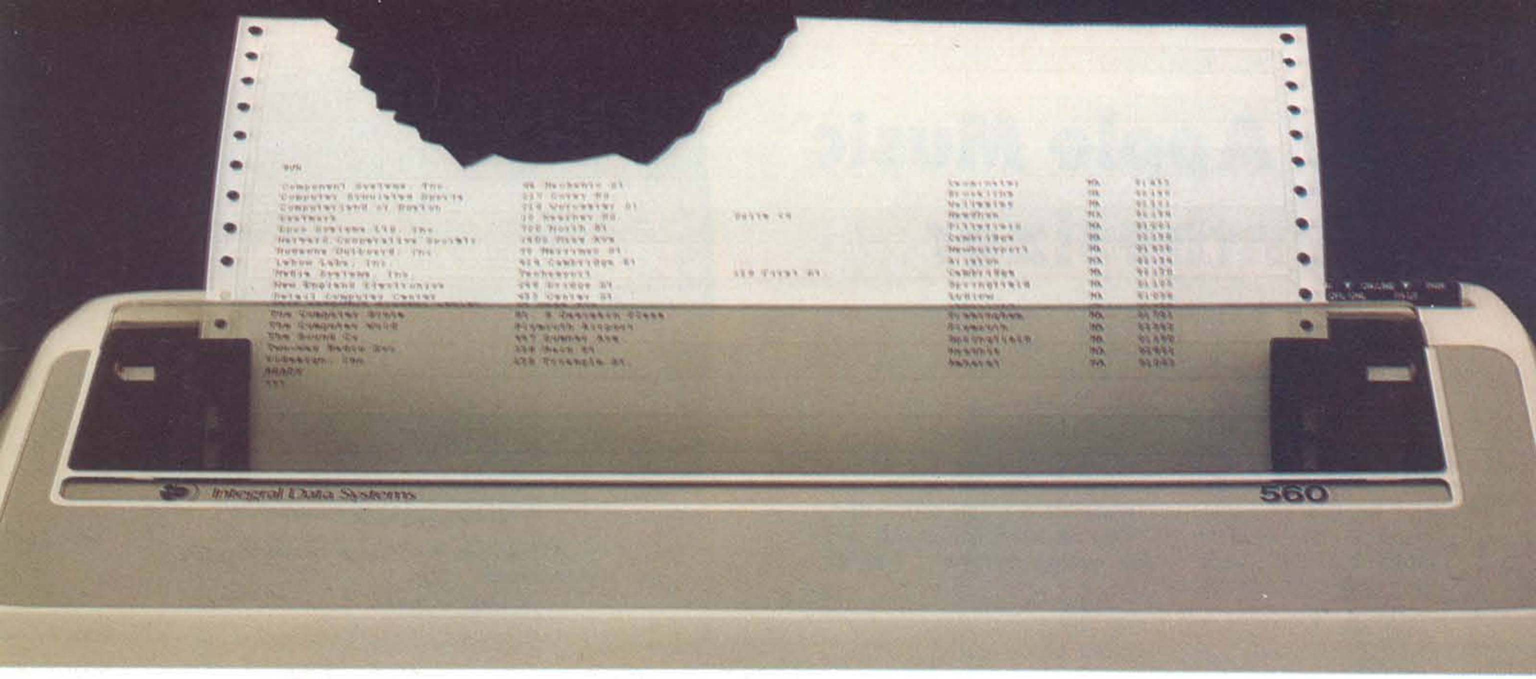
Andrew L. Homer
Research Associate
University of Missouri - Columbia
Department of Psychology
210 McAlester Hall
Columbia, MO 65211

Curtain Call

Dear Editor:

I especially enjoyed your feature on Actor Languages in the October issue. Smalltalk and its friends may not save the world from Basic and COBOL but at least it's concept-oriented (rather than machine-oriented). Here are some other fun ideas for special sections: program testing and verification, Very High Level Languages, exotic graphics systems, database models, compiler design for the layman . . . did I leave anything out?

Steve North
35A Orchard St.
Summit, NJ 07901



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With the ALF software, entry of music is easy, fast and accurate.

The ALF Apple Music Synthesizer (AMS) is an easy to use peripheral which allows you to program music into an Apple II computer using standard musical notation. The ALF kit includes the synthesizer board (plugs into any peripheral slot), exceptional quality software, and an extensive user manual.

Sophisticated Music Entry Program

Sheet music is easily entered using the Apple game paddles. The high-resolution ENTRY program features the familiar music staff with a "menu" of musical items listed beneath it (note lengths, rests, edit commands, accidentals, etc.). One game paddle moves a cursor up and down the music staff and is used to select the note pitch; the second paddle chooses from the menu items (note length, etc.) With the ALF hi-res ENTRY program, you won't have to use cryptic codes to select note parameters.

As you program sheet music with ENTRY, measure bars are inserted automatically (and note values are tied over the bar where necessary). Key signatures are also automatic—you don't have to keep writing in every sharp or flat!

Three monophonic, individual parts can be programmed with each ALF Music Synthesizer. Two boards are required for stereo. A total of three synthesizers can be used simultaneously for a maximum of nine voices. By controling the envelope (or shape) of each voice, many different instrumental sounds can be simulated.

Eight-octave Range

The ALF Music Synthesizer has a pitch range of eight octaves—a wider range than a grand piano. The ALF can also play semitones—"blues notes" or the pitches in between the keyboard notes of a piano. (The pitch range is from 27.5 to 55,000 Hertz, well beyond the limits of human hearing.) Tuning accurancy is virtually perfect within two cents of pitch value.

Every parameter of the ENTRY program can be changed again and again during a musical piece. For example, you can make changes in key, time signature, volume, and timbre (envelope). Parts can be edited at any time, also. Notes can be added or deleted, note length can be changed, as well as pitch, volume, etc.

You can save songs on either cassette or disk, and play them back using either ENTRY or PLAY. The playback speed is adjusted with one of the game paddles, and can be varied during the playback, if you wish to change the overall tempo.

Colorful Playback Display

The ALF Music Synthesizer features a 16-color low-res graphic display during song playback. Each musical part is represented on a stylized piano "keyboard"—the intensity of the note determines the color, and the pitch is shown in relation to "middle C".

The ALF Music Synthesizer requires the use of an external audio amplifier. Stereo programming is possible with the use of two or three synthesizer boards.

The ALF software includes the ENTRY and PLAY programs, sample songs, an introduction to "envelope shaping", and demonstrations of advanced uses of the synthesizer.

Nine Voices for only $198

The new ALF "AM-II" music synthesizer offers an unbeatable value for the Apple owner who is a music hobbyist. With nine voices on a single music board for $198.00, the AM-II is the most economical device for creating music with the Apple.

The AM-II uses the same excellent ENTRY and PLAY programs as the more sophisticated ALF Music Synthesizer (AMS); the same hi-res graphic display from which notes are selected with the Apple game paddles (not typed with cryptic codes). All of the conveniences of the ENTRY program apply—easy editing, playback with low-res display, ability to save songs on cassette or disk, etc.

The AM-II has **stereo output** (3 voices in left, 3 voices in the middle, 3 voices in the right).

How can the AM-II offer so much for only $198.00? The two basic differences between the AM-II and the ALF Apple Music Synthesizer (AMS) are pitch accuracy and dynamic range. The AM-II has an accurate pitch range of about six octaves. Pitch values above the treble staff become increasingly inaccurate. Also, the AM-II has a dynamic range of 28db, with 16 different volume levels, (the AMS has a dynamic range of 78db).

The AM-II is manufactured with the same high quality standards as other products from the ALF Corporation. No sacrifice has been made in reliability; the new AM-II is simply a great bargain.

Professional musicians will still want to use the original Apple Music Synthesizer (AMS) for its extended range and volume controls (the AMS has a range of 8 octaves). But for the Apple owner who is interested in music as a hobby, the AM-II is the best music peripheral value available today.

Requires: 16K Apple II or Apple II Plus, cassette or Disk II, and an external audio amplifier (all necessary patch cords are included).

AM-II ALF/Apple Synthesizer	$198.00
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To order, send payment plus $3.00 shipping and handling to Peripherals Plus, 119 Maple Ave., Morristown, NJ 07960. Credit card customers should include card number and expiration date of Visa, MasterCard or American Express. Credit card customers may also order toll-free:

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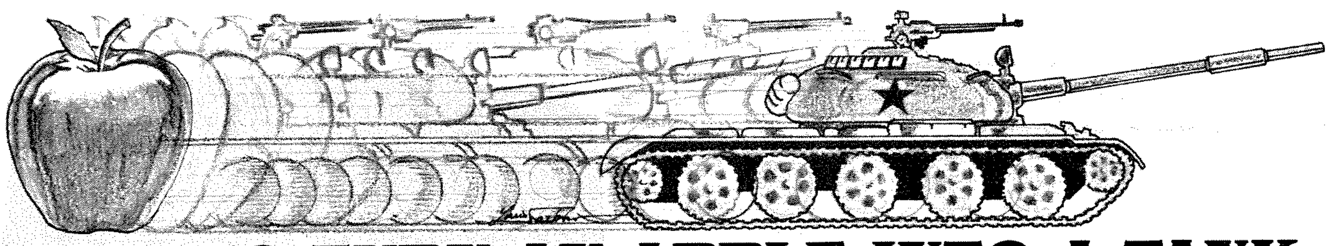


HOW TO TURN AN APPLE INTO A TANK.

With **Computer Conflict**™ and a little imagination, we'll transform your staid and respectable Apple computer into the fearsome war machine of the Soviet Red Army. Computer Conflict actually consists of two fast-paced, action-packed war-games played on full-color mapboards of Hi-Res graphics: **Rebel Force** and **Red Attack!**

REBEL FORCE puts you in the role of a Soviet commander whose regiment must face a computer-directed guerrilla uprising which has overrun a vital town. Armed with your tank, heavy-weapons, and infantry units, your mission is to regain the town through the annihilation of the Rebel Force.

Your advance will be brutally opposed by minefields, ambushes, militia, and anti-tank guns — all skillfully deployed by your computer. Survival and success of your units will depend on your ability to take advantage of the variable terrains - open, forest, and rough - each of which has different movement costs and shelter values.

In this finely-balanced solitaire wargame, every move is played under real-time conditions: Procrastinate and lose. At the same time, caution cannot be cast aside; severe unit losses will only result in a Pyhrric victory at best.

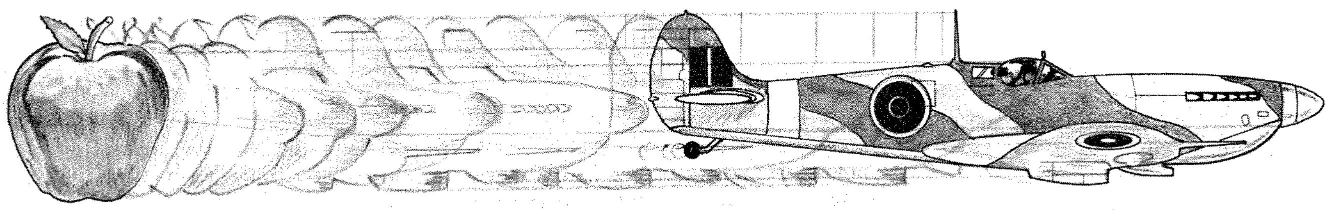
With its five levels of difficulty (plus one where you make up your own), the computer can and will stress your tactical skills to their fullest.

RED ATTACK! simulates an invasion by a mixed Soviet tank and infantry force against a defending battalion. As the defender, your task is to deploy your infantry units effectively to protect three crucial towns — towns that must not fall!

As the Russian aggressor, your objective is to crush the resistance by taking two of these three towns with your tanks and infantry. With control of these strongpoints, the enemy's capitulation is assured.

Red Attack! is a two-player computer simulation of modern warfare that adds a nice touch: At the start of each game, the computer displays a random setup of terrains and units, providing every game with a new, challenging twist.

Computer Conflict, for $39.95, comes with the game program mini-disc and a rule book.



OR A SPITFIRE.

After you're done playing Computer Conflict, you may be in a mood for something other than ground-attack wargames. In that case, **Computer Air Combat**™ is just what you need.

With Computer Air Combat, your screen lights up with an open sky generated by Hi-Res graphics offering global and tactical plots. Squint your eyes a bit, let loose your mind, and you'd swear your keyboard has melted into the throttle, rudder, altimeter, and other cockpit instrumentation of a World War II combat plane. In fact, any of 36 famous fighters or bombers, from a Spitfire and B-17 Flying Fortress to the Focke-Wulf 190 and A6M5 Zero. Each plane is rated - in strict historical accuracy and detail - for firepower, speed, maneuverability, damage-tolerance, and climbing and diving ability.

Practically every factor involved in flying these magnificent airplanes has been taken into account, even down (or up?) to the blinding sun. Climb, dive, twist, and turn. Anything a real plane can do, you can do. However, the computer prevents all "illegal" moves - such as making an outside loop (which in real life, would disastrously stall a plane).

PLAY THE COMPUTER. Aside from being the game's perfect administrator and referee, the computer will serve as a fierce opponent in the solitaire scenarios provided: Dogfight, Bomber Formation, radar-controlled Nightfighter, and V-1 Intercept. There's even an Introductory Familiarization Flight (with Air Race option) to help you get off the ground.

With the number and type of planes and pilot ability variable, you can make the computer as challenging as you want to give you the ultimate flying experience.

PLAY A HUMAN. Two can play this game as well, in dogfights and bomber attacks. Given a handicap of more or better planes or an ace pilot (or all of the above), even a novice at Computer Air Combat stands a chance to defeat a battle-hardened veteran.

For $59.95, Computer Air Combat gives you the game disc, a rule book, two mapboard charts (for plotting strategies between moves), and three player-aid charts.

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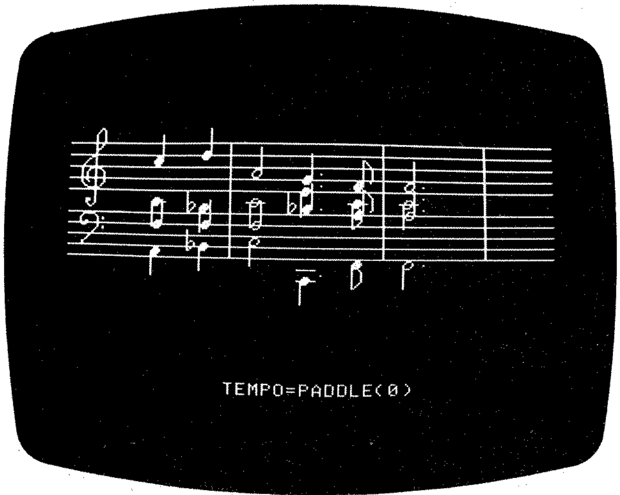
Music Editors for Small Computers

Rebecca T. Mercuri



Four-voice choral notation as seen in the MMI display. Notice that the second complete measure appears to contain only three beats due to the fact that rests are not visible.

An abundance of music editors for small computers have recently appeared on the market. At RCA's David Sarnoff Research Center, where I an involved with computer music experimentation, I have had the opportunity to compare these systems.

The presently available music editors appear to fall into three categories:

•Text editors which enable the user to directly enter a music file in a program like format.

•Editors which display musical notation, but require the user to enter the notes using an ASCII keyboard.

•Graphic editors where entry of notes directly on the music staves is made possible by cursor manipulation.

Text-Like Editors

The VIP's system could be called a machine-language editor since it requires the user to directly input hexadecimal codes for each of the notes, each hex word specifying both the pitch and duration of one note. Musicraft and Orchestra-80 both take this idea one step further, and permit the user to input notes as they would be read aloud from conventional music. For example, A3H would indicate a 440 Hz half note.

Since both of these systems are similar to standard text editors, features have been incorporated which make it easy to manipulate the music program. Insertion and deletion procedures can utilize line numbers, and looping, segmentation and external calls to other portions of the program are processes available to the user.

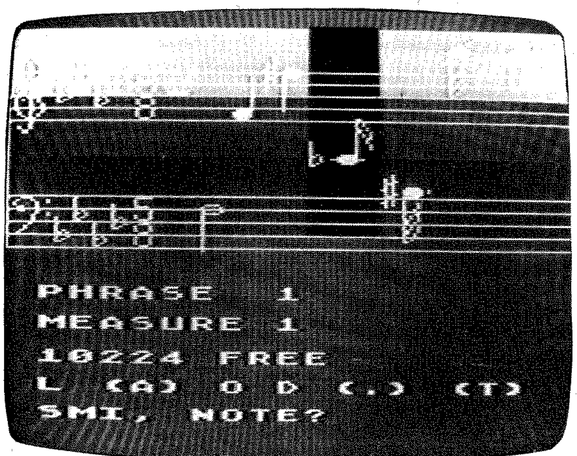
Both Musicraft and Orchestra-80 require compilation of the music program before playback, but an interesting feature of the Orchestra-80 editor allows the tempo to be changed during play by depressing number combinations on the keyboard. This feature enables the piece to be heard at various speeds: These may be adopted into the program text at a later time.

Rebecca Mercuri, RCA, David Sarnoff Reasearch Center, Princeton, NJ 08540.

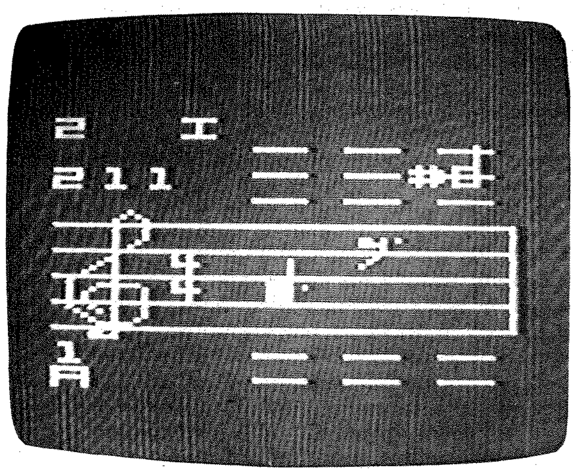
Display With ASCII Input

The MMI and Atari systems use ASCII input information similar to the Musicraft and Orchestra-80 systems, but provide a visual staff display for editing and playback. MMI utilizes a full four-voice display and requires that all notes in each chord be written vertically during editing. In the display-and-play mode, the score is scrolled from right to left, and note durations may not always be sounded precisely. In the play mode, there is no video display, but all rhythms are correctly performed.

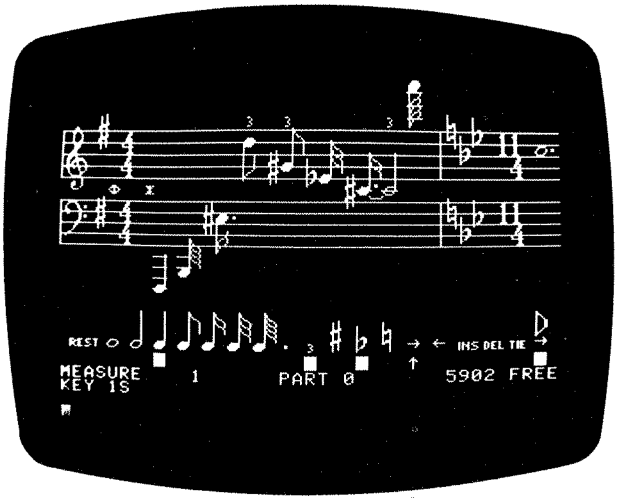
Atari permits the independent writing of up to nine separate phrases. The arrange mode enables the user to insert these phrases into any of the four voices. In addition, the volume of each phrase may be changed each time it is called. Looping can be used in order to implement repeats or rounds. The color display used in editing assists the user in specifying the octave for each note. On playback, only one voice at a time may be displayed, the display voice being selected by the user.



Double staff display of the Atari editor. When measure checking is on, this measure would not be allowed, since it is clearly oversized. Color bands (difficult to see in this B & W print) are used to delimit the octave ranges.



The Supersound display utilizes coded information to keep track of measure, voice, selection, section, and note numbers. The I above the staff indicates an oversized measure. The note currently being edited is printed below the staff.



The ALF system incorporates a menu and set of staves into its display. Notice that both key signatures and meters may be changed and displayed during the piece. User has the option to hear notes as cursor is moved or notes are deleted (see speaker diagram at right lower corner).

Single page of ideal music editor. Notice the similarity of the black-on-white display to actual musical notation. Staves are spaced far enough apart to permit insertion of text and dynamics markings.

Considering the rapid development of the personal computer industry, it should soon be possible to construct music editors which bear a striking resemblance to printed music, and can also be used in real-time performance. My photograph of the "ideal" music editor demonstrates the high level of readability which is presently possible using the Apple II graphics display. Notes were input using a light pen, and sufficient space is available between staves to permit insertion of text and dynamics markings. The black-on-white display further enhances the similarity to printed notation. Let me remind the reader that this editor is only in the development stage and is not commercially available.

KL-4M, Supersound, ALF, and Mountain Hardware all offer music editors which permit cursor manipulation and note insertion directly on the musical staff.

The Visible Music Monitor provided with the KL-4M DAC Board permits four-part harmonic input for PET/CBM Computers. The notes are displayed horizontally, but grouped into chords with small lines. The cursor can be moved up or down to change the pitch of notes, and may also be moved right or left for insertion or deletion purposes. Due to display requirements of the PET, the notation appears much like that used in medieval music, but this does not detract much from its readability.

Persons familiar with the VIP system will recognize the Super Sound name in reference to the four-channel music player. At RCA, an experimental prototype music editor for the VIP was developed. The VIP four-channel Super Sound has the same music-playing features as the prototype Supersound editor. The major difference is that with the VIP, notes and measures must be hand-coded into memory, while the Supersound editor permits graphic entry of notes. Another feature of the prototype involves the use of the note cursor. As the note is moved up or down in half-step increments on the staff, the pitch is also heard. Future availability of this editor will most likely depend on user interest; information may be obtained from RCA Customer Service.

The ALF system is similar to the two editors mentioned previously, in that it permits cursor manipulation directly on the musical staff. In addition, it incorporates many of the features of the text editors such as subroutine calls and recursiveness. Meters, key signatures, envelopes, volumes, and tempi can all be redefined at any point in the music, thus providing the capability for inventiveness and flexibility in musical interpretations. The pitch of notes is heard as they are entered, providing immediate auditory feedback for the user. In addition, measure bars are automatically inserted by the editor. Notes which exceed the measure boundaries are tied over into the subsequent measure. The ALF system resolves the problem of real-time music display by utilizing a set of horizontal bars. As the notes are played, a small rectangle moves across each bar, and its position relative to middle C may be viewed. The color of the rectangle is dependent upon the volume of the note. It is my understanding that ALF is now marketing a single nine-voice board which has a six-(rather than eight-) oatave range, and a 28 db dynamic range (instead of 78 db for the 3-voice board).

The Mountain Hardware system utilizes 16 oscillators in order to obtain high-quality polyphonic instruments. Instead of specifying a monophonic voice, the user may select one of six instruments which have been preset. Of course, the number of notes played at any one time must not exceed sixteen. This editor permits single or double stave notation utilizing the treble, bass, tenor and alto clefs. A wide range of dynamic and tempo resets are also available, which may be inserted throughout the music.

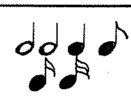
A light pen (which is provided) may be used to access the menu. Version #1.1, which I viewed, did not provide the software support which I understand will be available in future versions. For instance, it is not yet possible for the user to create his/her own instrument tables in order to augment those that are supplied. It may be useful to review this system again at a later date when more software becomes available. I regret that I was unable to obtain a picture of Mountain Hardware's unique display.

The folllowing chart is a 37-point comparison of eight available music editors, a VIP-compatible editor prototype, and what I feel would be the "ideal" music editor.

The music editors in this chart have been listed in order of increasing complexity, and grouped according to the categories mentioned above. Increased complexity does not imply that these editors are harder to use; in fact, the reverse is often the case. I have avoided subjective factors (e.g. which is best?) so that the reader will be able to peruse that chart and determine which system suits his/her present needs.

It is important to note that the cost listed for each editor can be deceptive, and should therefore be considered only in conjunction with the list of the equipment required. Some of the less expensive systems demand extensive hardware support; but, on the other hand, a number of the systems have special circuitry which cuts costs for the user.

Although all efforts were made to complete this chart, not all needed information was available. Where no information was available on a specific topic "NI" was used. "None" was only used if the product did not incorporate a particular feature. There were also occasional discrepancies between information presented in user's manuals and by the software representatives of the various music editors (or by the editors' performances alone). □

Music Editor / Features	VIP Super Sound	Musicraft	Orchestra-80	MMI	ATARI
For Further Information	RCA Customer Service New Holland Ave. Lancaster, PA 17604	Paul J. Medlack 1031 Marlou Drive Baltimore, MD. Distrib.:Newtech Computer Systems 230 Cinton St. Brooklyn, N.Y.	Jon Bakelman 473 Sopena Court Suite 1 Santa Clara, CA 95051	309 Braufort Normal, IL 61761	1195 Barregas Sunnyvale, CA 94026
Music Hardware Included	2 or 4 programable frequency generators, music circuitry and keypad	None	Sound Chip and D/A converter included on 1½ x 2" PC board.	Dividers, D/A converter, audio amplifier on board.	Hardware is part of Atari 800 Keyboard Console
Cost	2 channel VP550 $49 Expander VP531 $74 4 channels Total=$123	$79.95	$79.95	$200	Approx. $40
Other Equipment Required	Monitor, 4K VIP Audio Amplifier + Speakers and cable	CP/M System (Digital Research) Terminal with addressable cursor. Newtech Model 6 Music Board ($99.95)	TRS-80 Audio Amplifier & Speaker	Apple II 8 or 16 speaker.	Atari 800, TV
Number of Voices	2 + drum or 4 with a single VIP.	Editor can support 24 voices hardware can only supply 4 voices	4	4	4
Expandability	Chaining of multiple VIPS is possible.	More memory can be added in order to increase fill size. It may later be possible to expand to 24 voices.	2.66 MHz clock can be used for better sound resolution	Software may be added but is not presently available.	Sound can input through hi-fi, but cables are not provided
Required Minimum Memory Size	2K/4K	24K Need additional 8K with music board	16K	48K	16K
File Storage	Cassette Tape	Floppy disk	Floppy disk	Floppy disk	Cassette or disk
File Protection	NI	File can be destroyed if RESET or SHIFT seven is depressed.	NEW RETURN kills file (4 keystrokes) In edit mode, lines can be deleted by depressing CLEAR.	*Single* keystroke (Q) when in command mode can kill entire RAM file.	Erasure only occurs for *single phase* after query is answered by Y RETURN. User can retrieve *part* of file.
Display Characteristics	Hexadecimal Display For Memory Address and data byte.	All ASCII display	All ASCII display.	White lines and notes on black background. High resolution.	In editing mode, color bands are used to denote octave ranges. Color also used to highlight commands.
Editing Mode	Hexadecimal codes written into memory locations in order to create music file. Machine-language type editing.	Each line is one duration value. All notes in chords must have the same duration.	Each line is one complete measure. Voices are separated on the line.	Writing of each chord—all voices. Chord sounded after all voices are entered. Enter: duration, note, octave. Voices which contain sustaining notes are not requested in the subsequent beat(s).	Displays one measure at a time. Plays entire measure each time a note is entered. If display is exceeded in measure, only the remaining notes are seen.
Error Correction	Rewriting of incorrect memory locations.	Standard text editing methods for insertion or deletion of characters.	Standard text editing features plus: Move lines around in program. Split or merge lines. Duplicate lines. Locate any string.	Rewriting of each chord—all voices. User must remember to install dashes for voices containing sustained notes. Chords can be called by number.	Measures of phrases may be called. Cursor may be moved to insert, delete or rewrite individual notes.
Editing Program Structure	Not applicable	Menus or input area. Line numbered text.	Program text edit. Line numbered text.	Program is either in a command mode, or is requesting a new command mode.	Tree structure with menus, staff display or arrange display.
Music File Structure	Selection/Sections Envelope/ Pitch Voice 1&2 Measures Voice 1 Notes Voice 2 Notes Voice 3&4 Measures Voice 3 Notes Voice 4 Notes	Program text is stored. Note value, V1, V2, V3, V4 needed for each line. Other commands may be inserted directly into the text.	Program text is stored. A part may be defined as a group of measures and may be looped or called as a subroutine.	Table of waveforms can be stored separately. Music file stores chords consecutively V1, V2, V3, V41st chord V1, V2, V3, V4, & 2nd chord	Phrase records pitch, duration pairs. Voice records with voice info. Looping in voices is possible.
Playback Mode	No display. Play once or repeat. Play random Selections	No display. Delayed interactive system—compile is necessary before play.	No display. Compile necessary. Real-time interaction via keyboard is possible to change tempo during play.	Display + play shows full choral notation on double staff. Incorrect rhythms may occur. Play mode—no display. Correct rhythms.	Displays one voice in real-time. If tempo is too fast, sometimes notes on the display lag behind.
Note duration types		 Plus various pre-defined durations (triplets, quinteuplets).	 Triplets		
Dots	Only dotted half, quarter and eighth are available.	Single and double dots.	Single, double and triple dotting.	Single dots only. Dots appear in relation to line or space.	Single dots only. Dots appear in relation to line or space.

KL-4M	Supersound Graphics Editor Prototype	ALF	Mountain Hardware	Ideal
Mike Riley c/o A-B Computers 115 E. Stamp Rd. Montgomeryville, PA 18936	RCA Customer Service New Holland Ave. Lancaster, PA 17604	1448 Estes Denver, CO 80215	300 Harvey West Blvd. Santa Cruz, CA 95060	See upcoming articles in *Creative Computing*. R. Mercuri, M Keith, RCA DSRC
8-bit D/A converter. Low pass filter, audio amplifier, RCA jack.	1802 microprocessor, 2 supersound chips, RC filters, audio amplier, keyboard.	Latches, dividers and RC filter on each board. Each board has an individual crystal.	16 oscillators. Light pen board.	Sound generation equipment, D/A converter, audio amplifier included.
$59.90	Not on Market	$265 per board	$545	Not on Market
Commodore PET-CBM Speaker	TV	Apple II with paddles. Audio Amplifier Speaker(s)	Apple II with at least 1 paddle. Audio Amplifier Speaker(s).	Adapters to major small computer sockets should be available (Apple, S-100...) computer system. Speaker(s).
4	4	3 per board, up to 3 boards are possible	16	Virtually inifinite. Ability to assign voice numbers to any note sequence.
Hardware or software expansion would involve considerable program revision.	Sound can input through hi-fi. Two or more supersounds can be interfaced.	With more than one board, stereo becomes possible. Relatively easy to add user software.	NI	Light pen compartible. Stereo adaptability. Should allow for easy addition of software by user.
NI	5K ROM 3.5K RAM	36K	48K	As small as possible
Floppy disk	Cassette Tape	Floppy disk	Floppy disk	Disk
Virtually impossible to kill file while in editing mode.	C (clear), N (new) or R(read) followed by RETURN can destroy file..	NEW RETURN kills file (4 keystrokes)	When in editing mode, if quite is requested, you are asked to confirm quit using keyboard.	User should not be able to accidentally overwrite disk or destroy RAM file. Query before execution. User option to destroy or retrieve part or all of file.
Medium resolution white lines and notes on black background.	Low resolution white lines and notes on blue background. Measure and voice numbers are also in various colors.	White lines and notes on black background.	High resolution white lines and notes on black background menu display below staves. Choice of single of double staves. Choice of 4 menus.	Black lines on white background. Color option to indicate notes in individual voices. Color also used to define timbre and envelope. High Resolution.
Cursor is positioned at center of screen, and may be moved up or down, or the staff may be scrolled left or right. Notes are written horizontally and may sustain over other voices.	Pressure sensitive keys are depressed. Duration is determined and note may be moved up or down on the staff by repeated key presses.	Screen editing. Paddles are used for menu and note cursors. Any measure may be accessed. Only one voice at a time may be edited.	Single or double staves displayed with menu beneath. Menu may be accessed with light pen, paddle or keyboard. Note cursor accessed with paddle.	User should be able to input music directly from written page. Notes can be written in any order on the screen. Editor creates a playable file from the screen image.
Staff can be scrolled to permit note correction.	Can access any measure and scan next and previous measures and notes. Can't insert or delete measures. Can copy measures previously written.	Deletion, replacement and insertion is cursor controlled. File is compacted or expanded for deletion or insertion.	Beginning or end of file can be accessed. Staff can be scrolled to permit note correction, insertion or deletion.	Can stop music during playback and page will be displayed. Insertion and deletion of groups of measures or notes. Easy access with light pen to any item or page.
Command menu, or note display.	Staff Menus: Music Table → Sections? Select → Number?	Either editing a part or a subroutine. Menu driven edit. Menu appears at bottom of staff display.	Command menu. Instrument and speaker definitions. Staff display with main menu. 3 other menus can be called.	Menu and staff display on separate pages. Separate page for control menu (help, store, retrieve, etc.)
Coded in Hex. 2 hex digits for each note. Each pair is the pitch, voice and duration code for the note.	See VIP & Color Storage	Voices stored sequentially in variable size blocks. Subroutines stored before parts.	NI	Separate editing file and play file. Editing file contains visual data (words, spacings of notes).
Musical staff display on or off during playback.	See VIP	Low resolution bars with moving rectangle indicating pitch (relative placement) and volume (color).	No display. Save and compile is necessary prior to play.	Paging used in real-time display. Optional bouncing ball. Automatic rewrite when file is stored places notes in measures.
  Uses dashed flags for 32nds & 64ths. Triplets also.		 Also any length note can be user defined. Plus Triplets.		 Triplets with proper bracket. User defined note durations.
Single dots only.	Single dots only. Dots are in fixed position with note.	Single only. No dotted 64ths appear in relation to line or space. Dotted Triplets possible.	Single dots only.	Multiple dotting. Dots modify note values rather than separate storage for dotted units. Dots appear in relation to line or space on rewrite.

Features \ Music Editor	VIP Super Sound	Musicraft	Orchestra-80	MMI	ATARI
Rests	Same as note duration types.	Same as note duration types	Same as note duration types.	Same as note values. Not displayed during editing playback.	Same as note duration types Whole rest=whole measure (not just 4 counts).
Ties	Between measures by extending note duration.	Note has to be written again if it exceeds the specified value. Attack will occur again.	NI	None	Multiple ties can be written. Slur may be written, but is not executed.
Repeats	Selections can be played repeatedly.	Looping used for repeats. No levels of recursiveness are possible.	A part can be defined as a group of measures and can be repeated, or called in the program.	None	Arrange mode permits you tc call or repeat any of the nine phrases. Looping used to repeat phrase groups.
Key Signature	None	0–7 sharps or flats.	NI	None	0–7 sharps or flats. Displayed on staff.
Accidentals	# or b only remain for that particular note.	SHIFT 1,2, or 3 must be entered for each note. @ entered for natural or note in key sig.	#,♭,♮,x,♭♭,♮#,♮b.	# or ♭ only remain for that note.	#,b ♮ Remain for measure. Not displayed near note if in key signature.
Meter	3/8–4/4	None	None	2–9/2, 4, 8.	2–9/2,4,8. 8/2 and 9/2 are not allowed.
Transposition	12 half-steps up or down in play mode for all voices. 4 channnel only	NI	Pitch of entire file may be transposed up or down–does not affect file.	None	36 half steps up or down. Frequency transposition, not file. Phrases in voices may be independently transposed.
Pitch Range	4 octave settings each with 31 note range. Span is 3 A's below to 4E flats above middle C.	7 octave range A to G#	6 octave range B–E 8va notation used for upper and lower octaves.	2C's Below middle C, to 2C's Above	1C Below, to 2C's Above.
Measure Checking	None	All notes in chords are always of equal values.	voices are filled in on right with rests to match the duration of the longest voice for that measure.	None You can over or underwrite measures	On or Off. When on, return to menu is not permitted if measure is too large.
Tempo	Fast/slow presets. Also hardware tempo control.	Can vary tempo for any portion of the song by definitions within the edited file.	Can change speed of parts in edited file.	*Real-time* variations possible only during display & play mode. May change tempo prior to playback mode.	9 Tempos ranging from ♩=30 to 270. Many redefine tempo for each phrase in arragement prior to playback.
Volume	One preset volume	NI	256 gradations to specify relative volumes for each voice definition.	Volume slide switch may be used prior to playback.	7 volumes o,pp,p,mp,mf,f,ff may be redefined in arrangement prior to playback.
Tuning	Equal tempered fast & slow slide up & down pitch for each note presets	Equal Tempered	NI	Equal Tempered	Equal Tempered
Envelope	Each of the 4 voices in each of the 8 sections may call one of seven envelope tables. Envelopes have 16	NI	NI	Preset	Preset
Wave-shape	Square wave	16 fourier harmonics may be used to set up to 14 different waveforms in a data base.	4 harmonics may be used to create new waveshape presets.	16 Fourier harmonics may be manipulated in order to set timbres. 2 timbres may be stored in RAM.	Preset
Stems + Beams	Not Applicable Text editing only	Not Applicable Text editing only	Not applicable Text editing only	4 voice choral layout. No beams. Less than four voices, stems reverse direction in relation to middle staff line.	Stems down above 3rd line, up on or below 3rd line. No Beams.
Clefs	Notes called by using one of 4 notes range tables (2 treble, 2 bass)	Notes called by octave numbers.	Positive note numbers are Treble. Negative are Bass. Middle C=0.	Treble & Bass clefs displayed together.	Treble & bass clef displayed together.
Scrolling/Paging	None needed. Data placed directly into specific memory locations.	Upward scrolling of file. Wen the end of the file is encountered, downward scrolling begins. Cursor tabs to next input location as RETURN.	Upward scrolling of text file.	Notes scroll to left when line is exceeded. Measures may be called for display.	During edit, only one measure displayed at a time. If line exceeded, only the remainder of the measure is displayed. In play, scrolling is from right.

KL-4M	Supersound Graphics Editor Prototype	ALF	Mountain Hardware	Ideal
NI	Same as note duration types.	Same as note duration types.	Same as note duration types.	Same as note duration types. Dotted & triplets etc. Whole reset=whole *measure* not just by 4 counts. Movable position on staff by user or computer detection of overwrite.
NI	None	Multiple Ties. Tied notes are stored as single unit. Notes that exceed measure are automatically convertec into tied notes.	Multiple ties may be written. Slur may be written but not executed.	Multiply ties. Tie stored as separate character in fille. When tie connects notes of different pitches the envelope is changed for slur effect. Slur connects notes on rewrite.
Segments of any length may be repeated (even partial measures).	Selections can be played repeatedly. Measures can be selected for copying and then inserted.	Subroutine calls for repeats. Recursiveness is also possible	NI	Go—to type pointers in file for repeats, 1st, & 2nd ending etc. No duplication of file for storage of repeat passages.
0—7 sharps or flats.	None	0—6 sharps or flats. Key signature may be redefined at any time in piece & is displayed.	0—7 sharps or flats. Key signature may be redefined at any time & is displayed.	User can input either 0—7 sharps or flats or *name* of major or minor key. Signature displayed on staff and can be redefined during piece.
# or ♮ may be used for any notes. Not held for measure.	Sharps or flats are displayed during scan of notes for entry. User may select sharp or flat. Not held for measure.	#,♭♮ Remain for measure. Cannot appear near note if in key signature.	#,♭,♮,##,♭♭	♮,#,♭,x,♭♭ Remain for measure. Can be written even if in key signature.
None	1/4—4/4 3/8 5/8 7/8	1—19/1,2,4,8 or 16. Meter can be changed and displayed during piece.	2—32/1,2,4,8,16,32 meter may be changed & displayed during piece.	Meter affects amplitude of notes 1—20/1,2,4,8,16 Meter can be changed and displayed during piece. *No* meter is also permitted.
Pitch (not display) of any voice can be transposed higher or lower. User must check that pitch range is not exceeded.	12 half-steps up or down in play mode for all voices. Octave transposition for individual voices during edit mode.	4 octaves up or down in *quarter* steps. Changes pitch, not file.	None	Name key that is wanted for transposition. Transpose segment of song within voices, or entire voice, or all voices. Pitch and/or display. Semi-tone transposition.
Limited to notes on bass or treble clef staves. No ledger lines. Plus! will provide octave above or below.	4 Octave settings each with 31 note range. Span is 3 A's Below to 4 Eb's Above.	3Fb's below to 3F#'7s above middle C.	8 octave span. Various clef modes utilize different note ranges.	Range identical to 88 key piano. Octave (8va) notation used to avoid excessive ledger lines.
None	"I" displayed when measure exceeded. Will not play when oversize measures occur. Rests fill in measures automatically.	Automatically puts bar lines in. Ties note over bar if measure is exceeded. Can't write short measure except at end or part or subroutine.	None	On or off. Notifies user about incomplete or exceeded measures, but permits user to continue. Plays as written even if incorrect.
Can vary relative tempo between notes, or overall tempo between segments. 6 levels each of accelerado and ritardando.	Hardware tempo control.	2 increments for quarter note duration and 256 tempos may be redefined at any place in the piece. *Real-time* tempo control in playback mode.	8 tempos. Identified by Italian musical terminology.	Variable tempo gradations can be redefined during piece. Presets for major tempo terms callagro...). accel. & rit. functions.
NI	One preset volume	2 volume levels may be redefined at any point in the piece.	ppp, pp, p,mp, mf, f, ff,fff plus 9 accents.	Variable volume gradations. Also presets for ppp—fff. Should be able to have real time control of volume. Presets for cresc., dimin., & accent.
NI on tuning. Keyboard can be redefined, but tuning remains the same.	Equal tempered preset for slides up & down each note.	Equal Tempered	Equal Tempered?	New pitch tables can be easily created by user. Presets for major timing types/well, equal...).
User could write software in order to change the envelope preset.	8 envelopes can be set. 3 presets are available but can be overwritten. 16 time segments in each envelope.	4 point envelope can be redefined at any point in the piece	Envelope defined in instrument block. Option of staccato, tenuto or percussive envelopes.	User can create and call envelope tables throughout program. Graphic input of envelope should be possible.
80 waveshape tables can be created in a 32K PET.	Square wave or noise choice	Square or pulse selection	Fourier additive synthesis. 256 block used to define all features of each instrument. More than 1 oscillator may be used.	Fourier harmonics (16). Presets should be available. A large data base should be possible. Presets vary with octave range.
All upward stems. No beams.	All upward stems. No beams.	Down above 3rd line. Up for all other. No beams.	Melodic or chord notation option for stems. No beams.	Stems should be defined by user options—choice of choral, piano or other formats (all up, all down etc.) Options to beam 8ths etc. together.
Treble & Bass clefs displayed together.	Single stave may be used in 4 note ranges (2 Bass & 2 Treble)	Treble and Bass clefs displayed together.	Treble, bass, alto and tenor clefs. Double stave treble & bass clef option.	Treble and bass clefs should be user defined on staves. Movable C clef should also be possible.
Only 3 notes are displayed—scrolling is from right, one note at a time. Parts, selections, and measures may be called.	Scrolling either left or right past stationary cursor, one note at a time.	Scrolling either left or right by single notes. Measures, parts, and subroutines may be called.	Scrolling left or right by single notes. Can reference beginning or end of piece.	Complete pages should be displayed. Each page contains a double set of staves. Fixed measure size and number of measure per page.

Music Editor / Features	VIP Super Sound	Musicraft	Orchestra-80	MMI	ATARI
Prompting	Not applicable	Menu or music program text.	Music program text.	?? in command mode Note: Voice? for edit.	Menus or staff display. Letter codes given as ones at bottom of screen.
Item Limit of File	255 notes per voice. Fixed Block size for each voice.	Depends upon memory size. 48K will support 1100 four voice lines.	Depends upon RAM size. NI for number of lines.	8K music file. Approx. 4K= number of notes.	NI for number of notes. 127 arrange steps per voice.
Special Features	Random access of musical times or fragments. Drum option. 16 time segment envelopes can be set by user.	Automatic tab and scrolling features. 16 levels of recursiveness. Semitones and complex rhythms are possible.	*Readable* instruction manual. Real time manipulation of tempo on playback. Duration does not need to be specified with each note.	Displays all inserted voices during display and play. Fourier waveshapes can be set by user.	Arrange mode permits rounds. Ease of inputting phrases. Virtually indestructable files.

Music Editor / Features	KL-4M	Supersound Graphics Editor Prototype	ALF	Mountain Hardware	Ideal
Prompting	Menu or staff display.	2 menus or staff. When certain items are selected from menu, one word queries are given.	Staff and menu on same display.	Staff and menu on same display. 3 alternate menus can be called.	Full page of staff with floating note cursor, or full page(s) for menu.
Item Limit of File	32K PET can store 80 waveshape tables. NI for number of notes.	255 notes per voice. Fixed block size for each voice.	5900 Entries	NI	Chaining and paging of music files should be possible. Dual disk drive could be utilized.
Special Features	Waveshape tables can be created. Can change relative tempo between notes or segments. Accelerando and ritardando presets.	Random access of musical tunes or fragments. Display indicates note name, measure and part numbers.	Features can be reassigned (volume, key, tempo...) at any point in the piece. Can call subroutines from different voices.	Single or double stave option. Alto and tenor clefs. Melody or chord option. 16 voices possible.	Words and music displayed. Options for stem directions or color voices. Double definition of notes between the 2 staves. Correction of overlapping notes:

Radio Shack Line Printer VI

Roger and Bonnie Koester

After a long period of comparison shopping for a printer to use with our TRS-80 Model I/ Level II, we decided on a Line Printer VI. The first week of September we placed our order, even though the printer wouldn't be ready for shipment until September 30th. On October 21st the Radio Shack dealer phoned saying our printer had arrived.

The unpacking process was quick—partially because of the method of packing, and partially because we were eager to set-up and run the unit.

The printer was securely packed with styrofoam blocks holding it tightly in place. There was a dust cover over the Line Printer, and printer and dust cover were both inside a plastic bag. The manual, which is extremely informative, was packed inside with the Line Printer. The ribbon cable, which must be ordered separately, came in a second package. There are two ribbon cables available—one plugs into the keyboard,—the other plugs into the expansion interface.

Once unpacking was complete, it did not take long before a new sound was coming from our computer room.

The Line Printer VI, a 9 X 7 dot-matrix impact printer, has a very efficient output rate.

1.) It prints NORMAL characters at 100 characters per second, and 33 lines per minute.

2.) The CONDENSED characters are printed at 120 characters per second, and 37 lines per minute.

3.) There is a maximum of 132 characters per line.

4.) It has the capabilities to print in both directions. In the large (elongated) characters, however, it only prints left to right.

The printer has four sizes of print that are software selectable, and simple to use.

1.) Normal Characters
2.) Elongated Characters
3.) Condensed Characters
4.) Elongated—Condensed

Roger and Bonnie Koester, R.R. #1, Box 161A, Tennyson, IN 47637.

```
FIGURE #1

LPRINT"SMALL"; CHR$(31); "LARGE";CHR$(30);"SMALL AGAIN"
PRINTING OF NORMAL AND DOUBLE-SIZE CHARACTERS ON SAME LINE DEMONSTRATED.

LPRINTCHR$(27);CHR$(14);"CONDENSED"
PRINTS CONDENSED CHARACTERS.

LPRINTCHR$(27);CHR$(15); "NORMAL CHARACTER"
CONCELS CONDENSED CHARACTER MODE AND RETURNS TO NORMAL CHARACTER.
```

To change print size "CHR$( )" command is needed. (See Figure 1.)

The vertical spacing, also software selectable, can be six, eight, or twelve lines per inch. It automatically goes to six lines per inch at power-up. To change vertical line spacing, a two part code is needed. (See Figure 2.)

One of the best features is the choice of tractor feed or friction feed. With tractor feed you can use any standard tractor feed paper ranging from mailing label strips up to 15 inch forms. They can be single, double, or triple sheets, allowing an original and two copies. We'd like to mention that although the specifications say 4 to 15 inch paper, the tracks will go from 2 5/8 to 16 5/8 inches. The tractor feed paper can be entered at two locations. There is a paper insertion opening at the top center. If your printer stand allows, paper can also be fed into the bottom of the printer.

Changing from tractor feed to friction feed is simple. You turn off the power, remove the upper plastic cover, and pull up on both sides of the mechanism. The rear part will unlock and you'll be able to remove it by simply continuing to pull upward. Then you re-install the plastic cover and turn on the power. You're now ready for friction feed.

```
FIGURE #2

LPRINTCHR$(27);CHR$(54)
                        PRINTS LINES AT 6 LINES PER INCH.
                      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

LPRINT CHR$(27);CHR$(56)
                      PRINTS LINES AT 8 LINES PER INCH.
                      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

LPRINT CHR$(27);CHR$(54)
                      PRINTS LINES AT 12 LINES PER INCH.
                      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                        XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

(201) 623-6818
(201) 742-0858
(201) 777-0952
(202) 347-1400
(202) 783-2050
(203) 357-1800
(203) 522-0344
(203) 789-0211
(205) 251-2495
(205) 432-8015
(206) 447-9012
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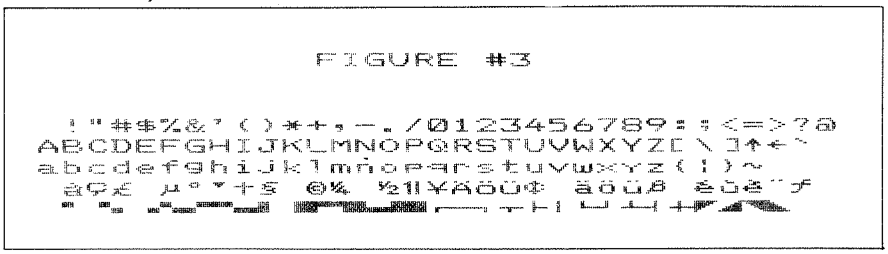
CIRCLE 206 ON READER SERVICE CARD



The friction feed is a real plus. It has all the same capabilities as the tractor feed, and more. The use of single sheets of paper is very beneficial. We've used typing paper to write letters. They look great.

It is very easy to keep track of the line you are on when you need to advance the paper. Mechanically, you use the Line Feed button, which advances by very definite spacing. Manually, the roller can be quietly heard, and distinctly felt, as it advances each line. Many printers simply roll freely in order to advance the paper, and you cannot tell how many actual lines you have moved.

The streamlined, attractive appearance is a plus in our computer room. The Line Printer VI measures 24.2 inches(W) X 6.3 inches(H) X 13.3 inches(D). On the front there are three buttons (left to right reset, line feed, 1/12 line feed), and one switch (on/off). Just above the buttons are three L.E.D.'s (power, alert (out of paper), ready). There is a self-test switch on the left rear corner. During testing the line printer does not need to be attached to the computer. The test prints the character set (See Figure 3.) Notice, as mentioned before, the graphics capabilities.

So far we've only touched on the good features. There are a few things with which we are not satisfied:

1. The high-pitched noise which one can hear any time the printer is on.
2. The lack of a method for setting tabs.
3. The lower case g, y, p, and q do not go below the line. It's a shame that a printer of this quality does not do this.
4. The absence of markings by the paper release lever denoting which position is LOCKED for friction feed, and which position is FREE for using tractor feed.

Regardless of these four points of dissatisfaction, we still believe the Line Printer VI is the best line printer we've seen for the money. □

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J. DiMaggio	H. Greenberg	W. Mays	L. Brock
J. Jackson	R. Hornsby	P. Rose	R. Carew
G. Sisler	H. Wilson	O. Cepeda	H. Killebrew
S. Musial	B. Terry	C. Yazstremski	R. allen
T. Cobb	M. Mantle	W. McCovey	R. Leflore
W. Mays	H. Aaron	R. Jackson	R. Zisk
C. Young-P	W. Johnson-P	G. Brett	B. Madlock
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Performance is based on the interaction of actual batting and pitching data. Game can be played by one or two players with the computer acting as a second player when desired. Players select rosters and lineups and excersize strategic choices including hit and run, base stealing, pinch hitting, intentional walk, etc. Highly realistic, there are two versions, ALL TIME SUPER STAR BASE—BALL, and SUPER STAR BASEBALL featuring players of the current decade. Each includes about 50 players allowing nearly infinite number of roster and lineup possibilities.

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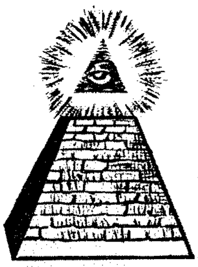

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CIRCLE 219 ON READER SERVICE CARD

Base 2 Makes its Mark

Wayne F. Cummings

The Base 2 Model 800 is among the printers presently undergoing extensive field testing at **Creative Computing**. *We'll keep you posted on the results.—DL*

A relative newcomer on the market, the Model 800 from BASE 2 Inc. is gaining a reputation as a good quality, low cost, impact printer. Recently, I purchased one for my business (Midwest Microcomputer) and thus far have been quite pleased.

Interfacing

The Model 800 accepts the four basic interface disciplines. Namely: Centronics parallel, IEEE-488, RS-232, and 20ma current loop. I presently use the parallel format with my TRS-80. The hook-up was simple: plug in the cable and set six microswitches to 'off'. Presto! It's ready to run.

Printing Specifications

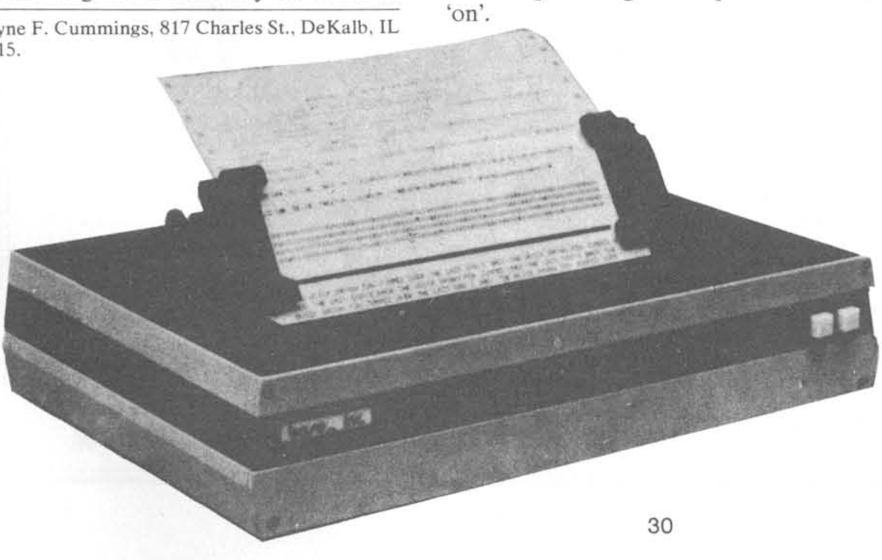
The unit is a 5 X 7 dot-matrix impact printer, available with either friction or tractor feed. It can print in six different densities; 64, 72, 80, 96, 120 or 130 character/second (CPS) at all densities. The quality of print is good, especially at 96 characters/line which I find to be the most readable with the least fatigue. However, character column alignment can vary as much as two dots (aprox. ½char.) from one line to the next. This variation can be completely eliminated by switching from bidirectional to unidirectional printing. However, this method also decreases throughput to 50 CPS. For most applications, I have found the faster bidirectional printing to be satisfactory.

Wayne F. Cummings, 817 Charles St., DeKalb, IL 60115.

Character Fonts

On power up, a standard 96 character ASCII character set (font) is accessed in the printer's 32K ROM. This set includes upper & lower case characters. The lower case does not feature true descenders. (i.e. the tails of the p,j,y,g, & q do not hang below the line).

Also, the user has the option of designing his or her own character set. This is done under software control by loading the printer's on board RAM with a data stream that formats the character set. This may seem a bit abstract, but is really quite simple. The operating manual gives complete instructions on how it works. If one additional set isn't enough for you, the Model 800 can accommodate eight more for a total of ten. Additional memory chips need to be installed for these eight sets. The printer is able to switch back and forth from one set to another, without reloading, as long as the printer remains 'on'.



Graphics

If the user wants, he can use no character fonts at all. This is the graphics mode. It works much like the user defined set except that instead of sending a data stream for one character, the computer sends a data stream for an entire line. This can be slow, as the printer must receive an entire line before printing. Even if, for example, only half a line is used. In connection with this mode, the printer can be set to allow no space between lines so that true graphical output is achieved.

Software Control

Probably the best feature of the 800 is its software control. There is nothing that can be done manually (i.e. by flipping switches) that can't be done by the software, and there is a whole lot that can be done by the software that can't be done manually. This is due to the incorporation of an 8085 microprocessor in the printer's logic. Space does not permit a listing of all software controllable items, but here are some of the more important ones:

- •variable line lengths (64,72,80,96,120,132 char./line)
- •elongated characters
- •character font selection
- •reset (sets all modes to their default (condition)
- •form feed
- •page length
- •tabs (vertical & horizontal)
- •graphics
- •vertical densities (# of dots between lines)
- •unidirectional printing

Exterior

Physically, the printer is compact; only 3" x 11" x 15" and it weighs only fifteen lbs. It has a heavy gauge aluminum chasis that appears able to withstand a very harsh environment. (A refreshing change from most of my other equipment, which is Radio Shack plastic.) The tractor mechanism is, unfortunately, plastic and looks

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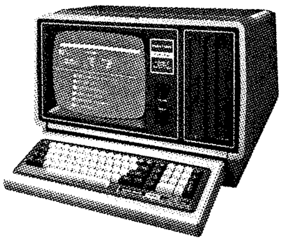

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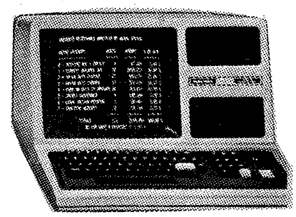

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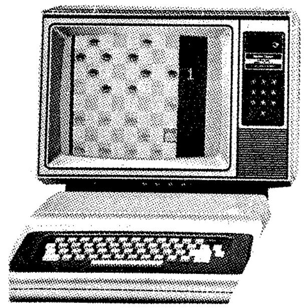

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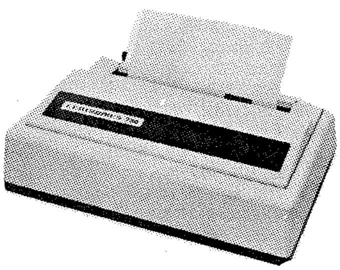

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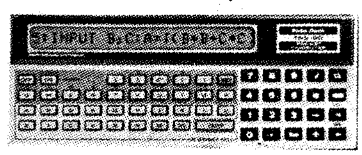

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CIRCLE 163 ON READER SERVICE CARD

BASE 2 PRINTER TEST

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NOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~▒

72 CHAR. PER LINE. !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTU
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80 CHAR. PER LINE. !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]
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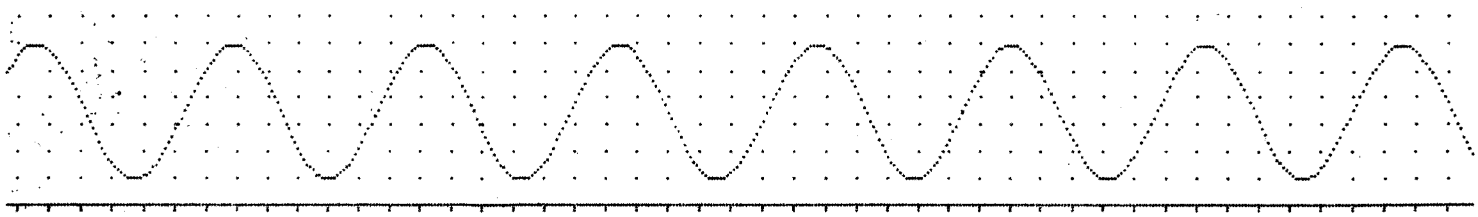

like a last minute addition when compared to the rest of the printer. Let us pray...

Noise

It does make some. When printing, the print head makes a high pitched racket, almost tinny sounding, that is quite loud. Apparently, there are some even higher pitched sounds emitted, because my dog looks distressed and whines whenever it runs. Fortunately, the printer makes no noise when standing by...zero. Noise can be minimized in two ways. First, always keep all metal covers on when printing. And second, use heavy gauge paper to reduce the sound of the impacting printhead.

Documentation

The operating manual is beautiful; 70 pages with plenty of illustrations, examples, charts, and appendices. A complete set of schematics is included for the hardware minded and a sample program for *every* software feature is included for the software minded. What else can I say? It's well done and even has a glossy cover.

Service

Last but certainly not least, the actual service. I ordered my printer directly from BASE 2. I was told it would be shipped in about six weeks. That's 42 days folks. After 87 days and several long distance phone calls, the printer arrived...without any operating manual. By day 117 I had received two manuals (one was a "preliminary" manual sent a few days before the real McCoy.) Keep in mind that a six week order turned into a sixteen week ordeal. Suggestion: buy from a retailer who has them *in stock*.

In summary, let me say that the Model 800 is an exceptional printer. It has a few draw-backs, but for the price ($699)* one would be hard pressed to find a better value in an impact printer.

Flash! Between the writing of this article and the date of publication my printer had an accident. The printhead burned out! This is most distressing, considering less then 1/4 box of paper has been run through it. BASE II charges a flat $50 to fix anything on its printer. By coincidence, the cost to send me a new printhead is also $50. The unit's on its way back to the factory. I'll keep you posted. □

---

*699 is the price for their 'loaded' model, the MST.
M= terminal screen buffer
S= high speed paper advance & graphics
T= tractor feed

I'm told they are phasing out "options" and making them standard.

from Quality Software

Three Sorcerer Games

Bob Stuckmeyer

One thing all Sorcerer owners have in common is that we are desperate for software! Exidy has made little effort to enhance their product with additional software or peripherals. Consequently, users like myself are forced to find other sources of Sorcerer software. This article will review three games from one such source—Quality Software.

Martian Invaders and *Head-on Collision* are modeled after popular video arcade games. Both are written in machine language and make excellent use of the Sorcerer's graphic capabilities. In *Martian Invaders* (see Photo 1) 28 aliens descend from the sky dropping bombs. You must maneuver your gunner to avoid the bombs while attempting to shoot the aliens before they land. As aliens are shot, those remaining descend faster. If all aliens are eliminated 28 more appear slightly closer to the ground. Points are awarded for each Martian destroyed. Flying saucers appear randomly and bonus points are awarded for their destruction. This game differs slightly from its arcade counterpart in that only one gunner is allowed and the gunner is not protected by barriers.

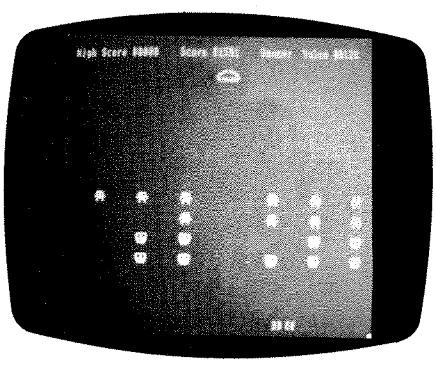

Photo 1. *Martian Invaders.*

Although its title may be offensive to some (I would prefer *Dodge Cars*), *Head-on Collision* (see Photo 2) is also an exciting game. The object is to drive your race car around a five-lane track in a manner which avoids collision with a computer-controlled car traveling in the opposite direction. Collisions are avoided by changing lanes at any of four intersections. Points are received for passing over dots in the tracks lanes. The game has three skill levels and models the arcade game very closely.

Bob Stuckmeyer, 2347 Cavendish Lane, St. Louis, MO 63129.

Both of these games are addictive in nature and not easily mastered. Either one will be over in a few seconds if you lack good hand-eye corrdination. These programs are quite good, but they would be even better if they had sound. Although the Sorcerer lacks an internal speaker, sound could be produced over an inexpensive amplifier connected to the computer's microphone jack. This arrangement has been used by several companies who offer programs for the TRS-80 and would work equally well with the Sorcerer.

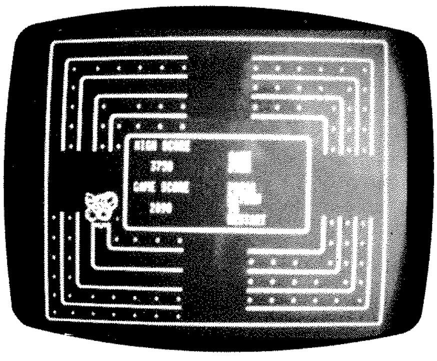

Photo 2. *Head-on Collision.*

Starbase Hyperion (see Photo 3) is a tactical simulation of war in outer space. The object is to prevent enemy forces from destroying your starbase. As commander you must decide how to deploy the starbase's energy each day. Energy may be used to generate warships, to release probes, to increase the starbase's shields, to create additional power bands, or to add power reserves. Different classes of warships may be generated. Each class has unique speed and armament ratings; those with the highest armament ratings require more energy to create. The commander directs ship movement with the aid of a sector map which displays the position of enemy and friendly ships on a polar coordinate grid. Battle between ships is graphically displayed on this grid.

Starbase Hyperion is rich in detail. Players will probably need hours of practice to become well versed in rules and tactics. Random events like enemy reinforcements, circuit overloads and the recovery of enemy battle maps make each game challenging. Unfortunately, the program has several minor errors which are irritating. The screen area which lists the status of all friendly ships is not always updated correctly when a ship is lost in battle. Advancing enemy ships occasionally disappear without having been destroyed. Sometimes the program erroneously reports a ship is destroyed as it is launched. Because I received one of the first copies shipped, the program may not have been fully debugged.

In addition to the programs reviewed, Quality Software offers about twenty other programs for the Sorcerer. About half of these are games; the others are "serious" programs including extensions to Exidy's assembler, a smart terminal program, a disassembler and more.

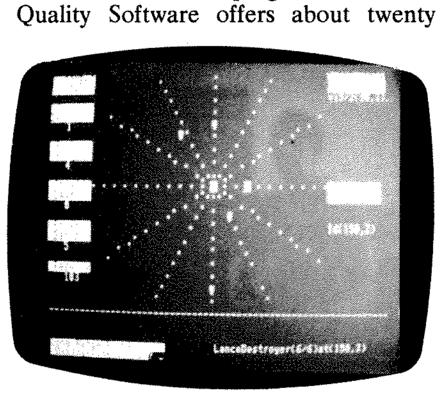

Photo 3. *Starbase Hyperion.*

Quality Software can be reached by calling (213) 344-6599 or by writing to: Quality Software, 6660 Reseda Blvd., Suite 105, Reseda, CA 91335. □

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Soft Centered

David Lubar

Battles in space and on Earth seem to be strong categories in the new software releases. This is a continuation of the computer-as-arcade-machine style, and I have to admit a fondness for it. No matter what other uses there are for computers, games will always represent a major portion of the new software. One such game is

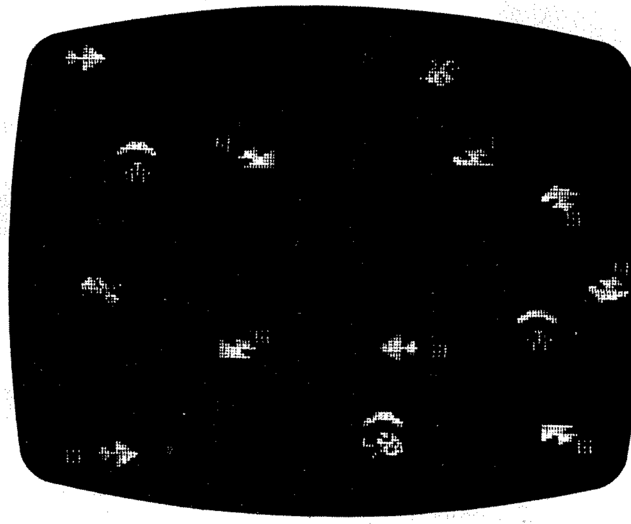
> **A clever, logical solution to a problem might not work because the programmer never thought of it.**

covered below. Another popular area is adventure-type games. The original concept has spawned several programs that, while bearing a kinship to Adventure, are only distant cousins. One will be discussed below. Filling out the column, we'll take a look at a mailing-list program.

Winging it

Dogfight ($29.95), from **Micro Lab,** 811 Stonegate, Highland Park, IL 60035 has several game variations on one Apple disk. This 32K machine-language program puts you in control of a jet plane flying against enemy jets and helicopters. At the start, you have the option of using keys, paddles, or one or two joysticks for control. Next, you can select from six modes. The single-player option allows you to play by yourself. With two players, you can play as partners or play as opponents. There are also two demo modes (one without sound) and a mode that lets up to eight players fly in competition. The game starts at level one. The player faces a single jet or helicopter. The enemy craft flies a random pattern, firing bullets. You must evade these bullets while making your own attack. A shot fired from a distance is less likely to down the enemy. Generally, you have to get rather close to the target. If you hit it, it explodes. Sometimes, the pilot will parachute from the plane. If you don't shoot him, he gets another plane and continues to fly. If you are hit, you have a chance to jump. Once the plane or helicopter is destroyed, you move to the next level. Each level either adds another craft or increases the speed at which the crafts fly and shoot. As mentioned in their ads, Micro Lab will award special certificates to the first ten persons who score 10,000 points. It might be some time before those certificates are claimed.

Dogfight is a good game. The helicopter is one of the nicest pieces of graphics programming I have seen. Two things should be mentioned. The disk will only boot if the drive controller card is in slot six. Also, when the game comes up, you'll see some extra text on the screen along with the title. There is nothing wrong with your Apple, those random-seeming letters are supposed to be there.



Dogfight

Interactive Literature

Ted Nelson

Bob Lafore's *Interactive Fiction* is a new genre he's invented. And it's great.

Unlike standard Adventure games, obsessed with knapsacks and secretive about the commands that make them work, *Interactive Fiction* is an adventure in a literary setting—a narrated story in which you are a character. Your chances for action consist mainly in deciding what to say when asked, but these interactive stories are generally vivacious and exciting. They are also excellent for parties, and for computer beginners and literati who do not find conventional Adventure games attractive. (And speaking as a jaded vetern, these were the most fun I've had with computers in a long time.)

Essentially *Interactive Fiction* is a Dialogue Adventure, a combination of Adventure and Eliza—since the programs behind the stories must parse your replies and branch appropriately.

Each story begins with a longish introduction—over-long, perhaps—but gets you wide awake with something like, "And we hope you are ready to become a fictional character." This really grabs you (—especially if, like most of us, you sometimes suspect you *are* a fictional character.)

Then the story begins—excruciatingly stylized, a combination of mood, whimsy and nostalgia—and soon you have your first chance to reply.

Each time you reply, it's a temptation just to go for keywords—but if you have any love of story-telling, you're more likely to reply in full sentences, befitting your station as a character.

The dialogue format,it must be admitted, is sometimes awkward; but it's a nice prompt. (And the whirring disk, the first part of the computer's response, creates a nice conversational tempo.)

Essentially Interactive Fiction is a Dialogue Adventure.

And what you say has consequences. You live or die, find the murderer or not, achieve fame or disgrace. And all in the framework of delightful story-telling and purple prosody:

"...As you raise the head droplets of coffee in Rodney's beard glisten in the light from the dirty window."

Lafore has thought through his format beautifully. By careful stacking of the stories, he gives you neat choices of action, but not so many as to make the story unwieldy. (The respones that lurk ready to pounce on *your* utterances are often choice.) Sometimes he will surprise you by speaking for you; sometimes he lets you off the hook, as in "Two Sides of the Coin," where you can ask your Dr. Watson to take over if your own initiatives don't work.

For a Swarthmore alumnus, Lafore unfortunately slips us a surprising number of misspellings—I noted "governement," "trolly," "reasonalby," "imaginitive," and the arresting "douchess." He is also not consistent in the spelling of the characters' names. But no matter.

Bob Lafore is obviously a talented writer with a nice command of atmosphere, fictional action and structure; not content to be merely a swell teller of conventional tales, we can be glad he favors us with an entire new system of interactive writing.

Never mind the swords and sacks of souvenirs; I'd rather curl up with a good interactive story. □

You are There

Interactive Fiction. The phrase does a good job of describing the product. These programs by Robert LaFore, on disk for a TRS-80, are stories where the player has a chance to take part in the development of the plot. This is done through dialogue. Throughout each story, the player has a chance to put words in the mouth of a character. The choice of words affects the outcome of the story. This approach has several ramifications. As with all interactive programs, you can succeed only with solutions that have been anticipated by the author. In other words, you are working within a well-defined universe. Part of the fun is in discovering the laws of this universe. Part of the frustration is in being unable to transcend these laws. A clever, logical solution to a problem might not work because the programmer never thought of it. Another important feature of these games is that you only get out of them what you put in. A user can approach *Interactive Fiction* as a contest between him and the computer, where the goal is to find the vocabulary and overcome the program. For instance, in *Interactive Fiction* you can enter sentences consisting not of real dialogue but of a string of potential keywords. This approach might reveal the design of the program, but it kills all the fun.

The early disks were structured in such a way that the drive was accessed fairly often. The programs vary in interest and quality. *Six Micro Stories* ($14.95) is one of the best. The player takes part in short stories, each with many outcomes. In one, you are a spy attending a German party during World War II. Another story involves a meeting with a young women in a park. The novel *Two Heads of the Coin* ($19,95) is a Holmes-and-Watson type affair. Billed as one of the more difficult programs to solve, it is clever, but not that tough. Again, the main thing is getting into the spirit of the program. Even after you've solved the story, you can go back and look at other branches.

The most recent release, *His Majesties Ship Impetuous*, takes a slightly different approach. There are fewer interruptions for disk access and the story is more linear. The series of events encountered during any "reading"of the story will not change much, but the outcomes will vary depending on decisions made earlier. As the captain of the Impetuous, you have many choices to make, each of which could come back to haunt you later. Whether you end in fame or infamy, you can always take another run through the game. This raises another interesting point. Since there is a goal (namely, ending in fame and glory), players might be discouraged from exploring all the avenues since many are obviously losers. But what seems obvious might not be correct. Besides being fun as games, these programs are a good way to show off your computer the next time someone asks, "What do you do with that thing?" The disks are available from several distributors including TSE (6 South St. Box 68, Milford NH 03055)

In the Mail

Software Technology for Computers, P.O. Box 428, Belmont MA 02178, produces *Mailing List Program* on disk for a 48K Apple with Applesoft. The program has ten pre-defined fields with pre-defined lengths, including first name, last name, address, and phone number. Data can be saved on any initialized diskette. Before printing a list, the format can be tested and changed. Data can be sorted in six different fields, and the sorted information can be printed. A search routine is included, allowing you to print out only those entries which fulfill a specific catagory. You can also print a list of names and phone numbers.

The program performs as promised. For $40, it is a bargain, with some qualifications. You cannot search on a subset. For instance, while the program will find everyone with the last name "Jones," it can't find everyone whose last name begins with "L." Also, you can't produce a sort of two fields such as an alphabetical list of names within a list sorted by zip code. But, if you don't need these extras, *Mailing List Program* is a capable program.

Scattered Bits

On Line Systems, who gave the world *Mystery Mansion* and *The Wizard and the Princess*, has another high-resolution adventure slated for release in the near future. They've also come out with a football game. These Apple products will be covered in an upcoming issue. The Sensational Software division of Creative Computing will be distributing several Atari games created by Thorn EMI, one of the most innovative software developers in England. □

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When Is A Program Intelligent?

Norman Whaland

Inventors of flying machines have one major advantage over designers of intelligent programs. It is always evident whether a machine is flying, but not whether a program is intelligent. A program as proficient as man in a wide range of intellectual activities would indubitably be intelligent. Such success is far off, however, and perhaps impossible. For the present, we must be satisfied with programs of limited intelligence. Unfortunately, the distinction between ordinary programs and somewhat intelligent programs is not entirely clear.

Writing programs is a major activity of AI researchers. The purpose of the programs is sometimes obscure, but most are apparently thought to be intelligent in some sense or are intended as pilot projects for programs that will exhibit true intelligence. The design and evaluation of AI programs requires an understanding of what it means for a program to be intelligent. Such understanding has been slow in coming.

The goals of the early research in AI were distorted by a one-sided conception of intelligence. The result was excessive optimism and wasted effort. Much of the early progress in AI is proving illusory, as the distinction between pseudo-intelligence and true intelligence becomes more apparent. Even today, the difficulty of defining goals is a serious impediment to AI research.

Pseudo Intelligence

In their introduction to *Computers and Thought,* Feigenbaum and Feldman say that the goal of AI research is "to construct computer programs which exhibit behavior that we call 'intelligent behavior' when we observe it in human beings." Most authorities offer essentially the same definition, although lately it is usually qualified in an attempt to repair its defects. The creation of programs to carry out *useful* intelligent behavior is obviously valid as an *ultimate* goal. However, it is incorrect to use behavior as the sole criterion of intelligence in formulating *proximate* goals. The behavior of most AI programs is completely useless. They have value only insofar as they embody principles that can eventually be incorporated in useful programs. Intelligent-seeming behavior is no guarantee that the program represents any progress at all toward true AI.

Norman D. Whaland, 430 E 9 St., Apt. 15, New York, NY 10009.

Intelligent-seeming behavior is no guarantee that the program represents any progress at all.

Many AI programs can attack only problems within a limited range, called a *task domain.* The rationale is that lessons learned with a small task domain can be applied to programs with much larger task domains. If this plan is to be successful, however, it is not sufficient that the behavior of the small-domain program appear intelligent. Methods that work for small domains can't always be applied to large domains.

If the task domain is sufficiently small, the number of different types of situation that can arise will be small compared to the number of instructions in a computer program. Under these circumstances, the domain can be handled by a conventional program, in which each type of situation is handled by a separate sequence of instructions. The programmer, using *his* intelligence, makes all the decisions and records them in the form of a program. Such a program may seem impressively intelligent, but it is worthless for the purposes of AI research.

A person who plays Nim perfectly is surely exhibiting intelligent behavior. Nevertheless, the existing Nim programs can't be considered intelligent. We can say to a person, "All right, now let's change the rules, and say that you can't draw more than five counters at a time." No great intelligence is required for us to change our behavior accordingly. Nim programs are completely unable to do this, let alone find the winning method under the new rules.

Of course, Nim programs can't understand English, but that isn't the crux of the matter. Even if we had a program that understood English, there would be no way to link it to a Nim program so as to duplicate human performance. The reason is that Nim programs and typical English sentences contain units of information of entirely different kinds. Also, the information in programs isn't in a suitable form for modification. A Nim program might contain an information unit like

```
230 IF X = Y(J) THEN 540
```

Deprived of its context, it is meaningless and useless. It exists only to be executed at the proper moment. Information in such a form can't readily be manipulated to produce appropriate behavior in changed circumstances.

A conventionally structured program lacks the flexibility that is an essential part of intelligence. This lack can't be remedied simply by adding to the program. New ways of structuring programs are needed if they are to use information flexibly and to accept and utilize new information.

The conventional techniques that succeed on small task domains are bound to fail on much larger domains. If each type of situation were to be handled by a separate section of code, computer memory and programmer endurance would both be pushed past their limits. The task-related information used by large-domain programs must be in the form of facts and principles, which (unlike commands) can be combined in various ways

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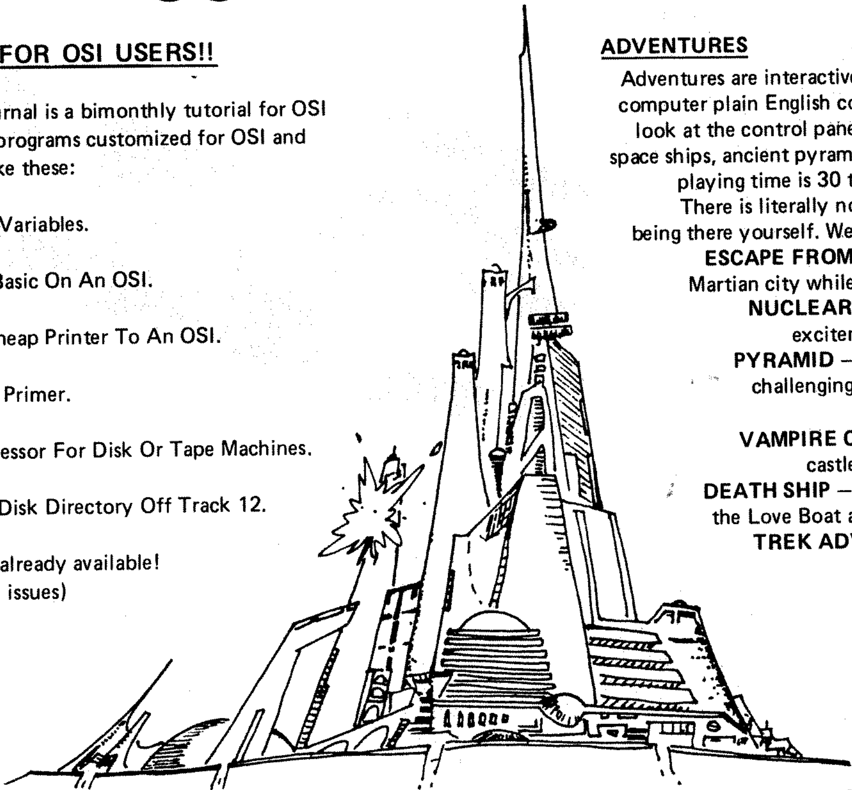

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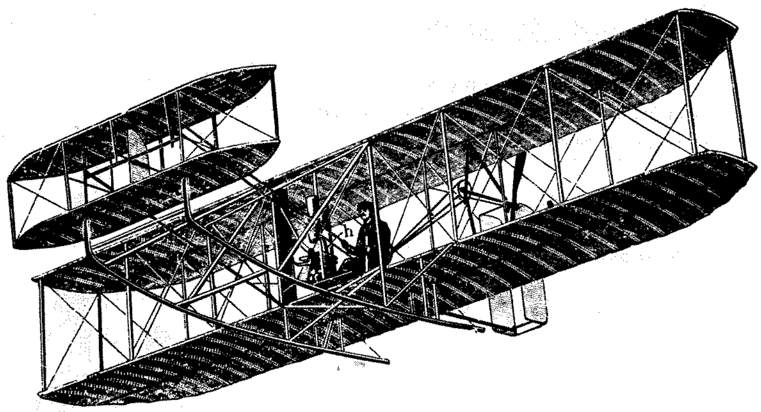
to generate appropriate behavior. In this way, the number of types of situation that the program handles can be many times larger than the number of items in the information store.

For very large task domains, easy communication with the computer is needed. When Turing predicted that his Test would be passed by the year 2000 — a prospect that now appears very unlikely — he believed that it would be necessary first to program computers to learn, so that they could be supplied with information more efficiently. Unfortunately, programs have so far been capable of only the most rudimentary sort of learning.

If the behavior of AI programs is to serve as an indicator of progress, they must do more than solve problems in a small task domain. Conventional programs, which add nothing to our knowledge of techniques useful for large task domains, can do as much. Intelligent behavior by itself is a sign of progress only when it includes the acceptance and flexible use of new information. It is possible for an AI program that does nothing but solve problems to have value, but the determining factor is not its behavior but its internal mechanism.



True Intelligence

The stress on behavior as a criterion of intelligence obscures the real goals of AI research. The naive definition is, in my opinion, the best one: the goal of artificial intelligence is the creation of programs that think. Improvement of the behavior of programs is too often accomplished by ruses of no general usefulness. Changing the processes that AI programs use, so that they more closely resemble thought, is a surer guide to progress.

AI programs needn't necessarily model human thought. It suffices that the mechanisms used by the program have the essential characteristics of thought. Just as a flying machine needn't flap its wings, a thinking machine needn't work exactly like the brain. Of course, it may be difficult to agree on a definition of thought, in this extended sense. The need for a clearly defined goal might seem to justify the customary emphasis on intelligent behavior.

Still, thought is no more vague a concept than intelligent behavior. Neither can be defined; both must be judged subjectively. The skeptic's judgment that the mechanism of an AI program is not thought is just as valid as the proponent's judgment that its behavior is intelligent. Success in problem solving is an objective criterion, but (as we have seen) an insufficient one. Those aspects of behavior that indicate true intelligence — flexibility, adaptability, and the ability to learn and understand — are difficult to measure objectively.

Although thought can't be defined precisely, a few necessary characteristics of programs that think can be stated. The specific information about the task domain should appear, not in the actual program, but in a data base consisting of discrete units of information. The information units in the data base should be used flexibly in accordance with the situation. The program should have entirely general methods, applicable to any subject matter, for retrieving relevant facts and principles and applying them to the given situation.

In the fifties, programs played checkers and proved mathematical theorems. In the seventies, they rearranged blocks and figured out how to turn on the light switch.

In assessing the intelligence of a program, we should ask these questions: How much of the information in the program is applicable only to certain types of tasks? Can it, like a conventional program, apply only specific instructions to the problem, or can it utilize factual information? Can it use any fact, or only certain kinds of facts? How flexibly does it use the facts in the data base? How well does it retrieve from the data base just those facts that are relevant to the problem? Are its problem-solving methods organized as a rigid procedure, or are they activated flexibly as the situation changes?

The existing programs that are relatively intelligent by these criteria are unimpressive problem solvers. This isn't surprising and shouldn't be discouraging, since there are many aspects of thought that are not well understood. Real progress is being made, however. There are computer programs that model such thought processes as logical deduction, goal setting, concept formation, analogy formation, and associative retrieval from memory. Still, not very much is known about any of these processes, with the exception of logical deduction. Lengthy experimentation will be necessary for the design of useful problem-solving programs that think.

False Optimism

In *What Computers Can't Do* (Part 1 in ROM, Vol. 1 #9, p. 66; Part 2 in *Creative Computing*, Vol. 6 #1, p. 54; both available from *Creative* for $2.50 each), Hubert Dreyfus called attention to the first-step syndrome that afflicts AI research. A worker writes a program that seems somewhat intelligent, hails it as a first step toward a much more powerful program, and then goes on to something completely different — another "first step." Second steps are uncommon.

When serious research in AI got underway in the late fifties, there seemed to be good cause for optimism. Some impressive programs were written then notably Samuel's checkers program and Gelernter's program for proving theorems in plane geometry. Contrary to expectations, still more powerful programs did not soon materialize. It now appears that many an impressive first step was not a step toward AI at all. Progress in producing intelligent behavior is not necessarily progress towards producing thought.

In recent years, AI researchers have become more aware of the difficulties to be overcome. Nowadays it is mainly the general public that is misled by reliance on behavior as a criterion of intelligence. Demonstrations of alleged artificial intelligence can be deceptively impressive because of the force of analogy. It is natural to assume that appropriate and

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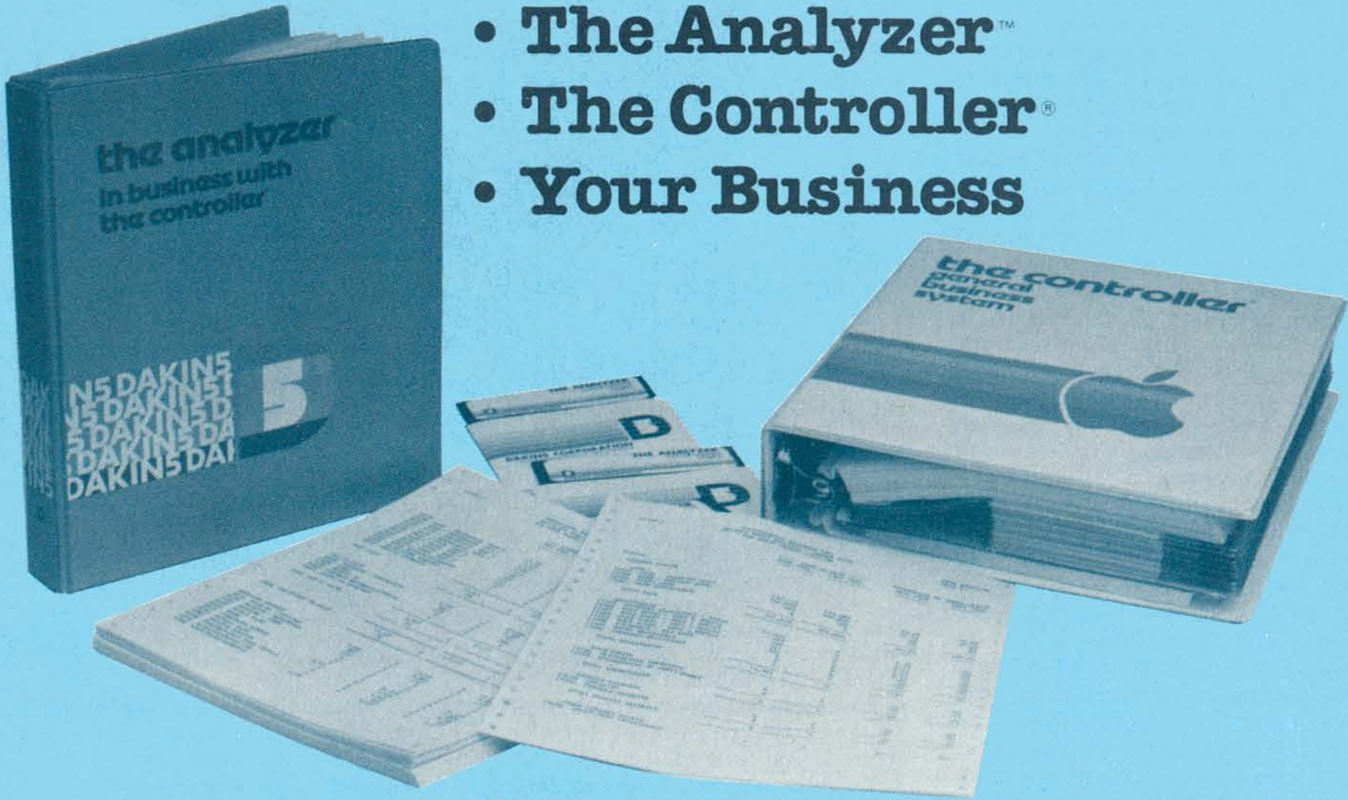

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Intelligent, continued...

seemingly purposeful behavior results from thought. Laymen aren't in a position to examine the program and determine whether it is a bag of ad hoc tricks or an approximation of true thought.

Since chess is one of the best-known and longest studied task domains, it makes a good case in point. Claude Shannon proposed in 1950 that a chess program could serve as a pilot project for programs that could do useful thinking, such as engineering design. Early success in writing programs that played mediocre chess was followed by a long period of little apparent progress. Finally, the Slate-Atkin program CHESS (I omit the ever-changing version number) astounded everyone by achieving an Expert rating — three levels above the rating of the average tournament player.

Many people overrate the significance of the progress in chess programming. Contrary to a widespread belief, it does not harbinger machine play of world championship caliber. While CHESS has highly sophisticated tree-searching techniques, it contains very little information about chess. Its success proves only that shallow but exhaustive analysis is more effective than anyone anticipated. Further surprises are possible, but it seems likely that programs will need far more chess knowledge in order to compete with top-ranking players. It will be difficult to build more knowledge into CHESS without slowing it down so much that it loses its tactical skill.

The contribution of chess programming to the science of AI is essentially nil. Some of the techniques used in chess programs can be applied to other games. However, they tell us nothing about reasoning processes that can be applied generally. As pilot studies for programs that could do engineering design, or anything useful, they are complete failures.

I am afraid that a picture is being created in the public mind of impressive, sustained progress in AI. I see blind groping and halting progress. Extravagant expectations are likely to be followed by picayune results, arousing suspicions that AI researchers don't know what they are doing or that AI is an impossible goal. Indeed, critics of AI like Hubert Dreyfus have already exploited overly optimistic predictions for purposes of ridicule. Funding may eventually be affected. The public shouldn't be led to expect of the young science of AI the predictable progress characteristic of the mature sciences.

The early AI programs were based on casual observation of the human thinking process. One reason for undue optimism was, perhaps, the belief that introspection would quickly provide an adequate picture of the mechanism of thought. Unfortunately, vital steps lie beyond the fringes of consciousness. We don't know, for example, how habits of thought organize problem solving purposefully yet flexibly.

Expertise consists of knowledge about objects and of successful habits. Knowledge about objects is largely conscious. It can be, and often is, written down in the form of declarative English sentences. Habit-knowledge is covert. Methods of problem solving are learned mainly from examples and by trial and error. An expert knows far more than he is able to put into words. So it is in chess. The chess literature is full of advice about the evaluation of positions. It has almost nothing to say about why the expert considers one move and not another. Combinative skill is acquired by practice, not by learning rules.

The goal of artificial intelligence is the creation of programs that think. Improvement of the behavior of programs is too often accomplished by ruses of no general usefulness.

In a typical chess position, there are usually about three moves worth serious consideration. In combinative variations, the average is less than two. It has proven difficult to write chess programs that come close to this degree of selectivity. The highly selective programs tend to perform poorly. Yet, it is the selection problem that is particularly relevant to AI. An understanding of the habits that guide the chess expert's analysis into productive channels might shed light on habit-knowledge in general.

The obstacles to making explicit the knowledge that underlies chess skill are formidable. No chess program has a hundredth part of the knowledge of a human expert. Moreover, it won't suffice to encode the knowledge by the usual method of the programmer: visualizing a situation and asking himself what he would do in that situation. The covert knowledge that leads to the decision must be made explicit. This is a much harder task, and it is only the beginning.

Once expertise is expressed as pieces of information, a procedure is needed for utilizing them to produce the desired behavior. Because intelligent programs generate their responses indirectly by combining pieces of information, it is hard to predict their behavior. They can be improved only by laborious trial and error. Writing truly intelligent programs for large task domains is much more difficult than writing pseudo-intelligent programs for small task domains.

To write pseudo-intelligent programs, we need only use our knowledge. To write intelligent programs, we must make our knowledge explicit. The volume of knowledge needed for useful problem solving and the inaccessibility of much of it pose a serious problem. Failure to grasp this problem has caused much of the excessive optimism with which the field of AI has been afflicted. It has also impaired the effectiveness of AI research.

Neglected Problems

The emphasis on the performance of AI programs to the neglect of the processes they use had an unfavorable effect on AI research, particularly in the early years. Lately, AI researchers have become more aware that their programs should do more than give the appearance of intelligence.

Even today, though, there seems to be a tendency to neglect certain fundamental problems.

The quest for impressive program performance sometimes results in the selection of overly complex task domains, although the trend is now towards simpler ones. In the fifties, programs played checkers and proved mathematical theorems. In the seventies, they rearranged blocks and figured out how to turn on the light switch. This return to the nursery has excited some ridicule, particularly among Soviet scholars, but it seems to me to be a constructive development. It seems likely that most of the ingredients of intelligence will manifest themselves in the solution of simple problems. The use of complex task domains tends to divert attention from the study of thought processes to the study of the subject matter of the task domain.

There remains a curious omission in the sorts of things that AI programs do. They never perform tasks for which there is a known procedure — arithmetic, for example, or payroll accounting. A bona fide AI program, it seems, must use some sort of hit-or-miss search. Programs that sometimes fail to find an answer are, oddly, regarded as more intelligent than those that always succeed.

Nevertheless, an *intelligent* program that does arithmetic would be well worth writing. We still don't know how to represent the information that underlies skills like arithmetic in a form suitable for AI. We would like to be able to represent a skill as individual units of information that can be learned from examples and used flexibly in a variety of situations. An understanding of just what it is that we learn when we learn arithmetic would be valuable for pedagogy as well.

Surely, arithmetic calculation is "intelligent behavior." The thought process that underlies routine behavior is simpler, perhaps, than that which gives rise to creative problem solving. Nevertheless, it is worth modeling on the computer, if only in order to develop intelligent business programs, which would be easier to communicate with and modify than conventional ones. This problem has been neglected apparently because conventional programs are believed, on the basis of their behavior, to be adequate models of routine skills.

The seeming intelligence of many a program is belied by its mechanism.

It is clear, however, that programs and people do arithmetic very differently. A person can use his knowledge of arithmetic to solve cryptarithms, for example. The same knowledge that he uses for routine calculations is combined with his general knowledge of problem solving to produce a new pattern of behavior. Computer instructions, frozen in a rigid procedure, aren't available for any purpose except the one task that the procedure performs.

Other poorly understood aspects of thought have also been neglected in the rush to produce programs that do something impressive. Many AI programs rely heavily on formal logic, which is essentially an idealization of one aspect of human thought. Relatively little work has been done on analogy formation, concept formation, learning, and so on. It would seem more logical to devote the most effort to those aspects of thought that are least understood.

The Outlook

Progress in AI is not as great as it may appear. The seeming intelligence of many a program is belied by its mechanism. The slow rate of progress should not, however, be taken as evidence that AI is impossible. The advent of the computer has stimulated work in the psychology of thinking, but great areas of ignorance remain. Programming is notoriously a slow activity. Writing intelligent programs is even slower, because of the indirect linkage between the program and the problem-solving behavior. We can expect progress to accelerate once sufficient fundamental knowledge is at hand. □

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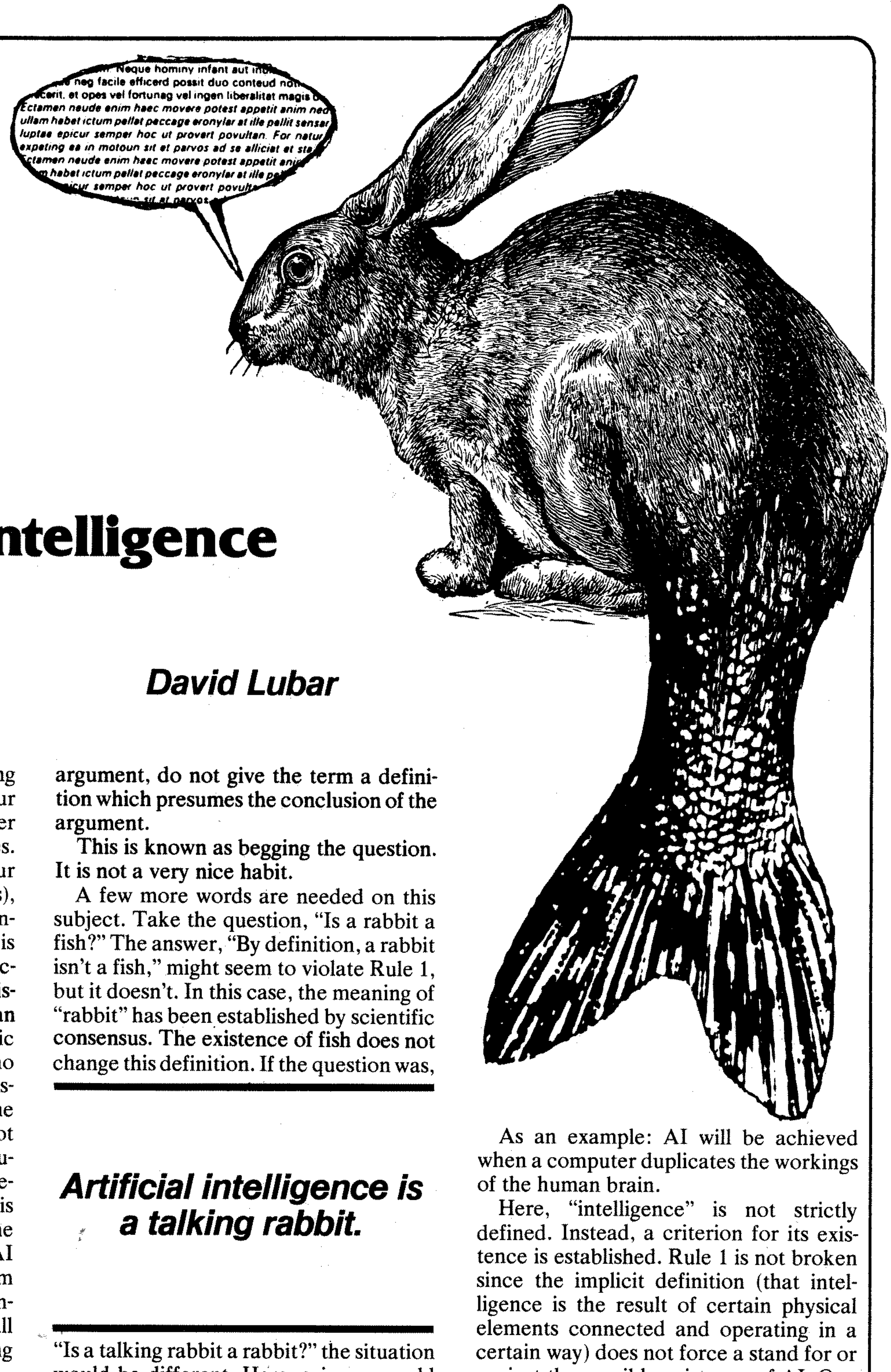

The Problem Of Defining Intelligence

David Lubar

One of the first phrases any fledgling philosophy student learns is "Define your terms." This catch-all argument stopper has been used and abused for centuries. While its use may be hazardous to your health (look what happened to Socrates), there are cases, such as discussions concerning artificial intelligence, where it is crucial to define the terms. Careless selection of a definition can make further discussion of AI pointless. To take an obvious example, imagine a dogmatic biologist (let's call him Felix Canus) who asserts, "Intelligence is a property possessed by all higher organisms." (The astute reader will notice that this is not really a definition. The astute and argumentative reader might ask Canus to define "higher organism.") Armed with this pseudo-definition, Canus will answer the question of the possible existence of AI with an emphatic "NO!" The dogmatism can swing 180 degrees. For example: "Intelligence is a property possessed by all higher biological and artificial computing devices."

The above examples would obviously be useless in any serious, open-minded discussion of AI. While they are blatantly bad, they do have subtle counterparts which are not so easily recognized. The focus of this article will be to examine the flaws and strengths of different kinds of definitions, and to determine what is needed for a working definition.

In the spirit of maintaining a scholarly facade, and since it helps break up the monotony of paragraphs, let's put the above discussion into a formal rule.

Rule 1: In defining a term within an argument, do not give the term a definition which presumes the conclusion of the argument.

This is known as begging the question. It is not a very nice habit.

A few more words are needed on this subject. Take the question, "Is a rabbit a fish?" The answer, "By definition, a rabbit isn't a fish," might seem to violate Rule 1, but it doesn't. In this case, the meaning of "rabbit" has been established by scientific consensus. The existence of fish does not change this definition. If the question was, "Is a talking rabbit a rabbit?" the situation would be different. Here, science would have to establish (or settle on) an answer. Relying on the previous definition (constructed before the discovery of talking rabbits) would violate Rule 1 because, in this case, the answer to the question will become part of the future definition.

Artificial intelligence is a talking rabbit.

Artificial intelligence is a talking rabbit.

Now for some various definitions of "intelligence" and the problems related to these definitions. The first kind that will be considered establishes a standard of one sort or another which must be attained by a computer if it is to be accepted as intelligent.

As an example: AI will be achieved when a computer duplicates the workings of the human brain.

Here, "intelligence" is not strictly defined. Instead, a criterion for its existence is established. Rule 1 is not broken since the implicit definition (that intelligence is the result of certain physical elements connected and operating in a certain way) does not force a stand for or against the possible existence of AI. One can use the example to enforce either view. Professor Canus might say, "We can never duplicate the brain. Therefore, artificial intelligence is impossible." His opponent, using the same initial definition, might conclude, "We can duplicate the brain. It's only a matter of time. So artificial intelligence is possible."

Unfortunately, they are both wasting their time. While the example doesn't violate Rule 1, it has other problems. Two assumptions have been made. First, that humans are intelligent. We can, with only minor discomfort, accept this. The second

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PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

REGRESSION I and II may be purchased together for $36.95 (cassettes) and $44.95 (diskettes).

Availability

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. All programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard 8" CP/M floppy disks for systems running under MBASIC.

BUSINESS and UTILITIES

MAIL LIST II (North Star only) — **Price: $21.95**

This many-featured program now includes full alphabetic and zip code sorting as well as file merging. Entries can be retrieved by user-defined code, client name or Zip Code. The printout format allows the use of standard size address labels. Each diskette can store more than 1100 entries (single density; over 2200 with double density systems)!

TEXT EDITOR I (Letter Writer) — **Price: $14.95 Cassette, $18.95 Diskette**

An easy to use, line-oriented text editor which provides variable line widths and simple paragraph indexing. This text editor is ideally suited for composing letters and is quite capable of handling much larger jobs. Available for all computers.

PERSONAL FINANCE SYSTEM (ATARI only) — **Price: $34.95 Diskette**

PFS is a single disk menu oriented system composed of 10 programs designed to organize and simplify your personal finances. Features include a 300 transaction capacity; fast access; 26 optional user codes; data retrieval by month, code or payee; optional printing of reports; checkbook balancing; bar graph plotting and more. Also provided on the diskette is ATARI DOS 2.

FINDIT (North Star only) — **Price: $19.95**

This is a three-in-one program which maintains information accessible by keywords of three types: Personal (e.g., last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

DFILE (North Star only) — **Price: $19.95**

This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

COMPARE (North Star only) — **Price: $12.95**

COMPARE is a single disk utility software package which compares two BASIC programs and displays the file sizes of the programs in bytes, the lengths in terms of the number of statement lines, and the line numbers at which various listed differences occur. COMPARE permits the user to examine versions of his software to verify which are the more current, and to clearly identify the changes made during development.

COMPRESS (North Star only) — **Price: $12.95**

COMPRESS is a single-disk utility program which removes all unnecessary spaces and (optionally) REMark statements from North Star BASIC programs. The source file is processed one line at a time, thus permitting very large programs to be compressed using only a small amount of computer memory. File compressions of 20-50% are commonly achieved.

GRAFIX (TRS-80 only) — **Price: $12.95 Cassette, $16.95 Diskette**

This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

TIDY (TRS-80 only) — **Price: $10.95 Cassette, $14.95 Diskette**

TIDY is an assembly language program which allows you to renumber the lines in your BASIC programs. TIDY also removes unnecessary spaces and REMark statements. The result is a compacted BASIC program which uses much less memory space and executes significantly faster. Once loaded, TIDY remains in memory; you may load any number of BASIC programs without having to reload TIDY!

SIMULATIONS and EDUCATION

BLACK HOLE (Apple only) — **Price: $14.95 Cassette, $18.95 Diskette**

This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

VALDEZ (Available for all computers) — **Price: $14.95 Cassette, $18.95 Diskette**

A simulation of supertanker navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256X256 element radar map and employs physical models of ship response and tidal patterns. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

FLIGHT SIMULATOR (Available for all computers) — **Price: $17.95 Cassette, $21.95 Diskette**

A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers.

TEACHER'S PET I (Available for all computers) — **Price: $ 9.95 Cassette, $13.95 Diskette**

This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

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All orders are processed and shipped postpaid within 48 hours. Please enclose payment with order along with computer information. If paying by VISA or Master Card, include all numbers on card. For orders outside North America add 10% for shipping and handling.

Add $2.50 to diskette price for 8" floppy disk (soft sectored, CP/M, Microsoft BASIC)

*TRS-80 diskettes are not supplied with DOS or BASIC.

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The Problem, continued...

assumption is that a model of the brain will have the same properties as the brain. But what is the crucial function which gives the brain intelligence? Is it speed of operation? If so, then why couldn't a slightly slower model also possess intelligence? Rather than make a function-by-function analysis of the brain, it would be swifter to show a defect that encompasses the entire example.

Suppose a computer was constructed that mirrored the brain. Now, claiming that it is intelligent would violate Rule 1. This all might seem frustrating, but it helps emphasize an important point: a definition has no value when applied to a future system unless that definition has meaning outside of the system. So while this kind of definition might be useful as a guideline for someone trying to construct a computer which could possibly be intelligent, it can't be used as a premise in an argument which claims that the resulting computer is actually intelligent.

Someone who wanted to use the above definition would have to do the following. First, define "intelligence." Then, show that the structure of the brain is such that it has the properties named in the definition. Now he can claim that any computer which mirrors the brain is intelligent. But the second step is extraneous. If we can define "intelligence," we don't have to find the structure which causes it and then recreate this structure. (Remember, we are trying to determine whether artificial intelligence is possible, we are not concerned with the mechanics of building such a device.)

In other words, it's back to square one.

How else can "intelligence" be defined? One approach is to relate it to certain human capabilities. But care must be taken. It is easy to fall prey to human chauvinism and use terms which only apply to the organic. To be blatantly obvious again, we can't use a definition such as, "A computer will be intelligent when it can cry." This does not mean that a definition of "intelligence" has to be devoid of all human terms. It just means that the terms cannot be arbitrarily accepted.

Capabilities that might relate to intelligence include originality, problem solving ability, and abstract reasoning. A definition along these lines would be, "Intelligence is the ability to produce original concepts." (Original to the system, not the world.)

This type of definition seems better than the last one. It makes no assumptions that violate Rule 1. It will not force a conclusion for or against the possibility of AI. Also, if a definition of this type is accepted, the future creation of a machine which produces original concepts (or does whatever else is involved in the accepted definition) will not affect the definition or bring about a need to do any redefining. In this case, the machine would not be analogous to our talking rabbit.

Having found a promising structure, another question arises. Can the blanks be filled in a satisfactory manner? The selection must be made carefully to avoid circularity. (Blatant example time again.) "Intelligence is the ability to think." "What is 'thinking'?" "Thinking is intelligent reasoning." As is seen in this example, the definition cannot include terms which are synonymous with "intelligence." Adding to the problem is the fact that it is not possible to completely avoid circularity. The dictionary is finite. If the terms of a definition are defined, and the terms of the new definitions defined, etc., sooner or later the same words will crop up. What has to be aimed for is a definition which isn't immediately circular.

Accepting this, the next task is to determine the nature of the characteristic or characteristics to be used in the definition. These characteristics will be exclu-

It is easy to fall prey to human chauvinism and use terms which only apply to the organic.

sive to intelligent entities. Wait a minute. Did he say "intelligent"? It seems that, to follow this method, we must assume that we know what "intelligence" is before defining it. This is not as bad as it sounds, and there are several ways around it. One approach would be to start out looking only for characteristics associated with human intelligence. Another approach would be to hold that recognition is not the same thing as definition. We can't define something unless we can recognize it.

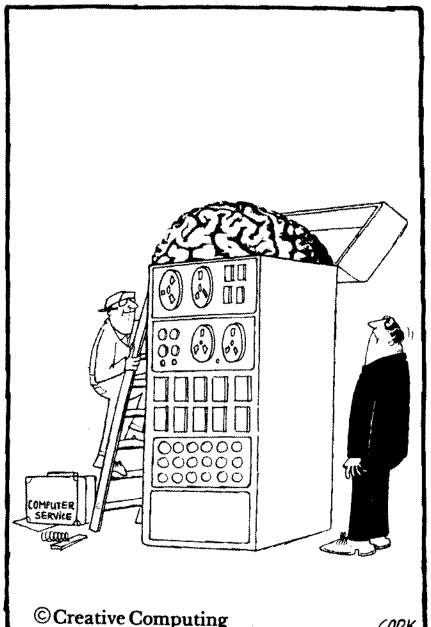
Here, someone might make the following objection: "If we can recognize it, we don't need to define it. We'll know it when we see it, whether in a human or in a computer."

It is true that we could get by without a definition if we could recognize intelligence in a certain computer, while another person might claim that he doesn't recognize any such thing in that particular machine. They could only resolve this by stating what they mean by "intelligence." So a definition is still needed.

Getting back to the definition, one other problem arises. It is possible that "intelligence" is an open concept. By this, I mean that there may not be one set of defining characteristics, but a number of subsets, each of which will be found in certain cases. This is analogous to the problem of defining "art." A statue may have properties A,B, and C; a painting properties B,C,D, and E; while a movie has properties D,E, and F. Both the movie and statue are art, though they share no common characterists. (Please don't send me any letters saying that they do share characteristics. This is *just* an example.) In cases such as this, the definition tends to become broader and broader until it is so general that it is almost useless. The original definition of what art was had to be changed as new forms evolved. Our idea of what intelligence is might also have to change.

It should be pointed out that there are two major questions concerning AI. One is, "Can a computer be intelligent?" The other is, "Is this computer intelligent?" Once a definition is established, the second question can be answered through empirical evidence. The first question can be answered either through empirical evidence (This computer is intelligent. Therefore a computer can be intelligent.), or, as mentioned before, by finding the physical cause of the properties mentioned in the accepted definition.

This discussion could go on, but enough has already been covered to convey the problems associated with constructing a definition, and the basic requirements of a useful definition. The ideal definition of intelligence may never be found. A suitable definition, which will be acceptable to the majority of scientists, psychologists, and philosophers, could be found. But the selection of this definition must be made with great care and thought. See what you (or your computer) can come up with. □



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Find Your Way Around The New Apple® DOS With The Dakin5® Programming Aids 3.3©

Dakin5 Corporation, a Colorado software house, is making available to the public 12 utility programs on one 16 sector diskette, utilizing the new Apple DOS 3.3, which provides 23% more storage.

These menu-driven utilities will facilitate the development of your own microcomputer programs.

All of the **Dakin5 Programming Aids 3.3** programs are also compatible with the Corvus Disk Drive system.

This 12-in-1 set of utility programs accomplishes the following:

The Lister sends BASIC programs to the printer to be listed, utilizing the full line capacity of the printer. Pagination and page headings, including program name and date, are also provided as additional options.

The Line Cross Reference produces a display or a printed listing of all lines referenced by GOTO, THEN, GOSUB, LIST or RUN statements in an Applesoft BASIC program. Cross-referencing of most programs is done in a few seconds. An option allows you to print only the line numbers referenced in GOSUB statements.

The Variable Cross Reference creates a display or a printed listing of all variable names used in an Applesoft BASIC program, showing all line numbers where a given variable name is used.

The Peeker displays or prints either all or selected records from a text file.

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The Copier copies absolutely ANY type of file or program on a normally formatted diskette from one diskette to another. The name of the program or file is the ONLY information needed.

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The Screen Printer permits contents of the text screen to be sent to the printer at any time the keyboard is active (i.e. the cursor is visible). This Screen Printer program remains in effect until you press RESET or "reboot" the system.

The Prompter is a data entry subroutine that handles both string and numeric data. You have the option of using commas, decimal points and leading zeros with right-justified numerics. Alphanumeric data is left justified with trailing spaces added as required. With the Prompter you are also able to specify maximum field length to prevent overflow in both numeric and alphanumeric fields. You can even define your own set of valid characters.

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Many of these utility programs have been developed and tested for in-house use while producing The Controller™ business package for Apple Computer Inc.

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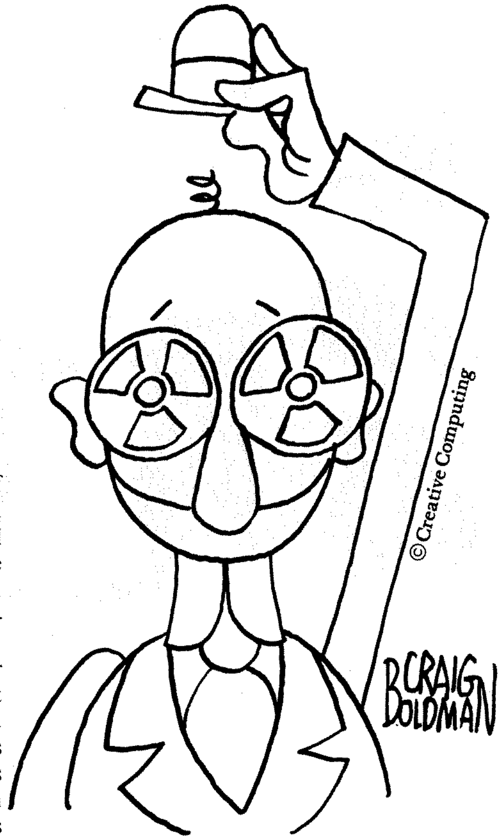
I Compute—Therefore I Am



Jim Connor

Of course the title will remind many of Descartes's "I think, therefore I am" and others of Sartre's "I am bored, therefore I am." A comparison of the possible meanings of these three statements and their implications could prove enlightening to the field of AI.

While "thinking" is important for Descartes as the one thing he cannot doubt, the idea of reason and thought as a part of the definition of a human was canonized by Aristotle two thousand years earlier. And when Aquinas, in the 13th century, based Christian theology on this Greek outlook, the position of reason was further emphasized. Within this tradition Descartes would separate the spiritual, reasoning soul from the mechanical body. And soon after, Newton's joining of heavens and earth under the law of universal gravitation led many to a mechanized view of the world. It could be considered a gigantic, magnificent clock in absolute space and time, with God as clockmaker.

But for many moderns, such a view is the opposite of the truth. Even without Einstein's contribution, there are no such absolutes of space and time and clocks and gods. To existentialists, phenomenologists, etc. Sartre's boredom can be much more meaningful than Descartes's thought. In fact, one of the results of AI seems to be that we know very little about computers, about human intelligence, or about boredom. And the more we learn about AI, the more respect and awe we have for Human Intelligence.

The basic problems connected with AI center around its youth and its breadth. While still only some two decades old, it has profoundly influenced such disparate disciplines as linguistics, mathematics, philosophy, and psychology, especially through the subdisciplines of logic, cognition, behavior, etc. And perhaps nowhere in history has there been such a close, constant, and mutually dependent union of the craft and scholarly traditions — the wedding of theory and technique.

Its youth has led it to make rash claims, to discount older traditions, to advance in practice without direction from theory, to confuse the parts with the whole, the means with the ends, the process with the product. Yet its growth has been magnificent. Brilliant, energetic, clever, far reaching scientist-technician-theoreticians have inspired one another to great leaps in a short time. And it will probably continue in the near future.

When one field merges with and affects so many others, there are great problems with finding common ground by way of accepted definitions, stated premises, hidden assumptions. The levels at which discussions take place is very important; the questions asked must be the right ones, the insightful ones, the productive ones.

For example, questions about the definitions are extremely important: How many varieties of AI are there? What is Human Intelligence? Are there levels, varieties? Where do Animal Intelligence, Infant Intelligence, the brain injured, and the superhuman genius all fit? How would each respond to a Turing test? Is behavior at all adequate as a sign and measure of intelligence, or a cop-out? But if I can only be sure that I myself am thinking, do I have any choice besides behavior as a clue to another person thinking? Is intelligence the same as reason? If so, must it be logical? Are intuition and creativity close to 'leaps of faith', or better considered as non-logical reasoning?

Other questions about values and prejudices, limitations and assumptions need to be asked;

Do we today have an intrinsic fear of any machine more sophisticated than a typewriter (Example of familiarity breeding contempt at low levels)?

Do we unconsciously assume that animals and robots are *qualitatively* less endowed intellectually than humans are? On the other hand, do we optimistically regard all limitations as temporary, bound to be overcome in time?

Do we consider ourselves having been 'programmed' by our parents, DNA, and our early surroundings?

The aim of this short paper, then, is to point out some of the successes in AI, some of the areas of continuing problems, some of the prejudices and the difficulties encountered in achieving worthwhile results. To do this, let us move through a brief history of some of the problems, then assemble some yeses about what has been done, and some noes about what has not, and some definite maybes about the future.

The problems, in order of successes:
Prove math theorems
Simulate experts
Play games
Respond to language

Prove Theorems

If reasoning and thinking are marks of intelligence, certainly proof of AI would be found with a machine that was able to solve math problems. And this was done early and well. Not only do computer

Jim Connor, 14A Washington Mews, New York, NY 10009.

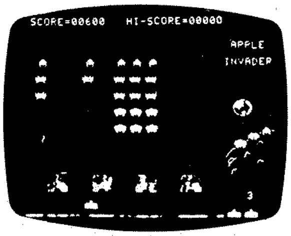
Apple II

sensational software

creative computing software

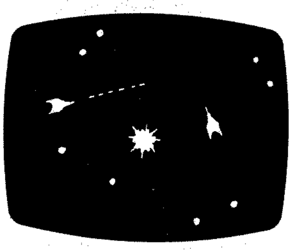
Super Invasion and Space War

Disk CS-4508 $29.95
Requires 48K Apple II or Apple II Plus



Super Invasion

This original invasion game features superb high resolution graphics, nail biting tension and hilarious antics by the moon creatures. Fifty-five aliens whiz across the screen, quickening their descent, challenging you to come out from behind your blockades and pick them off with your lasers. A self-running "attract mode" makes it easy to learn and demonstrate the game. Game paddles are required.



Space War

Take command in Space War. Select from five game modes, including reverse gravity, and the battle begins. Challenge your opponent with missle fire, force him to collide with the sun or to explode upon re-entry from hyperspace. Be wary... He may circle out of sight and re-appear on the opposite side of the galaxy. (This is the classic MIT game redisgned especially for the Apple.)

3 Adventures

Disk CS-4513 $39.95
Requires 48K Apple II or Apple II Plus

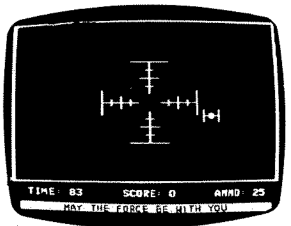
Adventureland (by Scott Adams) You'll encounter wild animals, dwarfs and many other puzzles and perils as you wander through an enchanted world, trying to rescue the 13 lost treasures. Can you rescue the Blue Ox from the quicksand? Or find your way out of the maze of pits? Happy Adventuring!

Pirate Adventure (by Scott Adams)— "Yo Ho Ho and a bottle of rum..." You'll meet up with the pirate and his daffy bird along with many strange sights as you attempt to go from your London flat to Treasure Island. Can you recover Long John Silver's lost treasures? Happy sailing matey..

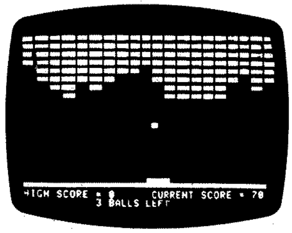
Mission Impossible Adventure (by Scott Adams)— Good Morning, Your mission is to... and so it starts. Will you be able to complete your mission in time? Or is the world's first automated nuclear reactor doomed? This one's well named, its hard, there is no magic but plenty of **suspense**.
Good Luck...

Space and Sports Games

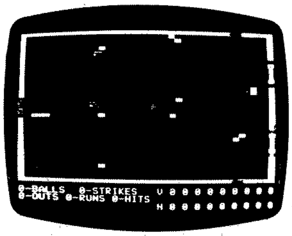
Disk CS-4501 $24.95 8 programs Requires 32k Apple II or Apple II Plus



Star Wars. Shoot down as many TIE fighters as possible in 90 seconds.



Breakout. Four skill levels and improved scoring make this the best breakout ever.



Baseball; A 2-player game with pitching, batting, fielding, stealing and double plays.

Saucer Invasion. Fire missles to destroy the invaders who fly at different speeds and altitudes.

Rocket Pilot. Maneuver your spaceship over the mountain using horizontal and vertical thrusters.

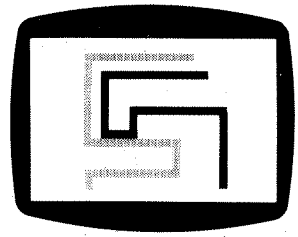
Torpedo Alley. Sink as many warships as possible in 2 minutes.

Darts. Use game paddles to control the throw of 6 darts.

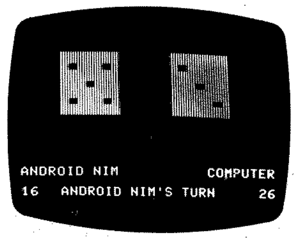
Dynamic Bouncer. A colorful, ever-changing graphics demonstration.

Strategy and Brain Games

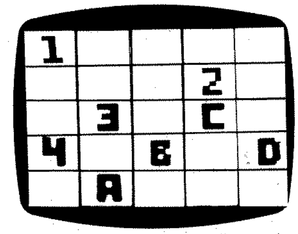
Disk CS-4502 $24.95 12 programs Requires 32K Apple II or Apple II Plus



Blockade. Build a wall to trap your opponent, but don't hit anything.



Skunk. A 2-player strategy game played with dice, skill and luck.



Dodgem. Be the first to move all your pieces across the board in this intriguing strategy game.

Nuclear Reaction. A game of skill, fast decisions and quick reversals of position.

UFO. Use lasers, warheads or guns to destroy an enemy spacecraft.

Genius. A fast-moving trivia quiz with scores of questions.

Parrot. A Simon-type game with letters and tones. **Dueling digits** is a version with numbers.

Midpoints and Lines. Two colorful graphics demonstrations. **Tones** lets you make music and sound effects.

Checkers. Pit your skill against the computer version of this all time favorite.

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I Compute, continued...

programs do arithmetic calculations correctly at fantastic speeds, but also algebra, plane geometry, and calculus. By 1963 Slagle's SAINT could solve complex integration problems in eleven minutes; by 1967 Moses' SIN could solve such problems at the level of the large integration tables in nine seconds! (Jackson, 1974 p 90) but far more surprising than the speed in solving integration problems and the solving of 38 of the 52 theorems in the *Principia Mathematica* of Russell and Whitehead was the finding of a better proof for one of the theorems (2.85). And the computer had *not been told* to find it!

The important point here is that what we normally associate with intelligence and a high degree of reasoning ability and logic was done early and comparatively easily by the computer. Another 'symbol of intelligence,' chess, took a bit longer.

Simulations

Possibly the easiest Artificial Intelligence programs to pass the Turing test would be those that simulated expert behavior. These would be problem solvers in other than mathematical and game areas that solve less abstract, more practical and therefore more "human" problems. The first really competent one, DENDRAL, was developed by Feigebaum (1971) and operates at the level of a Ph.D. chemist in analyzing the composition of organic materials.

The basic attempt was to simulate a chemist using the mass spectrograph. Thus the route followed Turing's direction that since we do not know if it is better to imitate the human approach or aim directly at getting the final results, we should work on both together. To understand the psychological workings, expert chemists were watched and questioned as to what they were doing and why. How did they select a few hypotheses out of all the possible ones that could be induced from the vast number of details presented by the mass spectrograph? Thus the DENDRAL problem was like that of the checkers and chess programs — how many ways did the experts look at things? How many "rules of thumb," short cuts, heuristics were at their command? How did they decide?

But this approach was the opposite of the general problem solver (GPS) attempt. In simulations, a great amount of data was considered but only in one narrow field. And the authors of DENDRAL believed that the process could not be too far removed from workings of the human intelligence or humans could not understand it. The current state of the art is to use the results and skills gained from DENDRAL to find a Meta-DENDRAL where chemists would not have to be questioned about their approach, but the knowledge would be acquired automatically.

Meanwhile, other medical simulations have been developed that also can easily pass Turing's test. There are Mac man (heart, bloodpressure), Mac puf (lungs, respiration), Mac dope (drug effects), and Mac pee (kidney, body fluids), etc. (Ahmed & Sweeney 1980, p. 112). The philosophical questions asked at the outset still remain, however. Do we consider enough the behavior that allows the machine to pass the Turing test? Does becoming imply being or imitation imply the essence? Do we consider it realistic to talk about intelligence in such a narrow domain since we have to start somewhere, however small?

Two experts in medical simulation have recently answered these questions in the negative, saying that human intelligence is still far beyond our most sophisticated programs (Szolovits, Pauker 1978, pp. 115-144). They speak of a human medical expert using both categorical (deterministic) and probablistic (evidential) reasoning in diagnosis. Other concepts mentioned as suitable substitutes for probabalistic were "belief functions" and "fuzzy set theory," giving perspective to the level at which the authors approached the problem.

They consider four programs of Artificial Intelligence in Medicine: PIP, INTERNIST, CASNET and MYCIN, rating all as quite impressive (thus able to pass the Turing test) but not reasoning at a truly expert level. That is, none covers the spectrum as adequately as a human expert, combining the categorical and its narrow context with the probabalistic and its many comparisons — on the way to recommending therapy. Where one routine will be too strict, others will be too broad, allowing the diagnosis to go on and on rather than deciding when it is complete, etc. Again we can ask the early questions but meanwhile realize even more how much Artificial Intelligence is helping each field as it challenges it to examine its tenets, its procedures, its results to a depth not reached before Artificial Intelligence entered the arena.

Play Games

Some games are more difficult than others. They require more 'intelligence,' usually dependent on the number of possible 'moves' or combinations of them. "Tic-tac-toe" was solved quickly. So was the 15-Puzzle (15 blocks in 4x4 squares; move to find a certain configuration); it only required ½ of 16! moves, about ten trillion. Checkers was harder, with some 10^{40} possibilities, but Samuels had a championship program by 1962. Chess was much, much harder with 10^{120} possible moves. And while Simon had predicted a grand-master program by 1968, another ten years were necessary before Berliner (1978) went so far as to say that chess had entered the jet age.

Yet we must remember that these chess programs are not 'intelligent' in the way that humans are. These programs depend on speed, not strategy and the use of a large memory, while human experts seem to have less than 100 patterns in mind. Moreover, very intelligent people are often mediocre chess players, while some chess experts would not be considered extremely intelligent.

Language

When *Understanding Natural Language* (Winograd, 1972) described SHERDLU, the program was hailed as a great breakthrough. Previous attempts to understand language and translate Russian into English had failed by the mid 60's, but programs like ELIZA, SAD SAM, STUDENT and SIR had been able to respond to language in limited ways. They seemed to fool the public by clever simulations, reactions to key words, phrases or syntactic structures. Clues from the context were very unsophisticated if present at all. On the other hand, SHERDLU used a heterarchical rather than hierarchical approach and represented knowledge as procedures rather than stored items.

The 'physical result' could be seen as simulated on a CRT. A robot moved blocks of various shapes and colors in and out of a box, all on a table top. There was an interactive English dialog. The robot acted on commands, gave answers, and asked questions. There was an interplay between semantic and syntactic programs as well as a deduction program. The great breakthrough! But nothing comparable has been done since. The state of the art at the practical level is dormant, waiting for the next thrust.

Limitations

But in spite of all of the successes, proofs and hopes mentioned up to now, there are still objections. Those who argue the existence of a truth for humans to the supernatural level cannot really be answered here other than to say such would not be against reason, but above reason. Rather, let us consider two objections at the natural, rational level. One is from the philosophers, the other from the mathematical logicians.

Limits from Philosophy — Intuition

As representative of the group of philosophers that hold some elements of science as unaccountable, Michael Polanyi holds a prime place. Well known and respected for his views on science, philosophy and mathematics, he believes that there is more than explicit reasoning used in science. This, he says, was acknowledged even by Kant when, in the midst of finding the rules for pure reason, Kant agreed that no system of rules can prescribe the procedure by which the rules themselves are to be applied. In fact,

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it's so inscrutable that it "is a skill so deeply hidden in the human soul that we shall hardly guess the secret trick that Nature here employs." We thus employ some secret trick every time we generalize and speak of dogs or trees or identify individual things as a dog or a tree, etc. Polanyi believes that Kant and his successors spent so very little time on such a powerful aspect of the mind because they were essentially afraid of it as too strong an irrational, unformalizable agent to be controlling the pure reason.

To examine how this works in practice Polanyi considers celestial mechanics as rigorous and predictive a discipline as can be found. Yet planets are not to be found where predicted; they deviate. The question is whether or not the deviation forms a trend or only a random pattern. And while statistical analysis may be used quite rigorously, how to start using it and how to interpret the result is far from formalized. (Is a chance pattern 1 in 10 or 1 in 100? What is noise and what is significant?) We have two illustrations from the history of astronomy:

Before Uranus was discovered as a planet in 1781, it had been recorded as fixed at least seventeen times. Later, when Neptune was discovered in 1846 following the predictions of Leverrier, a look back into the records showed that at least two other astronomers had recorded the movement of this "star" but disregarded the evidence. Yet this is excusable when we realize the tremendous mass of data an astronomer must interpret. A great deal of useless information would be collected if each star was investigated as a slowly moving planet. The question is, what is the source, rule, measure of this insight that allows a scientist to escape from the routine framework that began the study and chance a new interpretation that could lead to a new paradigm (Kuhn, 1962).

Intuition is the name given to this ability in scientific fields. According to Polanyi, it is the same as perception, it "is a skill, rooted in our natural sensibility to hidden patterns and developed to effectiveness by a process of learning. Scientific intuition is one of the higher skills, like music, politics or boxing, all of which require special gifts in which a few exceptional people greatly exceed all others. Great powers of scientific intuition are called originality, for they discover things that are most surprising and make men see the world in a new way." (Polanyi, 196-219).

In disagreeing with the usual description of scientific method as setting up a hypothesis and then testing, Polanyi opts for appreciating a deep and promising problem as more important yet more vague than formulating the hypothesis. And it is at the problem finding level that he sees intuition as most important. Why are intuitive gifts so rare and how do they operate are questions that look to the heart of scientific inquiry and the power of the mind.

Limits from Mathematics — Gödel

Mathematical logicans hail 1931 as a great breakthrough for understanding the limits of their discipline. In his lectures at Princeton's Institute of Advanced Study, Gödel stated his theorem that in any consistent system that can produce at least simple arithmetic there are formulae which cannot be proved-in-the-system, but which, from outside-the-system, can be seen to be true. John Lucas (1963, p.255) thought that this theorem pointed to an essential difference between machines and the human mind. He questioned others in the field of mathematical logic and found general agreement to the following arguments.

A computer satisfies Gödel's conditions since it essential that a machine, especially a computer, be the concrete expression of a formal system. And since such a machine is capable of simple arithmetic and usually much more, there is some formula which it is incapable of producing as provable-in-the-system. Yet *we* can know it to be true, being outside-the-system of the machine.

Our machine need not be completely determined. So, while it performs a set of operations under a certain set of rules, and it is given the initial information on which it is to perform its calculations, it will be allowed to randomize. That is, it is allowed to do *anything* that is consistent within the system. Thus it can add the *same* number to both sides of an equation, not different numbers; it can use any *valid* method of its choice to prove a given theorem as long as the theorem itself is true.

It is possible for us to write down on paper certain symbols for the initial assumptions and kinds of operations built into the system. We merely list the operations and the conditions before and after each operation and finally, the conclusions (e.g., theorems) the machine is able to arrive at as being true. Again, Gödel's theorem says that we can from the outside construct a true conclusion that cannot be proved-in-the-system. We can see that it is true but the machine cannot prove it by itself.

Now for the crux. It is easy to find a machine that is able to produce truths of arithmetic far better than a human. But no matter what truth the machine arrives at, there is a truth it cannot arrive at but a mind can. In theory we can produce a machine that can do *anything* a mind can do. But no machine can, even in theory, do *everything* a mind can. This is true even if machines can be made to self-replicate and improve on one another. The mind will always be able to see at least one truth more — from outside the system.

It is important to note that no claim is here made for a mind to triumph *simultaneously* over *all* machines. The claim is only that at any one time, for any machine, no matter how powerful, the mind is always able to triumph because it can go one truth better. That truth states that only outside-the-system can a general truth about the validity of the system be known. Thus a machine can *never* be equated with mind. Whatever level of sophistication may be achieved by one machine in any one instance, the mind can always advance a step beyond. Mind and machine are *never* the same, *never* equal.

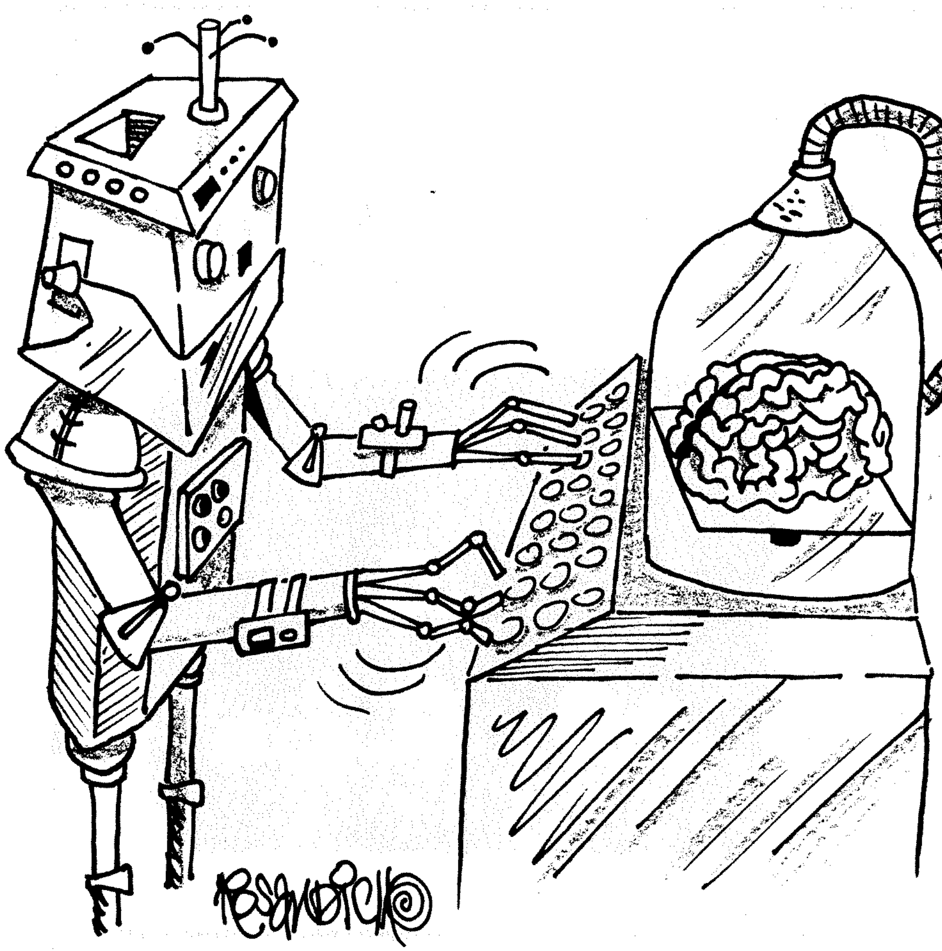
Other, deeper objections may be made involving deductive, consistent and formal systems. These are quite complex and need not be covered here as they have been very effectively answered by Lucas (1963, p.262). In the concluding remarks to his paper he states that ever since Newton's day the mechanical deterministic model has obsessed philosophers, unresolved even by Kant. But now, thanks to Gödel's theorem the philosopher will not have to deny freedom in the name of science nor the moralist make room for faith by abolishing science. In fact,

> "It will still be possible to produce mechanical models of the mind. Only, now we can see that no mechanical model will be completely adequate, nor any explanations in purely mechanist terms. We can produce models and explanations, and they will be illuminating: but, however far they go, there will always remain more to be said. There is no arbitrary bound to scientific enquiry: but no scientific enquiry can ever exhaust the infinite variety of the human mind."
>
> (Lucas 1963, pp. 270-271)

Child Prodigy Postscript

The careers of gifted children provide an interesting analogy with the difficulties in pattern recognition and understanding language. Prodigies seem to be found most often in the areas of mathematics, chess, and music. Yet over the years the adults of this group will not keep up to their promise in music as well as in the other two areas. It seems that great musicians need to bring to their discipline the experience of the world — joy, sorrow, etc., while chess masters and mathematicians do not. So too in pattern recognition and language understanding. There is such a rich background of shape, position and color, or semantics and syntax that only humans seem to be able to make sense of it — so far.

This is the hope of AI experimenters, to learn enough about the way humans think and the way computers work that they may get AI to at least simulate human intelligence very well. Possibly in the process AI will achieve more and more reason for its existence, seen in "I compute." □



Are Computers Alive?

Geoff Simons

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Technological developments do not proceed in isolation from other social factors. For example, microchip technology is influenced – in its pace of development and in other ways – by current public appetites for entertainment and sophisticated domestic appliances, by the state of the arms race, and by government policies on state investment.

The technology developments, mediated by social factors, in turn influence the character of society, often in unexpected ways. One consequence of computer developments is that we are being forced to scrutinise many traditional ideas about society and people. At the most intimate level we are forced to re-examine what is meant by many of the conventional adjectives traditionally applied to human beings – such words as *conscious, intelligent, thinking, perceptive, free* and *aware*. At one level we may even speculate on what it means to be *alive*. There is a consensus that *intelligence*, defined in some way, can be artificial. Can *life* be artificial? In what circumstances would we recognise a computer as alive?

One unreflective response to such an enquiry is to assert that only the recognisable biological species – the plants and animals – are alive, and that *this is a matter of definition*. Artefacts may behave *as if* they were alive, but they are not *really* so. They mimic the behaviour of animate creatures but are themselves *in*animate.

There are difficulties in this approach. If the semantic decision is taken, on *a priori* grounds, to exclude certain categories as a matter of principle then linguistic confusion may arise. Consider the case of mobile robots. Suppose it had been said, before the invention of articulated legs, that robots would never *walk*, that *walking* was, by definition, something only done by certain mammals, insects, etc. How would we then describe the behaviour of a biped robot as it progresses across the floor? Surely it *walks*.

This suggests that the limits of language should not be prejudged, that language developed for one purpose (eg. to describe the natural world) may come to be useful for another (eg. to describe artefacts). For example, no-one says that only birds, bats and insects can *fly*. Aircraft and kites can fly as well. (But do submarines *swim*? And if not, why not?)

A consequence of this approach is that particular 'biological' words – *conscious, aware, alive*, etc. may come to describe artefacts. Or they may not. Whether they do will depend upon whether the artefacts in question come to satisfy criteria by which such qualities are recognised. And the formulation of the criteria should be general in the sense that it is independent of the particular fields in which the qualities currently happen to exist. People get angry and machines do not. But the notion of any angry robot is not meaningless or self-contradictory. It should not be presumed that artefacts could never, by definition, experience emotion; or that they could never be alive.

It is interesting to note how 'intelligent' has come to denote certain machine systems. When writers first described such systems (eg. computer terminals with processing capability), they often put the word intelligent in quotes, viz: 'intelligent' terminals. Such writers often seemed reluctant to admit that machines could exhibit features that characterise the higher animals. But now such quotation marks are seldom if ever used: there is frequent talk of intelligent peripherals and terminals, machine intelligence, artificial intelligence. The linguistic usage suggests that intelligence, suitably defined, can equally characterise certain biological systems and certain artefacts.

(The response of one layman to the idea of artificial intelligence is nicely described by Margaret Boden in *Artificial Intelligence and Natural Man*. In Moscow, attending a conference on artificial intelligence, she encountered a taxi-driver who, on learning the name of the conference, 'roared with laughter and made the "crazy-sign" against his forehead; nor did he stop doing this, his shoulders shaking, until he had dropped us at our destination some five

• *Geoff Simons is the Chief Editor of NCC (National Computing Centre) publications. He is the author of* Introducing Microprocessors *(1979),* The Uses of Microprocessors *(1980) and* Robots in Industry *(1980).*

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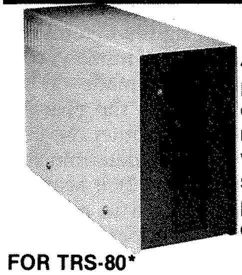

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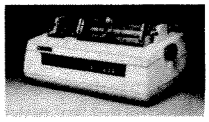

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minutes later.' To such a man there was no question of viewing his passengers with wariness or disdain – 'we offered no threat, just comic relief.')

Before considering the question of whether computers may be regarded as an emergent life-form, it is worth commenting briefly on some mental attributes that have traditionally been regarded as characterising human beings; namely – thought, consciousness and free will.

Part of the problem in trying to decide whether computers think is that we are not quite sure what we understand by thinking in general. We assume that human beings think, some more than others – but do animals think? Many of us would maintain that some of the higher animals – dogs, cats, apes, etc – are capable of rudimentary thought, but what about worms and insects? (There is evidence that snails are orgasmic. Electrodes register peaks of electrical activity during copulation which subside after ejaculation. Do snails think about such things?)

Already, technical and popular publications have noted the thought potential in computers. Hence Professor George declared (*Computers and the Year 2000,* 1972) that 'the ability to think logically has been shown to be within the capabilities of existing computers.' Dr. William E. Matheson observed (*Personal Computing,* April 1978) that 'the machine is closing the gap between itself and the brain.' And at the same time, Ernest W. Kent was proclaiming (*Byte,* April 1978) that 'it may be possible for a computer to have subjective experience.'*

A recent 1980 headline, 'A Speck that thinks for Itself,' advertised work at the University of Warwick and at the Colorado State University ('the superchip machine will be able to – literally – think for itself'). Dr. John Barker was quoted: 'The working of the superchip will be virtually indistinguishable from the working of the human brain.'

One approach is to compare the physics (and chemistry) of activity in the biological brain with activity in the processing units of modern computers. In the computer, sub-atomic particles move in solid material (metal conductors, chips of impure silicon, etc). The chemistry of the silicon and impurities is organised to realise electronic components packed into a small volume. The components operate in concert to perform the logic and arithmetic functions upon which all machine intelligence is based. In the brain, semiconducting properties are also exploited, and pulses of electricity are generated to control the behaviour of neurons (brain cells). The thousands of millions of neurons are interconnected to realise the necessary functions of the organism – from the control of heart beat and glandular secretion to motor control and all the mental processes of ratiocination and decision-making.

**See also Professor George's article,* Artificial Intelligence and The Layman, *in Issue 1.*

There are obvious similarities between the biological and artificial systems. Both exploit the properties of chemical elements (carbon and silicon, respectively) organised in complex arrays to realise particular analogous functions. It is likely that both types of organisation are physical realisations of theoretical two-state logic systems. Recent research suggests that certain columns of neurons are analogous to computer processors. (In passing, it is interesting to note that silicon has often been mentioned in speculative writing as one possible chemical base for life on other planets. Few elements can support the complex molecules necessary for the metabolic processes in sophisticated life-forms. However, silicon is used in computers because of its semiconducting properties, not because it can support macromolecules.)

I am sympathetic to efforts to identify thought processes with the physical behaviour of the brain. If the physical behaviour of computer processing units is *sufficiently similar* in important respects to internal brain behaviour, and moreover facilitates *the same sort* of 'intellectual' processes – reasoning, decision-making, etc. – then if the word 'thought' denotes certain brain activities there appears to be no good reason why is should not also denote certain computer processing activities. The key phrases, of course, are 'sufficiently similar' and 'the same sort'. We should not expect identity of, but close resemblance between, the processes and outputs of biological and machine systems.

'A potato in a dark cellar has a certain low cunning about him which serves him in excellent stead.'

It may be objected that thought implies consciousness, that people may be said to be thinking because they are aware of the process. For example, they reason, and *know* they are reasoning. This objection can hardly tell against the idea of machine thought. It would be a relatively easy matter to provide additional computer circuits to monitor the activities of the central processor. Would the computer then know that it was thinking? Would it then be conscious? However consciousness is described it seems difficult to show that its central features could not be provided, albeit at a rudimentary level, by machine facilities.

Another question is that of free will, a supposed characteristic of human beings which distinguishes them from computers. The distinction is illusory. Computers have a choice mechanism by virtue of conditional jump instructions provided in the program. The computer decides what to do according to the prevailing conditions, and very often the decision is unpredictable to the human programmer. If it is argued that this is a tightly deterministic system, uncharacteristic of human beings, then two points should be made – 1) there is a clear sense in which the prevailing conditions that affect computer choice can be unpredictable (ie. non-deterministic in the practical sense) and 2) it would be simple to provide a random (ie. non-deterministic) element in computer decision-making – if there was any point in doing so.

It follows that decision-making, choice and the exercise of free will are synonymous. The corollary is that the decision facility in the computer can serve as an adequate model of free will in the human being. Efforts to preserve the traditional status of free will derive from prescientific notions rather than from careful analysis. In this area, as elsewhere, we can see a close resemblance between machine possibilities and human mental processes.

If we believe that computers can think, be conscious and exercise choice it does not follow that computers are alive. It is paradoxical, but not self-contradictory, that a thinking conscious entity may not be alive. To show that computers are a

THE COLD BRAIN

The Josephson junction is a superconducting device based on principles enunciated by the British scientist Brian Josephson in 1962. A superconductor is an alloy or element (for example, tin or lead) which loses all electrical resistance when its temperature is lowered to a few degrees above absolute zero. If a current is then put through a loop of the superconductor, it will flow indefinitely so long as the temperature is maintained. An extremely thin layer of oxide sandwiched between two superconducting slices forms the junction, configurations of which can replace "conventional" semiconductor devices – at switching speeds measured in picoseconds. The junction consumes very little power; and there is a minimum of noise.

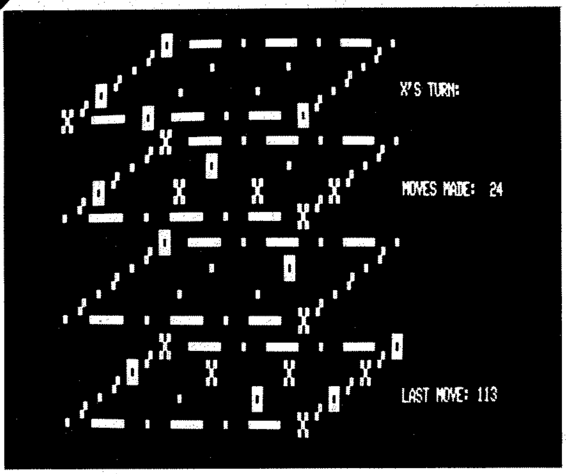
A "cryocomputer" (parts of which have already been constructed) will be very small. One of 15 by 15 by 15 cm dimensions will, on present calculations, be able to support about 16 megabytes of main memory and allow data transfer rates between itself and auxiliary storage at about 2.8 gigabits per second.

Although it is foolish to read too much into an analogy, it still is interesting that this "cold brain" will be immersed in a "brain fluid" of liquid helium. ■

*Acknowledgements to a fine article by Dr. Wilhelm Anacker in the May 1979 issue of the IEEE *Spectrum* magazine. A recent article on "cryocomputers" by Juri Matisoo appeared in the May 1980 issue of *Scientific American*. Both authors are at the IBM Thomas J. Watson Research Centre in Yorktown, New York, USA – **Editor.**

FOR TRS-80*

QUAD



by Charles Asper

Tic-Tac-Toe, *FOUR* in a row? That's only one of the differences with Quad, Acorn's challenging three dimensional game. A graphically represented cube, four rows by four columns by four levels, Quad gives you 64 different playing positions for your X's and O's, and 76 different winning four-in-a-row combinations.

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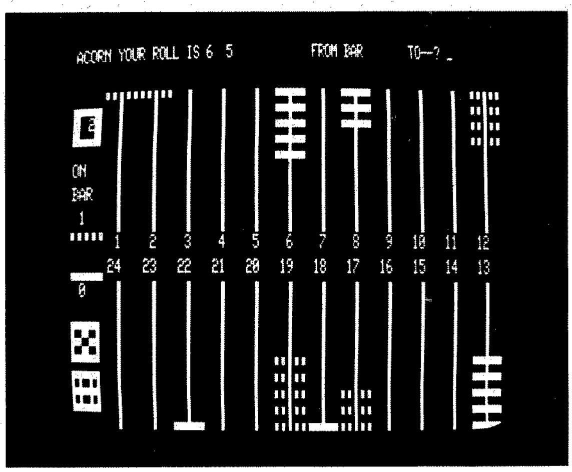

by Ray Daly & Tom Throop

The backgammon player featured in *Personal Computing* (August 1979) is now back in a faster, even better version! The game logic of the new Gammon Challenger has been compiled to machine language for extra speed, and there are more special features than ever.

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DEALER INQUIRIES INVITED

newly emerging life-form we have to do more than show that they have conscious thoughts and can take decisions.

Samuel Butler (in *Erewhon*, first published in 1872) suggested that machines would develop consciousness ('There is no security against the ultimate development of mechanical consciousness, in the fact of machines possessing little consciousness now'). And he proposed a materialism to show the continuity between the simplest forms of life and man.

After considering possible consciousness in the potato ('even a potato in a dark cellar has a certain low cunning about him which serves him in excellent stead'), he considers what would be the obvious objection to such an idea –

'If it be urged that the action of the potato is chemical and mechanical only, and that it is due to the chemical and mechanical effects of light and heat, the answer would seem to lie in an inquiry whether *every sensation* is not chemical and mechanical in its operation? *Whether those things which we deem more purely spiritual are anything but disturbances of equilibrium in an infinite series of levers*, beginning with those that are too small for microscopic detection, and going up to the human arm and the appliances which it makes use of? Whether there be not *a molecular action of thought*, whence a dynamical theory of the passions shall be deducible? Whether, strictly speaking, we should not ask what kind of levers a man is made of rather than what is his temperament?'
(my italics)

(There then follows a quite remarkable suggestion that prefigures the modern knowledge that the nucleus of every biological cell contains genetic material specifying the characteristics of the total organism – 'he anticipated a time when it would be possible, by examining a single hair with a powerful microscope, to know whether its owner could be insulted with impunity.')

Butler's willingness to believe in the possibility of machine consciousness ('germs of consciousness will be found in many actions of the higher machines') is also linked to his consideration of machines as an emerging life-form. At the same time he does not equate life with consciousness (plants are 'without apparent consciousness'). He saw nineteenth-century machines as prototypes of 'future mechanical life', and made an observation which is singularly relevant to modern computer developments – 'The present machines are to the future as the early Saurians to man. The largest of them will probably greatly diminish in size . . . a diminution in the size of machines has often attended their development and progress.'

I cannot explore in detail Samuel Butler's consideration of machines as an emergent life-form (see *Erewhon*, Chapters 23 to 25), but some of his ideas will inform what follows. It is worth exploring in outline some of the defining attributes of living forms to see to what extent computers share (or could share) such features.

A number of the behavioural attributes of living systems are obviously present also in machines. Artificial functional devices can, for example, hear, speak, respond to bright lights, aid their own survival by taking appropriate action in hazardous circumstances, and carry out a wide range of creative and intelligent tasks. (Robot technology, as one relevant area, is already providing tactile and vision sensors, to the point that such facilities as 'eyes' and 'artificial skin' will soon be commonplace elements in factory machines.)

To many people, the capacity for reproduction is central to the idea of life. The extent to which this ability can feature in machine systems needs to be analysed with care. An initial point is that methods of reproduction vary widely throughout the biological world – from simple binary fission in protozoa to all the complexities of sexual reproduction in plants and animals (internal fertilisation, external fertilisation, larval forms, pseudo-placental birth, placental birth, etc, etc). This suggests that the method of reproduction is not the central point. The key element is that, by whatever means, an entity can duplicate itself in a new entity that did not formerly exist. We all know that Unimation's PUMA robot is good at performing assembly tasks. Suppose it is set to assembling PUMA robots. Is it thereby, by virtue of its programming, granted a reproductive capacity? Samuel Butler would have said so ('Surely if a machine is able to reproduce another machine systematically, we may say it has a reproductive system').

'A number of the behavioural attitudes of living systems are obviously present in machines.'

The objection that man is the effective intermediary in allowing a PUMA to reproduce other PUMAs is not very telling. Butler cited the role of insects in plant reproduction – 'Would not whole families of plants die out if their fertilization was not effected by a class of agents utterly foreign to themselves. Does anyone say that the red clover has no reproductive system because the humble bee (and the humble bee only) must aid and abet it before it can reproduce?' In this way it can be shown that a robot programmed to assemble robots may be regarded as having a reproductive system.

Consider also the functional significance of the genetic material DNA (deoxyribonucleic acid) present in the cell nuclei of plants and animals. The genetic material is in part a blueprint, a definitive specification for the species (while allowing, according to the richness of the gene pool, for individual variation). The DNA is a way of remembering what the next generation should look like and how it should behave (so that apes produce baby apes, people produce baby people, and so on). Now, computers are very good at remembering things, and a section of computer store could be allocated to 'genetic memory' – the computer specification could be stacked away somewhere safe, possibly duplicated or triplicated for added security, so that the computer could retain a constant record of its own identity. *The computer could thus be given its own species-specific DNA for propagation purposes.*

This also relates to the biological life characteristics of *mutation* and *evolution*. Because of differences between individuals, biological species have been flexible in evolutionary terms. A changing environment favours particular individuals who are thus more likely to generate progeny, and so the character of the species changes. The mutation feature, in part responsible for the individual variation within a species, may be regarded as a random element (caused by sunspot activity, chemical aberration in DNA duplication, pollution in the environment, etc).

It would be easy to introduce such a random element into the 'species-specific DNA' held in the computer store. But it would be highly inefficient and costly to do so. A proliferation of unworkable machines would be generated which would have no chance of being 'selected out' by the environment which, being well controlled, would be unlikely to change in any way.

Another alternative would be to allow the computer 'species-specific DNA' to be modified by input received by sensors. For example, if the heat or humidity in the environment changed, it may be advantageous for the machine reproductive systems to generate different types of machines in the next generation. Heat sensors could transmit signals to modify information held in the computer store.

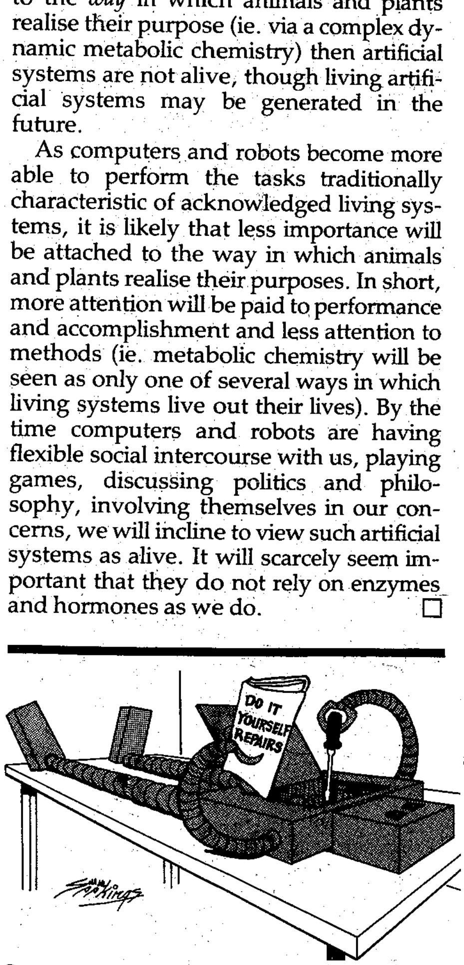
Such possibilities, though theoretically practical, are unlikely to be desirable in any practical environment. Nature, by being profligate with both biological individuals and species, enabled evolution to occur. Such profligacy would certainly not be cost-effective in the practical world of computers and robots (and would certainly be discouraged by a Thatcher administration).

Other characteristics of biological life-forms are such things as temperature regulation, self-repair of damaged tissue (extending to total limb regeneration in some species), growth, and ageing. Computers can regulate temperature, diagnose faults, switch faulty modules out of circuit, and organise repair procedures. And computers and robots obviously age: components wear out and have to be replaced, prior to total system replacement. In a sense computers can also grow. Extra peripherals and additional bits of store can be tacked on, and many systems specifically allow for modular development and expansion.

A key feature of biological life-forms is the complex metabolic chemistry, the highly complicated procedures that allow animals and plants to digest food, generate the necessary substances (enzymes, hormones, etc), grow, repair tissue and perform all the other bodily tasks that are necessary for development and survival from genesis to death. There is no artificial equivalent to the complex metabolic processes that characterise acknowledged living systems. Animals and plants achieve their purposes in a way that broadly depends upon rapid biochemical reactions that are too complex to define *in toto*. Computers and robots may be organised to achieve similar purposes, though at a more rudimentary level, but they will function in a different way, without complex metabolic chemistries.

The question as to whether computers are alive can only be answered if we decide what life is *in essence*. What are the key characteristics of living systems? If we look for behavioural characteristics – such as obvious intelligence, decision-making abilities and the capacity to generate duplicate entities (ie. to reproduce) – then artificial systems, where appropriately designed, may be said to be alive, albeit at a very lowly level. If, alternatively, we look to the *way* in which animals and plants realise their purpose (ie. via a complex dynamic metabolic chemistry) then artificial systems are not alive, though living artificial systems may be generated in the future.

As computers and robots become more able to perform the tasks traditionally characteristic of acknowledged living systems, it is likely that less importance will be attached to the way in which animals and plants realise their purposes. In short, more attention will be paid to performance and accomplishment and less attention to methods (ie. metabolic chemistry will be seen as only one of several ways in which living systems live out their lives). By the time computers and robots are having flexible social intercourse with us, playing games, discussing politics and philosophy, involving themselves in our concerns, we will incline to view such artificial systems as alive. It will scarcely seem important that they do not rely on enzymes and hormones as we do. □



Some A.I. Reports of Interest

We received a bibliography of recent research reports in the field of Artificial Intelligence. The bibliography is in the May 1980 issue of the AISB quarterly. Among the many entries, we noted the following titles:

"Teaching strategies to an advice taker/ inquirer system." N. Findler, et al. SUNY at Buffalo, Department of Computer Science, 4226 Ridge Lea Road, Amherst, NY 14426.

"A computer model of learning from examples." P. Langly. CIP-400. Carnegie-Mellon University, Computer Science Department, Pittsburgh, PA 15213.

"Models of competence in solving physics problems." J.H. Larkin, et al. CIP-408. Carnegie-Mellon, etc.

"A New Deal? Using computers to teach children with communication difficulties." J.A.M. Howe. Report No. 111, 1979. University of Edinburgh, Department of Artificial Intelligence, Forrest Hill, Edinburgh, EH1 2QL, United Kingdom.

"Teaching teachers mathematics through programming." J.B.H. Du Boulay. Report No. 113, 1979. University of Edinburgh, etc.

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"Microprocessor assisted learning: Turning the clock back?" J.A.M. Howe & B. Du Boulay. Report No. 114, 1979. University of Edinburgh, etc.

"Teaching Mathematics through LOGO programming: an evaluation study." J.A.M. Howe, T. O'Shea, and F. Plane. Report No. 11-, 1979. University of Edinburgh, etc.

"Development stages in learning to program." J.A.M. Howe. Report No. 119, 1979. University of Edinburgh, etc.

"Learning through model building." J.A.M. Howe. Report No. 120, 1979. University of Edinburgh, etc.

"Teacher transformations: student teachers programming in LOGO." B. Du Boulay. Report No. 122, 1979/80. University of Edinburgh, etc.

"Some Roles for the computer in special education." J.A.M. Howe. Report No. 126, 1980. University of Edinburgh, etc.

"Teaching mathematics through programming." J.A.M. Howe. Report No. 129, 1980. University of Edinburgh, etc.

"Understanding understanding mathematics." Edwina R. Michener. AIM-488, August 1978, $1.00. MIT Artificial Intelligence Laboratory, 545 Technology Square, Cambridge, MA 02139.

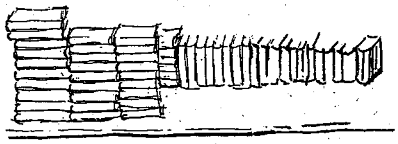
"Bandpass channels, zero-crossings, and early visual information processing." D. Marr. AIM-491, Sept., 1979, $1.00. MIT Lab, etc.

"Developing a computational representation of problem-solving skills." Ira Goldstein. AIM-495. Oct., 1978, $1.50. MIT AI Lab, etc.

"Information prosthetics for the handicapped." A. Seymour and Sylvia Weir. AIM-496, Sept., 1979, $1.50. MIT AI Lab, etc.

"Learning by understanding analogies." Patrick Winston. AIM-520, April, 1979, revised June 1979, $2.25. MIT AI Lab, etc.

"Logo music projects: experiments in musical perception and design." Jean Bamberger. AIM-523, May 1979, $1.50. MIT AI Lab, etc. □



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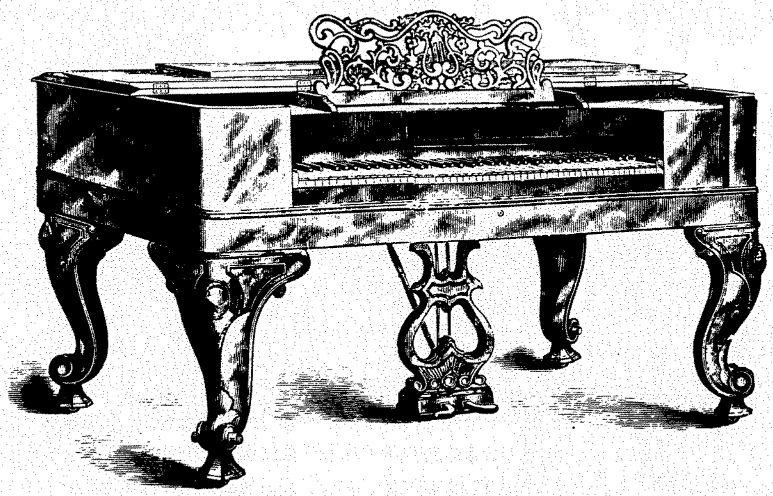

Bach

Michael Keith

Being an amateur musician as well as a small computer owner, I have observed with much interest the recent emergence of several small computer-compatible music systems for popular machines such as the Apple, PET, and TRS-80. A good survey of some available systems can be found in the article "Music Editors For Small Computers: A Comparative Study," by Rebecca T. Mercuri in this issue.

The purpose of this article is to describe BACH (Basic Aids for Composing Harmonies), a homebrew software music system which interfaces to existing hardware (an Apple II with ALF music boards and a light pen) to provide a flexible, easy-to-use computer music instrument.

Hardware

As mentioned previously, the hardware used is a standard Apple II with several ALF music boards. ALF boards were chosen since they are one of the few music boards available that have sufficient documentation to allow a user to interface custom software. Also used is a Symtec light pen. This is a high-resolution light pen capable of resolving a single Apple high-resolution point. It is used as the primary means of interaction with the music editor program.

As computer music hardware becomes more affordable, there will be an even greater need for good software support.

Michael Keith, RCA David Sarnoff Research Center, Route 1, Princeton, NJ 08540.

Software

Before describing the BACH software in detail, I will discuss some of the musical philosophy incorporated into its design.

One basic function of any music software system is the ability to enter, store, edit, retrieve, and playback music entered into the system. This is perhaps the most important function which it must perform, so it is essential that this step be as easy for

Figure 1

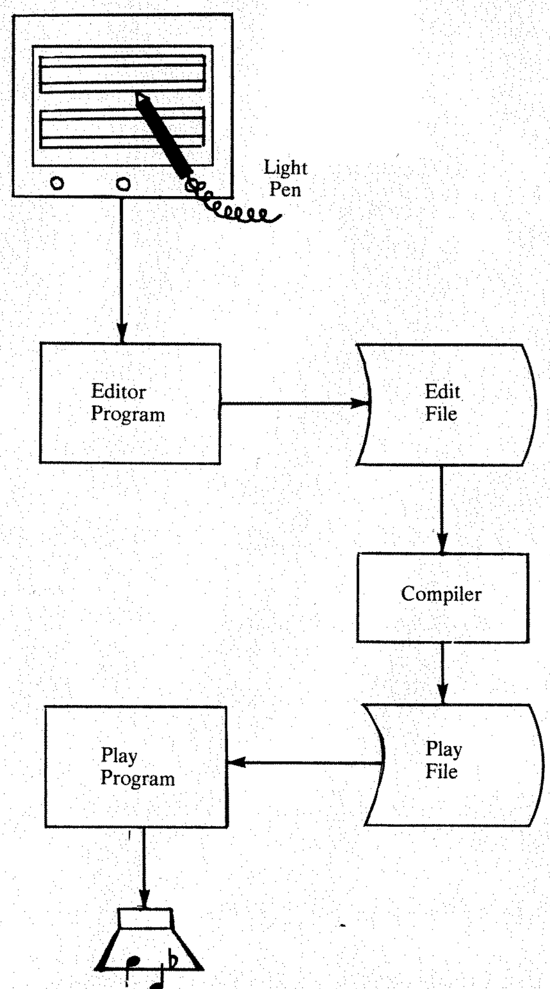

Figure 1. Basic structure of the BACH music editing system. Music is "drawn" on the TV screen with light pen, compiled and played through the music hardware.

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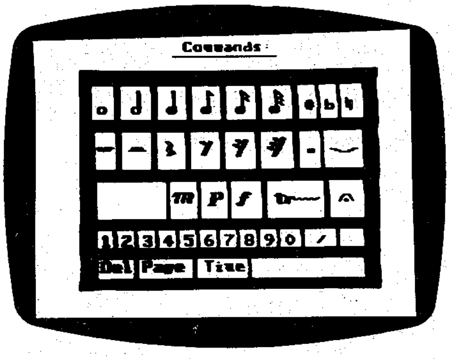


Photo 1. Commands available in editing command mode. There is still some blank space on this page for additional commands.

the user as possible. The music will generally be transcribed from printed sheet music, so it is very desirable that the system conform as closely as possible to standard musical notation, both in display and entry of music. Alphanumeric entry schemes, such as "F#3Q" should be avoided. The

There is sufficient space between the staves to include the words to a song.

user should be able to enter notes directly onto a set of standard musical staves.

It is also useful to be able to display as much music as is possible at one time on the video display. Some music systems give the feeling of looking at the music through a small "window", which makes it difficult to get a good overall view of the music entered. Another consideration in this respect is the ability to enter and display all the voices or parts of the piece of music at once. This again increases the clarity of the display and resemblance to standard music.

The basic format of the display is also a consideration. Most editors display the music on a single, continuous, horizontally-scrolling set of staves. Printed music, however, is organized in pages, each page containing several sets of staves. This format was chosen for BACH since it conforms to our previously mentioned philosophy of displaying the maximum amount of music possible and since it gives the user the familiar feeling of manipulating pages of music. This format is also used for display of the music during playback, with the computer automatically "turning the page" when the end of the currently displayed page is reached.

The components of the BACH system are shown schematically in Figure 1. The editor program is used to interactively create music on the video display with a light pen. This produces an edit file which is stored on disk. The compiler program takes this file and compiles it into ALF-compatible format (the compiler also performs other functions described below). The play program then plays this file using the ALF playing subroutines.

The editor program operates as follows. The light pen is used to move a note (or other object) around the page to the desired location on the staff. A letter in the upper left corner show the note name for the current position of the note on the staff. A touch of the light pen deposits the note. This is a very natural way to write music—similar to using a regular pen on paper. The display is black notes on a white background, which also resembles printed music.

Touching the left edge of the page brings up a command page, shown in Photo 1. This page contains various commands to change the current object to use, change key or time signature, enter delete mode, or move to another page of music. Command selection is again made with a light pen. Touching the bottom edge of this display returns to the music page being edited. The switch from music page to command page is made using the Apple hardware paging feature (which allows virtually instantaneous interchange of two high-resolution pages on the video display).

One unique feature of the system compared to most other small computer music editors is that the concept of "voices" or "parts" is completely absent. This refers to the operation taking the given piece of music and breaking it into several voices, each containing only one note. This is one of the more tedious aspects of using some music editors, and is not even easy for someone unskilled in music. Thus the approach taken in this system is to let the compiler program do the task of automatically splitting up the music into parts. This is not a trivial task as it requires some pseudo-intelligence in the compiler to decide which voice a note should be assigned to, but the compiler seems to do an acceptable job for most pieces of music.

The display for a completed page of music is shown in Photo 2. Note the following other features of the BACH editor:

Photo 2. A finished page of music as it appears on the video display. The words to the song are displayed during playback only, but otherwise the display is identical to the display during music editing.

1) Notes are allowed between the staves. For example, a middle C can be written in two places (one ledger line below the upper staff or one ledger line above the lower staff). The editor allows these redundant note positions. The compiler correctly translates these notes to their proper pitch.
2) Ornaments and special signs are possible such as the hold (𝄐), trill (tr~), and dynamic markings (mp, f, etc.). The compiler inserts

Figure 2

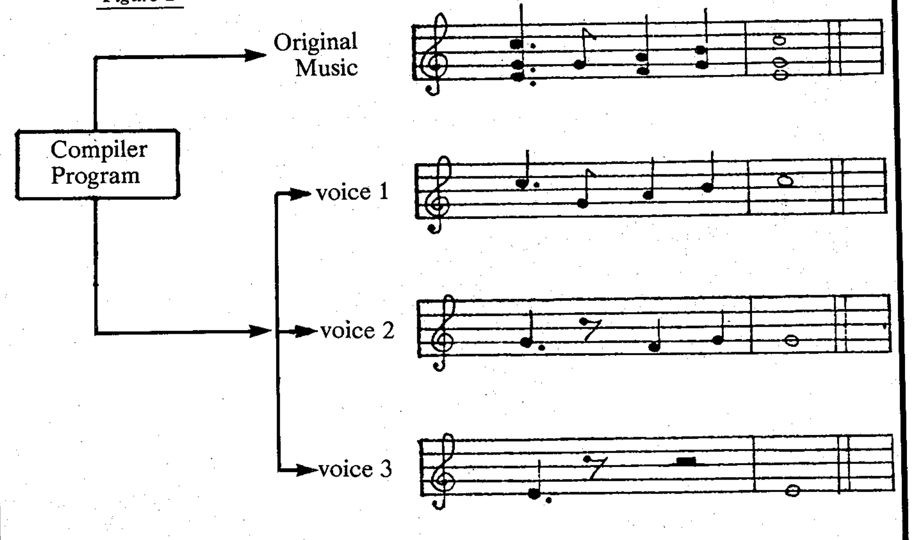


Figure 2. Example of the automatic voicing performed by the compiler. Note the rests automatically added in voices two and three.

the proper volume settings, notes, etc. into the play file as the special symbols are encountered.
3) Measure bar lines are in a fixed position on each page. The default spacing is determined by the time signature but can be changed by the user. The positions of the notes within the measures are determined by the user. This allows the notes to be spaced in roughly the same manner as they are on the printed music.
4) There is sufficient space between the staves to include the words to a song. These words do not affect the music but are displayed during playback (providing the capability for a computer sing-along).

Photo 3. Color graphics can be interspersed with the music displays during playback. It is also conceivable to have animated graphics accompanying the music as well.

Other Features

After creating a piece of music with the music editor program, it is possible to manipulate the music data with other programs to produce interesting variations on the piece. For example, one program I have written transforms the input piece of music into other modes (for example, it can change a piece from major to minor, with sometimes humorous results).

Also, during playback one can display an arbitrary sequence of high-resolution pages (not necessarily just the BACH sheet-music displays). These pages can contain, for example, all the words to the song plus chord names (for play-along or sing-along) and/or graphics displays such as the one shown in Photo 3. One could even have animated graphics, rather than a series of still pictures, accompanying the music, resulting in a "digital cartoon".

The compiler program, as described above, performs the functions of assigning notes to voices and translating into the codes required by the ALF play routines. The compiler also adds rests in voices which are momentarily silent. Figure 2 shows an example of the processing done by the compiler program.

The play program is a small Basic program which calls the ALF play subroutines and handles the task of turning the pages of the display. At present, only three pages of the playing music can be displayed. This is accomplished by constructing the video images for the pages in RAM prior to playing the music and doing fast memory moves during playback when it is time to turn the page. To display more pages would require drawing them on the fly as the music is playing, which would be much more difficult (but conceivably possible).

I have also experimented with other display formats. Photo 4 shows a sample vocal-piano score and Photo 5 show a slightly more exotic notation, banjo tablature. These alternate forms of notation could be integrated into the system to provide the ability to enter music in different formats or to have the computer automatically translate from one form of notation to another.

Photo 4. Sample vocal-piano score display format.

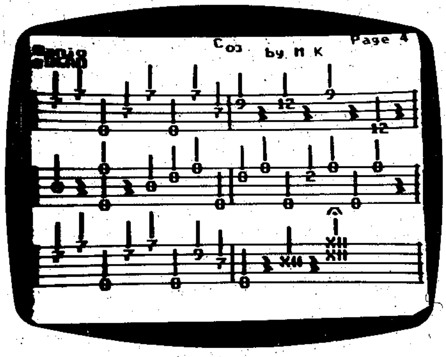
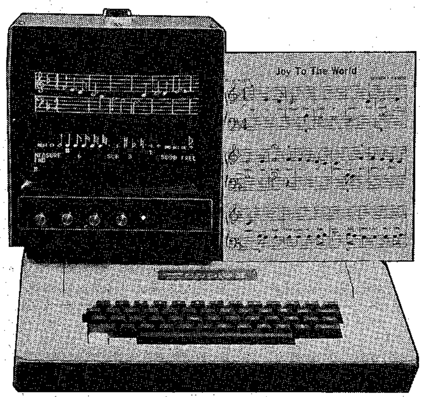


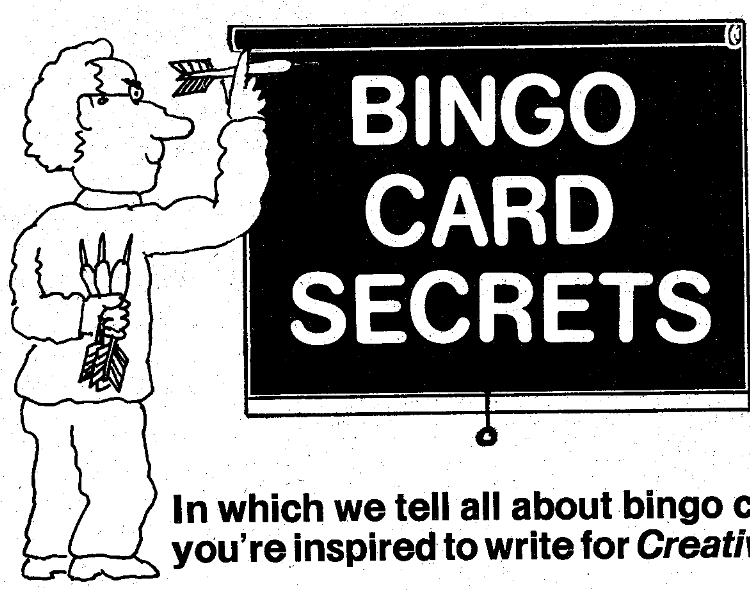
Photo 5. Sample tablature format, illustrating the possibility of entering music in one format and have the computer automatically translate to regular music notation.

Conclusions

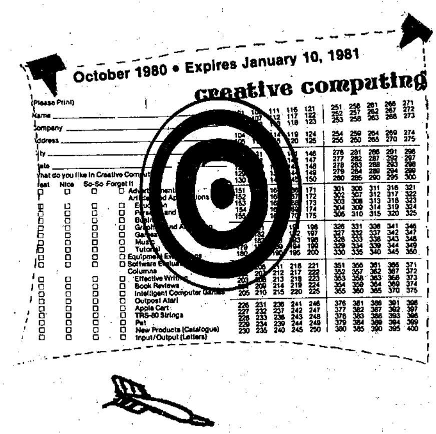
The experimental system described in this article demonstrates that it is possible to create an inexpensive computer music tool of reasonable musical sophistication with existing hardware.

As computer music hardware becomes more affordable, there will be an even greater need for good software support. Whereas the actual programs described in this article are somewhat hardware-dependent, the ideas are not. Adequate software support can help the small computer realize its full potential as a true musician's tool. □





BINGO CARD SECRETS



In which we tell all about bingo cards and hope you're inspired to write for *Creative Computing*.

David Ahl

Bingo cards. That's the affectionate publishing industry term for the reader service cards in the back of the magazine.

If you've ever used one of our reader service cards—and 84%of you have—you've probably noticed that we ask some questions on the left side of the card. We change these questions every few months. Your responses have given us a pretty good indication of who you are, what you have or plan to buy in the way of computer systems, and what you want to see in the magazine.

Table 1 is a list of magazine contents that we asked about recently. We've ranked the items by the percentage of people rating the item "great" or "nice."

Although this gives us a suggested list of topics to emphasize, we do not feel that we should be slaves to the list. For example, we'll continue to look for important new developments in software and systems and bring them to your attention. We'll also continue to philosophize a bit because we feel that someone ought to be "thinking out loud" about the future of technology and what it means to each of us.

Write for Creative Computing

On the other hand, we certainly don't intend to ignore your preferences. But to be responsive, we need your help too. Why not write us an article. Tell us about that neat program you've developed. Tell us your experience with Brand X computer, Brand Y peripheral or Brand Z software.

Product Reviews

A word about product reviews. They must be factual and objective. The biggest single group of people who read Ford ads are those people who have just bought a Ford. We all have a psychological need to justify a purchase. A product review is not an appropriate psychological outlet to justify a purchase. Nor is it the appropriate place to vent your passion against a manufacturer who has wronged you in some way.

Reviews should start with a brief description of the class of product (say modems or drill and practice software). Next should come a thorough description of the specific product being reviewed (no opinions yet). Next should follow your experience with the product: putting it together, using it the first time, using it later, and the reaction of others to it. It goes without saying that the product should be used in the environment for which it is intended.

The appropriate length for a product review is from 500 to 2500 words. Longer reviews are probably going into too much detail. Needless to say, a $1,000 computer warrants a longer review than a $10 software package. We favor comparative reviews of three or four of a similar item over single reviews, but both are acceptable.

Before writing a review, it's probably wise to write or call David Lubar to see that someone else is not doing it already.

Application articles

We routinely reject application and software articles that are either "gee whiz" success stories or naked programs. What we're looking for is an article that describes the problem you're attempting to solve (the background), how you went about it (the approach), algorithms, flowcharts, data gathering (the method), the program and several sample runs.

You probably didn't do everything right the first time through. Why not? Describe these experiences and bad starts in a way that someone else can learn from them.

Supporting Material

Pictures and illustrations. They're absolutely vital with a review or article. If we have to go to the manufacturer for a publicity shot or photograph the item here, it won't be nearly as effective as your photos. If you're not a photographer, find a friend with a 35mm SLR, load it up with TRI-X or Kodacolor 400 and shoot the item. Vary the angle and lighting. They won't all come out, but four or five usable shots out of 20 easily justifies the $7 or $8 for film and developing. We don't need 8 X 10 or even 4 X 5 prints; standard Fotomat 3 1/2 X 5 is fine. But they must be glossy finish; matte is not acceptable.

Illustrations should be done in black on white paper. Use India ink or a Pilot Razor Point or equivalent. We prefer to use your illustrations than redraw things here.

Program listings and runs must be done with a new black ribbon on white paper. Light copies, blue, or purple ribbons cannot be used. I can't emphasize this strongly enough. Even if an article is absolutely perfect, it is useless if the listing and run cannot be read easily.

Payment

Unlike other magazines, *Creative Computing* pays for an article at the time of acceptance. This means that even if it does not run for five or six months, you won't be waiting for your money.

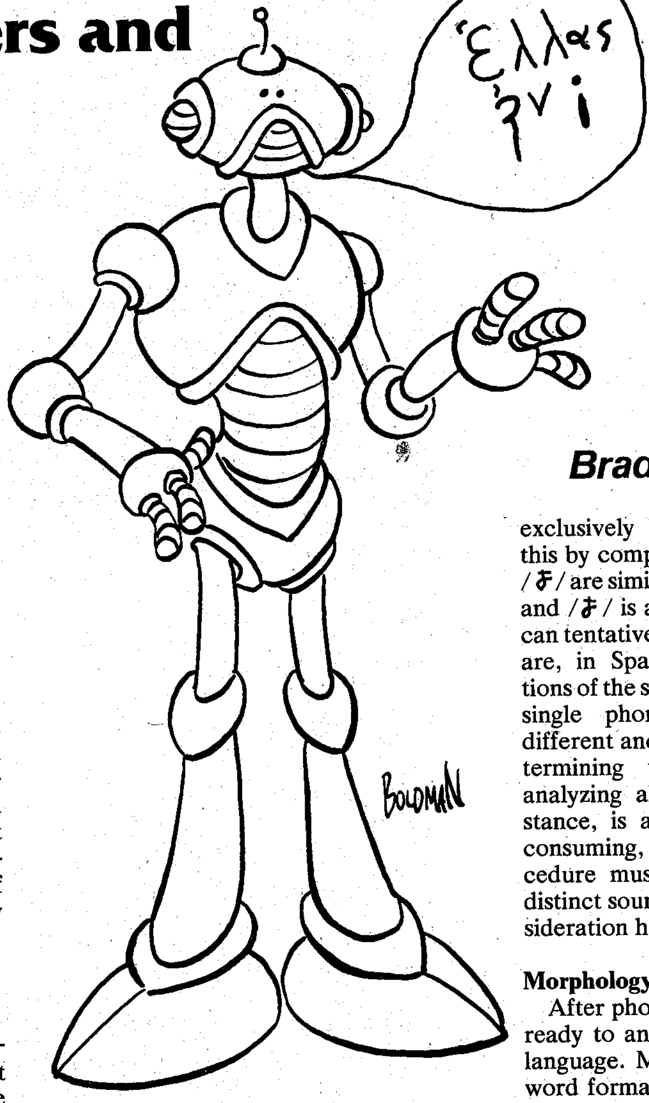
Share an idea with our readers. Don't put it off. Crank up that word processor today! □

Item		Rank
		Percent*
1	Advertisements	91.4
2	New products (Catalogue)	91.1
3	Software evaluations	90.5
4	Equipment evaluations	86.1
5	Personal and home application	83.3
6	Graphics and animation	80.8
7	Games	77.3
8	Input/Output (letters)	75.8
9	Intelligent Computer Games	72.2
10	Apple Cart column	71.2
11	Educational applications	67.1
12	Tutorials	63.4
13	Business applications	63.1
14	Book reviews	58.8
15	TRS-80 Strings column	55.9
16	Effective Writing column	55.0
17	Music Applications	48.9
18	Outpost: Atari column	38.4
19	PET column	34.7

*Percentage of reader service card respondents who checked the item as "Great" or "Nice."

Table 1

Computers and Descriptive Linguistics



Bradley Pritchett

Descriptive linguistics is the field which deals with the analysis and description of languages as systems within themselves. The linguist collects linguistic data—words and sentences—and then analyzes these data in order to describe the phonology, morphology and syntax of a language. This is a time-consuming and tedious task, particulary in the initial stages. Computers are excellent data analysts; the marriage of linguist and personal computer could not be more natural. Let us then briefly consider how to use a personal computer to simplify the task of describing the phonology, morphology and syntax of a language.

Phonology

Phonology concerns itself with the relevant sounds of a language. Not only must the linguist describe how these sounds are produced, but he must also state which sound features are important to speakers of the language, and which are not. For example, in English /t/ as in "type" may be pronounced by tapping the tongue against the alveolar ridge behind the upper teeth. Alternatively, it may be made by tapping the back of the upper teeth themselves. The difference is unimportant, and the English speaker ignores it.

In some languages, these two varieties of /t/ would be considered distinct, and the speakers of such a language would hear sounds which to them are as different as /t/ and /d/ are to us. Conversely, in some languages, including some American Indian languages, pairs such as /u/ and /g/, /t/ and /d/, and /b/ and /p/ would not be considered distinct. If these languages had a word "ball," it could be pronounced either /ball/ or /pall/, and the speakers of the language would hear no difference or, at least, not consider the difference significant.

Bradley Pritchett, 863 Mass. Ave., Apt. 24, Cambridge, MA 02138.

It is thus the first task of the descriptive linguist to determine all of the relevant sounds in a language. This can be greatly simplified by using a personal computer.

My first step toward using the computer as a linguistic tool was to define the character set of the International Phonetic Alphabet on my Apple II. If your computer does not have user-definable characters, you can develop your own phonetic alphabet using the standard character-set, as long as you employ it consistently. I then wrote a short program which would allow me to scan my data, transcribed phonetically, for any string. This allows me to obtain a listing of the occurrences of any sound.

Suppose we are suspicious about the sound /d/ in Spanish. We have the computer list all occurrences of that sound found in our data. We notice that there does not seem to be a /d/ between vowels. We can quickly check this by having the computer list all occurrences of vowel +d+ vowel. There are none. Now we notice that (the *th* sound of "this") occurs almost exclusively between vowels. We verify this by computer. Thus, because /d/ and /ð/ are similar (/d/ is a voiced dental stop and /ð/ is a voiced dental fricative), we can tentatively conclude that /d/ and /ð/ are, in Spanish, alternative pronunciations of the same sound and that they are a single phoneme. Each occurs in a different and definable environment. Determining this without a computer, analyzing all of the data without assistance, is arduous and extremely time consuming, especially since this procedure must be performed until every distinct sound of the language under consideration has been treated.

Morphology

After phonemic analysis, the linguist is ready to analyze the morphology of the language. Morphology is the science of word formation. It is morphology which explains, for example, how to form the simple past tense of English verbs. It is often said that one simply adds "ed" to the verb. This is totally insufficient for a linguist. He is concerned not with how a language is spelled but with how it is pronounced. Careful examination shows that "ed" is pronounced /d/ in some cases (screamed), /t/ in some other cases (walked), and /ed/ in other cases (bunted). When we notice this inconsistency, we can have the computer generate lists of past tense verbs ending in /t/, /d/ and /ed/.

Returning to our earlier problem with English verbs, we conclude that /t/ appears after unvoiced sounds (sounds not accompanied by vocal cord vibration), /d/ after voiced sounds (sounds with vocal cord vibration), as /ed/ after /t/ or /d/. Thus, we have determined how to form the past tense of most English verbs and determined that they are formed regulary and predictably. The computer has saved us a great deal of time by sorting the data and spared us from long visual searches and comparisons of data. Using the printer, we can also obtain neat and legible hard copy which is vital to the linguist.

Syntax

Finally, the computer can be used in a similar fashion in syntactic analysis. Syntax is basically the science of word order. Some languages, such as Latin, have very free word order. Some, like German or Chinese, have rigid syntax. Suppose that we wish to study the position of the verb in clauses. We have the computer search for verbs in our data. In Latin we find the position apparently unpredictable but with a propensity for the final position. In German we find that the verb is consistently the second element except when certain words introduce the clause, forcing the verb to the end. It is little trouble to have the computer generate a list of sentences with the verb in the final position. After this, it is up to the linguist to determine which words send the verb to the final position and whether these words are logically related.

Programming These Analyses

A note here on actual programs would be in order. Once you have defined a phonetic alphabet and chosen symbols to indicate parts of speech and other relevant features, the actual programming is quite simple. I have not included any examples here, as they would be different on each machine. Simply have the computer read in strings of data, one representing the word and one holding information about the word.

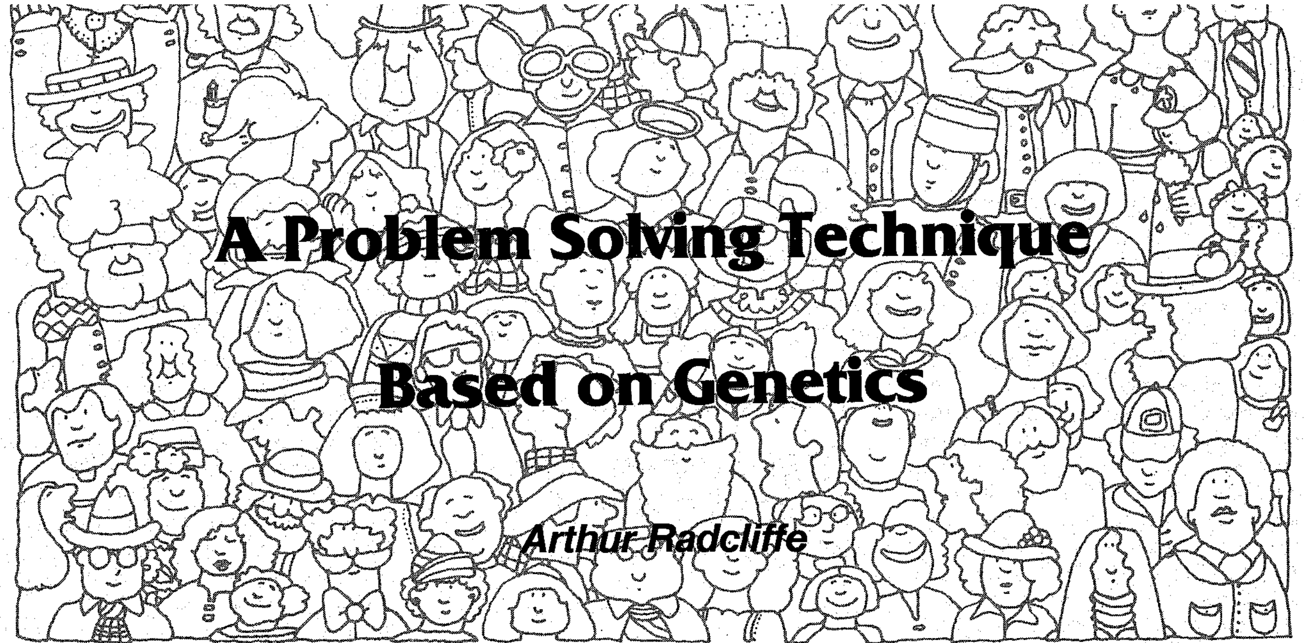
For instance, I label my data to indicate what part of speech each word is (as far as this is applicable). I use an "*" for verbs, a "!" for nouns an "@" for adjective, and a "#" for adverbs. When required, I can analyze different parts of speech rather than have the computer process all of the data.

The computer has searches and comparisons of data.

In addition, I code the data according to the relevant features of the language considered. Latin nouns would be coded for case, number and gender, verbs for person, number, tense, voice and mood. English nouns would only be coded for number and verbs for tense, person and number. This allows me to search for correspondences of form *and* meaning, which is the key to morphology. Thus a coding for a Latin verb would look like this: Data "laudo", "*1SPAI." This indicates that "laudo" is a verb in the first person singular present active indicative. Data "praise," "ØØP" indicates that the person and number are indeterminable and the verb is in the present tense.

The computer should then look at these strings and see if they fit the description which you input earlier. That is, initially have the computer ask you what part of speech to search for. If you say "noun," have it ask you for gender (if relevant) and number. Then have the computer compare what you are looking for with each string. If there is a match, have the word printed out. The resulting programs will be composed of simple string searches and comparisions. Despite their simplicity, they are really doing just what the linguist does, and they are doing it a good deal faster. Of course, the linguist must tell them what to do in the first place.

It is thus clear that by rapidly processing and sorting data, the computer can be an extremely powerful tool, one ideally suited to linguistics. The reader who is a linguist can extend these ideas to other related fields such as historical or comparative linguistics. There are also, of course, many uses of the computer in descriptive linguistics other than those outlined above. The author welcomes correspondence about linguistics, computers, or both, and suggests that any reader interested in specific programs contact me at my address (bottom of column one). □



A Problem Solving Technique Based on Genetics

Arthur Radcliffe

"Artificial intelligence," that ever-farther goal, may be a will-o-the-wisp; yet its many pathways of research have brought new insights to the study of psychology, language, and even, as described here, genetics.

Evolution is a process of multidimensional search: each newborn creature is exploring another position in genetic survival-space. Now artificial intelligence research has discovered that one of the best methods of multidimensional search is what we have always called sex. There being two sexes may not be merely an accidental strategy of protoplasm, but the most efficient scheme of search and adaptation. —TN

Mother Nature, in her wisdom, comes up with remarkable solutions to the problem of filling all available ecological niches on this planet; and perhaps elsewhere too. Beneath the surface charm of such diverse entities as butterflies and dolphins must therefore lie subtle and powerful evolutionary methodologies. Bypassing consideration of Who brought all this to pass, let us simply borrow a scheme for whose efficacy there is more than sufficient empirical evidence.

Curled in the nuclei of each cell of all the diverse creatures about us are strings of beads, each bead a part of the answer as to how to build and maintain the particular creature of which it is a part. (Note: the word "strings" in the preceding sentence is a clue to where I am leading you; keep it in mind.) If you want to know more about the chemistry of all this, read up on chromosomes and genes and DNA and double helices.

Remaining biological for a while, I wish to raise the topic, rare in computer literature, of sex. For an essential aspect of the proliferation of the species is sexual reproduction. In case you have forgoten, sex facilitates the mingling and passing on of minor variations of a main theme—offspring end up with half the beads of each parent.

Arthur Radcliffe, 1521 Hatcher Crescent, Ann Arbor, MI 48103.

Now we come to the vital process of selection; whether natural or un-natural, selection leads to changes in some favorable dimension, perhaps at the expense of other dimensions which may never be explored.

Beneath the surface charm of such diverse entities as butterflies and dolphins must lie subtle and powerful evolutionary methodologies.

Selection is based on some concept of fitness, of greater merit in a given environment. It may not make a turkey happier to have twice the breast meat, but the breeder smiles all the way home from the bank.

So let us focus on the concept of solving a problem by stringing together solution parameters, something easily done on a computer. Solution parameters are whatever elements we are searching for. Thus, we might form a string of the numbers which represent the temperatures, pressures and flow rates in an oil refinery, or string together symbols defining a musical tune. The point is that this method works for problems whose answers can be expressed in a string of symbols, not necessarily numbers.

Given that we have a problem whose answer can be expressed in string form, we proceed to form a population of strings representing possible answers. We may form this population randomly, with malice aforethought, or using precognition if it is available. Once we have a population of strings, it is time for selection. If does not matter how, but we must list the population in order of preference. We may decide this matter of ranking analytically, by mathematical methods; or we may solve it pragmatically, by weighing results on a scale or scanning a profit statement. Or we can rank the strings of our population interactively, esoterically: "I like that pattern on my display screen better than any of the others!"

Now for the last step in the process. We pair off the higher-ranking strings to generate offspring who will replace the lower-ranking strings, which are consigned to oblivion.

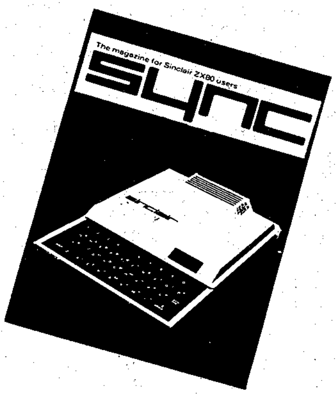
That is it, except for a bit of seasoning, salt and pepper in the form of a few random mutations. We just turn the string population over to the proclivities of a computer program which repeatedly executes the above sequence while we have a beer and voyeuristically watch the answer to the problem evolve.

To illustrate the genetic adaptive approach, a problem was written which employs binary strings. These strings define the X and Y coordinates of a point on the display screen. The merit of a given string is determined by the distance of its point from a target point. The odd positions along the string contain the bits of a binary number for one coordinate and the even positions contain a binary number for the other coordinate. The strings are created in line 910 and the target is plotted in line 980.

The strings are converted from binary numbers to decimal X,Y coordinates in lines 160 and 170 using a binary weighting

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync



SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, **SYNC** to be a respected and successful magazine.

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Right now we need all the help we can get. First of all, we'd like you to subscribe to **SYNC.** Subscriptions cost $10 for one year (6 issues), $18 for two years (12 issues) or, if you really want to beat inflation, $24 for three years (18 issues). Send to the address below or call our toll-free number, **800-631-8112** (in NJ 201-540-0445) to put your subscription on your MasterCard, Visa or American Express card. Canadian and other foreign surface subscriptions are $15 per year or $27 for two years. We guarantee your satisfaction or we will refund the unfulfilled portion of your subscription.

Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of **SYNC** so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

The exploration has begun. Join us.

The magazine for Sinclair ZX80 users

SYNC

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array created in line 910. Old points are deleted from the screen in line 230 and new points are added in line 280.

The distances of the points from the target are calculated in line 310. These distances are placed in rank order by the sequence from 400 to 490. The array R contains the serial numbers of the strings in the order ranked. Starting at line 500, the strings are copied from array C in to array A in rank order. Lines 520 to 540 introduce random mutations. The distances of the best four from the target are printed in line 620 and these four are copied into the top positions in array C in line 640.

The mating process is accomplished by pairing strings 1 and 2, then strings 3 and 4. Each pair is cut at random position and the head of each spliced to the tail of the other. Line 740 defines the cutting point; the heads are copied in lines 760 and 770; the tails are copied in lines 800 and 810.

At this point we have:

1.) extricated the odd and even bits from the string to define the X and Y coordinates
2.) plotted points defined by these coordinates
3.) calculated the distances of these points from the target
4.) ranked the strings by closeness to the target
5.) mutated the strings and rearranged them in rank order
6.) established the best four at the top
7.) mated the top four by cutting and slicing to create offspring replacing the bottom four.

That is all there is to it:

A) establish a rating process
B) create an initial population of strings
C) record the rating of each string
D) place the strings in rank order
E) mate and mutate the better strings to replace the poorer ones
F) continue the sequence C, D, E.

When are you done? The process tends toward a point of diminishing returns, often after 20 generations. If you do not like what is happening, tinker with the mating and mutation processes.

The remarks appended to the program should be studied as counterpoint to what has been written above. Experimentation is encouraged: for example, if the order of the bits for one coordinate is reversed, the head of each string will contain the most significant bits for one coordinate and the tail will contain the most significant bits of the other coordinate. Also, more kinky mating processes can be designed.

Credit for creating this genetic adaptation process belongs with John Holland of the Computer Science Department of The University of Michigan. □

Bibliography

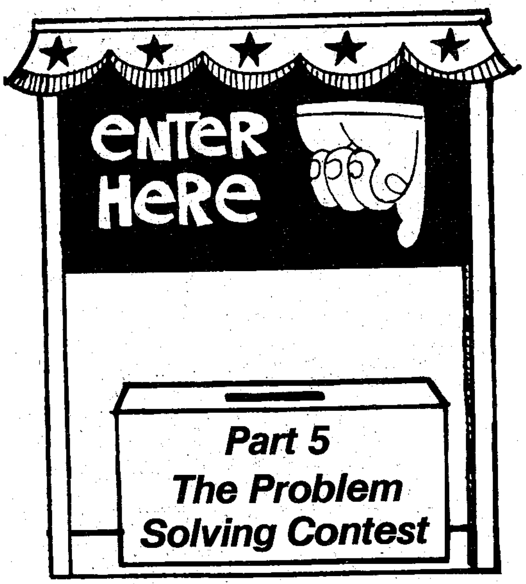
1) J.H. Holland, *Adaptation in Natural and Artificial Systems*. U. Michigan Press, 1975.

```
1  PRINT : PRINT : PRINT : PRINT "PROBLEM SOLVING USING GENETIC A
     DAPTATION"
10 A = B = C = D = E = F = G = X = Y = 0
20 DIM A(7,13): DIM B(7): DIM C(7,13): DIM D(7): DIM R(7): DIM W
     (7): DIM X(7): DIM Y(7): DIM Z(7)
30  PRINT "CONTACT ART RADCLIFFE                                  "
40  PRINT "1521 HATCHER CRESCENT                                  "
50  PRINT "ANN ARBOR, MI  48103                                   "
60  PRINT "(313)-769-3039                                         "
70  PRINT "SEE REMARKS STARTING LINE 1000                         "
80  GOTO 900
99  REM  TRANSLATE BINARY STRING TO X & Y COORDINATES:
100  PRINT "GENERATION=";H;
110  FOR D = 0 TO 7:X(D) = 0:Y(D) = 0: NEXT D
120  FOR A = 0 TO 7: FOR B = 0 TO 6
130 C = 2 * B
140 D = C + 1
150 E = B(B)
160 X(A) = X(A) + C(A,C) * E
170 Y(A) = Y(A) + C(A,D) * E
180  NEXT B: NEXT A
199  REM   PLOT:
200  FOR A = 0 TO 7
210 X = W(A)
220 Y = Z(A)
230  HCOLOR= 0: HPLOT X,Y: HPLOT X + 1,Y: HPLOT X,Y + 1: HPLOT X +
     1,Y + 1
240 X = X(A)
250 W(A) = X
260 Y = Y(A)
270 Z(A) = Y
280  HCOLOR= 3: HPLOT X,Y: HPLOT X + 1,Y: HPLOT X,Y + 1: HPLOT X +
     1,Y + 1
290  NEXT A
299  REM   CALC. DISTANCES FROM TARGET:
300  FOR A = 0 TO 7
310 D(A) =  INT (.5 +  SQR ((X(A) - 64) ↑ 2 + (Y(A) - 64) ↑ 2))
320 R(A) = A
330  NEXT A
399  REM   ESTABLISH RANK ORDER:
400  FOR A = 0 TO 6: FOR B = A TO 7
410 C = D(A)
420 D = D(B)
430  IF C <  = D THEN 490
440 D(A) = D
450 D(B) = C
460 E = R(A)
470 R(A) = R(B)
480 R(B) = E
490  NEXT B: NEXT A
499  REM   MUTATE AND COPY INTO ARRAY 'A':
500  FOR A = 0 TO 7
510 B = R(A)
520  IF  INT (2 *  RND (1)) = 0 THEN 550
530 D =  INT (14 *  RND (1))
540 C(A,D) = 1 - C(A,D)
550  FOR C = 0 TO 13
560 A(A,C) = C(B,C)
570  NEXT C: NEXT A
599  REM   COPY BEST 4 INTO ARRAY 'C':
600  PRINT "  BEST 4:";
610  FOR A = 0 TO 3
620  PRINT " ";D(A);
630  FOR B = 0 TO 13
640 C(A,B) = A(A,B)
650  NEXT B: NEXT A
660  PRINT
699  REM   CUT & SPLICE 1ST 4 TO MAKE NEW 2ND 4:
700  FOR A = 0 TO 2 STEP 2
710 B = A + 1
720 C = A + 4
730 D = A + 5
740 E = 1 +  INT (12 *  RND (1))
750  FOR F = 0 TO E
760 C(C,F) = A(A,F)
770 C(D,F) = A(B,F)
780  NEXT F
790  FOR G = E + 1 TO 13
800 C(C,F) = A(B,F)
810 C(D,F) = A(A,F)
820  NEXT G: NEXT A
830 H = H + 1
840  IF H = 21 THEN H = 0: GOTO 900
850  GOTO 100
899  REM   INITIALIZE:
900  FOR A = 0 TO 7: FOR B = 0 TO 13
910 C(A,B) =  INT (2 *  RND (1))
920  NEXT B: NEXT A
930  FOR A = 0 TO 6
940 B(A) = 2 ↑ A
```

```
950  NEXT A
960  FOR A = 0 TO 10: PRINT : NEXT A
970  HGR
980  HCOLOR= 3: FOR X = 64 TO 66: FOR Y = 64 TO 66: HPLOT X,Y: NEXT
     Y: NEXT X
990  GOTO 100
1000  REM   THIS IS AN APPLICATION OF A PERFECTLY GENERAL PROBLEM
      SOLVING SYSTEM WHICH I HAVE ALSO USED TO SOLVE THE TRAVELIN
     G SALESMAN PROBLEM: FIND THE SHORTEST ROUTE THROUGH N CITIES
     .
1001  REM   THIS TECHNIQUE WAS DEVELOPED UNDER PROFESSOR JOHN HOL
     LAND OF THE UNIVERSITY OF MICHIGAN COMPUTER SCIENCE DEPARTME
     NT BY D. J. CAVICCHIO AND R. B. HOLLSTIEN ABOUT 1970.
1002  REM   THIS TECHNIQUE CAN BE APPLIED TO ANY PROBLEM WHOSE SO
     LUTION CAN BE EXPRESSED AS A STRING, SUCH AS BY FORMING A ST
     RING FROM THE COEFFICIENTS OF AN EQUATION OR FROM ANY SYMBOL
     S DEFINING A PATTERN OR EVENT.
1003  REM   THERE IS ONE OTHER ESSENTIAL CONDITION: THAT THE POPUL
     ATION OF STRINGS CAN BE RANKED AS TO MERIT (EITHER ANALYTICA
     LLY, BY EXPERIMENT OR BY JUDGEMENT).
1004  REM   THE INITIAL FAMILY OF STRINGS CAN BE BASED ON ESIMATE
      OR CAN BE COMPLETELY RANDOM.
1005  REM   THE PROCEDURE STARTS WITH ASSIGNING A MERIT FACTOR TO
      EACH STRING.
1006  REM   THE NEXT STEP IS TO PLACE THE STRINGS IN ORDER OF MER
     IT.
1007  REM   PAIRS OF STRINGS FROM THE TOP OF THE LST ARE THEN 'MA
     TED' TO PRODUCE OFFSPRING WHICH REPLACE STRINGS AT THE BOTTO
     M OF THE LIST.
1008  REM   THE STRINGS ARE ANALOGOUS TO CHROMOSOMES AND THE PROC
     ESS IS ANALOGOUS TO SELECTIVE BREEDING.
1009  REM   THE MATING CAN CONVENIENTLY BE ACCOMPLISHED BY CUTTIN
     G A PAIR AT RANDOM LOCATION AND SPLICING THE HEADS AND TAILS
      TO FORM TWO NEW STRINGS (WHICH EACH CONTAIN ATTRIBUTES OF BO
     TH PARENTS).
1010  REM   IT IS HELPFUL TO THE EVOLUTIONARY PROCESS TO CREATE R
     ANDOM MUTATIONS, AS BY RANDOMLY SELECTING HALF THE POPULATIO
     N FOR ALTERATION OF A RANDOMLY CHOSEN ELEMENT OF THE STRING.

1011  REM   THE POPULATION WITH IT'S NEW MEMBERS AND MUTATIONS IS
      RECYCLED THROUGH THE SAME STEPS, STARTING WITH RATING AND R
     ANKING.  EACH CYCLE IS TERMED A GENERATION.
1012  REM   IN THIS EXAMPLE EIGHT STRINGS OF 14 1'S AND 0'S CONST
     ITUTE THE POPULATION.  THE ODD POSITIONS IN A STRING ARE THE
      BINARY EXPRESSION OF THE X COORDINATE OF A POINT AND THE EV
     EN POSITIONS DEFINE THE Y COORDINATE.
1013  REM   A TARGET IS DEFINED AS THE POINT 64,64.  THE STRINGS
     ARE RATED ACCORDING TO THE DISTANCE OF THE POINT THEY DEFINE
      FROM THIS TARGET.
1014  REM   ARRAY C CONTAINS 8 STRINGS.  ARRAY A IS USED TO BUFFE
     R ARRAY C DURING BREEDING.  ARRAY B CONTAINS THE VALUES OF T
     HE POSITIONS OF A BINARY NUMBER.  ARRAY D CONTAINS THE DISTA
     NCE OF EACH POINT FROM THE TARGET.
1015  REM   ARRAY R CONTAINS THE SERIAL NUMBERS OF THE STRINGS IN
      RANK ORDER.  ARRAYS X AND Y STORE THE X AND Y COORDINATES D
     EFINED BY EACH STRING.  ARRAYS W AND Z BUFFER ARRAYS X AND Y
     .
1016  REM   LINES 0-90: GET ORGANIZED.
1017  REM   LINES 900-990: INITIALIZE.
1018  REM   LINES  100-180: TRANSLATE STRING TO X AND Y COORDINAT
     ES.
1019  REM   LINES 200-290: PLOT THE POINTS.
1020  REM   LINES 300-330: CALCULATED DISTANCES OF POINTS FROM TA
     RGET.
1021  REM   LINES 400-490: ESTABLISH RANK ORDER.
1022  REM   LINES 500-570: MUTATE AND COPY STRINGS INTO ARRAY 'A'
      IN RANK ORDER.
1023  REM   LINES 600-660: COPY TOP (BEST) 4 STRINGS INTO ARRAY '
     C'.
1024  REM   LINES 700-850: CUT AND SPLICE COPIES OF THE BEST 4 TO
      REPLACE THE WORST 4.
1025  REM   THISPROGRAM WAS WRITTEN TO ILLUSTRATE THE PROCESS.  S
     ECTION 200 CAN BE MERGED WITH SECTION 100 TO ELIMINATE ARRAY
     S W AND Z, FOR INSTANCE.
1026  REM   IT IS INTERESTING TO EXPLORE POPULATION SIZES, MATING
      PROCESSES AND MUTATION RATES.  20 GENERATIONS SEEMS TO BE A
      MAGIC NUMBER FOR APPROACHING DIMINISHING RETURNS.
1027  REM   THE STRING ELEMENTS COULD BE SYMBOLS CODING A MUSICAL
      PIECE OR OTHER ARTISTIC COMPOSITION WITH THE RANKING BEING
      BASED ON ESTHETIC MERIT.
1028  REM   THE STRING ELEMENTS COULD ALSO REPRESENT CONTROL SETT
     INGS FOR A CHEMICAL PROCESSING PLANT.
1029  REM   THE RANKING COULD BE PROVIDED BY MEASUREMENTS OF PLAN
     T GROWTH OR BY ANIMAL ACTIVITY RECORDED WITH APPROPRIATE SEN
     SORS.
1030  REM   PLEASE CONTACT ART RADCLIFFE IN ANN ARBOR AND SHARE Y
     OUR EXPERIENCE: PROBLEMS AND RESULTS, WITH THIS SYSTEM.  THA
     NX.

]
```



How to Solve it— with the Computer

Donald T. Piele

For the past four years the University of Wisconsin — Parkside has conducted a computer problem solving contest for junior and senior high school students. For a period of two hours teams of up to three members each compete on interactive computer systems to solve five programming problems. The results are judged on whether they run properly using the test data supplied in the problem, are easy to read, logical, imaginative, and creative. Within two hours after the contest is over, the three best teams in each division are announced and the prizes awarded.

An Open Invitation

This year we would like to extend an invitation to schools throughout the country and the world to participate in our computer problem solving contest. We will share our 1981 contest problems with school districts, universities, or other organizations that are interested in conducting a similar local computer problem solving contest under the following guidelines.

Guidelines

1. To receive a copy of the 1981 contest problems, the director of a local organization should contact us by April 4th and agree to keep the problems confidential until Saturday, May 2, 1981. This is the date we have set for our contest this year.

2. On or after May 2, 1981, any organizations may use the problems to conduct their own contest. The results will be judged and the winners selected locally.

3. No organization that holds a local contest is required to enter their winner in the national and worldwide contest. However, to be eligible for this competition, the local contest must be held on May 2, 1981 and the set of rules (listed below) followed.

4. A national and worldwide ranking will be determined by a team of judges from the University of Wisconsin-Parkside. The first three places in each division will receive prizes from *Creative Computing* magazine. Winners will be notified by June 1, 1981 and the results will be announced in the August issue of *Creative Computing*.

Contest Rules

1. Category SR: Grades 10-12 (age <= 18)
JR: Grades 7-9 (age <= 15)

2. Team Size: A team consists of one to three members.

3. Computer System: Any interactive computer system may be used, however, each team may use only one input device (keyboard or terminal). Hard copy must be available for listing the programs and displaying the sample runs.

4. Time Limit: Each team will be given five problems to solve in a two hour time limit. In cases where a printer must be shared between two or more teams for the hard copy printout, time can be taken after the two hour limit to make listings and sample runs. This must be done with an official present. No program can be changed after the two hour limit.

5. Grading Procedure: The solutions will be judged as follows.

(a) Does it run properly, using the test data provided in the problem? (12 points)
(b) Is the program well designed and easy to read? (5 points)
(c) Is the program imaginative, creative? (3 points)

No partial credit is given under criteria (a) for a program that does not run.

6. Multiple Sessions: It is often necessary to run more than one session during the contest to accommodate all the teams on a limited amount of hardware. In this case, those responsible for the contest must make sure that each session is run so that no one sees the problems before their turn.

7. General: No outside help is allowed during the contest, including books, programs, or people not on the team. However questions concerning the operation of computers, terminals, or printers may be answered by those conducting the contest. Also, time may be taken before the session begins to familiarize the contestants with the operation of a computer system.

Grading

We have found it helpful to have each team attach the following score sheet to each program they submit. This ensures correct identification of listings and speeds up the grading process.

Team Identification

We require that each team pick a team name for identification purposes. The Devious Debuggers, The Apple Busters, Knights of Ni, and Microbits were examples used last year. Also, each team picks a captain.

Teams enter the contest by filling out the following application form.

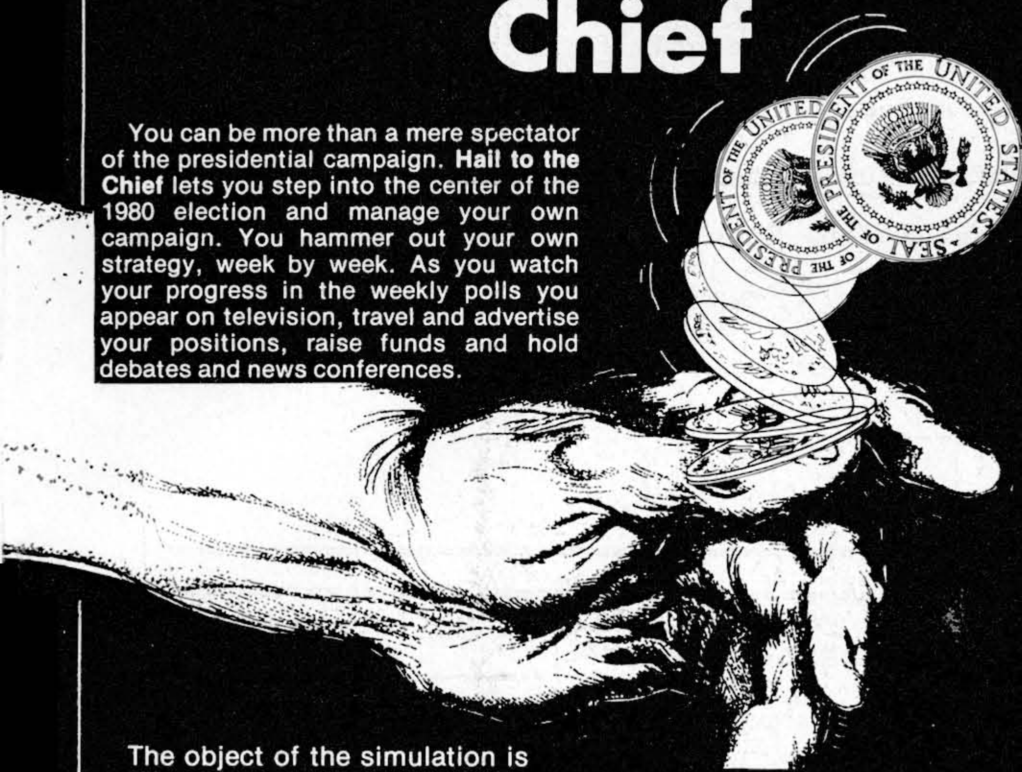
Contest Problems

The problems used in the third computer problem solving contest (1979) appeared in the September 1979 issue of *Creative Computing*. The fourth computer problem solving contest problems (1980) are presented here followed by a complete set of solutions and sample runs.

Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53141.

Hail to the Chief

You can be more than a mere spectator of the presidential campaign. **Hail to the Chief** lets you step into the center of the 1980 election and manage your own campaign. You hammer out your own strategy, week by week. As you watch your progress in the weekly polls you appear on television, travel and advertise your positions, raise funds and hold debates and news conferences.



The object of the simulation is to become president-elect when the final election results are in. Refinements of the simulation such as the influences of incumbency, campaign finance and spending limits are introduced in increasingly complex models. Each model can be played at ten levels of difficulty—a level 10 opponent is tough to beat.

This is a straightfoward simulation, without scenarios of blatent corruption, but temptations to compromise your ideals are still realistic and powerful...

Will you change your positions to capture the financial support of labor of Big Business? Or play down your unpopular positions to capture the votes of a particularly important and sensitive region? As in real life, the presidency can be captured by integrity or guile. Only the candidate knows the price of his, or her, success.

The ten pivotal camgaign issues in **Hail to the Chief** include Energy Policy, Unemployment, Mid-East Policy and Strategic Arms Limitations. Your positions are chosen from a nearly two hundred degree numerical scale which ranges from "Bleeding Heart Liberal" to "Middle-of-the-Road" to "Reactionary". For example, strong conservative and liberal statements on Strategic Arms Limitations are:

Our enemies understand only strength and they have proven that they will not honor any treaty obligation that stands in their path toward world domination.

An uncontrolled arms race is more likely to lead to war then any other policy the U.S. can follow; it is also a waste of our resources and puts too much power in the hands of the military industrial complex.

Hail to the Chief has been used as a teaching aid in Political Science, Computer Science and Voting Behaivior courses at the University level since 1976. Its authors are Associate Professors at the Eastern Kentucky University; Phillip W. Brashaer in Mathematics and Richard G. Vance in Political Science. A comprehensive manual, discussion questions and background materials have been prepared by the authors and accompany the fun and educational package. **Hail to the Chief** is available for the TRS-80 level II on a 32K cassette (CS-3205) and a 48K disk (CS-3701), for the Apple II and Apple II Plus on a 48K disk (CS-4704), for the Atari 400 and 800 on a 32K cassette (CS-7201) and for the Atari 800 on a 40K disk (CS-7701). All are $24.95.

Your local computer store should carry Creative Computing Software. If your favorite retailer does not carry the software you need, have him call in your order to 800-631-8112. Or, you can order directly from Creative Computing. Creative Computing Software, Dep't. AHGG, P.O. Box 789-M, Morristown, NJ 07960. Include $1.00 for postage and handling. For faster service, call in your bank card order toll free to 800-631-8112.

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CIRCLE 300 ON READER SERVICE CARD

SCORE SHEET

Problem Number ___________________________

Team Name ___________________________

==

(For grader's use only)

Correctness ______ (12 points)

Design and Readability ______ (5 points)

Imagination, Creativity______ (3 points)

Total ______

Grader_________________________

==
==

PROGRAMMING CONTEST ENTRY FORM

TEAM NAME ____

SCHOOL NAME____

SCHOOL ADDRESS____

____

ADVISOR'S NAME____

ADVISOR'S PHONE #(___)___-____

DIVISION ___ SR (Senior, grades 10-12, age <= 18)

___ JR (Junior, grades 7-9 , age <= 15)

TEAM MEMBERS

1. (CAPTAIN) ____

2. ____

3. ____

==

JUNIOR DIVISION

JR 1. Extended Fibonacci Sequences

The Fibonacci sequence 1,1,2,3,5,8,13,21,34,55 is given by the rule that the first two numbers are both 1, and each following number is the sum of the previous two numbers. For example, the first 6 terms are

```
1
1
2 = 1+1
3 = 1+2
5 = 2+3
8 = 3+5
```

To generalize this, we define the *3-Fibonacci sequence* such that the first three numbers are 1, and each following number is the sum of the previous *three* numbers. For example, the first 6 terms of the 3-Fibonacci sequence are 1,1,1,3,5,9.

You are to write a program which will print the first n terms of the 3-Fibonacci sequence, where n is given as an input value. Run your program once, with n = 20.

JR 2. Dart Throwing

Assume you are throwing darts at a 5-by-5 square checkerboard. Each throw will hit randomly at any of the 25 possible squares with equal likelihood. After throwing a certain number of darts, you count the total number of squares you hit.

Write a program to simulate this dart game by "throwing" n darts, where n is a given input value. After all n darts have been thrown, tally the results and display the dart board as in the following example:

```
* . . . .
. . * . *
. . . . .
. * * . *
. . . * .


NUMBER OF THROWS = 8
NUMBER OF SQUARES HIT = 7
```

Here a "*" in a position indicates that a square has been hit (at least once), and a "." means the square has not been hit. Run program twice each for the following values of n: 10, 25, 50, 100.

JR 3. Character Replacement

Write a program which will allow 3 inputs:
(A) An input string
(B) A character to be replaced
(C) A character to replace it with

The program should replace each character of the string given in (A) which matches the character given in (B) by the character given in (C). Here is an example of what your output should look like:

```
INPUT STRING  :  THE FAT FOX
REPLACE       :  F
BY            :  B
OUTPUT STRING :  THE BAT BOX
REPLACEMENTS  :  2
```

Run your program with the above example.

JR 4. Crowded Phone Booth

Ten people named A, B, C, D, E, F, G, H, I and J are trying to get into a small phone booth which can hold only two people at a time. There are exactly 45 different ways that they can get two of the 45 into the booth. Write a program to list them. Your output should list the combinations in the form.

```
AB    AC    AD    AE    AF    ...
```

JR 5. Twin Primes

Recall that a positive integer p > 1 is called a *prime* if its only positive factors are 1 and p. If both p and p+2 are prime, the pair p and p+2 is called a *twin prime* pair.

You are to write a program to print all twin prime pairs p and p+2 such that p+2≤n, where n is a given input value, and to print the total number of prime pairs found. For example, with n = 20, your output should look like this:

```
TWIN PRIME PAIRS NOT GREATER THAN 20

 3      5
 5      7
11     13
17     19

THERE ARE 4 SUCH PAIRS
```

Run your program for n = 20, and for n = 100.

SENIOR DIVISION

SR 1. Extended Fibonacci Numbers

The Fibonacci sequence 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 is given by the rule that the first two numbers are both 1, and each following number is the sum of the previous two numbers. For example, the first 6 terms are

```
1
1
2 = 1+1
3 = 1+2
5 = 2+3
8 = 3+5
```

To generalize this, we define an *m-Fibonacci sequence* (where m is an integer > 1) such that the first m numbers are 1, and each following number is the sum of the previous m numbers. For example, the first 6 terms of the 3-Fibonacci sequence are 1, 1, 1, 3, 5, 9.

You are to write a program which will print the first n terms of the m-Fibonacci sequence, where m and n are given input values with m≤n. *Your program should not retain more than the last m numbers displayed.* Run your program 3 times, using the following input values:

m	n
2	10
3	20
10	20

SR 2. Spirals

Write a program which will print a spiral of numbers 1 to n^2 in an n-by-n square display, where n is a given input value, n≤10. For example, for n = 4 the display should look like this:

7	6	5	16
8	1	4	15
9	2	3	14
10	11	12	13

and for n = 5 the display should look like this:

21	20	19	18	17
22	7	6	5	16
23	8	1	4	15
24	9	2	3	14
25	10	11	12	13

(The lines are for reference purposes only. You do not need to print them.)

Run your program twice, once with n = 4 and once with n = 5.

SR 3. Substring Replacement

Write a program which will allow three inputs:
(A) An input string
(B) A substring to be replaced
(C) A substring to replace it with

The program should then replace, from left to right, each substring of the string given in (A) which matches the substring given in (B) by the substring given in (C). If a replacement is made, the string search continues beginning with the character *following* the replaced substring. Here are two examples of what your output should look like:

```
Example 1:

        INPUT STRING    :  HE SHUD FU
        REPLACE         :  U
        BY              :  OUL
        OUTPUT STRING   :  HE SHOULD FOUL
        REPLACEMENTS    :  2

Example 2:

        INPUT STRING    :  FOOOOD
        REPLACE         :  OO
        BY              :  O
        OUTPUT STRING   :  FOOD
        REPLACEMENTS    :  2
```

Run your program with the above examples.

SR 4. Crowded Phone Booth

There are n people (n≤26) whose names are A, B, C, . . . , and a phone booth with capacity m (m≤n). Write a program to list all the possible ways m of these n people can get into the booth. Your output should list the combinations of names in a format similar to the following example with n = 5 and n = 3:

```
ABC  ABD  ABE  ACD  ACE
ADE  BCD  BCE  BDE  CDE

THERE ARE 10 COMBINATIONS
```

Run your program with the following values of m and n:

n	m
5	3
7	4
10	2
20	19

SR 5. Twin Near Primes

A positive integer k > 1 is called a *near prime* if K is not prime but is the product of exactly two (possibly equal) primes. If both k and k+1 are near primes, the pair k and k+1 is called a *near prime pair*. You are to write a program to print all near prime pairs k and k+1 such that k+1≤n, where n is a given input value, and to print the total number of near prime pairs found. For example, with n = 30, your output should look like this:

```
TWIN NEAR PRIME PAIRS NOT GREATER THAN 30.

 9     10
14     15
21     22
25     26

THERE ARE 4 SUCH PAIRS
```

Run your program for n = 30 and n = 100.

Contest Solution

The contest solutions listed below are written in North Star Basic and duplicate the logic used by the winning teams in the 1980 competition. With minor punctuation changes and string conversions, the same programs work in Applesoft Basic. These changes are noted after the listings.

```
10 PRINT "JR 1. EXTENDED FIBONACCI SEQUENCES"
20 PRINT "-----------------------------------"
30 INPUT "ENTER A VALUE FOR N:",N
40 DIM A(N+3)
50 A(1)=1 \ A(2)=1 \ A(3)=1
60 FOR I=1 TO N
70    IF I < 4 THEN 90
80    A(I)=A(I-1)+A(I-2)+A(I-3)
90    PRINT A(I),
100 NEXT I
110 END
READY
RUN

JR 1. EXTENDED FIBONACCI SEQUENCES
-----------------------------------
ENTER A VALUE FOR N:20
1 1 1 3 5 9 17 31 57 105 193 355 653 1201 2209 4063
7473 13745 25281 46499
READY
```

```
10 PRINT "JR 2. DART THROWING"
20 PRINT "-------------------"
30 REM        T = # OF TOSSES
40 REM     B(5,5)= THE DART BOARD
50 DIM     B(5,5)
60 REM    FNR(X) = RANDOM INTEGER BETWEEN 1 AND X
70 DEF    FNR(X) = INT(RND(0)*X) +1
75         X=RND(-1)            \ REM RANDOMIZE
80 INPUT "HOW MANY DARTS DO YOU WANT TO TOSS? ",T
90        PRINT
100       S=0
110 REM *** THROW DARTS ***
120       FOR I=1 TO T
130           B(FNR(5),FNR(5))=1
140       NEXT I
150 REM *** OUTPUT RESULTS ***
160       FOR I=1 TO 5
170         FOR J=1 TO 5
180           IF B(I,J)=0 THEN PRINT ". ",
190           IF B(I,J)=0 THEN 220
200           PRINT "* ",
210           S=S+1
220         NEXT J
230         PRINT
240       NEXT I
250       PRINT
260       PRINT "     NUMBER OF THROWS = ",T
270       PRINT "NUMBER OF SQUARES HIT = ",S
280 END
READY
RUN

JR 2. DART THROWING
-------------------
HOW MANY DARTS DO YOU WANT TO TOSS? 25

* . * * *
* . * * .
* * * . *
* * . * *
* * * * .

     NUMBER OF THROWS =  25
NUMBER OF SQUARES HIT =  19
READY
RUN

JR 2. DART THROWING
-------------------
HOW MANY DARTS DO YOU WANT TO TOSS? 25

* . . * .
. * * . *
* * * * *
. * . * *
* * * * .

     NUMBER OF THROWS =  25
NUMBER OF SQUARES HIT =  17
READY

JR 2. DART THROWING
-------------------
HOW MANY DARTS DO YOU WANT TO TOSS? 50

* * * * *
* * * * *
* * * * *
* . * * *
* * * * *

     NUMBER OF THROWS =  50
NUMBER OF SQUARES HIT =  24
READY
RUN

JR 2. DART THROWING
-------------------
HOW MANY DARTS DO YOU WANT TO TOSS? 50

* * . . *
* * * * *
. * . * *
* * * * *
* * * . *

     NUMBER OF THROWS =  50
NUMBER OF SQUARES HIT =  20
READY
RUN

JR 2. DART THROWING
-------------------
HOW MANY DARTS DO YOU WANT TO TOSS? 100

* * * * *
* * * * *
* * * * *
* * * * *
* * * * *

     NUMBER OF THROWS =  100
NUMBER OF SQUARES HIT =  25
READY
```

```
10 PRINT "JR 3. CHARACTER REPLACEMENT"
20 PRINT "---------------------------"
30       DIM A$(255), D$(255)
40       INPUT "INPUT STRING    :",A$
50         D$=A$
60       INPUT "REPLACE         :",B$
70         IF LEN(B$)=0 THEN 60
80       INPUT "BY              :",C$
90         IF LEN(C$)=0 THEN 80
100      FOR I=1 TO LEN(A$)
110        IF A$(I,I)<>B$(1,1) THEN 140
120           A$(I,I)= C$(1,1)
130           C=C+1
140      NEXT I
150      PRINT "OUTPUT  STRING  :",A$
160      PRINT "REPLACEMENTS    :",C
170 END
READY
RUN

JR 3. CHARACTER REPLACEMENT
---------------------------
INPUT STRING     :THE FAT FOX
REPLACE          :F
BY               :B
OUTPUT  STRING   :THE BAT BOX
REPLACEMENTS     : 2
READY
```

```
10 PRINT "JR 4. CROWDED PHONE BOOTH"
20 PRINT "-------------------------"
30 A$="ABCDEFGHIJ"
40 FOR I= 1 TO 9
50   FOR J=I+1 TO 10
60     PRINT TAB(C*4),A$(I,I),A$(J,J),
70     C=C+1
80     IF C<11 THEN 100
90     PRINT \ C=0
100  NEXT J
110 NEXT I
120 END
READY
RUN

JR 4. CROWDED PHONE BOOTH
-------------------------
AB  AC  AD  AE  AF  AG  AH  AI  AJ  BC  BD
BE  BF  BG  BH  BI  BJ  CD  CE  CF  CG  CH
CI  CJ  DE  DF  DG  DH  DI  DJ  EF  EG  EH
EI  EJ  FG  FH  FI  FJ  GH  GI  GJ  HI  HJ
IJ
READY
```

```
10 PRINT "JR 5. TWIN PRIMES"
20 PRINT "-----------------"
30 INPUT "N = ",N
40 T=0
50 PRINT "TWIN PRIME PAIRS NOT GREATER THAN ",N
60 PRINT
70   FOR I=3 TO N-2 STEP 2
80     FOR J=3 TO SQRT(I+2) STEP 2
90         IF I/J =INT(I/J) THEN EXIT 140
100        IF (I+2)/J = INT((I+2)/J) THEN EXIT 140
110      NEXT J
120   T=T+1
130 PRINT I,TAB(10),I+2
140 NEXT I
150 PRINT
160 PRINT "THERE ARE",T," SUCH PAIRS."
170 END
READY
RUN

JR 5. TWIN PRIMES
-----------------
N = 20
TWIN PRIME PAIRS NOT GREATER THAN  20
 3          5
 5          7
 11         13
 17         19

THERE ARE 4 SUCH PAIRS.
READY
RUN

JR 5. TWIN PRIMES
-----------------
N = 100
TWIN PRIME PAIRS NOT GREATER THAN  100
 3          5
 5          7
 11         13
 17         19
 29         31
 41         43
 59         61
 71         73
THERE ARE 8 SUCH PAIRS.
READY
```

```
10 PRINT "SR 1. EXTENDED FIBONACCI NUMBERS"
20 PRINT "--------------------------------"
30 INPUT "ENTER THE NUMBER OF TERMS  N = ",N
40 INPUT "ENTER A VALUE FOR THE 'M'    = ",M
50 DIM F(M)
60   FOR I=1 TO M
70     F(I)=1
80   NEXT I
90  FOR I=1 TO N
100    S=0
110      FOR J=1 TO M
120        S = S + F(J)
130        F(J-1)=F(J)
140      NEXT J
150    F(M)=S
160    PRINT F(0),
170  NEXT I
180 END
READY
RUN

SR 1. EXTENDED FIBONACCI NUMBERS
--------------------------------
ENTER THE NUMBER OF TERMS  N = 10
ENTER A VALUE FOR THE 'M'    = 2
 1 1 2 3 5 8 13 21 34 55
READY
RUN

SR 1. EXTENDED FIBONACCI NUMBERS
--------------------------------
ENTER THE NUMBER OF TERMS  N = 20
ENTER A VALUE FOR THE 'M'    = 3
1 1 1 3 5 9 17 31 57 105 193 355 653 1201 2209 4063
7473 13745 25281 46499
READY
RUN

SR 1. EXTENDED FIBONACCI NUMBERS
--------------------------------
ENTER THE NUMBER OF TERMS  N = 20
ENTER A VALUE FOR THE 'M'    = 10
1 1 1 1 1 1 1 1 1 1 10 19 37 73 145 289 577 1153 2305 4609
READY
```

Solve It, continued...

```
10 PRINT "SR 2. SPIRALS"
20 PRINT "-------------"
30 INPUT "WIDTH OF SQUARE :",N
40 N=INT(N)
50 DIM M(N,N)
60 Y = INT(N/2 +.5)
70 X = Y                    \ REM START AT X,Y
80 C=1 \ D=0
90  FOR S=1 TO N
100   IF INT(S/2)=S/2 THEN 120
110   RESTORE
120   FOR A = 1 TO 2
130     E=D
140     READ D
150     FOR T = 1 TO S
160       M(Y,X) = C
170       IF C=N^2 THEN 240
180       C=C+1
190       Y=Y+D
200       X=X+E
210     NEXT T
220   NEXT A
230 NEXT S
240 REM *** PRINT OUT ***
250 FOR I = 1 TO N
260   FOR J = 1 TO N
270     PRINT TAB(J*5),M(I,J),
280   NEXT J
290   PRINT \ PRINT
300 NEXT I
310 DATA 1,0,-1,0
320 END
READY
RUN

SR 2. SPIRALS
-------------
WIDTH OF SQUARE :4
      7    6    5    16

      8    1    4    15

      9    2    3    14

      10   11   12   13

READY
RUN

SR 2. SPIRALS
-------------
WIDTH OF SQUARE :5
      21   20   19   18   17

      22   7    6    5    16

      23   8    1    4    15

      24   9    2    3    14

      25   10   11   12   13
```

```
10 PRINT "SR 3. SUBSTRING REPLACEMENT"
20 PRINT "---------------------------"
30 DIM A$(200),B$(100),C$(100),D$(200)
40 INPUT "INPUT STRING     :",A$
50 INPUT "REPLACE          :",B$
60 INPUT "BY               :",C$
70 REM     R = NUMBER OF REPLACEMENTS
80 A=1
90 REM *** SEARCH FOR SUBSTRING POSITION ***
100 B=0
110 FOR I=A TO LEN(A$)-LEN(B$) + 1
120   IF A$(I,LEN(B$)+I-1)= B$ THEN B = I
130   IF A$(I,LEN(B$)+I-1) = B$ THEN EXIT 150
140 NEXT I
150 IF A>B THEN 250
160 REM *** MAKE REPLACEMENT ***
170   D$=A$
180   R=R+1
190   C=B+LEN(C$)
200 IF B + LEN(B$)<=LEN(D$) THEN 220
210   A$=D$(1,B-1)+C$ \ GOTO 250
220   A$=D$(1,B-1)+C$+D$(B+LEN(B$))
230   A=C
240   GOTO 90
250 PRINT "OUTPUT STRING    :",A$
260 PRINT "REPLACEMENTS     :",R
270 END
READY
RUN
```

```
SR 3. SUBSTRING REPLACEMENT
---------------------------
INPUT STRING     :HE SHUD FU
REPLACE          :U
BY               :OUL
OUTPUT STRING    :HE SHOULD FOUL
REPLACEMENTS     : 2
READY
RUN
```

```
SR 3. SUBSTRING REPLACEMENT
---------------------------
INPUT STRING     :FOOOOD
REPLACE          :OO
BY               :O
OUTPUT STRING    :FOOD
REPLACEMENTS     : 2
READY
```

```
10 PRINT "SR 4. CROWDED PHONE BOOTH"
20 PRINT "-------------------------"
30 DIM X(26), A$(26)
40 X(0)=64
50 INPUT "INPUT N,M ",N,M
60 IF N<M OR N>26 OR N>INT(N) OR M<1 THEN 50
65 L = INT(70/(M+2))
70    A=A+1
80    X(A)=X(A-1)
90    X(A)=X(A)+1
100 IF A < M THEN 70
110    C=C+1
120    FOR B=1 TO M
130      A$(B)=CHR$(X(B))
140    NEXT B
150 PRINT A$(1,M),"  ",
155 IF C/L=INT(C/L) THEN PRINT
160 IF X(A)<A+N-M+64 THEN 90
170    A=A-1
180 IF A>0 THEN 160
190 PRINT
200 PRINT "THERE ARE",C," COMBINATIONS."
210 END
READY
RUN

SR 4. CROWDED PHONE BOOTH
-------------------------
INPUT N,M 5,3
ABC  ABD  ABE  ACD  ACE  ADE  BCD  BCE  BDE  CDE
THERE ARE 10 COMBINATIONS.
READY
RUN

SR 4. CROWDED PHONE BOOTH
-------------------------
INPUT N,M 7,4
ABCD  ABCE  ABCF  ABCG  ABDE  ABDF  ABDG  ABEF  ABEG  ABFG  ACDE
ACDF  ACDG  ACEF  ACEG  ACFG  ADEF  ADEG  ADFG  AEFG  BCDE  BCDF
BCDG  BCEF  BCEG  BCFG  BDEF  BDEG  BDFG  BEFG  CDEF  CDEG  CDFG
CEFG  DEFG
THERE ARE 35 COMBINATIONS.
READY
RUN

SR 4. CROWDED PHONE BOOTH
-------------------------
INPUT N,M 10,2
AB  AC  AD  AE  AF  AG  AH  AI  AJ  BC  BD  BE  BF  BG  BH  BI  BJ
CD  CE  CF  CG  CH  CI  CJ  DE  DF  DG  DH  DI  DJ  EF  EG  EH  EI
EJ  FG  FH  FI  FJ  GH  GI  GJ  HI  HJ  IJ
THERE ARE 45 COMBINATIONS.
READY
RUN

SR 4. CROWDED PHONE BOOTH
-------------------------
INPUT N,M 20,19
ABCDEFGHIJKLMNOPQRS  ABCDEFGHIJKLMNOPQRT  ABCDEFGHIJKLMNOPQST
ABCDEFGHIJKLMNOPRST  ABCDEFGHIJKLMNOQRST  ABCDEFGHIJKLMNPQRST
ABCDEFGHIJKLMOPQRST  ABCDEFGHIJKLNOPQRST  ABCDEFGHIJKMNOPQRST
ABCDEFGHIJLMNOPQRST  ABCDEFGHIKLMNOPQRST  ABCDEFGHJKLMNOPQRST
ABCDEFGIJKLMNOPQRST  ABCDEFHIJKLMNOPQRST  ABCDEGHIJKLMNOPQRST
ABCDFGHIJKLMNOPQRST  ABCEFGHIJKLMNOPQRST  ABDEFGHIJKLMNOPQRST
ACDEFGHIJKLMNOPQRST  BCDEFGHIJKLMNOPQRST
THERE ARE 20 COMBINATIONS.
READY
```

```
10 PRINT "SR 5. TWIN NEAR PRIMES"
20 PRINT "----------------------"
30 DIM X(100)
40 INPUT "TWIN NEAR PRIME PAIRS NOT GREATER THAN ",N
50 FOR K= 2 TO N
60    FOR B= 2 TO SQRT(K)
70      IF INT(K/B)*B < K OR K=B*B*B THEN 90
```

```
80        X(K)=X(K)+1
90     NEXT B
100       IF X(K)<>1 OR X(K-1)<>1 THEN 130
110       PRINT K-1,"   ",K
120       C=C+1
130 NEXT K
140 PRINT "THERE ARE",C," SUCH PAIRS."
150 END
READY
RUN

SR 5. TWIN NEAR PRIMES
------------------------
TWIN NEAR PRIME PAIRS NOT GREATER THAN 30
 9    10
 14   15
 21   22
 25   26
THERE ARE 4 SUCH PAIRS.
READY
RUN

SR 5. TWIN NEAR PRIMES
------------------------
TWIN NEAR PRIME PAIRS NOT GREATER THAN 100
 9    10
 14   15
 21   22
 25   26
 33   34
 34   35
 38   39
 57   58
 85   86
 86   87
 93   94
 94   95
THERE ARE 12 SUCH PAIRS.
READY
```

Applesoft Version

A minor difference between North Star and Applesoft Basic is the way each uses punctuation after PRINT and INPUT statements. North Star uses a comma (,) while Applesoft uses a semi-colon (;). For example, the following are equivalent in the two Basics.

```
      North Star                     Applesoft

10 INPUT "NAME ",A$             10 INPUT "NAME ";A$

20 PRINT "NAME = ",A$           20 PRINT "NAME = ";A$
```

(In North Star Basic either the comma (,) or the semi-colon (;) can be used since they are equivalent, but the comma appears in the listing.)

This difference between North Star and Applesoft Basic will be called 'punctuation' and line numbers where it occurs will only be listed. All other changes will be made explicit.

```
Program            Changes

 JR1    Punctuation in line 30

 JR2    Punctuation in lines 80,180,200,260,270

        Use RND(1) instead of RND(0) in line 70.

        Delete 75

 JR3    Punctuation in lines 40,60,80,150,160.

        110 IF MID$(A$,I,1) <> LEFT$(B$,1) THEN 140

        120 A$=LEFT$(A$,I-1)+RIGHT$(C$,1)+MID$(A$,I+1)

 JR4    60 PRINT TAB(C*4+1);MID$(A$,I,1);MID$(A$,J,1);

        80 IF C < 10 THEN 100

 JR5    Punctuation in lines 30,50,130,160

        Change SQRT in line 80 to SQR.

        90 IF I/J = INT(I/J) THEN 140
```

Program	Changes
SR1	Punctuation in lines 30,40
	160 PRINT F(0);" ";
	165 IF POS(0)>35 THEN PRINT
SR2	Punctuation in line 270
	Use : instead of \ in lines 70,80
	170 IF C=INT(N↑2) THEN 240
SR3	Punctuation in lines 40,50,60,250,260
	120 IF MID$(A$,I,LEN(B$))=B$ THEN B=I
	130 IF MID$(A$,I,LEN(B$))=B$ THEN 150
	210 A$=LEFT$(D$,B-1)+C$: GOTO 250
	220 A$=LEFT$(D$,B-1)+C$+MID$(D$,B+LEN(B$))
SR4	Punctuation in lines 50,150,200
	115 A$=""
	130 A$=A$+CHR$(X(B))
SR5	Punctuation in lines 40,110,140
	Change SQRT in line 60 to SQR.

1980 Contest Results

In the senior division, the 1980 winners were The Knights of Ni (Dave Rosen, Eric Romesberg, and Ron Stolberg) from Prospect High School in Prospect, IL. They turned in a perfect performance — 100 points. Second place went to the Macrobytes (John Eng, Dale Smith, and Gary Steven) of Nathan Hale High School in Milwaukee, WI. Their total was 59 points. Third place was won by the Hawks (Stan Kantor, Mike Bors, and Kent Baumeister) of Main South High School, Park Ridge, IL with 37 points. Twenty teams entered the senior division contest and the average score was 27.

In the junior division, the Tutancompuns (David Nice and Robert Goll) from Lance Jr. High in Kenosha, WI took first place. They scored 96 points. Second place was awarded to the Apple Busters (Steve Scott and Dave Pagenkopf) from Wausau West Jr. High in Wausau, WI — total points 80. Third place went to the Z-80 Zappers (Arthur Claus, David Levine, and Jerry Monkman) from A.E. Stevenson High School in Prairie View, IL who scored 77 points. A total of 12 teams entered the junior division and the average score was 53 points.

Acknowledgement

I would like to pay special tribute to Tim Fossum, Associate Professor of Allied Computer Science, who has done an outstanding job as director of all of our programming contests over the past four years. He has been involved in all aspects of the contest, from thinking up problems to directing the contest and judging the results and has contributed greatly to its success.

A special thanks also goes to David Nice who wrote the Applesoft conversions listed above. □

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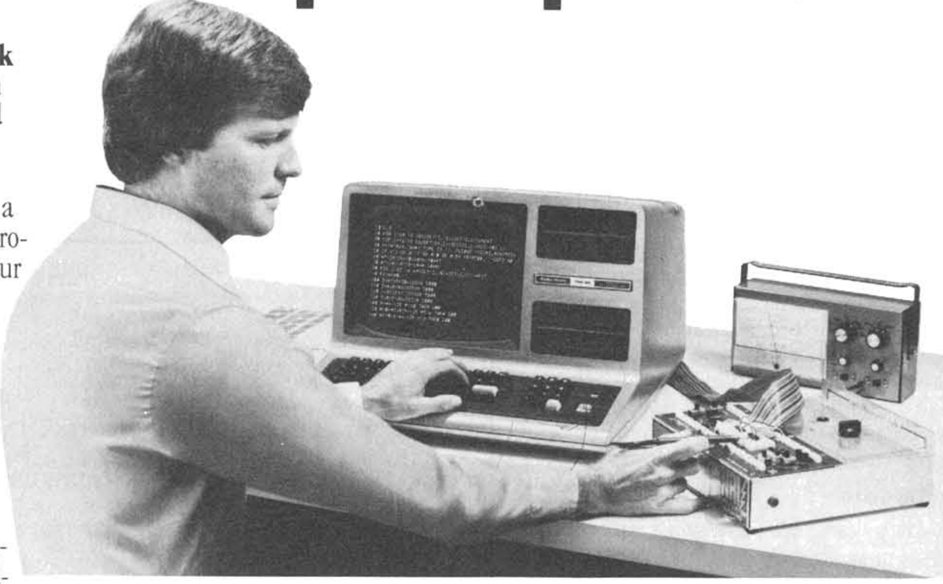

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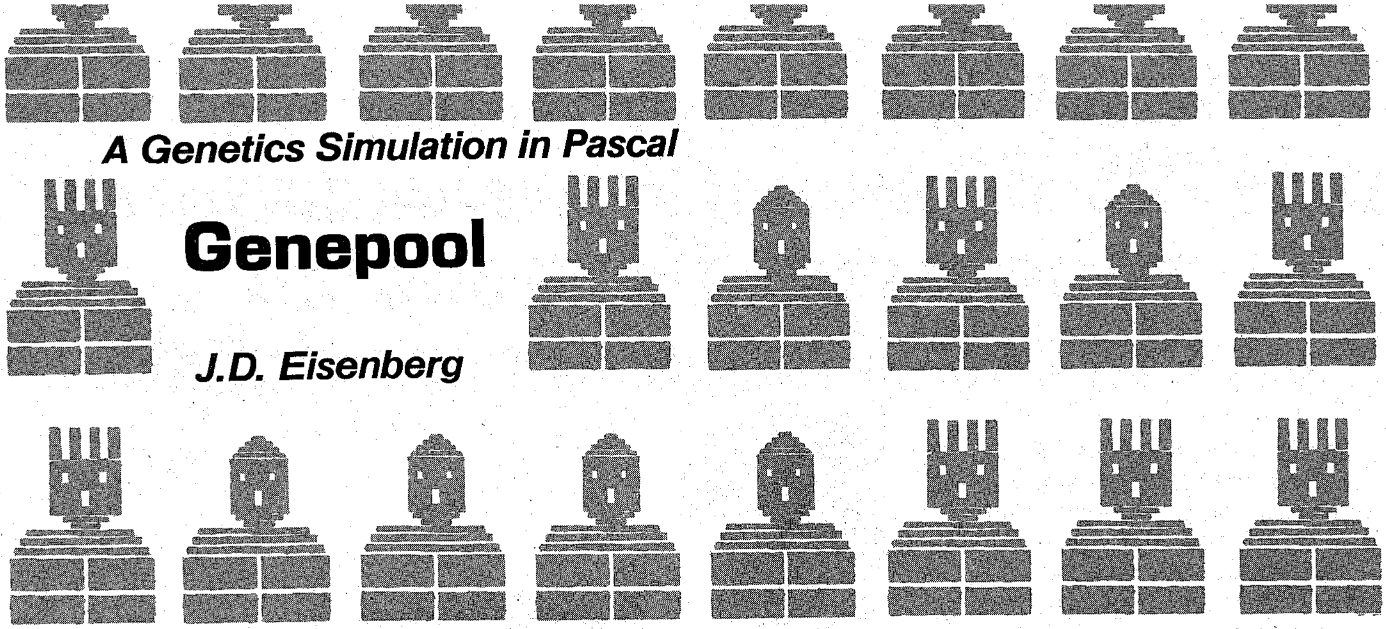
A Genetics Simulation in Pascal

Genepool

J.D. Eisenberg



It all started with Gregor Mendel, who discovered the rules of genetics from his experiments breeding peas. Biology students have, for years, bred fruit flies in the laboratory to see these rules in action. Now, the *Genepool* program allows you to simulate this kind of experiment in the comfort of your own home on an Apple II.

Background

You can use *Genepool* effectively if you have studied some of basic genetic theory:

Humans have *traits* (such as eye color, hair color, etc.) which are passed to their offspring by the *genes* carried in their cells.

Figure 1.

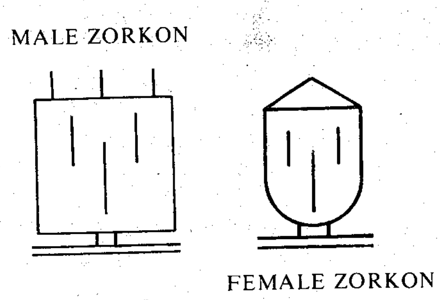
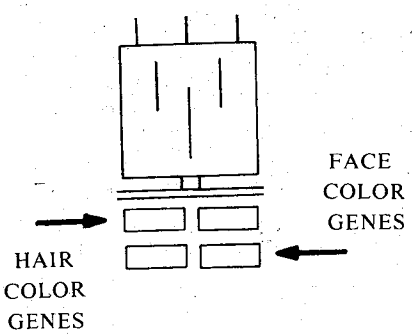


Figure 2.



J.D. Eisenberg, 1630 Ottawa Ct., Apt. K, Sunnyvale, CA 94087.

TABLE I

IF YOU CARRY THESE GENES:		YOUR EYE COLOR WILL BE:
BROWN (DOMINANT)	BROWN (DOMINANT)	BROWN (DOMINANT)
BROWN (DOMINANT)	BLUE (RECESSIVE)	BROWN (DOMINANT)
BLUE (RECESSIVE)	BLUE (RECESSIVE)	BLUE (RECESSIVE)

Eye color, as an example, is determined by genes which are "tagged" for brown eyes or blue eyes. The combination of genes that you received, one from each parent (as detailed in Table 1) determines what eye color you have.

In this example, the brown eye color gene is *dominant* over the blue eye color gene; if either gene is for brown eyes, you will have brown eyes. The blue eye gene is called *recessive;* you must have both your eye color genes "tagged" for blue to have blue eyes.

A combination of both dominant genes for a trait is called *homozygous dominant* (see Glossary). A combination of both recessive genes for a trait is called *homozygous recessive*. Finally, the combination of one dominant and one recessive gene for a trait is called *heterozygous dominant.*

Using the Program

The *Genepool* program allows you to see the results of combining genetic types. When you first run the program, you will see pictures of mythical creatures called Zorkons. They may have either green or white hair, and orange or blue faces. The gene for orange faces is dominant over the gene for blue faces, and the gene for green hair is dominant over the gene for white hair.

You can tell the males from the females easily; the males have square faces and straight hair; the females have rounder faces and flat, piled-up hair, as in Figure 1.

Beneath each Zorkon are two rows of boxes, as in Figure 2. The top row shows the hair color genes that the Zorkon carries; the bottom row shows its face color genes.

The Zorkons at the top of the screen are the current genetic types. Beneath them are twenty-four of their possible offspring, created by randomly selecting one gene from each parent for each trait.

At the very start of the program, you may either press the question mark (?) key for a brief explanation of the theory of the program, or you may press the spacebar to start experimenting.

When experimenting, the program will ask you to choose one male genetic type, and one female genetic type.

If your Apple has game paddles, you use paddle zero to move a cursor to the genetic type you wish to choose, and push the button on paddle zero to make the selection.

If you do not have game paddles, you are prompted to use the backward and forward arrow keys to move the cursor, and press the spacebar to make your selection. Once you have selected the male and female genetic types, you will see them at the top of the screen, and twenty-four of their potential offspring on the screen.

You may, at any time, press any of these keys:

RETURN to start the program over
ESC to exit from the program
S to see statistics

The statistics summarize how many of each genetic combination (homozygous dominant, etc.) there are in the current batch of twenty-four offspring.

Questions to Answer

Try using the program to answer these questions:

1. Is it possible to select genetic types so that you get only one kind of hair color or face color?

2. How many times do you have to choose (given luck of the draw) to get a screenful of Zorkons with only blue faces and green hair? (Once you get this combination, you can press RETURN to start all over again.)

3. Is there a way to assure that all the offspring in a batch will be heterozygous dominant for hair color?

In short, experiment and see what you can find out about genetics from this program. Remember, this program is a simplified simulation, and not a real genetics experiment. If you have interest in finding out more about genetics, consult your local library.

Inside the Program

Here is a brief description of the data structures and procedures inside the program, listed as Program A.

The major data structures that make the program work are in the TYPE definitions. The SEXTYPE, GENETYPE, and CHARACTERISTIC types are meant primarily to make the program easier to read by using symbolic names rather than numbers. To specify an offspring completely within the program, it is necessary to know its sex, what two genes it carries for each trait, and which gene (dominant or recessive) is outwardly visible for each trait. In many other languages, including Basic, it might be necessary to keep these pieces of information in separate variables. Pascal, however, allows you to put all this information in separate variables. Pascal, however, allows you to put all this information together in a single "packet," or RECORD. ZYGOTE is exactly such a record. This allows the program to create an array of twenty-four such "packets" of information (one for each of the displayed offspring) in THEKIDS.

STATS is also an array consisting of a RECORD of three integers that is used to keep statistics on the offspring's genetic types.

COLOURS is an array that tells which colors to display for each trait's dominant and recessive genes.

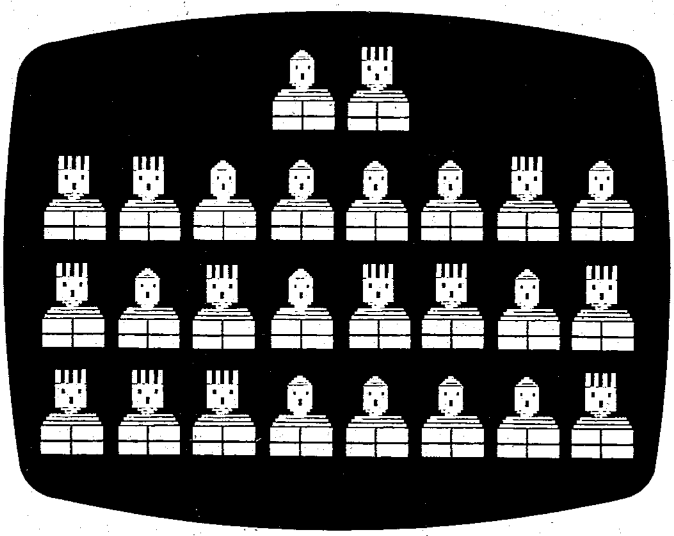
Here are the procedures and functions used by the *Genepool* program, in order of their appearance:

PROCEDURE SKIPTO (X,Y:INTEGER);
Moves to the specified X,Y screen coordinate; meant mostly as a convenience to avoid typing.

PROCEDURE DRAWFACE (PERSON:ZYGOTE;ATROW, ATCO:INTEGER);
Takes the information about the PERSON and draws its face and hair at the specified "row" and "column" of faces (ATROW,ATCOL) where each "row" holds eight faces.

PROCEDURE DRAWGENES (PERSON:ZYGOTE;ATROW, ATCOL:INTEGER);
Takes information in PERSON and plots the boxes beneath the face. ATROW and ATCOL are as in DRAWFACE.

PROCEDURE DRAWME (PERSON:ZYGOTE;ATROW, ATCOL:INTEGER);
Draws all the information about the PERSON by doing DRAWFACE followed by DRAWGENES. Note: the two procedures are separate because, in the help section, it is necessary to draw the faces independent of the gene boxes.



PROCEDURE AT (COL,ROW:INTEGER);
Moves to text row ROW, column COL on the hi-res page, in preparation for writing text via WCHAR or WSTRING.

PROCEDURE ERSLINE (ROW:INTEGER);
Erases the given ROW on the hi-res screen.

PROCEDURE PSPACEBAR;
Gives prompt to press the spacebar to continue, then waits for either spacebar or the ESCAPE key.

PROCEDURE GENERATION;
This procedure draws the parent genetic types at the top of the screen, then generates a new set of twenty-four offspring. Offspring are generated by randomly choosing one gene for each trait from each parent. Statistics about the offspring are tabulated during this process. The offspring's sex is chosen at random but for two children, one of whom will be male and the other of whom will be female. This assures that you will have at least one female and one male genetic type.

PROCEDURE STATISTICS;
Produces a summary of the traits possessed by the current generation of Zorkons.

PROCEDURE SHOWZYGOTE (WHO:ZYGOTE;WHAT: CHARACTERISTIC);
Takes a zygote (WHO) and tells whether it is homozygous or heterozygous, dominant or recessive for hair or face color characteristic (WHAT). Used in STATISTICS to summarize Mom & Dad's traits.

PROCEDURE LEGEND;
Puts up pictures of Mom and Dad Zorkon, with appropriate labels. Used within the help pages.

PROCEDURE EXPLAIN;
First of the help pages.

PROCEDURE SETCOLOURS (DOMFACE,RECFACE,DOMHAIR, RECHAIR:SCREENCOLOR);
Sets the DOMinant FACE, RECessive FACE, DOMinant HAIR, and RECessive hair colors. (This procedure lets EXPLAIN show a face and no hair by setting hair color to black, for example.)

PROCEDURE EXPLAIN2;
PROCEDURE EXPLAIN3;
PROCEDURE EXPLAIN4;
The remainder of the help pages.

PROCEDURE SPLASHPAGE;
Main title page; the help pages are called from here.

PROCEDURE INITPARENTS;
Sets up the gene patterns of the parents.

```
(*$S+*)
PROGRAM GENEPOOL;
(*$C Copyright 1980 JDEisenberg *)

USES TURTLEGRAPHICS,APPLESTUFF;

CONST
   GENE0=0;       GENE1=1;
   WIDTH=35;      HEIGHT=32;   (* AREA OF A FACE *)
   X0=0;          Y0=148;      (* BASE X,Y FOR FACES *)
   BEL=7;                      (* ASCII BELL CODE *)
   ESC = 27;                   (* CODE FOR ESCAPE KEY *)

TYPE
   SEXTYPE=(MALE,FEMALE);
   GENETYPE=(DOMINANT,RECESSIVE);
   CHARACTERISTIC=(FACE,HAIR);
   ZYGOTE=
      RECORD
        SEX:SEXTYPE;
        (* EACH TRAIT HAS TWO GENES *)
        TRAITS:ARRAY[FACE..HAIR,0..1] OF GENETYPE;
        SHOWSUP:ARRAY[FACE..HAIR] OF GENETYPE;
      END;

VAR
   DRAWCOLOR:SCREENCOLOR;
   COLOURS:
      ARRAY[FACE..HAIR,DOMINANT..RECESSIVE] OF SCREENCOLOR;
   KEY:CHAR;
   MOM,DAD:ZYGOTE;
   THEKIDS:ARRAY[0..23] OF ZYGOTE;
   STATS: ARRAY[FACE..HAIR] OF RECORD
              NHOMDOM,    (* NUMBER HOMOZYGOUS DOMINANT *)
              NHETDOM,    (* NUMBER HETEROZYGOUS DOMINANT *)
              NHOMREC:    (* NUMBER HETEROZYGOUS RECESSIVE *)
                 INTEGER;
            END;
   RESTART,
   NOPADDLES:BOOLEAN;
   NKIDS,          (* SIZE OF THEKIDS ARRAY *)
   NMALE,          (* HOW MANY MALES *)
   NFEMALE,        (* HOW MANY FEMALE *)
   ROWSIZE,        (* # TO DISPLAY PER ROW *)
   COLOFFSET:      (* IN ORDER TO CENTRE FACES *)
      INTEGER;

PROCEDURE SKIPTO(X,Y:INTEGER);
BEGIN
  PENCOLOR(NONE); MOVETO(X,Y); PENCOLOR(DRAWCOLOR)
END;

PROCEDURE DRAWFACE(PERSON:ZYGOTE;ATROW,ATCOL:INTEGER);
VAR

   GENE:INTEGER;
   TRAIT:CHARACTERISTIC;
   XBASE,YBASE:INTEGER;       (* WHERE X,Y LEFT CORNER IS NOW *)
   INX,                       (* WHICH FILLER LINE TO DRAW *)
   DRAWLEN:INTEGER;           (* HOW LONG TO DRAW THE LINE *)
BEGIN
   (* DRAW THE FACE FIRST *)
   XBASE:=X0+ATCOL*WIDTH+5;
   YBASE:=Y0-(ATROW*HEIGHT)+22;
   DRAWCOLOR:=COLOURS[FACE,PERSON.SHOWSUP[FACE]];
   FOR INX:=0 TO 5 DO BEGIN
      SKIPTO(XBASE,YBASE-INX);
      MOVE(13)
   END;
   DRAWLEN:=13;
   FOR INX:=6 TO 9 DO BEGIN
      SKIPTO(XBASE+(13-DRAWLEN),YBASE-INX);
      MOVETO(XBASE+DRAWLEN,YBASE-INX);
      IF PERSON.SEX=FEMALE THEN DRAWLEN:=DRAWLEN-1
   END;
   (* SHOULDERS *)
   DRAWCOLOR:=VIOLET;
   IF PERSON.SEX=MALE THEN DRAWLEN:=24 ELSE DRAWLEN:=22;
   XBASE:=X0+ATCOL*WIDTH;
   SKIPTO(XBASE+10,YBASE-10); MOVE(5);
   FOR INX:=11 TO 12 DO BEGIN
      SKIPTO(XBASE+(24-DRAWLEN),YBASE-INX);
      MOVETO(XBASE+DRAWLEN,YBASE-INX);
      IF PERSON.SEX=FEMALE THEN DRAWLEN:=DRAWLEN+2
   END;
   (* NOW DRAW THE HAIR *)
   DRAWCOLOR:=COLOURS[HAIR,PERSON.SHOWSUP[HAIR]];
   XBASE:=X0+ATCOL*WIDTH+6; YBASE:=Y0-(ATROW*HEIGHT)+23;
   INX:=0;
   WHILE INX < 13 DO BEGIN
      SKIPTO(XBASE+INX,YBASE);
      IF PERSON.SEX=FEMALE THEN MOVETO(XBASE+6,YBASE+3)
      ELSE MOVETO(XBASE+INX,YBASE+3);
      INX:=INX+4
   END;
   (* NOW DRAW EYES/NOSE/MOUTH *)
   DRAWCOLOR:=BLACK2;
   SKIPTO(XBASE+3,YBASE-3); MOVETO(XBASE+3,YBASE-3);
   SKIPTO(XBASE+8,YBASE-3); MOVETO(XBASE+8,YBASE-3);
   SKIPTO(XBASE+6,YBASE-7); MOVETO(XBASE+6,YBASE-9);
END;

PROCEDURE DRAWGENES(PERSON:ZYGOTE;ATROW,ATCOL:INTEGER);
VAR
   GENE:INTEGER;
   TRAIT:CHARACTERISTIC;
   XBASE,YBASE:INTEGER;     (* WHERE X,Y LEFT CORNER IS NOW *)
   INX:INTEGER;             (* WHICH FILLER LINE TO DRAW *)
BEGIN


   (* COLOUR IN THE GENE SQUARES *)
   FOR TRAIT:=FACE TO HAIR DO BEGIN
      YBASE:=Y0-(ATROW*HEIGHT)+ORD(TRAIT)*5;
      XBASE:=X0+ATCOL*WIDTH;
      FOR GENE:=GENE0 TO GENE1 DO BEGIN
         DRAWCOLOR:=COLOURS[TRAIT,PERSON.TRAITS[TRAIT,GENE]];
         FOR INX:=0 TO 3 DO BEGIN
            SKIPTO(XBASE,YBASE+INX);
            MOVE(9)
         END;
         XBASE:=XBASE+14
      END (* FOR GENE *)
   END (* FOR TRAIT *)
END;

PROCEDURE DRAWME(PERSON:ZYGOTE;ATROW,ATCOL:INTEGER);
BEGIN
   DRAWFACE(PERSON,ATROW,ATCOL);
   DRAWGENES(PERSON,ATROW,ATCOL)
END;

PROCEDURE AT(COL,ROW:INTEGER);
BEGIN
   PENCOLOR(NONE);
   MOVETO(COL*7,184-ROW*8)
END;

PROCEDURE ERSLINE(ROW:INTEGER);
BEGIN
   AT(0,ROW);
   WSTRING('
END;

PROCEDURE PSPACEBAR;
BEGIN
   AT(3,23);
   WSTRING('Press spacebar to continue
   REPEAT
      READ(KEYBOARD,KEY)
   UNTIL (KEY=' ') OR (KEY=CHR(ESC));
   ERSLINE(23)
END;

PROCEDURE GENERATION;
VAR
   INX:INTEGER;
   ASEX:SEXTYPE;
   TRAIT:CHARACTERISTIC;



BEGIN
   (* DRAW THE PARENTS *)
   FILLSCREEN(BLACK);
   DRAWME(MOM,0,3); DRAWME(DAD,0,4);
   (* GENERATE THE  KIDS *)


  INX:=0;
  NKIDS:=23;
  NMALE:=1;     NFEMALE:=1; (* GUARANTEE ONE OF EACH *)
  FOR TRAIT:=FACE TO HAIR DO BEGIN
     STATS[TRAIT].NHOMDOM:=0;
     STATS[TRAIT].NHOMREC:=0;
     STATS[TRAIT].NHETDOM:=0;
  END;
  ROWSIZE:=8;
  COLOFFSET:=0;
  FOR INX:=0 TO 23 DO BEGIN
     WITH THEKIDS[INX] DO BEGIN
        IF INX=1 THEN SEX:=MALE
        ELSE IF INX=2 THEN SEX:=FEMALE
        ELSE IF (RANDOM MOD 2)=0 THEN BEGIN
           SEX:=MALE; NMALE:=NMALE + 1
        END ELSE BEGIN
           SEX:=FEMALE; NFEMALE:=NFEMALE+1
        END;
```

ANNOUNCING

GET THE BEST

The Data Factory is the best data base management system on the market today and the new version is even better! Its capabilities, ease in starting the system, and back up support make it THE FINEST AVAILABLE AT ANY PRICE.

The Data Factory will SOLVE YOUR PROBLEMS. Thousands of people have chosen this system since we introduced it nationally last June. Major corporations have used The Data Factory to handle jobs that they did not want to put on their large computers, or that would be too time consuming or costly to program. Small businesses have used The Data Factory to control their accounts receivable and accounts payable. Their mailing lists and sales records were easily maintained with the system. Churches, Hospitals and Schools have kept their financial, inventory, and individuals records up to date. At home, lists of hobbies and collections, bank statement reconciliations, and appointment/renewal calendars kept our user's lives organized! At work or at home, The Data Factory solves problems.

WE ADDED YOUR IDEAS

THE NEXT VERSION OF THE DATA FACTORY IS READY. This new version, 4.0 (on 3.3 DOS), has over 40 new or expanded features that were not in the 3.0 edition. The features that we have chosen to include are those that make your work easier and expand the usefulness of the system. When dealers called us with suggestions we listened. When users wrote to us asking for new features we considered them all. We have been responsive to your needs and have given you a better and more valuable investment.

We have added two new menu Routines, UPDATE and TRANSFER. Using UPDATE you can select which fields from your entire record that you want to enter your data into — then save that format. With TRANSFER you may select records in a variety of ways, then move them to another data base. Other new features include a 20 level sort, an easier data entry review, a back-up and a repeat information entry key. Also, the new more powerful Replace routine allows you to change up to 10,000 fields of data at one time. You can use the 4.0 version to set up an Inventory Control System. Each day you would use Replace to enter your shipments or usage. With this new Replace feature, you can add to or subtract from your inventory automatically. Column totals and subtotals with right justification are now standard on the 4.0 Data Factory. There are many more labor saving devices that this system will provide for you.

We found that while adding more power and features to the Data Factory, it became larger than some people needed as a beginning system. We decided that there should be a way to introduce a user to the system on a more limited basis.

THE MINI FACTORY IS HERE

The Mini Factory is the EASIEST WAY TO LEARN the Data Factory System. The Mini Factory has the major routines of the original program. You can still add or delete fields after your information has been entered, do the same 20 level search (locates records by matching up to 20 different categories or entries within), and find records that are from one date to another date. You may also choose to seach for items by entering only a few characters within the record, replace information in your records with a constant, and do much of what was available in the 3.0 edition. Records may have up to 88 fields and each field may be as long as 239 characters. These are the largest limits presently available on any micro data base system on the market. But, the Mini Factory will NOT have a periodically updated version. The data that you store on the Mini Factory WILL be compatible with the big Data Factory if you decide to upgrade to the larger system. Many people may find that the Mini Factory is all that they need, but it is reassuring to know that if your needs expand, the Data Factory is there to grow with you. The Mini Factory is at your Micro Lab Dealer now.

UPDATE AVAILABLE NOW

There are two ways to upgrade your present 3.0 version of the Data Factory and receive the new 4.0 version. The Data Factory program disks cannot be copied. That's why we supplied 2 disks with every Data Factory sold. If your original master program disk developed a problem, you always had your back up ready while you sent your original master to Micro Lab to be renewed. If you didn't have our Extended Warranty you were charged $10 a disk. Our new version of the Data Factory (4.0) has been expanded so much that we had to place the program on TWO PROGRAM DISKS. If you send us one of the old copies of your program, we will send back two disks (one marked UTILITY, one marked REPORT). The cost for this is $20. You will also receive instructions detailing the new features with your first program sent in. The same procedure ($20 fee) would apply with your back up copy unless you have our Extended Warranty Policy which saves you money and gives you protection for accidental blowing of disks for a full year.

THE DATA FACTORY™

By William Passauer

WARRANTY CONVERSION PLAN

If you now have our EXTENDED WARRANTY (formerly called Insurance), mail your master program disks to Micro Lab, one at a time, in the mailer that was provided when you received your Extended Warranty. For each 3.0 Data Factory disk we receive, you will get two in return. There is no additional charge for the extra disks. During the life of your Extended Warranty, any "blown" or damaged disks will be renewed at no cost. If you have not applied for your Extended Warranty yet, you may do so now by mailing Micro Lab a check for $30 along with the serial # of your disks and the name of the Micro Lab Dealer from whom you purchased the Data Factory.

FROM MINI TO DATA FACTORY

There is only one way to upgrade from the Mini Factory to the Data Factory. Bring your two Mini Factory program disks and your Mini Factory Manual to your Micro Lab Dealer. He will exchange your printed manual and program disks for a new printed manual and four program disks. The Dealer will charge you the difference between the current retail price of the Mini Factory and the Data Factory plus $15. As an example, the current retail price of the Mini Factory is $75, and currently the Data Factory is $150: $150−$75+$15=$90 to convert (plus old disks and manual).

THE SYSTEM GROWS

Micro Lab will be introducing its first "Data Factory Compatible" business system shortly. You will be able to use all of the Data Factory features on this powerful but easy to use system. Check with your Micro Lab dealer for more information.

REQUIREMENTS AND COSTS

To operate the Data Factory or the Mini Factory you must have Applesoft in ROM and a 48K machine. You need only one disk drive but two are recommended. A printer is helpful but optional. Your Micro Lab Dealer has our products at the following prices, although some dealers supply other services along with the sale of our products so prices may vary.

The Data Factory	$150.00
The Mini Factory	75.00
The Mini-Data upgrade	90.00

SUPPORT COUNTS

Users know they can call us when they have questions. A short time ago, a new user called us in a panic. He had purchased his Apple computer for business at the same time that he also bought The Data Factory. He had never used a computer before that time. A few weeks earlier, we had helped him to get the system going, but now he had really done it! He blew both copies (his original and the back up) of his program — how or why he or his machine did this wasn't important now. He had a deadline to meet. The local dealer temporarily loaned him another program to solve his immediate need. He then shipped him two programs via Express Mail that day. Since he had the Extended Warranty, his cost was only the excess mail charge for Express service plus a small handling charge. This is the kind of service that we are prepared to give to users.

FROM OUR USERS

"Every time I use the program I find new tricks I can do, or think up new applications . . . I wish to thank you for providing a very powerful program for the Apple II computer at a very reasonable cost."

"Keep up your approach to simple and easy-to-understand instructions with examples. If the personal computer industry wants to make in-roads into wide spread use of the great tools, it is time to do away with all the technical language that only programmers understand. Your instruction book is excellent!!!"

There are many reasons why you should buy one of our products. The ease of use, the features, the updates, the service and the fact that your investment in a Micro Lab system pays off in time savings every day. But you will find the best reason, when you ask someone who already has a Micro Lab system. We are proud of our reputation and we will keep working hard to maintain it.

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systems that work

CIRCLE 156 ON READER SERVICE CARD

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CIRCLE 156 ON READER SERVICE CARD

```
         FOR TRAIT := FACE TO HAIR DO BEGIN
            TRAITS[TRAIT,GENE0]:=MOM.TRAITS[TRAIT,RANDOM MOD 2];
            TRAITS[TRAIT,GENE1]:=DAD.TRAITS[TRAIT,RANDOM MOD 2];
            IF TRAITS[TRAIT,GENE0]=TRAITS[TRAIT,GENE1] THEN BEGIN
               SHOWSUP[TRAIT]:=TRAITS[TRAIT,GENE0];
               IF SHOWSUP[TRAIT]=RECESSIVE THEN
                  STATS[TRAIT].NHOMREC:=STATS[TRAIT].NHOMREC+1
               ELSE
                  STATS[TRAIT].NHOMDOM:=STATS[TRAIT].NHOMDOM+1
            END ELSE BEGIN
               SHOWSUP[TRAIT]:=DOMINANT;
               STATS[TRAIT].NHETDOM:=STATS[TRAIT].NHETDOM+1
            END
         END
      END
   END; (* FOR *)
   (* AND DISPLAY THEM *)
   FOR INX:=0 TO NKIDS DO
      DRAWME(THEKIDS[INX],1+(INX DIV ROWSIZE),
        (INX MOD ROWSIZE)+COLOFFSET);
END;

PROCEDURE STATISTICS;
VAR KEY:CHAR;

   PROCEDURE SHOWZYGOTE(WHO:ZYGOTE;WHAT:CHARACTERISTIC);
   BEGIN
      IF WHAT=HAIR THEN
         WRITE('HAIR: ')
      ELSE
         WRITE('FACE: ');
      IF WHO.TRAITS[WHAT,GENE0]=WHO.TRAITS[WHAT,GENE1] THEN BEGIN
         WRITE('HOMOZYGOUS');
         IF WHO.TRAITS[WHAT,GENE0]=DOMINANT THEN
            WRITE(' DOMINANT')

         ELSE
            WRITE(' RECESSIVE')
      END ELSE BEGIN
         WRITE('HETEROZYGOUS DOMINANT');
      END
   END;


BEGIN
   (* WRITE INVISIBLY ON TEXT PAGE *)
   PAGE(OUTPUT);
   GOTOXY(1,1); WRITE('MOTHER');
   GOTOXY(10,2); SHOWZYGOTE(MOM,HAIR);
   GOTOXY(10,3); SHOWZYGOTE(MOM,FACE);
   GOTOXY(1,5); WRITE('FATHER');
   GOTOXY(10,6); SHOWZYGOTE(DAD,HAIR);
   GOTOXY(10,7); SHOWZYGOTE(DAD,FACE);
   GOTOXY(1,9); WRITE('OUT OF THESE 24 CHILDREN,');
   GOTOXY(6,10); WRITE(NMALE:2,' ARE MALE');
   GOTOXY(6,11); WRITE(NFEMALE:2,' ARE FEMALE');
   GOTOXY(1,13); WRITE('OFFSPRING''S HAIR');
   GOTOXY(10,14);
   WRITE('HOMOZYGOUS DOMINANT:   ',STATS[HAIR].NHOMDOM:3);
   GOTOXY(10,15);
   WRITE('HETEROZYGOUS DOMINANT:',STATS[HAIR].NHETDOM:3);
   GOTOXY(10,16);
   WRITE('HOMOZYGOUS RECESSIVE:  ',STATS[HAIR].NHOMREC:3);
   GOTOXY(1,18); WRITE('OFFSPRING''S FACES');
   GOTOXY(10,19);
   WRITE('HOMOZYGOUS DOMINANT:   ',STATS[FACE].NHOMDOM:3);
   GOTOXY(10,20);
   WRITE('HETEROZYGOUS DOMINANT:',STATS[FACE].NHETDOM:3);
   GOTOXY(10,21);
   WRITE('HOMOZYGOUS RECESSIVE:  ',STATS[FACE].NHOMREC:3);
   GOTOXY(2,23); WRITE('PRESS SPACEBAR TO CONTINUE');
   TEXTMODE; (* POOF-APPEARS LIKE MAGIC *)
   REPEAT
      READ(KEYBOARD,KEY)
   UNTIL KEY = ' ';
   GRAFMODE
END;

PROCEDURE LEGEND;
BEGIN
   FILLSCREEN(BLACK);
   AT(8,3); WSTRING('Mom ->');
   AT(25,3); WSTRING('<- Dad');
   DRAWME(MOM,0,3); DRAWME(DAD,0,4)
END;

PROCEDURE EXPLAIN;
VAR
   INX:INTEGER;
   EXPKIDS:ARRAY[0..3] OF ZYGOTE;

   PROCEDURE SETCOLOURS(DOMFACE,RECFACE,DOMHAIR,RECHAIR:SCREENCOLOR);
   BEGIN
      COLOURS[FACE,DOMINANT]:=DOMFACE;
      COLOURS[FACE,RECESSIVE]:=RECFACE;
      COLOURS[HAIR,DOMINANT]:=DOMHAIR;
      COLOURS[HAIR,RECESSIVE]:=RECHAIR
   END;
BEGIN
   FILLSCREEN(BLACK);

   (* SET UP ALL COMBINATIONS OF HAIR/FACE COLOURS *)
   FOR INX:=0 TO 3 DO BEGIN
      WITH EXPKIDS[INX] DO BEGIN
         IF (INX MOD 2)=0 THEN SEX:=MALE ELSE SEX:=FEMALE;
         CASE INX DIV 2 OF
            0: SHOWSUP[FACE]:=DOMINANT;
            1: SHOWSUP[FACE]:=RECESSIVE;
         END;
         CASE INX MOD 2 OF
            0: SHOWSUP[HAIR]:=DOMINANT;
            1: SHOWSUP[HAIR]:=RECESSIVE;
         END;
      END; (* WITH *)
      DRAWFACE(EXPKIDS[INX],0,INX+2);
   END;
   (* MAKE ONLY FACES SHOW UP *)
   SETCOLOURS(ORANGE,BLUE,NONE,NONE);
   EXPKIDS[0].SEX:=FEMALE;
   AT(1,6);  WSTRING('Above you see four Zorkons.');
   AT(1,8);  WSTRING('Zorkons may have green or white hair');
   AT(1,9);  WSTRING('and blue or orange faces.');
   AT(1,11); WSTRING('Orange face genes are');
   AT(1,12); WSTRING('dominant over blue face');
   AT(1,13); WSTRING('genes.');
   DRAWFACE(EXPKIDS[0],2,6); DRAWFACE(EXPKIDS[3],2,7);
   PSPACEBAR;
   (* MAKE ONLY HAIR SHOW UP *)
   SETCOLOURS(NONE,NONE,GREEN,WHITE1);
   DRAWFACE(EXPKIDS[0],2,6); DRAWFACE(EXPKIDS[3],2,7);
   (* RESTORE COLOURS TO NORMAL *)
   SETCOLOURS(ORANGE,BLUE,GREEN,WHITE1);
   AT(1,15); WSTRING('Green hair genes are dominant');
   AT(1,16); WSTRING('over white hair genes.');
   PSPACEBAR;
   AT(1,18); WSTRING('Male Zorkons have square');
   AT(1,19); WSTRING('faces and straight hair.');
   DRAWFACE(EXPKIDS[2],4,6);
   PSPACEBAR;
   AT(1,20); WSTRING('Female Zorkons have round');
   AT(1,21); WSTRING('faces and flat, piled-up hair.');
   DRAWFACE(EXPKIDS[3],4,7);
   PSPACEBAR
END;

PROCEDURE EXPLAIN2;


BEGIN
   LEGEND;
   AT(1,6);  WSTRING('This is a typical Zorkon couple,');
   AT(1,7);  WSTRING('Martha and Sam.');
   PSPACEBAR;
   AT(12,4); WSTRING('->');
   AT(12,5); WSTRING('->');
   AT(1,9);  WSTRING('The boxes beneath them tell you what');
   AT(1,10); WSTRING('genes they carry.');
   PSPACEBAR;
   AT(12,5); WSTRING('  ');
   AT(1,12); WSTRING('The top row shows their hair genes.');
   PSPACEBAR;
   AT(12,4); WSTRING('  ');
   AT(12,5); WSTRING('->');
   AT(1,13); WSTRING('The bottom row shows their face genes');
   PSPACEBAR;
   AT(12,5); WSTRING('  ');
   AT(1,15); WSTRING('Each Zorkon child wears two hair');
   AT(1,16); WSTRING('(and face) colour genes, one from');
   AT(1,17); WSTRING('from each parent.');
   PSPACEBAR;
END;

PROCEDURE EXPLAIN3;
VAR
   ONEKID:ZYGOTE;
   TRAIT:CHARACTERISTIC;
   GENE:INTEGER;
BEGIN
   ONEKID.SEX:=MALE;
   FOR TRAIT:=FACE TO HAIR DO BEGIN
      FOR GENE:=GENE0 TO GENE1 DO BEGIN
         ONEKID.TRAITS[TRAIT,GENE]:=DOMINANT;
      END;
      ONEKID.SHOWSUP[TRAIT]:=DOMINANT
   END;
```

Genepool, continued...

```
 FILLSCREEN(BLACK);
 DRAWME(ONEKID,0,3);
 AT(1,6);  WSTRING('If both genes for hair (or face) are');
 AT(1,8);  WSTRING('dominant, then the child is called');
 AT(1,10); WSTRING('HOMOZYGOUS DOMINANT for that trait.');
 PSPACEBAR;
 FOR TRAIT:=FACE TO HAIR DO BEGIN
    FOR GENE:=GENE0 TO GENE1 DO BEGIN
       ONEKID.TRAITS[TRAIT,GENE]:=RECESSIVE;
    END;
    ONEKID.SHOWSUP[TRAIT]:=RECESSIVE
 END;
 DRAWME(ONEKID,0,4);
 AT(1,12); WSTRING('If both genes are recessive, then the');
 AT(1,14); WSTRING('child is called HOMOZYGOUS RECESSIVE.');
 PSPACEBAR;
 FOR TRAIT:=FACE TO HAIR DO BEGIN

    ONEKID.TRAITS[TRAIT,GENE0]:=DOMINANT;
    ONEKID.SHOWSUP[TRAIT]:=DOMINANT
  END;
  DRAWME(ONEKID,0,5);
  AT(1,16); WSTRING('Finally, if the child gets one dominant');
  AT(1,18); WSTRING('and one recessive gene for a trait,');
  AT(1,20); WSTRING('the child is HETEROZYGOUS DOMINANT.');
  PSPACEBAR
END;

PROCEDURE EXPLAIN4;
BEGIN
   LEGEND;
   AT(1,6); WSTRING('You may select male and female genetic');
   AT(1,7); WSTRING('types, and a random sampling of their');
   AT(1,8); WSTRING('offspring will be produced.');
   AT(1,10);
   IF NOPADDLES THEN
      WSTRING('Use the arrow keys to select')
   ELSE
      WSTRING('Use paddle zero to select');
   AT(1,11); WSTRING('the genetic types.');
   PSPACEBAR
END;
```

```
 PROCEDURE SPLASHPAGE;
 VAR INX:INTEGER;
 BEGIN
    GENERATION;
    AT(7,1);  WSTRING('Welcome to the Gene Pool');
    AT(2,20); WSTRING('A simulation of a genetics experiment');
    AT(5,22); WSTRING('Copyright 1980 by JDEisenberg');
    AT(1,23); WSTRING('Press spacebar to start, ? for help');
    REPEAT
       READ(KEYBOARD,KEY)
    UNTIL (KEY=' ') OR (KEY='?');
    IF KEY='?' THEN BEGIN
       EXPLAIN; EXPLAIN2; EXPLAIN3;
       EXPLAIN4; GENERATION
    END ELSE BEGIN
       ERSLINE(1); ERSLINE(20);
       ERSLINE(22); ERSLINE(23)
    END
 END;

 PROCEDURE INITPARENTS;
 BEGIN
    (* SET UP MOTHER WITH ALL THE GENES *)
    WITH MOM DO BEGIN
       SEX:=FEMALE;
       TRAITS[HAIR,GENE0]:=DOMINANT;
       TRAITS[HAIR,GENE1]:=RECESSIVE;
       TRAITS[FACE,GENE0]:=DOMINANT;
       TRAITS[FACE,GENE1]:=RECESSIVE;

       SHOWSUP[HAIR]:=DOMINANT;
       SHOWSUP[FACE]:=DOMINANT
    END;
```

```
    (* SET UP FATHER SAME AS MOM, BUT MALE *)
    DAD:=MOM;
    DAD.SEX:=MALE
 END;

 PROCEDURE CHOOSETYPES;
 VAR
    LASTPOS,POSITION:INTEGER;
    GOTCHA,HADERROR:BOOLEAN;

    PROCEDURE DRAWCURSOR;
    VAR ROW,COL,XBASE,YBASE:INTEGER;
    BEGIN
       ROW:=(POSITION DIV ROWSIZE)+1;
       COL:=(POSITION MOD ROWSIZE) + COLOFFSET;
       XBASE:=X0+COL*WIDTH+11;
       YBASE:=Y0-(ROW*HEIGHT)+4;
       SKIPTO(XBASE-3,YBASE); MOVETO(XBASE+3,YBASE);
       SKIPTO(XBASE,YBASE-3); MOVETO(XBASE,YBASE+3)
    END;

    PROCEDURE GETPOSITION;
    BEGIN
       IF KEYPRESS THEN BEGIN
          READ(KEYBOARD,KEY);
          IF KEY=CHR(ESC) THEN EXIT(CHOOSETYPES);
          IF EOLN(KEYBOARD) THEN BEGIN
             RESTART:=TRUE;
             EXIT(CHOOSETYPES)
          END;
          IF KEY='S' THEN BEGIN
             STATISTICS
          END;
          IF NOPADDLES THEN BEGIN
             GOTCHA:=(KEY=' ');
             IF ORD(KEY)=8 THEN POSITION:=POSITION-1
             ELSE IF ORD(KEY)=21 THEN POSITION:=POSITION+1;
             IF POSITION < 0 THEN POSITION:=NKIDS;
             IF POSITION > NKIDS THEN POSITION:=0;
          END
       END;
       IF NOT NOPADDLES THEN BEGIN (* UNGRAMMATICAL BUT CORRECT *)
          POSITION:=PADDLE(0);

          (* MAKE SURE PADDLE REALLY IS MOVING *)
          IF ABS(POSITION-LASTPOS)>3 THEN LASTPOS:=POSITION;

          POSITION:=LASTPOS DIV (240 DIV NKIDS);
          IF POSITION > NKIDS THEN POSITION:=NKIDS;
          GOTCHA:=BUTTON(0)

       END
    END;

 BEGIN
    LASTPOS:=0; POSITION:=0;
    HADERROR:=FALSE;
    AT(3,20);
    WSTRING('Press S for statistics');
    AT(3,21);
    WSTRING('Press RETURN to start again');
    AT(3,22); WSTRING('Press ESC to exit');
    REPEAT
       GOTCHA:=FALSE;
       AT(3,18); WSTRING('Choose the new male genetic type');
       AT(3,19);
       IF NOPADDLES THEN
          WSTRING('<-,-> to move; spacebar to choose')
       ELSE
          WSTRING('Press button to choose');
       DRAWCOLOR:=REVERSE;
       REPEAT
          GETPOSITION;
          DRAWCURSOR;
          DRAWCURSOR
       UNTIL GOTCHA;
       IF THEKIDS[POSITION].SEX <> MALE THEN BEGIN
          WRITE(CHR(BEL)); (* K'DING *)
          IF NOT HADERROR THEN BEGIN
             CHARTYPE(5);      (* REVERSE VIDEO *)
             AT(3,23); WSTRING('Males have square faces');
             CHARTYPE(10);     (* NORMAL VIDEO *)
             HADERROR:=TRUE
          END;
       END
```

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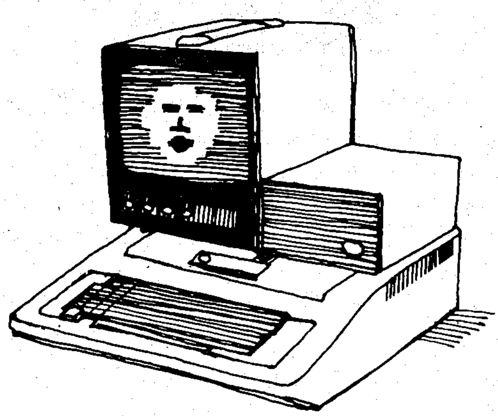

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Genepool, continued...

```
UNTIL THEKIDS[POSITION].SEX=MALE;
DAD:=THEKIDS[POSITION];
DRAWCURSOR;
IF HADERROR THEN ERSLINE(23);
HADERROR:=FALSE;
REPEAT
   GOTCHA:=FALSE;
   AT(3,18); WSTRING('Choose the new female genetic type.');
   REPEAT
      GETPOSITION;
      DRAWCURSOR;
      DRAWCURSOR
   UNTIL GOTCHA;
   IF THEKIDS[POSITION].SEX <> FEMALE THEN BEGIN
      WRITE(CHR(BEL));  (* K'DING *)
      IF NOT HADERROR THEN BEGIN
         CHARTYPE(5);  (* REVERSE VIDEO *)
         AT(3,23); WSTRING('Females have rounded faces');
         CHARTYPE(10); (* NORMAL VIDEO *)
         HADERROR:=TRUE;
         END;
      END
   UNTIL THEKIDS[POSITION].SEX=FEMALE;
   MOM:=THEKIDS[POSITION];
   DRAWCURSOR
END;

PROCEDURE INITIALISE;
VAR POS0,POS1,DELAY:INTEGER; (* FOR READING PADDLES *)
BEGIN
   INITTURTLE;

   (* IF BOTH PADDLES READ 255, AND BOTH BUTTONS *)
   (* ARE PRESSED, THEN IT'S A SAFE BET THAT YOU *)
   (* DON'T HAVE PADDLES ATTACHED                *)
   POS0:=PADDLE(0);
   FOR DELAY:=1 TO 50 DO BEGIN END;
   POS1:=PADDLE(1);
   NOPADDLES:= ((POS0=255) AND (POS1=255)) AND
            ((BUTTON(0)) AND (BUTTON(1)));

   (* SET UP COLOURS FOR FACE/HAIR DISPLAY *)
   COLOURS[HAIR,DOMINANT]:=GREEN;
   COLOURS[HAIR,RECESSIVE]:=WHITE1;
   COLOURS[FACE,DOMINANT]:=ORANGE;
   COLOURS[FACE,RECESSIVE]:=BLUE;

   RESTART:=FALSE;
   INITPARENTS
END;

BEGIN
   RANDOMIZE;
   REPEAT
      INITIALISE;
      SPLASHPAGE;
      REPEAT
         CHOOSETYPES;
         IF (NOT RESTART) AND (KEY <> CHR(ESC)) THEN
            GENERATION
      UNTIL RESTART OR (KEY=CHR(ESC));
   UNTIL KEY=CHR(ESC);
   PAGE(OUTPUT);
   TEXTMODE
END.
```

PROCEDURE CHOOSETYPES;

This procedure lets you choose the new parents from the current generation. Of interest is the boolean variable (HADERROR, which tells if an error message has already been given or not (for choosing male instead of female or vice-versa).

PROCEDURE DRAWCURSOR;

Draws the blinking cursor while choosing parents. It calculates the appropriate ROW and COLumn on the screen from the POSITION (see GETPOSITION below).

PROCEDURE GETPOSITION;

Determines which of the offspring the cursor is pointing to, and returns its POSITION. Offspring are numbered left to right, top to bottom, starting with zero at the top left.

PROCEDURE INITIALISE;

Determines whether you have paddles attached or not (yes, you can fool this procedure — but why do it?); initializes display colors, and sets up genetic patterns of parents with a call to INITPARENTS.

Glossary

These terms are defined as applies to this article; for more complete definitions, I suggest that you go to your local library and read some books about genetics.

DOMINANT: having precedence over another; for example, brown eye genes are dominant over blue eye genes.

GENE: a hereditary unit that has a specific influence on a trait.

HETERO-: a prefix from the Greek, meaning "different."

HETEROZYGOUS: means a zygote that has different genes in it.

HETEROZYGOUS DOMINANT: a zygote with one dominant and one recessive gene in it. The dominant trait shows up in a person with this combination.

HOMO-: a prefix from the Greek, meaning "same."

HOMOZYGOUS: means a zygote that has both genes the same.

HOMOZYGOUS DOMINANT: a zygote with two dominant genes; the dominant trait shows up in a person with this combination.

HOMOZYGOUS RECESSIVE: a zygote with two recessive genes; the recessive trait shows up in a person with this combination.

RECESSIVE: opposite of dominant; thus blue eye genes are recessive.

TRAIT: a characteristic of a living being, such as hair color, etc.

ZYGOTE: a cell with two genes in it. Most zygotes appear in living beings, but they may also be found in crossword puzzles and Scrabble games (usually on triple word scores, and shortly thereafter on the floor). □

Monster Combat

Lee Chapel

This monstrous program offers hours of fun. Think carefully before accepting its offer.

Monster Combat is a game in which you go wandering through a forest trying to win as much treasure as you can from various monsters without getting yourself killed in the process. It was written in Basic for a KIM microprocessor and for display on a high speed video board, but can easily be converted to almost any other Basic or video board. It requires at least 16K of RAM to be run, which is the main reason there are no spaces between commands on the program listing.

Play

When you play the game you will be randomly placed in a forest ten by ten squares in size. Only one of these squares, the one you are in, is displayed, thus allowing you to see only a small part of the forest at a time. The sector you are in is again divided into ten by ten squares. Each of these, too, is divided up to ten by ten; but these hundred smallest squares you see. Each of these little squares is shown by a single claracter. It covers an area of forest ten by ten yards, making the fuller square that is displayed a hundred by a hundred yards and the entire forest a thousand by a thousand yards. T's are trees, '-'s are paths, I's are walls, 's are inns, and M's are enchanted castles. The '0' is you.

Also displayed with the portion of forest you are in is your combat strength, treasure total, and the various magic spells you have. Your combat strength is used to fight the various monsters you meet, each

Of course, the innkeeper takes some of your treasure for providing you with his services.

monster having a combat strength of his own; these range from five (for a goblin) to a hundred (for a basilisk). Your combat strength is also used in movement, the amount used depending upon how far you go, how much treasure you're lugging around, and the type of terrain you end up on after you move.

At the inns you are allowed to regain the strength you began with and all the magic you had at the start. Don't worry when you find yourself displayed in the square below the inn when you stop there; that is the way the program is set up. Of course, the innkeeper takes some of your treasure for providing you with his services. However, sometimes he has information which he passes on to you at no additional cost — like where the forest edge is, or where an enchanted castle might be found.

There may be up to fifteen enchanted castles in the forest. These usually contain items of great value to treasure hunters, as you will see. (However, they tend to vanish if you make the wrong move, such as falling into a pit when you land on the castle square.)

Most of the time you will not be

Lee Chapel, 2349 Wiggins, Springfield, IL 62704.

Cast of Characters

The following is a description of each monster, giving its combat strength and telling something about the tales and myths surrounding it.

Goblin (5) — A mischievous little sprite only about a yard in height. Rather ugly, uses coarse and uncouth language, is generally evil and malicious; all in all, a rather unpleasant little fellow. Even though they're little they can be very vicious, and more than one warrior has been killed underestimating them.

Minotaur (10) — From Greek mythology, a monster with the head of a bull and the body of a man. Minos, king of Crete, received a bull from Poseidon, god of the sea, which he refused to sacrifice to the god. Poseidon inspired an unnatural love for the bull in Pasiphae, Minos' wife, and the minotaur resulted from the union. Minos enclosed the creature in a labyrinth constructed in the city of Knossos, and fed it seven young men and women (whom Athens had to pay as tribute to Crete) every few years. The original minotaur was eventually slain by the Athenian hero Theseus.

Cyclops (20) — Also from Greek mythology, a member of a race of one-eyed giants. According to Homer, the cyclopses were shepherds living on an island in the western area. The best known of these was Polyphemus who had his eye poked out by the hero, Odysseus. According to Hesiod, the cyclopses were three of the children of Uranus and Gaea. They forged the thunderbolt for Zeus, king of the gods, and became the assistants of Hephaestus, god of the forge.

Zombie (30) — From legends in the West Indies, a corpse which has been reanimated. A rather unpleasant person to meet, he generally smells of rot and decay. He often has rotting pieces of himself falling off his body, yet never seems to fall apart completely. He is difficult to kill, since he is already dead. A person has to chop him into tiny pieces and then get away before the monster can pull himself back together.

Giant (40) — Appears in the mythology of almost all nations, huge beings of terrible aspect. In the Greek myths the giants are said to live in volcanic regions where they were banished after an unsuccessful war against the gods. Some giants are peaceful, but others, like the ones in the forest, would think nothing of having you or anyone else for a snack.

In the Greek myths the giants are said to live in volcanic regions where they were banished after an unsuccessful war against the gods.

Harpy (50) — From Greek mythology, disgusting women with the wings and lower body of a bird, generally a bird of prey. They stole and befouled the food of blind Phineus as punishment from the gods. Phineus nearly died before Jason and the Argonauts arrived while sailing in search of the Golden Fleece. Two of the Argonauts, Zetes and Calais, drove the harpies away and were then told by one of the gods that the harpies would bother Phineus no more. The harpies continued their disgusting practices elsewhere.

Griffin (60) — From Eastern mythology, a creature usually represented as having the head, beak, and wings of an eagle, and the body and legs of a lion. It builds its nest of gold, making it very tempting to hunters and forcing the griffin to keep vigilant guard. It instinctively knows where buried treasure is hidden and does its best to keep any plunderers at a distance.

Chimera (70) — From Greek mythology, a monster with the foreparts of a lion, the rearparts of a goat with a goat's head in the middle of its back, and with a serpent for a tail. The original chimera was slain by Bellerophon, who was riding on Pegasus, the winged horse. Ironically, Pegasus was a distant relative of the chimera.

Dragon (80) — Found in many of the world's mythologies, a reptilic monster resembling a giant lizard and usually represented as having wings, huge claws, and a fiery breath. In some places the dragon is considered to be a peaceful creature, notably in Japan and China, where it is regarded as a symbol of good fortune. However, the dragons in the forest are of the other sort; they will kill and eat you if you let them, and they take very unkindly to anyone trying to steal their treasure.

Wyvern (90) — A distant relative of the dragon, this is a fabulous two-legged creature, with wings and the head of a dragon on a basilisk's body. Although he cannot kill you with one glance like the basilisk, he is still a very unpleasant creature to meet.

Basilisk (100) — The worst of all eleven monsters, his deadly glare kills anyone who gazes upon his face. From Greek mythology, the basilisk was called the king of serpents, being endowed with a scaly crest upon his head like a crown. This monster was supposedly produced from the egg of a cock hatched under toads or serpents. The weasel, the only animal which can withstand the basilisk's glare, often fought it to the death. Humans must use a mirror if they wish to be assured of victory over a basilisk, for the mirror will reflect the creature's gaze back upon it and kill it. This monster is not to be confused with the basilisk of South America, a harmless lizard with the ability to run across water.

visiting inns and castles. You will be hacking your way through thick underbrush or trotting along forest paths in search of treasure. And you will find it, usually guarded by some sort of monster. Upon encountering one or more of these creatures you are given a choice of fighting them, running away, bribing them, or casting a spell on them.

To fight you must hit a '1'; then, when it asks you to, you enter however much of your combat strength you wish to use against the monster. If you choose to use strength equal to the monster's strength you then have a fifty-fifty chance of winning. The more strength you use the greater the odds are of winning, the less you use the smaller your odds of winning. Also affecting what you use to fight the monster is your treasure total. The more treasure you have the more strength you must use.

The first and third parts of the sample run give examples of fighting a monster or monsters. In the first case there are three cyclopses. Cyclopses have a combat strength of 20 which means that three of them have a total strength of 60. I used 121 of my combat strength to fight them, over twice the cyclopses' strength, which gave me over a 95% chance of winning. And, as can be seen in the example, I did beat him.

In the third part of the sample run I am fighting 19 goblins. Since goblins have a combat strength of 5, 19 have a combined strength of 95. I used only 60 combat points that time, giving me around a 30% chance of winning. And, as can be seen in the example, I did get myself killed.

If you do not wish to fight the monster you can always run. However, the higher the strength of the monster the less likely you will get away and the more likely that you will be forced to fight. Whether or not you do get away is based upon a random number and the strength of the monster. If you do get away you are randomly placed in an adjacent square and get to find out what is there. Once in a while, when you attempt to run, the monster catches you and kills you.

If you don't care to run or fight you can try to bribe the monster. Few people like to do this since it means handing over some of your hard-earned treasure. Whether your bribe is accepted or not depends upon how much treasure the monster is guarding, his strength, and a random number. The greater the value of the treasure the monster has, the more you'll have to pay him if you don't care to fight. Usually if the monster doesn't care for your bribe you have to fight him. Sometimes, though, he just kills you anyway.

If you don't care to run or fight you can try to bribe the monster.

Finally, if you don't care for any of the previous choices, you may cast a spell. There are three types of spells: sleep, charms, and invisibility. Sleep spells tend to be the least effective and invisibility the most effective, with charms somewhere in the middle. Spells, no matter what kind they are, don't always work too well, sometimes not working at all, thus causing you to have to fight the monster.

In addition to the various monsters, there are other things you will occasionally run into; some are good and some bad, as you will see when you run the program. Everything is determined randomly and thus you can go back to a spot you were previously at and find something different there.

You have thirty days to hunt for treasure in the forest. Each little square you move through takes a tenth of a day to cross, meaning it takes an entire day to cross the entire displayed square. To move you enter the direction you wish to go (N meaning North, which is upwards, S meaning South, E meaning East, which is to the right, and W meaning West). Then you enter the distance, each little square being one. For example, in the first part of the sample run I enter S (south) for the direction and then 3 for the distance. This places me on top of the arrow, which is an inn, and thus I am shown in the square below the inn when the next map of the area is drawn. In moving from the inn I again go south, this time a distance of 7, which causes me to end up in the next large square.

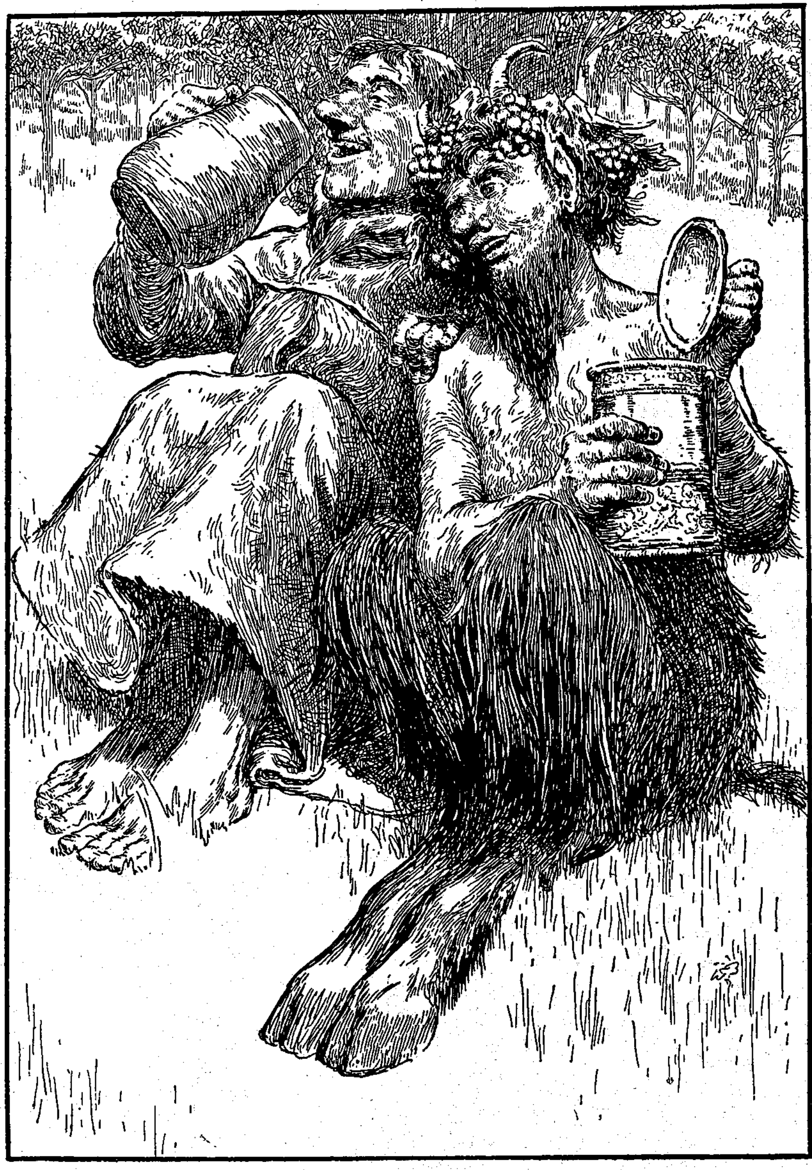
When you leave the forest, intentionally or accidentally, you can obtain a listing of the number of monsters you've killed, bribed and run from, plus the amount of treasure you have won so far. If you decide not to return to the forest or your thirty days are up, you are offered several choices: you may go to a new forest with the same strength and magic (the treasure total going back to zero); you may go to a new forest with new strength and magic; or you can stop playing the game. If you should wish to use the strength and magic left over from the game you just played, you can obtain a listing of these at the very end of the game and then write them down or store them however you wish. Then, the next time you play the game, you just answer the initial question asking if you wish to use an old combat strength and magic with a 'Y' and then enter the various things you are asked for.

This game was very popular at my dorm at the University of Wisconsin in Madison. The record treasure total so far, as of this writing, is 7562, set by me. Most of the time the scores run between a thousand and two thousand, with many lower and a few higher. If you get above two thousand you're doing well.

Possible Changes

A few of the major changes for use on other systems would be the random number generators which occur throughout the program and lines in which PRINTCHR$(3);CHR$(8) occurs, this being the command for clearing the screen and homing the cursor on my system. Also, if you don't have graphics you will want to leave out lines 1400 to 1487 and take out the GOSUB1400 from line 1210. If you do have graphics you'll have to change the POKE statements in lines 1400 and 1487 to suit your machine. The starting address for the display on my system is BC00 (48128), so you will probably have to subtract 48128 from all the POKEs and add whatever your start address is. □

```
2 REM    "GIANT MONSTER COMBAT!!"
3 REM    BY LEE J. CHAPEL 5/1/1980
5 PRINTCHR$(3);CHR$(8):PRINT"GIANT MONSTER COMBAT"
7 DIME(10,10),B(10,10),M(11),M$(11),N(11),T$(11),P(11),G$(3)
9 DIMC(15),D(15)
10 FORI=1TO11:READM$(I),T$(I),M(I),P(I):NEXT
13 V=INT(RND(1)*3)
15 C=INT(RND(1)*1501+500):S=INT(RND(1)*6):R=INT(RND(1)*4)
17 G$(1)="SLEEP SPELL":G$(2)="CHARM":G$(3)="INVISIBILITY SPELL"
18 PRINT:PRINT"DO YOU WISH TO USE THE STRENGTH AND MAGIC FROM A";
19 PRINT" PREVIOUS GAME?";:GETX$:PRINTX$:IFX$="Y"THEN1630
20 D=C:V1=V:S1=S:R1=R:PRINT"PLEASE WAIT..."
25 FORI=1TO10:FORJ=1TO10
27 T=INT(RND(1)*10):IFT<>1ORCS=15THENT=0
30 H=INT(RND(1)*2):W=INT(RND(1)*10):P=INT(RND(1)*51)
35 A(I,J)=10000*T+100*P+10*W+H
37 IFT=1THENCS=CS+1:C(CS)=I:D(CS)=J
40 NEXT:NEXT:T=0
45 X1=INT(RND(1)*8)+2:Y1=INT(RND(1)*8)+2
50 X=INT(RND(1)*10)+1:Y=INT(RND(1)*10)+1
55 IFX1<1ORX1>10ORY1<1ORY1>10THEN1000
56 FORI=1TO10:FORJ=1TO10:B(I,J)=0:NEXT:NEXT
57 CA=INT(A(X1,Y1)/10000):P=INT((A(X1,Y1)-(10000*CA))/100)
60 W=INT((A(X1,Y1)-(10000*CA)-(100*P))/10)
65 H=A(X1,Y1)-10000*CA-100*P-10*W:I=0:J=0
67 IFCA=1THENI=INT(RND(1)*10+1):J=INT(RND(1)*10+1):B(I,J)=7
70 IFCA=1ANDI=XANDY=JTHENB(I,J)=0:GOTO67
75 IFH=1THENI=INT(RND(1)*10+1):J=INT(RND(1)*9+1)
85 IFH=1ANDB(I,J)<>0THEN75
87 IFH=1THENB(I,J)=3
90 B(X,Y)=5:IFW=0THEN115
95 FORI=1TOW
100 J=INT(RND(1)*10)+1:K=INT(RND(1)*10)+1
105 IFB(J,K)<>0THEN100
110 B(J,K)=2:NEXT
115 IFP=0THEN140
120 FORI=1TOP
125 J=INT(RND(1)*10)+1:K=INT(RND(1)*10)+1
130 IFB(J,K)<>0THEN125
135 B(J,K)=1:NEXT
140 PRINTCHR$(3);CHR$(8):FORI=1TO10:FORJ=1TO10
143 PRINTTAB(3);
145 IFB(J,I)=0THENPRINT"T";
150 IFB(J,I)=1THENPRINT"-";
155 IFB(J,I)=2THENPRINT"I";
160 IFB(J,I)=3THENPRINT"↑";
165 IFB(J,I)=5THENPRINT"0";
167 IFB(J,I)=7THENPRINT"M";
170 NEXT:PRINTTAB(18);
175 IFI=2THENPRINT"COMBAT STRENGTH-"TAB(40)C
180 IFI=3THENPRINT"TREASURE TOTAL-"TAB(40)Q
185 IFI=4THENPRINT"MAGIC:"
190 IFI=5THENPRINT" SLEEP SPELLS-"TAB(40)S
195 IFI=6THENPRINT" CHARMS-"TAB(40)R
200 IFI=7THENPRINT" INVISIBILITY-"TAB(40)V
203 IFI=9THENPRINT"DAYS IN FOREST-"TAB(40)D1
205 IFI=1ORI=8ORI=10THENPRINT
210 NEXT:PRINT:IFT=1THENRETURN
213 IFT=2THEN515
215 I=INT(RND(1)*5):IFI=2THENGOSUB1500
220 IFI=1ANDT<>9THENPRINT"THERE WAS NOTHING THERE":GOTO515
223 IFI=1ANDT=9THEN513
225 I=INT(RND(1)*16+1):N=I:IFI=12THEN840
235 IFI=13THEN870
237 IFI=14THEN900
240 IFI>14THENJ=100:GOTO270
245 J=INT(RND(1)*100/M(I)):N1=J:IFJ=0THENJ=1:N1=J
255 IFJ=1THENM$=M$(I):PRINT"A "M$" IS GUARDING ";
260 IFJ<>1THENM$=M$(I)+"S":PRINTJ;M$" ARE GUARDING ";
```



```
265 M=M(I)*J:I=INT(RND(1)*14+1)
270 IFI>11ANDJ=100THEN215
271 IFI<12ANDJ=100THENPRINT"NOTHING IS GUARDING ";
272 IFI>11THEN975
273 IFI>11THENPRINT"NOTHING":P=0:GOTO277
275 PRINTT$(I):P=P(I)
277 IFM$=M$(11)ANDM1=7THEN835
279 IFJ=100THENPRINT"YOU GET THE TREASURE FREE":GOTO500
280 PRINT"DO YOU WISH TO (1)FIGHT,(2)RUN,(3)BRIBE,OR (4)";
283 PRINT"CAST A SPELL?":GETK
285 IFK<1ORK>4THEN280
290 ONKGOTO295,350,435,670
295 INPUT"HOW MANY COMBAT POINTS DO YOU WISH TO USE";K
```

```
300 IFK>CTHENPRINT"YOU ONLY HAVE"C"COMBAT POINTS":GOTO295
305 I=INT(RND(1)*1001):L=2:C=C-K:K=K-.01*Q
310 FORH=1000TO0STEP-50
315 IFL*M<=KANDH>=ITHEN490
320 L=L-.1:NEXT
325 PRINT"THE "M$" KILLED YOU. ";
330 PRINT"YOU LOSE EVERYTHING"
335 PRINT"DO YOU WISH TO TRY AGAIN?";:GETX$:PRINT
340 IFX$="Y"THENRUN
345 PRINT:PRINT"SO LONG.BETTER LUCK NEXT TIME":END
350 I=INT(RND(1)*12):IFI=11THEN325
360 FORH=0TO10:IFH*10>=MANDH<=ITHEN375
370 NEXT:GOTO480
375 A=X:B=Y:K=0:T=0:C=C-INT((RND(1)*21)+.001*Q)-5
380 X=A+INT(RND(1)*3)-1:Y=B+INT(RND(1)*3)-1
385 IFX=AANDY=BTHEN380
390 D1=D1+.1:IFX>10THENX=1:X1=X1+1:K=1
395 IFY>10THENY=1:Y1=Y1+1:K=1
400 IFX<1THENX=10:X1=X1-1:K=1
405 IFY<1THENY=10:Y1=Y1-1:K=1
410 IFB(X,Y)>1ANDK=0THEN380
415 B(A,B)=INT(RND(1)*3):B(X,Y)=5:IFI<>11THENZ=Z+1
425 IFK=1THEN55
430 GOTO215
435 INPUT"HOW MUCH DO YOU WISH TO PAY";K
440 IFK>QTHENPRINT"YOU ONLY HAVE"Q"TREASURE POINTS":GOTO435
445 I=INT(RND(1)*22):L=0:IFI=21OR(I>15ANDK<2)THEN325
455 J=(P+(M*.1))*N1:IFK<2THEN475
460 FORH=0TO20:IFK<=J*LANDI>=HTHEN475
470 L=L+.1:NEXT:GOTO485
475 PRINT"YOUR BRIBE WAS NOT ACCEPTED.";
480 PRINT"YOU MUST FIGHT":GOTO295
485 P=0:Q=Q-K:BR=BR+1:T=0:PRINT"YOUR BRIBE WAS ACCEPTED.";:GOTO505
490 N(N)=N(N)+N1
495 PRINT"YOU BEAT THE "M$
500 IFN<12THENI=INT(RND(1)*7):IFI=3THEN940
501 IFJ=100THENI=INT(RND(1)*5):IFI=3THEN965
502 Q=Q+P
503 IFP=25THEN770
504 IFT>5ANDT<>9THENQ=Q-P:GOTO985
505 PRINT"YOU NOW HAVE"Q"TREASURE POINTS"
510 IFP=200THEN800
513 IFT=9THENGOSUB1200
515 INPUT"WHICH DIRECTION (PRESS 1 FOR THE MAP)";X$
517 IFX$="1"THENT=2:GOTO140
520 T=0:INPUT"WHAT DISTANCE";K:IFK<>INT(K)THEN515
521 GOTO1100
523 A1=X1:B1=Y1:A=X:B=Y:C=C-INT(7.5*K*RND(1))
525 IFLEFT$(X$,1)="N"THENY=Y-K
530 IFLEFT$(X$,1)="S"THENY=Y+K
535 IFRIGHT$(X$,1)="E"THENX=X+K
540 IFRIGHT$(X$,1)="W"THENX=X-K
545 IFX>10THENX=X-10:X1=X1+1:IFX>10THEN545
550 IFX<1THENX=X+10:X1=X1-1:IFX<1THEN550
555 IFY>10THENY=Y-10:Y1=Y1+1:IFY>10THEN555
560 IFY<1THENY=Y+10:Y1=Y1-1:IFY<1THEN560
561 IFB(X,Y)=1THENC=C-5
563 IFB(X,Y)=0THENC=C-10
565 IFC<=0THENPRINT"YOU DIED FROM LACK OF STRENGTH.";:GOTO330
570 IFX1<>A1ORY1<>B1THEN55
573 IFB(X,Y)=7THENT=9
575 IFB(X,Y)=2THEN590
580 IFB(X,Y)=3THEN600
585 B(A,B)=INT(RND(1)*3):B(X,Y)=5:GOTO140
590 PRINT"YOU TRIED TO GO THROUGH A WALL"
595 C=C-INT(RND(1)*Q*.005)-25:X=A:Y=B:GOTO515
600 Y=Y+1:C=D:B(A,B)=INT(RND(1)*3):B(X,Y)=5:T=1:V=V1
603 R=R1:S=S1:GOSUB140
605 PRINT"YOU STOPPED AT AN INN AND REGAINED YOUR STRENGTH"
610 I=INT(RND(1)*Q*.75):IFI<5ANDQ>5THENI=5
615 IFI<5ANDQ<=5THENI=0
620 PRINT"YOU PAID"I"TREASURE POINTS TO STAY THERE":Q=Q-I
625 PRINT"YOU NOW HAVE"Q"TREASURE POINTS"
630 I=INT(RND(1)*3):IFI=2THEN515
633 IFI=1THENGOSUB1300:GOTO515
635 I=INT(RND(1)*4+1)
640 PRINT"THE INNKEEPER TOLD YOU THAT THE FOREST EDGE IS LESS THAN"
645 ONIGOTO650,655,660,665
650 PRINTY1*100"YARDS TO THE NORTH":GOTO515
655 PRINT(11-Y1)*100"YARDS TO THE SOUTH":GOTO515
660 PRINTX1*100"YARDS TO THE WEST":GOTO515
665 PRINT(11-X1)*100"YARDS TO THE EAST":GOTO515
670 IFT>5THENPRINT"YOU CAN'T USE MAGIC TO GET MAGIC":GOTO280
671 IFS+V+R=0THENPRINT"YOU HAVE NO MAGIC":GOTO280
673 PRINT"WHAT TYPE OF SPELL-(1)SLEEP,(2)CHARM,OR (3)INVISIBILITY";
675 GETK:PRINT:IFK<1ORK>3THEN670
680 ONKGOTO685,720,745
685 IFS=0THENPRINT"YOU HAVE NO SLEEP SPELLS.";:GOTO480
690 IFN=4THENPRINT"YOU CAN'T PUT "M$(4)"S TO SLEEP.";:S=S-1:GOTO480
695 I=INT(RND(1)*10):S=S-1
700 IFI<3THENPRINT"YOUR SPELL WAS UNSUCESSFULL.";:GOTO480
705 IFI<8THENPRINT"YOU GOT THE TREASURE SAFELY":GOTO500
710 PRINT"THE "M$" WOKE TOO SOON"
713 P=INT(RND(1)*P):Q=Q+P
715 PRINT"YOU GOT AWAY WITH"P"TREASURE POINTS":GOTO515
720 IFR=0THENPRINT"YOU HAVE NO CHARMS.";:GOTO480
725 I=INT(RND(1)*10):R=R-1
730 IFM<60ANDI>6THENPRINT"YOUR CHARM DIDN'T WORK.";:GOTO480
733 IFM>50ANDI<2THENPRINT"YOUR CHARM DIDN'T WORK.";:GOTO480
735 IFI=3THENPRINT"THE CHARM WORE OFF TOO SOON":GOTO713
740 I=3:GOTO705
745 IFV=0THENPRINT"YOU HAVE NO INVISIBILITY SPELLS.";:GOTO480
750 I=INT(RND(1)*10):V=V-1
755 IFM>50ANDI>8THENPRINT"THE "M$" SMELLED YOU":GOTO713
760 IFM<60ANDI=0THENPRINT"YOUR INVISIBILITY WORE OFF TOO SOON":GOTO713
765 GOTO740
770 I=INT(RND(1)*2)+1:ONIGOTO780,790
780 C=2*C:PRINT"YOU WON AN ENCHANTED SWORD.YOUR COMBAT STRENGTH "
785 PRINT"IS DOUBLED AND IS NOW"C:GOTO505
790 PRINT"YOU WON AN ORDINARY SWORD.YOUR COMBAT STRENGTH IS NOT"
795 PRINT"DOUBLED AND REMAINS AT"C:GOTO505
800 J=INT(RND(1)*10):I=INT(RND(1)*10)
805 IFJ=7ANDM1<>7THENM1=7:GOTO820
810 IFI=1THEN830
815 GOTO513
820 PRINT"THERE WAS A MIRROR IN THE CHEST.IT WILL PROTECT YOU"
825 PRINT"AGAINST ANY "M$(11)"S YOU MEET":M1=7:GOTO515
830 PRINT"THE TREASURE CHEST WAS A TRAP.YOU WERE KILLED WHEN ";
833 PRINT"YOU OPENED IT":GOTO330
835 PRINT"YOUR MIRROR KILLED THE "M$:N(11)=N(11)+1:M=0:GOTO500
840 PRINT"A GIANT BAT GRABBED YOU AND CARRIED YOU TO A NEW SPOT"
845 A=X:B=Y:T=0:D1=D1+.1
850 X=INT(RND(1)*10+1):Y=INT(RND(1)*10+1):IFB(X,Y)>1THEN850
860 B(A,B)=INT(RND(1)*3):B(X,Y)=5:GOTO215
870 PRINT"YOU FELL INTO A PIT.";:I=INT(RND(1)*21+.001*Q):C=C-I
875 IFC<=0THENPRINT"YOU DIED TRYING TO GET OUT":GOTO330
880 PRINT"YOU USED"I"COMBAT POINTS TO CLIMB OUT":I=11
885 FORJ=1TO750:NEXT:GOTO375
900 J=0:FORI=1TO11:J=J+N(I):NEXT:IFJ<11THEN215
910 PRINT"A GIANT EAGLE CARRIED YOU TO SAFETY.";
915 FORI=1TO1000:NEXT:T=0:GOTO1003
940 I=INT(RND(1)*11)+1:M=M(I):M$=M$(I):N=I
945 PRINT"A "M$" HEARD THE NOISE OF BATTLE AND CAME WANDERING BY"
947 IFI=11ANDM1=7THEN835
950 PRINT"DO YOU WISH TO (1)FIGHT,(2)RUN,OR (3)CAST A SPELL?":GETK
955 IFK<1ORK>3THEN950
960 ONKGOTO295,350,670
965 I=INT(RND(1)*11)+1:M=M(I):M$=M$(I):N=I
```

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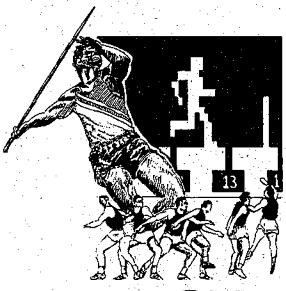
OLYMPIC DECATHLON



By Timothy Smith from Microsoft
The graphics capabilities you were promised when you bought your computer are finally utilized in this marvelous series of programs. Just like the real Decathlon, you compete in 10 demanding games that encompass different forms of running, jumping and throwing.

Play alone or with as many as eight competitors, the gold medal will always go to the skillful -- never the luckiest -- because your score depends entirely on skillful manipulation of the keyboard.

One of our more expensive game collections -- and worth every penny! You MUST see this system in action. Otherwise, you simply won't believe the combination of truly outstanding graphics, fast-paced action, nail-biting intensity, and even a touch of comedy you'll experience with Olympic Decathlon!

16K Tape...$24.95 32K Disk...$24.95

COSMIC FIGHTER

By B. Hogue & J. Konyu from Big Five
Terrific sound, graphics and unique challenges mark this new space game a winner! While fighting off the alien convoys, each more skillful than the last, you must keep track of your rocket fuel or risk explosion as you maneuver toward your space station. Can you dock immediately, or is the station overrun by aliens? Find out by ordering Cosmic Fighter today.

16K Tape...$14.95
32K Disk version...$17.95

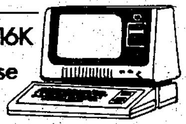
GAMMON CHALLENGER

By Ray Daly & Tom Throop from Acorn
The backgammon player featured in Personal Computing is now back in a faster, even better version! The game logic of the new Gammon Challenger has been compiled to machine language for extra speed, and there are more special features than ever.

Choose one of three levels of play, but don't get too ambitious -- Gammon Challenger will put your skill to the test at all levels. For serious players, the "doubling cube" option can be used for added excitement. There are other computer backgammon games, but none quite like Gammon Challenger.

Protected Tape...$14.95

TRS-80 Level II 16K unless otherwise noted

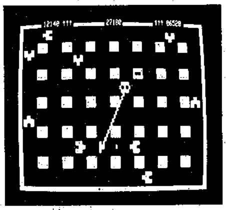


PROJECT OMEGA

By Bob Nicholas -- Adventure International
In probably the most accurate simulation ever produced for a microcomputer, you are responsible for the production, finance, health and well-being of Project Omega, the Earth's first deep space colony.

Painstakingly researched, Project Omega will provide much enjoyment and satisfaction as you overcome the frustrations and obstacles of taming an uncharted environment. The tape version is for one player; the disk version supports one or more, plus a special tournament option.

16K Tape...$14.95 32K Disk...$24.95



ATTACK FORCE!

By B. Hogue & J. Konyu from Big Five
Unlike the usual space "shoot-em-ups," your ship is not tied to the bottom of the screen. In Attack Force, you use the arrow keys to control both speed and direction as you maneuver all over the screen in search of the alien Ramships and Flagships. A realtime, machine language game with amazing graphics and sound.

You have to be quick to avoid the enemy ships that warp down on you, and the Flagships' lasers can fire in all directions -- even diagonally! And don't look away for an instant, because one of the alien spacecraft might be transformed into a mirror-image of your own!

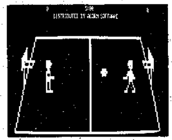
16K Tape...$14.95
32K Disk Version...$17.95

ZORK

By Infocom from Personal Software
In Zork, the Great Underground Empire, unearthly creatures guard 20 treasures. Bring all the treasures back to the trophy case and you can leave alive! You must pick your way through intricate mazes, collecting objects that may help or hinder you in your quest. But keep your wits about you, because in Zork, they take no prisoners!

TRS-80 or Apple II, 32K Disk...$39.95

BASKET BALL



By John Allen from Acorn
You have to be fast to keep up with the action as you try to outscore your opponent in five minutes of one-on-one basketball. Compete against a friend or your computer.

Steal the ball, duck around your opponent and slant toward the basket for a lay up! The graphics are based on a 3-dimensional depiction of a basketball court, and ball dribbling sounds add to the realism.

Protected Tape...$14.95
Protected Disk...$20.95

LDOS

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If new LDOS were just another disk operating system (DOS), we would not recommend it to you. However, two differences make this system unique and important: customer support and user benefits.

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With LDOS you get a well documented, thoroughly tested, and powerful DOS. The publisher is committed to a professionally written and detailed users' manual. Besides contracting with some of the best microcomputer systems houses for technical and customer support, a highly regarded technical writing firm is doing the manual.

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CIRCLE 175 ON READER SERVICE CARD

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970 PRINT"A "M$" CAME WANDERING BY":GOTO947
975 IFI<>14THEN273
980 I=INT(RND(1)*3+1):T=I+5:PRINT"A "G$(I):P=INT(RND(1)*11):GOTO277
985 I=INT(RND(1)*10)
986 IFI=5THENPRINT"YOU WERE UNABLE TO MASTER THE SPELL.";
987 IFI=5THENPRINT"YOU GAIN NO "G$(T-5)"S":GOTO515
988 IFT=6THENS=S+1:S1=S1+1
989 IFT=7THENR=R+1:R1=R1+1
990 IFT=8THENV=V+1:V1=V1+1
995 PRINT"YOU WON THE "G$(T-5):T=0:IFS1/5+R1/3+V1/2>6THENGOSUB1665
997 GOTO515
1000 FORA=1TO750:NEXT:PRINTCHR$(3);CHR$(8)
1003 PRINT"YOU SURVIVED THE FOREST":FORI=1TO1000:NEXT
1004 PRINT"DO YOU WISH TO SEE THE NO. OF MONSTERS YOU KILLED,RAN FROM,"
1005 PRINT"AND BRIBED?";:GETX$:PRINTX$:IFX$="N"THENPRINT:GOTO1030
1007 PRINT"MONSTER"TAB(11)"NO. SLAIN"TAB(32)"MONSTER"TAB(43)"NO. SLAIN"
1010 FORI=1TO5:PRINTM$(I);TAB(14);N(I);TAB(32);M$(1+5);
1013 PRINTTAB(46);N(I+5)
1015 NEXT:PRINTTAB(32);M$(11);TAB(46);N(11)
1020 PRINT:PRINT"BRIBED-"BR;TAB(32)"RAN FROM"Z
1030 PRINTTAB(10)"TREASURE TOTAL-"Q
1035 IFQ1<>0THENGOSUB1650
1040 PRINT"CONGRATULATIONS";:IFQ1<>0ANDQ1>0THENPRINT" ANYWAY":PRINT
1043 PRINT:X$=""
1045 IFD1<30THENPRINT"DO YOU WISH TO RETURN TO THE FOREST?";:GETX$
1047 IFD1<30THENPRINTX$
1050 S=S1:V=V1:R=R1:C=D:IFX$<>"Y"THEN1600
1055 PRINTCHR$(3);CHR$(8):GOTO45
1100 D1=D1+K/10:IFD1<30THEN523
1110 PRINT"YOUR TIME IS UP. 30 DAYS HAVE PASSED"
1115 FORI=1TO1000:NEXT:GOTO910
1200 FORI=1TO2500:NEXT:PRINTCHR$(3);CHR$(8):T=0
1203 PRINT"YOU MADE IT TO THE ENCHANTED CASTLE"
1205 I=INT(RND(1)*21)*100:J=INT(RND(1)*9):A(X1,Y1)=A(X1,Y1)-10000
1210 GOSUB1400:PRINT"YOU FOUND"I"TREASURE POINTS THERE":Q=Q+I
1215 IFJ<>7ORM1=7THEN1225
1220 PRINT"YOU ALSO FOUND A MIRROR WHICH WILL KILL ANY ";
1223 PRINTM$(11)"S YOU MEET":M1=7
1225 J=INT(RND(1)*20):IFJ=2THENC=2*C
1230 IFJ=2THENPRINT"YOU ALSO FOUND AN ENCHANTED SWORD WHICH DOUBLES ";
1235 IFJ=2THENPRINT"YOUR STRENGTH"
1240 FORI=1TOCS-1:IFC(I)<>X1THEN1245
1241 FORJ=ITOCS-1:C(J)=C(J+1):D(J)=D(J+1):NEXT
1245 NEXT:CS=CS-1:IFCS=0THENPRINT"YOU FOUND THE LAST OF THE CASTLES"
1250 RETURN
1300 IFCS=0THENRETURN
1301 I=INT(RND(1)*CS+1)
1302 PRINT"THE INNKEEPER TOLD OF A LEGEND OF A CASTLE.";
1303 IFC(I)=X1ANDD(I)=Y1THENPRINT"VERY CLOSE BY":RETURN
1304 J=X1-C(I):I=Y1-D(I)
1305 IFABS(I)=ABS(J)THENPRINT"DIRECTLY TO THE ";:GOTO1307
1306 PRINT"SOMEWHERE TO THE ";
1307 IFI<0THENPRINT"SOUTH";
1310 IFI>0THENPRINT"NORTH";
1315 IFJ>0THENPRINT"WEST";
1320 IFJ<0THENPRINT"EAST";
1325 PRINT:RETURN
1400 A=X:B=Y:FORY=7TO10:FORX=20TO32
1410 POKE48128+X+Y*64,128:NEXT:NEXT
1415 FORX=20TO32:POKE48832+X,164:NEXT
1420 FORX=20TO32STEP3:POKE48640+X,144:NEXT
1425 FORY=6TO10:POKE48161+Y*64,184:NEXT
1430 FORX=23TO24:POKE48576+X,136:POKE48582+X,136:NEXT
1435 POKE48795,191:POKE48794,191:POKE48474,136
1440 POKE48476,184:POKE48473,168:POKE48475,168
1445 POKE48538,160:POKE48730,164:POKE48731,164
1450 POKE48858,191:POKE48859,191:POKE48857,188
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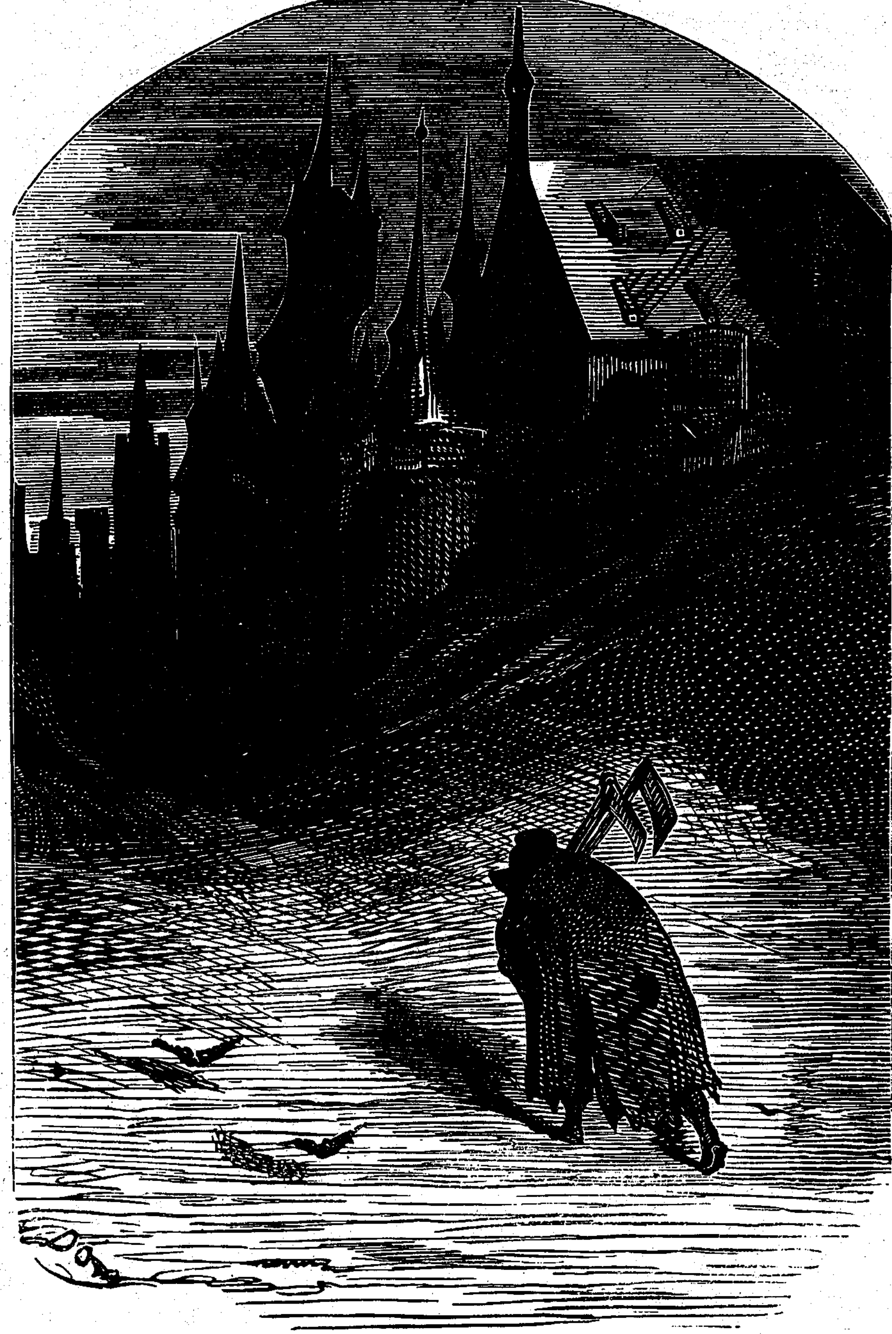

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1455 POKE48532,136:POKE48533,140:POKE48543,136
1460 POKE48544,140:POKE48534,184:POKE48545,184
1465 POKE48726,164:POKE48790,137
1470 POKE48793,184:POKE48729,160:POKE48865,188
1475 POKE48598,136:POKE48537,128:POKE48539,128
1480 POKE48540,184:POKE48734,160:POKE48735,132
1485 POKE48798,136:POKE48799,129:POKE48604,136
1487 X=A:Y=B:FORK=1TO1500:NEXT:RETURN
1500 I=INT(RND(1)*11+1)
1501 ONIGOTO1510,1520,1515,1530,1540,1550,1560,1570,1580,1590,1595
1510 PRINT"YOU STEPPED INTO A TIME WARP AND LOST 7 DAYS"
1513 D1=D1+7:RETURN
1515 I=INT(RND(1)*10+1):J=D1:D1=D1-I:IFD1<.1THEND1=.1:I=J-D1
1517 PRINT"YOU STEPPED INTO A TIME WARP AND GAINED"I"DAYS":RETURN
1520 IFC>=DTHENRETURN
1523 PRINT"YOU MET AN ELF WHO GAVE YOU A MAGIC DRINK THAT GAVE"
1525 PRINT"YOUR COMBAT STRENGTH BACK":C=D:RETURN
1530 IFV+R+S=V1+R1+S1THENRETURN
1533 PRINT"YOU RAN INTO A WIZARD WHO GAVE YOU A POTION THAT"
1535 PRINT"RESTORED ALL YOUR MAGIC":V=V1:R=R1:S=S1:RETURN
1540 IFQ<2THENRETURN
1543 PRINT"YOU FELL INTO SOME QUICKSAND.YOU LOST HALF OF YOUR"
1545 PRINT"TREASURE":Q=INT(Q/2):RETURN
1550 PRINT"YOU RAN INTO SOME THICK UNDERBRUSH AND USED UP HALF"
1553 PRINT"YOUR STRENGTH":C=INT(C/2):RETURN
1560 I=INT(RND(1)*50+1):PRINT"YOU FOUND"I"COINS LYING ON THE";
1563 PRINT" GROUND AND PICKED THEM UP":Q=Q+I:RETURN
1570 IFM1<>7THENRETURN
1573 PRINT"YOU TRIPPED OVER SOME ROOTS AND LOST YOUR MIRROR":M1=0:RETUR
N
1580 PRINT"A HERMIT TOLD YOU THAT THERE ARE"CS"CASTLES LEFT":RETURN
1590 IFV+S+R=0THENRETURN
1591 PRINT"YOU WANDERED INTO AN AREA WHERE MAGIC DOESN'T WORK"
1593 PRINT"YOU LOSE ALL YOUR PRESENT MAGIC":V=0:S=0:R=0:RETURN
1595 IFCS=0THENRETURN
1596 PRINT"YOU MET A HUNTER WHO TOLD YOU OF THE LEGEND OF A"
1597 PRINT"CASTLE ";:I=INT(RND(1)*CS)+1:GOSUB1303:RETURN
1600 FORI=1TO2000:NEXT:PRINT
1605 PRINT"DO YOU WISH TO GO TO A NEW FOREST WITH THE SAME STRENGTH";
1610 PRINT" AND MAGIC?";:GETX$:PRINTX$:IFX$="Y"THEN1625
1615 PRINT"DO YOU WISH TO GO TO A NEW FOREST WITH NEW STRENGTH AND";
1617 PRINT" MAGIC?";:GETX$:PRINTX$:IFX$="Y"THENRUN
1618 PRINT"DO YOU PLAN ON USING THIS SAME STRENGTH AND MAGIC AGAIN"
1619 PRINT"SOME OTHER TIME?";:GETX$:PRINTX$:IFX$="Y"THENGOSUB1700
1621 PRINT:PRINT"ONCE AGAIN, YOUR TREASURE TOTAL WAS"Q
1622 IFQ>Q1THENQ1=Q
1623 IFQ1<>0THENPRINT"THE LARGEST TREASURE TOTAL YOU GOT WITH THIS";
1624 PRINT" STRENGTH AND MAGIC WAS"Q1:PRINT:PRINT"BYE NOW":END
1625 BR=0:Z=0:D1=0:FORI=1TO11:N(I)=0:NEXT:IFQ1<QTHENQ1=Q
1627 Q=0:GOTO20
1630 INPUT"COMBAT STRENGTH";C
1635 IFC<500ORC>2000THEN1630
1640 INPUT"SLEEP SPELLS";S:INPUT"CHARMS";R:INPUT"INVISIBILITY";V
1645 INPUT"PREVIOUS LARGEST TREASURE TOTAL";Q1:GOTO20
1650 IFQ1<QTHENPRINT"YOU WON MORE TREASURE THIS TIME THAN BEFORE"
1653 IFQ1>QTHENPRINT"YOU DIDN'T OBTAIN AS MUCH TREASURE THIS TIME"
1660 RETURN
1665 PRINT"YOUR MAGIC TOTAL IS RATHER LARGE.DO YOU WISH CONVERT IT TO"
1670 PRINT"COMBAT POINTS?";:GETX$:IFX$="N"THENRETURN
1675 S1=S1-5:R1=R1-3:V1=V1-2:IFS1<=0THENS1=1
1680 IFR1<=0THENR1=1
1685 IFV1<=0THENV1=1
1690 S=S1:R=R1:V=V1:C=C+100:D=D+100:PRINT"YOUR COMBAT STRENGTH IS";
1695 PRINT" PERMANENTLY INCREASED BY 100":RETURN
1700 PRINT"COMBAT STRENGTH-"D:PRINT"SLEEP SPELLS-"S1:PRINT"CHARMS-"R1
1705 PRINT"INVISIBILITY-"V1:PRINT:RETURN
2000 DATAGOBLIN,10 SILVER SPOONS (10 POINTS),5,10,MINOTAUR
2005 DATAA SWORD WHICH MIGHT BE ENCHANTED (25 POINTS),10,25
2010 DATACYCLOPS,50 SILVER COINS (50 POINTS),20,50,ZOMBIE
2015 DATA100 GOLD PIECES (100 POINTS),30,100,GIANT
2020 DATAAN EMERALD BRACELET (50 POINTS),40,50,HARPY
2025 DATAA TREASURE CHEST (200 POINTS),50,200,GRIFFIN
2030 DATAA PEARL NECKLACE (50 POINTS),60,50,CHIMERA
2035 DATAA JEWELED SWORD (30 POINTS),70,30,DRAGON
2040 DATAA JAR OF RUBIES (75 POINTS),80,75,WYVERN
2045 DATAA BOX OF JEWELS (100 POINTS),90,100,BASILISK
2050 DATAA GOLD GOBLET (50 POINTS),100,50
9000 END
```

```
  -TTTTTTTTT
  T-T-TTTTTT     COMBAT STRENGTH-        1914
  TTT-0TTTTT     TREASURE TOTAL-         0
  TTTTTTTTIT     MAGIC:
  TTTTTTTT-T      SLEEP SPELLS-          2
  T-IT↑TTITI      CHARMS-                1
  -TTTTTTTTT      INVISIBILITY-          1
  TTTTTTTTTT
  TTTTTTTTT-     DAYS IN FOREST-         1.5
  TTT-TTT-TT

 3 CYCLOPSS ARE GUARDING 100 GOLD PIECES (100 POINTS)
DO YOU WISH TO (1)FIGHT,(2)RUN,(3)BRIBE,OR (4)CAST A SPELL?
1HOW MANY COMBAT POINTS DO YOU WISH TO USE? 121
YOU BEAT THE CYCLOPSS
YOU NOW HAVE 100 TREASURE POINTS
WHICH DIRECTION (PRESS 1 FOR THE MAP)? S
WHAT DISTANCE? 3

  -TTTTTTTTT
  T-T-TTTTTT     COMBAT STRENGTH-        1992
  TTT--TTTTT     TREASURE TOTAL-         100
  TTTTTTTTIT     MAGIC:
  TTTTTTTT-T      SLEEP SPELLS-          2
  T-IT↑TTITI      CHARMS-                1
  -TTT0TTTTT      INVISIBILITY-          1
  TTTTTTTTTT
  TTTTTTTTT-     DAYS IN FOREST-         1.8
  TTT-TTT-TT

YOU STOPPED AT AN INN AND REGAINED YOUR STRENGTH
YOU PAID 5 TREASURE POINTS TO STAY THERE
YOU NOW HAVE 95 TREASURE POINTS
WHICH DIRECTION (PRESS 1 FOR THE MAP)? S
WHAT DISTANCE? 7

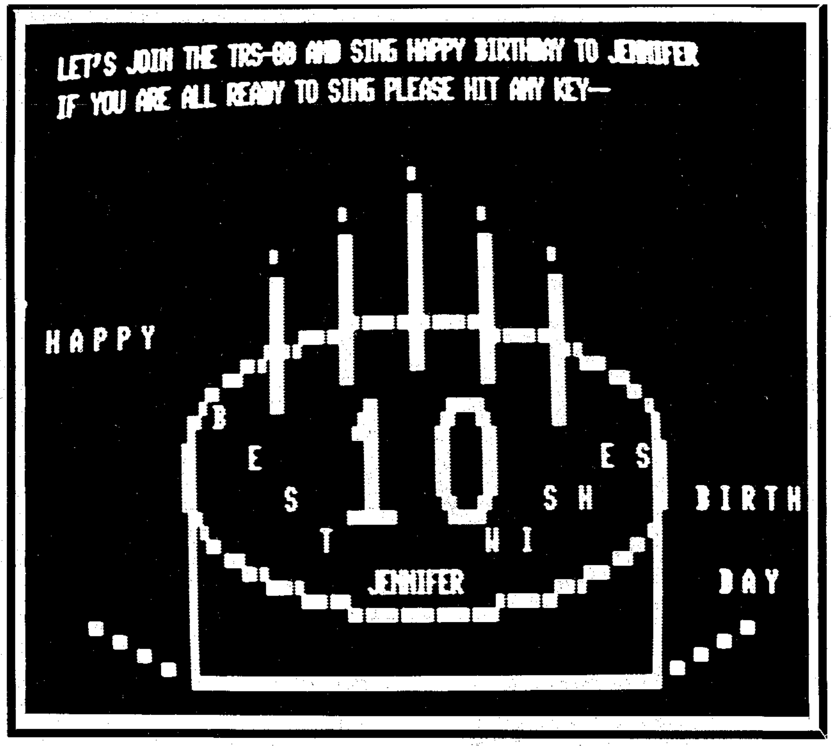
  -TTTTT-T-T
  T----TTT--     COMBAT STRENGTH-        1936
  -T-T-TTT--     TREASURE TOTAL-         95
  -T-T0-I-TT     MAGIC:
  -T--TT--T-      SLEEP SPELLS-          2
  T----TTTT-      CHARMS-                1
  ----TT-T-T      INVISIBILITY-          1
  --TTT---TT
  -T↑T--TTT-     DAYS IN FOREST-         2.5
  T----TTTT-

 19 GOBLINS ARE GUARDING A JEWELED SWORD (30 POINTS)
DO YOU WISH TO (1)FIGHT,(2)RUN,(3)BRIBE,OR (4)CAST A SPELL?
1HOW MANY COMBAT POINTS DO YOU WISH TO USE? 60
THE GOBLINS KILLED YOU. YOU LOSE EVERYTHING
DO YOU WISH TO TRY AGAIN?N

SO LONG.BETTER LUCK NEXT TIME
```

Birthday Celebration

Vida Harper



The next time someone in your family or a friend has a birthday, why not have your TRS-80 join in the celebration? The following program combines graphics and music to produce a unique display which will delight old and young.

The graphics include a cake decorated with best wishes, blinking candles, the person's age, and the name of the one who is celebrating. For an added extra, the computer plays the age-old favorites "Happy Birthday" and "How Old Are You?"

The three positions used depend on whether the birthday kid is one digit, two digits, or three digits old.

The numbers on the cake are constructed by using the 64 possible TRS-80 graphics characters plus the standard ASCII Control Codes. Each one is a block of graphics which are three characters high and six characters wide. By drawing the numbers on a graphics worksheet, one can easily see similarities in the ten digits. In line 370 of the program you will notice that the top third of the 0, 2, 8, and 9 are identical. Since each digit is a block of 18 graphics, it will be an advantage if you recognize similiarities and then define these strings, thus resulting in short cuts. Lines 350 to 550 are the concatenating of the strings which result in producing these ten digits. (Notice that the numerals are named R (0) through R (9) for ease in calling these from memory for display purposes.) In

Vida Harper, 1807 S. Shore Dr., Holland, MI 49423.

```
100 REM *  *                                            *  *
110 REM *  *         BIRTHDAY CELEBRATION               *  *
120 REM *  *           BY VIDA A. HARPER                *  *
130 REM *  *              JUNE  1980                    *  *
140 REM *  *         WRITTEN  FOR  TRS-80               *  *
150 REM *  *           LEVEL II  16K                    *  *
160 REM *  *                                            *  *
170 CLS
180 CLEAR 1000
190 DEFSTR Q,R,S
200 INPUT"DO YOU HAVE YOUR SPEAKER CONNECTED  (Y/N) -- ";QA
210 IF QA ="Y" THEN240
220 PRINT"IF YOU DO NOT HAVE A SPEAKER THEN PLACE AN AM RADIO"
230 PRINT"NEAR THE KEYBOARD SO YOU CAN HEAR THE MUSIC";
    :FORX=1TO2000:NEXTX
240 CLS:PRINT@384,"  B I R T H D A Y    C E L E B R A T I O N"
    :FOR X=1TO500:NEXT
250 PRINT:PRINT
260 INPUT"PLEASE GIVE THE FIRST NAME OF THE BIRTHDAY KID";Q7
270 INPUT"GIVE THE AGE OF THE ONE WHO IS CELEBRATING";Q8
280 L=LEN(Q8):IFL=1THENB=VAL(Q8)
290 IFL=2:C=VAL(LEFT$(Q8,1)):D=VAL(RIGHT$(Q8,1))
300 IFL=3:E=VAL(LEFT$(Q8,1)):F=VAL(MID$(Q8,2,1)):G=VAL(RIGHT$(Q8,1))
310 CLS
320 IFL>3THENPRINT@64,"  Y O U    M U S T    B E    K I D D I N G ! ! ! "
    :FOR X=1TO500:NEXT:GOTO270
330 CLS
340 PRINT@448,"H A P P Y":PRINT@759,"B I R T H":PRINT@889,"D A Y":PRINT@859,Q
350 ' THE NUMBERS ARE BLOCKS (6 ACROSS AND 3 DOWN) OF GRAPHIC
      CHARACTERS
360 Q1=STRING$(5,24)+CHR$(26)   'BACKSPACE 5 AND DOWN FEED
370 'Q2 IS TOP THIRD OF 0,2,8,&9
380 Q2=CHR$(184)+CHR$(135)+CHR$(131)+CHR$(139)+CHR$(180)
390 'Q3 IS BOTTOM THIRD OF 0,6,& 8
400 Q3=CHR$(139)+CHR$(180)+CHR$(176)+CHR$(184)+CHR$(135)
410 'Q4 IS BOTTOM THIRD OF 3 AND 5
420 Q4=CHR$(172)+STRING$(2,CHR$(176))+CHR$(184)+CHR$(135)
430 'Q5 IS TWO BLANK SPACES, Q6 IS 2 OF CHR 140, AND Q9 ERASES
     TO END OF LINE
440 Q5=STRING$(2,CHR$(128)):Q6=STRING$(2,CHR$(140)):Q9=CHR$(30)
450 'BUILDING THE NUMBERS ON THE CAKE BY USING GRAPHICS
460 R(0)=Q2+Q1+CHR$(191)+STRING$(3,CHR$(128))+CHR$(191)+Q1+Q3
470 R(1)=CHR$(128)+CHR$(184)+CHR$(191)+Q5+Q1+Q5+CHR$(191)+Q5+Q1+CHR$(160)
    +CHR$(176)+CHR$(191)+CHR$(176)+CHR$(144)
480 R(2)= Q2+Q1+CHR$(128)+CHR$(176)+CHR$(156)+CHR$(135)+CHR$(129)+Q1
    +CHR$(190)+CHR$(179)+STRING$(3,CHR$(176))
490 R(3)=CHR$(140)+ STRING$(2,CHR$(131))+CHR$(139)+CHR$(180)+Q1+CHR$(128)
    +Q6+CHR$(166)+CHR$(145)+Q1+Q4
500 R(4)=CHR$(160)+CHR$(158)+CHR$(131)+CHR$(191)+CHR$(128)+Q1+CHR$(143)
    +Q6+CHR$(191)+CHR$(140)+Q1+Q5+CHR$(128)+CHR$(191)
510 R(5)=CHR$(190)+STRING$(3,CHR$(131))+CHR$(129)+Q1+CHR$(139)+Q6
    +CHR$(172)+CHR$(144)+Q1+Q4
520 R(6)= CHR$(128)+CHR$(160)+CHR$(158)+CHR$(131)+CHR$(128)+Q1+CHR$(184)
    +CHR$(143)+Q6+CHR$(176)+Q1+Q3
530 R(7)= CHR$(142)+STRING$(2,CHR$(131))+CHR$(163)+CHR$(159)+Q1+Q5
    +CHR$(184)+CHR$(135)+CHR$(128)+Q1+CHR$(160)+CHR$(158)+CHR$(129)
540 R(8)=Q2+Q1+CHR$(162)+CHR$(153)+CHR$(140)+CHR$(166)+CHR$(145)+Q1+Q3
550 R(9)=Q2+Q1+CHR$(131)+Q6+CHR$(188)+CHR$(135)+Q1+CHR$(128)+CHR$(176)
    +CHR$(158)+CHR$(129)
```

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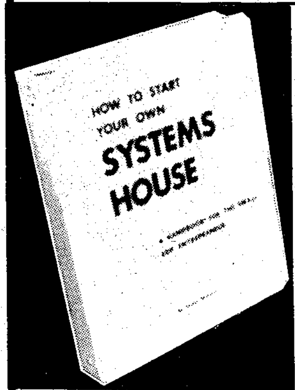

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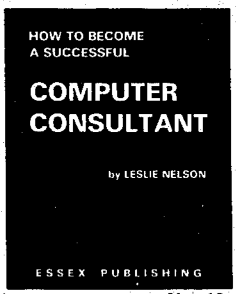

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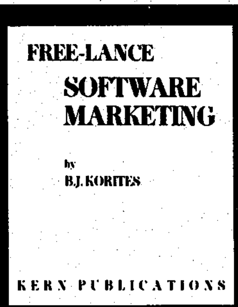

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560 'POSITIONING THE NUMBERS ON THE CAKE ACCORDING TO WHETHER
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570 IFL=1THENPRINT@605,R(B)
580 IFL=2THENPRINT@601,R(C):PRINT@609,R(D)
590 IFL=3THENPRINT@599,R(E):PRINT@605,R(F):PRINT@611,R(G)
600 'DECORATING THE CAKE WITH BEST WISHES
610 N=0:F$="BEST":G=LEN(F$):FORZ=1TOG:G$=MID$(F$,Z,1):PRINT@590+N,G$;
     :N=N+67:NEXT
620 N=0:H$="W  IS  HE  S ":I=LEN(H$):FORX=1TOI/4:I$=MID$(H$,4*X-3,4)
     :PRINT@805-N,I$;:N=N+59:NEXT
630 'BUILDING THE SIDES AND BOTTOM OF THE CAKE
640 X=7:Y=43:FORJ=0TO12 STEP4:SET(X+J,Y+J/4):NEXT
650 X=8:Y=43:FORJ=0TO12 STEP4:SET(X+J,Y+J/4):NEXT
660 FOR X=24TO102:SET(X,47):NEXT
670 X=106:Y=46:FOR J=0TO12STEP4:SET(X+J,Y-J/4):NEXT
680 X=107:Y=46:FORJ=0TO12STEP4:SET(X+J,Y-J/4):NEXT
690 FORY=29TO47:SET(24,Y):NEXT:FORY=30TO34:SET(23,Y):NEXT
700 FORY=29TO47:SET(103,Y):NEXT:FORY=30TO34:SET(104,Y):NEXT
710 'TOP OF THE CAKE USING AN ALTERED CIRCLE FORMULA
720 FOR X=-10TO10STEP.3
730 Y=SQR(110-X*X):SET(4*X+64,Y+32):NEXT
740 FOR X=-10TO10 STEP.3
750 Y=-SQR(110-X*X):SET (4*X+64,Y+32):NEXT
760 ' WHAT'S A CAKE WITHOUT CANDLES
770 FORX=38TO39:FORY=18TO27:SET(X,Y):NEXT:NEXT
780 FORX=50TO51:FORY=15TO25:SET(X,Y):NEXT:NEXT
790 FORX=62TO63:FORY=12TO24:SET(X,Y):NEXT:NEXT
800 FOR X=74TO75:FORY=15TO25:SET(X,Y):NEXT:NEXT
810 FOR X=86TO87:FORY=18TO28:SET(X,Y):NEXT:NEXT
820 ' THE GRAPHICS NECESSARY TO BLINK THE CANDLES
      1= ON AND 2=OFF
830 S(1)=CHR$(132):S(2)=CHR$(128)
840 PRINT@339,S(1);:PRINT@281,S(1);:PRINT@223,S(1);:PRINT@293,S(1);
     :PRINT@363,S(1);:FORX=1TO500:NEXT
850 FOR J=1 TO6:GOSUB 1330:NEXT J
860 'ORIGINAL MUSIC PROGRAM (MACHINE 4K-RAM) WRITTEN BY
     DEAN MCCULLOCH AND PUBLISHED IN TRS-80 USERS GROUP
     NEWSLETTER--NOV. 1978 --FOLLOWING PROGRAM IS FOR 16K
870 FORI=32624TO32662     '870-950 LOADS MACHINE PROGRAM & SETS UP USR
880 READ A
890 POKE I,A
900 NEXT I
910 DATA 205,127,10,14,255,6,1,205,136,127,6,2,205,136,127
920 DATA 43,62,0,180,181,194,117,127,201,237,65,237,91,159,127
930 DATA 27,62,0,178,179,194,142,127,201
940 POKE 16526,112
950 POKE 16527,127
960 PRINT@0,"LET'S JOIN THE TRS-80 AND SING HAPPY BIRTHDAY TO ";Q7
970 PRINT@64,"IF YOU ARE ALL READY TO SING PLEASE HIT ANY KEY--"
980 J$=INKEY$:IF J$=""THEN980ELSE1210
990 FOR J= 1 TO D        'FQ IS FREQUENCY--TM IS THE TIME DESIRED
1000 READ FQ,TM:CY=INT(FQ*.6*TM):IF FQ=0ANDTM=0 THEN 1320
1010 IF FQ>5000 THEN FQ=5000       'CHECK FOR FREQUENCY OUT OF RANGE
1020 IF FQ<50 THEN FQ=50
1030 D%=0:DE%=29480/FQ          'FIND AND STORE HALF WAVE TIME DURATION
1040 IF DE%>512 THEN D%=2:DE%=DE%-512
1050 IF DE%>256 THEN D%=D%+1:DE%=DE%-256
1060 POKE 32671,DE%:POKE 32672,D%
1070 X=USR(CY)              'CALL MACHINE PROGRAM
1080 NEXT J
1090 PRINT@0,"MAKE A WISH ";Q7;" AND BLOW OUT YOUR CANDLES!!! ";:PRINTQ9;
1100 PRINT@64,Q9
1110 FOR J= 1 TO 3:GOSUB 1330:NEXTJ
1120 PRINT@64,"OH COME ON YOU CAN BLOW HARDER THAN THAT!!!";:PRINTQ9
1130 FORJ=1TO2:GOSUB1330:NEXTJ
1140 PRINT@339,S(2);:PRINT@281,S(2);:PRINT@223,S(2);:PRINT@293,S(2);
     :PRINT@363,S(2);
1150 PRINT@128,"CONGRATULATIONS YOU WILL GET YOUR WISH!!!";
1160 FORJ=1TO1000:NEXTJ
1170 PRINT@0,"HOW ABOUT A FINAL CHORUS OF --- HOW OLD ARE YOU---";:PRINTQ9;
1180 PRINT@64,"HIT ANY KEY WHEN THE GANG IS READY TO SING!!!"
1190 PRINT@192,"HAVE A GREAT BIRTHDAY--";Q7;
1200 J$=INKEY$:IFJ$=""THEN1200ELSE1220
1210 AD=39:D=25:RESTORE:GOTO 1230
1220 AD=89:D=23:RESTORE
1230 FORW=1TOAD:READA:NEXTW:GOTO990
1240 DATA 264,.5,264,.5,297,.5,264,.5,352,.5,330,1
1250 DATA 264,.5,264,.5,297,.5,264,.5,396,.5,352,1
1260 DATA 264,.5,264,.5,528,.5,440,.5,352,.5,330,.5,297,1
1270 DATA 465,.5,465,.5,440,.5,352,.5,396,.5,352,2
1280 DATA 264,.5,297,.5,264,.5,352,.5,330,1
1290 DATA 264,.5,297,.5,264,.5,396,.5,352,1
1300 DATA 264,.5,528,.5,440,.5,352,.5,330,.5,297,1
1310 DATA 465,.6,440,.6,352,.6,396,.6,352,2,0,0
1320 FOR J=1 TO 1000:NEXTJ:RESTORE:GOTO 280
1330 PRINT@339,S(2);:PRINT@223,S(2);:PRINT@363,S(2);:FORX=1TO8:NEXT
1340 PRINT@339,S(1);:PRINT@223,S(1);:PRINT@363,S(1);:FORX=1TO600:NEXT
1350 PRINT@281,S(2);:PRINT@293,S(2);:FORX=1TO8
1360 PRINT@281,S(1);:PRINT@293,S(1);:FORX=1TO600:NEXT:RETURN
```

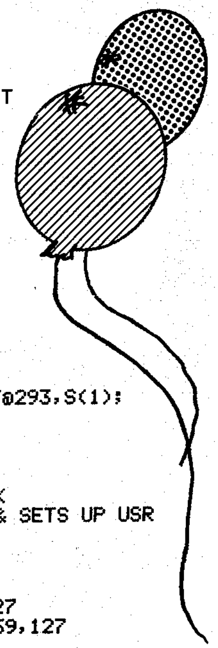

lines 570, 580 and 590 the numerals are placed on the cake with PRINT@ statements. The three positions used depends on whether the birthday kid is one digit, two digits, or three digits (???) old. The blinking of the candles is done by using graphic blocks 128 and 132, and timer loops combined with subroutines.

Now an explanation about the music in the last part of the program: The original tone generator program used here was published in the Nov. 1978 issue of *TRS-80 Users Group Newsletter* of Fayetteville NC. Dean McCulloch, the author, uses a machine program to produce a single frequency of short duration. (Mr. McCulloch has given full consent of the use of his tone generator program, which is incorporated into my program.) His original music program of "O Come All Ye Faithful" uses the cassette recorder as the note generator. You first remove the cassette tape and push down the play and record buttons simultaneously, then connect a speaker into the ear plug.

Lines were added so that the additional graphics, including blowing out the candles, would be executed between the playing of the two songs.

The Birthday Celebration program listed here uses this tone generator program of Mr. McCulloch with a few minor changes. The machine language program was expanded to a 16K location, and to speed up the tempo a .6 factor of TM (time) was inserted in line 1000. Of course the pairs of data in lines 1240 to 1310 had to be changed to coincide with the notes and timing of "Happy Birthday" and "How Old Are You?" The following notes and identified frequencies are suggested for use:

B (215) Middle C (233) D (264)
D# (286) E (297) F (319) F# (330)
G (352) A (396) B (440)
High C (465) D (528) and E (600).

Improvements are left to the musically minded readers. Lines 960-980 and 1090-1200 were added to the original music program, so that the additional graphics, including blowing out the candles, would be executed between the playing of the two songs.

Here's hoping that your TRS-80 will be invited to attend many birthday celebrations.

Personal Note: The inspiration behind this program was the desire to have something special to help celebrate my father's 90th birthday last fall. Since he claims that he will live to be 100, the program has the capabilities of positioning three digit numbers on the cake. □

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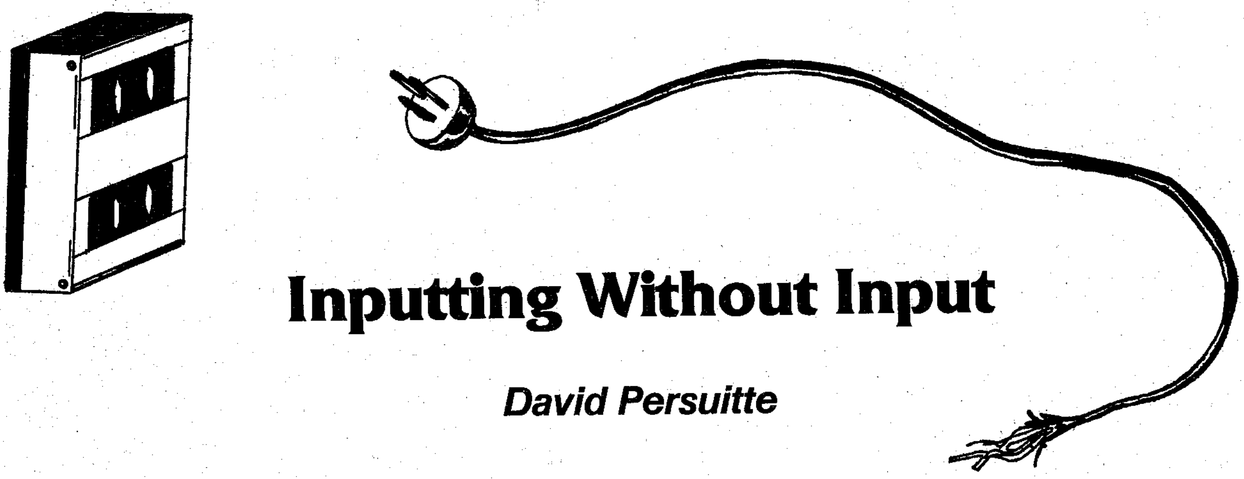

Inputting Without Input

David Persuitte

Making programs easy to use is hard. Here's some help for input on the Z-80.

It sometimes seems that Basic fights itself — or rather the person using it. A case in point is an apparent conflict between the INPUT statement and string functions. Theoretically, a string should be able to hold any of the standard characters, but someone using an INPUT statement to enter those characters into a string is likely to come out with something a bit different than he intended.

For example, suppose you whip a little program to sort out names. You try running the program and the query comes up as you intended — say:

ENTER NAME?

You casually enter the first name:

Smith, John H.

Your trusty computer responds with:

?EXTRA IGNORED

"What the heck does that mean?" you ask yourself.

You eventually find out when the time comes to print out the name. Whereas you had entered Smith, John H., the computer comes back with simply:

Smith

You go back to your Basic manual and find that an INPUT statement looks for a series of variables when it comes across a comma in the response. If the program was not set up to accept variables in the response field of the INPUT statement, the Basic interpreter will respond with ?EXTRA IGNORED. But — you say to yourself — you don't *want* a series of variables. All you want is a name with a comma separating its parts. You look further and find that you can use a comma if you enclose the whole name with quotation marks. The quotation marks won't come out in the printed out name, so you decide that is the way to go even if it is a bit of a bother.

While you are working on another program, however, you find yourself in a situation in which you actually want to enter quotation marks into a string by using an INPUT statement. How do you do that? You now find that using a colon has a result similar to that of a comma. And what about the carriage return? If you want to enter a carriage return into a string, you sure can't do it with an INPUT statement. A carriage return terminates the response and does not go into the string.

Obviously, while the INPUT statement is a handy means of entering information into a string, it does have its limitations. There is a way around this limitation, though. Rather than using the INPUT statement, you can have your program enter the characters into the string directly from the keyboard. The accompanying program is a model show-

```
LIST

10 REM   KEYBOARD INPUT, BY DAVID PERSUITTE
20 REM
30 CLEAR 600
40 FOR I=1 TO 9
50 READ X1,X2
60 POKE X1,X2
70 NEXT I
80 DATA 1,205,2,9,3,224,4,50,5,0,6,0,7,201,260,1,261,0
90 A$=""
100 PRINT CHR$(12)
110 PRINT CHR$(17);"ENTER INFORMATION:"
120 PRINT
130 FOR C=0 TO 254
140 V=USR(0):IF PEEK(0)=0 THEN140
150 Z=PEEK(0):IF Z<32 THEN210
160 A$=A$+CHR$(Z):PRINT CHR$(Z);:NEXT C
170 GOTO250
180 LET C=C+1:IF C=253 THEN250
190 LET A$=A$+CHR$(10):PRINT CHR$(10);
200 GOTO160
210 IF Z=13 THEN180
220 IF Z=4 THEN250
230 IF Z=8 THEN360
240 GOTO140
250 PRINT:PRINT CHR$(17);CHR$(12);"INFORMATION IN STRING."
260 FOR I=1 TO 1000:NEXT I
270 PRINT "DO YOU WANT INFORMATION DISPLAYED?"
280 V=USR(0):IF PEEK(0)=0 THEN280
290 PRINT:PRINT
300 IF CHR$(PEEK(0))="Y" OR CHR$(PEEK(0))="y" THEN PRINT A$
310 PRINT:
320 PRINT:PRINT "DO YOU WANT TO ENTER NEW INFORMATION?"
330 V=USR(0):IF PEEK(0)=0 THEN330
340 IF CHR$(PEEK(0))="Y" OR CHR$(PEEK(0))="y" THEN 90
350 GOTO380
360 PRINT CHR$(8);:IF C=0 THEN140
370 C=C-1:A$=LEFT$(A$,C):GOTO140
380 END
READY
```

David Persuitte, 1707 Independence Ct., Severn, MD 21144.

ing how to do this. It is designed to run on an Exidy Sorcerer, but with a few modifications it should run on most other personal computers. It should also be used in a larger user program which requires the capability of entering a full character set into a string. An additional value of this program is that it demonstrates how to request a response without the user's having to terminate it with a carriage return.

To use direct keyboard entry, it is necessary to enter a machine language routine in a user-available part of RAM. In the program listing, line numbers forty through eighty accomplish this by entering the appropriate Z-80 codes in the Sorcerer user RAM. The machine-language routine monitors the keyboard for an input. When it finds an input, it enters the character code into RAM location zero where the Basic routine can pick it up with a PEEK and concatenate it into the string. This machine-language part of the program must be tailored to the individual type of computer.

As the Basic program is set up here, it allows 255 characters to be entered into a string — in this case, the A$. It is possible to enter carriage returns into the string, but of necessity a line feed is automatically added to prevent overprinting. The consequence of this is that a carriage return takes up two characters in the string. Line numbers 180 and 190 take care of the required code entries.

Since the program bypasses some of the Basic functions, errors that are made during data entry cannot be corrected by the shift rub. Instead, this program checks for control H, which, if entered, backs up the prompt just as the shift rub would. Line numbers 360 and 370 perform this operation. Also, since carriage returns can be entered into the string, they cannot be used to terminate the entry. A control D is used instead. When the control D is pressed, the program goes to line number 250, which tells you that the information has been entered into the string. This also occurs if the string becomes filled up while you are entering your information.

After the string has been filled up, the program asks you if you want the information displayed. Again, instead of using an INPUT statement such as might have been used, the direct keyboard method is used (line number 280). All you have to do is type in "Y" or "y" (without the quotes) for "yes" and the program will display the information; a carriage return is not necessary. If you decide not to have the information displayed, simply type in "N" or "n" for "no" and the program will ask if you want to enter new information (line numbers 320 to 340). If you answer with a "Y", the program will start over again.

Again, this program is just a model for demonstration purposes. You can modify it to fit your own user program, perhaps by enlarging the string to a string array. □

Computer Store of the Month

MICROLITHICS

There are now numerous computer stores opening up all over the country due to an expanding market in computer technology. We at Creative Computing would like to honor some of the stores which were the earlier pioneers in the field. We commend their foresight and their service and dedication to the industry.

Charles and Patricia Gibson started out as proprietors of Bits, Bytes, and Micros in December of 1976. By July of 1977, the store was expanded and incorporated as Microlithics, Inc. In July of 1980, they moved to their third and present location with 3800 square feet in order to service their customers better.

Microlithics is a complete service center. The store stocks large amounts of software, books, and computer magazines, and offers components, boards, main frames, and complete systems for home, business, industry, and education. The store supports Apple, Atari, Texas Instruments, Data General, Vector Graphics, and Zenith. Microlithics also offers courses in Basic, advanced Basic, Cobol, and specialized training.

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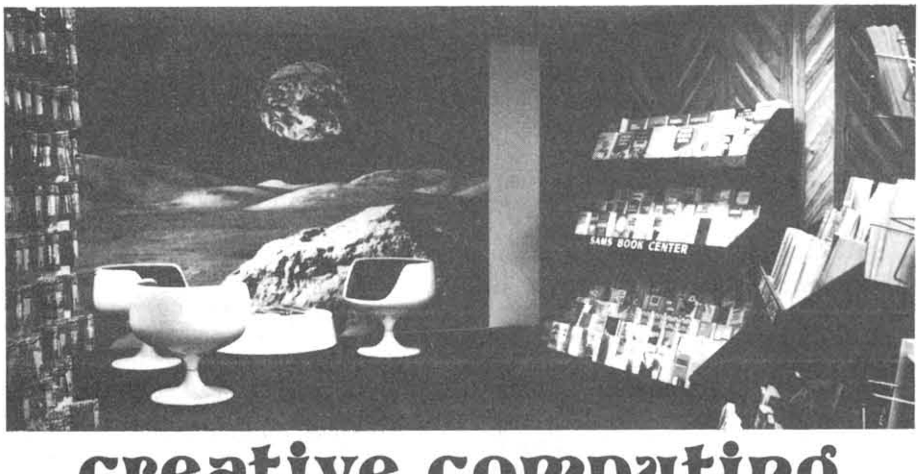

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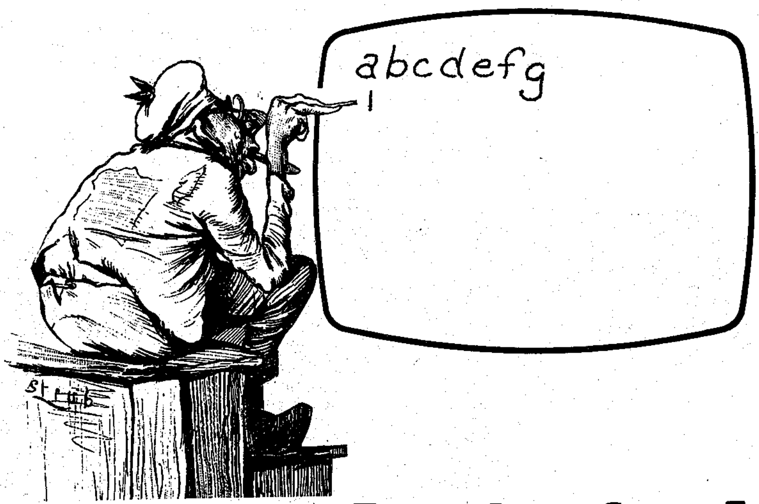


Lower-Case Display for Apple Writer

John E. Stith

Writing consumes almost all of the time I spend on my Apple II computer. Therefore, I was happy to see the arrival of several new text processor software packages for the Apple II. Unfortunately, no single package perfectly met my needs, so I decided to purchase one that came close and to modify it.

I examined three prominent text processors: Apple Writer, EasyWriter, and Super-Text. All three packages are versatile, comprehensive programs which run much faster than any Basic-language text editor and formatter I have tried, but each has its own disadvantages for my application, writing. All three packages fully support upper and lower-case printout, but they all have their own restrictions on lower-case display on the Apple II Monitor. The following paragraphs outline the drawbacks I found in each package. These may or may not be drawbacks to other users.

Apple Writer has a convenient file format and easy-to-use upper/lower-case shifting, but has the drawback of not displaying lower-case letters on the screen during editing. (It, like EasyWriter, uses inverse letters for capitals and normal upper-case characters to represent lower-case characters.)

EasyWriter is a flexible package but has two drawbacks for me. First, it uses its own file structure, incompatible with Apple DOS 3.2, so any text I already have that I would like to use with EasyWriter would have to be completely re-entered.

John Stith, P.O. Box 7463, Colorado Springs, CO 80933.

Therefore, I decided that, as is, no one of the three packages suited my needs. I picked the one that came closest and decided to buy and modify Apple Writer (after first calling Apple Computer and being assured that no plans existed for marketing a lower-case display version.)

It is more appropriate to tailor hardware/software systems to sound human-engineering concepts, rather than force the human to adapt to painful machine restrictions.

That alone is enough to prohibit me from converting to it; but, additionally, it doesn't support lower-case screen display unless you spend more on extra hardware than the purchase price of EasyWriter.

Super-Text has a convenient file format and has upper/lower-case, on-screen display, using the Dan Paymar lower-case adapter, which costs $50 and is well worth the price. Super-Text, however, has three significant drawbacks for my application. First, it has a cumbersome method of shifting in and out of upper case via control characters. Second, it uses embedded control characters for formatting, so it's difficult to exchange text with other ASCII computers. Third, it has no ability to print page headers automatically, a must for writing.

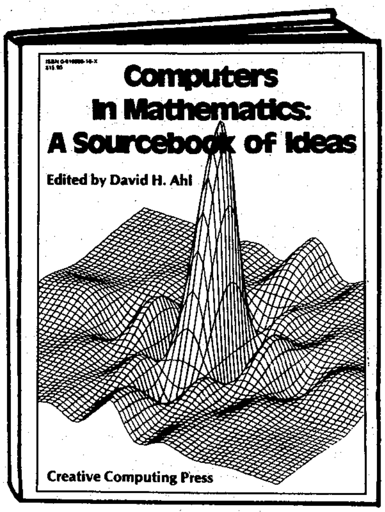
With the continued decrease in cost of computer capability, and the increasing cost of labor, I think it is more appropriate to tailor hardware/software systems to sound human-engineering concepts, rather than force the human to adapt to painful machine restrictions. It's obviously possible to make do with constraints such as inverse video to represent upper-case characters, or reading binary rather than decimal numbers, but I don't like to do it when it's unnecessary and time-wasting.

The Modifications

The balance of this article shows the modifications I made to Apple Writer to get around the problem of no on-screen, lower-case display. These modifications all depend on having the Dan Paymar lower-case adapter installed on the Apple II. The adapter has been described extensively in print, but, briefly, it is a small accessory that plugs into the Apple II in place of the normal character generator ROM. The Apple II operates normally, in both text and graphic modes, with the exception that lower-case characters are also included in the character set. The only limitation is that the new lower-case characters cannot

Sourcebook of Ideas

Many mathematics ideas can be better illustrated with a computer than with a text book.



Consider Baseball cards. If there are 50 cards in a set, how many packs of bubble gum must be purchased to obtain a complete set of players? Many students will guess over 1 million packs yet on average it's only 329.

The formula to solve this problem is not easy. The computer simulation is. Yet you as a teacher probably don't have time to devise programs to illustrate concepts like this.

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New Character Input and Conversion Routines for TEDITOR Program

```
18A0-  48        PHA                     ***CONVERT***
18A1-  A5 0C     LDA $0C    CONVERT CASE?
18A3-  D0 02     BNE $18A7  YES, BRANCH
18A5-  68        PLA
18A6-  60        RTS        DONE
18A7-  68        PLA
18A8-  C9 C0     CMP #$C0   UPPER CASE?
18AA-  30 12     BMI $18BE  NO, BRANCH
18AC-  C9 E0     CMP #$E0
18AE-  10 04     BPL $18B4  NO, BRANCH
18B0-  09 20     ORA #$20   CONVERT TO LOWER
18B2-  D0 0A     BNE $18BE  ALWAYS BRANCH
18B4-  C9 E0     CMP #$E0   LOWER CASE?
18B6-  30 06     BMI $18BE  NO, BRANCH
18B8-  C9 FF     CMP #$FF
18BA-  10 02     BPL $18BE  NO, BRANCH
18BC-  29 DF     AND #$DF   CONVERT TO UPPER
18BE-  60        RTS        DONE
18BF   00        BRK        SPACE FILLER
18C0-  C9 83     CMP #$83   CTRL-C?      ***INPUT***
18C2-  D0 03     BNE $18C7  NO, BRANCH
18C4-  09 E0     ORA #$E0   YES, MAKE LOWER CASE
18C6-  60        RTS        DONE
18C7-  48        PHA
18C8-  A5 0B     LDA $0B    HAVE TO CONVERT?
18CA-  D0 08     BNE $18D4  YES, BRANCH
18CC-  68        PLA
18CD-  C9 A0     CMP #$A0   BLANK?
18CF-  D0 02     BNE $18D3  NO, BRANCH
18D1-  A9 20     LDA #$20   DON'T CARE CHARACTER
18D3-  60        RTS        DONE
18D4-  68        PLA
18D5-  C9 C0     CMP #$C0   UPPER CASE?
18D7-  30 06     BMI $18DF  NO, BRANCH
18D9-  C9 E0     CMP #$E0
18DB-  10 02     BPL $18DF  NO, BRANCH
18DD-  09 20     ORA #$20   CONVERT TO LOWER
18DF-  60        RTS        DONE
18E0-  48        PHA                     ***BELL***
18E1-  A5 70     LDA $70    POP DESIRED?
18E3-  F0 05     BEQ $18EA  NO, BRANCH
18E5-  A0 0A     LDY #$0A   LOAD DURATION
18E7-  20 E4 FB  JSR $FBE4  BELL2 IN MONITOR
18EA-  68        PLA
18EB-  60        RTS        DONE
```

Figure 1. New Character Input and Conversion Routines for TEDITOR Program.

Patches to Apple Writer TEDITOR Program

```
0813-  20 E0 18  JSR $18E0  CALL BELL

14FA-  4C A0 18  JMP $18A0  JUMP TO CONVERT

1501-  4C C0 18  JMP $18C0  JUMP TO INPUT

1530-  EA        NOP        ELIMINATE INVERSE CURSOR
1531-  EA        NOP
1532-  EA        NOP
1533-  EA        NOP
1534-  F0 DF     BEQ $1515  BRANCH ALWAYS

1549-  20 01 15  JSR $1501  GET CORRECT VALUE TO PRINT
154C-  20 F0 FD  JSR $FDF0  PUT IT ON SCREEN
154F-  A9 C0     LDA #$C0   RESET FOR LOWER CASE
1551-  85 0B     STA $0B
1553-  EA        NOP
```

Figure 2. Patches to Apple Writer TEDITOR Program.

New Character Input Routine for PRINTER Program

```
INPUT
18E0-  48        PHA
18E1-  A5 10     LDA $10    CONVERT TO LOWER CASE?
18E3-  D0 02     BNE $18E7  YES, BRANCH
18E5-  68        PLA
18E6-  60        RTS        DONE
18E7-  68        PLA
18E8-  C9 C0     CMP #$C0   UPPER CASE?
18EA-  30 06     BMI $18F2  NO, BRANCH
18EC-  C9 E0     CMP $#E0
18EE-  10 02     BPL $18F2  NO, BRANCH
18F0-  09 20     ORA #$20   CONVERT TO LOWER CASE
18F2-  60        RTS        DONE
```

Figure 3. New Character Input Routine for PRINTER Program.

be flashed or shown in inverse video.

Since Apple Computer does not provide the source code for Apple Writer, I have no absolute guarantee that the portion of memory that contains my patches will never be destroyed, but in thorough testing and in writing this article, I had no problems at all.

Figure 1, New Character Input and Conversion Routines for TEDITOR Program, shows the additional code I wrote for the text editor program. It resides at 18A0 through 18EB. (All addresses in this article are in hex.) CONVERT, located at 18A0, is the routine used during the case-change mode, changing upper case to lower case and vice versa. All other characters are left untouched. INPUT, at 18C0, is the routine that handles case shift during text entry. It traps for control-C, since that character is used as an end-of-text indicator and would accidentally truncate text if entered into the text buffer. INPUT also converts a pseudo-character, an upper-case blank, for use as a don't-care character in string searches and replacements. The third routine, BELL, at 18E0, simply sounds a pop each time a character is entered in the text-input mode, if enabled by the control-P function of Apple Writer. BELL is optional, but if you omit it, you must also omit the patches for it in Figure 2.

Figure 2, Patches to Apple Writer TEDITOR Program, shows the changes that must be made to TEDITOR so that it calls the subroutines shown in Figure 1 at the correct times. The change at 0813 calls BELL upon character input. It is optional. The change at 14FA calls the CONVERT subroutine rather than execute the original Apple Writer version. The change at 1501 does the same for INPUT. The code at 1530 eliminates the inverse video feature. The change at 1549 causes the correct case to be displayed on the screen.

Figure 3, New Character Input Routine for PRINTER Program, shows the additional code that I wrote for the text formatter program. It resides at 18E0 through 18F2. It converts to the correct case when the page header is being entered. As in the regular editor, an ESCAPE entered causes the next input character to be upper case. In the editor, the case-change feature lets you change the case of as many characters as you want.

Figure 4, Patches to Apple Writer PRINTER Program, shows the changes that must be made to PRINTER so that it calls the subroutine in Figure 3 at the correct time and so that it handles case conversion correctly. The value at 0F56 corrects a check for an exclamation point in the text (used for text formatting) to the correct ASCII value. The code at 1095 jumps to the new CONVERT subroutine shown in Figure 3. The code at 10C8 eliminates the inverse cursor when typing in the header. The code at 12D8 eliminates most of the printer character output conversion routine since, with these modifications, the text buffer is now in ASCII (with the most significant bit in each byte set on.) The data at 1569 corrects the values to check against for lower-case letters used in text formatting parameters. The patches at 15DF, 15E3, 15E7, and 15FC correct parameters in the routine that converts characters that follow text formatting commands into binary numbers.

How to Make the Changes

Figure 5, Modification Checklist, shows a step-by-step procedure that will allow you to take the disk supplied with Apple Writer and generate a lower-case display version on your own disk. The character representations will be different from the original Apple Writer, but if you have a lot of text to convert, you can write

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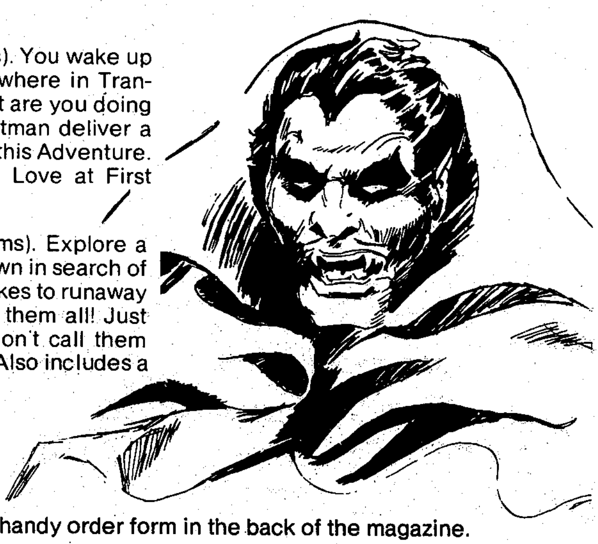

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Lower Case, continued...

a short program to do it. Once you are finished, you can use the lower-case version using the same rules as published in the Apple Writer manual.

The following buffer format is provided for those individuals who would like to use Apple Writer with text already created. The program uses binary (B) files to save text on disk. The text buffer starts at 1900 and can go up to 959F. The first byte of data must be a hex 83 and the last must be a hex 60. All characters inbetween, in the lower-case version, are normal ASCII characters, with the most significant bit set on. (The unmodified Apple Writer uses the same format except that most of the characters are not in ASCII representation.) Once the text is in the buffer, do a BSAVE TEXT. YOUR FILE NAME, A$1900, L$YOUR LENGTH.

The text editor program in Apple Writer is easy to use and very powerful, but perhaps future versions of the text formatter will incorporate more advanced features.

Then you can load the file under control of Apple Writer. You may see some garbage characters at the end of the buffer because there's no hex 60 end-of-text byte, but you can quickly delete them.

If you have a lot of text files, you can use the Disk Zap program from Apple PugetSound Program Library Exchange (A.P.P.L.E.). It enables you to modify your disk directory to tell Apple DOS that your text file is a binary file and then BLOAD FILE NAME, A$1900.

As with almost any program, there are extra features that would make nice improvements. The text editor program in Apple Writer is easy to use and very powerful, but perhaps future versions of the text formatter will incorporate more advanced features such as including headers in text files, pauses while printing, skipping headers on the first page, and printing only a specified range of page numbers. The Technical Systems Consultants' Text Processing System for the Motorola 6800 is an ideal example. But Apple Writer is a great improvement over the first generation of Apple text editors and processors. I hope the addition of lower-case display capability will make it even more useful. □

```
                  Patches to Apple Writer PRINTER Program

0F56-   A1           DATA        ASCII EXCLAMATION POINT

1095-   4C E0 18     JMP $18E0   CALL INPUT

10C8-   EA           NOP         ELIMINATE INVERSE CURSOR
10C9-   EA           NOP
10CA-   EA           NOP
10CB-   EA           NOP
10CC-   F0 DF        BEQ $10AD   BRANCH ALWAYS

12D8-   4C FB 12     JMP $12FB   SKIP CONVERSION

1569-   EC           DATA        ASCII l (LOWER CASE L)
156A-   ED                       m
156B-   F2                       r
156C-   ED                       m
156D-   F4                       t
156E-   ED                       m
156F-   E2                       b
1570-   ED                       m
1571-   F3                       s
1572-   F0                       p
1573-   EC                       l
1574-   EA                       j
1575-   E3                       c
1576-   EA                       j
1577-   F2                       r
1578-   EA                       j
1579-   E6                       f
157A-   EA                       j
157B-   EE                       n
157C-   F0                       p

15DF-   A0                       BLANK

15E3-   B0                       0

15E7-   BA                       "9" + 1

15FC-   B0                       0
```

Figure 4. Patches to Apple Writer PRINTER Program.

```
                          Modification Checklist

1.   Follow the steps outlined in the Apple Writer manual to make a
copy of the Apple Writer disk.  DO NOT modify the original Apple Writer
disk.  Also, do not LOCK the TEDITOR and PRINTER files on the working
copy, yet.  For all following steps that say to type in text, follow
each line with a carriage return.

2.   Reboot the system from the working disk copy.  (Apple Writer is
intended to run under DOS 3.2.)

3.   In response to the editor menu, type:
Q

4.   Type:
BLOAD TEDITOR

5.   After the program is loaded, reset the system, placing control in
the Apple monitor.  (If you have an Apple II Plus, use Apple's
recommended method of getting into the Apple monitor.)

6.   Using the monitor, install the patches shown in figures 1 and 2 by
typing the following input lines:
18A0: 48 A5 0C D0 02 68 60 68 C9 C0
18AA: 30 12 C9 E0 10 04 09 20 D0 0A
18B4: C9 E0 30 06 C9 FF 10 02 29 DF 60 00
18C0: C9 83 D0 03 09 E0 60 48 A5 0B
18CA: D0 08 68 C9 A0 D0 02 A9 20 60
18D4: 68 C9 C0 30 06 C9 E0 10 02 09 20 60
18E0: 48 A5 70 F0 05 A0 0A 20 E4 FB 68 60
At this point, you should double-check your entries by typing 18A0L and
successive L's to disassemble the code and compare it to figure 1.
```

Figure 5. Modification Checklist.

Figure 5 - Continued

Next, type the following lines:

```
0813: 20 E0 18
14FA: 4C A0 18
1501: 4C C0 18
1530: EA EA EA EA F0
1549: 20 01 15 20 F0 FD A9 C0 85 0B EA
```

To check these inputs, type the following lines and compare the code to figure 2.

```
0813L
14FAL
1501L
1530L
1549L
```

Once you are satisfied that all of the changes were entered properly, move on to the next step. If you made errors that are too hard to correct, you can start over at step number 2.

7. To go back to BASIC, type:

```
3D0G
```

8. To save the new version to disk, type:

```
BSAVE TEDITOR,A$803,L$10FB
```

(This will save a few more bytes than actually necessary.)

9. To protect your efforts, type:

```
LOCK TEDITOR
```

10. Type:

```
BLOAD PRINTER
```

11. After PRINTER is loaded, reset the system to get into the monitor.

12. Using the monitor to install the patches shown in figures 3 and 4, type the following input lines:

```
18E0: 48 A5 10 D0 02 68 60 68 C9 C0
18EA: 30 06 C9 E0 10 02 09 20 60
18E0L
```

(This last entry will allow you to double-check against the code in figure 3. Reenter it if necessary.)

Now type the following lines. (Most of them are parameter changes. Enter them carefully since you won't be able to double-check by disassembling them.)

```
0F56: A1
1095: 4C E0 18
10C8: EA EA EA EA F0
12D8: 4C FB 12
1569: EC ED F2 ED F4 ED E2 ED F3 F0
1573: EC EA E3 EA F2 EA E6 EA EE F0
15DF: A0
15E3: B0
15E7: BA
15FC: B0
```

Now, use the monitor to inspect this last set of input values to make sure that you entered them correctly. If you find an incorrect value, you are running the risk that you typed in an incorrect address during the changes and therefore wiped out some random section of memory, possibly in Apple Writer itself, or DOS. Once you are satisfied that the changes were entered correctly, proceed to step number 13. If you make errors, you can reboot the system, type Q, and start over at step 10.

13. To get back to BASIC, type:

```
3D0G
```

14. To save the modified text processor, type:

```
BSAVE PRINTER,A$803,L$10FB
```

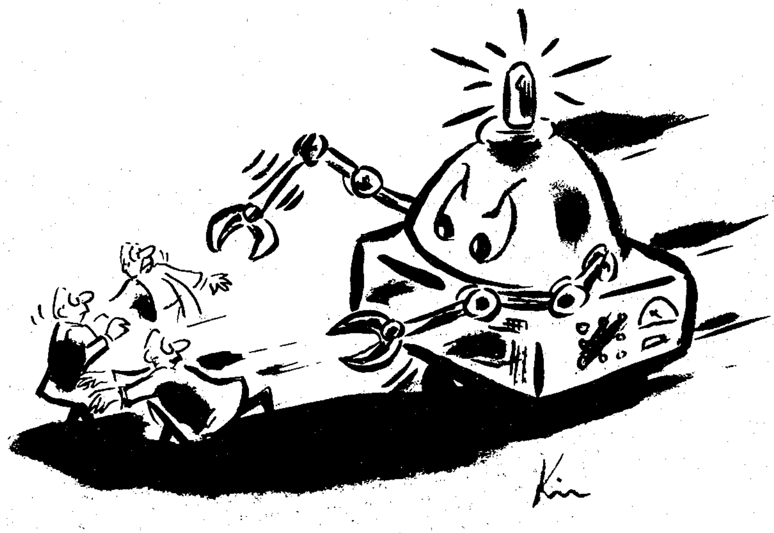
(This saves a few more bytes than actually necessary.)

15. To protect your efforts, type:

```
LOCK PRINTER
```

16. Your working copy is now complete. To try it out, reboot the system using the working copy. If your Dan Paymar lower-case adapter is installed, you should see lower-case letters as you enter text in the text-insert mode.

17. Once you are satisfied that your new version is working, you can copy it to a backup disk, using the same procedure as in the Apple Writer manual. Just remember that the L field on the BSAVE commands for the TEDITOR and PRINTER programs is now $10FB rather than $1040 since both programs are now a bit longer. The control-P function in Apple Writer will now turn on a short pop that sounds each time a character is input in the text mode (unless you omitted the applicable changes.)



An Introduction to Computer Control

Ronald K. Pearson

Computer control of real-world gadgets is a fascinating subject, combining hardware and software in about equal proportions. For this reason, most practitioners of automatic control around the home are those who enjoy building their own hardware, writing their own software and debugging both. A few manufacturers, however, do seem to have sensed the commercial possibilities inherent in this idea and it is not unreasonable to expect more to follow suit as it catches on. (See, for example, Paul Daro's description of the Introl/X-10 system in the November 1979 issue of *Creative Computing.*) Still more basic than the question of building or buying, however, are those of exactly what to build or buy and what you get for the trouble. The best way to approach these questions is to consider a few typical examples.

A Simple Controller

The simplest type of controller is the on/off switch. Lamps, coffee pots, home-made automatic donut makers and an unending variety of other gadgets can be automated by providing your computer with the ability to connect and disconnect them from their power sources. To do this, some sort of computerized on/off switch must be available for each appliance, as shown in the block diagram of Figure 1.

The simplest type of controller is the on/off switch.

Other necessary components are the computer itself, of course, a CRT or other device for communicating with the user, and a collection of interface hardware to make the computer controlled switches compatible with the computer's I/O ports or expansion bus.

There are nearly as many devices that can serve as computer-controlled on/off switches as there are devices to be turned on or off. The most common examples are electromagnetic relays, solid state relays, bipolar transistors, FET's, CMOS analog switches, SCR's and TRIAC's. The three main considerations in selecting one of these devices for any particular application are the nature of the power to be switches (i.e., AC or DC), the maximum value of the voltage that will appear across the switch when it is open and the maximum value of the current that will flow through the switch when it is closed. For household appliance control, the switch must be capable of handling 120 volts AC at currents from less than an amp for night lights and reading lamps to 10 amps or more for toasters and coffee pots. Solid state relays are an ideal choice for this type of control application because they are generally cheap and designed to be easy to interface to digital logic. However, the most common of these devices have fairly limited current capacities (typically an amp). Higher-current versions can be found if you are persistent. Alternatively, SCR's and TRIAC's are readily available with current ratings of 20 amps or more, although they are not as easy to interface. Finally, a somewhat inelegant but effective means of handling high current loads is to use a low-current solid-state relay to turn on or off an AC electromagnetic relay

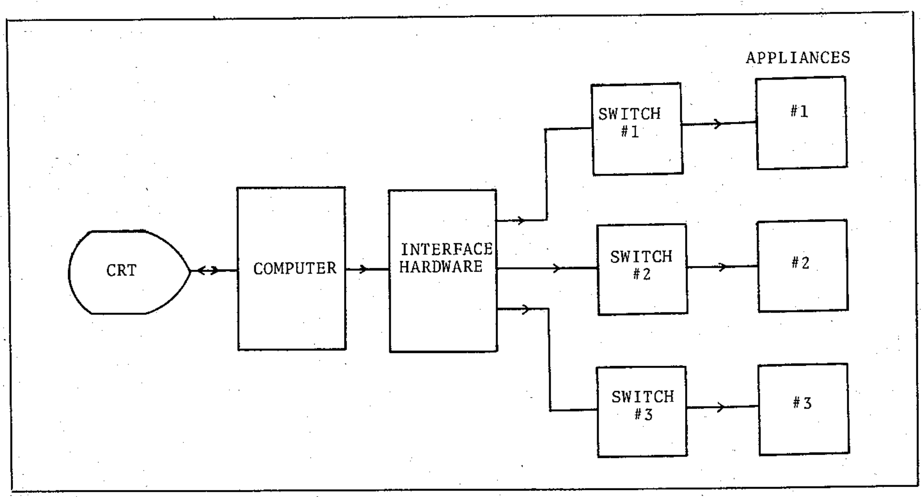


Figure 1.
On/off Control System.

Ronald K. Pearson, 123 Elm St., Apt. B11, Quincy, MA 02169.

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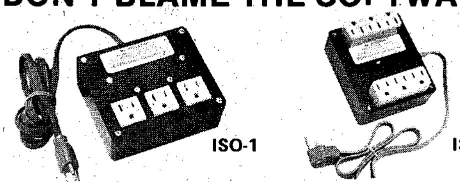

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The task of interfacing any computer controlled switch to its computer varies widely in expense and complexity with the details of both the computer's I/O hardware and the chosen switch. In the simplest case, the interface hardware will consist of a few TTL ("transistor-transistor logic") integrated circuits between an available peripheral I/O port and a relatively compatible device like a solid-state relay. In more complex cases, it may be necessary to add your own I/O ports to the expansion bus, interface different logic families and provide electrical isolation between this logic and the device to be controlled. Note that even if both the switch and the I/O port to which it is to be connected claim "TTL compatibility," they may not be directly compatible with each other, since the specification on the I/O port may mean "this hardware just barely provides enough current to drive low-power TTL" while the specification on the switch means "this device can just barely be driven by high-speed TTL."

A great deal of flexibility is possible in the software, however, especially if your system includes a real-time clock.

Strictly speaking, both are "TTL compatible" even though these current levels differ by two orders of magnitude (0.18 ma vs. 20 ma). In any case, if you plan to do your own interfacing, obtain a copy of the interface handbook or technical reference manual for your machine before starting. The *TRS-80 Microcomputer Technical Reference Handbook*, for example, includes a detailed description of the TRS-80 expansion bus along with schematics and software for a simple electromagnetic-relay-based coffeepot controller.

Not shown in Figure 1 is the software that determines when each device is turned on and off. In many ways, this is the most important part of the system, since there is very little flexibility in the hardware — either it works or it doesn't. A great deal of flexibility is possible in the software, however, especially if your system includes a real-time clock. Then automatic wake-up services (i.e., lights on at 6:30 AM, coffeepot and donut maker on at 7:00), random sequencing of house lights, TV and radio when the house is empty (to keep it that way until you get back), and soothing music for an hour at bedtime — all can be provided by your computer. If your real-time clock is compatible with Basic (or any other high-level language like Pascal or C), then all of the control software needed for your system can probably be written in Basic (or Pascal or C) as well. If this is not the case, or if your interface hardware uses interrupts or other features not available in higher-level languages, then assembly-language software will be required. If you like assembly-language programming, this is no problem, but if you don't, it is important to bear the possibility in mind while you are designing your system and keep the interfaces simple.

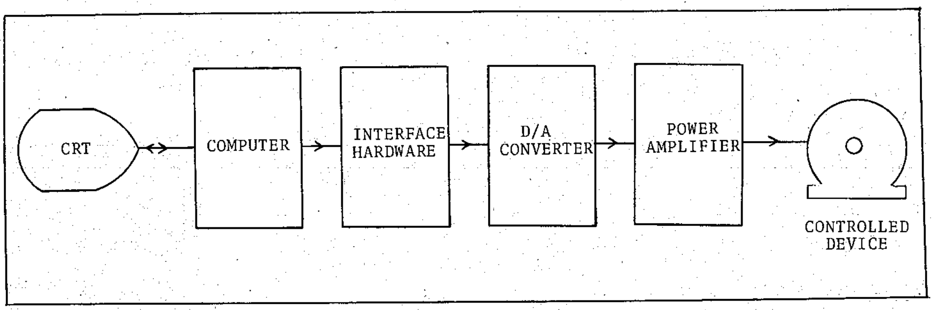


Figure 2. Proportional Control System.

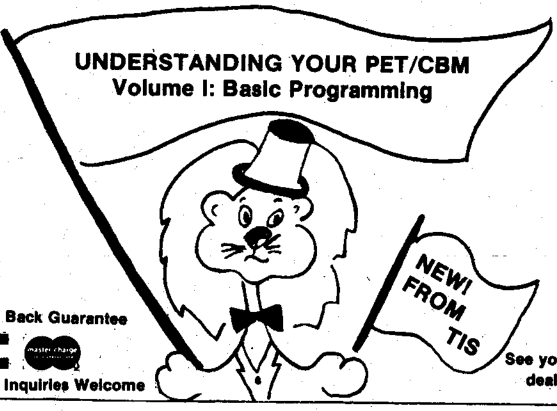
Proportional Controllers

As an example of a more complex type of control, consider the water faucet. Unlike the light switch that was either "on" or "off," here intermediate settings like "two-thirds on" are useful, providing two-thirds of the flow of water that results when the faucet is fully open. This is called proportional control because the state of the thing being controlled (i.e., the flow rate of the water) is proportional to the control signal applied (i.e., how far the faucet has been turned). Proportional control systems thus provide the advantage of allowing continuous variation of the quantity being controlled, but generally at the cost of more complex hardware and software.

Consider, for example, the block diagram of a proportional controller for DC operated devices shown in Figure 2. Here, a digital-to-analog converter (DAC or D/A) generates an analog control signal for the attached device from the digital output signals of the computer's I/O hardware. Typically, the D/A might have an output voltage range of 0-15 volts, generating +15 volts when the digital inputs were all "high" (corresponding to a binary 11111111 written to the appropriate I/O port), 0 volts when the digital inputs were all "low" (corresponding to a binary 00000000 written to the appropriate I/O port) and intermediate voltages for other combinations of "low" and "high" inputs. (Two excellent references on the D/A and its cousin the A/D are Walter G. Jung's *IC Converter Cookbook* and the Datel-Intersil *Data Acquisition and Conversion Handbook*.) Also included in the system is a digital interface between the computer's I/O hardware, the D/A, and an analog power amplifier (to boost the D/A's output current to the level required by the device under control.) The digital interface problem is not too much different from that for on/off controllers, but the power amplifier is another matter. Because even small DC motors and light bulbs draw a lot more power than most integrated circuits can deliver, the power amplifiers required must be built from discrete components like power transistors. Unless you are interested in the art of power amplifier design for its own sake, this may be more than you want to tackle and you might consider scouring the surplus markets for a cheap audio amplifier whose output voltage and current are suitable.

A useful trick for proportional control of some AC operated devices like lights and motors, called "AC phase control," is the basis for many commercially available light dimmers and variable speed motorized appliances. The basic idea here is to use an SCR or TRIAC to turn the light or motor on for only part of each AC cycle. The resulting light intensity or motor speed is then proportional to the fraction of each cycle that power is applied to the device. Detailed construction plans for a computerized control system of this type are given by John H. Gibson in the January 1980 issue of *Byte*.

In either AC or DC proportional control, the basic function of the software is to translate the user's instructions into the command word that must be written to the D/A's I/O port in order to generate the correct control signal. For example, the user input in a light-intensity controller might be a three digit number between 0 and 100, representing the percentage of maximum intensity desired. The software must translate this into the hex value required to generate the correct control signal. This value will depend on the characteristics of both the control hardware (i.e., D/A, power amplifier, interface logic, etc.) and the device being controlled, and will probably require some experimenting to determine. Note that the relation between the user input and the control signal is simplest if the D/A, power amplifier and the device being controlled all behave linearly — i.e., if doubling the input doubles the output. In this case, the software would just have to multiply the user's input value by the appropriate constant, convert it to binary and write it to the I/O port connected to the control



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hardware. If the control hardware is not linear, more complex calculations will be required.

Feedback Controllers

One of the most powerful automatic-control concepts is that of feedback. Here, measurements are made of the quantity being controlled and "fed back" to the controller so that corrective action may be taken if the desired results are not being accomplished. Controllers of this type are called "closed-loop" systems and have the tremendous advantage of being self-regulating, unlike the "open-loop" systems described in the previous two sections. The principal disadvantages of this type of controller are their increased complexity relative to open-loop systems and their tendency to exhibit bizarre behavior if designed incorrectly. The complexity problem is apparent in Figure 3, which shows that a closed-loop controller includes, among other things, a complete open-loop controller. Read on for more about the bizarre behavior.

The most common example of a feedback control system is the thermostatically-controlled home heating system.

One of the most powerful automatic-control concepts is that of feedback.

This is a closed-loop version of the on/off controllers described earlier, in which the furnace is turned on when the measured temperature is too low, and turned off again when it exceeds the desired value. As a second example, consider the advantages of adding feedback to the DC motor-speed controller described in the last section. Without feedback, if the mechanical load on the motor is increased (i.e., it is used to pull an elephant out of quicksand), the motor will run slower than normal for any value of the control signal. If the measured speed is too low, the controller automatically increases the control signal until the measured speed is correct. Note that if this control system is designed incorrectly and the motor's control signal is *decreased* when the measured speed is too low, the motor will run even slower, causing the controller to decrease the control signal even further. Thus, if additional demands were made on the motor, instead of maintaining a constant speed, the controller will keep turning the speed *down* until the motor grinds to a halt. Clearly, a badly designed closed-loop controller is worse than no controller at all.

Returning to Figure 3, in addition to an open-loop controller, a closed-loop controller includes a data acquisition subsystem consisting of a sensor to measure the quantity under control, some analog-signal-conditioning electronics, an analog-to-digital converter and more of the ever-present digital-interface hardware to connect the A/D to the computer's I/O ports. Sensors are available to measure almost any quantity you can think of, but some are easier to find and use than others. Temperature sensors, for example, exist in a wide variety of inexpensive types, ranging from thermocouples that require reference junctions and generate very low level output signals to more convenient devices like the National Semiconductor LX5600. The latter is also suitable for humidity and wind velocity measurements (see National's *Linear Applications Handbook 2* for details). The electrodes required for pH measurements, on the other hand, are expensive, hard to find, and even harder to use. In the simplest cases, the signal-conditioning electronics consists of an amplifier to match the output voltage and current levels of the sensor to the input requirements of the A/D converter. In more complex systems, additional gadgetry might include special circuits like logarithmic amplifiers to compensate for sensor nonlinearities, filters to remove high-frequency noise or analog multiplexors to allow a single A/D to serve multiple sensors. For a more complete introduction to the problems of analog electronics and how to solve them, there is probably no better reference than *How to Build and Use Electronic Devices Without Frustration, Panic, Mountains of Money or an Engineering Degree*, by Stuart A. Hoening and F. Leland Payne. This is a very readable book (the cartoons are good, too) that starts with the assumption that you don't know anything about analog electronics but takes you to the point of being able to design simple data-acquisition electronics without any trouble.

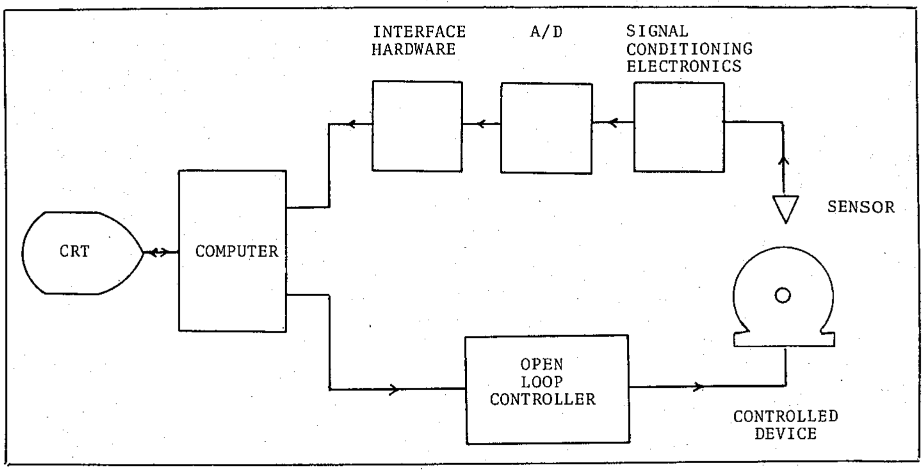

Figure 3.
Feedback Control System.

Because of the possibility of wild, unstable behavior in closed-loop systems, the software is of critical importance. In a correctly designed system, the software should periodically read the measured value of the quantity under control from the appropriate I/O port, compute the difference between this measured value and the desired value specified by the user and compute from this the control signal necessary to reduce the magnitude of this error to zero. The most common way to compute this control signal is to make it equal to some nominal value, minus a positive constant times the error signal. Thus, if the measured quantity is too low or too high, the control signal will be increased (or decreased) in proportion to the difference. The larger this feedback constant is, the faster the system will correct for errors when they do occur. But if this value is too large, instability may result, causing the system to oscillate wildly. For a more detailed discussion of this problem, along with some fancier ideas about feedback control systems, see Robert J. Bibbero's *Microprocessors in Instruments and Control*. (This book is somewhat more advanced than those referenced before, but this is unavoidable because feedback is really a fairly complicated phenomenon.)

Where to Go from Here

The list of automatic-control ideas presented so far is by no means exhaustive. If, however, you are building your first such system, the possibilities presented here should be enough to start your creative juices flowing. If you have never built anything before, you might consider starting with a fairly well-defined project like John Gibson's light dimmer and work up from there. If you prefer to buy your hardware, keep your eyes open as you peruse the back pages of the computer magazines. While the present selection is somewhat limited, you never know what you might find. Be sure, though, *before* you sell the family estate to buy the ultimate in control systems, that it will work with your system just as it is and doesn't require more disk drives, interface boxes or system software than you can afford to add. □

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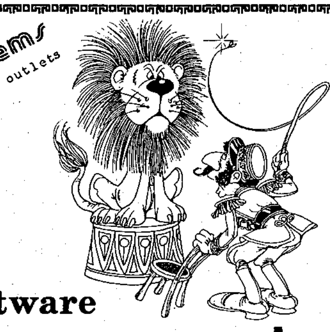

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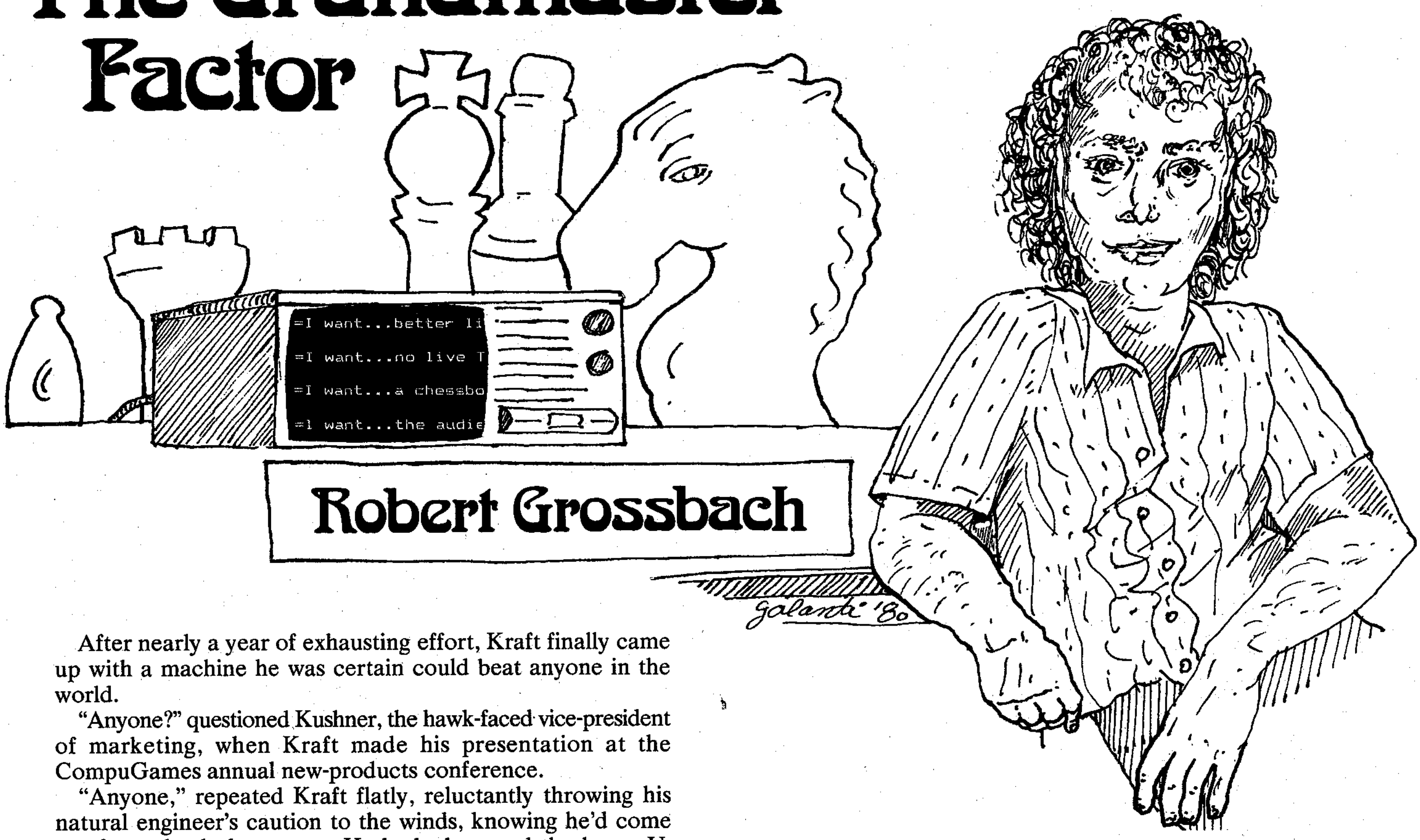

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MATE-7 could defeat Kraft ninety percent of the time. And MATE-9, just slightly larger than a shoebox, could beat anybody.

"But how can you be sure?" persisted Kushner.

Kraft glanced quickly at the president, saw the laser orbs narrow slightly. "We were able to arrange thirty-five separate games with International Masters," he said dryly. He paused to heighten the effect. "MATE-9 won them all."

A murmur of delighted surprise rippled through the room. It was choked off suddenly, however, when a gravelly voice declared, "Not good enough."

Venator stood up. "The Toys Unlimited chess computer has also defeated Masters, so what we've got is a 'me-too' item. Unless we can sell it for half the price—and we can't—that's an awfully slim rationale for a ten million dollar production investment." He extended a tapered, rich-man's index finger. "Compu-Games has never been a 'me-too' company," he declared sonorously.

Kushner nodded approval. All eyes turned to Kraft, whose face had visibly reddened with the effort of retaining control. Of course, he had known it would come to this. The progression was as inevitable as an endgame with only kings and pawns. "MATE-9," he offered shakily, "can also defeat Grandmasters."

Again, the surprised buzz. A Grandmaster represented a different *order* of mind from those in the lower categories. Not just a little better or deeper or more trained, but ***unique***, profound, standing to the others as Einstein would to a high school physics teacher. No machine yet invented could consistently beat a Grandmaster.

Kushner, again: "How do you know?"

"We have pitted MATE-9 against more than five hundred Grandmaster opponents," said Kraft. "Matches from chess history, of course, with the machine taking the side of one of the players, and the opponent's moves being fed in. Out of all the games, MATE-9 lost only one."

Venator nodded slowly. "Well," he said, a thin smile flickering over his lips. "That's something, isn't it?" He looked at Kraft carefully. "Tell me, Croft, where do we go from here?"

"Kraft," said Kraft. He had not come unprepared. "I suggest," he said, "a tournament. Man versus machine. Grandmaster against MATE-9, winner take all. The prize would be a million dollars. I have taken the liberty of contacting several hotels in Las Vegas; each of them offered to put up at least half the amount if we went for the remainder."

"The publicity alone would easily justify the purse, in terms of units sold," commented Kushner.

"Provided we win," said Venator ominously. He shot Kraft a job-threatening look.

Robert Grossbach, c/o Candida Donadio and Associates, Inc., 111 West 57th St., New York NY 10019.

"And who would you select as MATE-9's opponent?" asked Bauer, the head of finance. "Korchnoi?"

"Too flighty," said Kraft. "And besides, he's already endorsed the Toys Unlimited machine." He paused. "Actually, since Fischer's retired, and Karpov's been defeated, there's only one man who would give our product instant total credibility. The one man, I might add, whose game caused MATE-9's sole defeat to date."

It was Venator who spoke first, the name pressuring through his tightened lips and filling the room like an expanding gas.

Schiff.

The problems with existing chess playing machines resulted from the incredible number of possibilities involved in looking ahead even a few moves. A reasonable, though still limited, search in an average game would require examination of over a hundred *billion billion* positions, an impossibility, even for the largest computers. And so the programmers were forced to impose constraints: "backward pruning," "quiescence," "plausible-move generators." And the humans beat them. "Horizon effects" were observed: A computer that could look ahead six moves was easily trapped by a human whose mating plan suddenly surfaced after seven. The programmers grew more clever. But still, the Grandmasters appeared untouchable.

Kraft had begun with a study of the men, rather than the game. He'd immersed himself in Grandmaster biographies. Paul Morphy, greatest player of his time, who died a paranoid recluse. William Steinitz, who held the world title for 27 years, and claimed to be in electrical communication with God. The womanizer and philanderer, Capablanca. The sadistic Alekhine. And, of course, the brilliant new champion, the unpredictable boy terror, Schiff. *Ego*, Kraft realized. Each man simultaneously owner and owned. Master and servant to a set of conditioned responses and perceptions, possessed of monomaniacal drive, concentration, determination, detachment, and *will*. Kraft set out to make a machine he could punish.

That, to him, seemed the key. Learning. Reward and penalty. Make the right moves, win the game, and experience gratification. Act stupidly, blunder, and know retribution. Starve. Feel pain. Kraft's computers began to learn how to play chess. MATE-1 was used just to test the basic microprocessor functions. MATE-2 couldn't handle castling or captures *en passant*. MATE-3 incorporated the first feedback systems: The circuits that produced good moves were stepped up in voltage. MATE-7 could defeat Kraft ninety percent of the time. And MATE-9, just slightly larger than a shoebox, could beat anybody.

They were worried about Schiff. His extensive demands and complaints in previous matches were matters of record; similar behavior here could wreck the entire MATE-9 promotion. Kushner headed the committee that was to insure everything ran smoothly. The strategy was simple: Anticipate anything Schiff could possibly ask, and give it to him before he did so. Schiff himself dealt through a lawyer-intermediary and supplied a short list of desirable playing conditions. The monetary prize and match site were accepted without protest. Unbidden, the Kushner committee nevertheless offered a new Mercedes to be placed at Schiff's disposal, a tennis court and swimming pool for his exclusive use, exclusion of children from the audience, and soundproofing of the live TV cameras to any reasonable level of inaudibility. A visual sensor attached to MATE-9 would detect Schiff's moves so that he need not waste time punching them in. The machine's responses would be made graphically on a special 25-inch display screen.

"I'm still worried," said Kraft, the night before the scheduled first game. "What if he suddenly balks at the live TV? What if he just decides not to show?"

Kushner shrugged. "What can you do?" he said. "It's out of our hands. That's why Schiff is Schiff."

Even now, months afterward, it is difficult to say exactly why the match was halted and never resumed. Although the organizers attributed it to the impossibility of meeting the demands and conditions, later observers claim it was more the shock of their suddenness and precise nature. Pure and simple fear, said one chess columnist. The organizers were unprepared; they had to pull back, study the implications. The facts, certainly, are indisputable. At 4 p.m., exactly on time, Schiff strolled into the specially prepared Exhibition Hall at the Las Vegas Hilton. Seeming scarcely to notice the small audience, he mounted the stage, strode to his 600 dollar, Danish-made swivel chair, and briskly made the opening move he is famous for, P-K4. In the background, the TV cameramen, change removed from their pockets, padded silently on stockinged feet. Kraft, sitting with Kushner and Venator in the first row of the audience, watched intently as MATE-9 replied: P-QB4. It was to be a classic battle, Schiff on the attack, the machine playing the sharp Sicilian Defense. On the fifth move the computer played P-QR3, the so-called "Najdorf's line," a pet Schiff sequence. On the eighth move, Schiff offered a "poisoned pawn" sacrifice; MATE-9 took it. The ninth through the twentieth moves saw Schiff on a furious offensive, the machine appearing barely able to fend off his assault. But then, gradually, the attack seemed to peeter out, and MATE-9 was left with material and positional advantages. At the thirty-first move, it played N-K6, and Schiff's face drained of blood. Experts in the rear of the hall began to whisper excitedly. No question, the wunderkind was in deep trouble. Although both players had moved briskly, and neither was in time difficulty, Schiff now immersed himself in thought. An hour passed, as all eyes in the room watched expectantly. All eyes but one, that is.

It was Venator who spoke first, the name pressuring through his tightened lips and filling the room like an expanding gas.

It was Venator who noticed it first. The panel of photocells that constituted MATE-9's visual sensor suddenly began to move. From an angle that pointed directly down at the chessboard the servomechanism slowly repositioned itself until it was facing... Kraft. Schiff looked up in surprise.

"What the... What's it *doing*?" whispered Venator loudly.

"I don't know," said a shaken Kraft. "I don't know."

Slowly, the blue-green printout began to fill the area of MATE-9's display screen. Gasps came from the audience at each new, neatly lettered line.

I want...better lighting.
I want...no live TV coverage.
I want...a chessboard with smaller squares.
I want...the audience seated farther away.
I want...Schiff not to stare at me before moves.
I want...a higher voltage power supply.
I want...an IBM 3033 to use as a second during adjournments.
I want...Schiff to stop trying to hypnotize me.
I want...a 30-game limit on the match.

And unless I get what I want...without compromise...I will not play.

The screen went dead. Schiff, grinning, rose from his chair. Venator turned angrily to Kraft, who could only shrug. Of course, Kraft understood, his career at Compu-Games was over. His only compensation, an admittedly meager one, was the single piece of knowledge the entire affair had yielded: A Grandmaster—*regardless of construction*—was still a Grandmaster. □

Compleat Computer Catalogue

TERMINALS & I/O

THE DADA TERMINAL

The FLUXUS 5000 is the latest in DADA processing! This fast, powerful unit permits an output of exceptionally high performance DADA:

Words, sentences, phrases, facts, numbers & symbols that represent the logical concepts of beauty, form, reason, order & harmony

are manipulated and "processed" with miniaturized high technology electronic gadgetry into pure, unfiltered, unrefined DADA!

This desired result is achieved through a secret process for re-arranging raw logical data into deliberate madness and discordant chaos & negation

by utilizing the most advanced research into the Laws of Randomness and Chance, the Uncertainty Principle, plus some pure unscientific foolishness!

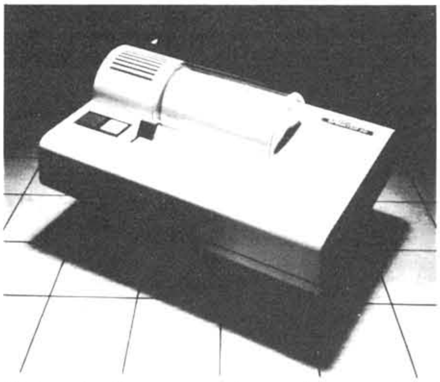
DADA processors are suitable for all sorts of things in the Modern World ranging from absurdist ideas and theories of reality to non-sensical notions of

Doom & Gloom!

The FLUXUS 5000 is highly recommended for all political, military, business & religious leaders, and all others

who have a need for high quality and exorbitant quantities of DADA at their fingertips!

HIGH-SPEED MATRIX PRINTER/PLOTTER



Alphacom has introduced Sprinter 40, a high speed matrix printer/plotter, which provides program control up to 240 full 40-character lines per minute utilizing a graphic 280 x n dot matrix.

Sprinter 40 can be connected with TRS-80, Apple II, Atari 800, Commodore Pet and other computers using standard interfaces.

The unit provides numerous programmable ASCII controls including automatic carriage return, automatic line feed, reset, right justification, form feed, graphic control and multi-line feed. It uses standard thermographic paper in roll or fan-fold pack; roll width is 4.33" with 2.45" diameter. Printer/plotter size is 10-½" wide x 7½" deep x 4" height. $390.

Alphacom, Inc., 3031 Tisch Way, San Jose, CA 95128. (408) 249-2152.

CIRCLE 247 ON READER SERVICE CARD

PRINTER FEATURES DISPOSABLE PRINTHEAD

The Epson MX-80 features a disposable print head. Once the MX-80's Micro-Nine Print Head has reached its life expectancy, rated at between 50 and 100-million characters, it can be discarded. A new one costs less than $30 and can be installed with one hand.

The MX-80 prints a full character set, in up to twelve print modes, of which more than half utilize multi-strike and/or multi-pass techniques to generate correspondence-quality printing. It prints bidirectionally at 80 CPS, with a logical seeking function. Print densities of 40, 66, 80 or 132 printing columns in an 8" field are possible, and the adjustable mini-tractor accomodates paper widths from 4" to 10". $650.

Epson America, Inc., 23844 Hawthorne Blvd., Torrance, CA 90505 (213) 378-2220.

CIRCLE 248 ON READER SERVICE CARD

COMPUTERS

SELF-CONTAINED COMPUTER

Zeda Computers International Ltd. has introduced its 520 series, a line of portable microcomputers with each self-contained system featuring a central processing unit, CRT display, floppy disk drive and detachable keyboard.

Included in the series are the 522, 525 and 529 with 12-inch, 5-inch and 9-inch screens respectively. The software selectable screen format can be either 16 lines by 56 characters or 25 line by 81 characters.

All 520 models use a 4 Mhz, Z-80A microprocessor with implementation of a full vectored interrupt structure. Each unit contains 48K bytes of dynamic random-access memory (RAM) and 2K bytes of Video RAM as well as a double density mini-Floppy disk controller and built-in, 200 byte, double density drive.

Three ports providing interfacing capabilities include a Centronics printer port, an RS-232C serial port, and a bar code reader port for an HP HEDS-3000 Digital Wand.

The CP/M-compatible ZEDOS operating system includes all CP/M and CDOS system calls as well as additional ZEDOS system calls. Prices range from $3995 to 4495.

Zeda Computers International Ltd., 1662 West 820 North Provo, Utah 84601, (801) 377-9948.

CIRCLE 249 ON READER SERVICE CARD

BUSINESS COMPUTER SPEAKS ENGLISH

David, the latest addition to Logical Machine Corporation's family of user-programmed computers, functions as a stand alone computer or as an intelligent terminal in a system of up to twenty users.

David operates in practically any spoken language, including French, German, Italian, Portuguese and Spanish, as well as English. The user or a programmer can create customized business programs, which can be modified to accommodate the changing needs of the business.

David features 1.25 megabytes of floppy disk storage, 64K memory, and a choice of a 730 printer ($8,500), 703 printer ($11,225), or no printer at all ($7,750).

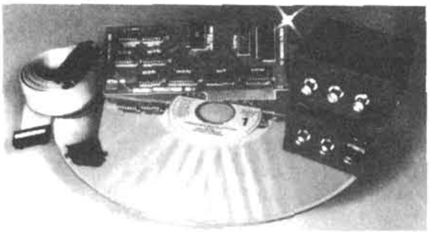
Logical Machine Corp., 1294 Hammerwood Ave., Sunnyvale, CA 94086. (408) 744-1290.

CIRCLE 250 ON READER SERVICE CARD

PERIPHERALS

VIDEODISC-APPLE INTERFACE

The Coloney VAI-1 is a Videodisc-Apple Interface. The circuit board fits inside the microcomputer housing and allows complete computer control of the Disco-Vision industrial videodisc player. In addition, the package provides circuitry to switch computer or disc generated video on a single TV monitor.

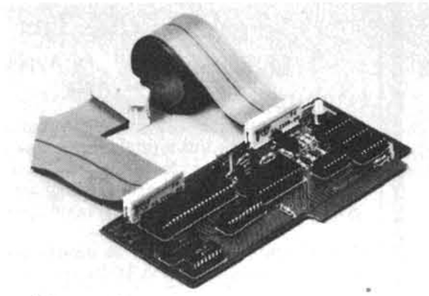


The package includes a user's manual, one controller card, a junction box for video connections, a complete set of control subroutines in Assembler and Pascal (listings and diskette), all of the cables needed for video and control connections, and a videodisc-based demonstration program. $525.

Coloney Productions, 1248 Blountstown Hgwy., Tallahasse, Fl 32304. (904) 575-0691.

CIRCLE 251 ON READER SERVICE CARD

SERIAL AND PARALLEL APPLE INTERFACE



SSM Microcomputer Products has introduced the enhanced AIO serial and parallel Apple interface.

The AIO interface provides expanded flexibility and capability to interface the computer with a broad range of peripherals including printers, plotters, terminals, modems and other computers.

The RS-232 serial interface has three handshaking lines (RTD, CTS, DED), and eight standard baud rates from 110 to 9600.

The enhanced AIO serial and parallel Apple interface is available assembled and tested for $225 or in kit form for $175.

SSM Microcomputer Products at 2190 Paragon Dr., San Jose, CA 95131. (408) 946-7400.

CIRCLE 252 ON READER SERVICE CARD

MISCELLANEOUS

JOYSTICK ADAPTER

Star Fleet Fabrications has introduced a joystick adapter/extension for computer games which use Atari-type joysticks. The adapter/extension fits directly over the existing joystick control handle, and has its own fire control button built into the Viper-like grip.

A simple modification adapts the grip to the joystick control, and does not interfere with normal joystick operation when removed. $19.95

Star Fleet Fabrications, P.O. Box 508, Rochdale, MA 01542.

CIRCLE 253 ON READER SERVICE CARD

APPLICATIONS SOFTWARE

PERSONAL

Microhome for the Atari 800 includes eight programs for home management: Family Budgeting, Checkbook Balancing, Energy Saving, Shopping Comparison, Appointment Calendar, Car Fuel Consumption, Measurement Conversion and Perpetual Calendar. The programs require 24K memory, a single disk drive and printer. $79.95. Compumax, Inc., P.O. Box 1139, Palo Alto, CA 94301 (415) 321-2881.

CIRCLE 254 ON READER SERVICE CARD

The **Property Analysis System** is a program which provides investment analysis and future financial projections for all types of income properties. Information provided includes cash flow before and after taxes, operating income, and tax consequences from both operation and sale of the property. The program runs on most popular microcomputers with 48K of RAM, one disk drive and an 80-column printer. $250. A-T Enterprises, 221 N. Lois, La Habra, CA 90631. (213) 947-2762.

CIRCLE 255 ON READER SERVICE CARD

The **Real Estate Analyzer** enables users to compute true net cash flows and annualized after-sale return-on-investment for any property. All information is itemized in tabular form on the video screen or line printer year-by-year for the ten years after purchase. The program is available on disk or cassette for the 48K Apple with Applesoft. $49. Howard Software Services, 7722 Hosford Ave., Los Angeles, CA 90045.

CIRCLE 256 ON READER SERVICE CARD

Designed for the "active trader," the **Stock Market Monitor System** for TRS-80 Model I and Model III tracks user-selected issues in a technical manner that reflects the issue's performance against the overall market. It will also perform comparisons of the issue against itself, allowing the user to spot "unusual" activity. Cassette, $89; disk, $99. Galactic Software, 11520 N. Port Washington Rd., Mequon, WI 53092. (414) 241-8030.

CIRCLE 257 ON READER SERVICE CARD

Standard and Poor's Corporation introduces a four-disk package, **Stockpak**, which is said to allow TRS-80 users to duplicate the professional investment strategies used by the financial community. The program permits the user to evaluate and manage a stock portfolio of up to 100 securities with as many as 30 transactions on each issue; analyze 900 New York and American exchange and over-the-counter common stocks and generate reports to guide investment decisions. $49.95. Available at Radio Shack outlets.

The **Stock Manager** is a collection of programs and subroutines designed to provide information on a portfolio of up to 500 stocks. The program calculates average cost per share, total cost, total dividends received and long or short term gain or loss for income tax purposes. Provision is also made for reinvested dividends and additional purchases of the same stock. Written in North Star Basic, the system requires 32K RAM and a one or two drive system using 5 ¼" single or double density disks. $70. Omni Software Systems, Inc., 146 North Broad St., Griffith, IN 46319. (219) 924-3522.
CIRCLE 259 ON READER SERVICE CARD

Data Master from High Technology, Inc., is designed to expand the capabilities of the company's Information Master and Data Base Management System by allowing the user to reorganize an existing data file without re-entering the data. The menu-driven program runs on the Apple II with 48K and at least one disk drive. $100. Also available is a collection of the programs featured in **Some Common Basic Programs** by Adam Osborne. The programs are available on disk for the Atari 800. $40. High Technology, Inc., 8001 N. Classen Blvd., P.O. Box 14665, Oklahoma City, OK 73113.
CIRCLE 260 ON READER SERVICE CARD

Record Manager for the 48K Apple II with Applesoft in ROM allows a complete file to be brought into memory so that record searches and manipulations are instantaneous. Records within any file can contain up to 20 fields with user-defined headings, and information can be string or numeric. $35. Connecticut Information Systems, 218 Huntington Rd., Bridgeport, CT 06608. (203) 579-0472.
CIRCLE 261 ON READER SERVICE CARD

Atari Safari for Atari 400 and 800 computers is a collection of 25 programs including finance, math, programming utilities and games. Written in Atari Basic, it will run on either a 16K Atari with cassette or 24K with disk drive. Cassette, $29.95; disk, $39.95. CDS Corporation, 695 East Tenth North, Logan, UT 84321. (801) 753-6990.
CIRCLE 262 ON READER SERVICE CARD

The **Bowling Data System** provides record keeping and report generation for bowling leagues. Designed for leagues of up to 40 teams with up to six bowlers per team, the system will run on an Apple II with 32K of RAM, Applesoft in ROM, one disk drive and an 80-column printer. $79.95. Rainbow Computing, Inc., 9719 Reseda Blvd., Northridge, CA 91324. (213) 349-5560.
CIRCLE 263 ON READER SERVICE CARD

WORD PROCESSING

T/Maker combines a report generator with word processing to provide analysis and presentation of numerical data and text copy used in financial modeling and report preparation. It requires a 48K CP/M system and CBasic 2. $275. Lifeboat Associates, 1651 Third Ave., New York NY 10028. (212) 860-0300.
CIRCLE 264 ON READER SERVICE CARD

E Z Edit is an editor designed for use with a Z-80 CP/M microprocessor system using the Heath H-19 terminal. It takes advantage of all H-19 special cursor-control, insert, and delete editing keys. E Z Edit is available on both North Star 5 ¼" disks and 8" 3740 format CP/M disks. $125. Financial Software, 54 Grove St., Haddonfield, NJ 08033. (609) 795-5607.
CIRCLE 266 ON READER SERVICE CARD

Computer Solutions announces publication of its **Word Processor** software for the Apple II. The program includes true upper and lower case and full mailmerge facilities. $295. Computer Solutions, 6 Maize Pl., Mansfield, Q 4122, Australia.

WordSearch is an automated spelling dictionary designed for use with CP/M-compatible word processing systems. It is distributed on 8" single-density disks. $195. Key Bits, Inc., P.O. Box 592293, Miami, FL 33159.
CIRCLE 267 ON READER SERVICE CARD

© Creative Computing

UTILITIES AND MISCELLANEOUS

Macro-Sced is a cursor-oriented screen editing tool for the Apple. Commands are executed through Control characters, and the program is completely transparent to the user. $39.95. Computer Station, 12 Crossroads Plaza, Granite City, IL 62040. (618) 452-1860.

CIRCLE 268 ON READER SERVICE CARD

N*BUS, a North Star Basic Utility Set, features a co-resident source program editor with advanced editing facilities that can reduce programming time and error. Also included is BPak, a program pack utility; BPRT, a program formatted list and cross-reference utility; and RE, a file rename utility. $69. SZ Software Systems, 1269 Rubio Vista Rd., Altadena, CA 91101.

CIRCLE 269 ON READER SERVICE CARD

Cat.001 **Disc Catalog Package** for North Star computers establishes a directory convention and sets up a directory file which automatically reads individual disk directories into the master directory file and enables the user to keep track of where his software resides. $20. Snow Micro Systems, Inc., P.O. Box 1704, Silver Spring, MD 20902. (302) 622-2194.

CIRCLE 270 ON READER SERVICE CARD

Disk Master is a disk cataloging program for the PET/CBM with a 2040 disk, which can catalog up to 140 disks, by forming a large master directory on a single disk. Five major functions include: update master directory, delete disk entry, display directory, find specified file, list disk ID's and names. Cassette, $10; disk $12. Baker Enterprises, 15 Windsor Dr., Atco, NJ 08004. (609) 767-3085.

CIRCLE 271 ON READER SERVICE CARD

Pascal Express Utility Package, a package of utilities and other software for the Apple II, is designed to help users with some programming experience in Basic to become acquainted with UCSD Pascal. Four procedural units and five sample programs are provided. $45. Software Express, P.O. Box 50453 Palo Alto, CA 94303. (415) 856-9244.

CIRCLE 272 ON READER SERVICE CARD

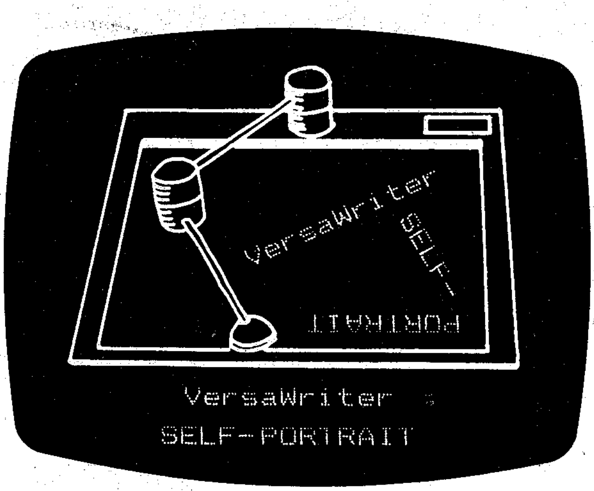
Owners of the Stringy Floppy can access remote computers and transfer data with **Smart80E**, an intelligent terminal program designed to be used in conjunction with the Microconnection, a direct connect telephone interface. The Microperipheral Corporation, Box 529, Mercer Is., WA 98040. (206) 454-3303.

CIRCLE 273 ON READER SERVICE CARD

B17 Version 2 is designed to increase the TRS-80 saving and loading speed of Basic and machine language programs. $20. ABS Suppliers, P.O. Box 8297, Ann Arbor, MI 48107. (313) 971-1404.

CIRCLE 274 ON READER SERVICE CARD

PRICE BREAKTHROUGH



We have used the VersaWriter to draw a picture of itself. Text may be added in any size or direction.

VersaWriter

High-Resolution Color Graphics for Apple II or Apple II Plus

The VersaWriter graphics tablet lets you create multicolor graphics and drawings with your Apple computer. It compares in quality to graphic bit pads and digitizers costing three times more money.

VersaWriter is a digitizer and software package which presents a new approach to hi-res graphics. It consists of a mylar plotting board with a clear plastic overlay. Attached to this board is the drawing arm, which has a magnifying lens with a crosshairs at its end. You simply place any graph, picture or drawing (up to 8½" x 11") under the plastic overlay and "trace" it with the drawing arm. As you trace the drawing appears on the video screen.

The superior software of the VeraWriter enables you to do much more than just trace. Immediate commands include: color choice, brush size (the width of the drawing line), fill figure with color, draw a straight line between two points, use a different scale for drawing (.25 to 4), edit, erase, smothing factor (rounds off the rough edges as you draw), store picture on disk, and more.

One exceptional feature of the VersaWriter is the Shape Table function. You can take any picture, or portion of a picture, and store it as a shape table. Then the table can be recalled from memory and placed on any part of the screen. You can change the size of the image, rotate it, add to it, etc. By incorporating a series of images into a single shape table, commonly used symbols can be easily inserted into a variety of different programs. VersaWriter software includes an Electronic Drawing program which is a shape table of common schematic symbols-this program will give you a good idea of what the shape table can do, as well as let you easily produce electronic or logic diagrams.

Other programs included in the software are: the Textwriter, with which text can be added to graphics (UPPER & lower case, choice of color, text size, direction of text, starting point of text). Area/Distance-this program allows you to calculate distances (or perimeters) by establishing a measuring unit (of your choice) and tracing the shape or map route with the drawing arm. Areas of figures are calculated in the same way-this includes irregular and open figures. A very simple calibration program is also on this software disk.

A second software disk contains VersaWriter demonstration programs. For more advanced use of high-res graphics, there is a skeleton program which contains the guts of the VersaWriter. The VersaWriter is a sturdy peripheral device which plugs into the game paddles I/O port-the VersaWriter does not use up a card slot in the Apple computer. Also, the VersaWriter is not subject to the grounding problems and strong magnetic field problems of other, more expensive, hi-res graphic devices.

VersaWriter requires an Apple II with Applesoft in ROM (or an Apple II Plus), Disk, and a least 32K of memory.

VersaWriter comes complete with 8½" x 11" drawing surface, plastic overlay and two disks of software. Price $252.00 postpaid in continental USA. VersaWriter has a 90-day warranty on parts and labor.

Credit card customers include card number and expiration date of your Visa, Mastercard or American Express card. No C.O.D.'s. Bankcard customers may order toll-free to:

800-631-8112

(In NJ call 201-540-0445)

Dealer Inquiries Invited.

Peripherals Plus

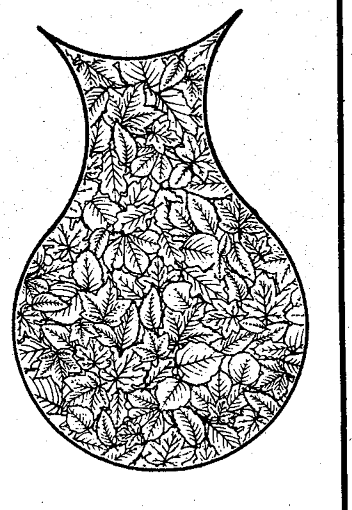
119 Maple Ave., Morristown, NJ 07960

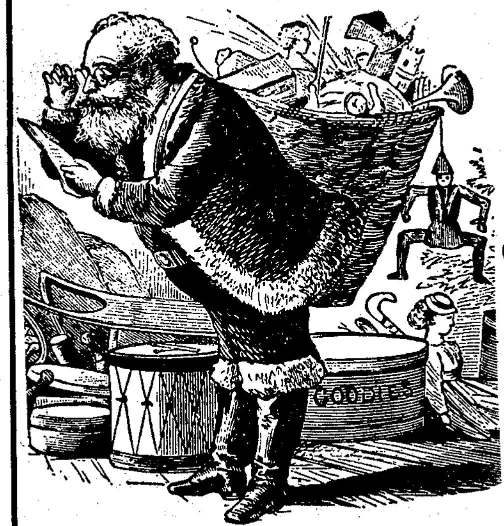
CIRCLE 239 ON READER SERVICE CARD

puzzles & problems

A Potty Problem

For the cut-ups in our audience we have a neat stumper from Merlin's court artist, Ector Pendragon. It seems that Ector was sketching an old jug one day when he noticed something about its symmetry in profile that reminded him of an old puzzle. He quickly got out a pair of scissors and cut the silhouette of the jug out of his drawing. He then cut the jug into three pieces using two straight cuts. He was then able to rearrange these three pieces to form a square. How did he do it? (This puzzle is from that grand old book "Merlin's Puzzler #3").





Santa's Puzzle

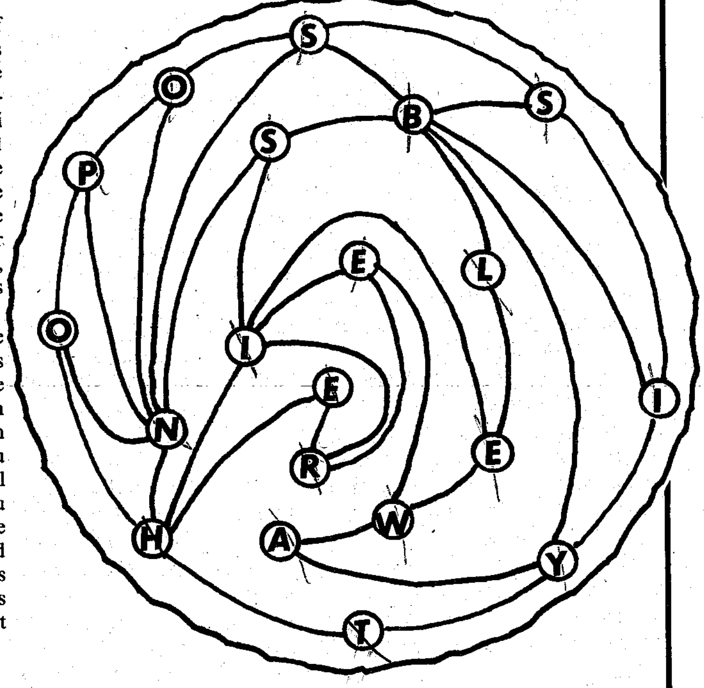
The following puzzle almost caused Santa to be late last Christmas. Some young programmer included it at the end of the list of computer games he was asking for. The puzzle asks the question: "How is it that Halloween, October 31, equals Christmas, December 25, and, Thanksgiving, November 27, also equals Christmas, December 25". How indeed! Our thanks go out to George Zimmerman of Yellow Springs, Ohio. You've earned a copy of "Merlin's Puzzler 2" from "Santa" Merlin.

There is no possible way

A Martian Puzzle

We are informed that Willard Starfinder, the chief astronomer at Mount Merlin Observatory, has again sighted those mysterious lines on the planet Mars that were once thought to be man-made canals. Willard thinks that Giovanni Schiaparelli and Percival Lowell were right and that the lines are really canals dug by some ancient Martian civilization. Merlin says that he will keep an open mind on the subject, while Ector Pendragon thinks that Willard has spider webs in his telescope. Regardless of who is right, one positive thing has come out of all the fuss and argument, a new puzzle.

Willard has identified 20 points of intersection on the planet for the numerous "canals" he claims to have seen. When Merlin saw Willard's map he decided to have a try at turning it into a puzzle. In a little while he presented us with the map shown here. He had placed a letter at each point of intersection. "If you start at intersection point 'T', at the south pole, you can plot a course over the surface of Mars that will take you through each point of intersection once, and only once, and that will also spell out a complete sentence in English. Remember though, you can only pass through each intersection *once!*" After working on the puzzle for an hour Willard declared "There is no possible way", and stormed out of the room. He was wrong of course and Merlin showed us how easy it was to solve. Let us see how long your journey around Mars will take. (Adapted from a grand old puzzle by Sam Loyd, the best American puzzle maker of all time).



The Wolf, The Goat and The Cabbages

A boatman has to ferry across a stream, a wolf, a goat and a basket of cabbages. His boat is so small that only one of the three, besides himself, can be contained in it. How is he to manage so that the wolf shall have no opportunity of killing the goat, or the goat of eating up the cabbages? (From Merlin's Puzzler 3).

The Old Dictionary Quiz

Since old dictionary quizzes have proved so popular Merlin has decided to test you again with some entries from an old copy of a Funk and Wagnalls dictionary circa 1915. The following 14 words contain the seven words pictured down the left side of this page.

The words are: (A) Diligence; (B) Generatrix; (C) Pediment; (D) Lardoon; (E) Moulage; (F) Periwig; (G) Coupe; (H) Colophon; (I) Obelisk; (J) Balista; (K) Halberd; (L) Quoins; (M) Pylon; (N) Oriel.

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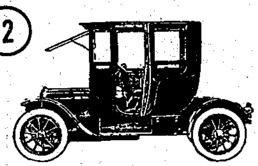

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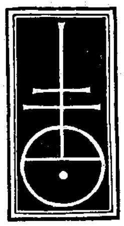

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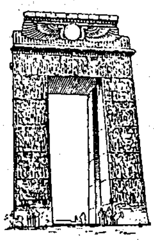

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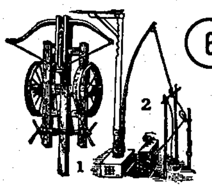

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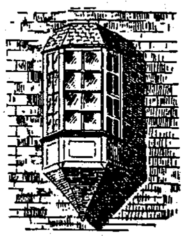


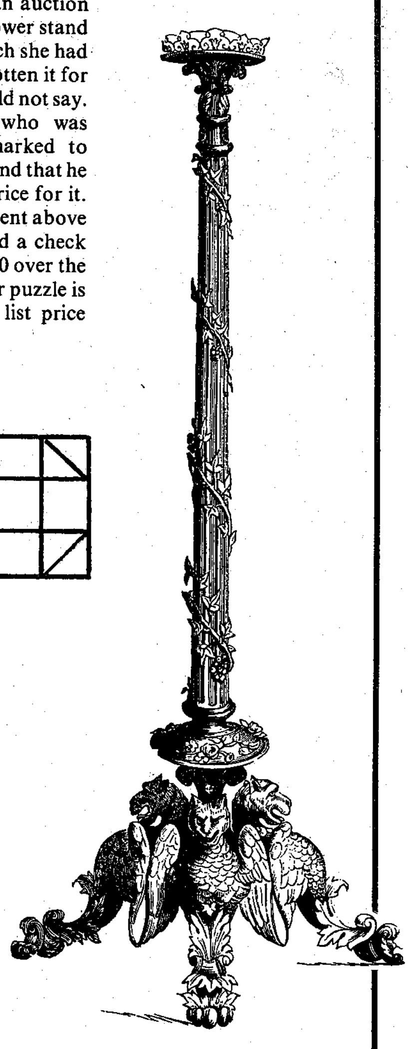
The Nifty Nines

What word containing 5 letters will make the following equation correct?

$$99 + 9 = 9$$

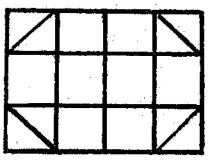
An Ancient Problem

Merlin's cousin, Wisteria, came back from an auction the other day with a beautiful Victorian flower stand fashioned in bronze. When asked how much she had spent for it Wisteria replied that she had gotten it for 15 percent less than list price. More she would not say. Several days later an antique dealer, who was cataloging some armor for Merlin, remarked to Wisteria that he liked the stand very much and that he would give her 20 percent above the list price for it. Wisteria, who is not the type to hold sentiment above profit, handed him the stand and pocketed a check that allowed her to make a profit of $122.50 over the price that she had originally paid for it. Our puzzle is to figure out just what was the original list price anyway?



A One-Liner

Our next problem is a "continuous Line" puzzle. You must duplicate the design shown here by drawing one continuous line without lifting your pencil from the paper, without folding the paper in any way, and, without crossing one line over another.



The Three Peanuts

This is propounded in the shape of a conjuring trick, usually after two or three bona fide tricks have been performed. You place three peanuts on the table, and cover each with a borrowed hat. You make a great point of having nothing concealed in your hands, and profess your willingness to allow the audience, if they please, to mark the three articles, so that there can be no question of substitution.

You then take up each hat in succession, pick up the peanut beneath it, and gravely eat it, replacing the hat mouth downward on the table. Any one is at liberty to see that there is nothing left under either hat. You then undertake to bring the three peanuts under whichever of the three hats the company may select; and the choice being made, you at once do so. How is it to be done? (From "Merlin's Puzzler 2").

Answers on page 194

I hope that you enjoyed Merlin's puzzles. The old boy tries his best to come up with an interesting variety for you each issue. Remember, if you have a favorite puzzle you would like to share with the readers of *Creative Computing,* send it along. If Merlin uses it he will send you a copy of one of his books. For those of you that would like to buy copies of "Merlin's Puzzler" series just write to *Creative Computing,* they carry the complete line.

Until next month, good puzzling to one and all!

Your editor,

Charles Barry Townsend

Oops!

Some Scientific Boo Boos by the Ancients

Peter Payack

1. "The Sun is one foot wide," at least that's what Heraclitus of Ephesus (535-475 B.C.) had written in an epigramatic fragment.

2. Anaxagoras (500-420 B.C.) taught that the Sun was a "red hot stone," while the Moon was made of "Earth Stuff."

3. Earthquakes were thought by Thales of Miletus (636-546 B.C., one of the world's first, if not the first scientist) to occur when the Earth was rocking on the water in which it floated!

4. Thunder, Anaximander (611-547 B.C.) suggested, was caused by the wind, while lightning was produced when clouds split in two.

5. Incidently, Anaximander (who it seems did a lot of thinking, erroneous though it might be) also thought the Earth was shaped like a flat topped cylinder.

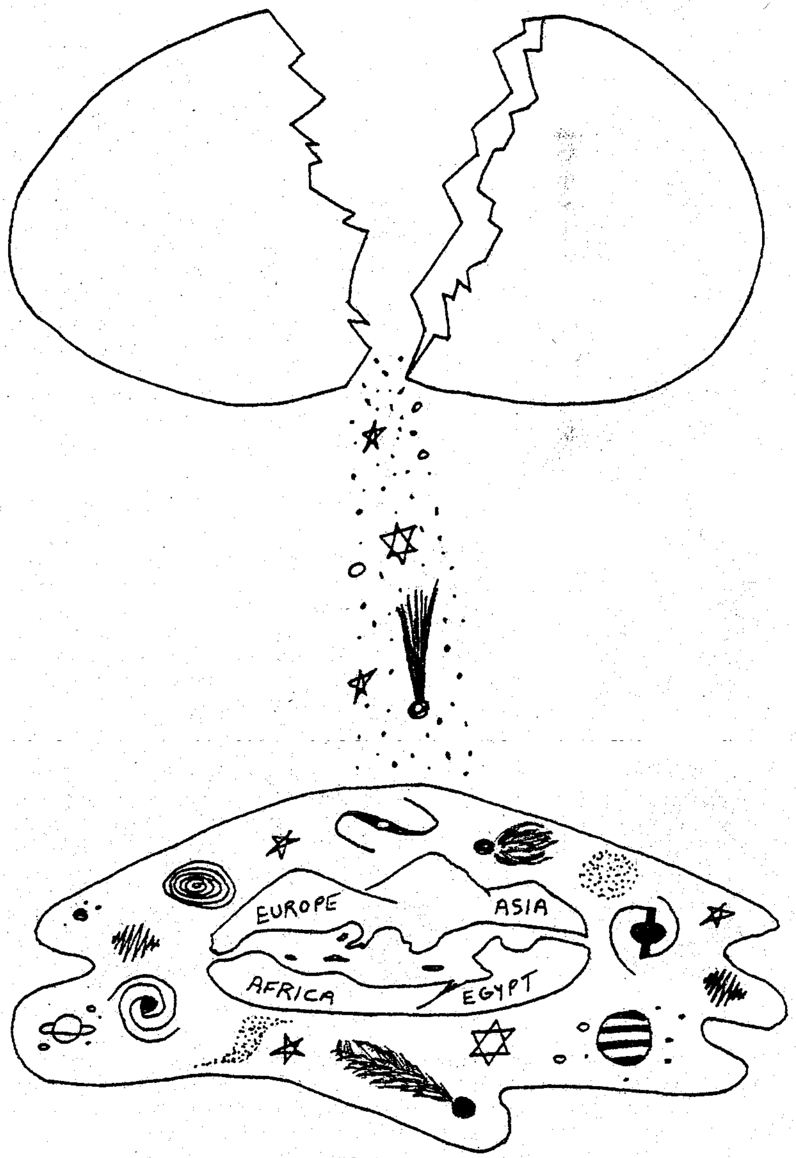
6. Epicurus (341-270 B.C.), who always argued for moderation and common sense, held that the Sun and the Moon were about the same size, exactly as they appear to be!

7. Theophrastus (372-287 B.C.) related specific tastes, smells, and colors to atomic configurations. For instance, he thought that an "acid taste" is composed of angular atoms!

8. Aristotle (382-322 B.C.) believed that the material substance of the planets was fundamentally different for the 4 elements found on Earth (earth, air, fire, water), and was of an altogether higher substance, and hence the term quintessence.

9. Theodore of Mospeustia (350-428 A.D.) held that the stars are moved by Angels appointed by God to the task!

10. Cosmas, an early Christian philosopher, posited the Earth as being rectangularly shaped, like the Arc of the Covenant. He came to this conclusion, because according to the Bible, God instructed Moses on Mt. Sinai to build that Tabernacle as a copy of the world! □



"Cosmic Egg"

In which we sell a 386 page, $11.95 book for just 2¢.

Liquidation Giveaway

Byte magazine. You've seen it. It's the fat technical one.

Back when *Byte* was first publishing independently, *Creative Computing* and *Byte* cooperated in many areas. We ran joint promotions, directed articles to each other and the like.

In 1976, Creative published *The Best of Creative Computing, Volume 1*. I proposed to Virginia Londoner, publisher of *Byte*, that we also publish articles from *Byte* in book form. She agreed, and so we published *The Best of Byte, Volume 1*. It's a huge book of 386 pages with articles on hardware, software, technical tutorials, how-to materials and even some philosophy.

Although some of the technical material in *The Best of Byte* is out of date today, it nevertheless provides a good historical framework for the personal computing field. Not at all out of date are most of the software articles and tutorials. Similar books of other publishers are selling for $20 and up, so at $11.95, this one is quite a bargain.

Big Hearted

About the same time we were preparing *The Best of Byte* for publication, Nat Wadsworth of Scelbi approached Byte about doing a similar book. Virginia wanted to be nice to everyone, so she gave permission. Thus was born the *Scelbi-Byte Primer*.

Unfortunately, about half of the content of the two books was identical. Thus *Byte* was faced with a dilemma of which book to endorse and sell through their magazine. Inexplicably, they chose the Scelbi book. Thus we were left with twelve skids of *The Best of Byte*.

Hidden Away

In the next three years we sold a lot of these books. In fact, after we ran a special in 1979, we thought we had sold out.

However, we just moved to new quarters. In the move we found, lurking away in the back of our old garage, four skids of *The Best of Byte*. After some fitting words, the boss said "for 2¢, I'd give them away." So that's what we're doing.

Our Ridiculous Offer

The original price of *The Best of Byte* was $11.95. If you order $11.95 worth of any of our other books or records, we'll throw in *The Best of Byte* for 2¢.

Thus you could order *The Best of Creative Computing, Vol. 3* ($8.95) and *Computer Coin Games* ($3.95). The toal price is $12.90. For $12.92 you also get *The Best of Byte.* Shipping and handling on all book orders is $2.00.

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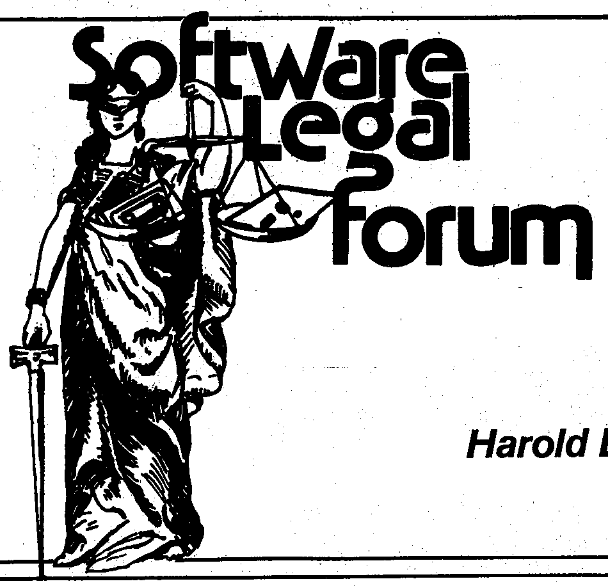


The comments and opinions of the author are given for educational purposes only and are not meant to be legal advice. Specific legal questions should be referred to your personal attorney.

Harold L. Novick

Exactly at the stroke of 10 o'clock on Tuesday morning, October 14, 1980, a United States marshal introduced the nine black-robed men and addressed the assembled gathering as follows:

"The Honorable, the Chief Justice and the Associate Justices of the Supreme Court of the United States. Oyez! Oyez! Oyez! All persons having business before the Honorable, the Supreme Court of the United States draw near and give their attention for the Court is now sitting. God save the United States and this Honorable Court."

Approximately one hour later the first case was finished and Chief Justice Warren Burger left the court room (presumably because he is excusing himself from considering or deciding the next case). Then Mr. Justice William Brennan called Case No. 79-855, *Diamond, Commissioner of Patents v. Bradley*, the first of the two so-called computer programming cases to be heard. The *Bradley* case actually concerns whether firmware that regulates the internal operation of a computer is patentable subject matter. The Patent and Trademark Office said no; the Court of Customs and Patent Appeals (a reviewing court of decisions made by the Patent and Trademark Office) said yes; and the government asked the Supreme Court to decide.

Mr Justice Brennan recognized Jerry Wallace, an assistant solicitor for the United States and the man who had argued other cases involving the patentability of so-called computer programs. Mr. Wallace approached the lectern situated below and centered in front of the huge arcuate table that protected the eight remaining black-robed decision makers. Dressed in his "morning coat", a gray full length tuxedo coat with tails and his monotone deep voice in a slow, methodical and precise manner, Mr. Wallace began what appeared to be a funeral service.

Harold L. Novick, Patent Attorney, Larson, Taylor & Hinds, Arlington, VA 22202.

The Supreme Court with its technology ignorant justices were about to hear arguments on a most technologically complex subject. The Court was unusually active as it repeatedly interrupted Mr. Wallace to ask questions so that they could not only understand the present invention, but also gain an appeciation of the ramifications of their decision and the words they chose to express it. Perhaps the system is unfair to expect that nine liberal arts experts can decide the fate of the most important technological innovation in modern times. However, it is the only thing that can be done at this time. The alternative of having Congress pass legislation is not feasible in today's "busnopolitical atmosphere" (a made-up phrase to describe the amorphous process of business influencing the passage of pork barrel legislation).

The system we are left with incorporates a statute passed in 1952, a later technological development, and a judicial system to interpret that law in view of prior judicial decisions and to decide whether the subsequent invention is patentable under a statute that never considered the question.

The law is simplicity personified. It reads as follows: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."

The prior decisions, going back to the 1880's have said that laws of nature, mental processes, mathematical formulae, and abstract intellectual concepts are not patentable. In the recent *Flook* case, six justices (Brennan, White, Marshall, Blackmun, Powell, and Stevens) said that a method for determining the set point of a temperature alarm in an exothermic chemical process was unpatentable subject matter. The method chiefly comprised measuring the present temperature and using it and previously measured temperatures in a novel mathematical formula to calculate the new alarm temperature. The claims that verbally described the invention did not mention a computer or a computer program; only written description mentioned using a programmed computer to make calculations. Interestingly enough, three justices (Burger, Stewart and Rehnquist) said that this was a patentable process.

In trying to understand the "computer program" in the *Bradley* case that was being argued, Mr. Justice Rehnquist observed that this case involved machine claims, not method claims as in the *Flook* case. Mr. Wallace, trying to hammer in one more coffin nail, replied that even the court below recognized that any good patent attorney could define a computer program as a method or as a machine. Mr. Wallace observed that what we have here is the doctrine of transitory novelty, similar to replacing the typing element on an IBM selectric and then trying to patent the changed typewriter as a new method or a new machine.

Mr Justice Brennan, looking through the claim (see the appendix) asked whether the claim was only on the firmware. Mr. Wallace, swinging his hammer, said no, the claim was on the whole machine, the "machine as fired up by the firmware".

Mr. Justice Rehnquist was confused. He asked if an electronic typewriter was not patentable subject matter because of prior existence of a mechanical typewriter. Mr. Wallace, continuing his fine job of obfuscating, said that it was a different machine and hence patentable subject matter. However, he continued, the situation in this case involves the same machine.

Mr. Justice Stevens (who wrote the *Flook* decision) also read the claim and wanted to know the meaning of the words "data structure" as in a data structure for storing coded signals for communicating between groups of processes and operating system.

Justice Stevens did concede that the claim described a machine; Mr. Wallace did not. Responding, he said that there is no known accepted meaning of "data structure," but that it meant the computer. He also said that the claimed invention was "basically for a process of transforming data, but was written in machine language." Mr. Wallace, not being a patent attorney or a computer trained person may or may not have intended the double entendre. Another nail.

Attempting to further tie the fate of firmware to software, Mr. Wallace argued that there was no legal significance between them. "All that there is here is that the microprogram fits into the control unit as opposed to the main computer memory".

However, there is no fun unless the confusion is compounded. Mr. Wallace, who was also able to read the claim in the Bradley case, noticed that the claim did not contain a mathematical formula and that the opponents had made a big issue of that fact. Not to be deterred, he boldly espoused that all digital computers perform mathematical computations. They do nothing else. Ergo, all computer programs must be mathematical algorithms.

Unfortunately, just as he was talking about the Milwaukee telephone book, in the middle of a word to be more mathematically precise, the gavel came down. However, instead of saying "sold", Mr. Justice Brennan merely said "lunch break".

After lunch, Mr. Wallace continued and responded to Mr. Justice Steven's question about the location of the "mathematical algorithm" in the claim by pointing out that the only thing new in the claim was the computer program. He compared the present application to a recently published patent by the same company in which the only difference was a flow chart of the firmware. Subtract the patent disclosure from the Bradley application and all that's left (besides the anathema of this process of claim mutilation) is firmware.

He had no more to say at this time, so Mr. Wallace sat down, and Mr. Nicholas Prasinos of Honeywell Information Systems got up to speak for the inventor. Surprisingly, Mr. Prasinos completely agreed with Mr. Wallace and the government's position regarding the non-patentability of computer programs. In fact, Honeywell had filed briefs before the Supreme Court in other cases arguing that computer programs were not patentable subject matter. Mr. Prasinos only disagreed with Mr. Wallace on one minor point. The claim in this case was for hardware, not software; for a machine, not for a process of solving an algorithm.

Mr. Prasinos should have stayed at lunch. By adding to the confusion, by not responding to the question of Mr. Justice Blackmun, by not appreciating the obfuscation of the justices, Mr. Prasinos nearly held the nails as Mr. Wallace hammered them home. The coffin was sealed. Only if the Supreme Court can become Houdini, or can figure out what a computer program is, is there a chance.

Appendix

The following is Claim 1 of the Bradley patent application:

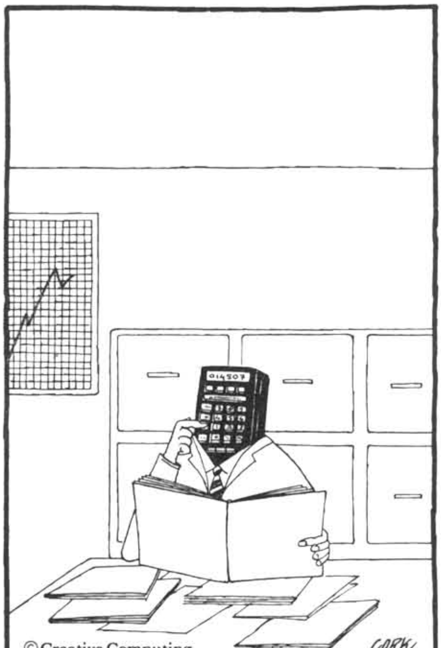
In a multiprogramming computer system having a main memory, a central processing unit (CPU) coupled to said main memory, said (CP) controlling the state of a plurality of groups of processes being in running, ready, wait or suspended state, said computer system also having scratchpad registers being accessible to an operating system for controlling said multiprogramming computer system, a data structure for storing coded signals for communicating between said processes and said operating system, and said scratchpad registers, said data structure comprising:

(a) first means in said data structure and communicating with said operating system for storing coded signals indicative of an address for a selected one of said processes;

(b) second means in said first means for storing coded signals indicating priority of said selected one of said processes in relation to others of said processes for obtaining control of said CPU when ready;

(c) third means in said data structure and communicating with said operating system, for storing coded signals indicative of an address for a selected one of said plurality of groups of processes, and

(d) fourth means coupled to said data structure and said scratchpad registers, for generating signals causing the changing of information in said data structure and said scratchpad registers. □



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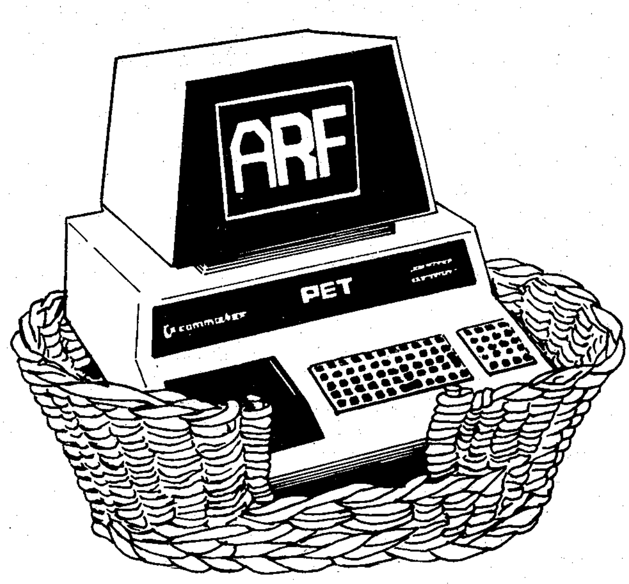


Gregory Yob

I am happy to hear from you, and encourage your correspondence. I will try to acknowledge all correspondence, and a SASE makes things easier for both of us. Please send your letters to "Personal Electronic Transactions" c/o PO Box 354, Palo Alto, CA 94301.

My PET Now Has Some Character

About a year ago, when the Programmer's Toolkit was still hot off the silicon dies, a problem was evident — some PET owners, such as those with the Computhink disks, could not use the Toolkit. Their $B000 socket was already occupied with their disk system ROM. One solution, provided you were an experienced PET hacker, was to make a relocating program which moved the Toolkit into the top of your RAM and then copy the result on tape. (That is, a RAM version of the ROM.) However, this approach has some severe disadvantages, including:

1) Relocation isn't as easy as you think it is. For example, in some cases a subroutine is called by the RTS instruction! Simple minded relocation jobs will *not* discover these obscure tricks, and the result will not work correctly. (There is one such mangled version of the Toolkit marketed in Europe.)

2) Though a program which only relocates another program is probably legal, as the user of said program needs the original ROM to start with, it is far too tempting to distribute copies of the relocated program — which is (or should be) both illegal and unethical.

3) Then a new ROM program comes out — and you have to do it all again.

(NOTE: For those curious re the Toolkit. Yes, a relocating program exists. This program is owned by Nestar/PAICS and they will market it when they feel conditions are right. If you try making such a program, be aware that Nestar *will* take legal action. Though the case may ultimately not be provable, keep in mind that a trial is the least part of such actions. It costs money to handle all of the legal moves, and many cases are settled when the party with the least resources runs out.)

A far superior solution (and more ethical) is to buy some hardware which permits several ROM sockets to share the same address, though not all at once. Skyles Electric Works offers several variations, called Socket-Two-Me and ROM-It-To-Me, which expand a 4K ROM socket into two 2K ROM sockets, and permit switching between the two sockets. Micro Technology Unlimited (Box 4596 Manchester NH 03108) provides five ROM sockets on their PET Visible Memory board, with each socket individually addressable and selectable.

Kobetek Systems (RR #1, Wolfville, Nova Scotia, Canada BØP 1XØ) also provides a "Dial-A-Rom" ($88.00 + $5.00 airmail) to give you a choice between ROMs. Two models are available, one with a manual rotary switch and the other operated by POKEs. Six sockets are provided for six ROMs.

Though the instructions are a little rough at the edges, using the Dial-A-Rom is simple enough. Remove the ROM from its socket and put the ROM on the Dial-A-Rom's socket. Then plug the Dial-A-Rom into the ROM socket in the PET. A cable with a 24-pin DIP connector comes with the Dial-A-Rom. The unit comes in a gray and white case, so there's no danger of a paperclip destroying everything.

The Dial-A-Rom may be used for ROMs such as the Toolkit, Wordpro, Extramon, Visicalc or Sort. You can switch between ROMs with the PET's power on — however, many of the ROMs hold operating software which may get confused if you actually do this. (Example: The Toolkit changes the Basic Charget routine in the base page. In normal operation, the PET will use the software in the Toolkit each time a Basic statement is executed or a line entered from the keyboard. If you switch ROMs, the PET will still transfer to where it thinks the Toolkit is. However, now something else is there, and the result is chaos (and a reset required).)

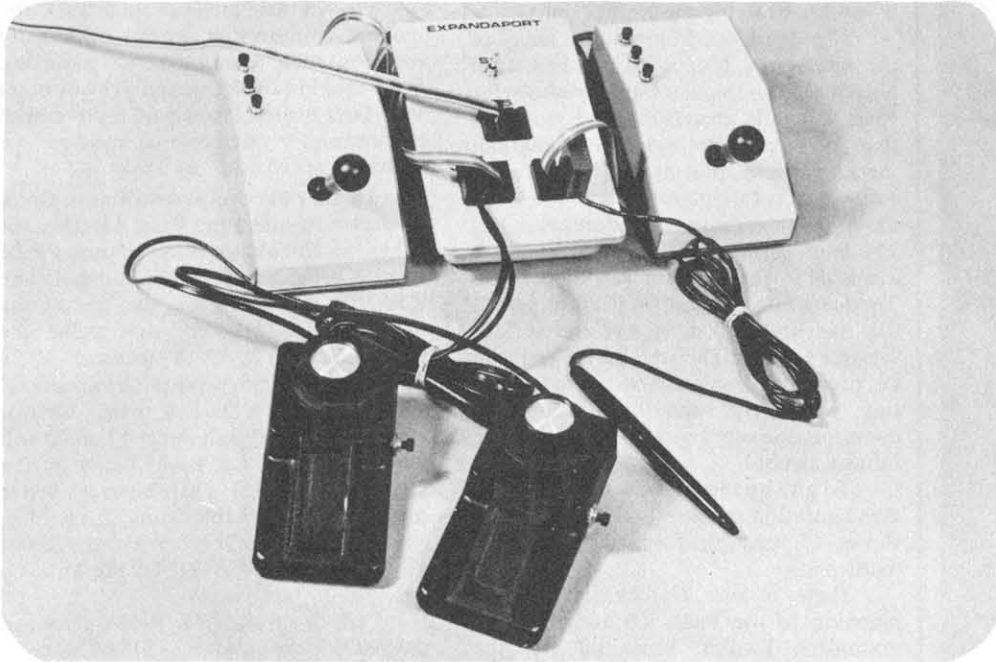
Since the Dial-A-Rom can be plugged into *any* ROM socket, there's a nice surprise: This includes the PET's character generation ROM. Kobetek will provide you with two "Alternate character" ROMs, one for mathematics and the other for foreign languages (those which use our familiar alphabet plus some funny letters. I expect to see Katakana and Arabic ROMS eventually. The Katakana ROMs are distributed in Japan.)

Both ROMs are activiated by POKEing the PET to the alternate character set by POKE 59468,14. If you do this, your PET is now in the "Business Character Set", with the keyboard now similar to a typewriter's. Pressing "A" gives you "a" on the screen, and Shift-A gives you "A". (Note: This is true of most PETs. If your PET has the full-sized keyboard, this will probably be the case. Some PETs, (the early ones produced until June 1978) will be "backwards", with Shift-A required for the "a" on the screen. One cure for this is to get the Foreign Language ROM from Kobetek, which is done — "typewriter" style.)

The Foreign Language ROM uses the less often used punctuation keys (such as $ or &), the shifted punctuation keys, the shifted number keys and the punctuation keys found on the lower row (like @) to give you the French, Spanish, German, Polish and Czech special characters. This includes umlauts, accents, diacritical marks, inverted question marks, and the various little hooks, wedges and curls needed in these languages.

If you are interested in teaching foreign languages or in the European market, this ROM will be a great help to you. The price is $69.00. (Both ROMs are the same price. Their USA distributor is

JOYSTICK & EXPANDA-PORT FOR YOUR APPLE II® COMPUTER



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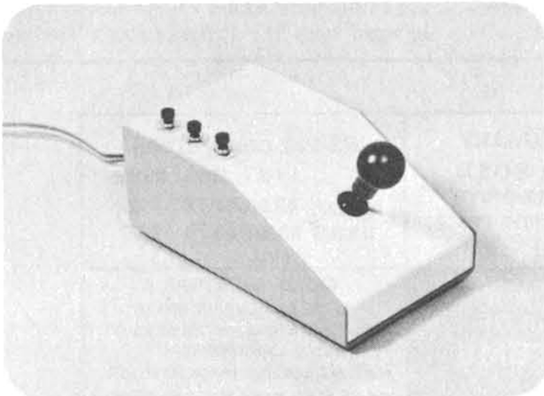
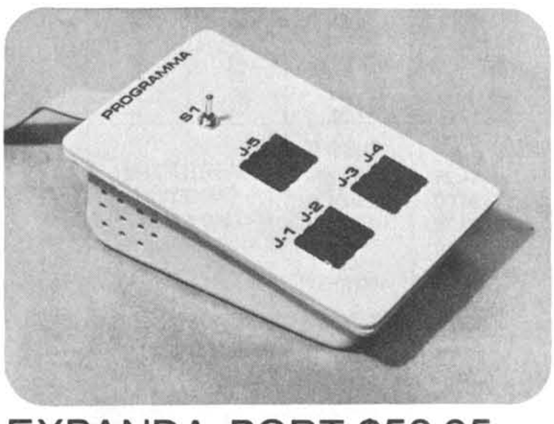


JOYSTICK $49.95

The PROGRAMMA JOYSTICK is an input peripheral that attaches to the APPLE II Computer's game I/O Port. The JOYSTICK is a must for the serious game player, and it offers a degree of linearity not currently available with other joysticks. The ease of manueverability and the availability of the "functional" switches make the PROGRAMMA JOYSTICK a much needed enhancement to any APPLE II Computer System owner. The PROGRAMMA JOYSTICK comes completely assembled and tested.



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The PROGRAMMA EXPANDA-PORT is a multi-port expander for the game I/O port of any APPLE II Computer System. In addition to allowing expansion for up to six devices, the EXPANDA-PORT contains a built-in speaker that replaces the function of the Apple II's speaker. The switch on the EXPANDA-PORT allow for the selection of the specific device desired and for the switching of that device. No unplugging of any device connected to the EXPANDA-PORT is required. The PROGRAMMA EXPANDA PORT comes completely assembled and tested.

The PROGRAMMA JOYSTICK and EXPANDA-PORT are available on a limited basis through your local computer dealer. Apple II is a registered trademark of Apple Computers, Inc.

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PET, continued...

West River Electronics, Box 650, Stony Brook, NY 11790. Contact West River if you are ordering the ROMs only.)

The Math ROM gives you many of the characters needed in mathematical notation. This includes the symbols for roots, integrals, greater than or equals, less than or equals, not equals, summation, theta, epsilon, plus-minus. For superscripts and subscripts, the numbers 0-9 and the common variables x,n,t,c are available. The four "corners of a box" characters are available for making brackets of any size. The integral comes in two parts to permit any size integral signs and the surface integral symbol. The superscript zero can be used for degrees. Also included are tiny parentheses and the arithmetical operators for sub/superscript use and the infinity symbol.

To give an idea of how to use these, a demonstration cassette is available which shows 15 example formulae typical of mathematics.

There is one *Gotcha!* if you are planning to use Basic 4.0 and the Programmer's Toolkit. Basic 4.0 uses the $B000 area for many essential operations of Basic, and if you try to mount the $B000 ROM of Basic 4.0 in the Dial-A-Rom, your PET will depart to computer's heaven when you try to switch to the Toolkit.

Thinking about Basic 4.0 — Get a Disk-O-Pro Instead!

I haven't said much about disks, Commodore or otherwise, in this column for one reasonable reason: I didn't have disks. Well, that has changed, and like any other PET Disk owner, I have paid my dues with the extremely cumbersome methods required to speed with my Disks.

To alleviate this awkwardness, Commodore now offers the Basic 4 ROMs, for either the 40-column or 80 column PETs. Basic 4 provides 15 Disk commands like DSAVE, DLOAD, etc, the use of the Shift RUN/STOP key to execute the sequence LOAD "*",8 (return) RUN (return) and sundry other conveniences.

If you get the Basic 4, there's a major *Gotcha!* — The Programmer's Toolkit will no longer work, for Basic 4 eats up the $B000 ROM socket. There's a much better solution now available from Skyles Electric Works, 231-E South Whisman Road, Mountain View, CA 94041, the Disk-O-Pro.

Disk-O-Pro is a 4K ROM placed in the $9000 socket, and costs $75.00 for most PET users. Skyles is experienced with all of the PET variations and memory expansions (such as Expandamem) and some 16 variations on mounting Disk-O-Pro are available. As Disk-O-Pro works hand-in-hand with the Programmer's Toolkit, you can also order the Toolkit at the same time for some cost savings.

Figure 1 lists the commands available in Disk-O-Pro. As well as the 15 commands in Basic 4.0, Disk-O-Pro includes three more disk commands to MERGE (disk version of Toolkit's APPEND), SEND (any command in the PRINT# format you are used to) and INITIALIZE.

Disk-O-Pro also includes a repeat key function, the "Softkey" which lets you define a keystroke to be any string up to 80 characters, and the Scroller which lists the Basic program up or down if the Cursor Up or Down keys hit the screen's edge.

One of the nicest things about Disk-O-Pro is that the Programmer's Toolkit commands are still available. If you have the Toolkit, starting Disk-O-Pro will also start the Toolkit.

Disk-O-Pro also includes a PRINT USING, which is useful if you have columns of figures to line up. PRINT USING is not as well done as the other Disk-O-Pro commands, and will do strange things if the number would normally be printed in Scientific form (ie, 3.12 E-12).

If you already have Basic 4, Skyles offers a "Command-O" which provides the Toolkit and non-disk functions in Disk-O-Pro.

Make no mistake, I feel that Disk-O-Pro is as useful to the Commodore Disk owner as the Toolkit is with any PET owner.

PILOT

If you walk into a school using personal computers, take a look at where the computers appear. You will find them in the math and science departments mostly, with some stragglers in the business administration and typing departments. You will *not,* in most cases, find the noble PET around the English or Art classes.

You might attribute this to the traditional disdain that liberal arts people seem to hold towards technological things in general, and if you do, you will not discover that it isn't the technology that the non-technical people are against, it is the insensitivity of scientific and technologic systems towards people, both in groups and as individuals. Before personal computers, most machinery was *incredibly* stupid. If no one was there to run the machine, the machine could (and did) do terrible things. Most machines that we know *have no senses.* They also know nothing of how people like to be approached.

In addition, many technically inclined persons are not extremely proficient at the delicate art of personal relations. Though it is not often discussed, my impression is that the technical "game" is a relatively safe place for some who are frightened of many human relationships. We are all familiar with the computer nut who is hard to follow when discussing computers, and if the topic changes, collapses into an awkward silence.

With this in mind, it's no surprise that many computer programs end up as rigid, incomprehensible, and unfriendly. You can't call Space Invaders a friendly game! The computer programs I have seen tend to be: 1) Shoot, Hunt or Chase games, 2) Puzzles (Which includes all of programming) or 3) Practical stuff (all business applications, data keeping, etc.).

These categories are not attractive to those in the liberal arts, with the single exception of the Practical Stuff called Word Processing, which helps the writer in this daily battle with the Dumb Typewriter. What we need are programs which use words, not numbers and symbols, or images instead of flow-charts.

One place, then, to begin, is with a word-oriented language. To date, the only conversationally oriented language I know of is PILOT. Several versions of PILOT are available for the PET, and the list of marketers is in Figure 2. If you want to get the computer into the English department, may I suggest starting with PILOT. PILOT can, in a limited way, maintain "conversations" with students which provide considerable freedom when it comes to the student's input. You need never again see ?REDO FROM START or ?ILLEGAL QUANTITY messing up your PET's screen or your student's self-esteem.

```
Value-Added Commands

     SYS 9*4096  -  Start Disk-O-Pro
     KILL        -  Stop  Disk-O-Pro
     BEEP (duration),(tone)  - CB2 Sound
     SCROLL      -  Key Repeat & Editing
     OUT         -  Stop SCROLL
     SET "key string" (ON "key value")
     PRINT USING (# logical file# ) "image string",
          variables list
          #### - numbers
            .  - decimal point
            ,  - comma
     PROGRAMMER'S TOOLKIT - All Toolkit commands legal. AUTO
          changed to NUMBER.

Disk Commands

     INITIALIZE (D drive#) (ON U device#)
     SEND "command string" (ON U device#)
     HEADER "disk name",(D drive#)(I  disk id)(ON U device#)
     CATALOG (D drive#) (ON U device#)
     DIRECTORY (D drive#) (ON U device#)
     BACKUP D drive# TO D drive# (ON U device#)
     COPY (D drive#) "filename" TO (D drive#) "newfilename" (ON U device#)
          or:  D drive# TO D drive# (ON U device#)
     COLLECT (D drive#) (ON U device#)

     DSAVE "filename" (,D drive#) (,R) (ON U device#)
     DLOAD "filename" (,D drive#) (ON U device#)
     EXECUTE "filename" (D drive#) (ON U device#)
     RENAME "filename" (D drive#) TO "newfilename" (ON U device#)
     SCRATCH "filename" (D drive#) (ON U device#)
     MERGE (# line number ,) "filename" (D drive#) (ON U device#)
     CONCAT (D drive#) "filename" TO (D drive#) "recipient
          filename" (ON U device#)

     DOPEN # logical file#, "filename" (,L record size) (,D drive#)
          (ON U device#) (,W) (,R)
     DCLOSE # logical file# (ON U device#)
     APPEND # logical file# (,D drive#) (ON U device#)
     RECORD # logical file#, record # (, byte #) ......
```

Figure 1: Disk-O-Pro Commands Summary

PILOT Introduction

PILOT consists of these statements:

T: Type a line on the screen.
A: Get someone's answer.
M: Match the last answer with some key words.
Y: If the last Match worked, type this line. (Yes)
N: If the last Match didn't work, type this line. (No)
J: Jump somewhere. (like GOTO)
U: Subroutine. (like GOSUB)
E: Return from subroutine.
R: Remark.

Here is a sample PILOT program to show how all this works:

```
T:HELLO, I AM YOUR FRIENDLY COMPUTER.
T:BY THE WAY, WHO ARE YOU?
A:NAME$
T:ALL RIGHT THERE, NAME$, I HAVE A QUESTION
T:FOR YOU. DO YOU LIKE COMPUTERS?
A:
M:YES,YEAH,SURE,OK,SUPER,WOW

Y:I'M HAPPY TO HEAR THAT. YOU ALREADY
Y:KNOW WHY - I'M A COMPUTER.

  JY:*STEP2
   M:NO,NEVER,YEECH,YUCK
   Y:SIGH, PERHAPS YOU SHOULD TURN ME OFF.
   Y:I DID ENJOY TALKING WITH YOU, NAME$.
   EY:
   N:I'M NOT SURE I UNDERSTAND THAT, BUT
   N:LET'S SEE IF YOUR OPINION WILL BECOME
   N:CLEARER AS WE GO ON.

*STEP2 T:WELL NOW, WHEN DID YOU FIRST MEET A
       T:COMPUTER?
```

PET, continued...

This is almost readable. Here are three sample "dialogs" using this little program.

Dialog 1

```
HELLO, I AM YOUR FRIENDLY COMPUTER.
BY THE WAY, WHO ARE YOU?
MARY WILLIAMS                    (underline indicates user's input)
ALL RIGHT THERE, MARY WILLIAMS, I HAVE A QUESTION
FOR YOU. DO YOU LIKE COMPUTERS?
NOT PARTICUARLY
SIGH, PERHAPS YOU SHOULD TURN ME OFF.
I DID ENJOY TALKING WITH YOU, MARY WILLIAMS.
```

Dialog 2

```
HELLO, I AM YOUR FRIENDLY COMPUTER
BY THE WAY, WHO ARE YOU?
HERKIMER MC GURK
ALL RIGHT THERE, HERKIMER MC GURK, I HAVE A QUESTION
FOR YOU. DO YOU LIKE COMPUTERS?
I SURELY DO!
I'M HAPPY TO HEAR THAT. YOU ALREADY
KNOW WHY _ I'M A COMPUTER.
WELL NOW, WHEN DID YOU FIRST MEET A
COMPUTER?
```

Dialog 3

```
HELLO, I AM YOUR FRIENDLY COMPUTER
BY THE WAY, WHO ARE YOU?
HJ HHARRY
ALL RIGHT THERE, HJ HHARRY, I HAVE A QUESTION
FOR YOU. DO YOU LIKE COMPUTERS?
U UH MAAYBE
I'M NOT SURE I UNDERSTAND THAT, BUT
LET'S SEE IF YOUR OPINION WILL BECOME
CLEARER AS WE GO ON.
WELL NOW, WHEN DID YOU FIRST MEET A
COMPUTER?
```

Now for a closer look. In Dialog 1, PILOT printed two lines and then waited for Mary to type her name. This was stored in the string named (in PILOT) NAME$. In the next line, where NAME$ appears in the program, Mary's name was printed instead. After the question about liking computers, PILOT again waited for a reply.

The first M: line holds several "positive" responses, none of which matched Mary's reply. The three Y: lines (two Y: and one JY:) were skipped, for these only execute if the Match was successful, and here it wasn't. The second M: found a match between NO and Mary's NOT, so the next two Y: were printed, and the EY: stopped the program.

We can in a similar way trace through the other two dialogs — this is for you to do. Anything at all is acceptable to the A:, including just the carriage-return. If the reply is redisplayed later, in this case as the user's name, the exact reply appears, mistakes or whatever fully intact. PILOT makes no pretense to be a person, just to accept your entries without much fuss and to "converse" in a limited way.;.

The Match can carry several similar items to look for. Any single success results in a successful Match, and subsequent Y's will be executed. Various options on matching are available, with the simple substring match being used here. For example, the match item OUT will match BOUT, CLOUT, OUTRAGEOUS, but will not match HEAD or SOU TH.

The J: will jump to the indicated line labeled with an * followed by a label name. PILOT does not need line numbers, though many versions of PILOT use line numbers to help you edit the programs.

Dialog 3 illustrates the N:, which only works when the last Match was *not* successful.

The PET PILOTs

The four versions of PILOT available for the PET would lead you to believe that at least one of these would be suitable for serious educational use. After reviewing each of them, my conclusion is that this is not the case. Each version of PILOT does work, and I didn't try to maliciously make the programs crash. However, each version has serious limitations, and you can take your pick as to which ones to put up with. My ranking is:

1. Peninsula PILOT
2. Practical Applications PILOT
3. Dr. Daley's PILOT
4. PET PILOT

One nice thing about PILOT is that you don't have to use it for major projects. You can throw out the day's work if you need to. Peninsula PILOT is probably the best to begin with.

Keep in mind that each of these PILOTs were developed for the 8K PET without disks. This left about 4K for the actual PILOT interpreter written in Basic, and 4K is a small amount of space to do a computer language in. Though a fully developed PILOT would be free of many of the limitations in these versions, such a PILOT would take about 12K — at least 8K of memory.

Peninsula PILOT

A major hazard with PILOT is the editor — that is, how to get the program into the machine. Most editors are harder to learn than PILOT! This version avoids the matter — by storing the PILOT lesson within the program. Lines 10 to 200 are simply empty lines beginning with a quotation mark. You use the PET's normal Basic editor to fill in these "blanks" with some PILOT lesson lines. The program is run by a lot of PEEKs and POKEs (that is, the Basic program which does the PILOT language is doing all of this. You don't see this stuff.) which look at the program and performs the lesson.

To save or load, you merely SAVE or LOAD the whole thing — PILOT language and lesson together. The PET thinks this is a Basic program.

Peninsula PILOT sets the PET into the alternate "business" character set, so both upper and lower case letters show on the screen. Some limitations, especially in variable names and the total program size exist.

Practical Applications PILOT

Rather than store the lesson as Basic statements, this PILOT uses a string array, and will hold about 500 lines, which is usually more than your PET's memory will hold (unless you have the 32K machine). The PILOT used here is almost the "barebones" minimum, and a simple editor is provided to enter and modify your programs. One major problem is that the INPUT statement isn't "RETURN-proofed", that is, pressing RETURN will end the program when in an INPUT statement.

PILOT lessons are saved & read as tape data files.

Dr. Daley's PILOT

This is not a true PILOT, but a variation known as "tiny" PILOT. "Tiny" PILOT is not compatible with PILOT, and you will have to make some modifications to work your programs. If you are selecting a PILOT for serious use, I do *not* recommend "tiny" PILOT. (Actually, "tiny" PILOT was an attempt to improve PILOT which didn't work out too well. I admit to being rather prejudiced about the stylistic details of PILOT, for reasons too lengthy to describe here.)

Both Practical Applications and Dr. Daley's PILOTs make some concessions to the Basic INPUT statement. True PILOT uses the colon and the comma (ie, M: ITEM, ITEMS, ITEMS AGAIN) which are anathema to the INPUT statement unless within quote marks. Rather than force the user to continually type quote marks, the semicolon (;) and period

(.) are substituted for colon (:) and comma (,). The only alternative is to write a GET routine, which takes about 200-400 bytes. Even then, there's the problem of making easily readable data tapes.

A serious limitation of this PILOT is that the Match (M:) does not work the way it should. M:THING will find THINGEY but not A THING. The comparison starts at the first letter, and does not permit the keyword's being further along in the student's reply. Bad!

PET PILOT

This PILOT is closest to the PILOT "standard" (yes there is such a thing), with enough limitations to limit use to very patient people. The system is to read a tape with the lesson on it (prepared via a separate editor program) and to store about 60 lines in the PET at one time. Though unlimitedly long programs are possible, any jumps must be short in the backwards direction. A long forward jump causes the tape to be read, and as new lines come in, old ones go away.

Entry of a program uses one tape drive, however to change a program involves reading a tape and subsequent copying onto the other tape drive — thus you need two tape units for this PILOT.

There are several picky limitations on variables and their display in T: which are hard to learn. These limitations only serve to make the programming somewhat simpler.

Do It Yourself

Some miscellaneous comments: First, where are all the PILOT lessons, or even better, curricula and lesson plans? The sad fact is that there aren't any. Some example lessons exist, but you will have to "roll your own" in PILOT. This is not as bad as you may imagine, for "canned" PILOT lessons would require modification anyway.

Second, yes, the four PILOTs can be modified to work on the PET disk. Peninsula PILOT needs no modifications (other than four the "old" vs "new" ROMs, and these changes come with the instructions). Practical Applications and Dr. Daley's PILOT are fairly easily modified. Add a filename request, change the OPEN statements, and be sure to replace:

PRINT# x, something

with

PRINT# x, something;CHR$(13);

These PILOTS avoid the INPUT "choke" characters quote, comma, and colon. PET PILOT is another story. It took me about two hours to make this one work on the disk, and when it does, the requirement of GET# makes the execution very slow. The editor could be changed to fix this, but my intension was only to review these programs.

```
1) Peninsula PILOT

        Peninsula School Software
        Computer Project
        Peninsula School
        Peninsula Way
        Menlo Park, CA 94025

        Price: $19.95

2) Practical Applications PILOT

        PET Practical Pilot
        Practical Applications
        PO Box 4139
        Foster City, CA 94404

        Price: $14.95

3) Dr. Daley's PILOT

        Dr. Daley
        425 Grove Ave.
        Berrien Springs, MI 49103

        Price: $14.95

4) PET PILOT

        David Gomberg
        Seven Gateview Court
        San Francisco, CA 94116

        Price: $17.95

Further information on PILOT is
available from:

        The PILOT Exchange
        Earl Keyser
        22 Clover Lane
        Mason City, Iowa 50401
```

Figure 2: PILOTs for the PET

Have Someone Else Do It

Your alternative, of course, is to write your own PILOT. One approach, for example, is a "PILOT to Basic translator", a Basic program which reads the PILOT lesson and creates an equivalent Basic program. This can be done with the PET's disk. A translator is not desirable for developing lessons as a lot of time is taken in translating. The final lesson will run much more quickly than PILOTs which interpret lessons in string arrays.

Keep in mind that this column is *not* a sufficient description of PILOT. Contact the PILOT Exchange (in Figure 2) for further information on the definition of PILOT.

(To be crassly commercial: I have known PILOT for over 10 years, and have implemented it in several ways. I won't do a super PILOT for love, but I would for money.)

Plug, Plug, Plug

The two best PET oriented publications are:

Compute!
PO Box 5406
Greensboro, NC 27403 USA
$16.00 per year (USA)

Printout
PO Box 48
Newbury, Berkshire
England RG16 ØBD
$35.00 per year (USA)

Compute! covers the other 6502 machines, but its major emphasis is on the PET. *Printout* is strictly on the PET. The English view of PET is very different from ours, and worth looking at. A lot is stuff is happening over there.

Machine Language Goodie #7

Figure 3 shows a program which you can enter into your PET for a winter's fantasy. The machine language routine was taken from *Printout*, October 80, Page 34, and will work for *both* ROMs ("old" and "new"). If you merely SYS 826 after line 30, the screen will be reversed, white to black and vice versa. The remaining program, which I won't explain, does horrible things to the screen reversal routine. Line 50, by the way, is really:

50 PRINT "clr";

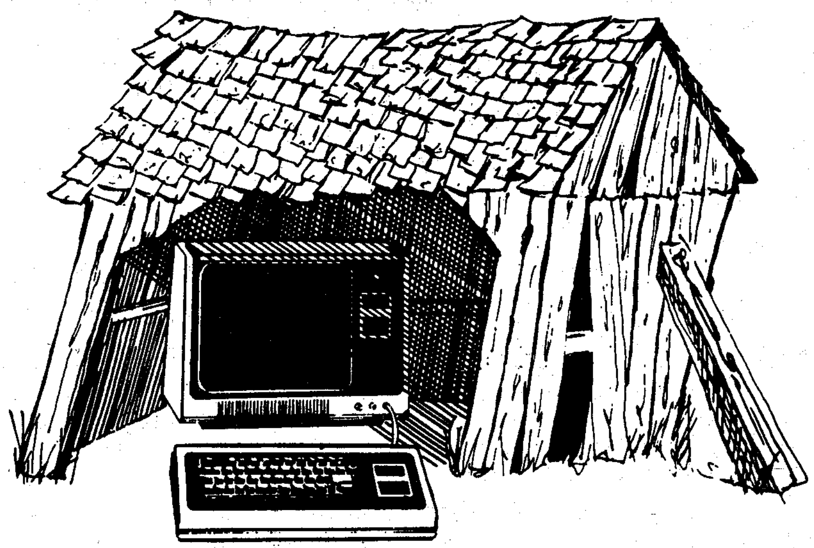
Caution: This program does flash a bit, and if flashing things bother you, don't hesitate to press the Stop key. □

Figure 3: Machine Language Goodie #7

```
REVERSE FLAKER
 10 AD=826
 20 READ BY:IFBY =-1 THEN 50
 30 POKE AD,BY:AD=AD+1:GOTO20
 40 REM NOW FOR SOME FUN!
 50 PRINT"";
 60 SC=32768:SX=826:SK=1000:S1=1:SJ=81
 70 FORJ=1TO222:SYS SX:SYS SX:POKESC+SK*RND(S1),SJ:NEXT
 75 CLR:AA=256
 80 AB=826:AC=827:AD=829:AE=831:AF=840:AG=835:BA=832:BB=838:R=4:S=128
 85 CD=32768:CE=1000:SP=42
 90 FORJ=1TO5+10*(S-127):POKE AC,RND(1)*AA:POKE AD,RND(1)*AA:SYS AB
 95 POKE CD+CE*RND(1),SP
 100 POKE BA,S:POKEBB,S:NEXT
 110 S=S+1:IFS=132THEN80
 130 GOTO 90
 1000 DATA 160,0,162,0,189,0,128
 1010 DATA 24,105,128,157,0,128,232
 1020 DATA 224,0,208,242,238,64,3
 1030 DATA 238,70,3,173,64,3,201
 1040 DATA 132,208,229,169,128,141,64
 1050 DATA 3,141,70,3,96,-1
```

TRS-80 Strings

Stephen B. Gray



In this 27th column, we'll check out 18 programs: five that comprise a four-voice music-synthesizer system; six that make up a graphics cassette; six that are part of an educational package; and a short one you'll probably never figure out unless you RUN it.

Orchestra-80

There I was, with the converter plugged into the TRS-80 and also connected to a hi-fi amplifier, and the machine-language software wouldn't load. I kept on trying, with SYSTEM and then ORCHST, and nothing happened.

After checking everything several times, I finally looked closer at the name of the program. It was ORCH8T, not ORCHST, and once I used the right name, the program loaded without a hitch, and I had the pleasure of listening to several remarkable four-part demonstration pieces that are on the tape along with the five-program system.

Orchestra-80, which you can get from Software Affair (473 Sapena Court Suite 1, Santa Clara, CA 95051), is $79.95 plus $2 for postage and handling. It's a music synthesis system for a 16K Level II TRS-80, with both tape and disk versions on the cassette, along with a utility program to transfer music files between tape and disk.

For your $79.95 you get a small PC board, 1½ by 2 inches in size, which plugs into the left rear of your keyboard, or into the expansion interface. It's a digital-to-analog converter that changes the binary computer outputointo an audio signal, and takes its power from the TRS-80.

Even if you connect the board to an inexpensive amplifier/speaker such as the $11.95 Radio Shack 277-1008, you'll hear music you may not believe at first, if all you've heard is single-voice music such as provided by Radio Shack's Micro Music.

Get a three-foot (or longer) audio cable with a RCA phono plug at each end, plug one into the audio jack on the Orchestra-80 board, the other into the AUX, TAPE or TUNER input of an amplifier or receiver, hook up a speaker or two, and you're in for a musical treat.

Now, let's be honest. This is electronic music, with fairly simple waveforms, and if you're a Julliard or Eastman graduate, it may not please your ears. But if you just want to make computer music, and like the idea of writing four-part harmony with an absolute minimum of fuss, this is the way to go.

If you're wondering why you pay $79.95 and get such a small piece of hardware, consider that the software took several years to develop. Also, the manual is extensive and excellent, rare qualities in this business.

Orchestra-80 is a software-driven music-synthesis system consisting of five machine-language parts: digital synthesizer that produces up to four simultaneous voices in a six-octave range; a music-language compiler that allows you to enter your favorite written music (Bach's or your own) in any key or time signature; a full screen editor for entering and modifying music programs; a file manager for storing and retrieving named files on tape or disk; and an initialization routine for setting up the parameters before you start.

The 39-page instruction manual is one of the best I've ever seen (even though several words are misspelled), with complete details on how to use Orchestra-80, including 11 pages that show you exactly how to convert written music into keyboard characters for your TRS-80. It's so detailed that you can use it within an hour or two even if you can't read a note of music.

The manual makes the seven-page Radio Shack manual for Micro Music look pretty sad; the latter has only five simple sample bars to show how to write music. But then again, it's $9.95, has no hardware, and plays only one voice. If all you want is an idea of what computer music is like, Micro Music may be all you need. But if you want polyphony, more than one voice, there are at this writing only two TRS-80 programs on the market. The other one will be described in this column shortly, so stay tuned.

Run the Orchestra-80 program into your TRS-80, and the first thing you get is the initialization program, for configuring the software. A menu asks if you want to duplicate the program for a back-up copy, if you want four voices or the higher-resolution three-voice synthesizer, if you want to listen to a sample scale played by the four different tone-colors available, if you want to modify the waveforms to create your own tone-colors, and if you want to save all this information on tape "and avoid the lengthy dialog in the future."

Then you can enter GET LONE to hear the first sample of music, which is the Lone Ranger's theme (the William Tell Overture) and the first of four sample pieces on the tape.

If you want to start writing music, just enter EDIT, and you're ready to transcribe. First you enter a line or two, each prefaced with a slash (/) to show they're comment lines, indicating the name and author of the piece:

```
/CAPRICCIO
/J.S. BACH
```

Then, if you're about to write a bar or bars that will be repeated, you enter a section number so the computer will know where to start the repeat, and perhaps you add some more information about the piece, preceded by a slash:

```
P50/ARIA DI POSTIGLIONE
```

After that, you write a line to indicate the key, such as

```
K2&
```

which means in the key of two flats. For three sharps, write K3#. The next line defines the time signature and tempo:

```
NQ=CO
```

which means that each quarter-note gets a beat, and CO is one of 96 hexadecimal

Basic In A Nutshell

Name: Step-By-Step
Vendor: Program Design, Inc., 11 Idar Court, Greenwich CT 06830
Price: $49.95
Purpose: Teaches how to program a TRS-80 using BASIC
Documentation: Outstanding
Loading: OK—Level 6, not critical
Implementation: This is a case of a BASIC program that teaches BASIC programming. It starts out with the assumption that the student only knows how to turn the TRS-80 on. Three cassette tapes are mounted in the cover of a loose-leaf notebook that also contains supplementary information frames. The course is divided into ten two-part lessons. From a simple PRINT "HI" through arrays and graphics to complex programs, all of the Level II commands and statements are exercised.

The instruction method consists of explanation, example, trial and testing. Commands and statements are presented and explained, examples are shown both on the screen and in the notebook, and then the student is presented with some problems to solve using the BASIC elements under discussion. If an incorrect answer is given, two more tries are allowed, and then the correct answer is displayed. Each lesson ends with a test that is administered and scored by the computer. The results are then entered into the student's progress chart. More comprehensive examinations are given at the end of Lesson 5 and at the end of the course.

Suitability: This is the kind of educational programming that personal computing needs more of. The student (my teenage son) learned much more quickly than I could have taught him, and at his own pace. However, this course isn't just for youngsters but for anyone who wants to be able to program effectively using the BASIC language. In a household where there isn't anyone to do the teaching, this course would be especially useful. I'd like to see a similar course for assembly-language programming.

Other software available from the same vendor: IQ Builders (four different kinds), Memory Builder and Story Builder.

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80 Microcomputing, February 1980

Step by Step also available for Apple II and Pet   Apple II version also available on disks for $59.95.
Available at Computerland and other fine computer dealers. Or, use the coupon below.

Program Design, Inc. 11 Idar Court Greenwich, Conn. 06830 203-661-8799

ORDER FORM

Quantity	Title	Computer	Price
________	STEP BY STEP	________	________

Please send me a list of dealers in my area ☐
Check or m.o. enclosed ☐

Shipping 5% ________
CT resident add 7% ________
TOTAL ________

BankAmericard/VISA # ________ Name: ________
Mastercharge # ________ Address: ________
MC 4 digits over name ________ City: ________
EX date ____ Phone ________ State & Zip: ________

*Foreign orders: U.S. funds Add $10.

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designations for tempo, ranging from 40 to FE. Each of the 96 corresponds to a combination of the numeric keys 1-7. You can experiment with different tempos, while a tune is being played by the program, by pressing the numeric keys to slow down or speed up the tempo, until you find just the right one.

If you want to transpose the piece up or down, just enter an arrow and the number of semitones involved:

>2

will transpose the piece up a whole tone. This is handy if you're transcribing music arranged for different instruments in different clefs. You can define each voice as belonging to a different clef.

The next line defines the tone-color registers to be used by the different voices. The four choices are trumpet, oboe, clarinet and organ, labeled A through D. To assign the four sounds to the four voices (which can in some cases be thought of as soprano, alto, tenor and bass), simply write

V1YA V2VB V3YC V4YD

and you're ready to start with the notes themselves.

First you write the measure number, such as M1 for the first measure. Then a * to indicate you're in the treble clef, or a @ for the bass clef.

You enter the time-value for the first note, using W, H, Q, I, S, T or X, depending on whether it's a whole, half, quarter, eighth, sixteenth, thity-second or sixty-fourth note. That's followed by a letter or number indicating the note itself. Middle C is zero, the sixteen notes above it are +1 through +G, and the sixteen below it are -1 through -F. Using * or @ eliminates the need for the plus or minus signs most of the time. For a rest, use $. After a while, you remember which keys mean which notes.

V1 need not be entered to define the first voice, but V2, V3 and V4 must be. Simply enter each in the measure when they're to be used, followed by the time-value symbols and the notes.

As an example, here's one of the 16 written musical samples in the manual:

```
*I$Q9'I9$QB'IB
V2I$Q7'I7$Q7#'I7
V3I$Q4'I4$Q6&'I6
V4H0Q2'2
```

V1 is understood for the first voice, * means treble clef, I$ means eighth-note rest, Q9' is a quarter note that is nine notes up from middle C, which is E (a numbered scale in the manual makes this easy; you don't have to count notes on your fingers); the single quote means the note is articulated, meaning a small rest is inserted after the note to separate it from the note following, which is also an E. For a longer articulation, use a double quote (").

After an eighth-note E, the first voice has another quarter-note rest, followed by an articulated quarter-note G, and an eighth-note G.

V2 and V3 are similar, with V2 using 7# for the C-sharp and V3 using 6& for the B-flat. V4 uses a whole-note middle C, an articulated quarter-note E, and a regular quarter-note E. If the time-values for two or more notes are the same, only one indicator need be used, as with Q2'2.

For dotted notes, just use dots, as in I.O for a dotted eight-note C, or Q..3 for a double-dotted quarter-note F. Triplet time-values are indicated by a colon (:), which can be combined with the dots (H:..).

To repeat a group of notes, put them in parentheses followed by a number indicating how many times they're to be repeated, as in (I6;SD6")3, where the semicolon means a long staccato (a comma means a short staccato).

Anytime you want to hear what you've written so far, press BREAK, then enter SCORE (which compiles the music) and PLAY. To get back to writing, enter EDIT again.

During or after writing, you can use the editor to insert or delete characters or lines, or perform a global character-string search. Using the four arrows facilitates cursor movement.

A page on How It Works says the synthesizer uses a sampling technique, and explains it briefly. The program generates seven error messages and "whenever possible, the file pointer is positioned at or near where the error was encountered."

There's more, of course, but for that you'll have to check out Orchestra-80 yourself. You're in for a very pleasant surprise. Now you too can make the same kind of polyphonic music heard at the *Creative Computing* booth at computer conferences.

Graphics Special

Les Logan, who wrote the Computer Doodler (May 1979, p 130) and Happy Face (Nov. 1979, p 180) programs, has created a new tape, Graphics Special, with six 16K Level II programs, including the two just mentioned, for $20 (from TCS, Box 10281, Norfolk, VA 23513).

The first of the six is Lincoln, which simply draws a face of Honest Abe, created with 960 graphics characters by the Doodler program "and with coordinates converted to POKE graphics for faster display." The "portrait" closely resembles a photographic halftone.

Second is Happy Face, which puts a winking-eye happy face on the screen in a "program for young children to sharpen their recognition skills." They look for a key on the keyboard to match the character displayed, and if they hit the right key, the face appears on the screen. The characters, which are letters and numbers, can be displayed three ways: made up of dots, or as small or large solid alphanumerics.

Third is Doodler, which draws lines on the screen in response to your simply indicating where you want the line to start, and in which direction to go. The lines can go left, right, up, down, or at a specified angle. The display tells you how far each line can extend, in numbers of graphics blocks, and gives the X-Y coordinates of your present location. Very helpful.

Fourth is Craps, which Les says is a "standard Las-Vegas-rules game which is only a few lines long. But its purpose is to demonstrate the graphics dice-rolling subroutine that is fairly sophisticated. This utility subroutine has high line numbers so it can easily be inserted into almost any game and called by GOSUB." The dice are shaken, tossed against a backboard, and come to rest with the faces showing, plus a number above each die indicating the number of spots, to speed up the game.

Fifth is Graphs, which draws bar-graphs for months of the year "but can easily be changed to display days, weeks, quarters, years or many other formats," as the first display says. It displays up to 24 months of data on a vertical bar-graph, Les says, and "Data can be any range and mix of positive or negative numbers including non-integers. The scale can be chosen by the operator or done automatically by the computer."

The Graphs program uses menus. You specify whether one or two years are to be displayed, which month the graph will end with and the title (if any) of the graph. After you enter the data for each month, the program displays the range of your data and asks if you want to specify the limits of the graph scale and the graph increments, or have the computer automatically scale the graph. Then your graph is drawn on the screen. The whole process can be done in a very short time, since as much as possible is automated.

A variation of Graphs is demonstrated with the sixth program, BOWLAVG, "which keeps a person's league bowling statistics on a data tape that can be updated weekly. Alternately, it will display every game bowled during the league and history of weekly average changes." Extensive use is made of INKEY$ keying in multi-digit numbers without using ENTER. The program asks for the bowler's name, league's name, date bowled, and scores for three games.

After you enter all the data, the program displays a graph of the scores, and gives figures for how many games, how many pins, average, handicap, high game, and high series, plus the bowler's name, team name and last date played.

As Les says, "It is intriguing to watch this program even if you're not a bowler."

Economic and Ecology Simulations

The Ecology Simulations series are a unique educational tool. They are based on "simulation models" developed by the Huntington Two Computer Project at the State University of New York at Stony Brook under the direction of Dr. Ludwig Braun. The programs and accompanying documentation are written for self-teaching or classroom use and include background material, sample exercises and study guides. Graphic displays were specially developed by Jo Ann Comito at SUNY and Ann Corrigan at Creative Computing. The Ecology Simulations packages are a remarkable educational application of micro-computers.

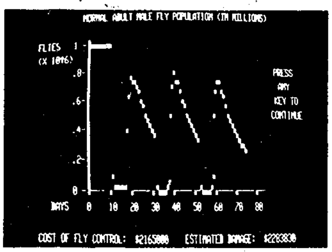
Ecology Simulations-1, CS-3201 (16K)

1. Pop

The POP series of models examines three different methods of population projection, including exponential, S-shaped or logistical, and logistical with low density effects. At the same time the programs introduce the concept of successive refinement of a model, since each POP model adds more details than the previous one.

2. Sterl

STERL allows you to investigate the effectiveness of two different methods of pest control—the use of pesticides and the release of sterile males into the fly population. The concept of a more environmentally sound approach versus traditional chemical methods is introduced. In addition, STERL demonstrates the effectiveness of an integrated approach over either alternative by itself.



3. Tag

TAG simulates the tagging and recovery method that is used by scientists to estimate animal populations. You attempt to estimate the bass population in a warm-water, bass-bluegill farm pond. Tagged fish are released in the pond and samples are recovered at timed intervals. By presenting a detailed simulation of real sampling by "tagging and recovery," TAG helps you to understand this process.

4. Buffalo

BUFFALO simulates the yearly cycle of buffalo population growth and decline, and allows you to investigate the effects of different herd management policies. Simulations such as BUFFALO allow you to explore "What if" questions and experiment with approaches that might be disastrous in real life.

Ordering Information

The series is designed for the 16K TRS-80 Level II and is attractively packaged in a vinyl binder with a complete study guide. *Ecology Simulations-I:* disk CS-3501, cassette 3201. *Ecology Simulations-II:* disk CS-3502, cassette CS-3204. *Social and Economic Simulations:* disk CS-3508, cassette CS-3204. At a modest $24.95 each, the series is an affordable necessity.

To order, send payment plus $1.00 shipping and handling to Creative Computing Software, Dept. ACGG, P.O. Box 789-M, Morristown, NJ 07960. For Faster Service, call in your order toll-free to our order hotline 800-631-8112. In NJ call 201-540-0445.

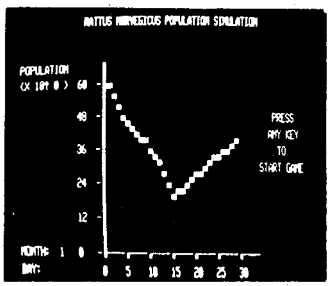
Ecology Simulations-2, CS-3202 (16K)

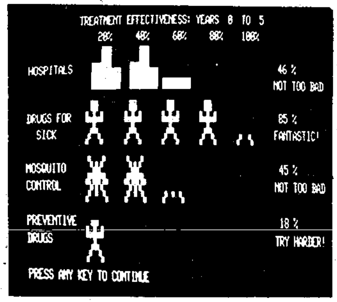
1. Pollute

POLLUTE focuses on one part of the water pollution problem; the accumulation of certain waste materials in waterways and their effect on dissolved oxygen levels in the water. You can use the computer to investigate the effects of different variables such as the body of water, temperature, and the rate of dumping waste material. Various types of primary and secondary waste treatment, as well as the impact of scientific and economic decisions can be examined.

2. Rats

In RATS, you play the role of a Health Department official devising an effective, practical plant to control rats. The plan may combine the use of sanitation and slow kill and quick kill poisons to eliminate a rat population. It is also possible to change the initial population size, growth rate, and whether the simulation will take place in an apartment building or an entire city.





3. Malaria

With MALARIA, you are a Health Official trying to control a malaria epidemic while taking into account financial considerations in setting up a program. The budgeted use of field hospitals, drugs for the ill, three types of pesticides, and preventative medication, must be properly combined for an effective control program.

4. Diet

DIET is designed to explore the effect of four basic substances, protein, lipids, calories and carbohydrates, on your diet. You enter a list of the types and amounts of food eaten in a typical day, as well as your age, weight, sex, health and a physical activity factor. DIET is particularly valuable in indicating how a diet can be changed to raise or lower body weights and provide proper nutrition.

Social and Economic Simulations CS-3204 (16K)

1. Limits

LIMITS is a micro-computer version of the well known "Limits to Growth" project done at MIT. It contains a model of the world that is built of five subsystems (population, pollution, food supply, industrial output, and resource usage) linked together by six variables: birth rate, death rate, pollution generation, resource usage rate, industrial output growth rate, and food production rate.

2. Market

Market allows two or more people to play the roles of companies who are competing for the market for a particular product: in this case, bicycles.

Each player makes marketing decisions quarterly including the production level, the advertising budget, and the unit price of the product for his/her company.

3. USPop

USPOP allows the user to study many aspects of the United States' human demography (population change) including population growth, age and sex distribution. USPOP makes population projections and investigates the consequences of many different demographic changes.

CIRCLE 300 ON READER SERVICE CARD

Introduction to Microcomputers

That's the title of a six-program package "designed to help students acquire the keyboard skills, knowledge of computer terminology and computer components necessary for survival in a society increasingly influenced by computers."

That's a tall order for a three-cassette package with a teacher's guide in a three-ring binder, designed for "grades K-8," and for a 4K Level II TRS-80. The price is $54.95, from Mentor Software, Box 791, Anuka, MN 55303.

Mentor also has other TRS-80 packages, for "guided drill, practice and instruction" in math and spelling, each around the $50-$55 mark.

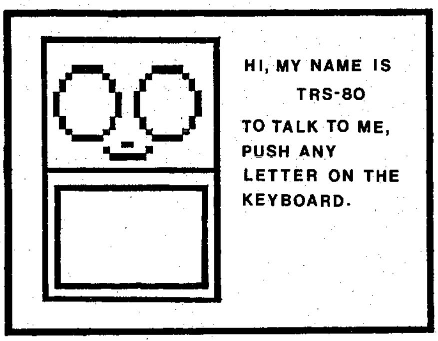
The Introduction to Microcomputers "unit" is divided into four sections: Introduction to the TRS-80, How Computers Affect Our Lives, Parts of a Computer System, and Capabilities of a Computer.

Each section is divided into four parts overview, program description, teaching hints, and Helpers, which are worksheets and transparency masters to be duplicated for class use.

The teacher's guide says that "although this material is not divided into a day-by-day lesson plan, the unit should take about one week of class time if worked on every day."

The first section, Introduction to the TRS-80, uses two programs. The first, Intro, "is designed to be used by the teacher in front of the class." Three Helpers are provided: a small nine-item list on how to load and run the cassette tapes, "to be taped to the face of the TV below the on/off switch"; a full-page version of the list, to be duplicated and handed out to the class; and a drawing of the TRS-80 keyboard, to make transparencies from "when introducing students to the computer."

The Intro program first displays an anthropomorphic face that spins its eyes when a student correctly locates the



ENTER key, the number-key row, asterisk, L, M, %, and so on, for half a dozen characters. And then the program displays, "That's all for this lesson." The program takes up 3,104 bytes memory and about a minute to run, maybe two minutes for a slow keyboarder. (The illustration above, taken from the manual, is an approximation of the program display.)

The other first-section program, Meet TRS-80 (written only once on the tape, like all the others), displays a robot-looking face and a waving hand, and asks you to type your name (then prints "Johnny is a nice name"), your age ("I wish I could be 10"), your favorite sport ("Oh, you like baseball. My favorite sport is Keyball"), and whether you know what Keyball is or not ("Well, I'll have to teach you"). Then comes "I have to go now." The program requires 3,003 bytes to do all that, and runs in a minimum of 45 seconds.

Among the teaching hints for these two programs are (1) using the third Helper to point out all the keyboard features, (2) asking the students to "write a description or design a game which speculates on what they think the computer's favorite game would be like" (it randomly selects Keyball, Space Ball, Rocket Number, and a couple of others), and (3) handing out the fourth Helper "for students to take home or work"; it is a letter puzzle that conceals ten computer words such as BREAK, TAPE and SHIFT.

Section Two involves one program, Keyball, a game for keyboard familiarization, requiring the user to press the key for the character shown on the screen within a certain time to score.

As for classroom activities, students are asked to find computer uses around them. One of the Helpers is a sheet with space of listing "all the words you can make from the word 'microcomputer'."

Section Three includes one program, Compu-Tration, similar to the game of concentration, but involving pairs of computer words, such as DISK and PROGRAM, instead of playing cards. The program selects different words for each play of the game.

Classroom activities include "discussing the parts of the computer and how they relate to the TRS-80." The Helpers include a block diagram of a computer.

Section Four uses two programs, The first, How Great I Am, spells out "the capabilities of a computer system," such as being fast, not getting bored, never making mistakes, and then shows how fast it can add numbers entered by the user, and how it can keep track of time without getting bored, by displaying a digital clock until the student gets bored enough to end the program.

The second program, The Computer 500, is "a game to reinforce computer words and definitions," a race for two players. The player who answers questions correctly on computer words and definitions will have his "car" moved along the track ahead of the player who doesn't know the answers.

Classroom activities include having the students "list features they think the computer is better at than they are." The Helper for this section is a crossword puzzle using computer words.

The appendixes are a glossary, a list of references and films, and tips on using the cassette tapes.

There you have it: an education package that may seem a little skimpy for $54.95, but which does improve after a slow start. Well, most children do have a short attention span. Then again, perhaps the teacher, as with so many educational packages, is expected to flesh it out.

I've described this package in more detail than usual, because there aren't many such packages around. If you know of a similar one that you consider better, please let me know about it.

Short Program #155

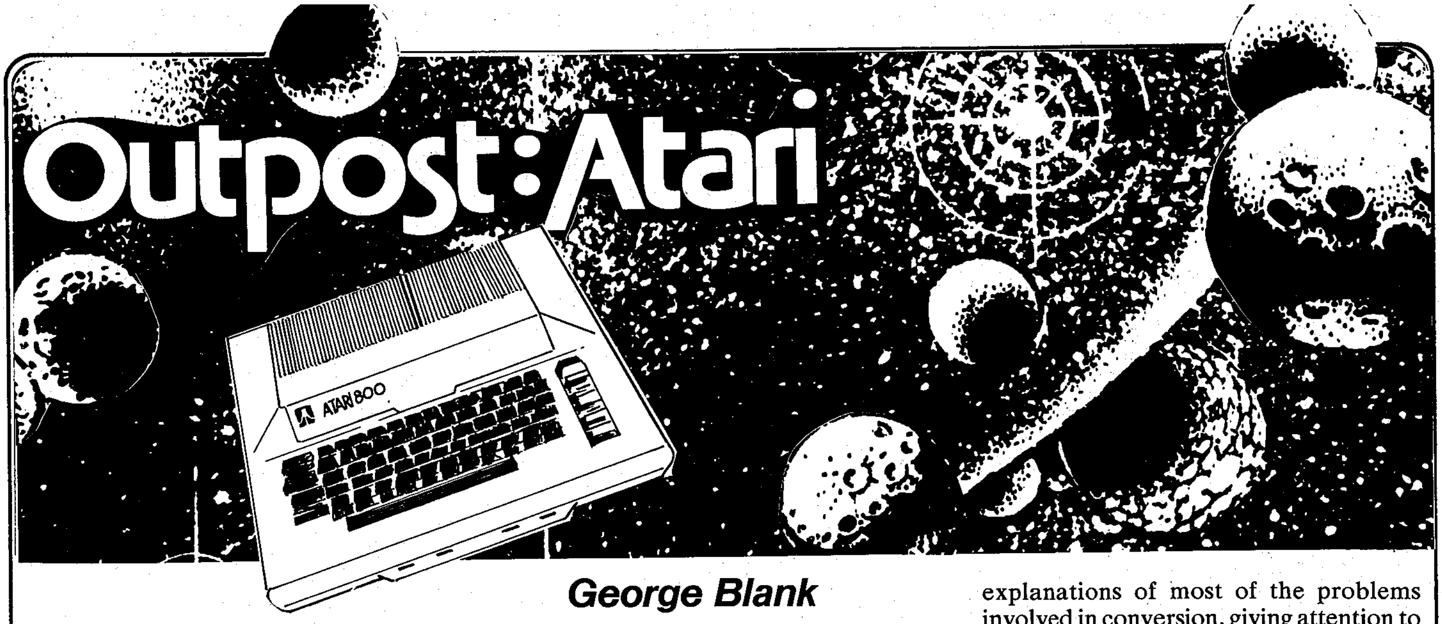
From Cedar Grove, NJ, James M. Curran sent this program which he believes to be the "definitive can-you-figure-out-what-this-program-does-without-using-a-computer? program. All I will say about it is that it performs a nominally useful task, although obviously there are easier ways of doing it, and there are no errors in it, insomuch as it runs exactly the way it's supposed to."

That [in line 1000 is what some printers print instead of the up-arrow; that portion of the line should be (SQR(4) ↑ 2).

Jim signs his letter "17-year-old programmer, mild-mannered lunatic, and soon-to-be-president of the as-yet-unfounded Hyperbolic System Inc."

Two hints: some of the program is superfluous; and by the time you figure out how it works, you'll know much more about TRS-80 error codes than you do now. □

```
0 ON ERROR GOTO 1000
10 DEFINT X,T,S
13 Z=1*2*3*4*5*6*7*8*9*0:V=SIN(12345.6789):Y=PEEK(V)
14 FOR D=0 TO 938:B=D
16 S=B/2:GOTO 24
21 ON T GOTO 24,1010,72,35,43,99,67
24 T=B-S*2+4:GOTO 72
35 X=Y+ :GOTO 100
43 X=V/Z:GOTO 100
72 B=S+(Z*4)-Z:GOTO 42:GOTO 21
76 X=Z-Y:GOTO 100
99 X=V+Y:GOTO 100
100 F$=CHR$(X)+F$:PRINT F$+CHR$(23+14-8);:
106 IF B=Z/2 PRINT CHR$(Z*V+10);:F$=CHR$(Z):NEXT ELSE 16
1000 X=ERL+ERR/3+(SQR(4)[2)-(8/2)
1010 RESUME NEXT
```



George Blank

View from the Outpost

This month I can't even see out the windows of the outpost. The whole station is filled with mail! Back in November I reported on an article that was scheduled to appear in *Byte* in August. The author had described it to me and *Byte* was kind enough to give me an advance look. Unfortunately, *Byte* rescheduled the article, and the post office and telephone company made a killing. I have been receiving several letters and phone calls a day asking where to find the *Byte* article, which describes how to modify the display list for fancy graphics. At a seminar in New York City in November, Chris Morgan told me the article had been rescheduled for January, but there is no guarantee that it is in that issue.

While we try to make our columns timely (Happy Valentines Day!), it takes over two months to prepare an article for publication, put a magazine together, have it printed, and deliver it through the mail. That means that by the time you read this issue, I will be working on the May column. Although columns are usually regular, there are many things that may cause an article to be postponed to a later issue or even dropped altogether. Usually an editor will try to create the best possible mixture of articles in a given issue right up to the last possible moment. I have seen articles changed even after getting the proofs from the printer.

In the listing of the error trapping routine in November, submitted by Larry Seftor, one line of the listing was transposed. The "* 256+PEEK (186)" should be at the end of line 1010, not the end of 1000.

Dandy Display

Walter Knoch, of Boca Raton, Florida, sent in this interesting graphics program. It demonstrates an effective use of color changes.

```
10 GRAPHICS 23:DEG:SETCOLOR 2,4,10:DIM C(3)
20 R=20:COLOR 1:C=1
30 X0=79:Y0=47
40 FOR K=0 TO 3:C(K)=K+1*2:NEXT K
50 FOR K=1 TO 3
60 X=X0+R*COS(360):Y=Y0:PLOT X,Y
70 FOR I=0 TO 5*360 STEP 75
80 X=X0+R*COS(I) : Y=Y0+R*SIN(I)
90 DRAWTO X,Y
100 NEXT I:R=R+12:C=C+1:COLOR C
110 NEXT K
120 FOR I=0 TO 2: SETCOLOR I,C(I),10 :NEXT I
130 FOR J=1 TO 100 : NEXT J
140 FOR I=1 TO 3: C(I-1)=C(I) :NEXT I
150 C(2)=RND(1)*16 : GOTO 120
```

The Secret is Out!

At the Boston Computer Show, dressed in a black cape and wizard's cap, Russ Walter was selling copies of his series of books, *The Secret Guide to Basic*. As I paused to greet him, he thrust a fluorescent pink book into my hands and proclaimed, "Its about time for me to give you something else!"

The title of the book was *Hassles in Basic*, volume 2 of the series. The subject is converting programs from one Basic to another, and the Atari is one of the principal systems covered, along with the TRS-80, Apple, and PET. He also occasionally mentions a bunch of obscure computers I never heard of, with weird names like PDP-11 and IBM.

The book has brief, easy to understand explanations of most of the problems involved in conversion, giving attention to graphics, music, tricky functions, style, and even speed. There is even a page with genuine English language explanations of the most frequent Atari error codes!

The Secret Guide to Basic is an excellent series, and I especially endorse this volume. Russ sells them for the ridiculously low price of $3.70 each, and even pays the postage. Order from Russ Walter, 92 St. Botolph St., Boston, MA 02116.

Peeping Thomasina

Since so many of you have expressed an inordinate curiosity about the inner working of the Atari, I will devote more attention to it. First, here are three programs to help you discover what's going on in there. All display memory, the first one in decimal, the second in hexadecimal, the last in ASCII characters. I deliberately kept them short, so you can type them into other programs to look at the display lists and other mysteries.

If you are using these programs within your other programs, you will want to use different line numbers, eliminate remarks and most print statements, abbreviate statements, and use multiple statements per line. If you are just looking at memory, you may want to add features, combine all three into one program, and expand such conveniences as the pause feature in lines 5, 12, 13, and 14 of the Hex Dump routine.

If you want to experiment by writing directly into memory locations to see what happens, use a routine such as this one.

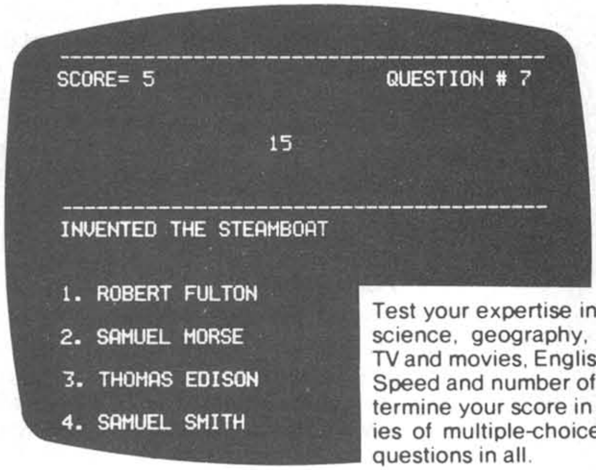
```
1 REM * MEMORY MODIFICATION *
2 INPUT S
3 PRINT S,: INPUT C
4 POKE S,C : S=S+1 : GOTO 3
```

Not that you have the tools for peeking and poking around in memory, what can you find there? Last month's column discussed how to use these locations:

240 This sets the page number for the top of memory.

Atari Software

Trivia Unlimited



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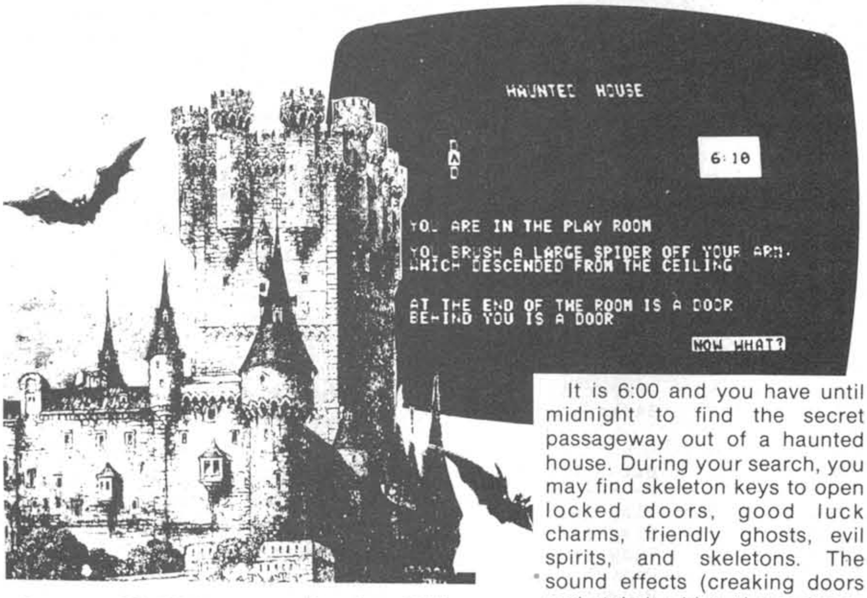
Haunted House



It is 6:00 and you have until midnight to find the secret passageway out of a haunted house. During your search, you may find skeleton keys to open locked doors, good luck charms, friendly ghosts, evil spirits, and skeletons. The sound effects (creaking doors and stairs) add to the eeriness. The house layout changes in every game.

Cassette CS-7003
$11.95

Requires 32K

Other Atari Software —

- Outdoor Games (Forest Fire, Fishing Trip, Treasure Island 1 & 2), Cassette CS-7002, $11.95
- Outdoor Games and Haunted House, Disk CS-7502, $24.95
- Hail to the Chief (Presidential election simulation) Cassette (32K) CS-7201, $24.95; Disk (40K) CS-7701, $24.95.

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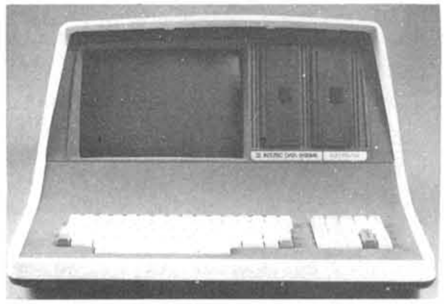
SUPERBRAIN



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CIRCLE 157 ON READER SERVICE CARD

```
1 REM * DECIMAL DUMP *
2 PRINT"START";:INPUT S
3 PRINT S,PEEK(S):S=S+1:GOTO 3
```

(You have to press BREAK to stop the decimal or the ASCII dump.)

```
1 REM * HEX MEMORY DUMP *
2 GR.0:DIM H$(16)
3 H$="0123456789ABCDEF"
4 PRINT"STARTING ADDRESS (DECIMAL)";:INPUT S
5 PRINT"HOLD SPACE BAR TO STOP"
6 PRINT S;" ";
7 FOR M=S TO S+7
8 H=PEEK(M):L=INT(H/16):R=H-L*16
9 L=L+1:R=R+1:PRINT H$(L,L);H$(R,R);" ";
10 NEXT M:PRINT
11 S=S+8
12 IF PEEK(764)>254 THEN 6
13 PRINT" (1 - CONTINUE  2 - STOP)";:INPUTH
14 IFH=1THEN6
```

```
1 REM * ASCII DUMP *
2 INPUT S
3 PRINT S;" ";
4 FOR M=S TO7 IF
5 A=PEEK(M)
6 IF A>26 AND A<30 THEN 11
7 IF A>124 AND A<128 THEN 11
8 IF A>154 AND A<160 THEN 11
9 IF A>252 THEN 11
10 PRINT CHR$(A);" ";:GOTO 12
11 PRINT". ";
12 NEXT M : PRINT : PRINT : S=S+10 : GOTO 3
```

559 This sets the playfield size.

704—712 These are the "shadow" registers for the player missile color registers at 53266 to 53276. You can write directly to the ANTIC chip or to the shadow register.

54279 This is the player/missile base address register which holds the page number of the beginning of the player missile graphics area.

In addition to these locations, Appendix I of the Basic Reference manual lists a few more. Whenever you have a two byte address register, multiply the contents of the second address by 256 and add the contents of the first address. Thus, to find the highest memory location used by Basic, use this line:

```
PRINT PEEK(14) + 256 * PEEK(15)
```

Now for the special effects! Here are descriptions of the effects of the CTIA chip and its memory locations. Since the chips behave differently depending whether you are writing (POKE) to the address given or reading (PEEK) it, I will explain first what happens when you write, then when you read the memory location.

CTIA Chip (53248 to 53279) POKE effects:

53248 to 53255 These are the horizontal position registers explained last month.

53256 to 53269 These are the size registers discussed last month.

53260 (Player 0) to 53264 (Player 3) and 53265 (All missiles) These addresses write directly into the player graphics registers without going through direct memory addressing.

53266 to 53274 These are the color registers discussed last month.

53275 This is the priority control register. Bits 0 through 3 select the priority of the different players, so that the player with the highest priority will appear to be in front of the player with the lower priority. Setting a bit to true (1) establishes priority. If more than one bit is true, the playfield will be black when those players overlap. Here is the table of priorities for the different bits. The highest priority is at the top of the list.

Bit 0 = 1	Bit 1 = 1
Player 0	Player 0
Player 1	Player 1
Player 2	Playfield 0
Player 3	Playfield 1
Playfield 0	Playfield 2
Playfield 1	Pf 3 & Pl 5
Playfield 2	Player 2
Pf 3 & Pl 5	Player 3
Background	Background

Bit 2 = 1	Bit 3 = 1
Playfield 0	Playfield 0
Playfield 1	Playfield 1
Playfield 2	Player 0
Pf 3 & Pl 5	Player 1
Player 0	Player 2
Player 1	Player 3
Player 2	Playfield 2
Player 3	Pf 3 & Pl 5
Background	Background

Bit 4 enables the fifth player by causing all missiles to assume the color of playfield 3. That is why playfield 3 and player 5 are combined in the chart above.

Bit 5 enables a logical OR function for the colors of player 0 with player 1 and player 2 with player 3, enabling a choice of three colors when they overlap.

53276 This is the vertical delay register. By writing to this register, you can move objects down the screen by one TV line in the two line direct memory access mode. Bits 0 to 3 control missiles 0 to 3 and bits 4 to 7 control players 0 to 3. For example, writing a 1 to bit 3 with a POKE 53276,8 will cause missile 3 to drop one line.

53277 This is the graphics control register discussed last month.

53278 This write address resets all the collision registers after you have read them to determine collisions so that you can continue on the next cycle. The collision registers are explained below.

53279 Writing a zero to this address resets the console switches. See the read table below for an explanation of the switches.

PEEK Effects:

53248 to 53263 are addresses that you can read to determine collisions between players, missiles, and playfields. In each case, the first object given is the one being read. The second object is the type of object being checked. Bit 0 to 3 indicate the number of the colliding object. For example, if Missile 0 collides with playfield 2, Bit 2 of location 53248 will contain a 1, and PEEK(53248) is equal to 4. Only the four least significant bits of each address are used, with the high bits always zero. In addition, on player to player registers, player 0 to player 0 will always read zero, as will each of the others when compared to itself.

Address	Primary Object	Objects tested (0-3)
53248	Missile 0	Playfields
53249	Missile 1	etc.
53252	Player 0	Playfields
53253	Player 1	etc.
53256	Missile 0	Players
53257	Missile 1	etc.
53260	Player 0	Players
53261	Player 1	etc.
53263	Player 3	Players

The other objects can be interpolated from those given.

53264 to 53267 are the controller trigger latches. When the trigger is pressed, bit 0 of the appropriate latch goes to 0. All the other bits are forced to 0 at all times. Bit 2 of the graphics control register at 53277 controls these, as described last month. If it is 1, the inputs are latched when they go to zero. If bit 2 of the graphics control register is set to 0, these latches are reset to 1, (Note: the term "latched" means that a computer memory location is locked in one state, and held until it is changed deliberately.)

53264	Trigger 0
53265	Trigger 1
53266	Trigger 2
53267	Trigger 3

53268 to 53278 do not have separate functions as read addresses. See the write descriptions above.

53279 is the console switch register. Bits 3 to 7 are forced to 0, and are not used. Bits 0 to 2 correspond to the console switches as follows:

```
Bit 0   Game Start
Bit 1   Game Select
Bit 2   Option Select
```

These bits are normally ones, but become zero while the switch is held down. Thus PEEK(53279) is usually 7, but becomes 3 when the option select button is pressed.

In future columns I hope to experiment with the ANTIC and POKEY chips. The PIA chip was explained in the October 1979 column in the section on Input and Output with the light sensor. The program in Figure 2 of that column demonstrates the PIA.

Assembly Language Aid

My first computer language was 6800 assembly language, which I learned with Heathkit's ET 3400 Microprocessor Trainer and ET 3401 Microprocessor self instruction program. This course teaches both hardware and software concepts, and the hardware section requires a good background in electronics, so I have hesitated to recommend it to the average person in the past. Heath has now taken the software portion of that course and packaged it separately, and also provided a less expensive trainer. The course has part number EC 6800, and the trainer is part number ET 6800.

Once you have a good understanding of assembly language, it is easy to switch from one chip to another, and the 6800 is fairly close to the 6502, so do not let the different chip stop you. Perhaps one of you readers could write a 6800 emulator for the Atari, and save others the $130 cost of the trainer. The course itself sells for $29.95, and I consider it the best way I have yet seen to learn assembly language.

For you aliens (owners of non-Atari computers) reading this column, Heath also has a course in 8080 and 8085 assembly language for $49.95. I have built a number of Heathkits, and taken several of their courses, and I feel they have always given me my money's worth. The only complaint I have had is that every kit including integrated circuits has had bad ones, but Heath is good about replacing defective parts.

If you haven't mastered Basic, you may not like me dwelling on assembly language. I feel that this course is good preparation for learning Basic. Six months after completing the Heathkit course, I bought a TRS-80 and learned Basic in one week using David Lien's Learning Level I. It was very easy to learn because the Heath course gave a good understanding of the internal workings of the computer.

Let Someone Else Pay for Your Computer!

Right now the Atari computers give owners the easiest route to publishing success. It is obviously coming on strong as the best of the current personal computers, and it is being supported strongly by several magazines and software publishers. However, there are not as many owners as there are for the antiquated TRS-80s and Apples, so good articles and programs are easy to sell.

Do your part to support the Atari. The more articles and software that is available, the more people will buy the Atari. That in turn will make more and better programs available for all Atari owners. Don't forget *Creative Computing* and Sensational Software when you are seeking a publisher. □

The Mini-Calculator

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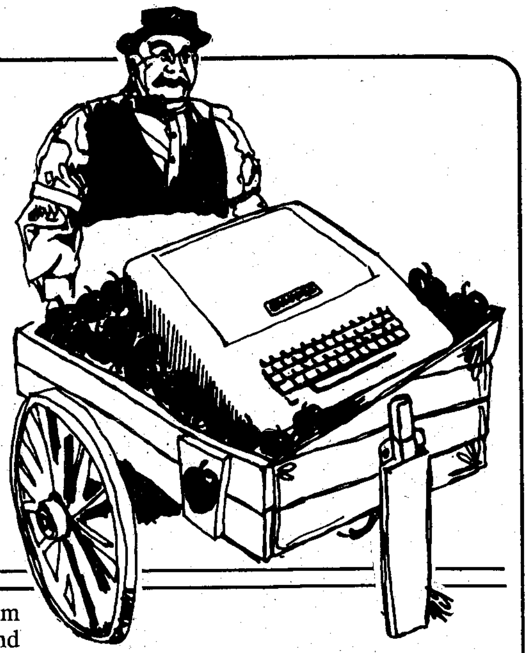
Apple~Cart



Chuck Carpenter

Correspondence is always welcome and a response will be made to those accompanied by a SASE. Send your letters to: Chuck Carpenter, 2228 Montclair Pl., Carrollton, TX 75006.

Programming languages for the Apple II come in all sizes. There are at least three versions of Basic available: Integer, Applesoft, and now Microsoft Basic-80 with the new Softcard. With the language card you can have Pascal and Fortran. Languages like Forth, XPL0 (experimental programming language zero) and Tiny Pascal are around too. Another language called Pilot is available from Apple and other sources. This language comes in a variety of sizes. Some are extended versions with lots of power. Others are less powerful. All versions of Pilot have common features; they use simple syntax and complicated command structures. The syntax of Pilot is elementary, non-mathematical, and lends itself readily to Computer Aided Instruction (CAI) programs. Included in this column is a version of Pilot that I call Mini Pilot. The language is easy to learn and is useful for teaching beginners the basics of programming.

MINI PILOT

Mini Pilot was written in 1978 by N. Dealy who has placed it in the public domain. I obtained a copy and made a couple of modifications to it. The Mini Pilot interpreter was coded to conform to a version of Pilot described on pages 56 to 60 in the Sept/Oct '77 issue of *People's Computers* magazine (now *Recreational Computing*). Charles Shapiro, a Junior in High School at the time, wrote his version of the interpreter in HP3000 Basic. It uses only six commands, a label designator and a designation for strings. The version to be described here is written in Applesoft Basic and uses a similar—Apple enhanced—format. I have added disk capability and a command to clear the screen. Here's how Mini Pilot works.

Program Features

Single letter commands are used to write programs. Other symbols used in programs are the asterisk (*) for labels and the dollar sign ($) for strings. An option in this version of Pilot uses the exclamation (!) to designate a remark. Listing 1 is a simple program written to illustrate the commands and symbols of Mini Pilot. Here are some of the features of Mini Pilot.

•Commands T:, A:, M:, J:, Y or N, E:, C:, and R:
•Subroutine labels and strings
•Disk SAVE, LOAD and REPLACE
•Named programs
•Soft entry to interpreter after exit with BYE
•Paddle (0) control of list speed
•Syntax error message
•Suspend listing with space bar
•Continue listing with any key
•Line length limit warning bell

Program Directives

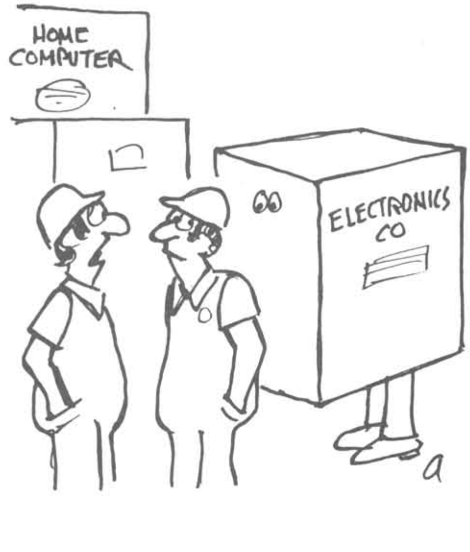
These features provide you with functions to develop and use your Mini Pilot programs. The directives are prompted with REQUEST? followed by one of several options. The options are:

•NEW—Start of a new program, asks for a program name
•LIST—Lists the named program currently in memory
•EDIT—Allows changing a specified line number
•RUN—Runs the named program
•DSAVE—Saves the named program to disk
•DLOAD—Loads the named program from disk
•REPLACE—Replaces previous named program on disk with current program in memory
•BYE—Exits Pilot back to Basic

Because the interpreter includes disk commands, named programs are needed. A NEW input to REQUEST asks for a program name. Inputs LIST and RUN use the named program. EDIT lets you change any line in your program. The previous line is displayed on the screen too so you can see where you are. The disk command DSAVE, saves on the disk, as a text file, the current named program. REPLACE

```
REQUEST? RUN

RUN OF APPLE BLOSSOMS

HI...MY NAME IS APPLE II !
     WHAT IS YOUR NAME?

?CHUCK

DO YOU WANT TO TRY A VOWEL (V)
OR A CONSONANT (C)
TYPE A 'V' OR A 'C'

?V
NAME A VOWEL CHUCK !

?C

THAT IS NOT A VOWEL CHUCK !
NAME A VOWEL CHUCK !

?A

THAT IS CORRECT CHUCK !!!


DO YOU WANT TO TRY IT AGAIN ?
TYPE Y FOR YES OR N FOR NO.

?Y


DO YOU WANT TO TRY A VOWEL (V)
OR A CONSONANT (C)
TYPE A 'V' OR A 'C'

?C

NAME A CONSONANT CHUCK !

?R

THAT IS CORRECT CHUCK !!!


DO YOU WANT TO TRY IT AGAIN ?
TYPE Y FOR YES OR N FOR NO.

?N

THANKS FOR PLAYING CHUCK .
HOPE WE CAN DO IT AGAIN SOON.

BYE....

END OF RUN

REQUEST?
```

Sample Run of Apple Blossoms—Pilot Program.



"I THINK OUR PRODUCTIVITY IS BEING MONITORED."

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exchanges the program on disk with the current program in memory. You DSAVE the program when it's NEW. After the first time, you REPLACE to resave a program. REQUEST of BYE exits the Apple II Mini Pilot interpreter and returns you to Applesoft Basic. If you don't do anything else to the interpreter program at this point, you can return to pilot via the soft entry point by typing—and executing—GOTO1230.

Other features listed earlier included: A syntax error message if you didn't start the line right; listing speed control with game paddle #1; listing suspension with the space bar and continuation by pressing any key; and a line limit warning bell to keep you from exceeding the 39 character line length limit.

```
REQUEST? LIST

       APPLE BLOSSOMS


 0  R:VOWELS AND CONSONANTS
 1  C:
 2  T:HI...MY NAME IS APPLE II !
 3  T:     WHAT IS YOUR NAME?
 4  T:
 5  A: $NAME
 6 *BEGIN
 7  T:
 8  T:DO YOU WANT TO TRY A VOWEL (V)
 9  T:OR A CONSONANT (C)
10  T:TYPE A 'V' OR A 'C'
11  T:
12  A:
13  M:V,'
14  JN:*CONSONANT
15 *VOWEL
16  T:NAME A VOWEL $NAME !
17  T:
18  A:
19  T:
20  M:A,E,I,O,U,'
21  TN:THAT IS NOT A VOWEL $NAME !
22  JN:*VOWEL
23  JY:*CORRECT
24 *CONSONANT
25  T:
26  T:NAME A CONSONANT $NAME !
27  T:
28  A:
29  T:
30  M:B,C,D,F,G,H,J,'
31  MN:K,L,M,N,P,Q,R,'
32  MN:S,T,V,W,X,Y,Z,'
33  TN:THAT IS NOT A CONSONANT $NAME !
34  JN:*CONSONANT
35  T:
36 *CORRECT
37  T:
38 ! SOME POSITIVE FEEDBACK
39  T:THAT IS CORRECT $NAME !!!
40  T:
41 !
42  T:
43  T:DO YOU WANT TO TRY IT AGAIN ?
44  T:TYPE Y FOR YES OR N FOR NO.
45  T:
46  A:
47  T:
48  M:Y,
49  JY:*BEGIN
50  T:THANKS FOR PLAYING $NAME .
51  T:HOPE WE CAN DO IT AGAIN SOON.
52  T:
53  T:BYE....
54  END:

REQUEST?
```

Listing 1. Example Pilot Program.

Program Commands

Some of the single-letter commands were mentioned briefly under features. As indicated, the commands are single letters followed by a colon. Here is a description of each Instruction, conditioner, and variable used by Mini Pilot.

Instructions
•T: Type whatever is included on this line
•A: Ask a question and/or wait for input. String input is allowed with the A: command
•M: Match for characters/keywords from an input command
•J: Jump to a labeled line as a result of a Match test
•C: Clear the screen
•R: Remark or comment line
Conditioners
•Y Condition instruction with a positive match
•N Condition instruction with a negative match
Variables
•$= String included with the A: command. Requires a leading and trailing space
•*= Label or subroutine
•!= Alternate for remark—R:—or comment

The program in Listing 1 uses each of the commands listed and the sample run shows what the program does. Since the program is quite simple, I have not included any detailed description. Note the use of an apostrophe character at the end of a match line. This delimiter is needed to show the program where the end of the match items are. Figure 1 is a short demo of a programming sequence. This example uses many of the program directives. There were many Pilot programs printed in *people's computers* magazine prior to mid 1979. If you can find a library of this magazine, you can see many examples of how Pilot is used. Listing 2 is the Mini Pilot interpreter.

```
REQUEST? NEW
PROGRAM NAME?LOOP

 0?*BEGIN
 1?T:THIS PROGRAM LOOPS
 2?J:BEGIN
 3?E:          E OR END-OK
 4?DONE

REQUEST? EDIT
STARTING AT LINE? 2
1 T:THIS PROGRAM LOOPS
2 J:BEGIN
                 ← FORGOT
 2?J:*BEGIN        ASTERISK
 3?DONE

REQUEST? LIST

       LOOP


 0 *BEGIN
 1  T:THIS PROGRAM LOOPS
 2  J:*BEGIN
 3  E:

REQUEST? DSAVE

REQUEST? DLOAD
PROGRAM NAME?LOOP

REQUEST? REPLACE

REQUEST? RUN

RUN OF LOOP


THIS PROGRAM LOOPS
THIS PROGRAM LOOPS
THIS PROGRAM LOOPS
THIS PROGRAM LOOPS
                    CONTROL C
REQUEST? BYE
```

Figure 1. Example Programming Sequence and Use of Programming Directives.

The Interpreter

Organization of the interpreter is straightforward. Each section is highlighted by function. You can follow the program sequence starting with the operating system (Pilot O.S.). As you make selections from the REQUEST command line, a branch is taken to a corresponding section of the program. The actual coding and logic of each section is more obscure. Since I didn't write it, I'm not going to try and explain it. Analysis of the code detail is left to the reader. (Commonly called a cop out.)

Some changes are easily made though. For instance turning on a printer. Include code lines like the disk commands in lines 1340 to 1360. Then add a subroutine at a convenient spot in the program. Another example is the way I added the C: command for clearing the screen; lines 2030 to 2070. The disk and screen-clear changes did not affect any of the critical interpreter code. The interpreter is not too complicated. Make several copies of the program before you start experimenting. Have fun changing it and learning something about the construction of a programming language.

For those who would like to try Mini Pilot, I have a deal. If you will send me a good quality diskette and $2.50 for my time and return postage, I'll make a copy of the program and return it to you. Be sure to adequately package the diskette. I use Floppy Armor from Square One. You can use two pieces of fiber board from a box too. Cut two pieces about one-half inch larger than the diskette and jacket. Then tape the edges and put it in an envelope. If I don't get the money I'll keep the diskette until you send it. If you don't like typing in a long listing, I'll be as helpful as I can.

SUPER—TEXT II

I promised a review of the Super-Text word processor from Muse so here it is. Since I started using the word processor, a new enhanced version has been released. I have also had the chance to see a couple of others recently. My choice is still for Super-Text for the kind of word processing I do now. Super-Text is easy to learn, easy to use, and easy to remember. The new

Super-Text II is even easier to use. Many changes have been made to improve the human factors of the program. One change, the preview mode, was a waste of time as far as I am concerned. I can find no practical use for this mode. You have to do too many things to see line lengths greater than forty columns. Once you use the word processor for any length of time, you get quite good at judging how your output is going to look. It's less involved than trying to use the new preview mode.

What It Can't Do

In the comparable cost catagory, there are only a couple of things. There is no header, trailer or footnote capability. And, you can't move lines of text and paragraphs around easily. Another 'can't do' might include hyphenation. If you don't use right margin justification, you get very ragged, ragged right. I haven't seen this capability in other word processors either.

Documentation

Super-Text II comes packaged in a book-size three-ring binder. The binder includes two diskettes of premium quality and the manual. The manual is rewritten and re-arranged from the original version. Most of the changes make the instructions easier to follow. One change makes it harder to use. The old manual had summary sheets of all the control codes at the end. Now, these summary sheets are at the end of each related section. You have to thumb through the manual to find what used to be all in one place. My personal preference is for a users guide. Visicalc and others have used this approach. Once you have reasonably mastered the operation of the software, usually you only need a quick reference to bring something back to mind. It's much easier than thumbing through the manual.

The manual is divided into eleven sections. The introduction provides you with enough information to get you up and running. In subsequent sections you find out how to initialize data disks, learn the five modes of operation, develop your printer interface requirements, and use the trade marked AUTOLINK function. Also included are a copy program and section on loading non Super-Text files. This last section is only useful for loading you own binary print driver or files from an older compatible word processor. The manual claims to be prepared with Super-Text. I think the old one was but this one appears to be type-set. None-the-less, the manual is well done and easy to follow. I like the new bookshelf size. Also many of the new manuals designed to contain the diskettes have a new feature. The pocket is formed so the diskettes can't be damaged by the binder rings. Things are looking-up for the software buyer.

Human Factors

Operating the new Super-Text II is much easier the old version. You no longer have to be a programmer to set up the printer slot and change the program if you want to use lower case (assuming you have an adapter). These things can be done right from the master menu. Some help might be needed if you want to use the printing replacement table. This feature lets you include special control functions needed by your printer. For instance, my printer has two pitches, enhanced characters and two character sets. With the replacement table, I have included control characters to do these things in my manuscripts and letters. You need to exit the program and do some things in machine language to set-up a replacement table. The manual is pretty clear but will be confusing to the beginner. Apparently most people wanted the print mode more often than the math mode. The new software loads the print module first and initializes the printer for you. I had to make changes in my old version to do this. If Muse would just come out with an 80 column version to work with my new Videx Videoterm board and make it work with DOS 3.3, things would be great. One more point. Some have found it awkward to use the various Super-Text modes. You have to exit one mode to use another. I have gotten used to this feature and now find it quite natural. Like anything else, it's easy once you understand it.

Operating Features

Earlier, five modes of operation were mentioned. Actually, there are only three. The add mode and the print mode are used in combination. The print mode is the most powerful of the operating modes. In this mode you use the format codes to make the printed output be whatever you need it to be. Within the physical restrictions of your system of course. The entry of text into the word processor is free-form. You do not have to be concerned

Some of the lines of the interpreter contain a bell (control G). Here is a listing of the specific lines. All these lines contain a bell between the quotes. Note that line 1450 is a control D. A null string is represented by all other quote pairs.

1290 "-BYE"	2490 ""
1570 "END OF RUN"	2570 "COMMAND ERROR"
2480 ""	

Listing 2.

```
LIST
300 L
1000  REM ***************************
1010  REM * MINI - PILOT INTERPRETER *
1020  REM ***************************
1030 :
1040  REM CODING BY:N. DEALEY  1978
1050  REM DISC MODS BY:
1060  REM CHUCK CARPENTER 1979
1070 :
1080  SPEED= 175
1090  TEXT : HOME : VTAB 6: FOR I = 1 TO 35: PRINT "*";:
      NEXT
1100  VTAB 8: HTAB 11
1110  PRINT "MINI - PILOT II"
1120  HTAB 14: PRINT "REV. 3.00": PRINT : HTAB 13: FLASH
     : PRINT "MODS-BY-CRC": NORMAL
1130  PRINT : FOR I = 1 TO 35: PRINT "*";: NEXT
1140  PRINT
1210  FOR W = 0 TO 5000: NEXT W: HOME
1220  GOSUB 2860
1230 :
1240  REM *** PILOT O.S. ***
1250  REM ****************
1260 :
1270  PRINT
1280  INPUT "REQUEST? ";R$
1290  IF R$ = "BYE" THEN  POKE 216,0: SPEED= 255: VTAB  PEEK
     (37): HTAB 13: PRINT "-BYE": END
1300  IF R$ = "RUN" THEN  GOSUB 1470
1310  IF R$ = "EDIT" THEN  GOSUB 2130: GOSUB 2380
1320  IF R$ = "LIST" THEN  GOSUB 2200
1330  IF R$ = "NEW" THEN  GOSUB 2340
1340  IF  LEFT$ (R$,7) = "REPLACE" THEN  GOSUB 2600
1350  IF  LEFT$ (R$,5) = "DSAVE" THEN  GOSUB 2650
1360  IF  LEFT$ (R$,5) = "DLOAD" THEN  GOSUB 2760
1370  GOTO 1240
1380 :
1390  REM *** ERROR ROUTINE ***
1400  REM *******************
1410 :
1420  SPEED= 255
1430  IF  PEEK (222) = 255 OR  PEEK (222) = 5 GOTO 1240
1440  PRINT : PRINT "SYSTEM ERROR #"; PEEK (222);"L:"; PEEK
     (218) +  PEEK (219) * 256: PRINT : GOTO 1240
1450  LET D$ = ""
1460 :
1470  REM *** RUN ***
1480  REM **********
1490 :
```

about the 40 column limitation of the screen. Words longer than the remaining length of the line are moved to a new line. Words are not broken at the end of a line. I have heard this called the 'mind-dump stream of consiousness' concept. The idea being that you can just type what you're thinking. The format can be easily added later. I do a combination of things. Somethimes I just type away so I don't lose my train of thought. Other times I put the paragraph and format markers in as I go. Additionally, the math mode is not used independently. You have to load the math module in place of the print module to use it.

The Cursor Mode

All of the other Super-Text modes are entered from the cursor mode. While in the cursor mode, there are forty-two key combinations to load and save files, move the cursor, move text, delete text, find and replace text, query the system, do block operations, use the split screen, do three special functions, enter other modes, and exit Super-Text to Basic. Don't be alarmed by the number of key combinations. Some are used infrequently and others are the same in other modes. You will find yourself using only a few combinations all the time and others only once in a while.

The Add and Print Modes

In the add mode, there are fourteen key combinations to use upper and lower case, start a new line or a paragraph, ditto and fill space, tabbing and justification, and exit the add mode. You return to the cursor mode by pressing the key marked ESC twice. Print mode is the mode that makes Super-Text powerful. Format and printer control are established in the add mode using seventeen key combinations. With these combinations, you can format and tab, number and text, turn the printer off and on under program control, and use the user definable replacement table.

There are also sixteen default conditions you can set from the main menu during initial boot. These options can be your most used requirements during printing. The format line can then be used to make local changes in the text during development.

Change Mode

In the change mode, you have thirteen key combinations for cursor movement (same as cursor mode and non-destructive), text movement, deleting text and changing text. The change mode is useful for editing text that is incorrect. Use the add mode to start new text or add more text into existing text.

Math Mode

This mode is used to perform calculations on numbers in a file or to act as a

```
1500  FOR I = 0 TO NV: FOR I1 = 0 TO 1:I$(I1,I) = "": NEXT
     : NEXT
1510 C1 = 0
1520  PRINT : PRINT "RUN OF ";CP$: PRINT : PRINT
1530  FOR A = 0 TO MX: IF  LEN (P$(0,A)) = 2 AND  RIGHT$
     (P$(0,A),1) <  > M$ GOTO 1560
1540  FOR C2 = 1 TO 6: IF  LEFT$ (P$(0,A),1) = S$(C2) THEN
      ON C2 GOSUB 1590,1660,1820,1940,2020,2090
1550  NEXT C2
1560  NEXT A
1570  PRINT : PRINT : PRINT "END OF RUN": RETURN
1580 :
1590  REM *** ASK ***
1600  REM **********
1610 :
1620  FOR Z = 1 TO  LEN (P$(1,A))
1630  IF  MID$ (P$(1,A),Z,1) = "$" THEN I$(0,C1) =  MID$
     (P$(1,A),Z): HTAB 1: INPUT I$(1,C1):Z$ = I$(1,C1):C
     1 = C1 + 1: RETURN
1640  NEXT Z: HTAB 1: INPUT Z$: RETURN
1650 :
1660  REM *** TYPE ***
1670  REM ***********
1680 :
1690  HTAB 1
1700  FOR Z = 1 TO  LEN (P$(1,A))
1710  IF  MID$ (P$(1,A),Z,1) = "$" GOTO 1730
1720  NEXT Z: GOSUB 1800: RETURN
1730  FOR Z1 = Z TO  LEN (P$(1,A)) + 1
1740  IF  MID$ (P$(1,A),Z1,1) = " " OR  MID$ (P$(1,A),Z1
     ,1) = "" GOTO 1760
1750  NEXT Z1: GOSUB 1800: RETURN
1760 V$ =  MID$ (P$(1,A),Z,Z1 - Z)
1770  FOR H = C1 - 1 TO 0
1780  IF V$ = I$(0,H) THEN  PRINT  MID$ (P$(1,A),1,Z - 1
     );I$(1,H); MID$ (P$(1,A),Z1, LEN (P$(1,A)) - Z1 + 1
     ): RETURN
1790  NEXT H: GOTO 1720
1800  PRINT P$(1,A): RETURN
1810 :
1820  REM *** MATCH ***
1830  REM ************
1840 :
1850 M$ = "N":E1 = 1
1860  FOR E = 1 TO  LEN (P$(1,A))
1870  IF  MID$ (P$(1,A),E,1) = D1$ GOTO 1890
1880  GOTO 1910
1890  IF  MID$ (P$(1,A),E1,E - E1) = Z$ THEN M$ = "Y": RETURN

1900 E1 = E + 1
1910  IF  MID$ (P$(1,A),E,2) = " " OR  MID$ (P$(1,A),E,1
     ) = "" THEN  RETURN
1920  NEXT E: RETURN
1930 :
1940  REM *** JUMP ***
1950  REM ***********
1960 :
1970  FOR D = 0 TO MX
1980  IF P$(0,D) <  > "" GOTO 2000
1990  IF  MID$ (P$(1,A),1,40) =  MID$ (P$(1,D),1,40) THEN
     A = D: RETURN
2000  NEXT D
2010  PRINT : PRINT "JUMP TO UNFOUND LABEL FROM LINE #";
     A: POP : RETURN
2020 :
2030  REM *** CLEAR SCREEN ***
2040  REM *******************
2050 :
2060  PRINT : HOME
2070  RETURN
2080 :
2090  REM *** END ***
2100 :
2110 A = MX: RETURN
2120 :
2130  REM *** EDIT ***
2140  REM ***********
2150 :
2160  INPUT "STARTING AT LINE? ";C
2170  IF C > 0 THEN  PRINT C - 1; TAB( 2);P$(0,C - 1);D0
     $;P$(1,C - 1): PRINT C; TAB( 2);P$(0,C);D0$;P$(1,C)

2180  RETURN
2190 :
2200  REM *** LIST ***
2210  REM ***********
2220 :
2230  IF CP$ = "" THEN  RETURN
2240  PRINT : INVERSE : HTAB 8: PRINT CP$: NORMAL : PRINT
```

Apple, continued...

direct fifteen digit calculator. To use this mode you have to load it in place of the print module. This can be done from the menu by using a control L from the cursor mode. If your text requires computation of tabulated data then you will find this module useful. My work does not require calculations so I have not used the math mode.

Autolink

Here's another one I haven't used yet. An example would be if my column used more space than available memory (There is a little over 20K bytes available in RAM memory. This equates to about fifteen doubled spaced pages at ten characters per inch.) The Autolink feature would be used to link the next section to the first. This way you can make your text as many pages as a disk can hold. An example of a phone list linked from list to list is included on the disk. I've tried it so I know it works.

Conclusion

For my applications, I have found Super-Text more than adequate. I have not found a need for the more exotic and complicated features. The ease of use is a definite plus for this word processor. And the software is practically goof proof too. You can easily recover from a RESET. And going in and out of the program to make changes to the replacement table has always worked for me—no crashes. Muse has now adopted the policy of sending two diskettes with the system. This is a definite improvement over their previous policy. Should you damage a disk, you can keep going while you obtain a replacement. The replacement cost is with proof of purchase during the first year. You are on your own after that. Since I have calculated that a disk isn't likely to wear out for over eight years, this policy doesn't make sense. If you damage the disks after the first year, presumably you have to spend the full price all over again. Muse's replacement policy is as good as I've seen. However, support of software for more than a year at some nominal cost would be helpful. You can find Super-Text II at your computer for $150.

PROGRAMMING HELP

Several people have written to me asking for help on different programs included in the Apple Cart. I want to provide all the help I can but...Trying to analyze a program without seeing it is tough. It's got to be a lot like trying to diagnose a patient who's at home. If you are going to write, also include a diskette with a copy of the program on it. This way I can see what's happening as it happens. Also, most of the problems have been typos. If you will send the diskette with return postage, I'll try to find the problem, fix it if I can, and return it to you. We can both save a lot of time and your frustrations this way. □

```
2250  PRINT
2260  FOR A = 0 TO MX: IF  PEEK ( - 16384) > 127 THEN  POKE
      - 16368,0: WAIT  - 16384,128,0: POKE  - 16368,0
2270  IF P$(0,A) = "" AND P$(1,A) = "" GOTO 2320
2280  SPEED= 255 -  PDL (0): IF A <  = 9 THEN  HTAB 2
2290  IF P$(0,A) <  > "" THEN  PRINT A;: HTAB 5: PRINT P
     $(0,A);D0$;P$(1,A): GOTO 2310
2300  PRINT A;: HTAB 4: PRINT P$(1,A)
2310  NEXT A
2320  SPEED= 255: RETURN
2330 :
2340  REM *** NEW ***
2350  REM **********
2360 :
2370 C = 0: INPUT "PROGRAM NAME?";CP$: FOR A = 0 TO MX: FOR
     A1 = 0 TO 1:P$(A1,A) = "": NEXT : NEXT
2380  PRINT : FOR A = C TO MX: IF A <  = 9 THEN  HTAB 2
2390  PRINT A;: HTAB 3: PRINT "?";
2400 A$ = " ": FOR I = 2 TO LL
2410  GET A1$: IF  ASC (A1$) = 8 AND I > 2 THEN  PRINT  CHR$
      (8);:I = I - 1: GOTO 2410
2420  IF  ASC (A1$) = 8 AND I <  = 2 THEN  PRINT : GOTO
      2390
2430  IF  ASC (A1$) = 3 THEN  PRINT : RETURN
2440  IF  ASC (A1$) = 21 THEN  POKE 36, PEEK (36) + 1: GOTO
      2480
2450  IF  ASC (A1$) = 13 GOTO 2500
2460  IF  ASC (A1$) >  = 97 AND  ASC (A1$) <  = 122 THEN
      A1$ =  CHR$ ( ASC (A1$) - 32)
2470  PRINT A1$;:A$ =  LEFT$ (A$,I - 1) + A1$ +  MID$ (A
      $,I + 1,36)
2480  IF I = LL - 5 OR I = LL - 1 THEN  PRINT "";
2490  NEXT I: PRINT ""
2500  PRINT :A$ =  RIGHT$ (A$, LEN (A$) - 1)
2510  IF A$ = "DONE" THEN  RETURN
2520  IF A$ = "EDIT" THEN  GOSUB 2130:A = C - 1: GOTO 25
      80
2530  IF  LEFT$ (A$,1) = "*" OR  LEFT$ (A$,1) = "!" THEN
      P$(0,A) = "":P$(1,A) = A$: GOTO 2580
2540  FOR B = 1 TO  LEN (A$)
2550  IF  MID$ (A$,B,1) = D0$ THEN P$(0,A) =  LEFT$ (A$,
      B - 1):P$(1,A) =  MID$ (A$,B + 1, LEN (A$) - B + 2)
      : GOTO 2580
2560  NEXT B
2570  PRINT "COMMAND ERROR":A = A - 1
2580  NEXT A: RETURN
2590 :
2600  REM *** REPLACE ***
2610  REM ***************
2620 :
2630  PRINT D$;"UNLOCK";CP$: PRINT D$;"DELETE";CP$
2640 :
2650  REM *** DISK SAVE ***
2660  REM *****************
2670 :
2680  FOR A = MX TO 0 STEP  - 1: IF P$(0,A) = "" AND P$(
      1,A) = "" THEN  NEXT
2690  PRINT D$;"OPEN";CP$
2700  PRINT D$;"WRITE";CP$
2710  FOR I = 0 TO A: PRINT P$(0,I): PRINT  CHR$ (34);P$
      (1,I); CHR$ (34): NEXT
2720  PRINT D$;"CLOSE";CP$
2730  PRINT D$;"LOCK";CP$
2740  RETURN
2750 :
2760  REM *** DISK LOAD ***
2770  REM *****************
2780 :
2790  INPUT "PROGRAM NAME?";CP$
2800  PRINT D$;"OPEN";CP$
2810  PRINT D$;"READ";CP$
2820  FOR I = 0 TO MX: INPUT P$(0,I),P$(1,I): NEXT I
2830  PRINT D$;"CLOSE";CP$
2840  RETURN
2850 :
2860  REM *** INITIALIZE ***
2870  REM ******************
2880 :
2890  ONERR  GOTO 1390
2900 D0$ = ":":D1$ = ","
2910 MX = 99:LL = 36:NV = 19
2920  DIM P$(1,99),I$(1,19),S$(7)
2930  LET D$ =  CHR$ (4): REM  (CTRL) D
2940  DATA     A,T,M,J,C,E
2950  FOR I = 1 TO 6: READ S$(I): NEXT
2960  PRINT
2970  PRINT D$;"NOMON I,O,C": HOME
2980  PRINT
2990  RETURN
]
```

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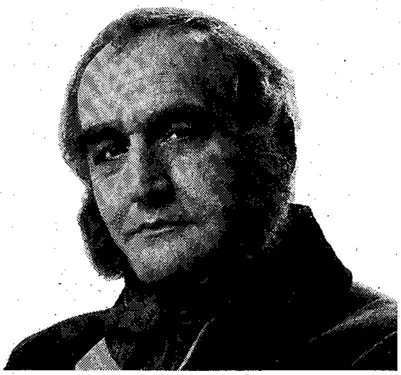

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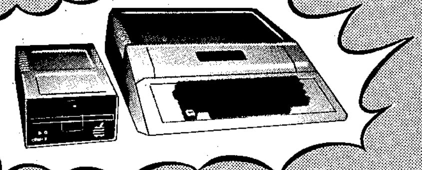

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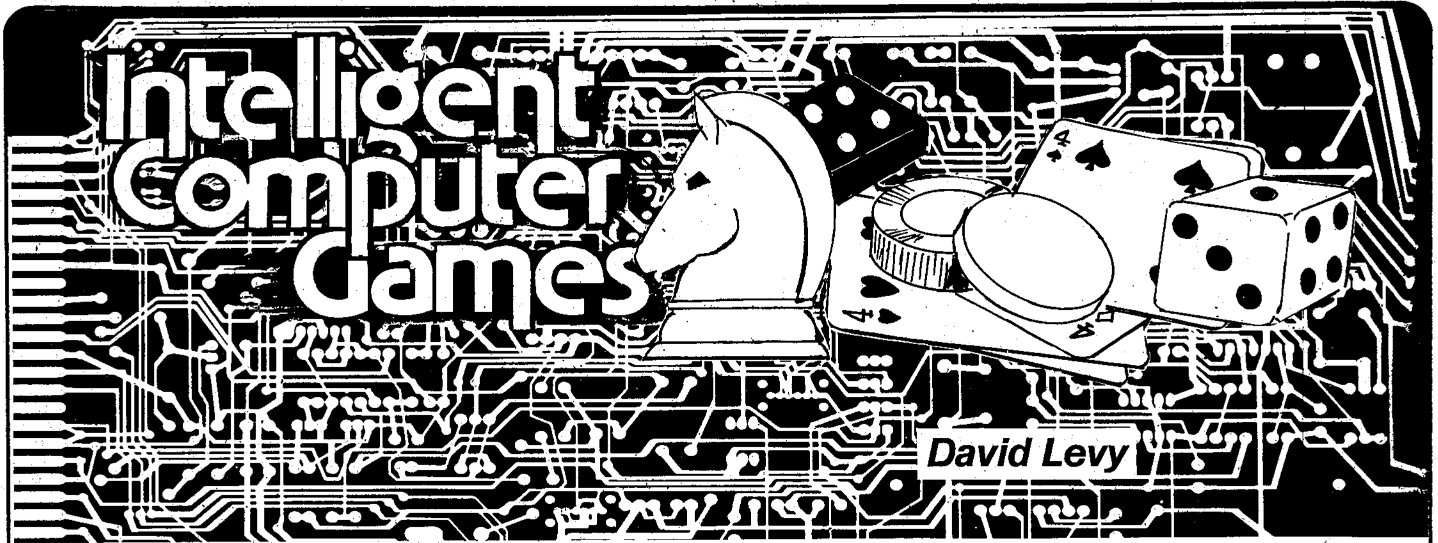

Correspondence is welcome. Letters with interesting questions and ideas will be used in the column along with a response. No personal replies can be made. Send to: David Levy, 104 Hamilton Terrace, London NW8 9UP, England

BACKGAMMON

The game of backgammon introduces special problems into the tree search. Some of these problems are caused by the fact that, before s/he decides what move to make, a player must throw a pair of dice and only then will s/he know which 'moves' are legal. The very fact that two dice can be thrown in 21 different ways gives rise to an enormous branching factor and this is the source of the second major problem. In this month's article we consider how these problems might best be approached. We also examine a strategy for determining when to make or accept a double.

The opening move of a backgammon game is easy for a computer program. Depending on how the dice appear, there are set moves which have been shown by experience to be best. The program merely stores these moves in a table and makes the move corresponding to the particular fall of each die. It is what happens after the first move that is interesting. Let us first consider a program which performs only a one-ply search.

The program need not begin to 'think' until after the dice have been thrown, since it is only then that its possible moves are known. For a one-ply search there is little difference between a backgammon program and a chess program — an evaluation function provides a score for the terminal nodes and the program chooses the move which leads to the highest scored terminal node. We shall discuss the evaluation process in more detail later in this article. Here it is only necessary to comment on the fact that when one player throws a double (1,1) or (2,2), etc., he makes two sets of moves, as though he had thrown four individual dice. This can be accounted for easily enough by calculating every possible way of playing the double throw, and making each of these ways into one branch of the tree.

Probabilistic Trees

Once the search extends beyond one ply, the trees become probabilistic. We have already encountered such trees in another form, earlier in this series. The tree in Figure 1 will enable the reader to understand the problem.

Let us assume that it is the program's turn to move from the root of the tree after the dice have been thrown. Berliner has calculated that in an average board position there are roughly 40 possible ways of making each move but that in typical game positions (assuming sensible play) the number drops to around 17. So from the root of the tree the program can choose from the moves $M_1, M_2, \ldots, M_{17}$. Let us assume that we first examine move M_1. In a one-ply search we would apply the evaluation function to the resulting position and back up the score S_1 to the root of the tree, assigning to S the value of the best score found so far.

After the program makes move M_1, its opponent throws the dice. The move $M_{1,(11)}$ corresponds to the opponent throwing double 1 after the program has played M_1. Thus, there are 21 possibilities to consider after the program makes the move M_1. Associated with each of these possibilities there is a probability measure. $P_{(11)}$ corresponds to the probability of the

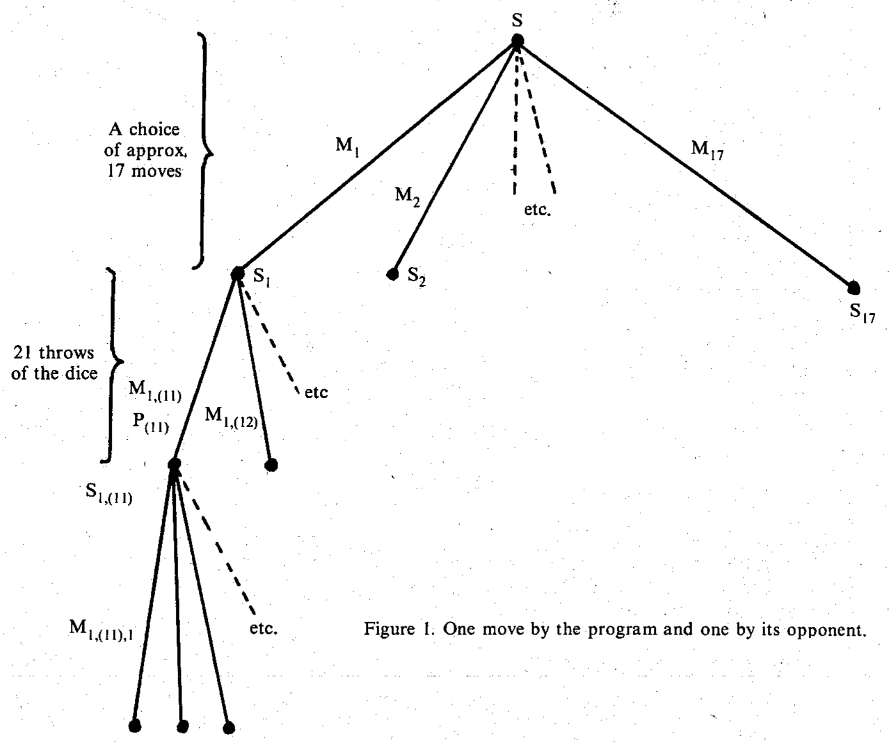

Figure 1. One move by the program and one by its opponent.

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opponent throwing a double 1 (which is 1/36). $P_{(12)}$ is the probability of throwing a 1 and a 2 (which is 1/18). In fact the probability of throwing each particular double is 1/36 and the probability of each of the other possible combinations of the die is 1/18.

Let us see what happens if the program's opponent throws a double 1. He then has the choice of the (roughly) 17 moves which we denote by $M_{1,(11),1}$, $M_{1,(11),2} \ldots M_{1,(11),17}$. For each of these 17 moves the program applies its evaluation function to the resulting position, and the best of the 17 scores is backed-up to $S_{1,(11)}$. Corresponding to the opponent's throw of a 1 and a 2 there are once again some 17 moves: $M_{1(12),1}$, $M_{1,(12),2} \ldots M_{1,(12),17}$, each of which has its own associated score. The best of these scores is backed-up to $S_{1(12)}$.

Once we know the values of the scores $S_{1,(11)}$, $S_{1(12)}, \ldots S_{1,(66)}$, we would like to back-up these scores to S_1 so that S_1 represents the best of these scores. But the program's opponent cannot choose how the die will fall and so he is unable to choose whether S_1 has the value of $S_{1,(11)}$ or some other backed-up value. The actual merit of the node at a depth of one-ply is, therefore, not the merit of the best node at two-ply, but a weighted sum of the two-ply scores — the weightings corresponding to the probabilities of the various throws of the die. Thus, there is a probability of 1/36 that the program's opponent will be able to choose for his value of S_1 and backed up score $S_{1,(11)}$. There is a probability of 1/18 that the program's opponent will be able to choose for S_1 the value of $S_{1,(12)}$. And so on. The actual score which should be assigned to S_1 is therefore:
$S_1 = (1/36 \times S_{1,(11)}) + (1/18 \times S_{1,(12)}) + (1/18 \times S_{1(13)}) + \ldots$

The Size of Tree and How to Cope with it

It will already be clear that, in order to perform the equivalent of a two-ply search, the program must do a lot of three-ply work. Some of this work is very fast: the moves at the second-ply are nothing more than the throw of the die and these remain fixed for the whole game, as do their probabilities; they can be stored in a simple table. But the choice that arises after the throw requires a legal move generator, which may also be table driven but which increases the branching factor to approximately 17 x 21, or 357, though this number *can* rise to over 800. Since it is impossible to choose how the dice will fall, the alpha-beta algorithm has no place in the tree search. The program must examine every possibility from a node before backing-up. There is, however, another method of pruning the tree, which in some ways is analogous to alpha-beta pruning.

Let us assume that M_1 is, in fact, the best move that the program can make. After calculating the scores and backing-up to S_1, the program knows the value of making the move M_1. It then begins to look at the move M_2, and it calculates the score S_2 by adding: $(1/36 \times S_{2,(11)}) + (1/18 \times S_{2,(12)}) + (1/18 \times S_{2,(13)}) + \ldots$ and since M_1 is better than M_2, the score S_1 will be higher than S_2 (I have assumed that we are following the normal convention under which high scores are good for the program and low, or negative, scores are good for its opponent).

To determine that S_1 will be higher than S_2, if we examine M_1 before M_2 it will be necessary to sum all 21 terms in the expression for S_2. But what happens if we examine the moves in the reverse order, with the worst move being examined first? To show that M_{16} is better than M_{17} it will not necessarily be essential to add all 21 terms in the expression for S_{16}. It might be the case that after adding only 18 of the terms, the score would already be better than that of S_{17}. From that point on it is no longer important in the relationship between M_{16} and M_{17} whether the three remaining terms in the expression for S_{16} add up to a relatively small or large number. We know for certain that S_{16} is larger than S_{17}. Unfortunately, the whole of the pruning process is not this simple. In order to know that S_{15} is greater than S_{16} we *do* need to know the exact total of the 21 terms in S_{16}. So how can we afford to prune certain parts of the tree?

The answer lies in an analogy argument, which involves some approximation and hence some risk. But I doubt that it will give rise to serious errors.

It seems reasonable to argue that if, in position A, the results of n of the 21 possible throws add up to something better than the results of the same n throws in position B, then position A is better than position B. This is certainly true when n=21, and it is least likely to be true when n=1. Readers can experiment to see how low n can become without producing large errors in comparing nodes. The important thing to remember is that we choose a 'cross section' of possible throws — at least one throw with a 1, one throw with a 2, and so on. The absolute minimum number of throws to be compared is three, for example 1 and 2, 3 and 4, 5, and 6. I would expect it to be that if $S_{1,(12)} + S_{1,(34)} + S_{1,(56)} > S_{2,(12)} + S_{2(34)} + S_{2,(56)}$, then $S_1 > S_2$.

Of course there would be exceptions to this generalization, but the number of exceptions ought to be a small price to pay for cutting down the possible throws of the dice from 21 to only 3.

When we consider a deeper tree, which takes into account the first two moves by the program and the first reply by its opponent, instead of examining a three-ply sequence we are, in fact, looking at a five-ply probabilistic tree. The number of nodes on this tree will already be so large that, without alpha-beta pruning, it is very doubtful whether a micro-program can search it within an acceptable time span,

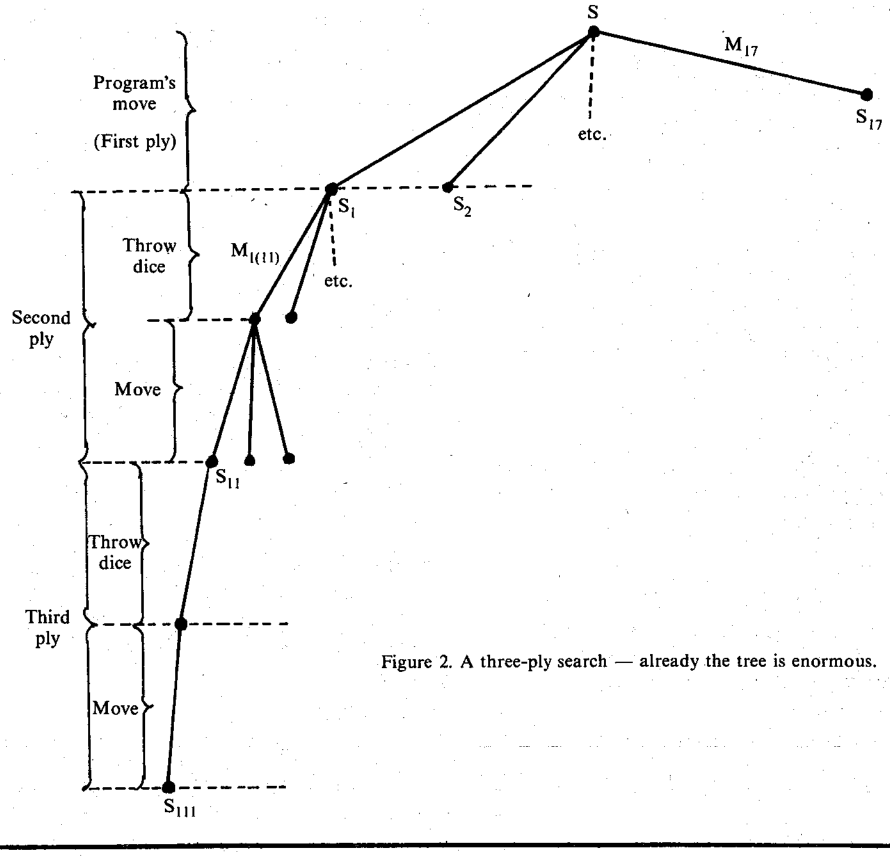

Figure 2. A three-ply search — already the tree is enormous.

and alpha-beta pruning is not possible because of the nature of the tree — a player does not have complete freedom of choice because of the dice. The tree in Figure 2 will illustrate the magnitude of the problem. Since none of the scores at any ply can be known until *all* successor moves from that node have been examined, there is no way that alpha-beta can be employed. Of course forward pruning is always possible, using either the apparent merit of a node as measured by the evaluation function or the backed-up merit as determined from an extra ply of look-ahead (which would be slow) but this is all that one can do.

The Evaluation Function

Backgammon can be divided into two distinct stages. For most of a game the two sides are 'engaged.' That is to say, there are one or more opposing men standing between one or more men and the inner table. Once this stage is over the two sides are 'disengaged,' and the game becomes a race to 'bear off' all of one's men; the first player to do this is the winner.

During the engaged stage there are two features of paramount importance. Berliner, who as well as being a former World Champion at correspondence chess is also the world's leading backgammon programmer, calls these feaures 'Blot Danger' and 'Blockading Factor.' A blot is a single man on a point, which is liable to be 'hit' by an opposing man landing on the same point. The blot is then sent off the board onto the bar, and must remain there until that player throws a dice in such a way as to allow the man on the bar to move to a point which is not blockaded by the opponent. By hitting many of your opponent's blots you force many of his men onto the bar and thereby slow down his progress around the board. Berliner's blot danger feature finds the optimal way to play every potential roll of the dice so as to hit the greatest number of blots, or to hit the most advanced blot(s) if there is a choice of equally powerful plays.

It is a relatively easy matter for the program to compute the probability of one side or the other landing on a point where his opponent has a blot. Clearly the blot danger feature must use such a calculation in order to arrive at an accurate estimate of danger, which in turn will discourage the program from making moves which leave vulnerable blots. In any game where chance plays a part it is impossible to be sure that a particular strategy will be fool-proof, but it makes good sense to play with the odds.

The notion of a blockade is very important in impeding the progress of your opponent's men, since an enemy man cannot land on a blocked point (i.e., a point with two or more of your own men on it). Setting up a succession of adjacent blockades is a particularly powerful strategy if it can be successfully adopted because it prevents the opponent from moving unless he is lucky enough to roll high numbers from a point just on one side of the blockade. Berliner's program considers every combination of from zero to seven blockading points (seven is the maximum number possible, since each side has only 15 men), at a distance of from one to 12 points in front of each man. It employs a table of these blockading patterns to store the number of rolls of the dice that could legally be played by the side who is trying to pass the blockade. This number indicates the extent to which each man is blockaded.

When the two sides' men become disengaged, the 'running game' begins, so called because each player's men run as fast as possible towards the inner (or home) table. At this stage of the game it is possible to estimate fairly accurately the probability that a particular player will win the game by bearing off all his men before his opponent is able to do so. One method of doing this is to 'count' the position — simply add up the number of steps each man must take before he can bear off, assuming no wasted motion. This count can be employed in a simple table to determine the odds of winning, and such tables are found in most backgammon books. For example, the books will tell you that if your count is 60 and your lead over your opponent is four when it is your turn to roll, the odds are eight to five in your favor. Until the last few moves of the game, when special heuristics apply, it is relatively simple for the program to decide which men to move and in many situations it will make no difference. But it is just in this stage of the game that the complication of the doubling cube becomes of paramount importance.

Backgammon is traditionally played for stakes. One of the essential elements of a backgammon set is a cube with the numbers, 2, 4, 8, 16, 32 and 64 on the faces. If a player feels that he has a good chance of winning he may put the cube with the 2 face uppermost, at which point his opponent must either resign or agree to play the game for double the usual stake. Having accepted a double a player may, later in the game, double again, by turning the 4 face uppermost. This process may continue until the players are wagering 64 times the original stake — people have won and lost fortunes through the doubling cube.

Not surprisingly, statisticians have calculated formulae which indicate when a player should double and when a double should be accepted and these formulae are obviously easier for a program to apply than for a human. There is, however, an important psychological aspect to doubling. If most players double when their probability of winning is around 0.6, it will be better to double at 0.7 and keep your opponent in the game (if he assumes that he still has some chance he will be less likely to resign, and you will win twice as much). Of course if both players can calculate perfectly one will always resign when the other doubles, and neither will double until the 'correct' moment.

Backgammon books give quite a lot of useful information on when a player should double and when a double should be accepted. This makes the programmer's task easier, and helps to reduce the element of skill in the game below its normal tiny amount. My own view of the game is that it is rather shallow, with virtually no scope for brilliant or imaginative play but with features that allow a fast mind to score a steady though slight advantage against a player with a lesser facility for calculation. It can be a fun game to program, with plenty of scope for neat graphics work and the problem of coping with the enormous trees certainly makes it a challenge to the serious games programmer. □

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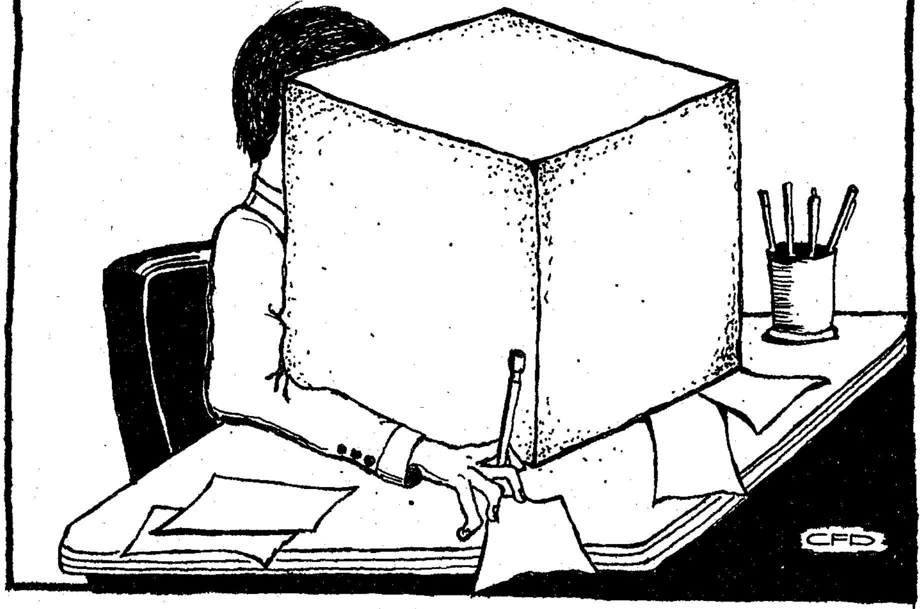
Barbara Schwartz

Getting Around the Block



Whether you have to write business letters, magazine articles, or the documentation for your latest programs, you've probably faced writer's block, and that gnawing fear that you'll never be able to think of anything to say. And the fact that we now suffer facing a blank CRT rather than a blank piece of paper hasn't made it one bit easier to take. But if you go about it properly, writing can be at least pleasant, if not euphoric, and disarrange your stomach lining as little as possible.

A common writer's problem that can produce almost total paralysis is the feeling that you have to produce perfect prose each time you write. So you wait and wait for the muse to strike, and when you finally do force yourself to start, you hammer the cursor control keys endlessly trying to get that beginning sentence just right.

The best way to overcome the inhibition of perfectionism is to tell yourself that you are going to sit down, and write, and not be too critical of your first product. After all, its been said that there are two products that would utterly repel the public if they could see them in their intermediate stages—bologna, and writing. So your first step in overcoming writer's block is to vanquish your "internal critic," that little voice inside you head of a long ago English teacher reminding you that *every* comma must be correct, or your own voice telling you that if you don't write flawlessly and rapidly, you're not really a writer.

One way to do this is called the freewrite. Set a timer for a given length of time—say 5 or 10 minutes—and write continuously for that period, whether or not you feel that you're saying anything meaningful. Write notes to the milkman (or your favorite computer magazine), or write about why you feel you can't write, or why you may not *want* to write. But keep writing until the timer goes off. When you look over your freewrite (or nonstop, as it's sometimes called), you may find one or two ideas pertinent to your topic. These can be the foundation for either a first draft, or another freewrite. You may have to do as many as five or six freewrites before you get a feeling for exactly what you're trying today.

If you still find it hard to suspend your feelings about how you "should" write, pretend that you are writing something else. Instead of writing documentation for an anonymous user, pretend that you're writing a letter to a friend who has absolutely no knowledge of computers, and explain how the program works. If you have a tendency to be wordy and wander from your theme, try to sum up what you're trying to write in a telegram.

Now this may sound a little odd if you were once taught in school that you first had to write an outline, all neat and proper with Roman numeral I, sub A, sub 1, sub a, etc., and then, and *only then* were you permitted to start to write. Unfortunately, this method forces you to solidify your ideas so early in the game that potentially better angles will be blocked out as you proceed from I.A.1 to I.A.2, and again paralyzes many people as they wait for the "perfect" outline to take form.

Another misconception is that you *must* start at the beginning and proceed merrily to the end in rigid sequential order. Many writers, therefore, find themselves absolutely immobilized as they sit and wait for the perfect lead, or agonize endless hours on section C, when they could have breezed through section D. So, if you have a great idea for the ending, start there. If you have to, start somewhere in the middle and work backwards and forwards. Many times you'll find that perfect lead buried somewhere else in the piece, all ready for a block move!

Of course, now that you have overcome your fear of writing and are zinging along, this doesn't mean that you should just take your freewrites and ship them off. The work is just beginning—the rewriting, cutting, rearranging, etc.

But since you now have some kind of draft to work with, you can use those hours you would have previously spent watching the cursor and biting your nails to be as much of a perfectionist as you like about the final copy.

If you've read this short introduction to some of the newer "blockbusting" techniques, and you're still sitting there watching the cursor blink, you might want to learn some others from one of the three books that go into more detail.

Writing Without Teachers (Peter Elbow, Oxford University Press, NY, 1973) discusses freewrites with many details on how to use them to write, to find subjects for writing, etc. The author also describes what he calls teacherless writing classes, a way of getting together with other writers to help each other improve (Someone doesn't have to be a professional instructor to tell you that he can't figure out paragraph three, but that he likes the joke at the end!)

Overcoming Writing Blocks (Karin Mack, Ph.D. and Eric Skjei, Ph.D., J.P. Tarcher, Inc., LA, 1979) helps you through every possible stage of writing blocks—getting your material together, organizing it, writing the rough draft, and revising and polishing the final draft. The last section of the book discusses case studies of writing problems in four specific areas—business writing, student writing, technical, academic and professional writing, and personal writing.

The New Diary (Tristine Rainer, J.P. Tarcher, Inc., LA, 1978) contains a good chapter on overcoming writer's block. Incidentally, keeping a journal or diary is one of the best ways to practice writing, without the horrible feeling that someone is going to judge and/or grade your work. □

Reviews

Steve Gray

Multi-Processors: A Comparative Study, by M. Satyanarayanan. Prentice-Hall Inc., Englewood Cliffs, NJ. 207 pages, hardcover $21.50. 1980.

The author's aim in writing what he calls a monograph is, according to the back cover, "to give the reader an idea of how multiprocessing is done in some of the computer systems found today."

Because he found "woefully insufficient information, other than manufacturers manuals, published on the available systems," he wrote this comparative study of the IBM 370/168, Control Data Cyber-170, Honeywell Series 60 Level 66, Univac 1100 Model 80, Burroughs B7700, Digital Equipment Corp. System 10 Model KL10, and two university multiprocessors built at Carnegie-Mellon, the C.mmp and Cm* systems.

The author, incidentally, is in the Dept. of Computer Science at Carnegie-Mellon, and typeset the book himself on a CAT-8 photocomposer at the university.

Each case study opens with a description of the multiprocessor's architecture, system organization, error-recovery features, and operating system. These surveys are followed by evaluations and annotated bibliographies of related literature. The book ends with a discussion of the architectural and software issues in multiprocessing, with specific references to the case studies.

The appendix, an annotated guide to further reading, includes 65 papers in seven basic areas, such as performance, theoretical results, scheduling, applications, etc.

The writing is surprisingly clear for such a highly technical subject, and the author gives what seem to be well balanced evaluations, pointing out both the positive aspects and the drawbacks of each system, playing no favorites.

Guidebook to Small Computers, by William Barden Jr. Howard W. Sams & Co., Indianapolis. 127 pages, paperback $4.95. 1980.

At his current rate of writing computer books, Barden will soon outdistance Lance Leventhal and maybe even Donald Spencer. This is something like his sixth book for Sams and, as usual, it is packed with useful information.

After an introductory chapter on Small-Computer Basics, Barden presents eight chapters on the products of individual companies: Apple II, Atari, Commodore PET, Cromemco, Heath, Ohio Scientific, Radio Shack TRS-80, Synertek SYM-1, and Vector Graphic. The last chapter, on Some Other Systems, covers Compucolor II, Exidy Sorcerer, North Star Horizon, Southwest 6800 and S/09, and the ill-fated Texas Instruments TI-99/4.

Each of the product chapters discusses first the hardware, then the software, and provides a one-page summary of both, along with a rating of the publications, and notes on warranties and repair. Photographs are liberally sprinkled throughout this book, which is aimed at people who "contemplate buying a small computer system for home or business."

Barden's short summaries are very useful. For example, he says that OSI computers "are some of the best examples of state-of-the-art computer equipment available today," that the Sorcerer "is a unique design because of the removable ROM and definable graphics characters," and that the TI-99/4 "is not compatible with the needs of those interested in assembly-language programming or computer system experimenters."

All in all, this is probably the best and fastest-reading guidebook to small computers now available.

The CP/M Handbook with MP/M, by Rodnay Zaks. Sybex Inc., 2344 Sixth St., Berkeley, CA 94710. 331 pages, paperback $13.95. 1980.

If you don't have a disk drive, you may not be familiar with CP/M, Control Program for Microprocessors, the industry standard for personal-computer operating systems.

The back cover says this handbook is an introduction for beginners, and a reference text for experienced programmers. The press release says it was written "for all users of the CP/M operating system from clerical personnel who use a computer to enter data or execute specific programs to experienced programmers who want to develop their own programs."

The introductory chapter assumes no prior knowledge of computers, briefly describes a computer system, defines MP/M as multi-user operating system, and shows, with many photographs and drawings, exactly how to bring up CP/M, how to use it, run a program, create a file, etc.

The second chapter teaches all the CP/M commands, and subsequent chapters are Handling Files With PIP, Using the Editor, Inside CP/M (And MP/M), Reference Guide to Commands and Programs, Practical Hints, and The Future (mostly about the history of CP/M, two pages).

Thirty-four pages are devoted to 15 appendixes, on error messages, ASCII conversion table, PIP keywords, command editing controls, supplies (checklist), basic troubleshooting rules etc.

Written very clearly and in great detail, this handbook can be read with profit by anyone using CP/M or interested in learning about it.

Entering Basic, by John Sack and Judith Meadows Gabriel. Science Research Associates Inc., Chicago IL. 137 pages, paperback $9.95. Second edition, 1980.

The first two chapters of this thin volume "are included solely to fit Basic into the context of the computer hardware and software surrounding it," according to the preface.

Those two chapters tell how a computer works, look at peripherals, examine the writing and testing of programs, and get into interactive processing.

The Basic language itself is featured in 10 chapters, in an introduction, Assigning Values to Variables, Input/Output, Program Control, Basic Functions, Subroutines, Array Handling, String Manipulation, Advanced Features (multiple assignments, logical operators), and Debugging Aids.

The first appendix provides a summary of Basic features, and the second gives solutions to selected exercises, of which there are several at the end of each chapter.

The Introduction to Basic begins poorly, with a flowchart for printing out square roots, a seven-line program to do the calculations, and then four dull pages explaining in gory detail all the rules and restrictions for entering constants, variables, operators, etc. Starting off with an eight-element flowchart is confusing enough, but the confusion is highly compounded by the flowchart's square-root sign being only partial, and not looking like a square-root sign at all.

The rest of the book is about as dull as those four pages, with a rather stiff writing style, and little if any planned relationship between chapters, which stand apart like tombstones. Many better books on Basic have been written.

From Television to Home Computer: The Future of Consumer Electronics, Angus Robertson, Editor. Blandford Press, distributed by Sterling Publishing Co., Inc. Two Park Ave., New York, NY 10016. 331 pages, hardcover $19.95. 1979.

Although published in England, most of this book can be read profitably by those with more than a passing interest in consumer electronics.

To be sure, all the prices and the cost comparisons are in pounds sterling, and the TV broadcast standards are different, but the majority of the products described are familiar in the U.S.

The nine-page chapter on home computers, for example, mentions the PET, Apple II, and Atari 800, in looking briefly at the software and hardware, and providing questions to ask when choosing a personal computer.

The 28-page chapter on Television and Electronic Games describes games familiar here, such as Odyssey, Atari, Chess Challenger, Boris, two Mattel hand-held games, and two Coleco games, along with games from Ingersoll, Teleng, Optim, Grandstand and Interton, not available here.

And so on, for the rest of the contributed chapters, on video cassette recorders, video disks, aerials, TV receivers, Teletext and Viewdata, home protection and security, amateur and CB radio, hi-fi and in-car entertainment. Many of the names are Japanese, and thus familiar here, such as Sony, JVC, Akai, Technics, Panasonic, Sharp, etc.

The chapters look briefly at the early history of each type of product, then examine what"s available today in considerable tutorial detail. A few chapters also look at the product"s future.

This may be the only book on the subject, but it carries a price that will keep it out of the hands of most consumers.

Microcomputer Primer, by Mitchell Waite & Michael Pardee. Howard W. Sams & Co., Indianapolis. 384 pages, paperback $11.95. Second edition, 1980.

The "small typewriter-size computers have become so popular with the public and industry that many new features have been added since the first edition was introduced in 1976. This new edition has been completely revised to reflect the latest in microcomputer technology," according to the back cover.

Chapter 1 is a brief introduction to small computers while Chapter 2 covers the basic computer concepts. Chapters 3, 4 and 5 discuss the electronics behind the logical operations that the computer performs. Chapter 6 involves programming, while Chapter 7 examines operating systems.

The appendixes, expanded for this second edition, cover number systems, memories, tables of RAM-memory and MOS PROM specs, and number-conversion tables.

Many photographs, drawings and schematics are used, the text is packed with detail and well-written in an informal style. The book starts out with the basics and, with a little serious study, can provide the beginner with a vast amount of information.

The British Lectures, by A.P. Ershov. Heyden & Son Inc., 247 South 41 St., Philadelphia. 69 pages, paperback $14. 1980.

The subtitle of this skinny book, as shown on the title page, is "Four lectures presented by Professor A.P. Ershov, Computing Center, Siberian Division of the USSR Academy of Sciences, Novosibirsk, USSR, and delivered to British Computer Society audiences after his award as Distinguished Fellow of the BCS."

The first lecture, The Human Factor in Programming, describes programming as "the most humanly difficult of all professions involving numbers of men," discusses the question of "organizing software development using an assembly-line approach," among others and describes a combination of teaching and training that "requires no less than seven years" non-interrupted teaching.

Lecture 2, An Outline of the History of Computing in the USSR, takes up some 40 percent of the test, with a brief chronological history of USSR computer development, "relying exclusively on its own intellectual and technological resources," and descriptions of the first books on programming in the USSR, the first scientific meeting on electronic computers, Algol in the USSR, and The Educational and Academic Status of Programming in the USSR.

Lecture 3 is about The First Soviet Compilers. Lecture 4 is on The Systematic Obtaining of Object Code and Object Code Generator from Interpretational Semantics.

The lectures are mostly of historical value, especially since three of the lectures were given in 1976, and the fourth in 1977. However, the first lecture should be of interest to programming managers, if only because of its insights into the craft: "Intelligence itself is manifest in the perfected machine/program combination. The programmer plays a full trinity of roles in this familiar miracle. He feels himself to be the father-creator of a program, the son-brother of the machine on which it runs, and the carrier of the holy spirit whice infuses life into the program/machine combination. This triumph of intellect is perhaps the strongest and the most characteristic aspect of programming."

The story behind the two best selling computer games books in the world.

Computer Games

by David H. Ahl

Everybody likes games. Children like tic tac toe. Gamblers like blackjack. Trekkies like Star Trek. Almost everyone has a favorite game or two.

It Started in 1971

Ten years ago when I was at Digital Equipment Corp. (DEC), we wanted a painless way to show reluctant educators that computers weren't scary or difficult to use. Games and simulations seemed like a good method.

So I put out a call to all our customers to send us their best computer games. The response was overwhelming. I got 21 versions of blackjack, 15 of nim and 12 of battleship.

From this enormous outpouring I selected the 90 best games and added 11 that I had written myself for a total of 101. I edited these into a book called 101 Basic Computer Games which was published by DEC. It still is.

When I left DEC in 1974 I asked for the rights to print the book independently. They agreed as long as the name was changed.

Converted to Microsoft Basic

The games in the original book were in many different dialects of Basic. So Steve North and I converted all the games to standard Microsoft Basic, expanded the descriptions and published the book under the new name Basic Computer Games.

Over the next three years, people sent in improved versions of many of the games along with scores of new ones. So in 1979, we totally revised and corrected Basic Computer Games and published a completely new companion volume of 84 additional games called More Basic Computer Games. This edition is available in both Microsoft Basic and TRS-80 Basic for owners of the TRS-80 computer.

Today Basic Computer Games is in its fifth printing and More Basic Computer Games is in its second. Combined sales are over one half million copies making them the best selling pair of books in recreational computing by a wide margin. There are many imitators, but all offer a fraction of the number of games and cost far more.

The games in these books include classic board games like checkers. They include challenging simulation games like Camel (get across the desert on your camel) and Super Star Trek. There are number games like Guess My Number, Stars and Battle of Numbers. You'll find gambling games like blackjack, keno, and poker. All told there are 185 different games in these two books.

Whether you're just getting started with computers or a proficient programmer, you'll find something of interest. You'll find 15-line games and 400-line games and everything in between.

The value offered by these books is outstanding. Every other publisher has raised the price of their books yet these sell for the same price as they did in 1974.

Contents of *Basic Computer Games* (right) and *More Basic Computer Games* (below).

Introduction
The Basic Language
Conversion to Other Basics
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Amazing
Animal
Awari
Bagels
Banner
Basketball
Batnum
Battle
Blackjack
Bombardment
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Boxing
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Bullfight
Bullseye
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Combat
Craps
Cube
Depth Charge
Diamond
Dice
Digits
Even Wins
Flip Flop
Football
Fur Trader
Golf
Gomoko
Guess
Gunner
Hammurabi
Hangman
Hello
Hexapawn
Hi-Lo
High I-Q
Hockey
Horserace
Hurkle
Kinema
King
Letter
Life
Life For Two
Literature Quiz
Love
Lunar LEM Rocket
Master Mind
Math Dice
Mugwump
Name
Nicomachus
Nim
Number
One Check
Orbit
Pizza
Poetry
Poker
Queen
Reverse
Rock, Scissors, Paper
Roulette
Russian Roulette
Salvo
Sine Wave
Slalom
Slots
Splat
Stars
Stock Market
Super Star Trek
Synonym
Target
3-D Plot
3-D Tic-Tac-Toe
Tic Tac toe
Tower
Train
Trap
23 Matches
War
Weekday
Word

Artillery-3
Baccarat
Bible Quiz
Big 6
Binary
Blackbox
Bobstones
Bocce
Bogá II
Bumbrun
Bridge-It
Camel
Chase
Chuck-A-Luck
Close Encounters
Column
Concentration
Condot
Convoy
Corral
Countdown
Cup
Dealer's Choice
Deepspace
Defuse
Dodgem
Doors
Drag
Dr. Z
Eliza
Father
Flip
Four In A Row
Geowar
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Nomad
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Obstacle
Octrix
Pasart
Pasart 2
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Rotate
Safe
Scales
Schmoo
Seabattle
Seawar
Shoot
Smash
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AIR TRAFFIC

CONTROLLER

In **Air Traffic Controller** you assume responsibility for the safe flow of air traffic within a 15x25 mile area up to 5,000 feet in altitude. During your shift as a controller in charge of this airspace, 26 aircraft become active and under your control. Jets and prop planes have to be guided to and from the two airports, navigational beacons and ten entry/exit fixes. The aircraft enter the controller's airspace at various altitudes and headings whether or not you are ready.

Air Traffic Controller retains the basic realism of air traffic control. This program requires the same steady nerves under pressure and the same instant, almost instinctive, analyses of complex emergencies which are demanded of a professional air traffic controller. But "ATC" adds the excitement and well-defined goals of a game. This is just a simulation, and all passengers left in air traffic limbo by a panicked player will live to fly another day.

Your goal is to get all of the aircraft to their assigned destination before the shift is completed. At your disposal are a radar display of the aircraft positions in the control area; coded information concerning aircraft heading, destination and fuel supply; navaids enabling you to hold aircraft or assign them automatic approaches; and commands to alter the altitude and heading of the aircraft. Working against you are altitude and heading requirements, fuel restrictions and, of course, the inimitable clock.

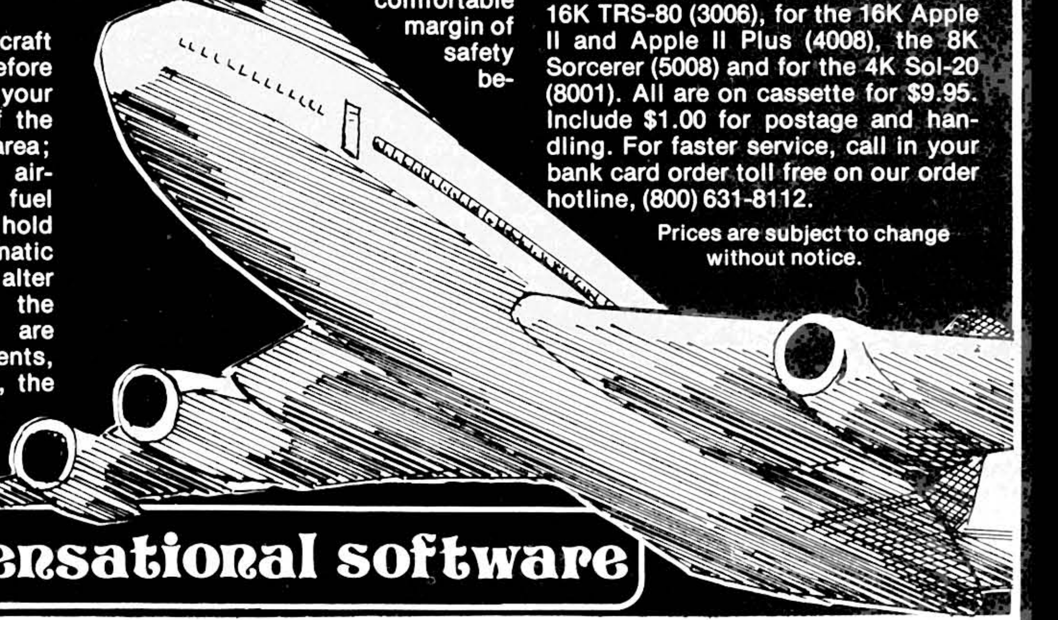
The most obvious measure of difficulty of a game is the clock setting at the beginning. In a 99 minute game you will have time to go fix a sandwich between the appearance of two successive aircraft, while in the 16 minute game you may not have time to swallow before all of the aircraft have appeared.

No two games, even at the same clock setting, are ever alike. As controller, you must cope with the unique requirements of each aircraft. The game will end if you commit a "boundry error," that is, if an aircraft fails to leave your area at the proper altitude and exit fix...causing an unpleasant surprise for the controller next door. The game also ends if you fail to leave a comfortable margin of safety between the aircraft as they whiz past each other. In cases of excessive delay, fuel supply considerations will become invested with a particular sense of urgency.

Successful guidance of all aircraft to their destination is a heady accomplishment. This never fails to thrill ATC enthusiasts at each successive level of play.

Your local retail store should carry Creative Computing Software. If your favorite retailer does not carry the software you need, have him call in your order to (800) 631-8112. Or you can order directly from Creative Computing. Write to Creative Computing Software, P.O. Box 789-M, Morristown, NJ 07960. **Air Traffic Controller** is now available for the 16K TRS-80 (3006), for the 16K Apple II and Apple II Plus (4008), the 8K Sorcerer (5008) and for the 4K Sol-20 (8001). All are on cassette for $9.95. Include $1.00 for postage and handling. For faster service, call in your bank card order toll free on our order hotline, (800) 631-8112.

Prices are subject to change without notice.



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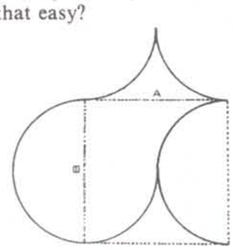
puzzle answers

A Potty Problem: Cut the jug along lines *A* and *B*. Rearrange the three pieces thus formed into the square depicted by the dotted lines. Now, wasn't that easy?



Santa's Puzzle: The catch here is that if we use the abbreviations for these three months we get:

Oct. is an abbreviation for OCTAL
Nov. is an abbreviation for NOVEM
Dec. is an abbreviation for DECIMAL

From this we get an OCTAL 31 = a NOVEM 27 = a DECIMAL 25.

A Martian Puzzle: Willard gave the answer without even knowing he had solved the puzzle. The answer is "THERE IS NO POSSIBLE WAY".

The Wolf, The Goat, and The Cabbages: This is a very simple problem. It is solved as under:

1. He first takes across the goat and leaves him on the opposite side.
2. He returns and fetches the wolf, leaves him on the opposite side, and takes back the goat with him.
3. He leaves the goat at the starting point and takes over the basket of cabbages.
4. He leaves the cabbages with the wolf and, returning, fetches the goat.

Or,

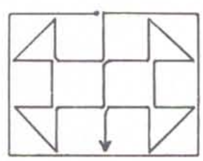
1. He takes over the goat.
2. He returns and fetches the cabbages.
3. He takes back the goat, leaves him at the starting point, and fetches the wolf.
4. He leaves the wolf on the opposite side with the basket of cabbages and goes back to fetch the goat.

The Old Dictionary Quiz: (1,C), (2,G), (3,H), (4,M), (5,A), (6,J), (7,N).

The Nifty Nines: 99 + 9 = 9 DOZEN.

An Ancient Problem: 35 percent of the list price was $122.50. $122.50 divided by 35 gives us $3.50 for each percent. Therefore, the list price had to be $350.00.

A One-Liner:



The Three Peanuts: This is a very ancient "sell," but it still finds victims. The performer's undertaking is performed by simply putting on the hat selected. No one can deny that the three peanuts are thereby brought under the hat.

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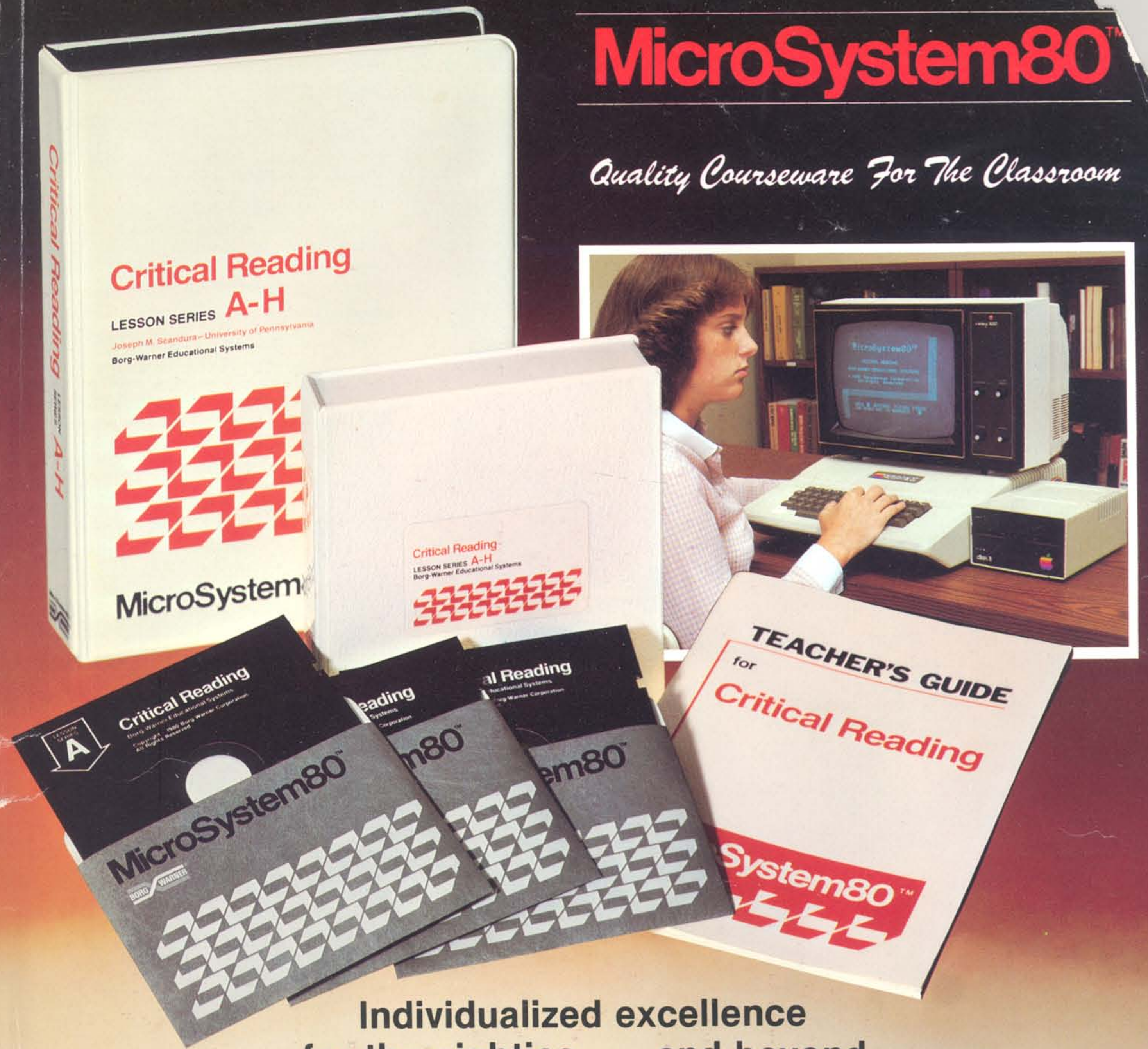

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