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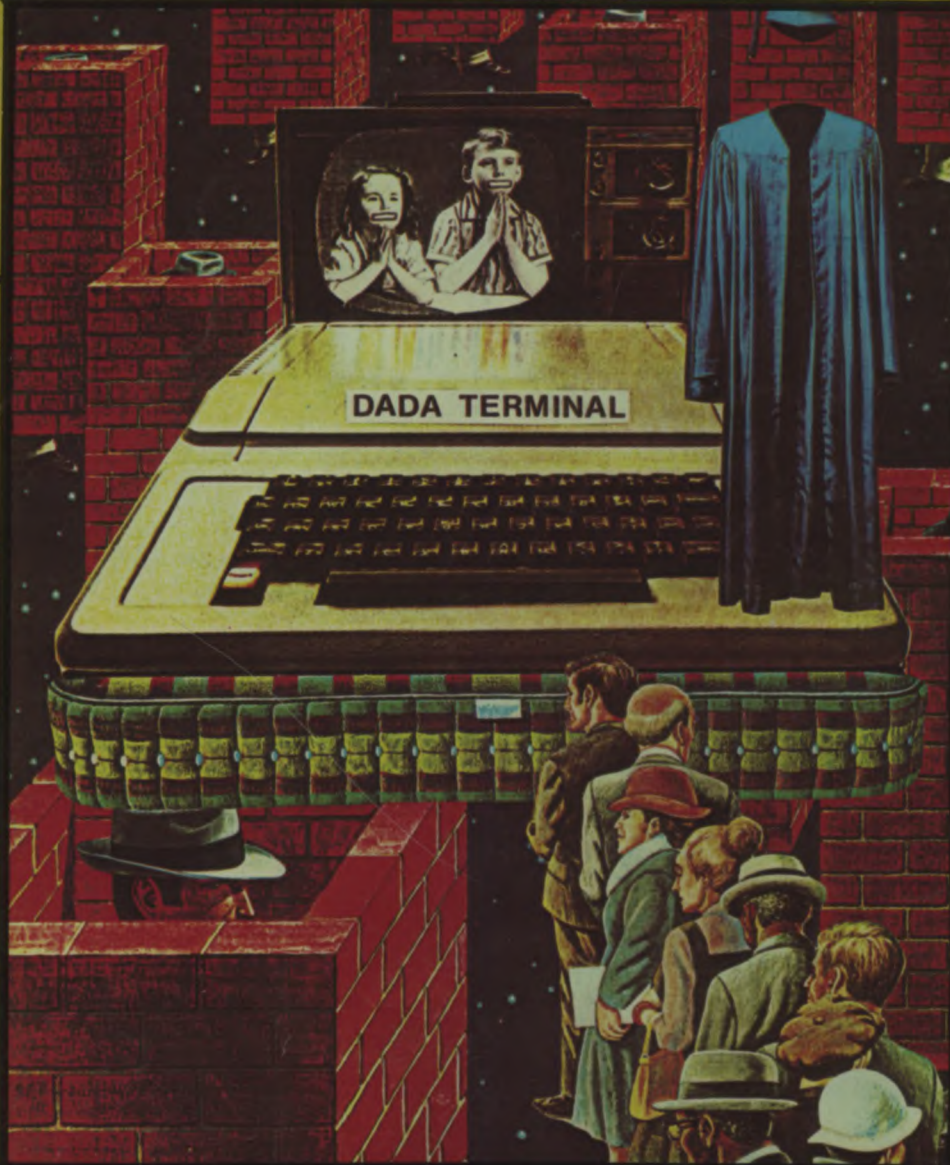
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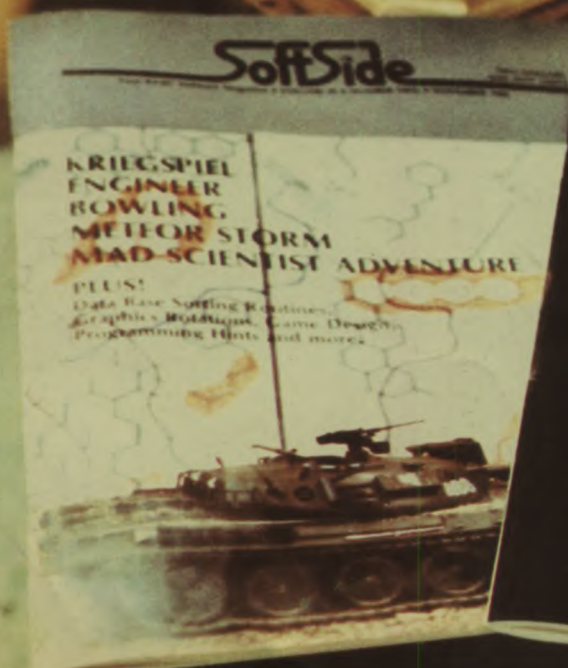
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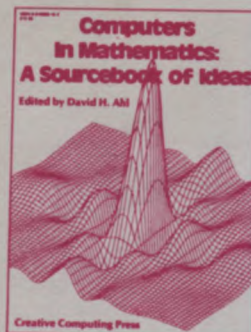
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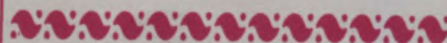
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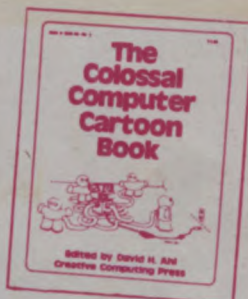
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This month's cover was designed by Peter Payack and Opal Louis Nations of Cambridge, MA. For more information, see page 140.

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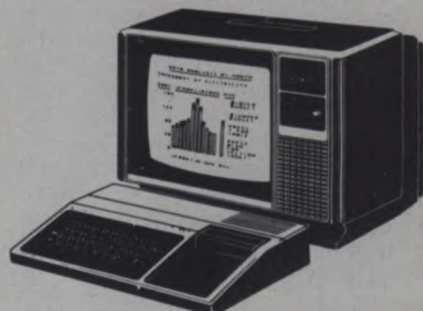
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Congratulations!

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)

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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:
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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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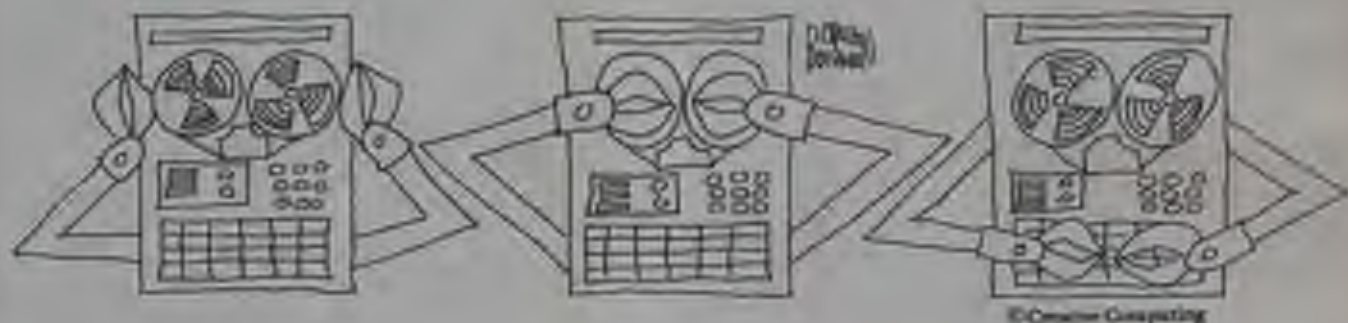
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Business as Usual

Dear Editor:

I would like to comment on the article written by Mr. Paul F. Diering, 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. Diering'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 replaced 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
Tallahassee, FL 32312

Bleak House

Dear Editor:

I couldn't agree more with the observations of Mr. Diering 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 businessmen.

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 biased and determined to get a complete computer system for the least amount of money. Therefore, they invite Mr. Diering's 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. Diering 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 entrepreneurial programmers (CEPs) 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 or 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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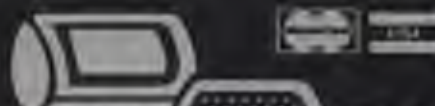
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I/O, continued...

engineered to protect the buyer's investment. Yet, it was cheap! Computer enthusiasts bought such hardware thinking they were getting a bargain. Thankfully, many of these early marketers are no longer with us. Instead, we have a relatively stable community of computer hardware vendors who are conscientiously trying to deliver a reliable product at a reasonable cost, but not necessarily cheap. They recognize the value of doing it right even if it must cost a few dollars more.

Daryl A. Frame, President
Discreet Computer Service, Inc.
88 Victor Herbert Drive
Vernal, 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 80320

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, *Synr*, for 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 produced a Reagan landslide with only Kentucky and Indiana — but then who believes a "computer knot" that early in the evening? (Actually not even the knot.)

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 own all the appropriate magazines at the University Library.

Thank you and congratulations for a most enjoyable evening.

Elis C. Hall
Resident Manager
University of Kentucky
Carrigan 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 (since 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. Sadrowsky
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 east-coast 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 Wickflower Drive
Ithaca, NY 14850

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On Computing, Summer 1980

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Microcomputing, June 1980

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Creative Computing, August 1980

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CIRCLE 181 ON READER SERVICE CARD

I/O continued...

In Addition

Dear Editor:

Your October, 1980 issue carried a letter in the Compendium column by a Susan J. Wilkins wherein an advertisement of equally uncreative type was required to be included by the programmer in determining a listing program.

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

When I phoned 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 value and a provision for overrunning errors, the computer could add down, and both sets of numbers (total work) 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 guarantee (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 history.

Sally Seale
Public Accountant
710 East Washington Street
Marine Del Rey, CA 90291

Summing It Up

Dear Editor:

I am not the first to need to write columns in publications but in reference to Susan J. Wilkins' "A Short Episode" in the October Compendium, Page 12, I have been misled.

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

The image of the programmer tucked up in the back room with his chocolate bars and root beer is not helped much by Mr. 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 a programmer but once in a while I do advise 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 Mr. Wilkins and Creative Computing were looking for Halloween stories since her story appeared in your October issue.

R. W. Witsell
418 Laramie, S.E., Suite 3
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 into her").

Mr. Yob seems to have missed the overall point of the system (which is to produce high quality music as 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 & timbre. 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).

Mark Gans & Fred Conitz

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., 1976, 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, $(5-10)/2 = 2.5$. You use 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 Magnascrip 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 10000 as the precision constant.

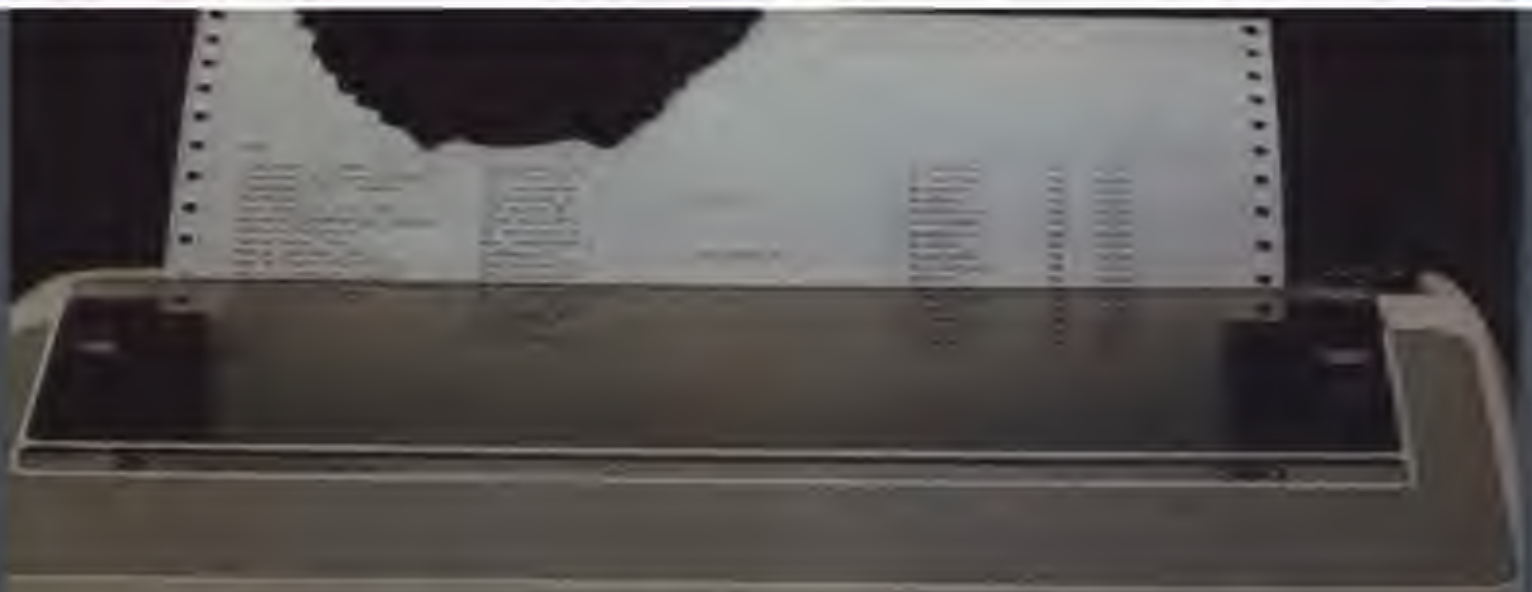
Andrew L. Horner
Research Associate
University of Missouri - Columbia
Department of Psychology
210 McAlester Hall
Columbia, MO 65211

Curtain Call

Dear Editor:

I especially enjoyed your feature on Astor Languages in the October issue. Semblance 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 miss anything out?

Steve Nank
35A Orchard St.
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CIRCLE 297 ON READER SERVICE CARD

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ALF/Apple Music Synthesizer

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

Good 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 controlling the envelope (or shape) of each voice, many different instrumental sounds can be simulated.

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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 accuracy 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 tempo (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 hi-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.



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

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.

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

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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).

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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 rout 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 terrain — open, forest, and rough — each of which has different movement costs and shelter values.

In this finely-balanced software Vergasta, every move is played under real time conditions. Victory goes to the last.

the same time, caution cannot be cast aside; severe unit losses will only result in a Pyrrhic 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 towns and units, providing every game with a new, challenging twist.

Computer Conflict for \$39.95, arrives with the game program minidisc 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. Spare your eyes a bit, let loose your mind, and you'll swear your keyboard has melted into the throttle, rudder, elevator, 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 A6M 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 hostile-hardened veteran.

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CIRCLE 201 ON READER SERVICE CARD

Music Editors for Small Computers

Rebecca T. Mercuri

An abundance of music editors for small computers have recently appeared on the market. At RCA's David Sarnoff Research Center, where I am 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 file 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-Line Editors

The VIP's system could be called a machine-language editor since it requires

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the user to directly input hexadecimal codes for each of the notes, each hex word specifying both the pitch and duration of one note. Minicraft 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, A2H 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 Minicraft 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.

Display With ASCII Input

The MMI and Atari systems use ASCII input information similar to the Minicraft 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 view being selected by the user.



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



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



The Superscore display utilizes coded information to keep track of measure, voice, rhythm, volume, and note numbers. The 1 above the staff indicates an oversized measure. The note currently being edited is primed below the staff.



The ALF system incorporates a menu and set-up screen just as desktop. Notes that both key signatures and meters may be changed and displayed during the piece. User has the option to hear notes as played or moved by notes are defined two 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 Vulture Music Monitor provided with the KL-4M DAC board permits four-part harmonic input for FET/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 FET, 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 best editors such as subroutine calls and overstatements. Measures, 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-) octave range, and a 28 db dynamic range (instead of 78 db for the 3-voice board).

The Mountain Hardware system utilizes 80 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 staff notation utilizing the treble, bass, tenor and alto clefs. A wide range of dynamic and tempo marks 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 following chart is a 32-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 "N" 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	VIP Super Sound	Musicraft	Orchestra-66	MMI	ATARI
Features						
For Further Information	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101	2124 Corporate Services, Inc. P.O. Box 1000, Suite 100 11101
Music Hardware Included	2 or 4 instruments. Frequency Converter, Music Storage and Output.	1 or 2	Sound Chip and 4 or 8 instruments. Includes 1 or 2 or 4 or 8.	Sound Chip and 4 or 8 instruments. Includes 1 or 2 or 4 or 8.	Sound Chip and 4 or 8 instruments. Includes 1 or 2 or 4 or 8.	Sound Chip and 4 or 8 instruments. Includes 1 or 2 or 4 or 8.
Cost	2 or 4 instruments: \$100 4 instruments: \$150 4 instruments: \$150	\$150	\$150	\$150	\$150	\$150
Other Equipment Required	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines	Monitor, 640 x 480, 1000 lines, 1 monitor, 1000 lines
Number of Voices	2 or 4	2 or 4	2 or 4	2 or 4	2 or 4	2 or 4
Expandability	Changing or adding voices is possible.	Changing or adding voices is possible.	Changing or adding voices is possible.	Changing or adding voices is possible.	Changing or adding voices is possible.	Changing or adding voices is possible.
Required Minimum Memory Size	2K	2K	2K	2K	2K	2K
File Storage	Sequential	Sequential	Sequential	Sequential	Sequential	Sequential
File Protection	Yes	Yes	Yes	Yes	Yes	Yes
Display Characteristics	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Editing Mode	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Error Correction	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Editing Program Structure	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Music File Structure	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Playback Mode	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Note duration types	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.
Data	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.	Sequential display. For Memory Address and data files.

[illegible]

Music Editor	VIP Super Sound	Muscraft	Orchestra-80	MMI	ATARI
Features					
Rests	None as rests are never coded	None as rests are never coded	None as rests are never coded	None as rests are never coded	None as rests are never coded
Ties	Between measures by underlining first measure	None as it is not written again & it sounds the specific note. Attack and sustain again	Yes	None	Multiple ties can be written that may be written but is not permitted
Repeats	Repeating can be played continuously	Looping used for repeats, for individual measurements are possible	A part can be entered as a group of measures and can be repeated, included in the program	None	A single measure permits you a lot of repeat any of the time phrases. Looping used to repeat phrase groups
Key Signature	None	C, F, G, A, B, D, E	B	None	C, F, G, A, B, D, E, F#
Accidentals	A lot of only accidentals and particular notes	Sharp, flat, double sharp, double flat, natural, and all notes in key	Sharp, flat, double sharp, double flat, natural, and all notes in key	Sharp, flat, double sharp, double flat, natural, and all notes in key	Sharp, flat, double sharp, double flat, natural, and all notes in key
Meter	1/2, 3/4, 4/4	None	None	2/4, 3/4, 4/4	2/4, 3/4, 4/4, 5/4, 6/4, 7/4, 8/4, 9/4, 10/4, 11/4, 12/4, 13/4, 14/4, 15/4, 16/4, 17/4, 18/4, 19/4, 20/4, 21/4, 22/4, 23/4, 24/4, 25/4, 26/4, 27/4, 28/4, 29/4, 30/4, 31/4, 32/4, 33/4, 34/4, 35/4, 36/4, 37/4, 38/4, 39/4, 40/4, 41/4, 42/4, 43/4, 44/4, 45/4, 46/4, 47/4, 48/4, 49/4, 50/4, 51/4, 52/4, 53/4, 54/4, 55/4, 56/4, 57/4, 58/4, 59/4, 60/4, 61/4, 62/4, 63/4, 64/4, 65/4, 66/4, 67/4, 68/4, 69/4, 70/4, 71/4, 72/4, 73/4, 74/4, 75/4, 76/4, 77/4, 78/4, 79/4, 80/4, 81/4, 82/4, 83/4, 84/4, 85/4, 86/4, 87/4, 88/4, 89/4, 90/4, 91/4, 92/4, 93/4, 94/4, 95/4, 96/4, 97/4, 98/4, 99/4, 100/4, 101/4, 102/4, 103/4, 104/4, 105/4, 106/4, 107/4, 108/4, 109/4, 110/4, 111/4, 112/4, 113/4, 114/4, 115/4, 116/4, 117/4, 118/4, 119/4, 120/4, 121/4, 122/4, 123/4, 124/4, 125/4, 126/4, 127/4, 128/4, 129/4, 130/4, 131/4, 132/4, 133/4, 134/4, 135/4, 136/4, 137/4, 138/4, 139/4, 140/4, 141/4, 142/4, 143/4, 144/4, 145/4, 146/4, 147/4, 148/4, 149/4, 150/4, 151/4, 152/4, 153/4, 154/4, 155/4, 156/4, 157/4, 158/4, 159/4, 160/4, 161/4, 162/4, 163/4, 164/4, 165/4, 166/4, 167/4, 168/4, 169/4, 170/4, 171/4, 172/4, 173/4, 174/4, 175/4, 176/4, 177/4, 178/4, 179/4, 180/4, 181/4, 182/4, 183/4, 184/4, 185/4, 186/4, 187/4, 188/4, 189/4, 190/4, 191/4, 192/4, 193/4, 194/4, 195/4, 196/4, 197/4, 198/4, 199/4, 200/4, 201/4, 202/4, 203/4, 204/4, 205/4, 206/4, 207/4, 208/4, 209/4, 210/4, 211/4, 212/4, 213/4, 214/4, 215/4, 216/4, 217/4, 218/4, 219/4, 220/4, 221/4, 222/4, 223/4, 224/4, 225/4, 226/4, 227/4, 228/4, 229/4, 230/4, 231/4, 232/4, 233/4, 234/4, 235/4, 236/4, 237/4, 238/4, 239/4, 240/4, 241/4, 242/4, 243/4, 244/4, 245/4, 246/4, 247/4, 248/4, 249/4, 250/4, 251/4, 252/4, 253/4, 254/4, 255/4, 256/4, 257/4, 258/4, 259/4, 260/4, 261/4, 262/4, 263/4, 264/4, 265/4, 266/4, 267/4, 268/4, 269/4, 270/4, 271/4, 272/4, 273/4, 274/4, 275/4, 276/4, 277/4, 278/4, 279/4, 280/4, 281/4, 282/4, 283/4, 284/4, 285/4, 286/4, 287/4, 288/4, 289/4, 290/4, 291/4, 292/4, 293/4, 294/4, 295/4, 296/4, 297/4, 298/4, 299/4, 300/4, 301/4, 302/4, 303/4, 304/4, 305/4, 306/4, 307/4, 308/4, 309/4, 310/4, 311/4, 312/4, 313/4, 314/4, 315/4, 316/4, 317/4, 318/4, 319/4, 320/4, 321/4, 322/4, 323/4, 324/4, 325/4, 326/4, 327/4, 328/4, 329/4, 330/4, 331/4, 332/4, 333/4, 334/4, 335/4, 336/4, 337/4, 338/4, 339/4, 340/4, 341/4, 342/4, 343/4, 344/4, 345/4, 346/4, 347/4, 348/4, 349/4, 350/4, 351/4, 352/4, 353/4, 354/4, 355/4, 356/4, 357/4, 358/4, 359/4, 360/4, 361/4, 362/4, 363/4, 364/4, 365/4, 366/4, 367/4, 368/4, 369/4, 370/4, 371/4, 372/4, 373/4, 374/4, 375/4, 376/4, 377/4, 378/4, 379/4, 380/4, 381/4, 382/4, 383/4, 384/4, 385/4, 386/4, 387/4, 388/4, 389/4, 390/4, 391/4, 392/4, 393/4, 394/4, 395/4, 396/4, 397/4, 398/4, 399/4, 400/4, 401/4, 402/4, 403/4, 404/4, 405/4, 406/4, 407/4, 408/4, 409/4, 410/4, 411/4, 412/4, 413/4, 414/4, 415/4, 416/4, 417/4, 418/4, 419/4, 420/4, 421/4, 422/4, 423/4, 424/4, 425/4, 426/4, 427/4, 428/4, 429/4, 430/4, 431/4, 432/4, 433/4, 434/4, 435/4, 436/4, 437/4, 438/4, 439/4, 440/4, 441/4, 442/4, 443/4, 444/4, 445/4, 446/4, 447/4, 448/4, 449/4, 450/4, 451/4, 452/4, 453/4, 454/4, 455/4, 456/4, 457/4, 458/4, 459/4, 460/4, 461/4, 462/4, 463/4, 464/4, 465/4, 466/4, 467/4, 468/4, 469/4, 470/4, 471/4, 472/4, 473/4, 474/4, 475/4, 476/4, 477/4, 478/4, 479/4, 480/4, 481/4, 482/4, 483/4, 484/4, 485/4, 486/4, 487/4, 488/4, 489/4, 490/4, 491/4, 492/4, 493/4, 494/4, 495/4, 496/4, 497/4, 498/4, 499/4, 500/4, 501/4, 502/4, 503/4, 504/4, 505/4, 506/4, 507/4, 508/4, 509/4, 510/4, 511/4, 512/4, 513/4, 514/4,

[illegible]

Music Editor	VIP Super-Sound	MusicaSoft	Orchestra-50	MMS	ATARI
Features					
Pricing	Not applicable	MusicSoft version costs \$100	\$100 (one-time fee)	One-time purchase: \$100; \$100 for 1000 songs	MusicSoft: \$100; Atari: \$100 for 1000 songs
Size Limit of File	250,000 bytes (100,000 bytes for each song)	10,000,000 bytes (10,000,000 bytes for each song)	10,000,000 bytes (10,000,000 bytes for each song)	10,000,000 bytes (10,000,000 bytes for each song)	10,000,000 bytes (10,000,000 bytes for each song)
Special Features	Features a unique musical notation system (MMS) that allows you to create musical notation for each song.	Features a unique musical notation system (MMS) that allows you to create musical notation for each song.	Features a unique musical notation system (MMS) that allows you to create musical notation for each song.	Features a unique musical notation system (MMS) that allows you to create musical notation for each song.	Features a unique musical notation system (MMS) that allows you to create musical notation for each song.

[illegible]

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GALAXY SPACE WAR I

[illegible]

2003). A player's network shape and a player's behavior are jointly shaped and may well have consequences for each other's. That is, any social network visualization of the experiment must include player location, the starting point and utility of a player's behavior, and a player's previous decisions of joining the club and voting to elect the president to give their network the basic structure of interest for future study.

[illegible][illegible]

in a series of 10 studies and designed with a single group. A post-attack control group, composed of 100 subjects, was also included. The first group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The second group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The third group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The fourth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The fifth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The sixth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The seventh group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The eighth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The ninth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication. The tenth group of 100 subjects was given a 10-min lecture on the importance of the use of the telephone as a means of communication.

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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 primer 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 39 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.

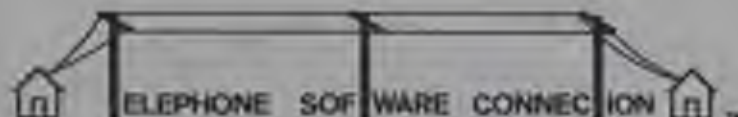
- 1.) Normal Characters
- 2.) Elongated Characters
- 3.) Condensed Characters
- 4.) Elongated—Condensed

Roger and Bonnie Koester, P.O. #1, Box 101A,
Trenton, IN 47377

FIGURE 1: 8-1

PRINTS SMALL, VERTICAL, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340, 342, 344, 346, 348, 350, 352, 354, 356, 358, 360, 362, 364, 366, 368, 370, 372, 374, 376, 378, 380, 382, 384, 386, 388, 390, 392, 394, 396, 398, 400, 402, 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 426, 428, 430, 432, 434, 436, 438, 440, 442, 444, 446, 448, 450, 452, 454, 456, 458, 460, 462, 464, 466, 468, 470, 472, 474, 476, 478, 480, 482, 484, 486, 488, 490, 492, 494, 496, 498, 500, 502, 504, 506, 508, 510, 512, 514, 516, 518, 520, 522, 524, 526, 528, 530, 532, 534, 536, 538, 540, 542, 544, 546, 548, 550, 552, 554, 556, 558, 560, 562, 564, 566, 568, 570, 572, 574, 576, 578, 580, 582, 584, 586, 588, 590, 592, 594, 596, 598, 600, 602, 604, 606, 608, 610, 612, 614, 616, 618, 620, 622, 624, 626, 628, 630, 632, 634, 636, 638, 640, 642, 644, 646, 648, 650, 652, 654, 656, 658, 660, 662, 664, 666, 668, 670, 672, 674, 676, 678, 680, 682, 684, 686, 688, 690, 692, 694, 696, 698, 700, 702, 704, 706, 708, 710, 712, 714, 716, 718, 720, 722, 724, 726, 728, 730, 732, 734, 736, 738, 740, 742, 744, 746, 748, 750, 752, 754, 756, 758, 760, 762, 764, 766, 768, 770, 772, 774, 776, 778, 780, 782, 784, 786, 788, 790, 792, 794, 796, 798, 800, 802, 804, 806, 808, 810, 812, 814, 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 118 231-2884
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 119 763-2333
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 117 378-1400
 117 755-8810
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 103 451-3331
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 111 224-3588
 111 211-1922
 111 828-7691
 111 518-8861
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 114 824-1710
 114 841-5711
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 116 454-3430
 116 887-0600
 117 276-7202
 101 766-2684
 101 629-8966
 101 233-3488
 101 256-1100
 101 585-5421
 104 358-1961
 104 625-8291
 101 659-4660
 113 224-9920
 113 823-3223
 114 453-7561
 114 515-7566
 116 474-1600
 117 376-7397
 101 723-2563
 104 232-8637
 104 756-0790
 112 236-2600
 113 732-6816
 114 474-5600
 114 682-8733
 111 966-9670
 116 647-7921
 118 376-1000
 118 386-2211
 119 475-0231
 119 549-8511
 119 761-1957

FIGURE #3

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

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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ALL TIME
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Sample lineup

SUPER STAR BASEBALL
Sample lineup

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CIRCLE 218 ON READER SERVICE CARD



Base 2 Makes its Mark

Wayne F. Cummings

The Base 2 Model 800 (earning the printers prize) is an extremely competitive font-setting or 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 3 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 144 characters/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 (approx. 1/2 char.) 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.

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, 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, 144 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

Extras

Physically, the printer is compact: only 3" x 11" x 15" and it weighs only fifteen lbs. It has a heavy gauge aluminum chassis 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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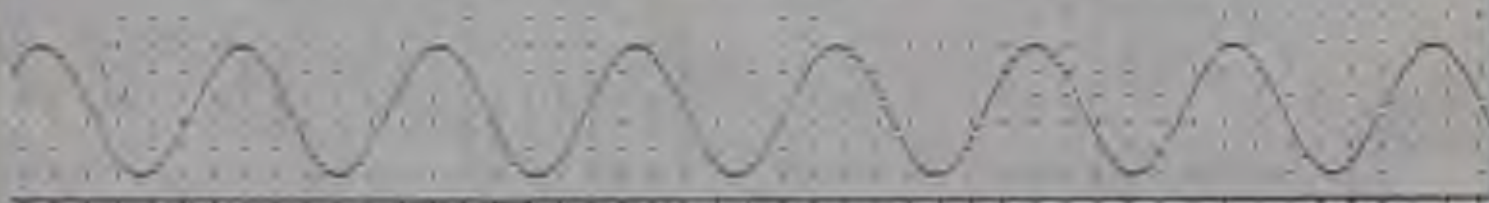
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like a last minute addition when compared to the rest of the printer. Let us prove...

References

It does make noise. When printing, the print head makes a high pitched racket, almost tizzy 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 print-head.

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 glossary.

Appendix

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 57 days and several long distance phone calls, the printer arrived...without any opening 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, by no way was the Model 800 an exceptional printer. It has a few drawbacks, but for the price (\$499)* 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 than a 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 wait's on its way back to the factory. I'll keep you posted. □

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Three Sorcerer Games

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

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.

Both of these games are addictive in nature and not easily mastered. Either



Photo 2. *Head-on Collision*.

one will be over in a few seconds if you lack good hand-eye coordination. 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.

Starbase Hypertion (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 reclaim 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

Bob Stuckmeyer

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 Hypertion 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



Photo 1. *Martian Invaders*.

allowed and the gamer is not protected by barriers.

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



Photo 3. *Starbase Hypertion*.

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.

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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SOFTWARE FOR THE SORCERER*



FASTGAMMON



HEAD-ON COLLISION



ARROWS AND ALLEYS

UTILITY PROGRAMS

FORTH by Jim Jones. Now Sorcerer owners can enjoy the convenience and speed of the lightweight FORTH programming language. Based on the FORTH and adapted for the Sorcerer by James Johnson, this version uses simulated disk memory in RAM and does not require a disk drive. Added to standard FORTH are an on-screen editor, a serial RS-232 driver, and tape save and load capability. Light input/output has been added allowing use of the Sorcerer's graphics key. Documentation includes examples. Requires 32K or more of RAM. **\$49.95**

BEDIT by Ernest Bergman. A BASIC editor. This short and easy to use program is a machine language routine that loads into memory and allows you to edit your BASIC program by modifying text on the video screen. No more retyping a long line just to change one character. A few cursor movements make the necessary modification. Even renumbering lines is easy to do. This program is a real time-saver. **\$12.95**

GRAPHICS ANIMATION by Lee Anders. This package provides the BASIC programmer with a powerful set of commands for graphics and animation. The program is written in machine language but is loaded together with your BASIC program and graphics definitions with a GLOAD command. Any image from a character to a large graphic shape may be defined, moved, or erased with simple BASIC commands. Examples of simple character sets with background characters are included and background images are presented. Contains a machine language plotting routine. A keyboard routine detects key presses without carriage returns. Includes a separate program for connecting images. Runs on any line Sorcerer. **\$29.95**

QSMART TERMINAL by Bob Florio. Convert your Sorcerer to a smart terminal. Used with a modem, this program provides the capability for you to communicate efficiently and save connect time with larger computers and other microcomputers. The program transfers incoming data from line sharing systems such as the Source for the Sorcerer; incoming data can be stored (buffered) only in RAM. Files, including programs, may be saved to or loaded from cassette, listed as the video transmitted out through your modem, or printed with on-board text editor. Includes with BASIC and the Word Processor Pac. **\$49.95**

QST (Development Pac Extension) by Jim Jones. Serious QST program developers will find this utility program to be invaluable. Move the line pointer upward. Locate a word or symbol. Change a character string whenever it occurs. Simple commands allow you to jump directly from QST to MOSCOW or QST80 modes and automatically set on the fly the way you want for listing. Edit or reset power. Stop and restart listings. Interact with the QST key. Save backup files on tape at 1500 baud. Load and merge files from tape by file name. Supports for EN, UN, ZN, and AN Sorcerer all on one cassette. Requires the Sorcerer's Development Pac. **\$29.95**

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CLASHING HYPERNO™ by Don Green. At last, a fast strategic maze game for the Sorcerer! Defend a lost life Blue Fortress against invasion forces of an alien empire. You create, design, and command entire ship squadrons as well as ground defenses in the complex tactical situations of war in the far future. Written in BASIC and J-BASIC. Full graphics and realistic vector video display. Includes full instructions and STARCOR battle manual. Requires at least 16K of RAM. **\$17.95**

HEAD-ON COLLISION™ by Lee Anders. You are driving clockwise and a computer-controlled car is driving counter clockwise. The computer's car is trying to hit you head on, but you can avoid a collision by changing lanes and changing your speed. At the same time you try to drive your car and obstacles to avoid them. Three levels of play, machine language programming, and excellent graphics make this game challenging and exciting for all. At least 16K of RAM is required. **\$14.95**

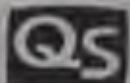
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FASTGAMMON™ by Bob Christensen. Backgammon games. Use this machine language program that provides a fast, skillful opponent. Option to display a game with the game line only. Eight page instruction manual includes rules of backgammon. **\$19.95**

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WREX 8™ by Charles Fitch and Bob Weather. You may never get your nemesis back from your kids once they start playing Wrex 8. The object is to destroy enemy numbers by using Mike's power of three. If you miss the numbers, they launch your missiles and return for a second pass. Nine levels of play make this game a challenge for everyone without machine language. **\$11.95**



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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, 411 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 6A. 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.



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Interactive Literature

Ted Nelson

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

Unlike standard Adventure games cluttered with keypunches and mnemonics about the commands that make them work, *Interactive Fiction* is an adventure in a literary setting—a surreal story in which you are a character. Your choices for action create words in reading what to say when asked. In these interactive stories, are generally situations well writing. They are also excellent for parties, and for computer beginners and literati who do not find conventional Adventure games attractive. (And speaking as a self-victim, there were the ones but I've had with computers in a long time.)

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

Each story begins with a tough introduction—usually, perhaps, has you get your words 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 wonder if you are a fictional character!

Then the story begins—usually through a prompt, a combination of nouns, verbs, and objects—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 storytelling, you're quite likely to reply in full sentences, building your reader as a character.

The dialogue fiction is meant to be

Essentially Interactive Fiction is a Dialogue Adventure.

initiated; it sometimes uses words that it's a nice prompt. (And the scrolling disk, the best part of the computer's response, creates a nice conversational aspect.)

And what you see has consequences. You live or die, find the treasure or not, achieve fame or disgrace. And all in the framework of delightful story telling and purple prose.

"As you raise the head dragon of

castle in Hecley's head, golden in the light from the story window."

Lafore has thought through his format beautifully. He careful working of the system, he gives you more choices of action, but not so many as to make the story unmanageable. (The responses that look ready to please on your attention are often choices.) Sometimes he will surprise you by speaking for you, usually to let you off the hook, as in "Two Heads of the Coin," where you can ask your Dr. Watson to take over if your own resources don't work.

For a minimalist attempt, Lafore unfortunately slips in a surprising number of unapologies—I noted "government," "truth," "humanity," "imaginary," and the screeching "machines." 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 vocabulary, fictional action and structure, not content to be merely a mere teller of conventional tales, we can be glad he has found such an entire new system of interactive writing.

Never mind the words and snags of computers. I'd rather start 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. *Sir 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 woman 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 Majesty's Ship Imperious*, 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 depend-

ing on decisions made earlier. As the captain of the *Imperious*, 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 listed 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 category. 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 indisputably 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 rarely 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.

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

210 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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Intelligent, continued...

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 rules 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 three 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 I in ROM, Vol. 1 #9, p. 86; Part 2 in *Creative Computing*, Vol. 6 #1, p. 56; 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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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 Sussman-Atkins program CHESS II (with the ever-changing version number) astonished 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 harbor 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 overgrown 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 pitying 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 Herbert 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

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.

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.

In a typical chess position, there are usually about three moves worth serious consideration. In combinatorial 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 in the light 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 domains.

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, on 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

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

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.

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, 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 de-

inition or being 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 characteristics. (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 problem 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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I Compute—Therefore I Am

Jim Connor

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

While "thinking" is important for Descartes as the one thing he cannot doubt, the idea of reason and thought is a part of the definition of a human was current by Aristotle two thousand years earlier. And when Aquinas, in the 13th century, based Christian theology on this Greek outlook, the primacy 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 heaven and earth under the law of universal gravitation led many to a mechanical 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 restless 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 scientists-technicians-theoricians 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 grime all fit? How would

such 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 "craps of faith", or better considered as non-logical reasoning?

Other questions about values and priorities, limitations and assumptions need to be asked:

Do we today have an intrinsicness 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 symptomatic, 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 questions 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 pieces about what has been done, and some ideas about what has not, and some definite sayings about the future.

The problems, in order of success:
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 computers



programs do arithmetic calculations correctly at fantastic speeds, but algebra, plane geometry, and calculus. By 1963 Stagle'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. 96) 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 currently 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

Typically 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 (but often heretofore, more practical and therefore more "human" problems). The first easily computerized one, DENDRAL, was developed by Feigenbaum (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 Tating'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 inferred from the vast number of details presented by the mass spectrograph? Thus the DENDRAL problem was like that of the chickens 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 powers 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, blood pressure), Mac puff (lungs, respiration), Mac dogs (drug effects), and Mac yes (history, body fluids), etc. (Ahmed & Sweeney, 1983, 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, simply being, or intuition 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 (Sokolovs, Parker, 1978, pp. 115-144). They speak of a human medical expert using both categorical (deterministic) and probabilistic (evidential) reasoning in diagnosis. Other concepts mentioned as suitable substitutes for probabilistic 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 (then 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 probabilistic and its many comparisons — in the way to recommending therapy. Where one reason will be too strict, others will be too broad, allowing the diagnosis to go in 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 such field as it challenges it to examine its limits, 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 square move to find a certain configuration); it only required 1/3 of 181 moves; about ten trillion. Checkers was harder, with some 10¹⁶ possibilities, but Nemeth had a championship program by 1962. Chess was much, much harder with 10¹⁹ possible moves. And while Simon had produced 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 SHERLOCK, 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 in language in limited ways. They seemed to find the public by clever simulations, reactions to key words, phrases or syntactic structures. Clues from the context were very unexploited if present at all. On the other hand, SHERLOCK used a hierarchical 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 deflection 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 in 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.

Limit 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, may be acknowledged even by Karl when, in the midst of finding the rules for gamma decay, Karl 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 is no inevitable that it "is a skill so deeply hidden in the human mind that we shall hardly guess the secret trick that Nature here employs." We, then, employ some secret trick every time we generalize and speak of objects from a class of individual things as a dog or a tree, etc. Polanyi believes that Kant and his successors spent a very little time on such a powerful aspect of the mind because they were too busy afraid of it as not seeing an irrational,不可思议的 aspect to be considering the pure reason.

In examining 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, I look back into the records and find that at least two other astronomers had recorded the movement of this "star" but disregarded the evidence. Yet this is reasonable when we realize the tremendous mass of data of astronomical 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, rate, direction of this thought that allows a scientist to escape from the existing framework that began the study and choose a new interpretation that could lead to a new paradigm (Kuhn, 1962).

Insight 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 sensitivity to hidden patterns and developed to effectiveness by a process of learning. Scientific intuition is one of the higher skills. The artist, poet, or peering, 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, 1966-219).

In disagreeing with the usual description of scientific method as setting up a hypothesis and then testing, Polanyi opt for appreciating a deep and proving problem as more important yet more vague than formulating the hypothesis. And it is at the problem finding level that he was intuition as more 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 logicians had 1911 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 formulas which cannot be proved in the system, but which, from outside the system, can be shown to be true. John Lucas (1963, p.235) 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 is 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 with 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 (in principle) 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 grin. 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 over

anybody 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 status 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 in his paper he states that even since someone's day the mechanical deterministic model has obsessed philosophers, interested 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 mechanistic model 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 mechanistic 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 inquiry; but no scientific inquiry 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. Prodiges 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 as the present AI will achieve more and more reasons for its existence, seen as "I compute."

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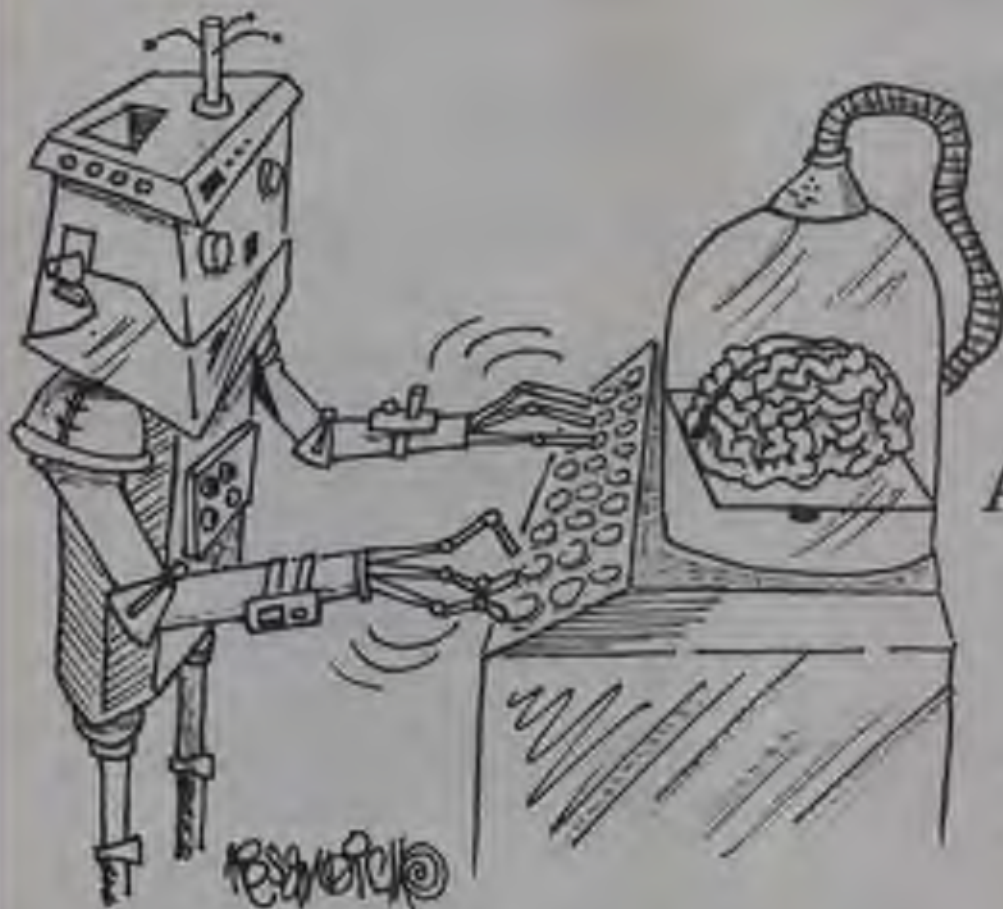
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Are Computers Alive?

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 ani-

mals - 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 inanimate.

There are difficulties in this approach. If the semantic decision is taken, on a pragmatic basis, 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 legged robot as it progressed 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 an angry robot is not meaningless or self-contradictory. It should not be presumed that artefacts could never, by definition, experience emotion: is 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 leaving 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 *NEC (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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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 organic. 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. Maifon 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 1976) that 'it may be possible for a computer to have subjective experience'.

A recent 1980 headline, 'A Spock 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 rationalisation 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 in-

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

ternal 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 it 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.

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 highly 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 creature 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.

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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 Arnold in the May 1979 issue of the *IEEE Spectrum* magazine. A review article on 'cryocomputers' by Jan Mattern 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.

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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 *Erushim*, 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 modest struggle'), 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 creature is not chemical and mechanical in its operations? Whether those things which we deem most purely spiritual are anything but disturbances of equilibrium in an already system of forces, beginning with those that are too small for microscopic detection, and going up to the human soul 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?' (see *ibid*)

(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 - the anticipated 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 emerging life-form (see *Erushim*, 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 liv-

ing 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, and 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 fertil-

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

isation, 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').

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 fertilisation 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 (deoxy-ribonucleic acid) present in the cell nuclei of plants and animals. The genetic material is in part a blueprint, a definitive speci-

cation for the species (while allowing, according to the richness of the gene pool, for individual variations). 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 then 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 computer activity, chemical alteration or 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. That 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 prolific 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 parts (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 tickled 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 characterize 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 this. 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 chemistry.

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 (or to reproduce)—then artificial systems, where appropriately designed, may be said to be alive, albeit at a very low level. If, alternatively, we look to the way in which animals and plants realise their purpose (or, 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 (i.e. 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 interaction 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. □



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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 1981 issue of the *AISS* quarterly. Among the many studies, we noted the following titles:

"Teaching strategies in an advice taker/inspector system," N. Frazier, et al. SUNY at Buffalo, Department of Computer Science, 4220 Ridge Lea Road, Amherst, NY 14226.

"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-400, 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.

"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 P. Platt, Report No. 115, 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 transformation: 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 mathe-

matics," Tatiana R. Michener, AIM-468, 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 Burdicker, AIM-523, May 1979, \$1.50, MIT AI Lab, etc. □



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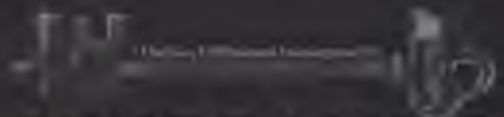
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Bach

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. Mercari in this issue.

The purpose of this article is to describe BACH (Basic Aids for Composing Harmonies), a hardware/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

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 "played" on the TV screen with light pen, compiled and played through the music hardware.

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

available that have sufficient documentation to allow a user to interface custom software. Also used is a Symbolic 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 programs.

Michael Keith, RCA David Sarnoff Research Center, Route 1, Princeton, NJ 08542.



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. Alphabetic entry schemes, such as "TWOQ" 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 the 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 shows 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 very 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 higher 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 mordent (♯), trill (tr), and dynamic markings (mp, f, etc.). The compiler inserts

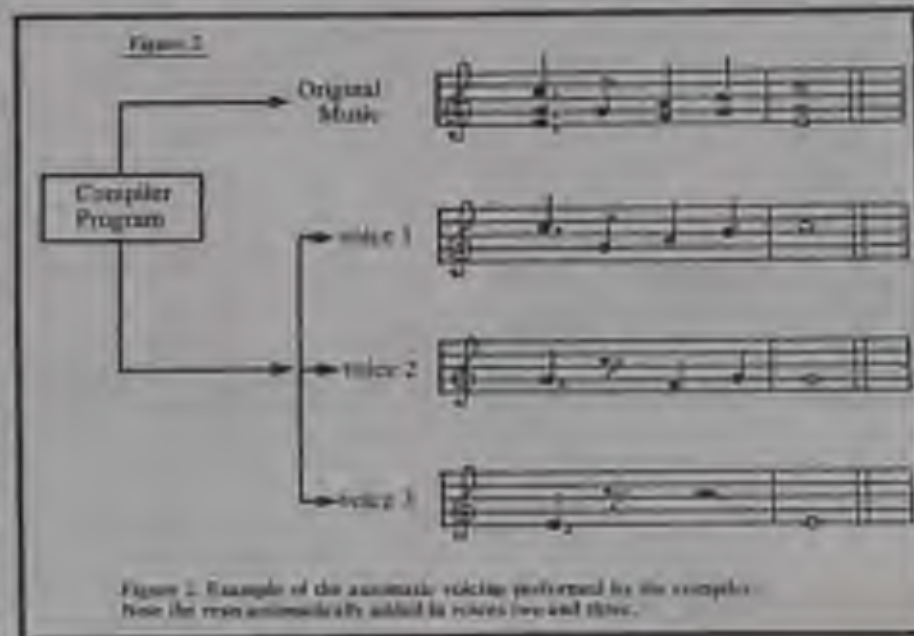


Figure 2. Example of the automatic voicing performed by the compiler. Note the rests automatically added in voices two and three.

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).

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



Photo 4. Sample vocal-piano score display format.



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

Conclusion

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. □

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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 I think 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 cool 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, modern 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 \$40 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 Labar 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 methods), the program and several sample runs.



You probably didn't do everything right the first time through. Why not? Describe these experiences and bad habits 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 Kodachrome 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 Polaroid 3 1/2 X 5 is fine. But they must be glossy. Matte is not acceptable.

Illustrations should be done in black on white paper. Use India ink or a Pilot Rapid Point or equivalent. We prefer to see 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 can cannot be read easily.

Payments

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	99.4
2 New products (Catalogs)	91.1
3 Software evaluations	86.5
4 Equipment evaluations	86.1
5 Personal and home applications	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	67.3
12 Tutorials	63.4
13 Business applications	63.3
14 Book reviews	58.8
15 TRS-80 Strings column	55.9
16 Effective Writing column	54.0
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



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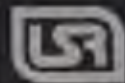
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Computers and Descriptive Linguistics

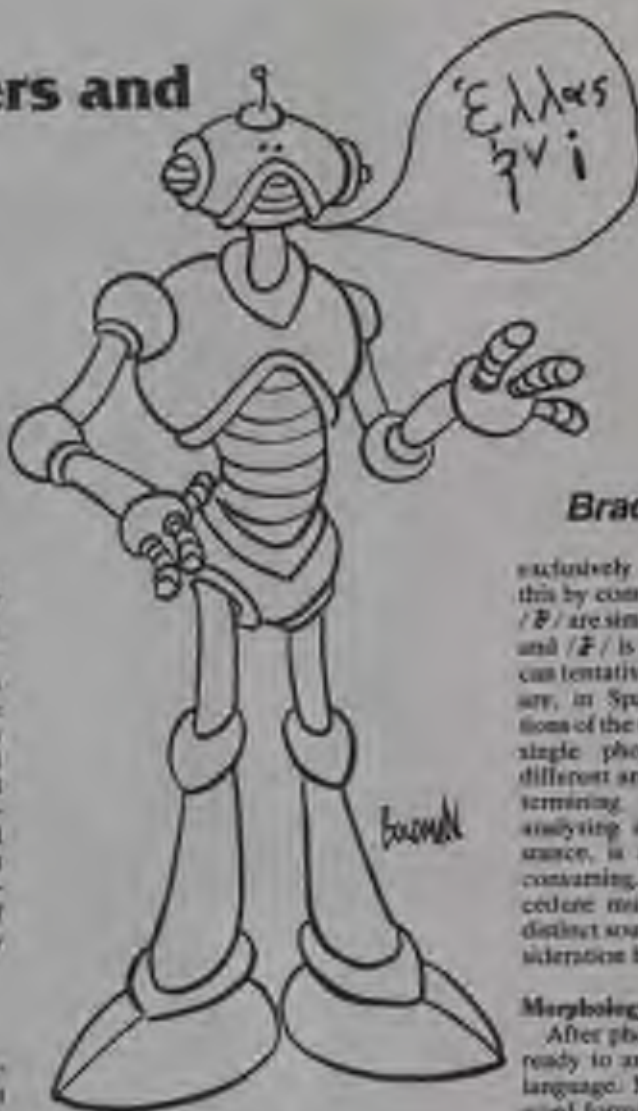
Descriptive linguistics is the field which deals with the analysis and description of languages as systems within themselves. The linguist collects linguistic data—words and sentences—and then analyzes these data in order to describe the phonology, morphology and syntax of a language. This is a time-consuming and tedious task, particularly 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 "tell," it could be pronounced either /tɛll/ or /pɛll/, and the speakers of the language would hear no difference or, at least, not consider the difference significant.

Bradley Pritchett, 865 Mass. Ave., Apt. 26, Cambridge, MA 02135



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 /θ/ are similar (/d/ is a voiced dental stop and /θ/ is a voiced dental fricative), we can tentatively conclude that /d/ and /θ/ 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 tedious 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 (scramed), /t/ in some other cases (walked), and /ɪd/ in other cases (thunted). When we notice this inconsistency, we can have the computer generate lists of past tense verbs ending in /t/, /d/ and /ɪd/.

Returning to our earlier problem with English verbs, we conclude that /t/ appears after unvoiced sounds (sounds not accompanied by vocal cord vibrations), /d/ after voiced sounds (sounds with vocal cord vibration), as /ɪd/ after /t/ or /d/. Thus, we have determined how to form the past tense of most English verbs and determined that they are formed regularly 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 "V" for verbs, a "N" for nouns, an "A" for adjective, and a "P" 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 "probe", "0001" indicates that the person and number are indeterminate 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 comparisons. 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 to 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 two). □

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A Problem Solving Technique Based on Genetics

Arthur Radcliffe

"Anytime intelligence," that even further past, may be a mile to the moon, its many pathways of research have brought new insights to the study of psychology, sociology, and even, as described here, genetics.

Evolution is a process of multidimensional search, such multidimensional search is exploring whether possible to generate, simultaneously. New method of multidimensional search 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 feature of life, perhaps, but the most efficient scheme of search and exploration. — ER

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 middle of each cell of all the diverse organisms 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" is 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 forgotten, sex facilitates the mingling and passing on of minor variations of a male theme—offspring end up with half the funds of each parent.

Now we come to the vital process of selection; whether natural or artificial, 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. Then, 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

as 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 pre cognition if it is available. Once we have a population of strings, it is time for selection. It 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 iteratively, empirically: "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 010 and the target is plotted in line 990.

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

Arthur Radcliffe, 1521 Hallock Crescent, Ann Arbor, MI 48102.

*The Sinclair ZX80 is innovative and powerful.
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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 Microbee). 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\$(0) and CHR\$(255) 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 TAB function which wipes 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 kinks 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 languages. 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 permeate because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as Insertion 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 this 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. Acry Dupey 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 Hurtle, another game in the charter issue, you have to find a happy little Hurtle who is hiding on a 10 X 10 grid, in response to your guesses, the Hurtle sends out 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 *Arithmetic* around 100 A.D. You'll find a computer version of this puzzle in SYNC.

Hard-Hitting, Objective Evaluations

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Problem Solving continued...

array created in line 910. Old points are deleted from the screen in line 230 and new points are added in line 260.

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 680.

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 860 and 870.

At this point we have:

- 1.) estimated 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 splicing to create offspring replacing the bottom four.

That is all there is to it:

- A) establish a mating process
- B) create an initial population of strings
- C) record the mating 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, tinkering 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.

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1 PRINT : PRINT : PRINT : PRINT "PROBLEM SOLVING USING GENETIC A
CAPTATION"
20 A = 0 : B = 0 : C = 0 : D = 0 : E = 0 : F = 0 : G = 0 : H = 0
30 DIM A(100), B(100), C(100), D(100), E(100), F(100), G(100), H(100)
40 DIM X(100), Y(100), Z(100), R(100)
50 PRINT "CONTACT ARE RADDLETT"
60 PRINT "1000 HATTON CRESCENT"
70 PRINT "WIMBORNE, WILT 41001"
80 PRINT "01223-248-3800"
90 PRINT "SEE MONARCH STANDING LINE 1000"
100 GOTO 990
110 FOR N = 1 TO 1000
120 PRINT "GENERATION "N
130 FOR B = 0 TO 1000 : B = B + 1 : NEXT B
140 FOR A = 0 TO 1000 : A = A + 1 : NEXT A
150 C = 0 : D = 0
160 X(1) = 0 : Y(1) = 0 : Z(1) = 0
170 X(2) = 1 : Y(2) = 1 : Z(2) = 1
180 NEXT B : NEXT A
190 FOR N = 1 TO 1000
200 FOR A = 0 TO 1000
210 X = 0 : Y = 0 : Z = 0
220 NEXT B : NEXT A
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6050 X = 0 : Y = 0 : Z = 0
6060 NEXT B : NEXT A
6070 FOR N = 1 TO 1000
6080 FOR A = 0 TO 1000
6090 X = 0 : Y = 0 : Z = 0
6100 NEXT B : NEXT A
6110 FOR N = 1 TO 1000
6120 FOR A = 0 TO 1000
6130 X = 0 : Y = 0 : Z = 0
6140 NEXT B : NEXT A
6150 FOR N = 1 TO 1000
6160 FOR A = 0 TO 1000
6170 X = 0 : Y = 0 : Z = 0
6180 NEXT B : NEXT A
6190 FOR N = 1 TO 1000
6200 FOR A = 0 TO 1000
6210 X = 0 : Y = 0 : Z = 0
6220 NEXT B : NEXT A
6230 FOR N = 1 TO 1000
6240 FOR A = 0 TO 1000
6250 X = 0 : Y = 0 : Z = 0
6260 NEXT B : NEXT A
6270 FOR N = 1 TO 1000
6280 FOR A = 0 TO 1000
6290 X = 0 : Y = 0 : Z = 0
6300 NEXT B : NEXT A
6310 FOR N = 1 TO 1000
6320 FOR A = 0 TO 1000
6330 X = 0 : Y = 0 : Z = 0
6340 NEXT B : NEXT A
6350 FOR N = 1 TO 1000
6360 FOR A = 0 TO 1000
6370 X = 0 : Y = 0 : Z = 0
6380 NEXT B : NEXT A
6390 FOR N = 1 TO 1000
6400 FOR A = 0 TO 1000
6410 X = 0 : Y = 0 : Z = 0
6420 NEXT B : NEXT A
6430 FOR N = 1 TO 1000
6440 FOR A = 0 TO 1000
6450 X = 0 : Y = 0 : Z = 0
6460 NEXT B : NEXT A
6470 FOR N = 1 TO 1000
6480 FOR A = 0 TO 1000
6490 X = 0 : Y = 0 : Z = 0
6500 NEXT B : NEXT A
6510 FOR N = 1 TO 1000
6520 FOR A = 0 TO 1000
6530 X = 0 : Y = 0 : Z = 0
6540 NEXT B : NEXT A
6550 FOR N = 1 TO 1000
6560 FOR A = 0 TO 1000
6570 X = 0 : Y = 0 : Z = 0
6580 NEXT B : NEXT A
6590 FOR N = 1 TO 1000
6600 FOR A = 0 TO 1000
6610 X = 0 : Y = 0 : Z = 0
6620 NEXT B : NEXT A
6630 FOR N = 1 TO 1000
6640 FOR A = 0 TO 1000
6650 X = 0 : Y = 0 : Z = 0
6660 NEXT B : NEXT A
6670 FOR N = 1 TO 1000
6680 FOR A = 0 TO 1000
6690 X = 0 : Y = 0 : Z = 0
6700 NEXT B : NEXT A
6710 FOR N = 1 TO 1000
6720 FOR A = 0 TO 1000
6730 X = 0 : Y = 0 : Z = 0
6740 NEXT B : NEXT A
6750 FOR N = 1 TO 1000
6760 FOR A = 0 TO 1000
6770 X = 0 : Y = 0 : Z = 0
6780 NEXT B : NEXT A
6790 FOR N = 1 TO 1000
6800 FOR A = 0 TO 1000
6810 X = 0 : Y = 0 : Z = 0
6820 NEXT B : NEXT A
6830 FOR N = 1 TO 1000
6840 FOR A = 0 TO 1000
6850 X = 0 : Y = 0 : Z = 0
6860 NEXT B : NEXT A
6870 FOR N = 1 TO 1000
6880 FOR A = 0 TO 1000
6890 X = 0 : Y = 0 : Z = 0
6900 NEXT B : NEXT A
6910 FOR N = 1 TO 1000
6920 FOR A = 0 TO 1000
6930 X = 0 : Y = 0 : Z = 0
6940 NEXT B : NEXT A
6950 FOR N = 1 TO 1000
6960 FOR A = 0 TO 1000
6970 X = 0 : Y = 0 : Z = 0
6980 NEXT B : NEXT A
6990 FOR N = 1 TO 1000
7000 FOR A = 0 TO 1000
7010 X = 0 : Y = 0 : Z = 0
7020 NEXT B : NEXT A
7030 FOR N = 1 TO 1000
7040 FOR A = 0 TO 1000
7050 X = 0 : Y = 0 : Z = 0
7060 NEXT B : NEXT A
7070 FOR N = 1 TO 1000
7080 FOR A = 0 TO 1000
7090 X = 0 : Y = 0 : Z = 0
7100 NEXT B : NEXT A
7110 FOR N = 1 TO 1000
7120 FOR A = 0 TO 1000
7130 X = 0 : Y = 0 : Z = 0
7140 NEXT B : NEXT A
7150 FOR N = 1 TO 1000
7160 FOR A = 0 TO 1000
7170 X = 0 : Y = 0 : Z = 0
7180 NEXT B : NEXT A
7190 FOR N = 1 TO 1000
7200 FOR A = 0 TO 1000
7210 X = 0 : Y = 0 : Z = 0
7220 NEXT B : NEXT A
7230 FOR N = 1 TO 1000
7240 FOR A = 0 TO 1000
7250 X = 0 : Y = 0 : Z = 0
7260 NEXT B : NEXT A
7270 FOR N = 1 TO 1000
7280 FOR A = 0 TO 1000
7290 X = 0 : Y = 0 : Z = 0
7300 NEXT B : NEXT A
7310 FOR N = 1 TO 1000
7320 FOR A = 0 TO 1000
7330 X = 0 : Y = 0 : Z = 0
7340 NEXT B : NEXT A
7350 FOR N = 1 TO 1000
7360
```



```

900 NEXT A
901 FOR A = 0 TO 10: PRINT : NEXT A
902 END
903 MOODS: 3: FOR X = 0.4 TO 0.6: FOR Y = 0.4 TO 0.6: HPLOT X,Y: NEXT
Y: NEXT X
904 GOTO 100
1000 FOR THIS IS AN APPLICATION OF A PERFECTLY GENERAL METHOD
SOLVING SYSTEM WHICH I HAVE ALSO USED TO SOLVE THE TRAVELIN
G SALESMAN PROBLEM: FIND THE SHORTEST ROUTE THROUGH N CITIES
.
1001 FOR THIS TECHNIQUE WAS DEVELOPED UNDER PROFESSOR JOHN HOL
LAND OF THE UNIVERSITY OF MICHIGAN COMPUTER SCIENCE DEPARTMENT
BY D. W. SAVITCH AND R. B. MILLSTEIN ABOUT 1970.
1002 FOR THIS TECHNIQUE CAN BE APPLIED TO ANY PROBLEM WHERE SE
LECTION CAN BE EXPRESSED AS A STRING, SUCH AS FORMING A ST
RING FROM THE COEFFICIENTS OF AN EQUATION OR FROM ANY SYMBOL
S DEFINING A PATTERN OR EVENT.
1003 FOR THERE IS ONE OTHER ESSENTIAL CONDITION: THAT THE POPUL
ATION OF STRINGS CAN BE PASSED AS TO MERIT (EITHER ANALYTICA
LLY, BY EXPERIMENT OR BY JUDGMENT).
1004 FOR THE INITIAL FAMILY OF STRINGS CAN BE SAID OR ESTIMATE
OR CAN BE COMPLETELY RANDOM.
1005 FOR THE PROCEDURE STARTS WITH ASSIGNING A MERIT FACTOR TO
EACH STRING.
1006 FOR THE NEXT STEP IS TO PLACE THE STRINGS IN ORDER OF MER
IT.
1007 FOR PAIRS OF STRINGS FROM THE TOP OF THE LIST ARE THEN 'MA
TED' TO PRODUCE OFFSPRING WHICH REPLACE STRINGS AT THE BOTTOM
OF THE LIST.
1008 FOR THE STRINGS ARE ANALOGOUS TO CHROMOSOMES AND THE PROC
ESS IS ANALOGOUS TO SELECTIVE BREEDING.
1009 FOR THE MATING CAN CONVENIENTLY BE ACCOMPLISHED BY CUTTING
A PAIR AT RANDOM LOCATION AND SPLICING THE HEADS AND TAILS
TO FORM TWO NEW STRINGS (EACH EACH CONTAIN ATTRIBUTES OF SO
ME PARENTS).
1010 FOR IT IS HELPFUL TO THE EVOLUTIONARY PROCESS TO CREATE A
RANDOM MUTATIONS, AS BY RANDOMLY SELECTING HALF THE POPULATION
FOR ALTERATION BY A RANDOMLY CHOSEN ELEMENT OF THE STRING.
1011 FOR THE POPULATION WITH ITS NEW MEMBERS AND MUTATIONS IS
RECYCLED THROUGH THE SAME STEPS, STARTING WITH RATING AND S
ORTING. EACH CYCLE IS TERMED A GENERATION.
1012 FOR IN THIS EXAMPLE EIGHT STRINGS OF 16 1'S AND 0'S CONST
ITUTE THE POPULATION. THE 16 POSITIONS IN A STRING ARE THE
BINARY EXPRESSION OF THE X COORDINATE OF A POINT AND THE 16
TH POSITIONS BEING THE Y COORDINATE.
1013 FOR A TARGET IS DEFINED AS THE POINT 0.4,0.4. THE STRINGS
ARE RATED ACCORDING TO THE DISTANCE OF THE POINT THEY DEFINE
FROM THIS TARGET.
1014 FOR ARRAY C CONTAINS 8 STRINGS. ARRAY A IS USED TO BUFFER
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 FOR ARRAY H CONTAINS THE SERIAL NUMBERS OF THE STRINGS IN
RANDOM 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 FOR LINES 0-99: SET-ORGANIZED.
1017 FOR LINES 100-199: INITIALIZE.
1018 FOR LINES 200-299: TRANSLATE STRING TO X AND Y COORDINAT
ES.
1019 FOR LINES 300-399: PLOT THE POINTS.
1020 FOR LINES 400-499: CALCULATED DISTANCES OF POINTS FROM TA
RGET.
1021 FOR LINES 500-599: ESTABLISH RANK ORDER.
1022 FOR LINES 600-699: MUTATE AND COPY STRINGS INTO ARRAY 'A'
IN RANK ORDER.
1023 FOR LINES 700-799: COPY TOP (BEST) 4 STRINGS INTO ARRAY '
C'.
1024 FOR LINES 800-899: CUT AND SPLICED COPIES OF THE BEST 4 TO
REPLACE THE WORST 4.
1025 FOR THIS PROGRAM WAS WRITTEN TO ILLUSTRATE THE PROCESS. S
ECTION 1000 CAN BE MERGED WITH SECTION 1001 TO ELIMINATE ARRAY
S W AND Z. FOR INSTANCES.
1026 FOR IT IS INTERESTING TO EXPLORING POPULATION SIZES, MATING
PROCEDURES AND MUTATION RATES. 50 GENERATIONS SEEMS TO BE A
MAJOR NUMBER FOR APPROACHING DIMINISHING RETURNS.
1027 FOR THE STRING ELEMENTS COULD BE SYMBOLS FORMING A MUSICAL
PIECE OR OTHER ARTISTIC COMPOSITION WITH THE RANKING BEING
BASED ON ESTHETIC MERIT.
1028 FOR THE STRING ELEMENTS COULD ALSO REPRESENT CONTROL SETS
OR A CHEMICAL PROCESSING PLAN.
1029 FOR THE RANKING COULD BE PROVIDED BY MEASUREMENTS OF PLAN
T GROWTH OR BY ANIMAL ACTIVITY MEASURED WITH APPROPRIATE SON
DORS.
1030 FOR PLEASE CONTACT ART FACLETTE IN ANN ARBOR AND SHARE Y
OUR EXPERIENCE, PROBLEMS AND RESULTS WITH THIS SYSTEM. THA
NK.

```

**THE LEAST
EXPENSIVE PROGRAMS
YOU CAN BUY.**

© 1998 by The McGraw-Hill Companies, Inc.

New Basic—expands disk basic
Now configure your Basic in as few as
all of the following:

[illegible]

Level II Taxes

[illegible]

Wade no response. I did not know I was, again, alone. I sat about 100 yards into Level 10 West—grazing. I saw eight horses feed at troughs on the left. One of them, T. 1000, I'd know.

Topic 6: Present's Present	\$12.00
Topic 7: 34 min. - var. - same group	\$12.00
Topic 8: 37 minutes - same - same group	\$12.00
Continued: Same Topic	\$12.00
Topic 9: 34 min. - var. - same group	\$12.00
Topic 10: 35 min. - var. - same group	\$12.00
Topic 11: 36 min. - var. - same group	\$12.00
Topic 12: 37 min. - var. - same group	\$12.00

PASPATCH

FasPatch, Tiger SP, makes Tandy tiny
Pascal's powerful disk system!

1. **Model:** *Model 1000*
 2. **Year:** *2000*
 3. **Make:** *Model 1000*
 4. **Model:** *Model 1000*
 5. **Year:** *2000*
 6. **Make:** *Model 1000*
 7. **Model:** *Model 1000*
 8. **Year:** *2000*
 9. **Make:** *Model 1000*
 10. **Model:** *Model 1000*
 11. **Year:** *2000*
 12. **Make:** *Model 1000*
 13. **Model:** *Model 1000*
 14. **Year:** *2000*
 15. **Make:** *Model 1000*
 16. **Model:** *Model 1000*
 17. **Year:** *2000*
 18. **Make:** *Model 1000*
 19. **Model:** *Model 1000*
 20. **Year:** *2000*
 21. **Make:** *Model 1000*
 22. **Model:** *Model 1000*
 23. **Year:** *2000*
 24. **Make:** *Model 1000*
 25. **Model:** *Model 1000*
 26. **Year:** *2000*
 27. **Make:** *Model 1000*
 28. **Model:** *Model 1000*
 29. **Year:** *2000*
 30. **Make:** *Model 1000*
 31. **Model:** *Model 1000*
 32. **Year:** *2000*
 33. **Make:** *Model 1000*
 34. **Model:** *Model 1000*
 35. **Year:** *2000*
 36. **Make:** *Model 1000*
 37. **Model:** *Model 1000*
 38. **Year:** *2000*
 39. **Make:** *Model 1000*
 40. **Model:** *Model 1000*
 41. **Year:** *2000*
 42. **Make:** *Model 1000*
 43. **Model:** *Model 1000*
 44. **Year:** *2000*
 45. **Make:** *Model 1000*
 46. **Model:** *Model 1000*
 47. **Year:** *2000*
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 49. **Model:** *Model 1000*
 50. **Year:** *2000*
 51. **Make:** *Model 1000*
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 57. **Make:** *Model 1000*
 58. **Model:** *Model 1000*
 59. **Year:** *2000*
 60. **Make:** *Model 1000*
 61. **Model:** *Model 1000*
 62. **Year:** *2000*
 63. **Make:** *Model 1000*
 64. **Model:** *Model 1000*
 65. **Year:** *2000*
 66. **Make:** *Model 1000*
 67. **Model:** *Model 1000*
 68. **Year:** *2000*
 69. **Make:** *Model 1000*
 70. **Model:** *Model 1000*
 71. **Year:** *2000*
 72. **Make:** *Model 1000*
 73. **Model:** *Model 1000*
 74. **Year:** *2000*
 75. **Make:** *Model 1000*
 76. **Model:** *Model 1000*
 77. **Year:** *2000*
 78. **Make:** *Model 1000*
 79. **Model:** *Model 1000*
 80. **Year:** *2000*
 81. **Make:** *Model 1000*
 82. **Model:** *Model 1000*
 83. **Year:** *2000*
 84. **Make:** *Model 1000*
 85. **Model:** *Model 1000*
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 87. **Make:** *Model 1000*
 88. **Model:** *Model 1000*
 89. **Year:** *2000*
 90. **Make:** *Model 1000*
 91. **Model:** *Model 1000*
 92. **Year:** *2000*
 93. **Make:** *Model 1000*
 94. **Model:** *Model 1000*
 95. **Year:** *2000*
 96. **Make:** *Model 1000*
 97. **Model:** *Model 1000*
 98. **Year:** *2000*
 99. **Make:** *Model 1000*
 100. **Model:** *Model 1000*
 101. **Year:** *2000*
 102. **Make:** *Model 1000*
 103. **Model:** *Model 1000*
 104. **Year:** *2000*
 105. **Make:** *Model 1000*
 106. **Model:** *Model 1000*
 107. **Year:** *2000*
 108. **Make:** *Model 1000*
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 112. **Model:** *Model 1000*
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 115. **Model:** *Model 1000*
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 117. **Make:** *Model 1000*
 118. **Model:** *Model 1000*
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 120. **Make:** *Model 1000*
 121. **Model:** *Model 1000*
 122. **Year:** *2000*
 123. **Make:** *Model 1000*
 124. **Model:** *Model 1000*
 125. **Year:** *2000*
 126. **Make:** *Model 1000*
 127. **Model:** *Model 1000*
 128. **Year:** *2000*
 129. **Make:** *Model 1000*
 130. **Model:** *Model 1000*
 131. **Year:** *2000*
 132. **Make:** *Model 1000*
 133. **Model:** *Model 1000*
 134. **Year:** *2000*
 135. **Make:** *Model 1000*
 136. **Model:** *Model 1000*
 137. **Year:** *2000*
 138. **Make:** *Model 1000*
 139. **Model:** *Model 1000*
 140. **Year:** *2000*
 141. **Make:** *Model 1000*
 142. **Model:** *Model 1000*
 143. **Year:** *2000*
 144. **Make:** *Model 1000*
 145. **Model:** *Model 1000*
 146. **Year:** *2000*
 147. **Make:** *Model 1000*
 148. **Model:** *Model 1000*
 149. **Year:** *2000*
 150. **Make:** *Model 1000*
 151. **Model:** *Model 1000*
 152. **Year:** *2000*
 153. **Make:** *Model 1000*
 154. **Model:** *Model 1*

SuperPIMS—People's Database

11411 has been generally considered as one of the most important and most common of the plant diseases of the world. It is caused by a fungus, *Ascochyta blight*, which attacks the roots, stems, and leaves of the plant. The disease is characterized by the formation of dark, sunken lesions on the plant parts. The lesions are often surrounded by a yellowish halo. The disease can be controlled by the use of fungicides and by the selection of resistant plant varieties.

program (C42)	415.00 (310.00 460.00)
book (C43 1.00)	40.00 (30.00 50.00)

Tiny Payroll

We're going to have Computer Exchanges on
 the Computer Unit. Don't miss this if
 you're interested. For more information
 call 366-22 (CRA 311-41)
 or write to: CRA, 366-22

Games for color TMS-80

• PUNCH 80 • SORTAP • INFORMATION (Free
Brochure) • TRAPP (Grand Prix 1984)
• DATA PEEK (only 250K) • SORT/BLK (1000K)
1000-2000 • \$19.95 (USD) U.S.A.

Word Processing Newsletter

Want to really tell your company? Then send photos to info@flickr.com. For your company, we'll give you some stock photos, nothing can be.

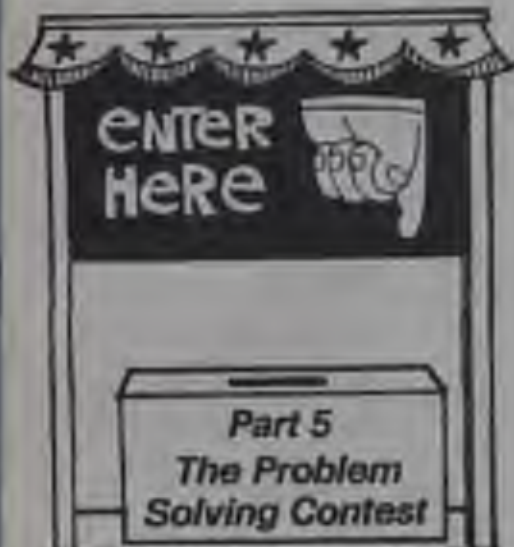
South along the new 71st and immediately west of 100th Street approximately 1000 feet. The 100th Street station is on the "Green" Line. The 71st Street station is on the "Blue" Line. The 100th Street station is on the "Green" Line. The 71st Street station is on the "Blue" Line.

They should not be interpreted as a challenge to the FBI's investigation, but rather as a call for more information and a more thorough review of the evidence.

Presidential election and more in *How Fast Were*
Practicing, the only newspaper about work
 improving using your personal computer. Just
 \$10 for 12 issues.

add 10 days charge each, check or m/c.
 Total revenues add 1 per lot. Dealer reg. limited
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How to Solve It— with the Computer

Donald T. Piele

Part 5 The Problem Solving Contest

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 problems, 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 organization 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 9-12 (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

Donald T. Piele, University of Wisconsin-Parkside, Kenosha, WI 53144

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 program, 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? (3 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 Bunch, 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.

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 shoes 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 policies, 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 straightforward simulation, without scenarios of blatant corruption, but temptations to compromise your ideals are still realistic and powerful.

Will you change your positions to capture the financial support of labor or 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 campaign 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 than 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 Behavior courses at the University level since 1976. Its authors are Associate Professors at the Eastern Kentucky University, Phillip W. Brashers 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 500 on a 32K cassette (CS-7201) and for the Atari 800 on a 48K 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, Monticello, NJ 07060. Include \$1.00 for postage and handling. For faster service, call in your bank card order toll free to 800-631-8112.

**sensational
software**

CIRCLE 118 ON READER SERVICE CARD

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. _____

=====

APPLE II **TRS-80** **QUALITY DISK SOFTWARE** **HOME FINANCE PAK I: Entire Series \$49.95**

CHECK REGISTER AND BUDGET: This comprehensive CHECKING ACCOUNT MANAGEMENT SYSTEM not only keeps complete records, it also gives you the analysis and control tools you need to actually manage your account. The system provides reviews for BUDGETING INCOME AND EXPENSE, AUTOMATIC CHECK STATION, and BANK STATEMENT RECONCILING. EXT or printer outputs are produced for ACTUAL EXPENSE vs BUDGET, CHECK SEARCH DISPLAY, RECONCILIATION REPORT and CHECK REGISTER DISPLAY by month. Check entry is prompted by user-defined names of standard purposes and response codes, spending date entry and reducing disk storage and retrieval time. Six fields of data are stored for each check: amount, check no., date, purpose, recipient and TAX DEDUCTIBLE REMINDER. CHECK SEARCH reviews allow searching on any of these data fields. Reviews are also provided for CHECK SORT by date and check no., DATA EDITING and Report Formats. Up to 100 checks/dates, storage.\$29.95

SAVINGS: Account management system for up to 20 separate Savings accounts. Organize, file and displays deposits, withdrawals and interest earned for each account. Complete records stored on CRT or printer.\$24.95

CREDIT CARD: Get Control of your credit cards with this program. Organize, store and displays purchases, payments and service charges for up to 20 separate cards. Get the credit cards or bank loans, CRT or printer reports.\$24.95

UNIVERSAL COMPUTING MACHINE: \$49.95

A user programmable computing system structured around a 30 row x 30 column table. User defines row and column names and sequences forming a unique computing machine. Table elements can be multiplied, subtracted, divided, subtracted or added to any other element. One row defines repeated functions common to row of address greatly simplifying table setup. Hundreds of unique computing machines can be defined, used and stored, and recalled, with or without test data. See later use. Excellent for sales forecasts, engineering design analysis, budgets, inventory lists, income statements, production planning, project cost estimates or short for any planning, analysis or reporting problem that can be solved with a table. Unique control commands allow you to move to any element, change its value and immediately see the effect on other table values. Entire table can be printed by machine paper (user-defined 2-6 columns) on a 40 column printer.\$49.95

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Solve It, continued...

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

$$\begin{aligned} 1 \\ 1 \\ 2 &= 1+1 \\ 3 &= 1+2 \\ 5 &= 2+3 \\ 8 &= 3+5 \end{aligned}$$

To generalize this, we define the n -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 n -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:

```

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

sum of throws = 6
sum 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:

- An input string
- A character to be replaced
- 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 10 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 $p \leq n$, 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
11	13
17	19

TOTAL ARE 3 PAIR

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 two 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 $m \leq n$. 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. Spiral

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, $n \leq 10$. For example, for $n = 4$ the display should look like this:

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

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

21	20	19	18	17
22	7	8	9	16
23	6	1	2	15
24	5	4	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 $n = 5$.

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SR 3. Substring Replacement

Write a program which will allow three inputs:

- An input string.
- A substring to be replaced.
- 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 GUESS
REPLACE	: H
BY	: THE
OUTPUT STRING	: HE GUESS THE
REPLACEMENTS	: 2

Example 2)

INPUT STRING	: HOOO
REPLACE	: OO
BY	: O
OUTPUT STRING	: HOO
REPLACEMENTS	: 2

Run your program with the above examples.

SR 4. Crowded Phone Booth

There are n people ($n \leq 20$) whose names are A, B, C, ..., and a phone booth with capacity m ($m \leq n$). 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 $m = 3$:

ABC ABD ABE ACD ACE
ADE ACD BCE BDE CDE
THESE ARE 10 COMBINATIONS

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

n	m
5	3
7	4
10	2
20	10

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 $k+1 \leq n$, 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

TOTAL ARE 4 PAIR

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 conventions, the same programs work in AppleSoft Basic. These changes are noted after the listings.

Solve It, continued...

```

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=4 TO N
70   IF I < 4 THEN GO
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 2 3 4 5 7 10 15 22 33 50 75 111 167 250 375 556 833
READY

```

```

10 PRINT "JR 2. DART THROWING"
20 PRINT "-----"
30 REM T = # OF TOSSES
40 REM S(15,5)= THE DART BOARD
50 DIM S(15,5)
60 REM FNR(I) = RANDOM INTEGER BETWEEN 1 AND 5
70 DEF FNR(I) = INT(RND(1)+.5) * 5
75 S=FNR(I-1) \ REM RANDOMIZE
80 INPUT "HOW MANY DARTS DO YOU WANT TO TOSST?": T
90 PRINT
100 S=0
110 REM *** THROW DARTS ***
120 FOR I=1 TO T
130   S=FNR(I): FNR(I)=S
140   NEXT I
150 REM *** OUTPUT RESULTS ***
160 FOR I=1 TO 5
170   FOR J=1 TO 5
180     IF S(I,J)=0 THEN PRINT " ", " "
190     IF S(I,J)=0 THEN 220
200     PRINT "X "
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 TOSST? 25

```

X . . . .
X . . . .
X . . . .
X . . . .
X . . . .

```

```

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

```

JR 2. DART THROWING

HOW MANY DARTS DO YOU WANT TO TOSST? 25

```

X . . . .
X . . . .
X . . . .
X . . . .
X . . . .

```

```

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

```

JR 2. DART THROWING

HOW MANY DARTS DO YOU WANT TO TOSST? 25

```

X . . . .
X . . . .
X . . . .
X . . . .
X . . . .

```

```

NUMBER OF THROWS = 20
NUMBER OF SQUARES HIT = 24
READY
RUN

```

JR 2. DART THROWING

HOW MANY DARTS DO YOU WANT TO TOSST? 25

```

X . . . .
X . . . .
X . . . .
X . . . .
X . . . .

```

```

NUMBER OF THROWS = 10
NUMBER OF SQUARES HIT = 20
READY
RUN

```

JR 2. DART THROWING

HOW MANY DARTS DO YOU WANT TO TOSST? 100

```

X . . . .
X . . . .
X . . . .
X . . . .
X . . . .

```

```

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

```

JR 3. CHARACTER REPLACEMENT

```

10 PRINT "JR 3. CHARACTER REPLACEMENT"
20 PRINT "-----"
30 DIM A(1000), B(1000)
40 INPUT "INPUT STRING " A: A=0
50 B=0
60 INPUT "REPLACE " R: R=0
70 IF LEN(R)=0 THEN 80
80 INPUT "BY " C: C=0
90 IF LEN(C)=0 THEN 80
100 FOR I=1 TO LEN(A)
110   IF A(I)=C THEN 140
120   B(I)=R: C=1
130   NEXT I
140   NEXT I
150 PRINT "OUTPUT STRING " B
160 PRINT "REPLACEMENTS " C
170 END
READY
RUN

```

JR 3. CHARACTER REPLACEMENT

```

INPUT STRING CTHE FAT FOX
REPLACE AT
BY AB
OUTPUT STRING FTHE BAT BOX
REPLACEMENTS 12
READY

```

JR 4. CROSSED PHONE BOOK

```

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

```

JR 4. CROSSED PHONE BOOK

```

AB BC AD BE AF AG AH AI AJ BK BL
BE BF BG BH BI BJ BK BL CM CN CO CP
CI CJ DK DP DG DH DI DJ EK EL EN
EI EJ FK FL FH FI FJ GK GL GN HO
HJ
READY

```



```

80      1101+0101+1
90      NEXT B
100     IF K1<C1 OR K1<11<C1 THEN 120
110     PRINT K+1," " C
120     C=C+1
130     NEXT K
140     PRINT "THERE ARE",C," SUCH PAIRS."
150     END
READY
RUN

```

OR 5. THEN NEAR PRIME:

```

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

```

OR 5. THEN NEAR PRIME:

```

TWIN NEAR PRIME PAIRS NOT GREATER THAN 100
9      10
14     15
21     22
25     26
33     34
39     40
57     58
65     66
83     84
93     94
THERE ARE 12 SUCH PAIRS.
READY

```

Applesoft Version

A minor difference between North Star and Applesoft Basic is the way each two 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
J#1	Punctuation in lines 30
J#2	Punctuation in lines 80,180,200,250,270 Use PEEK() instead of PEEK() in line 75. Delete 75
J#3	Punctuation in lines 40,50,90,150,160, 110 IF MID\$(A\$,1,1) < LEFT\$(B\$,1) THEN 140 120 A\$=LEFT\$(A\$,1-1)+RIGHT\$(B\$,1)+MID\$(A\$,1+1)
J#4	80 PRINT TAB(C/4+1);MID\$(A\$,1,1);MID\$(B\$,1,1) 90 IF C < 10 THEN 100
J#5	Punctuation in lines 30,50,130,140 Change SORT in line 90 to SQR. 90 IF 1/2 = INT(1/2) THEN 140

FEBRUARY 1981

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CIRCLE 217 ON READER SERVICE CARD

Problem	Checksum
SR1	Punctuation in lines 30-40 140 PRINT FROTT " " 145 IF POS(1)>25 THEN PRINT
SR2	Punctuation in line 270 Use / instead of \ in lines 20-80 170 IF C=INT(200/2) THEN 240
SR3	Punctuation in lines 40-70, 80-200, 240 120 IF MID\$(A\$,1,LEN(B\$)+1) <> B\$ THEN B=1 130 IF MID\$(A\$,1,LEN(B\$)+1) <> B\$ THEN 150 210 A\$=LEFT\$(B\$,B-1)+C\$: GOTO 200 220 A\$=LEFT\$(B\$,B-1)+C\$+MID\$(B\$,B,LEN(B\$)-1)
SR4	Punctuation in lines 30, 150, 200 115 A\$="" 120 A\$=A\$+CHR\$(X/2)
SR5	Punctuation in lines 40-110, 140 Checksum 1087 in lines 40 to 1087.

1980 Contest Results

In the senior division, the 1980 winners were The Knights of N (Dave Rosen, Eric Rosenburg, and Ron Stalberg) from Prospect High School in Prospect, IL. They turned in a perfect performance — 100 points. Second place went to the Macabrebits (John Eng, Dale Smith, and Gary Stevens) of Nathan Hale High School in Milwaukee, WI. Their total was 39 points. Third place was won by the Hawks (Stan Kantor, Mike Bors, and Kent Baumister) 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 Tetanusmptoms (David Nico and Robert Gelf) from Lanos Jr. High in Kenosha, WI took first place. They scored 95 points. Second place was awarded to the Apple Butters (Steve Scott and Dave Pagenkopf) from Wauwatosa West Jr. High in Wauwatosa, WI — total points 86. Third place went to the Z-80 Zappers (Arthur Class, David Levine, and Jerry Mackman) 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.

Acknowledgment

I would like to pay special tribute to Tim Fennerty, 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 Nico who wrote the Applebut conversion listed above. □

A one-hour LP record of eight synthesizers may change your views about computer music forever

Binary Beatles

by David AH

Computer music. Who needs it? It's mostly boring beep, beep, beeps or wildly modern stuff. It's certainly nothing you'd want to listen to more than once. That's what I thought about computer music and most of my friends agreed.

In 1978 I entered Yankee Doodle Dandy into my Software Technology system just to be different. Dick Moberg heard of it and asked me to perform in the Philadelphia Computer Music Festival. I agreed expecting to be the only one with something out of the ordinary. I was wrong.

Computer Accompanist

Nine individuals and groups performed in the festival. There were the usual Bach pieces but even they were different. Goodtzen van der Wal performed the last movement of the 2nd Bach Suite in a unique way. He played the flute solo while using the computer as accompaniment.

Then Dorothy Siegel did the same thing, playing the clarinet solo part of Werhah's Sonata in b flat. The audience went wild.

Hal Chamberlin played Bach's Tocatta and Fugue in d minor. But also with a difference. He used a large computer before hand to "compute" the waveform of every

instrument playing every note. It took one hour of computation time for each two minutes of playback time. The result could hardly be distinguished from the organ in the Hapsburg Cathedral.

Don Schertz had a home brewed synthesizer truly mounted on a breadboard that allowed him to control 25 parameters of each note. It produced spectacular sounds in his arrangement of Red Wing.

Singing Computer

In 1962, D.H. Van Lenten at Bell Laboratories produced the first talking computer. Bell engineers taught it to recite the soliloquy from Hamlet. Then they went one step further and taught it to sing Daisy both alone and accompanied by another computer. This was also performed at the festival.

Yes, the Beatles were represented. Andrew Molde played Hey Jude on his COSMAC VIP system with a program called PTH-5 (Play It Now).

Superb Quality Recording

All these pieces and twelve others were recorded with broadcast quality equipment. Because of audience noise, eight were re-recorded later in a studio. We then took these tapes to Tru-Tone, a top recording

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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 at work. 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 many traits (eye color, hair color, etc.) which are passed to their offspring by the genes carried in their cells.

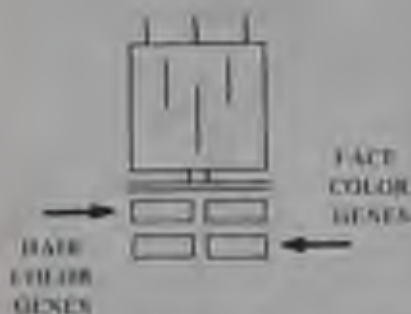
Figure 1

MALE ZORKON



FEMALE ZORKON

Figure 2



J.D. Eisenberg, 1630 Owens Ct., Apt. R, Sunnyvale, CA 94087.

TABLE 1

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 inherit, 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* (one *homozygous*). 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
F to see statistics

The statistics substructure how many of each genetic combination (heterozygous, 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 back 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 used 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 is 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 *Genesoul* program, in order of their appearance.

PROCEDURE SKIPTO
(X,Y:INTEGER);

Moves to the specified X,Y screen coordinate, means mostly as a convenience to avoid typing.

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

Takes the information about the **PERSON** and shows 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 letters behind 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 screen, 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 help page, in preparation for moving text via **WCHAR** or **WSTRING**.

PROCEDURE ERSKLINE
(ROW:INTEGER);

Erases the given **ROW** on the help screen.

PROCEDURE PSPACCHAR;

Gives prompt to press the letter to continue, then waits for either spacebar or the **ESC** 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 STATISTIC;

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 heterozygous or homozygous, 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,BDFACE,DUMHAIR,
BFCOLOR,SCHEMOLOR);

Sets the **DOMINANT FACE**, **RECESSIVE FACE**, **DOMINANT HAIR**, and **RECESSIVE** hair colors. (This procedure lets **EXPLAIN** show a face and we can be seeing hair color to black, for example.)

PROCEDURE EXPLAIN2;
PROCEDURE EXPLAIN3;
PROCEDURE EXPLAIN4;

The remainder of the help pages.

PROCEDURE SPLASHPAGE;

Makes the pages the help pages are called from here.

PROCEDURE INTPARENTS;

Sets up the gene patterns of the parents.



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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.

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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 236 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.



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.

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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).

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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.

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The Mini-Data upgrade	90.00

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David Ari, Founder and
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creative computing

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Genetool, continued...

```

UNTIL THINKING[POSITION] <=X-MALE;
END;+THINKING[POSITION];
REPEAT
  IF REMARK THEN SAYING(1);
  SAYING:=FALL;
  REPEAT
    SAYING:=FALL;
    AT(1,0); THINKING[CONSUME THE NEW (female growth type-7)]
  REPEAT
    CONSUMPTION;
    REPEAT
      SAYING;
    UNTIL THINKING
  IF THINKING[POSITION]-ONE => FINALLY THIS MATE
    AS(YES/NO(SAY)); (* X'S/ONE *)
    IF NOT SUCCESS THEN AGAIN
    SAYING(1); (* SAYING (1) *)
    AT(1,1); THINKING[Female has mated (male)];
    SAYING(1); (* MATE THIS *)
    SAYING:=TRUE;
  END;
  UNTIL THINKING[POSITION] <=X-FEMALE;
  END;+THINKING[POSITION];
  THINKING
END;

PROCEDURE INITIALISE;
VAR M1,M2,RELAT:CHARACTER; /* THE FEMALE PARTNER */
BEGIN
  INITIALISE;
  (* IF M1 HAS PARTNER M2, AND NOT THINKING *)
  (* AND PREVIOUS, THEN SET A SAFE SAY THAT M2 *)
  (* DON'T HAVE PARTNER ATTACHED. *)
  M1:=CHAR(0);
  FOR RELAT:=1 TO 40 DO BEGIN END;
  M2:=CHAR(0);
  M1PARTNER:= (M1(20-21) AND (M2(1-21)) AND
    (M1(20-21) AND (M2(1-21)));
  (* SET ON OTHERS FOR BACK/BACK SINGLY *)
  COLOR(SAY,CONJUNCT):=COLOR;
  COLOR(SAY,REJECTIVE):=REJECT;
  COLOR(SAY,CONJUNCT):=CONJUNCT;
  COLOR(SAY,REJECTIVE):=REJECT;
  REJECT:=FALL;
  CONJUNCT
END;

END;
SAYING;
REPEAT
  INITIALISE;
  SAYING;
  REPEAT
    CONSUMPTION;
    IF NOT THINKING AND (YES->CONJUNCT) THEN
      SIMULATION
    UNTIL THINKING OR (YES->CONJUNCT);
  UNTIL YES->CONJUNCT;
  SAYING(1);
  THINKING
END;

```

RT-40511

These specimens were of the high-quality category (see Table 1) and have full NMR data available for (3a) to (3f) and (4a) to (4d) (see Table 1).

9474 9475 9476 9477 9478 9479 9480 9481 9482 9483 9484 9485 9486 9487 9488 9489 9490 9491 9492 9493 9494 9495 9496 9497 9498 9499 9500 9501 9502 9503 9504 9505 9506 9507 9508 9509 9510 9511 9512 9513 9514 9515 9516 9517 9518 9519 9520 9521 9522 9523 9524 9525 9526 9527 9528 9529 9530 9531 9532 9533 9534 9535 9536 9537 9538 9539 9540 9541 9542 9543 9544 9545 9546 9547 9548 9549 9550 9551 9552 9553 9554 9555 9556 9557 9558 9559 9560 9561 9562 9563 9564 9565 9566 9567 9568 9569 9570 9571 9572 9573 9574 9575 9576 9577 9578 9579 9580 9581 9582 9583 9584 9585 9586 9587 9588 9589 9590 9591 9592 9593 9594 9595 9596 9597 9598 9599 9600 9601 9602 9603 9604 9605 9606 9607 9608 9609 9610 9611 9612 9613 9614 9615 9616 9617 9618 9619 9620 9621 9622 9623 9624 9625 9626 9627 9628 9629 9630 9631 9632 9633 9634 9635 9636 9637 9638 9639 9640 9641 9642 9643 9644 9645 9646 9647 9648 9649 9650 9651 9652 9653 9654 9655 9656 9657 9658 9659 9660 9661 9662 9663 9664 9665 9666 9667 9668 9669 9670 9671 9672 9673 9674 9675 9676 9677 9678 9679 9680 9681 9682 9683 9684 9685 9686 9687 9688 9689 9690 9691 9692 9693 9694 9695 9696 9697 9698 9699 9700 9701 9702 9703 9704 9705 9706 9707 9708 9709 9710 9711 9712 9713 9714 9715 9716 9717 9718 9719 9720 9721 9722 9723 9724 9725 9726 9727 9728 9729 9730 9731 9732 9733 9734 9735 9736 9737 9738 9739 9740 9741 9742 9743 9744 9745 9746 9747 9748 9749 9750 9751 9752 9753 9754 9755 9756 9757 9758 9759 9760 9761 9762 9763 9764 9765 9766 9767 9768 9769 9770 9771 9772 9773 9774 9775 9776 9777 9778 9779 9780 9781 9782 9783 9784 9785 9786 9787 9788 9789 9790 9791 9792 9793 9794 9795 9796 9797 9798 9799 9800 9801 9802 9803 9804 9805 9806 9807 9808 9809 9810 9811 9812 9813 9814 9815 9816 9817 9818 9819 9820 9821 9822 9823 9824 9825 9826 9827 9828 9829 9830 9831 9832 9833 9834 9835 9836 9837 9838 9839 9840 9841 9842 9843 9844 9845 9846 9847 9848 9849 9850 9851 9852 9853 9854 9855 9856 9857 9858 9859 9860 9861 9862 9863 9864 9865 9866 9867 9868 9869 9870 9871 9872 9873 9874 9875 9876 9877 9878 9879 9880 9881 9882 9883 9884 9885 9886 9887 9888 9889 9890 9891 9892 9893 9894 9895 9896 9897 9898 9899 9900 9901 9902 9903 9904 9905 9906 9907 9908 9909 9910 9911 9912 9913 9914 9915 9916 9917 9918 9919 9920 9921 9922 9923 9924 9925 9926 9927 9928 9929 9930 9931 9932 9933 9934 9935 9936 9937 9938 9939 9940 9941 9942 9943 9944 9945 9946 9947 9948 9949 9950 9951 9952 9953 9954 9955 9956 9957 9958 9959 9960 9961 9962 9963 9964 9965 9966 9967 9968 9969 9970 9971 9972 9973 9974 9975 9976 9977 9978 9979 9980 9981 9982 9983 9984 9985 9986 9987 9988 9989 9990 9991 9992 9993 9994 9995 9996 9997 9998 9999 10000

The 14th and 15th meetings in July 1996 and 1997 were without previous programming. Space for poster and round table sessions was limited. The 16th meeting in 1998 was the last. Space available for the poster sessions was limited. The 17th meeting in 1999 was the last. Space available for the poster sessions was limited.

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These results suggest that the model is a good approximation of the system. The model is a good approximation of the system. The model is a good approximation of the system.

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Left: William H. Miller, Jr. right: John Miller, Jr.
Left: William H. Miller, Jr. right: John Miller, Jr.

Modeling

The last January, we in America (and many other nations) celebrated the 50th anniversary of the end of World War II. It was a time when we were united in a common purpose and a common goal. We were all working together to win the war and to build a better world for ourselves and for our children. We were all proud to be part of a great team that had overcome the greatest challenge of our time.

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

For my paper, my friends and I performed a survey of 1000 people and found that they like having the money right in hand.

25. A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.

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FIG. 3. Summary statistics of *Stylocoma* assemblages for Level 2.

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CIRCLE 11 ON READER SERVICE CARD

PROCEDURE CHOOSETYPES:

This procedure lets you choose the new parents from the current generation. An internal variable (HADERRUR, which tells if an error message has already been given or not) this choosing may result of female or a new male.

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 published or not (yes, you use from this procedure). But why do it? sometimes display colors, and sets up genetic parents 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.

HERO- a prefix from the Greek, meaning "different."

HETEROZYGOUS: means a zygote that has different genes in it.

HETEROZYGOUS

DOMINANT: the 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 as living beings, but they may also be found in row-weed seeds and scabious grasses (usually on ripe weed seeds and shortly thereafter on the floor). □

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23.5 23.6 23.7 23.8 23.9 24.0 24.1 24.2 24.3 24.4 24.5 24.6 24.7 24.8 24.9 25.0 25.1 25.2 25.3 25.4 25.5 25.6 25.7 25.8 25.9 26.0 26.1 26.2 26.3 26.4 26.5 26.6 26.7 26.8 26.9 27.0 27.1 27.2 27.3 27.4 27.5 27.6 27.7 27.8 27.9 28.0 28.1 28.2 28.3 28.4 28.5 28.6 28.7 28.8 28.9 29.0 29.1 29.2 29.3 29.4 29.5 29.6 29.7 29.8 29.9 30.0 30.1 30.2 30.3 30.4 30.5 30.6 30.7 30.8 30.9 31.0 31.1 31.2 31.3 31.4 31.5 31.6 31.7 31.8 31.9 32.0 32.1 32.2 32.3 32.4 32.5 32.6 32.7 32.8 32.9 33.0 33.1 33.2 33.3 33.4 33.5 33.6 33.7 33.8 33.9 34.0 34.1 34.2 34.3 34.4 34.5 34.6 34.7 34.8 34.9 35.0 35.1 35.2 35.3 35.4 35.5 35.6 35.7 35.8 35.9 36.0 36.1 36.2 36.3 36.4 36.5 36.6 36.7 36.8 36.9 37.0 37.1 37.2 37.3 37.4 37.5 37.6 37.7 37.8 37.9 38.0 38.1 38.2 38.3 38.4 38.5 38.6 38.7 38.8 38.9 39.0 39.1 39.2 39.3 39.4 39.5 39.6 39.7 39.8 39.9 40.0 40.1 40.2 40.3 40.4 40.5 40.6 40.7 40.8 40.9 41.0 41.1 41.2 41.3 41.4 41.5 41.6 41.7 41.8 41.9 42.0 42.1 42.2 42.3 42.4 42.5 42.6 42.7 42.8 42.9 43.0 43.1 43.2 43.3 43.4 43.5 43.6 43.7 43.8 43.9 44.0 44.1 44.2 44.3 44.4 44.5 44.6 44.7 44.8 44.9 45.0 45.1 45.2 45.3 45.4 45.5 45.6 45.7 45.8 45.9 46.0 46.1 46.2 46.3 46.4 46.5 46.6 46.7 46.8 46.9 47.0 47.1 47.2 47.3 47.4 47.5 47.6 47.7 47.8 47.9 48.0 48.1 48.2 48.3 48.4 48.5 48.6 48.7 48.8 48.9 49.0 49.1 49.2 49.3 49.4 49.5 49.6 49.7 49.8 49.9 50.0 50.1 50.2 50.3 50.4 50.5 50.6 50.7 50.8 50.9 51.0 51.1 51.2 51.3 51.4 51.5 51.6 51.7 51.8 51.9 52.0 52.1 52.2 52.3 52.4 52.5 52.6 52.7 52.8 52.9 53.0 53.1 53.2 53.3 53.4 53.5 53.6 53.7 53.8 53.9 54.0 54.1 54.2 54.3 54.4 54.5 54.6 54.7 54.8 54.9 55.0 55.1 55.2 55.3 55.4 55.5 55.6 55.7 55.8 55.9 56.0 56.1 56.2 56.3 56.4 56.5 56.6 56.7 56.8 56.9 57.0 57.1 57.2 57.3 57.4 57.5 57.6 57.7 57.8 57.9 58.0 58.1 58.2 58.3 58.4 58.5 58.6 58.7 58.8 58.9 59.0 59.1 59.2 59.3 59.4 59.5 59.6 59.7 59.8 59.9 60.0 60.1 60.2 60.3 60.4 60.5 60.6 60.7 60.8 60.9 61.0 61.1 61.2 61.3 61.4 61.5 61.6 61.7 61.8 61.9 62.0 62.1 62.2 62.3 62.4 62.5 62.6 62.7 62.8 62.9 63.0 63.1 63.2 63.3 63.4 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Monster Combat

Lee Chapel

This program offers hours of fun. That's why it's called Monster Combat.

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 in 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; in these hundred smallest squares you see. Each of these little squares is shown by a single character. 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, P's are paths, F's are walls, Y's are rivers, 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 inn 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 or 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

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 (2) — A mischievous little speck only about a yard in height. Rastily, 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 maddening 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 Pasiphaë, 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 cyclopes were shepherds living on an island in the western sea. The best known of these was Polyphemus who had his eye poked out by the hero, Odysseus. According to Hesiod, the cyclopes were three of the children of Uranus and Gaia. 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 strolls at night and decays. 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, large 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.

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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 King Phoenix as punishment from the gods. Phoenix 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 betray Phoenix 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 vigilantly guard. It instinctively knows where buried treasure is hidden and tries to keep away plunderers at a distance.

Chimera (70) — From Greek mythology, a monster with the foreparts of a lion, the midparts 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 Belshazzar, 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 reptile 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 a toad or serpent. The sound, 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 urns and caskets. 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 'T'; 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 cyclopes. Cyclopes 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 cyclopes' 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, charm, 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, if 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 may 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 treasure 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 generator which occurs throughout the program and lines in which PRINT CHR\$(32);CHR\$(6) occurs, this being the command for clearing the screen and moving the cursor on my system. Also, if you don't have graphics you will want to leave out lines 1440 to 1487 and take out the GOSUB 1460 from line 1210. If you do have graphics you'll have to change the POKE statements in lines 1488 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. □

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A total entertainment center with color, sound and music. There are Chess, Backgammon, Star Trek, Black Jack, Volleyball, Touchdown, Hangman, Showdown, Computer Maze, Breakthrough and more! Challenge the computer or another opponent. Each game brings the family and friends together for hours of quality fun.

SERVICE AND WARRANTY

If the unit fails because of factory defect within 90 days of purchase, it will be repaired at no charge for labor and parts - you just send the unit (United Parcel prepaid to the Service Center designated and it will be sent back to you promptly (United Parcel prepaid). A complete Diagnostic program tape and instructions are available. You can get a Service manual, Cassette alignment tape, Schematics, and parts list plus a money Saver Service and warranty Card. Everything you need to check and service your computer!

IT CAN BE EXPANDED AT LOW COST

It is a single board computer. RS232C Interface is available now at \$89.50 for adding printers and telephone modems. A telephone modem allows you to access "MICRONET", "SOURCE" and other data banks. You can also talk to other computers. Plans for expanding ROM and RAM capabilities are being considered. Our factory sponsored National Computer Club membership is available to learn from other owners the fantastic things you can do with this computer.

PRICE COMPARISON

Competitive 16K RAM Personal Computer Suggested List prices are: Radio Shack \$649, T's \$950, Alan \$1,125, Apple \$1,190, Ohio Scientific \$950. Radio Shack's TRS-80 has only 4K RAM, no color or sound, sells for \$499.

WHY SUCH A LOW PRICE

Selling on a factory direct to customer basis, we save you the profit normally made by computer stores and distributors. You also save the cost of a computer monitor as this computer is FCC approved and designed to hook up to any TV antenna terminal. We are willing to take a small margin at the factory to develop volume that allows lowest cost operation.

THE EDUCATIONAL COMPUTER

- Learn to program a computer
- Learn to operate a computer
- For Students
- For Hobbyists
- For the Professional
- For Small Business
- For the Home Owner

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You get the newest MODEL 'P' computer that includes 16K RAM, 2K ROM, 8080A microprocessor, color, sound, full 63 keyboard, high speed cassette deck, power cord, AC adapter, connector cord rack, tape storage tray, B connector cable, R.F. modulator with TV switch box and owner's manual.

SPECIAL FACTORY PACKAGE SALE DEAL \$344.00

Everything you get for \$249.00 plus LEVEL II DOCUMENTATION: Level II users manual, Level II Basic Program Tape, Level II Command Cards, Level II Basic Examples Book, SERVICE AND WARRANTY PACK: Diagnostic Program Tape, Diagnostic Instruction Manual, Service Manual, Cassette Head Alignment Tape, Schematics and Parts List, Money Saver Service and Warranty Card. Two II ACTION CONTROLLERS with Pot Knob, Finobution and Lever, PLUS THREE TAPE PROGRAMS. (Everything you need to learn to operate, program and service your computer.)

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CIRCLE 179 ON READER SERVICE CARD

1/19/83

OLYMPIC



DECATHLON

By Timothy Smith from Microsoft

The graphics capabilities you were promised when you bought your computer are finally evident in this marvelous series of 10 events, just like the real Decathlon. You compete in 10 demanding games that encompass different facets of running, jumping and throwing.

Play alone or with 30 many at night opponents. The goal is to win the gold medal in the skillful use of the keyboard. Because your score depends entirely on whether you're faster than the keyboard.

One of the most expressive video collections — and worth every penny! — has been added to this system in action. Otherwise, you simply won't believe the combination of truly outstanding graphics. Fast-paced action, satisfying results, and every aspect of reality you'll be surprised with Olympic Decathlon.

IBM Tapes... \$29.95 IBM Disk... \$29.95

COSMIC FIGHTER

By E. House & J. Koppa from Big Five
Tactical games, graphics and sound. The longest work this new series game is a winner! While fighting off the alien invaders, each more skilled than the last, you must keep track of your rocket fuel or risk explosion as you maneuver toward your space station. Can you stick, indefinitely, in the station from the by alien? Find out by ordering Cosmic Fighter today.

IBM Tapes... \$29.95
IBM Disk... \$29.95

GAMMON CHALLENGER

By Ray Daly & Tom Howard 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 68010 speed, and there are many special features that make it...

Choose one of three levels of play, but don't get too ambitious — Gammon Challenger will put you (and the rest of the world) to the test. For serious players, the "Modifying game" allows you to modify the game conditions. There are other computer backgammon games, but none with the Gammon Challenger.

IBM Tapes... \$29.95

TRS-80 Level II MK
unless otherwise
noted



PROJECT OMEGA

By Bill Nicholas, Adventure International
In probably the most accurate simulation ever produced for a home computer, you are responsible for the production, finance, health and well-being of Project Omega, the famous first deep space colony.

Paradoxically restricted, Project Omega will provide many enjoyment and satisfaction as you experience the frustration and intricacies of having an uncharted environment. The next version is for two players; the disk version supports two in turn, plus a special two-player mode.

IBM Tapes... \$29.95 IBM Disk... \$29.95



ATTACK FORCE!

By E. House & J. Koppa from Big Five
Click the mouse to shoot at the alien ships in the top of the screen. In Attack Force, you use the arrow keys to control both movement and direction as you maneuver all over the space in search of the alien invaders and their ships. A pattern, machine language game with amazing graphics and sound.

You have to be quick to avoid the enemy ships that warp across the screen. The "Fire" button can fire in all directions — even diagonally! And don't look away for a moment, because one of the alien spacecraft might be transformed into a secret weapon of your own!

IBM Tapes... \$29.95
IBM Disk Version... \$29.95

ZORK



By William from Personal Software
At last, the Great Underground Empire, an earthy adventure game in three parts. Bring all the treasures back to the first cave, and you can leave great. You must pick your way through various mazes, collecting objects that may help or hinder you in your quest. But never forget: when you're in the cave, they take no prisoners!

IBM Disk or Tapes... \$29.95

BASKET BALL



By John Allen from Acorn
This game is the best to know on a 16-bit system. It's the only one that's been in the market for 10 years and is still going strong. Computer graphics at their best.

Shoot the ball, shoot around your opponent and shoot toward the basket for a lay-up! The graphics are based on a 1-dimensional display of a basketball court, and ball-in-motion sounds add to the realism.

IBM Tapes... \$29.95
IBM Disk... \$29.95



BEST ALTHOUGH PRETTY GOOD

If you LDOS were just another disk operating system (DOS), we would not recommend it to you. However, you will find it makes life so much easier and simpler. Customer support and user benefits.

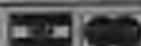
When you buy any DOS, you need services for programming assistance, updates and how-to books to use the features. This is part of what you buy with LDOS. First, you will be supported by a full-time phone line based on your registration card. Second, you will be provided with all updates and how-to books. Your original package is a service manual for updates. You can use the rest of the manual. Third, to make sure you will be able to use all the features, we provide you with a copy of LDOS, many special features.

With LDOS you get a well documented, thoroughly tested, and powerful DOS. The package is complete as a professional writer and detailed user's manual. Besides the training with one of the best microcomputer systems, the technical and customer support, a highly regarded technical writing firm is doing the manual.

The power of LDOS is its ease of installation, its independence of hardware configuration, and its diverse independence. You can use selected features, like together a series of programs and operations, and operate several different types of systems from the computer. LDOS has all the features of DOS 3.3, fully documented and working. There are many kinds of features which are the best from year to year, but the best feature is its ability to use for the user disk space combined with its other power features for the user. So we gladly want you to see what we can do for you. Call or write for more information.

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THE PROGRAM STORE
4200 Wisconsin Avenue NW, Dept. RS Box 9609
Washington, D.C. 20016



```

570 PRINT "YOU CAN PROBABLY GO TO THE"
575 IF 1=1 THEN GOTO 570
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995 IF 1=1 THEN GOTO 570

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A New Type of Game



Welcome to an astonishing new experience! **ADVENTURE** is one of the most challenging and innovative games available for your personal computer. This is not the average computer game in which you shoot at, chase, or get chased by something, master the game within an hour, and then lose interest. In fact, it may take you more than an hour to score at all, and will probably take days or weeks of playing to get a good score. (There is a provision for saving a game in progress).

The original computer version of *Adventure* was written by Willie Crowther and Don Woods in Fortran on a PDP-10 at MIT. In this version the player starts near a small wellhouse. Upon entering the house, he finds food, water, a set of keys and a lamp. Armed with only these items, he must set out to explore the countryside in search of treasure and other objects of play. He must also confront dwarfs, snakes, trolls, bears, dragons, birds, and other creatures during his quest. The game accepts one- or two-word commands such as GET LAMP, GO SOUTH, or KILL DWARF. Of course, if you don't have the proper tool to carry out an action, or if you do something foolish, you may find yourself in big trouble.

In playing the game you wander thru various "rooms" (locations), manipulating the objects there to try to find "treasures". You may have to defeat an exotic wild animal to get one treasure, or figure out how to get another treasure out of a quicksand bog. You communicate thru two-word commands such as 'go west', 'climb tree', 'throw axe', 'look around'.



Adventure

For Apple, TRS-80, Sorcerer, PET, CP/M

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 field, there is no magic but plenty of suspense. Good luck.

THE COUNT (by Scott Adams) - You wake up in a large brass bed in a castle somewhere in Transylvania. Who are you, what are you doing here, and WHY did the physician deliver a bottle of blood? You'll love this *Adventure*, in fact, you might say it's LOVE AT FIRST BITE....

ADVENTURELAND (by Scott Adams) - You wander through an enchanted world trying to recover the 12 lost treasures. You'll encounter WILD ANIMALS, MAGICAL BEINGS, and many other perils and puzzles. Can you rescue the BLUE OX from the quicksand? Or find your way out of the maze of pits? Happy *Adventure*ing....

VOODOO CASTLE (by Scott Adams) - Count Cristo has had a fiendish curse put on him by his enemies. There he lies, with you his only hope. Will you be able to rescue him or is he forever doomed? Beware the Voodoo Man....

ORIGINAL ADVENTURE (by Crowther, Woods, Marston, and Riechert) - Somewhere nearby is a colossal cave where others have found fortunes in treasures and gold, but some who have entered have never been seen again. You start at a small brick building which is the wellhouse for a large spring. You must try to find your way into the underground caverns where you'll meet a giant clam, nasty little dwarves, and much more. This *Adventure* is Bi-Lingual—you may play in either English or French—a language learning tool beyond comparison. Runs in 32K CP/M system (48K required for SAVE GAME feature). Even includes SAM76 language in which to run the game. The troll says "Good Luck."

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....

sensational software

TRS-80 Level II (16K) Machine language cassettes for only \$14.95 each
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CS-3008 Pirate Adventure
CS-3009 Mission Impossible
CS-3010 Voodoo Castle
CS-3011 The Count

TRS-80 Disk (32K) Menu-driven machine language disks for only \$39.95 each
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CS-3517 Voodoo Castle, The Count and Ghost Town

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CS-7003 Haunted House (16K Basic cassette, only \$11.95)
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CS-4012 Pirate Adventure
CS-4013 Mission Impossible
CS-4014 Voodoo Castle
CS-4005 Haunted House (in Basic, only \$11.95)

Apple II Disk (48K) Menu-driven machine language disks for only \$39.95 each
CS-4513 Adventureland, Pirate Adventure and Mission Impossible
CS-4514 Voodoo Castle, The Count and Ghost Town
CS-4504 Haunted House and 4 Outdoor Games (only \$24.95)

Pet (24K) Basic cassette
CS-1009 Adventureland and Pirate Adventure, only \$10.95

Sorcerer (16K) Machine language cassettes for only \$14.95 each
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CS-6004 Pirate Adventure
CS-6005 Mission Impossible
CS-6006 Voodoo Castle
CS-6007 The Count

CP/M 8" Disk (48K) for only \$24.95 each
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CS-8004 Original Adventure, bi-lingual with SAM76 language system.

Order directly from Creative Computing Software Dept., APOD, P.O. Box 788-M, Morrisville, NC 27560. Rush payment plus \$1 shipping and handling. For faster service call or your bank card under to (800) 531-6112. In NJ call (201) 540-3445.

CIRCLE 39 ON READER SERVICE CARD



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 similarities and then define these strings, thus resulting in short cuts. Lines 350 to 359 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

LET'S JOIN THE TWO-ON AND SING HAPPY BIRTHDAY TO JENNIFER
IF YOU ARE ALL READY TO SING PLEASE HIT ANY KEY—

HAPPY



```

180 REM * * * * *
190 REM * * BIRTHDAY CELEBRATION * * *
200 REM * * BY VIDA A. HARPER * * *
210 REM * * JUNE 1988 * * *
220 REM * * WRITTEN FOR TRS-80 * * *
230 REM * * LEVEL 11 BASIC * * *
240 CLS
250 CLEAR 1000
260 DEFSTR Q,R,S
270 INPUT "DO YOU HAVE YOUR SPEAKER CONNECTED (Y/N) — ";D$
280 IF D$="Y" THEN GOTO 40
290 PRINT "IF YOU DO NOT HAVE A SPEAKER THEN PLACE AN MPX-10"
300 PRINT "NEAR THE KEYBOARD SO YOU CAN HEAR THE MUSIC!"
310 FOR N=1 TO 999: NEXT N
320 CLS:PRINT#4," BIRTHDAY CELEBRATION"
330 FOR N=1 TO 999: NEXT N
340 PRINT#PRINT
350 INPUT "PLEASE GIVE THE FIRST NAME OF THE BIRTHDAY KID";F$
360 INPUT "GIVE THE AGE OF THE ONE WHO IS CELEBRATING";A$
370 L=LEN(Q$):IF L=1 THEN Q$=Q$(0)
380 IF L=2 THEN Q$=Q$(0)+Q$(1):IF L=3 THEN Q$=Q$(0)+Q$(1)+Q$(2)
390 IF L=4 THEN Q$=Q$(0)+Q$(1)+Q$(2)+Q$(3):IF L=5 THEN Q$=Q$(0)+Q$(1)+Q$(2)+Q$(3)+Q$(4)
400 CLS
410 IF A$="1" THEN PRINT#4," YOU MUST BE KIDDING!!!"
420 FOR N=1 TO 999: NEXT N
430 CLS
440 PRINT#4," H A P P Y B I R T H D A Y "
450 PRINT#4," THE NUMBERS ARE BLOCKS 16 ACROSS AND 3 DOWN OF GRAPHIC"
460 PRINT#4," CHARACTERS"
470 Q$=STRING$(5,24)+CHR$(26) "BACKSPACE H AND DOWN FREQ"
480 "02 IS TOP THIRD OF 0,2,8,9"
490 Q$=CHR$(184)+CHR$(128)+CHR$(131)+CHR$(133)+CHR$(135)
500 "03 IS BOTTOM THIRD OF 0,2,8,9"
510 Q$=CHR$(129)+CHR$(180)+CHR$(176)+CHR$(184)+CHR$(135)
520 "04 IS BOTTOM THIRD OF 3 AND 5"
530 Q$=CHR$(172)+CHR$(176)+CHR$(176)+CHR$(184)+CHR$(135)
540 "05 IS TWO BLANK SPACES, OR IS 2 OF CHR 166, AND 25 SPACES"
550 TO END OF LINE
560 Q$=STRING$(2,CHR$(126))+Q$+STRING$(2,CHR$(148))+Q$+CHR$(135)
570 "BUILDING THE NUMBERS ON THE CAKE BY USING GRAPHIC"
580 R(0)=Q$+Q$+Q$+CHR$(131)+Q$+CHR$(126)+CHR$(131)+Q$+Q$
590 R(1)=CHR$(128)+CHR$(184)+CHR$(131)+Q$+Q$+Q$+CHR$(131)+Q$+Q$+CHR$(184)
600 +CHR$(176)+CHR$(131)+CHR$(176)+CHR$(144)
610 R(2)=Q$+Q$+CHR$(128)+CHR$(176)+CHR$(184)+CHR$(135)+CHR$(129)+Q$
620 +CHR$(180)+CHR$(172)+CHR$(176)
630 R(3)=CHR$(148)+CHR$(131)+CHR$(129)+CHR$(184)+Q$+CHR$(126)
640 +CHR$(166)+CHR$(145)+Q$+Q$
650 R(4)=CHR$(160)+CHR$(180)+CHR$(131)+CHR$(131)+CHR$(128)+Q$+CHR$(143)
660 +CHR$(131)+CHR$(148)+Q$+Q$+CHR$(126)+CHR$(131)
670 R(5)=CHR$(180)+CHR$(131)+CHR$(131)+CHR$(129)+Q$+CHR$(139)+Q$
680 +CHR$(172)+CHR$(144)+Q$+Q$
690 R(6)=CHR$(129)+CHR$(160)+CHR$(180)+CHR$(131)+CHR$(126)+Q$+CHR$(144)
700 +CHR$(143)+Q$+CHR$(176)+Q$+Q$
710 R(7)=CHR$(142)+CHR$(131)+CHR$(163)+CHR$(135)+Q$+Q$
720 +CHR$(184)+CHR$(135)+CHR$(126)+Q$+CHR$(148)+CHR$(176)+CHR$(129)
730 R(8)=Q$+Q$+CHR$(163)+CHR$(163)+CHR$(140)+CHR$(166)+CHR$(145)+Q$+Q$
740 R(9)=Q$+Q$+CHR$(131)+Q$+CHR$(180)+CHR$(126)+Q$+CHR$(129)+CHR$(176)
750 +CHR$(150)+CHR$(129)

```

Vida Harper, 1077 S. Shore Dr., Holland, MI 49421.

Birthday, continued...

```

000 *POSITING THE HAPPERS ON THE CAKE ACCORDING TO WHETHER
001 THE PERSON IS ONE DIGIT, TWO DIGITS, OR THREE DIGITS (???). OLD
002 IFL=1THENPRINT#4:GOTO
003 IFL=2THENPRINT#4:R/C3:PRINT#4:GOTO
004 IFL=3THENPRINT#4:R/C5:R/C2:PRINT#4:GOTO
005 *DOORWAY TO THE CAKE WITH BEST WISHES
006 H=H+R/4:R/C2:PRINT#4:R/C2:PRINT#4:GOTO
007 *HAPPY BIRTHDAY
008 H=H+R/4:R/C2:PRINT#4:R/C2:PRINT#4:GOTO
009 *BUILDING THE SIDES AND BOTTOM OF THE CAKE
010 X=X+Y/4:FOR J=1 TO 2:STEP 1:SET X=X+J,Y=Y+J:GOTO
011 X=X+Y/4:FOR J=1 TO 2:STEP 1:SET X=X+J,Y=Y+J:GOTO
012 FOR X=1 TO 10:SET X=X+1:GOTO
013 X=X+Y/4:FOR J=1 TO 2:STEP 1:SET X=X+J,Y=Y+J:GOTO
014 FOR J=1 TO 4:SET X=X+1,Y=Y+1:GOTO
015 FOR J=1 TO 4:SET X=X+1,Y=Y+1:GOTO
016 *TOP OF THE CAKE USING AN ALTERED CIRCLE FORMULA
017 FOR X=1 TO 10:STEP 1
018 Y=SQRT(10-X*X):SET X=X+1,Y=Y+1:GOTO
019 FOR X=1 TO 10:STEP 1
020 Y=SQRT(10-X*X):SET X=X+1,Y=Y+1:GOTO
021 *WANT'S A CAKE WITHOUT CANDLES
022 FOR X=1 TO 10:SET X=X+1:GOTO
023 FOR X=1 TO 10:SET X=X+1:GOTO
024 FOR X=1 TO 10:SET X=X+1:GOTO
025 FOR X=1 TO 10:SET X=X+1:GOTO
026 FOR X=1 TO 10:SET X=X+1:GOTO
027 *THE GRAPHICS NECESSARY TO BLINK THE CANDLES
028 1=ON AND 2=OFF
029 GOTO
030 PRINT#4:GOTO
031 PRINT#4:GOTO
032 PRINT#4:GOTO
033 PRINT#4:GOTO
034 PRINT#4:GOTO
035 PRINT#4:GOTO
036 PRINT#4:GOTO
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lines 570, 580 and 590 the numbers 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 (777) old. The blinking of the candles is done by using graphic blocks 128 and 132, and timer blocks 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 *tone 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 more generalist program of Mr. McCulloch with a few minor changes. The machine language program was expanded to a 16K location, and in speed up the tempo a 1/2 factor of TM (time) was inserted in line 1000. Of course the price 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 lines and identified frequencies are measured for use.

N (145): MAA, C (215): D (254)
DW (280): E (297): F (309): Fe (480)
G (302): A (380): B (400)
High C (460): D (528) and E (540)

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 TBS-90 will be invited to attend many birthday celebrations.

Funeral 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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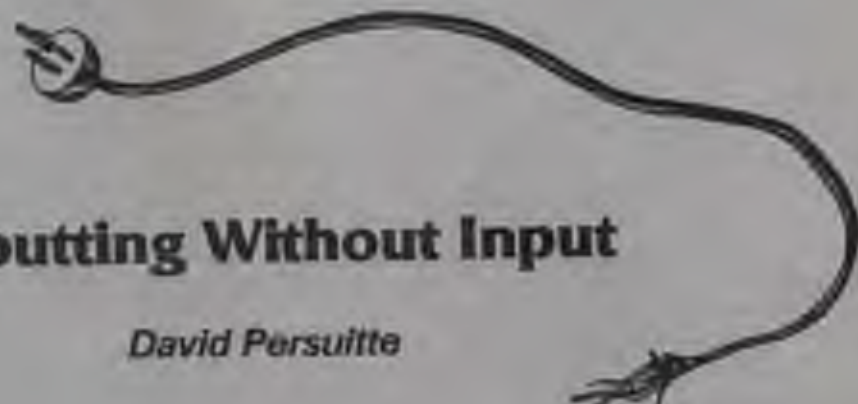
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621



Inputting Without Input

David Persuitte

Missing characters enter in BASIC. That's what happens when you don't do it right.

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 somehow 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 write a little program to ask for a name. You try running the program and the query comes up as you intended — say:

ENTER NAME?

You usually enter the first name:

Smith, John H.

Your trusty computer responds with

TEXTA IGNORED

"What the heck does that mean?" you ask yourself.

You eventually find out what the error comes to point 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 where it stores 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 TEXTA 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

variable if you replace 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 soon find that using a colon has a result closer to that of a comma. And what about the carriage return? If you

want to enter a carriage return into a string, you 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 showing

LIST

```

10 REM  REMOVED INPUT, BY DAVID PERSUITTE
20 REM
30 CLEAR 800
40 FOR I=1 TO 5
50 READ A1,X1
60 PRINT A1,X1
70 NEXT I
80 DATA 1,105,2,5,3,1234,4,55,1,0,5,0,7,201,240,1,201,0
90 AS=""
100 PRINT CHR$(12)
110 PRINT CHR$(17);"ENTER INFORMATION:"
120 PRINT
130 FOR C=0 TO 254
140 V=CHR$(C):IF PEEK(C)=0 THEN 140
150 D=PEEK(C):IF 1<D THEN 150
160 AS=AS+CHR$(D):PRINT CHR$(12);NEXT C
170 GOTO 250
180 LET C=0:IF C=255 THEN 180
190 LET AS=AS+CHR$(10):PRINT CHR$(10);
200 GOTO 140
210 IF I=1 THEN 210
220 IF I=4 THEN 220
230 IF I=5 THEN 230
240 GOTO 140
250 PRINT:PRINT CHR$(17);CHR$(12);"INFORMATION IN STRING:"
260 FOR I=1 TO 100:NEXT I
270 PRINT "DO YOU WANT INFORMATION DISPLAYED?"
280 V=CHR$(0):IF PEEK(0)=0 THEN 280
290 PRINT:PRINT
300 IF CHR$(PEEK(0))="Y" OR CHR$(PEEK(0))="y" THEN PRINT AS
310 PRINT
320 PRINT:PRINT "DO YOU WANT TO ENTER NEW INFORMATION?"
330 C=CHR$(0):IF PEEK(0)=0 THEN 330
340 IF CHR$(PEEK(0))="Y" OR CHR$(PEEK(0))="y" THEN 30
350 GOTO 280
360 PRINT CHR$(12);IF C=0 THEN 360
370 C=C+1:AS=LEFT$(AS,C):GOTO 140
380 END
390 REM

```


ing how to do this, it is designed to run on an Easy 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's RAM. The machine-language routine monitors the keyboard for an input. When it finds an input, it enters the character code into RAM location 2000 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 instruction 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 ASCII 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 entry entries.

Since the program bypasses some of the Basic functions, errors that are made during data entry cannot be corrected by the shift key. Instead, this program checks for control H, which, if entered, backs up the prompt just as the shift key 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 "N" (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. □

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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 processing software packages for the Apple II. Unfortunately, no single package perfectly met my needs, so I decided to purchase one that was 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 print-out, but they all have their own restrictions on inter-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 displays all 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 an odd 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.

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 computers 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

New Character Input and Conversion Routines for TEDITOR Program

18A0-	48	PSA	***CONVERT***
18A1-	A5 0C	128 81C	CONVERT CASE
18A3-	20 02	800 01807	YES, BRANCH
18A5-	48	FLA	
18A6-	42	RYV	NONE
18A7-	48	FLA	
18A8-	09 0A	009 8100	UPPER CASE
18AA-	10 12	80C 01800	NO, BRANCH
18AC-	09 07	000 8100	
18AD-	10 04	80L 01804	NO, BRANCH
18AE-	09 20	00A 8100	CONVERT TO LOWER
18B0-	00 0A	000 0180C	ADJUST SPACE
18B4-	09 07	000 8100	LOWER CASE
18B6-	00 0A	80L 01800	NO, BRANCH
18B8-	09 07	000 8100	
18BA-	10 04	80L 01804	NO, BRANCH
18BC-	29 02	400 8100	CONVERT TO UPPER
18BE-	00	800	NONE
18BF-	00	800	SPACE FILLER
18C0-	09 45	000 81A3	YES-YES ***INPUT***
18C2-	10 02	800 01A07	NO, BRANCH
18C4-	09 00	00A 8100	YES, MAKE LOWER CASE
18C6-	00	800	NONE
18C8-	48	FLA	
18CA-	A5 0A	128 100	MOVE TO CLERKIFY
18CB-	10 00	800 01A04	YES, BRANCH
18CD-	48	FLA	
18CE-	09 30	000 1A05	BRANCH
18CF-	00 00	800 01A01	NO, BRANCH
18D0-	A5 05	128 8100	DON'T CARE CHARACTER
18D2-	00	800	NONE
18D4-	48	FLA	
18D6-	09 0A	000 8100	UPPER CASE
18D8-	00 0A	80C 01800	NO, BRANCH
18DA-	09 00	000 8100	
18DC-	10 02	80L 01800	NO, BRANCH
18DE-	09 20	00A 8100	CONVERT TO LOWER
18E0-	00	800	NONE
18E2-	48	FLA	***ELL***
18E4-	A5 01	128 400	FOR CONTINUED
18E6-	10 00	80C 01A0A	NO, BRANCH
18E8-	10 0A	128 8100	MAKE POSITION
18EA-	10 0A 70	000 01804	WELL TO NEXT
18EC-	48	FLA	
18ED-	40	800	NONE

Figure 1. New Character Input and Conversion Routines for TEDITOR 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 pip 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 in 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 1540 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 18F0 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 other, 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 in PRINTER so that it calls the subroutine in Figure 3 at the

Patches to Apple Writer TEDITOR Program

0813-	20 00 10	000 0000	CALL BELL
14FA-	4C A2 10	000 015A5	MOVE TO CONVERT
1501-	4C 00 10	000 01A01	MOVE TO INPUT
1530-	4A	80C	ELIMINATE INVERSE VIDEO
1532-	4A	80C	
1534-	4A	80C	
1536-	4A	80C	
1538-	4A	80C	
1540-	40 00 10	000 0111A	BRANCH ALWAYS
1542-	20 00 10	000 015A5	MOVE TO CONVERT
1544-	20 00 10	000 015A5	MOVE TO CONVERT
1546-	20 00 10	000 015A5	MOVE TO CONVERT
1548-	20 00 10	000 015A5	MOVE TO CONVERT
154A-	20 00 10	000 015A5	MOVE TO CONVERT
154C-	20 00 10	000 015A5	MOVE TO CONVERT
154E-	20 00 10	000 015A5	MOVE TO CONVERT
1550-	20 00 10	000 015A5	MOVE TO CONVERT
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15DE-	20 00 10	000 015A5	MOVE TO CONVERT
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15F8-	20 00 10	000 015A5	MOVE TO CONVERT
15FA-	20 00 10	000 015A5	MOVE TO CONVERT
15FC-	20 00 10	000 015A5	MOVE TO CONVERT
15FE-	20 00 10	000 015A5	MOVE TO CONVERT
1600-	20 00 10	000 015A5	MOVE TO CONVERT
1602-	20 00 10	000 015A5	MOVE TO CONVERT
1604-	20 00 10	000 015A5	MOVE TO CONVERT
1606-	20 00 10	000 015A5	MOVE TO CONVERT
1608-	20 00 10	000 015A5	MOVE TO CONVERT
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16A0-	20 00 10	000 015A5	MOVE TO CONVERT
16A2-	20 00 10	000 015A5	MOVE TO CONVERT
16A4-	20 00 10	000 015A5	MOVE TO CONVERT
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16C0-	20 00 10	000 015A5	MOVE TO CONVERT
16C2-	20 00 10	000 015A5	MOVE TO CONVERT
16C4-	20 00 10	000 015A5	MOVE TO CONVERT
16C6-	20 00 10	000 015A5	MOVE TO CONVERT
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16CA-	20 00 10	000 015A5	MOVE TO CONVERT
16CC-	20 00 10	000 015A5	MOVE TO CONVERT
16CE-	20 00 10	000 015A5	MOVE TO CONVERT
16D0-	20 00 10	000 015A5	MOVE TO CONVERT
16D2-	20 00 10	000 015A5	MOVE TO CONVERT
16D4-	20 00 10	000 015A5	MOVE TO CONVERT
16D6-	20 00 10	000 015A5	MOVE TO CONVERT
16D8-	20 00 10	000 015A5	MOVE TO CONVERT
16DA-	20 00 10	000 015A5	MOVE TO CONVERT
16DC-	20 00 10	000 015A5	MOVE TO CONVERT
16DE-	20 00 10	000 015A5	MOVE TO CONVERT
16E0-	20 00 10	000 015A5	MOVE TO CONVERT
16E2-	20 00 10	000 015A5	MOVE TO CONVERT
16E4-	20 00 10	000 015A5	MOVE TO CONVERT
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16E8-	20 00 10	000 015A5	MOVE TO CONVERT
16EA-	20 00 10	000 015A5	MOVE TO CONVERT
16EC-	20 00 10	000 015A5	MOVE TO CONVERT
16EE-	20 00 10	000 015A5	MOVE TO CONVERT
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16FA-	20 00 10	000 015A5	MOVE TO CONVERT
16FC-	20 00 10	000 015A5	MOVE TO CONVERT
16FE-	20 00 10	000 015A5	MOVE TO CONVERT
1700-	20 00 10	000 015A5	MOVE TO CONVERT
1702-	20 00 10	000 015A5	MOVE TO CONVERT
1704-	20 00 10	000 015A5	MOVE TO CONVERT
1706-	20 00 10	000 015A5	MOVE TO CONVERT
1708-	20 00 10	000 015A5	MOVE TO CONVERT
170A-	20 00 10	000 015A5	MOVE TO CONVERT
170C-	20 00 10	000 015A5	MOVE TO CONVERT
170E-	20 00 10	000 015A5	MOVE TO CONVERT
1710-	20 00 10	000 015A5	MOVE TO CONVERT
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1714-	20 00 10	000 015A5	MOVE TO CONVERT
1716-	20 00 10	000 015A5	MOVE TO CONVERT
1718-	20 00 10	000 015A5	MOVE TO CONVERT
171A-	20 00 10	000 015A5	MOVE TO CONVERT
171C-	20 00 10	000 015A5	MOVE TO CONVERT
171E-	20 00 10	000 015A5	MOVE TO CONVERT
1720-	20 00 10	000 015A5	MOVE TO CONVERT
1722-	20 00 10	000 015A5	MOVE TO CONVERT
1724-	20 00 10	000 015A5	MOVE TO CONVERT
1726-	20 00 10	000 015A5	MOVE TO CONVERT
1728-	20 00 10	000 015A5	MOVE TO CONVERT
172A-	20 00 10	000 015A5	MOVE TO CONVERT
172C-	20 00 10	000 015A5	MOVE TO CONVERT
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1730-	20 00 10	000 015A5	MOVE TO CONVERT
1732-	20 00 10	000 015A5	MOVE TO CONVERT
1734-	20 00 10	000 015A5	MOVE TO CONVERT
1736-	20 00 10	000 015A5	MOVE TO CONVERT
1738-			

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If You Think Your Child Is Gifted...

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Gifted Children is a newsletter for the parents of children with great promise. It is a reliable and thoughtful source of information on recognizing, nurturing, and helping for all of the problems, opportunities, frustrations and joys of raising a gifted child. It brings to light some of the latest thinking on gifted education, and will be a constant source of help in the difficult decisions you as a parent have to make. Created by the editors of the award-winning *Learning Magazine*, each issue of *Gifted Children Newsletter* will bring you summaries like these to help you stretch all of the learning experiences of your gifted child.

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 - What To Do About Biting
 - Mistaken Parents Often Make with Their Gifted Children
 - Reviews of the new available TV viewing
 - Buyer's Guide for toys, electronic games and books, and
 - Answers to your specific questions about gifted education.
- Plus an every-month three-four page section filled with puzzles, word games and thinking-skills activities for your child—and for you and your child together.

Above all, *Gifted Children Newsletter* is a publication sensitive to the needs of the gifted and talented children of today. And it is the only publication comprehensive enough to give you the support you truly need to meet the many challenges of raising a gifted child. If you think your child is gifted, you owe it to yourself—and to your child—to use the coupon below to order your free copy of *Gifted Children Newsletter* today.

Yes! Send me the next issue of *Gifted Children Newsletter* as obligation and enroll me as a *Gifted Children Newsletter* subscriber. I understand that if I am not completely satisfied I may write "cancel" on the bill, which I request. Keep my copy of *Gifted Children Newsletter* free and not be obligated to me with more or ever. Otherwise, you will consider my subscription for a full year (12 issues) at the rate of just \$2 per month.

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CIRCLE 161 ON READER SERVICE CARD

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 (0) files to save text on disk. The text buffer starts at 1000 and can go up to 9599. The first byte of data must be a hex 03 and the last must be a hex 00. All characters between, in the lower-case version, are internal ASCII characters, with the most significant bit set to 0. (The unmodified Apple Writer uses the same format except that some of the characters are not in ASCII representation.) Once the text is in the buffer, do a **SAVE TEXT YOUR FILE NAME.ASYM LAYOUT 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.

That you can load the file under control of Apple Writer. You may see some garbage characters as stored in the buffer because there's no hex 00 at the end of the file, but you can quickly delete them.

If you have a lot of text files, you can use the Disk Zap program from Apple PageMaker Program Library Exchange (A.P.P.L.E.). It enables you to modify your disk directory to set Apple DOS that your text file is a binary file and then **LOAD FILE NAME.ASYM**.

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, justify when printing, skipping headers on the first page, and printing only a specified range of page numbers. The Technical Systems Corporation's 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. □

FIGURE 1: Apple Writer PRINTER Program

0000-	A1	DATA	ASCII ENLIGHTENMENT POINT
1000-	4C 00 18	END FIRST	CALL FIRST
1020-	88	END	ALPHABETIC JOURNAL FORM
1040-	88	END	
1060-	88	END	
1080-	88	END	
1100-	88 00	END	VALUES ABOVE
1120-	4C 00 18	END FIRST	END FORMATION
1140-	80	DATA	ASCII 1 LOWER CASE 1
1160-	80		"
1180-	F0		"
1200-	00		"
1220-	F0		"
1240-	00		"
1260-	F0		"
1280-	00		"
1300-	F0		"
1320-	00		"
1340-	F0		"
1360-	00		"
1380-	F0		"
1400-	00		"
1420-	F0		"
1440-	00		"
1460-	F0		"
1480-	00		"
1500-	00		"
1520-	00		"
1540-	00		"
1560-	00		"
1580-	00		"
1600-	00		"
1620-	00		"
1640-	00		"
1660-	00		"
1680-	00		"
1700-	00		"
1720-	00		"
1740-	00		"
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1820-	00		"
1840-	00		"
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1880-	00		"
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1920-	00		"
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1960-	00		"
1980-	00		"
2000-	00		"
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2060-	00		"
2080-	00		"
2100-	00		"
2120-	00		"
2140-	00		"
2160-	00		"
2180-	00		"
2200-	00		"
2220-	00		"
2240-	00		"
2260-	00		"
2280-	00		"
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2980-	00		"
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3060-	00		"
3080-	00		"
3100-	00		"
3120-	00		"
3140-	00		"
3160-	00		"
3180-	00		"
3200-	00		"
3220-	00		"
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An Introduction to Computer Control

Ronald K. Pearson

Computer control of real-world gadgets is a fascinating subject, involving hardware and software in about equal proportions. For this reason, most practitioners of automatic control around the house are those who enjoy building their own hardware, writing their own software and debugging both. A few manufacturers, however, do seem to have missed the conceptual possibilities inherent in this idea and it is not unreasonable to expect more to follow suit as it catches on. (See, for example, Paul Dunn's description of the Intel 8-B system in the November 1979 issue of *Creative Computing*; I will come back to this

later.) Necessary components are the computer itself, of course, a CPU or other device for communicating with the user, and a collection of interface hardware to make the computer-controlled variables 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 more basic considerations in selecting one of these devices for any particular application are the nature of the power to be switched (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 15 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 intelligent but somewhat naive of handling high current loads is to use a low-current solid-state relay to turn on or off an AC electromagnetic relay.

The simplest type of controller is the on/off switch.

questions 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 doors, mixers and an amazing 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.

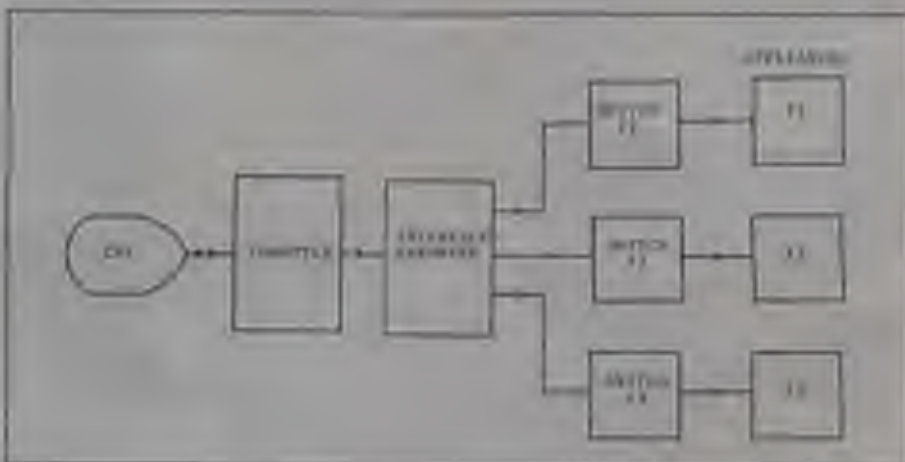


Figure 1
The On/Off Control System

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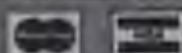
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whose contacts are rated in terms of the required current.

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 in 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.

Simply 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 electromagnet-relay-based output port 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 — unless 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 automatically wake-up services (i.e., lights on at 8:30 A.M., coffee pot and stove 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 anything else for an hour at bedtime — all can be provided by your computer. If

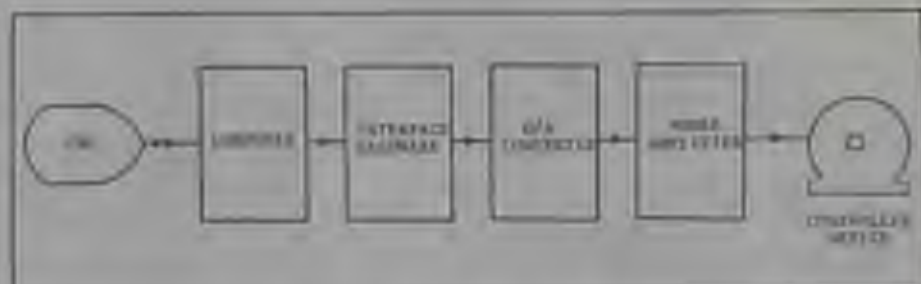


Figure 2: Proportional Control System.

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 interface simple.

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 (D/A 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 *Digital: Internal 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 buying the various modules from a cheap audio amplifier whose output voltage and current are suitable.

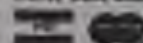
A useful trick for proportional control of some AC-operated devices like lights and motors is called "AC phase control," is the basis for many commercially available light dimmers and variable speed motorized appliances. The basic idea here is to use an SCR or TRIAC to turn the light or motor on for 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 is a light-intensity controller might be a three digit number between 0 and 999, 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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Control, continued...

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 thermodynamically-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

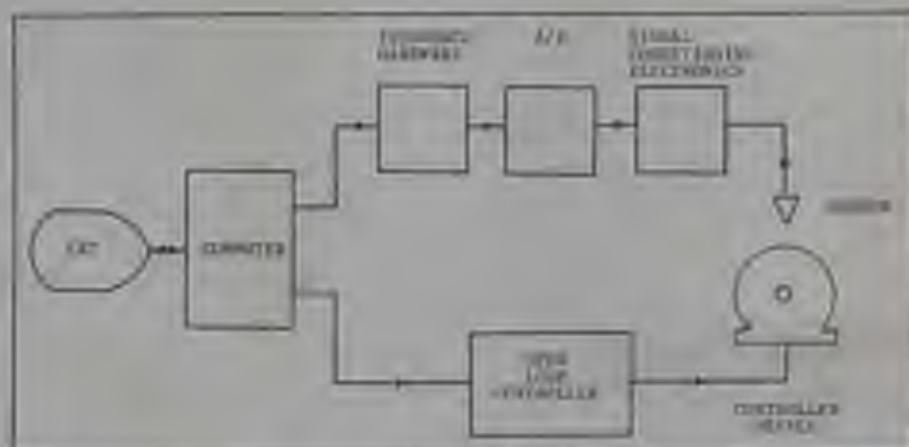


Figure 3
Feedback Control System

measure the quantity under control, some analog-signal-conditioning electronics, an analog-to-digital converter and some 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 LM5600. 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 multiplexers 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 Alarming Degree*, by Stuart A. Hoesing and F. Leland Payne. This is a very readable book (the cartoons are good), one 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.

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 the 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 ensues, 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. Bittgen's *Mathematics 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 to you is by no means exhaustive. 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 car 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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The Grandmaster Factor



Robert Grossbach



After nearly a year of exhausting effort, Kraft finally came up with a machine he was certain could beat anyone in the world.

"Anyone," questioned Kushner, the hawk-faced vice-president of marketing, when Kraft made his presentation at the CompuGames annual new-products conference.

"Anyone," repeated Kraft flatly, reluctantly throwing his natural engineer's caution to the winds, knowing he'd come too far to back down now. He looked around the large, U-shaped table at the assemblage of high-powered executives: vice-presidents of accounting and financial planning, of quality control and production, sales and personnel. And at the crutch of the U, Venator himself, the hard-driving, millionaire president and chairman of the board, a man of legendary ruthlessness. Venator's long-grey eyes regarded Kraft with birdlike remoteness.

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. "CompuGames 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, Kraft, where do we go from here?"

"Kraft," said Kraft. He had no more anticipated, "I suggest," he said, "a tournament. Man versus machine. Grandmasters 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.

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"And who would you select as MATE-9's opponent?" asked Bauer, the head of finance. "Krechner?"

"Too flighty," said Kraft. "And besides, he's already endorsed the Toys Unlimited machine." He paused. "Actually, since Fischer's retired, and Kasparov'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 pressing through his tightened lips and filling the room like an expanding gas. Schiff.

The problems with aiming 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 tripped by a human whose mating plan suddenly surfaced after seven. The programmers grew more clever. But still, the Grandmasters appeared unreachable.

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 Alkhine. And, of course, the brilliant new champion, the unpredictable boy terror, Schiff. Ego, Kraft realized, each man simultaneously owner and owned. Master and servant in 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 zapped 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 extreme 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 strode into the specially prepared exhibition hall at the Las Vegas Hilton. Seemingly 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 stockings 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-QB3, 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 peter 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 wonderkid was in deep trouble. Although both players had moved briskly,

***It was Venator who spoke first,
the name pressing through
his tightened lips and filling the room
like an expanding gas.***

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 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 pinpoint began to fill the area of MATE-9's display screen. Gasps came from the audience at each new, neatly lowered 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 8033 to use as a second during adjustments.

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. □

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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 10 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 fanfold pack; roll width is 4.37" with 2.45" diameter. Printer/plotter size is 16-1/2" wide x 7-1/2" deep x 4" height. \$390.

Alphacom, Inc., 3031 Tech Way, San Jose, CA 95128, (408) 249-2152.
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PRINTER FEATURES DISPOSABLE PRINTHEAD

The Epson MX-80 features a disposable print head. Once the MX-80's Micro-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 backing function. Print densities of 40, 66, 80 or 132 printing columns in an 8" field are possible, and the adjustable mini-trimline accommodates paper widths from 4" to 11". \$650.

Epson America, Inc., 2384 Hawthorne Blvd., Torrance, CA 90505 (213) 378-2223.
CIRCLE 248 ON READER SERVICE CARD

COMPUTERS

SELF-CONTAINED COMPUTER



Zed 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, 9-inch and 9-inch screens respectively. The software selectable screen format can be either 16 lines by 36 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, 300 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 CDS 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.

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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 720 printer (\$8,500), 703 printer (\$11,225), or no printer at all (\$7,750).

Logical Machine Corp., 1294 Hammerwood Ave., San Jose, CA 94065, (408) 744-1200.

CIRCLE 258 ON READER SERVICE CARD

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CIRCLE 249 ON READER SERVICE CARD



Super Invasion and Space War

Disk CS-4608 \$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 stockades 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 missile fire, force him to collide with the sun or to explode upon re-entry from hyperspace. Or vary... He may circle out of sight and re-appear on the opposite side of the galaxy. (This is the classic MIT game redesigned especially for the Apple II.)

creative computing

To order use handy order form in the back of the magazine.

CIRCLE 300 ON READER SERVICE CARD

PERIPHERALS

VIDEO-DISC-APPLE INTERFACE

The Coloney VAF-1 is a Video-Disc-Apple Interface. The circuit board fits inside the microcomputer housing and allows complete computer control of the Disco-Visor 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, \$325.

Coloney Productions, 1248 Bloomington Hwy., Tallahassee, FL 32304, (904) 375-0691.

CIRCLE 281 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, DTR), 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 Pecoson Dr., San Jose, CA 95131, (408) 945-7400.

CIRCLE 282 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 283 ON READER SERVICE CARD

Outdoor Games

Cassette CG-401G & 14 DS

4 Programs

Requires 18K Apple II or Apple II Plus



Forest Fire. Use chemical retardants and backfires to control raging forest fires.



Fishing Trip. Try to catch flounder and salmon while avoiding logs, sharks, bad weather and running out of fuel.



Treasure Island I. Your map shows hidden treasure but unfortunately you don't know where you are. Try to find the treasure while moving about and observing your surroundings. You have a 3-day supply of food and water. You may find useful objects (compass, weapons, a horse) but watch out for hazards (robot guards, pirates, caves, crocodiles, mountain lions and more).

Treasure Island II. Same game except you have to use a metal detector to find the treasure.

Outdoor Games is available with Haunted House on disk for \$19.95. To order use handy order form in the back of the magazine.

CIRCLE 285 ON READER SERVICE CARD

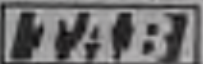
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CIRCLE 129 ON READER SERVICE CARD

APPLICATIONS SOFTWARE

PERSONAL

Microbans 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. Computar, 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, (714) 947-2762.

CIRCLE 288 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 displayed in tabular form on the video screen or laser 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 Hollywood 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 market-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 "anomalous" activity. Cassette, \$89; disk, \$99. Galactic Software, 11520 N. Port Washington Rd., Mequon, WI 53092, (414) 241-8030.

CIRCLE 267 ON READER SERVICE CARD

Standard and Pizer'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

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 crosshair at its end. You simply place any graph, picture or drawing (up to 8 1/2" 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 VersaWriter 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, smoothing 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 8 1/2" x 11" drawing surface, plastic overlay and two disks of software. Price \$252.00 postpaid in continental U.S.A. VersaWriter has a 90-day warranty on parts and labor.

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CIRCLE 248 ON READER SERVICE CARD

puzzles & problems



A Potty Problem

is 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 sketching. 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 Puzzles #37").



Santa's Puzzle



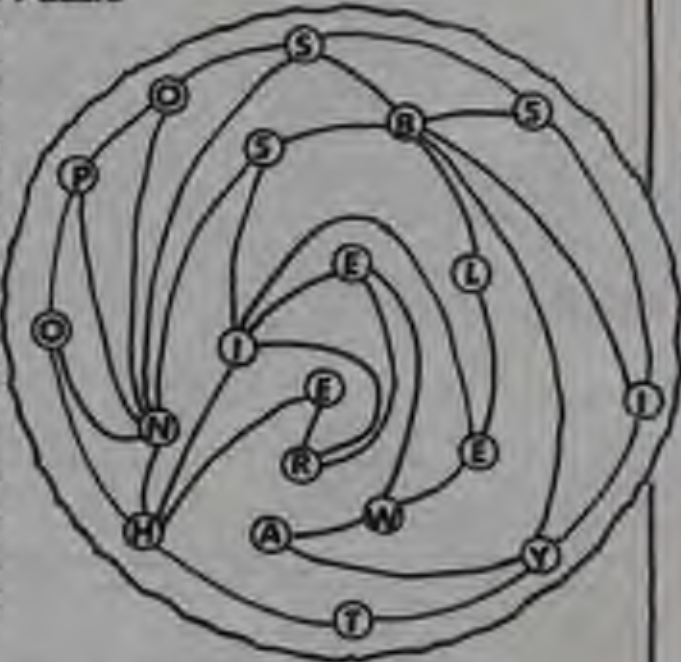
he following puzzle almost caused Sam to be late last Christmas. Some young programmer included it at the end of the list of computer games he was asking for. The puzzle asks the question: "How is it that Halloween, October 31, equals Christmas, December 25, and, Thanksgiving, November 27, also equals Christmas, December 25? How indeed! Our thanks go out to George Zimmerman of Yellow Springs, Ohio. You've earned a copy of "Merlin's Puzzles 2" from "Santa" Merlin.

A Martian Puzzle



are informed that Willard Starbuck, 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 mysterious "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 summed up 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

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 Puzzles 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 Thuck and Waggoner dictionary circa 1815. The following 14 words contain the seven words pictured down the left side of this page.

The words are: (A) Disgrace; (B) Groceries; (C) Podium; (D) Lashless; (E) Montage; (F) Perring; (G) Coupe; (H) Colophon; (I) Chaise; (J) Balise; (K) Hatter; (L) Quint; (M) Pyroc; (N) Grit.



The Nifty Nines

What word containing 9 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 brass. When asked how much she had spent for it, Wisteria replied that she had gotten it for 12 percent less than list price. Moon, who 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 30 percent above the list price for it. Wisteria, who is not the type to hold resentment above profits, 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 prearranged in the shape of a conjuring trick, usually after two or three false 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 touch 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 griously 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 persons 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 Puzzles" 27)



Answers on page 194



I hope that you enjoyed Merlin's puzzles. The old boy likes his best to come up with an interesting twister for you each time. 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 Puzzles" series just write to Creative Computing, they carry

the complete line.

And next month, good puzzling to one and all!

Your editor,

Charles Barry Townsend

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 epigrammatic 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 (626-546 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. Incidentally, Anaximander (who it seems did a lot of thinking, erroneously though it might be) also thought the Earth was shaped like a flat topped cylinder.

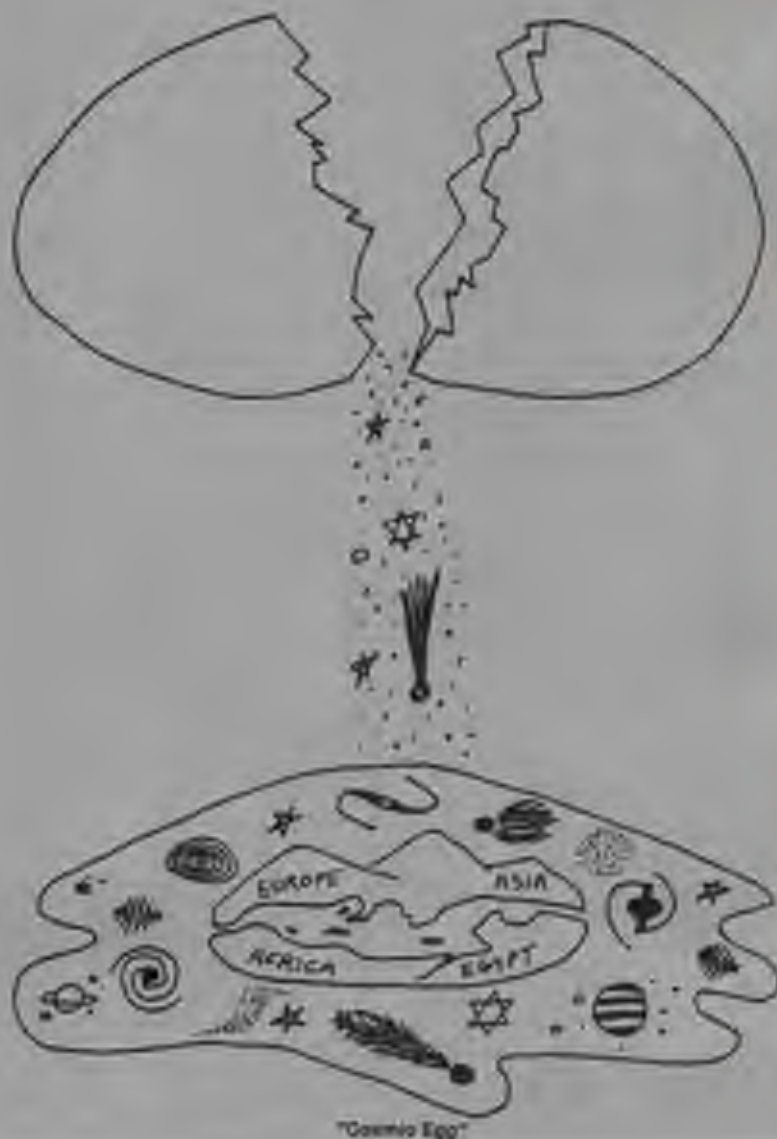
6. Epicurus (341-270 B.C.), who always argued for moderation and common sense, held that the Sun and the Moon were about the same size, exactly as they appear to be!

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. Theodorus of Mopsuestia (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 Ark 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! □



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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, Ned Vachworth of Sci-Fi approached Byte about doing a similar book. Virginia wanted to be nice to everyone, so she gave permission. Thus was born the *Sci-Fi-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 Sci-Fi 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.

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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 called 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 v. Commission 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 scanned in front of the huge audience table that provided the eight remaining (black-robed) decision makers. Dressed in his "morning coat", a gray full length frock coat with tails and his monocle 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 intensely active as it repeatedly interrupted Mr. Wallace to ask questions so that they could not only understand the present invention, but also gain an appreciation 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 invention 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 "bureaucratic 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 simply phrased. 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 1880s 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, Blackman, 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 composed 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 expounded 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 "suff", Mr. Justice Brennan merely said "lunch break".

After lunch, Mr. Wallace continued and responded to Mr. Justice Stevens' 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 Prasinov of Honeywell Information Systems got up to speak for the inventor. Surprisingly, Mr. Prasinov 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. Prasinov 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. Prasinov 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. Prasinov nearly

held the nails as Mr. Wallace hammered them home. The coffin was sealed. Only if the Supreme Court can become Houdini, we 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 (CPU) 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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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 58000 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 off 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 mangling 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 as to 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

robust) is to buy some hardware which permits several ROM sockets to share the same address, though not all at once. Skylar Electric Works offers several variations, called Socket-Two-Me and ROM-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 B0P 1X0) also provides a "Dial-A-Rom" (\$88.00 + \$3.00 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, Extremem, Viscalc 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 Chngt 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 activated by POKING the PET to the alternate character set by POKING 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 5 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 something 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

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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: MERGE (disk version of Toolkit's APPEND), SEND (any command in the PRINT format you see 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 lets the Basic program up or down if the Cursor Up or Down keys hit the screen's edge.

One of the newest 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 volumes 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 numbers would normally be printed in Scientific form (ie, 3.12 E-12).

If you already have Basic 4, Styles offers a "Command-Q" 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 raffle 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 technological systems towards people, both as groups and as individuals. Before personal computers, most machinery was incredibly stupid. If an axe was there to run the machine, the machine could (and did) do terrible things. Most machines that we know have no sense. 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: BREED FROM START or ILLEGAL QUANTITY mousing up your PET's screen or your student's self-esteem.

PILOT Introduction

PILOT consists of these elements:

- 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 anywhere. (like GOTO)
- S: Subroutine. (like GOSUB)
- R: Return from subroutine.
- E: 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,YES,YES,OK,YES,NO
Y:I'M HAPPY TO HEAR THAT. YOU ALREADY
T:KNOW WHY I'M A COMPUTER.

J:MYSTERY
M:NO,NEVER,YES,NO,YES
Y:WOW, PERHAPS YOU SHOULD TURN ME OFF.
Y:I DID ENJOY TALKING WITH YOU. NAME?
A:
M:I'M NOT SURE I UNDERSTAND THAT, BUT
M:LET'S SEE IF YOUR OPINION WILL BECOME
M:CLEARER AS WE GO ON.

*STEP T:WELL NOW, WHEN DID YOU FIRST MEET A
T:COMPUTER?
```

Newly-Added Commands

```
SYS 98000 - Start Disk-O-Pro
KILL - Stop Disk-O-Pro
BEEP (duration),(tone) - CBE 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) (U disk id) (ON U device)
CATALOG (D drive) (ON U device)
DIRECTORY (D drive) (ON U device)
BACKUP D drive TO U drive (ON U device)
COPY (D drive) "filename" TO (D drive) "newfilename" (ON U device)
or: D drive TO U drive (ON U device)
COLLECT (D drive) (ON U device)

ERASE "filename" (D drive) (U) (ON U device)
DELNO "filename" (D drive) (ON U device)
EJECTS "filename" (D drive) (ON U device)
RENAME "filename" (D drive) TO "newfilename" (ON U device)
SCRATCH "filename" (D drive) (ON U device)
MERGE (A line number) "filename" (D drive) (ON U device)
CONCAT (D drive) "filename" TO (D drive) "replaced
filename" (ON U device)

OPEN # logical file, "filename" (U record size) (D drive)
(ON U device) (A) (U)
CLOSE # logical file (ON U device)
APPEND # logical file (D drive) (ON U device)
RECORD # logical file, record # (A, byte #) .....
```

Figure 1: Disk-O-Pro
Commands Summary

PET, continued...

This is almost available. 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 (smoothing indicatrix what's (name)  
ALL RIGHT THERE, MARY WILLIAMS. I HAVE A QUESTION  
FOR YOU. DO YOU LIKE COMPUTERS?  
NOT PARTICULARLY.  
STOP, 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?  
BERKINER MC DURE.  
ALL RIGHT THERE, BERKINER MC DURE. I HAVE A QUESTION  
FOR YOU. DO YOU LIKE COMPUTERS?  
I SUPPLY 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 HARRY.  
ALL RIGHT THERE, HJ HARRY. I HAVE A QUESTION  
FOR YOU. DO YOU LIKE COMPUTERS?  
U UN HARRY.  
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) NAMES. In the next line, where NAMES 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-returns. 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 BOOT, CLOUT, OUTRAGEDOUS, but will not match HEAD or SOUTH.

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. Península 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. Península 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. Through 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.

Península PILOT

A major barrier 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 lessons within the program. Lines 10 to 300 are simply empty lines beginning with a question 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 perform the lessons.

To save or load, you merely SAVE or LOAD the whole thing — PILOT language and lessons together. The PET thinks this is a Basic program.

Península 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 "bare-bones" 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



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PET, continued...

are substituted for colon (:) and comma (,). The only alternative is to write a GET message, which takes about 200-400 bytes. Even then, there's the problem of making easily available data maps.

A serious limitation of this PILOT is that the Match (M:) does not work the way it should. **THINGY** 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 words. Bull!

PET PILOT

This PILOT is closest to the PILOT "standard" (yes there is such a thing), with enough limitations to limit me to very patient people. The system is to read a line with the lesson on it (prepared via a separate editor program) and to store about 80 lines in the PET at one time. Though unthinkably 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 into 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 clumsy.

Do It Yourself

Some miscellaneous comments: First, where are all the PLEOT 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 PLEOT. This is not as bad as you may imagine, for "cantered" PLEOT lessons would require modification anyway.

Second, yes, the four PILOTs can be modified to work on the PET disk. Pentasoft 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# 1, "something"

PRINTS s. something CHES/11c

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 requirements of GET# makes the execution very slow. The editor could be changed to fix this, but my intention was only to review these programs.

2) Testicula FILET

Pymorosa School Software
 Computer Project
 Pymorosa School
 Pymorosa Mesa
 Pueblo Park, LA 94025

Price: \$19.95

21. *Practical Applications* P1189

PEY Practicality Files
Practical Applications
PO Box 4129
Foster City, CA 94404

Price: \$14.95

Hi Dr. Saleem's friend

Dr. Bailey
425 Grove Ave.
Barren Springs, W. 29102

Price: \$14.95

63 PRF PILOT

David Soreng
Seven Starview Court
San Francisco, CA 94116

Price: \$17.95

Further information on PILOT is available from:

The PILOT Exchange
Earl Rysner
22 Elver Lane
Minnetonka, Iowa 52401

Figure 2. PLOTs for the PFI

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.)

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Greenville, NC 27403 USA
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Primrose
PO Box 88
Newbury, Berkshire
England RG16 0BD
\$35.00 per year (U.S.A.)

Comstar¹ covers the other 852 machines, but its major emphasis is on the PET. Primarily is strictly on the PET. The English view of PET is very different from ours, and worth looking at. A lot is still in harnessing over there.

Machine Language Codelle #3

Figure 3 shows a program which you can enter into your PET like a woman's fantasy. The machine language routine was taken from *Provoid*, October 80, Page 34, and will work for both ROMs ("old" and "new"). If you merely **SYN 828** 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 30, by the way is really

SO PRINT "v1"

Cautions: This program does flash a bit, and if flashing things bother you, don't hesitate to press the Stop key. □

Figure 3. Machine Language Control #1

RESEARCH PLAN

```

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2000000000
3000000000
4000000000
5000000000
6000000000
7000000000
8000000000
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11000000000
12000000000
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15000000000
16000000000
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18000000000
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20000000000
21000000000
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CIRCLE 178 ON READER SERVICE CARD

TRS~SO 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 ORCHST, 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 margin of your keyboard, or into the expansion interface. It's a digital-to-analog converter that changes the binary computer output into 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 Juilliard 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, and qualifies 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, as 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-voices available, if you want to modify the waveforms to create your own tone-voices, 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:

```
/CAPPUCCIO  
/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 CASTIGLIONE
```

After that, you write a line to indicate the key, such as

```
K26
```

which means in the key of two flats. For three sharps, write K38. 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

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Basic In A Nutshell

Name: Step-By-Step

Vendor: Program Design, Inc., 11 Ida Court, Greenwich, CT 06830

Price: \$49.95

Purpose: Teaches how to program a TRS-80 using BASIC.

Documentation: Outstanding

Loading: OK - Level 2, not official

Implementation: This is a case of a BASIC program that teaches BASIC programming. It starts out with the assumption that the student already knows how to turn the TRS-80 on. Three cassette tapes are included in the cover of a boxed individual that also contains supplementary information sheets. The course is divided into ten two-part lessons, from a simple PRINT statement through arrays and graphics to complex programs. All of the level 1 commands and statements are covered.

The instruction method consists of explanation, examples, test and testing. Commands and statements are presented and explained, examples are shown both on the screen and in the textbook, and then the student is presented with some problems to solve using the BASIC statements under discussion. (An incorrect answer is given,

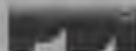
two more tries are allowed, and then the correct answer is displayed. Each lesson ends with a test that is administered and scored by the computer. The results are then entered into the student's progress chart. More comprehensive examinations are given at the end of Lesson 5 and at the end of the course.

Usability: This is the end of educational programming that personal computing needs more of. The student (the average Joe) 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. It is a course where the student is allowed to do the learning; this course would be especially useful to the teacher. I'd like to see a similar course for assembly language programming.

Other software available from the same vendor: IQ Builder (four different sizes), Memory Builder and Disk Builder.

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CIRCLE 218 ON READER SERVICE CARD

TRS-80, continued...

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.

11

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 colors 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

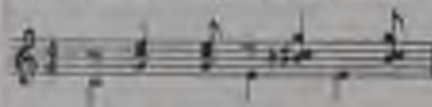
and you're ready to start with the notes themselves.

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, thirty-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 +6, and the sixteen below it are -1 through -6. Using * or @ eliminates the need for the plus or minus signs most of the time. For a rest, use S. 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 statistical exercises in the manual:



879428 * 204028 * 18
 9209427 * 279427 * 27
 930944 * 349404 * 20
 949404 * 3

V1 is understood for the first voice. * means treble clef, 25 means eighth-note rest, QV 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 f# 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 O2'.

For dotted notes, just use dots, as in I.O for a dotted eighth-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 (16:5D6~1), 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. 138) 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 10288, 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 bust.

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 alphanumeric.

This 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 Lee 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 total 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-integer. 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 Lee 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 Twin 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 Corrado at SUNY and Ann



Corrado 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 logistic, and sigmoidal 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 lake 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 developed in real life.

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 program to investigate the effects of different variables such as the type of water, temperature, and the rate of dumping waste material. Various types of primary and secondary waste treatment, as well as the impact of economic and economic decisions can be examined.

2. Rats

IN RATS, you play the role of a Health Department official devising an effective practical plan to control rats. The plan may combine the use of sanitation and wire snare 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 urban city.



3. Malaria

WITH MALARIA, you are a Health Officer trying to control a malarial epidemic while taking into account financial considerations in setting up a program. The busy use of field hospitals, drugs for the ill, free tests of persons, and preventative medication may be properly prioritized 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 set of data types and amounts of food eaten in a typical day, as well as your age, weight, sex, height and a physical activity factor. DIET is particularly valuable in indicating how a diet can be changed to meet body weights and provide proper nutrition.

Social and Economic Simulations CS-3204 (16K)

1. Limits

LIMITS is a micro-oligopoly 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.

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-3201, cassette 3201. Ecology Simulations-II: disk CS-3202, cassette 3204. Social and Economic Simulations: disk CS-3204, 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. ACDG, P.O. Box 782-M, Morrisown, NJ 07960. For Faster Service, call in your order toll-free to our order hotline 800-631-8112. In NJ call 201-540-0445.

TAS-00, continued.

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-6" and for a 4K Level II TRS-80. The price is \$54.95. From Mentor Software, Box 791, Ankeny, MN 55303.

Mentor also has other TRS-80 packages, for "guided drill, practice and instruction" in math and spelling, each around the \$30-\$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-1, 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, 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

slow keyboarder. (The illustration above, taken from the manual, is an approximation of the program display.)

The other first-session 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'd 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, *Keybill*, 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-Tronics*, 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 appendices 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 \$24.95, but which does improve after a close start. Well, most children do have a short attention span. Then again, perhaps the teacher, at least 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 STAC

From Cedar Grove, Ill., James M. Curran sent this program which he believes to be the "definitive way 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, inasmuch as it runs exactly the way it's supposed to.

That C in line 1000 is what some printers print instead of the up-arrow; that portion of the line should be (50B(4) 2).

Jim signs his letter "17-year-old programmer, wild-haired punk, and soon-to-be-president of the supertransformed 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.

```

8 DN KNOX LITO 1968
10 28FINT 8.7.8
12 1-2-10-20-30-40-50-60-70-80-90-100-110-120-130-140-150-160-170-180-190-200-210-220-230-240-250-260-270-280-290-300-310-320-330-340-350-360-370-380-390-400-410-420-430-440-450-460-470-480-490-500-510-520-530-540-550-560-570-580-590-600-610-620-630-640-650-660-670-680-690-700-710-720-730-740-750-760-770-780-790-800-810-820-830-840-850-860-870-880-890-900-910-920-930-940-950-960-970-980-990-1000-1010-1020-1030-1040-1050-1060-1070-1080-1090-1100-1110-1120-1130-1140-1150-1160-1170-1180-1190-1200-1210-1220-1230-1240-1250-1260-1270-1280-1290-1300-1310-1320-1330-1340-1350-1360-1370-1380-1390-1400-1410-1420-1430-1440-1450-1460-1470-1480-1490-1500-1510-1520-1530-1540-1550-1560-1570-1580-1590-1600-1610-1620-1630-1640-1650-1660-1670-1680-1690-1700-1710-1720-1730-1740-1750-1760-1770-1780-1790-1800-1810-1820-1830-1840-1850-1860-1870-1880-1890-1900-1910-1920-1930-1940-1950-1960-1970-1980-1990-2000-2010-2020-2030-2040-2050-2060-2070-2080-2090-2100-2110-2120-2130-2140-2150-2160-2170-2180-2190-2200-2210-2220-2230-2240-2250-2260-2270-2280-2290-2300-2310-2320-2330-2340-2350-2360-2370-2380-2390-2400-2410-2420-2430-2440-2450-2460-2470-2480-2490-2500-2510-2520-2530-2540-2550-2560-2570-2580-2590-2600-2610-2620-2630-2640-2650-2660-2670-2680-2690-2700-2710-2720-2730-2740-2750-2760-2770-2780-2790-2800-2810-2820-2830-2840-2850-2860-2870-2880-2890-2900-2910-2920-2930-2940-2950-2960-2970-2980-2990-3000-3010-3020-3030-3040-3050-3060-3070-3080-3090-3100-3110-3120-3130-3140-3150-3160-3170-3180-3190-3200-3210-3220-3230-3240-3250-3260-3270-3280-3290-3300-3310-3320-3330-3340-3350-3360-3370-3380-3390-3400-3410-3420-3430-3440-3450-3460-3470-3480-3490-3500-3510-3520-3530-3540-3550-3560-3570-3580-3590-3600-3610-3620-3630-3640-3650-3660-3670-3680-3690-3700-3710-3720-3730-3740-3750-3760-3770-3780-3790-3800-3810-3820-3830-3840-3850-3860-3870-3880-3890-3900-3910-3920-3930-3940-3950-3960-3970-3980-3990-4000-4010-4020-4030-4040-4050-4060-4070-4080-4090-4100-4110-4120-4130-4140-4150-4160-4170-4180-4190-4200-4210-4220-4230-4240-4250-4260-4270-4280-4290-4300-4310-4320-4330-4340-4350-4360-4370-4380-4390-4400-4410-4420-4430-4440-4450-4460-4470-4480-4490-4500-4510-4520-4530-4540-4550-4560-4570-4580-4590-4600-4610-4620-4630-4640-4650-4660-4670-4680-4690-4700-4710-4720-4730-4740-4750-4760-4770-4780-4790-4800-4810-4820-4830-4840-4850-4860-4870-4880-4890-4900-4910-4920-4930-4940-4950-4960-4970-4980-4990-5000-5010-5020-5030-5040-5050-5060-5070-5080-5090-5100-5110-5120-5130-5140-5150-5160-5170-5180-5190-5200-5210-5220-5230-5240-5250-5260-5270-5280-5290-5300-5310-5320-5330-5340-5350-5360-5370-5380-5390-5400-5410-5420-5430-5440-5450-5460-5470-5480-5490-5500-5510-5520-5530-5540-5550-5560-5570-5580-5590-5600-5610-5620-5630-5640-5650-5660-5670-5680-5690-5700-5710-5720-5730-5740-5750-5760-5770-5780-5790-5800-5810-5820-5830-5840-5850-5860-5870-5880-5890-5900-5910-5920-5930-5940-5950-5960-5970-5980-5990-6000-6010-6020-6030-6040-6050-6060-6070-6080-6090-6100-6110-6120-6130-6140-6150-6160-6170-6180-6190-6200-6210-6220-6230-6240-6250-6260-6270-6280-6290-6300-6310-6320-6330-6340-6350-6360-6370-6380-6390-6400-6410-6420-6430-6440-6450-6460-6470-6480-6490-6500-6510-6520-6530-6540-6550-6560-6570-6580-6590-6600-6610-6620-6630-6640-6650-6660-6670-6680-6690-6700-6710-6720-6730-6740-6750-6760-6770-6780-6790-6800-6810-6820-6830-6840-6850-6860-6870-6880-6890-6900-6910-6920-6930-6940-6950-6960-6970-6980-6990-7000-7010-7020-7030-7040-7050-7060-7070-7080-7090-7100-7110-7120-7130-7140-7150-7160-7170-7180-7190-7200-7210-7220-7230-7240-7250-7260-7270-7280-7290-7300-7310-7320-7330-7340-7350-7360-7370-7380-7390-7400-7410-7420-7430-7440-7450-7460-7470-7480-7490-7500-7510-7520-7530-7540-7550-7560-7570-7580-7590-7600-7610-7620-7630-7640-7650-7660-7670-7680-7690-7700-7710-7720-7730-7740-7750-7760-7770-7780-7790-7800-7810-7820-7830-7840-7850-7860-7870-7880-7890-7900-7910-7920-7930-7940-7950-7960-7970-7980-7990-8000-8010-8020-8030-8040-8050-8060-8070-8080-8090-8100-8110-8120-8130-8140-8150-8160-8170-8180-8190-8200-8210-8220-8230-8240-8250-8260-8270-8280-8290-8300-8310-8320-8330-83
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CIRCLE 234 ON READER SERVICE CARD

Outpost: Atari



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

provable 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 Selzer, one line of the listing was transposed. The "256 * PEEK(180)" 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 13:END:SETCOLOR 2,4,10:DIM C(3)
20 B=20:COLOR 1:C=1
30 XX=73:YY=47
40 FOR K=0 TO 3:C(0)=B+1*2:NEXT K
50 FOR K=1 TO 3
60 X=BB+B*COS(345):Y=YY+PLAY K/Y
70 FOR I=0 TO 3*360 STEP 75
80 S=BB+B*COS(I):T=Y+BB*B*SIN(I)
90 DRAWTO S,Y
100 NEXT I:B=B+13:C=C+1:COLOR C
110 NEXT K
120 FOR I=0 TO 3:SETCOLOR 1,T(1),10:NEXT I
130 FOR J=1 TO 120:SET J
140 FOR I=1 TO 1:C(1-1)=C(I):NEXT I
150 C(2)=B*3(1)*34:GOTO 120
```

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 Valentine's 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

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 threw a fluorescent pink book into my hands and proclaimed, "It's about time for me to give you something else!"

The title of the book was *Hamlets 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, 92-51, Boscoph St., Boston, MA 02216.

Peeping Thematics

Since so many of you have expressed an insatiable curiosity about the inner workings 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 is decimal, the second in hexadecimal, the last is ASCII characters. I deliberately kept them short, so you can type them into other programs to look at the display list 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 each convenience as the peace 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 DIM % REMYST MODIFICATION %
2 INPUT B
3 PRINT B,; INPUT C
4 FOR K=C TO B+1:GOTO 3
```

Not that you have the tools for peeping and poking around in memory, what can you find there? Last month's column discussed L/R to use these locations:

240 This sets the page number for the top of memory.

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CIRCLE 167 ON READER SERVICE CARD

CIRCLE 169 ON READER SERVICE CARD


```

1 REM = DECIMAL DUMP *
2 PRINT "START"; INPUT X
3 PRINT X, PEEK(15) : GOTO 1

(You have to press BREAK to stop the decimal of the ASCII dump.)

1 REM = HEX MEMORY DUMP *
2 OR, C=DEC HEX(15)
3 N0="0123456789ABCDEF"
4 PRINT "STARTING ADDRESS (DECIMAL)"; INPUT X
5 PRINT "HOLD SPACE BAR TO STOP"
6 PRINT N1; " "
7 FOR N=0 TO 255
8 D=PEEK(N):L=INT(D/16):R=D-L*16
9 D=L*16+R+1:PRINT N1/L:15:16:R:1; " "
10 NEXT N:PRINT
11 D=D+8
12 IF D=176+1:256 THEN 1
13 PRINT "1 - CONTINUE 2 - STOP"; INPUT X
14 IF X=1 THEN GOTO 1

1 REM = ASCII DUMP *
2 INPUT X
3 PRINT N1; " "
4 FOR N=0 TO 255 IF
5 A=PEEK(N)
6 IF A<16 AND A<32 THEN 11
7 IF A<128 AND A<129 THEN 11
8 IF A<154 AND A<160 THEN 11
9 IF A<232 THEN 11
10 PRINT CHR$(A); " " : GOTO 12
11 PRINT " "
12 NEXT N : PRINT : PRINT : D=D+10 : GOTO 1

```

5329 This sets the playfield size.

704-712 These are the "shadow" registers for the player/missile color registers at 5326 to 5327. You can write directly to the ANTIC chip or to the shadow register.

53279 This is the player/missile base address register which holds the page number at the beginning of the player/missile graphics area.

In addition to these locations, Appendix I of the Basic Reference manual has 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. This is 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 lowest priority. Setting a bit to true (1) establishes priority. If more than one bit is true, the playfield will be blank 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 & PF 5
Playfield 2	Player 2
PF 3 & PF 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 & PF 5	Player 1
Player 0	Player 2
Player 1	Player 3
Player 2	Playfield 2
Player 3	PF 3 & PF 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 those 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 53276,3 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 3 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

33268 to 33278 do not have separate functions as read addresses. See the write descriptions above.

33279 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(33279) 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 PLA 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 PLA.

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 6900, 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 \$120 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 alien 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 Lee's Learning Level 1. It was very easy to learn because the Heath course gave a good understanding of the internal workings of the computer.

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Apple-Cart

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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) 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. Deady 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, L, 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
- Padlock (!) 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 facilities to develop and use your Mini Pilot program. 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 in 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

REDACTED RUN

NAME OF APPLE II DISK

PI...MY NAME IS APPLE II
WHAT IS YOUR NAME?

CHUCK

DO YOU WANT TO TRY A VOWEL (Y)
OR A CONSONANT (C)?

Y

NAME A VOWEL CHUCK

PC

THAT IS NOT A VOWEL CHUCK
NAME A VOWEL CHUCK

PC

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 (Y)
OR A CONSONANT (C)?

Y

NAME A CONSONANT CHUCK

PC

THAT IS CORRECT CHUCK ...

DO YOU WANT TO TRY IT AGAIN?
TYPE Y FOR YES OR N FOR NO.

Y

THANKS FOR PLAYING CHUCK...
HOPE WE CAN DO IT AGAIN SOON.

BYE...

END OF RUN

REDACTED

Simple Run of Apple II Disk—Pilot Program

Apple, continued...

exchanges the program on disk with the current program in memory. You **SAVE** the program when it's **NEW**. After the first time, you **REPLACE** it to reuse 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; lining speed control with game paddle #1; lining suspension with the space bar and continuation by pressing any key; and a line limit warning bell to keep you from exceeding the 80 character line length limit.

REQUEST LIST

APPLE BLOSSOMS

```

0  R:VOWELS /AO CONSONANTS
1  C:
2  T:HI...MY NAME IS APPLE II
3  T:  WHAT IS YOUR NAME?
4  T:
5  AT: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 C:
12 A:
13 R:V..
14 JN:CONSONANT
15 #VOWEL
16 T:NAME A VOWEL NAME
17 T:
18 A:
19 T:
20 R:A-E-I-O-U..
21 T: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 R:C-B-D-F-G-H-J-L-
31 R:K-L-M-N-P-Q-R-S-
32 R:T-V-W-X-Y-Z..
33 T:THAT IS NOT A CONSONANT NAME
34 JN:CONSONANT
35 T:
36 #CORRECT
37 T:
38 I: SOME POSITIVE FEEDBACK
39 T:THAT IS CORRECT NAME...
40 T:
41 I:
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 R:Y..
49 JY:BEGIN
50 T:THANKS FOR PLAYING NAME..
51 T:HOPE HE 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

- *S= String included with the A: command. Requires a leading and trailing space
- *L= 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

```

REQUEST? NEW
PROGRAM NAME? DOG

AT:BEGIN
1:THIS PROGRAM LOOPS
2:J:BEGIN
3:  & OK. END-OK
4:END

REQUEST? END
STARTING AT LINE? 2
1:THIS PROGRAM LOOPS
2:J:BEGIN

27:J:BEGIN  ← FORMAT APPEARS
28:END

REQUEST? LIST
LOOP

4:BEGIN
1:THIS PROGRAM LOOPS
2:J:BEGIN
3:END

REQUEST? DONE

REQUEST? IS:DO
PROGRAM NAME? DOG

REQUEST? REPLACE

REQUEST? END

END OF LOOP

THIS PROGRAM LOOPS
THIS PROGRAM LOOPS
THIS PROGRAM LOOPS
THIS PROGRAM LOOPS

REQUEST? BYE

```

Figure 1. Example Programming Sequence and Use of Programming Directives.

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.

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 D.5.). 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 clear board from a box set. 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 Mame 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 the 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

Apple, continued...

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 category, 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 rearranged 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 state marked AUTOLINK function. Also included are a copy program and section on loading new Super-Text files. This last section is only useful for loading your 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 typeset. Note the text, the manual is well done and easy to follow. I like the new bookbush 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 than 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). Those 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 Mine would just come out with an 80 column version to work with my new Video 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 edit 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 introductory manual contain a bold control G. Here is a listing of the specific lines. All those lines contain a bold between the quotes. Note that line 1430 is a control D. A bold letter is recognized by all other word processors.

```

100  "G"
110  "END OF FILE"
120  "
130  "
140  "
150  "
160  "
170  "
180  "
190  "
200  "
210  "
220  "
230  "
240  "
250  "
260  "
270  "
280  "
290  "
300  "
310  "
320  "
330  "
340  "
350  "
360  "
370  "
380  "
390  "
400  "
410  "
420  "
430  "
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800  "
810  "
820  "
830  "
840  "
850  "
860  "
870  "
880  "
890  "
900  "
910  "
920  "
930  "
940  "
950  "
960  "
970  "
980  "
990  "

```


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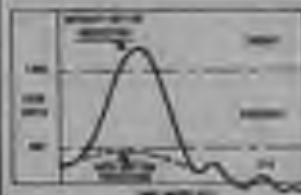
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CIRCLE 123 ON READER SERVICE CARD

Agile, continued...

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 consciousness" 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. Sometimes 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 module is not used independently. You have to load the math module in place of the print module menu is.

The Corner 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, dim and fill space, tabbing and justification, and edit the add mode. You return to the main 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 saved most need requirements during printing. The format line can then be used to make local changes in the text during development.

Change Media

In the change mode, you have thirteen key combinations for cursor movement (home as cursor mode and not 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.

Mark Mander

This mode is used to perform calculations on numbers in a file or to act as a

```

1000 FOR I = 1 TO 1000: FOR J = 1 TO 1000: GOTO 1001
1001 NEXT J
1002 GOTO 1000
1003 PRINT "END OF DATA PRINT : PRINT"
1004 FOR K = 1 TO 1000: IF LEN (P(K,1)) = 2 AND RIGHT (P(K,1),1) = "A" GOTO 1005
1005 FOR L = 1 TO 1000: IF LEN (P(K,L)) = 10: THEN FOR M = 1 TO 10: IF P(K,L,M) = "A" THEN GOTO 1006
1006 NEXT M
1007 NEXT L
1008 PRINT "END OF DATA PRINT : PRINT"
1009 RETURN
1010
1011 REM *** END ***
1012 REM *****
1013
1014 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1015
1015 IF P(I,J) = "A" THEN GOTO 1016
1016 NEXT J
1017 NEXT I
1018
1019 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1020
1020 IF P(I,J) = "A" THEN GOTO 1021
1021 NEXT J
1022 NEXT I
1023
1024 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1025
1025 IF P(I,J) = "A" THEN GOTO 1026
1026 NEXT J
1027 NEXT I
1028
1029 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1030
1030 IF P(I,J) = "A" THEN GOTO 1031
1031 NEXT J
1032 NEXT I
1033
1034 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1035
1035 IF P(I,J) = "A" THEN GOTO 1036
1036 NEXT J
1037 NEXT I
1038
1039 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1040
1040 IF P(I,J) = "A" THEN GOTO 1041
1041 NEXT J
1042 NEXT I
1043
1044 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1045
1045 IF P(I,J) = "A" THEN GOTO 1046
1046 NEXT J
1047 NEXT I
1048
1049 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1050
1050 IF P(I,J) = "A" THEN GOTO 1051
1051 NEXT J
1052 NEXT I
1053
1054 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1055
1055 IF P(I,J) = "A" THEN GOTO 1056
1056 NEXT J
1057 NEXT I
1058
1059 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1060
1060 IF P(I,J) = "A" THEN GOTO 1061
1061 NEXT J
1062 NEXT I
1063
1064 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1065
1065 IF P(I,J) = "A" THEN GOTO 1066
1066 NEXT J
1067 NEXT I
1068
1069 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1070
1070 IF P(I,J) = "A" THEN GOTO 1071
1071 NEXT J
1072 NEXT I
1073
1074 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1075
1075 IF P(I,J) = "A" THEN GOTO 1076
1076 NEXT J
1077 NEXT I
1078
1079 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1080
1080 IF P(I,J) = "A" THEN GOTO 1081
1081 NEXT J
1082 NEXT I
1083
1084 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1085
1085 IF P(I,J) = "A" THEN GOTO 1086
1086 NEXT J
1087 NEXT I
1088
1089 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1090
1090 IF P(I,J) = "A" THEN GOTO 1091
1091 NEXT J
1092 NEXT I
1093
1094 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1095
1095 IF P(I,J) = "A" THEN GOTO 1096
1096 NEXT J
1097 NEXT I
1098
1099 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1100
1100 IF P(I,J) = "A" THEN GOTO 1101
1101 NEXT J
1102 NEXT I
1103
1104 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1105
1105 IF P(I,J) = "A" THEN GOTO 1106
1106 NEXT J
1107 NEXT I
1108
1109 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1110
1110 IF P(I,J) = "A" THEN GOTO 1111
1111 NEXT J
1112 NEXT I
1113
1114 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1115
1115 IF P(I,J) = "A" THEN GOTO 1116
1116 NEXT J
1117 NEXT I
1118
1119 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1120
1120 IF P(I,J) = "A" THEN GOTO 1121
1121 NEXT J
1122 NEXT I
1123
1124 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1125
1125 IF P(I,J) = "A" THEN GOTO 1126
1126 NEXT J
1127 NEXT I
1128
1129 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1130
1130 IF P(I,J) = "A" THEN GOTO 1131
1131 NEXT J
1132 NEXT I
1133
1134 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1135
1135 IF P(I,J) = "A" THEN GOTO 1136
1136 NEXT J
1137 NEXT I
1138
1139 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1140
1140 IF P(I,J) = "A" THEN GOTO 1141
1141 NEXT J
1142 NEXT I
1143
1144 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1145
1145 IF P(I,J) = "A" THEN GOTO 1146
1146 NEXT J
1147 NEXT I
1148
1149 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1150
1150 IF P(I,J) = "A" THEN GOTO 1151
1151 NEXT J
1152 NEXT I
1153
1154 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1155
1155 IF P(I,J) = "A" THEN GOTO 1156
1156 NEXT J
1157 NEXT I
1158
1159 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1160
1160 IF P(I,J) = "A" THEN GOTO 1161
1161 NEXT J
1162 NEXT I
1163
1164 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1165
1165 IF P(I,J) = "A" THEN GOTO 1166
1166 NEXT J
1167 NEXT I
1168
1169 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1170
1170 IF P(I,J) = "A" THEN GOTO 1171
1171 NEXT J
1172 NEXT I
1173
1174 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1175
1175 IF P(I,J) = "A" THEN GOTO 1176
1176 NEXT J
1177 NEXT I
1178
1179 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1180
1180 IF P(I,J) = "A" THEN GOTO 1181
1181 NEXT J
1182 NEXT I
1183
1184 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1185
1185 IF P(I,J) = "A" THEN GOTO 1186
1186 NEXT J
1187 NEXT I
1188
1189 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1190
1190 IF P(I,J) = "A" THEN GOTO 1191
1191 NEXT J
1192 NEXT I
1193
1194 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1195
1195 IF P(I,J) = "A" THEN GOTO 1196
1196 NEXT J
1197 NEXT I
1198
1199 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1200
1200 IF P(I,J) = "A" THEN GOTO 1201
1201 NEXT J
1202 NEXT I
1203
1204 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1205
1205 IF P(I,J) = "A" THEN GOTO 1206
1206 NEXT J
1207 NEXT I
1208
1209 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1210
1210 IF P(I,J) = "A" THEN GOTO 1211
1211 NEXT J
1212 NEXT I
1213
1214 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1215
1215 IF P(I,J) = "A" THEN GOTO 1216
1216 NEXT J
1217 NEXT I
1218
1219 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1220
1220 IF P(I,J) = "A" THEN GOTO 1221
1221 NEXT J
1222 NEXT I
1223
1224 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1225
1225 IF P(I,J) = "A" THEN GOTO 1226
1226 NEXT J
1227 NEXT I
1228
1229 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF P(I,J) = "A" THEN GOTO 1230
1230 IF P(I,J) = "A" THEN GOTO 1231
1231 NEXT J
1232 NEXT I
1233
1234 FOR I = 1 TO 1000: FOR J = 1 TO 1000: IF
```


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CIRCLE 223 ON READER SERVICE CARD

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 test 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.

Autoflink

Here's another one I haven't used yet. An example would be if my columns used more space than available memory. (There is a little over 20K bytes available in RAM memory. This equates to about fifteen double-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 SuperText 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 fool 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. Mase 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. Mase'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 SuperText II in 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. □

[illegible]

Intelligent Computer Games



David Levy

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 6UP, England.

BACKGAMMON

The game of backgammon introduces special problems into the tree search. Some of these problems are caused by the fact that, before a player 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 an 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 $M_1, M_2, \dots, M_{17}$. 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. $P_{1(11)}$ corresponds to the probability of the

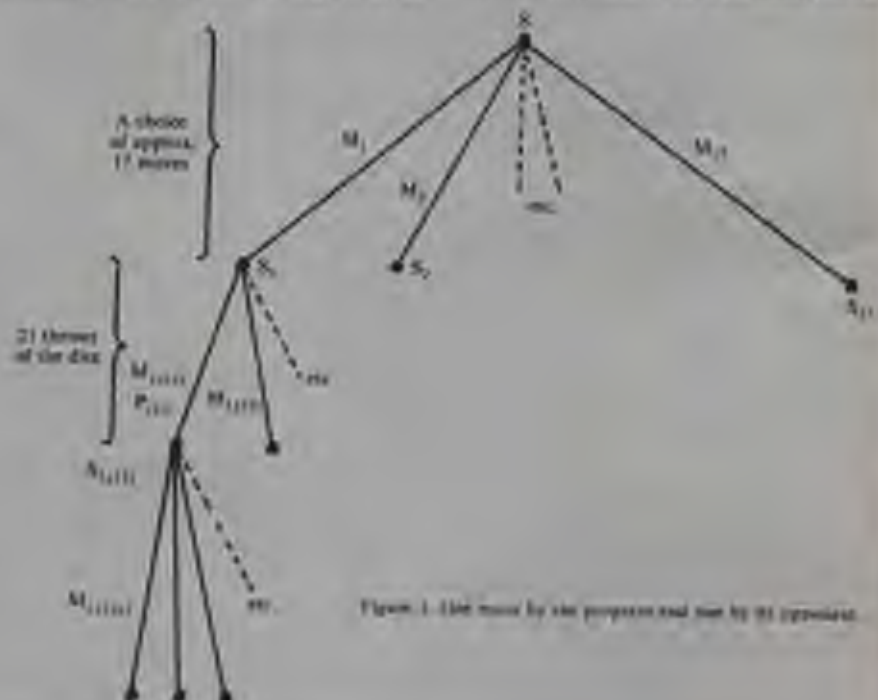


Figure 1. The move by the program and one by its opponent.

Retail Roster

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Games, continued..

opponent throwing a double 1 (which is $1/36$). But 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 dice is $1/36$.

Let us see what happens if the program's opponent throws a double 3. He then has the choice of the (roughly) 17 moves which we denote by $M_{1,1}, M_{1,2}, \dots, M_{1,17}$. For each of these 17 moves the program applies its evaluation function to the resulting position, and the best of the 17 scores is hooked-up to $S_{1,1}$. Corresponding to the opponent's throw of a 1 and a 2 there are once again some 17 moves: $M_{2,1}, M_{2,2}, \dots, M_{2,17}$, each of which has its own associated score. The best of these scores is hooked-up to $S_{2,1}$.

Then we know the values of the scores S_{Alice} , S_{Bob} , ..., S_{Alice} , we would like to back-up those scores to S_i so that S_i 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_i has the value of S_{Alice} or some other backed-up value. The actual result of the node at a depth of one-ply is, therefore, not the sum 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_i and backed up score S_{Alice} . There is a probability of $1/18$ that the program's opponent will be able to choose for S_i the value of S_{Bob} . And so on. The actual score which should be assigned to S_i is therefore:

$$S_1 = (1/35 \times S_1(1)) + (3/35 \times S_1(2)) + (1/35 \times S_1(3)) + \dots$$

The Size of Trees 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 17×21 , or 357, though this number can rise to over 800. Since it is impossible to choose how the die 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 $(1/18 \times S_2(1)) + (1/18 \times S_2(2)) + (1/18 \times S_2(3)) + \dots$ 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_0 will be higher than S_1 , if we examine M_1 before M_2 it will be necessary to sum all 23 terms in the expression for S_1 . But what happens if we examine the moves in the reverse order, with the worst move being examined first? To show that M_1 is better than M_2 it will not necessarily be essential to add all 23 terms in the expression for S_0 . It might be the case that after adding only 18 of the terms, the score would already be better than that of S_1 . From that point on it is no longer important in the relationship between M_1 and M_2 whether the three remaining terms in the expression for S_0 add up to a relatively small or large number. We know for certain that S_0 is larger than S_1 . Unfortunately, the whole of the pruning process is not this simple. In order to know that S_2 is greater than S_0 we do need to know the exact total of the 21 terms in S_0 . So how can we afford to prune certain parts of the tree?

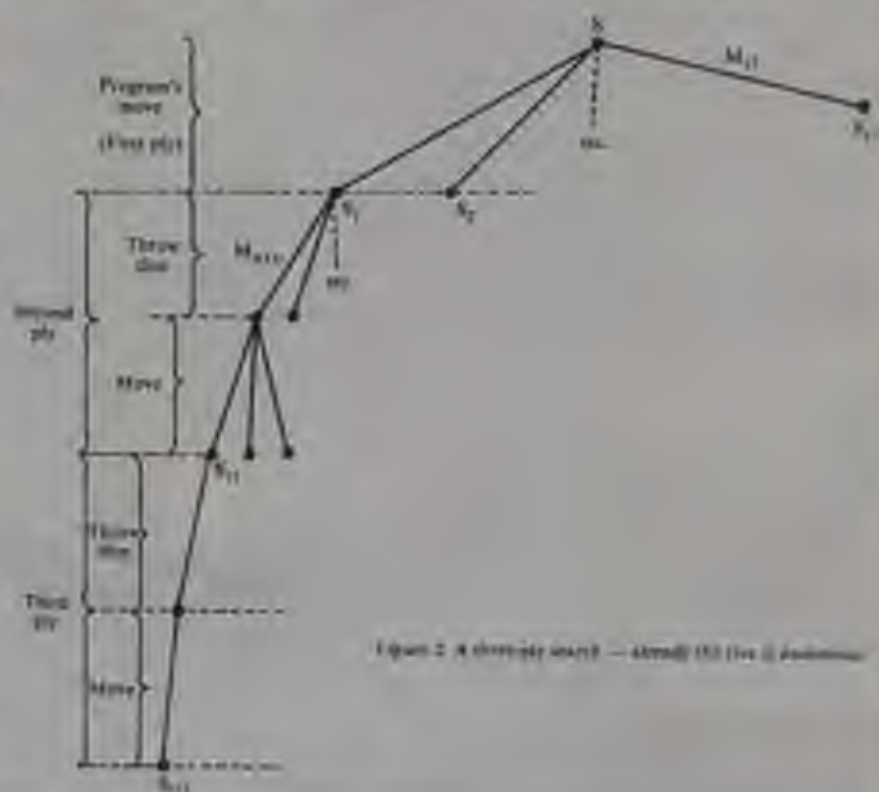
The answer lies in an analogy

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 $S(1/12) + S(1/36) + S(2/36) > S(2/12) + S(2/36) + S(1/36)$, 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 coming 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 limit.

Equation 2: A three-way linear model — Akaike (1973) (eq. 2) [download](#)

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 opponent 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 features '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 blocked 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 blocked.

When the two sides' men become disengaged, the 'racing 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 64 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 upmost, 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 upmost. 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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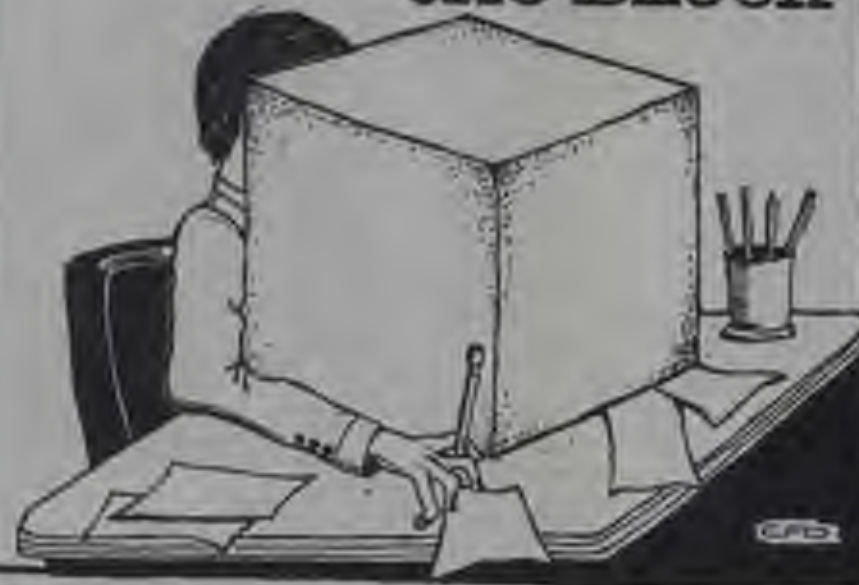
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Getting Around the Block



Whether you have to write business letters, magazine articles, or the documentation for your latest program, 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 madly 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, it's 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 your 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 free write. 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 outcrop, 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 to do.

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 I, sub a, etc., and then, and only then were you permitted to start to write. Unfortu-

rately, 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 methodically 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 sections 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 hitting 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 (Randy Mack, Ph.D. and Eric Skjel, Ph.D., J.P. Tarcher, Inc., LA, 1979) helps you through every possible stage of writing blocks—getting your materials 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.



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Reviews

Steve Gray

Multiprocessors: A Comparative Study, by M. Satyanarayanan.
Prentice-Hall Inc., Englewood Cliffs, NJ. 277 pages, hardcover
\$21.50, 1983.

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 86, Univac-1100
Model 80, Burroughs B7700, Digital Equipment Corp. System
10 Model KL10, and two university multiprocessors built at
Carnegie-Mellon, the Campus and Cmr* 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 Compacolor II, Eddy Sorcerer, North Star
Horizon, Southwest 6800 and S/09, and the IHanel 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 experimentation.

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 Rodney Zaks, Sybase, 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 Microprocesses, 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.

These two chapters tell how a computer works, look at peripherals, examine the writing and testing of programs, and get into interactive processing.

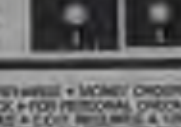
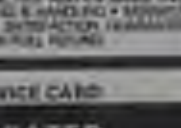
The Basic language itself is featured in 10 chapters, in an introduction, Assigning Values to Variables, Input/Output, Program Control, Basic Functions, Subroutines, Array Handling, String Manipulation, Advanced Features (multiple assignments, logical operators), and Debugging Aids.

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 full 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.

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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 "inquires no less than seven years" non-interrupted teaching.

Lecture 2, An Outline of the History of Computing in the USSR, takes up some 80 percent of the text, 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-heir of the machine on which it runs, and the carrier of the holy spirit which infuses life into the program/machine combination. This triumph of intellect is perhaps the strongest and the most characteristic aspect of programming."

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puzzle answers

A Potty Problem: Can the jag along line d and b rearrange the three points that formed into the square displaced by the dotted line. Now, wouldn't that make?



Santa's Puzzle: The catch here is that if we use the observations for June through month we get:

Del. is an abbreviation for DCTAL.

Nov: is an abbreviation for NOVEM

Doc is an abbreviation for DECIMAL.

From this we get an $O(\sqrt{A})$ J = a NUMBER 27
= a DECIMAL 24

REFERENCES

A Martian Puzzle: Ward 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 feeds 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. Dr.
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: F1/C1 (2.6%), C3/F1, (6.3%), F3/C3, (6.2%), F7/F1

The Nifty Niners: 99 + 9 = 9 DOZEN

An Ancient Problem: 35 percent of the list price was \$121.50. \$122.50 divided by .35 gives us \$350 for unit price. Therefore, the list price had to be \$350.00.

A One-Liner:



The Three Pearls: This is a very difficult "sell," but it will fade away. The performer's undertaking is performed by simply putting on the hat selected. No one can deny that the three pearls are closely brought under the hat.

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1. How many children live at home between ages 6 and 18?
☐ A. None
☐ B. One
☐ C. Two
☐ D. Three or more
☐ E. Four or more

2. How much money do you spend annually on Software
☐ A. Less than \$50
☐ B. \$50-100
☐ C. \$100-250
☐ D. \$250-500
☐ E. over \$500

3. Your annual income
☐ A. Under \$10,000
☐ B. \$10-15,000
☐ C. \$15-20,000
☐ D. \$20-25,000
☐ E. \$30,000 or over

4. Which type of Printer do you own or operate
☐ A. Thermal
☐ B. Dot-Matrix impact
☐ C. Type ball printer
☐ D. Print thimble
☐ E. At present do not own a printer

101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
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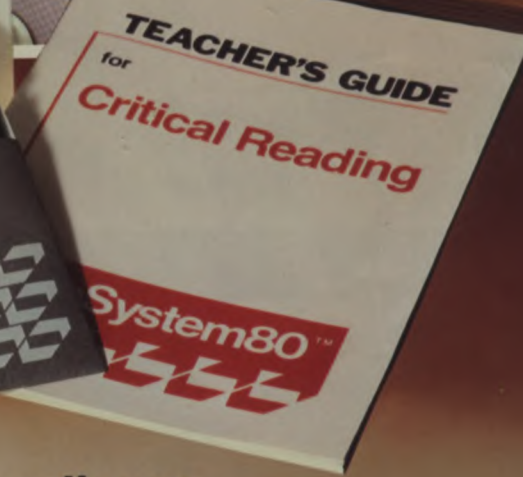
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The image shows three people sitting around a desk with a large, white, multi-tiered Ohio Scientific Challenger computer. On the left, a woman with dark hair and glasses is holding a book. In the center, a man wearing a black top hat and a tuxedo is holding a book. On the right, a man with glasses and a white shirt is holding a book and a pen. The computer has a keyboard and a small screen. The background is a plain, light-colored wall.

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