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THE 6502 JOURNAL

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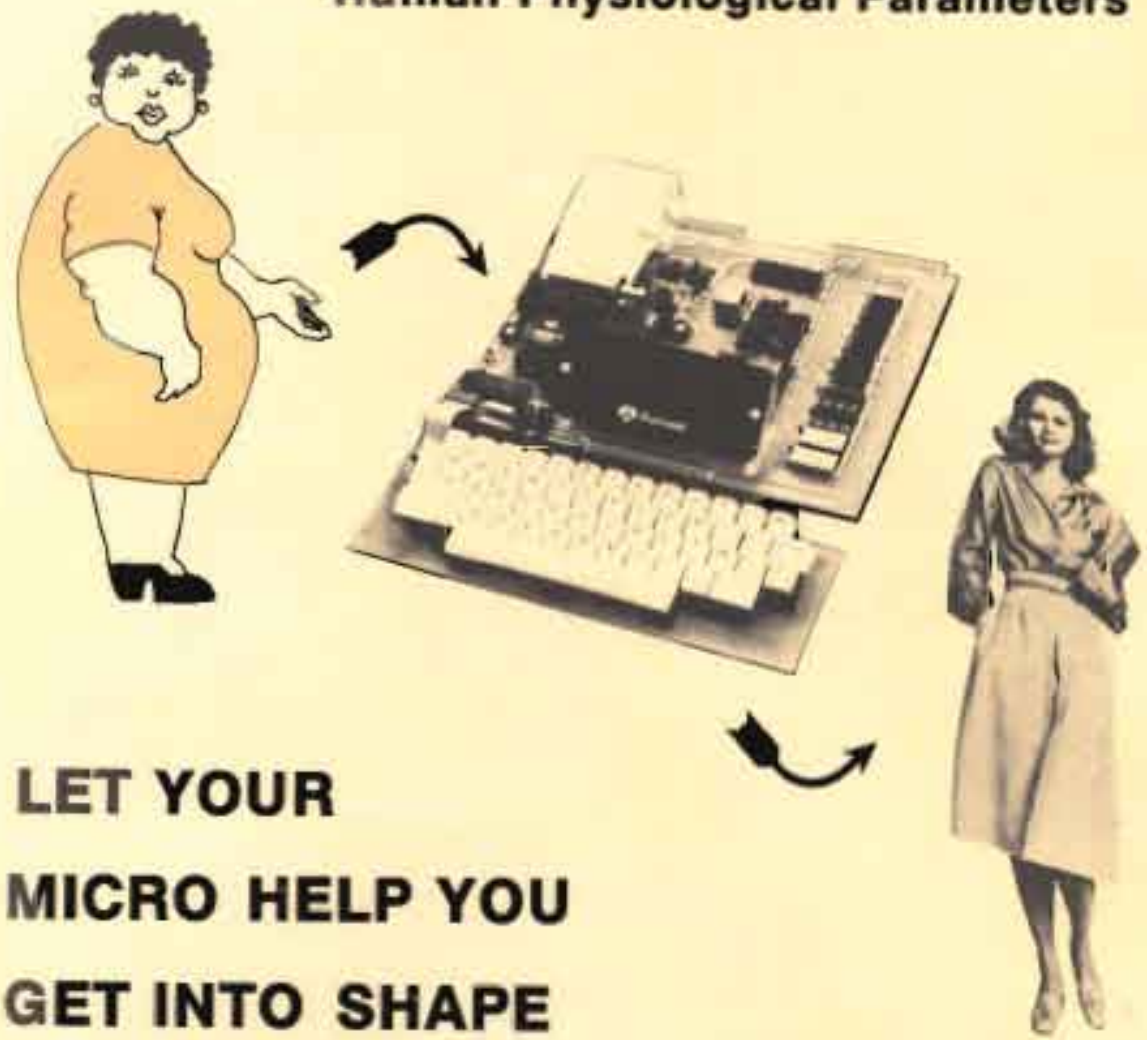

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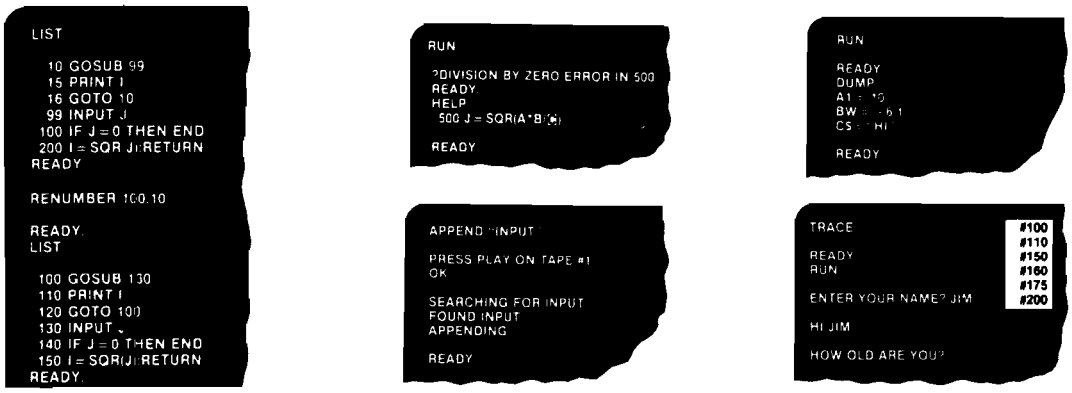

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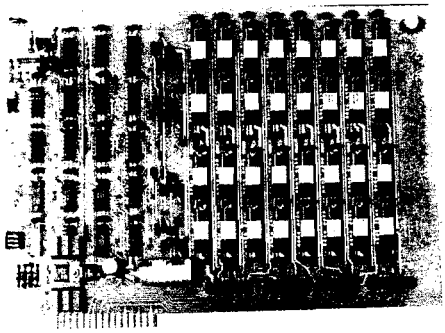

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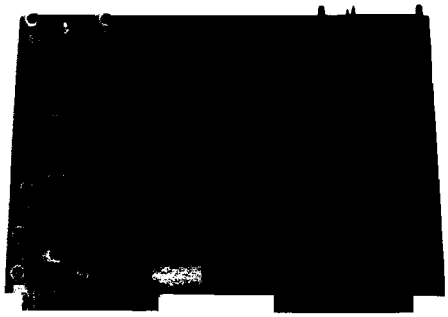

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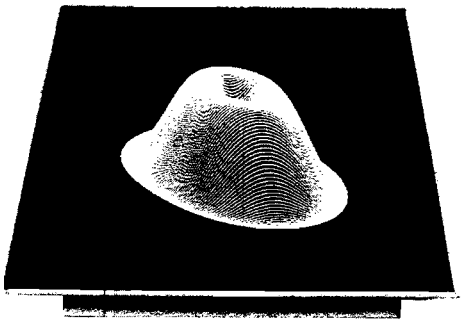

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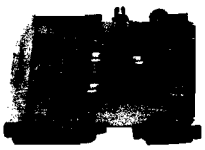

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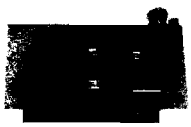

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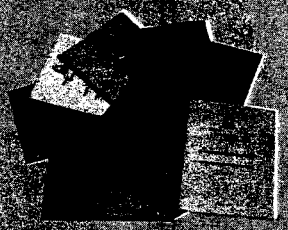

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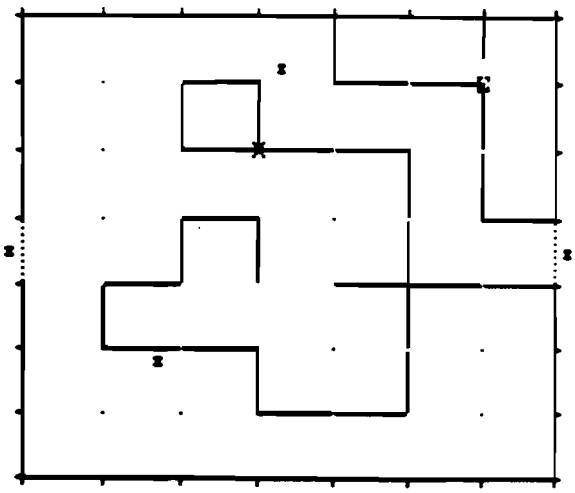

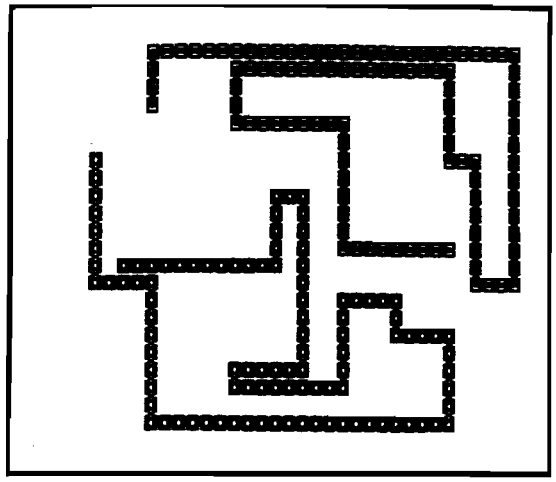

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Tape Execute File Create and Use

Once upon a time, a computerist wanted to convert his integer BASIC programs to Applesoft BASIC. He read about a great technique - but it required a disk. He did not have a disk, but did have cassettes. Could the technique be modified for tape? And, what other changes would be required for the complete conversion? Some interesting things were discovered, and are reported here.

Allen J. Lacy
1921 Oglethorpe Avenue
Albany, GA 31707

For a long time, I had been trying to find a way to convert Integer programs to Applesoft. So it was with great interest that I read the How to Section titled "Disk Magic;; in Contact 5. A short summary follows for those who didn't get Contact 5. It was a way to list the Integer programs on to disk and then load it into Applesoft. This was done by placing the following line in the program:

```
0 PRINT"@ OPEN X":POKE 33,33:
P R I N T ' ' @ W R I T E
X":LIST:PRINT"@CLOSE X":END
```

(Where @means Control D)

When this line is entered type "RUN" and press "RETURN". When the operation is complete, enter Applesoft and EXECute the file.

The only problem with this method is that I do not have a disk yet.

I started to think about how this could be done with just a tape. During a normal "SAVE" both Integer and Applesoft write the program to tape the way it is stored in memory, not the way it is listed. The program is stored as tokens; and since the tokens do not match, Applesoft cannot load Integer programs.

So I wrote two routines which link into the input and output hooks CSW and KSW at $36-$39. (This article uses "$" to indicate a hexadecimal number.)

The output routine gets each byte as the Apple outputs it and stores it in a buffer before the actual output. When the Apple outputs a carriage return, the routine writes the buffer to tape. This continues until the Apple outputs a carriage return as the first character, the routine then resets the output hook.

The buffer is 256 bytes long. This number was chosen because that is the length of the Apple's input buffer. Note the buffer is from $3F00 to $3FFF (decimal 16128 to 16383). This is because my Apple has 16K. For different memory sizes this can be changed. If you have an assembler, change the SAVE address to the values in table 1. If you do not have an assembler, change the locations shown in table 2.

The input routine reads the tape records back into memory and passes the bytes through the input hooks. This continues until a record comes in which contains a carriage return as the first byte, the routine then gives control back to the keyboard.

MEMORY SIZE	SAVE ADDRESS	HIMEM
32K	$7F00	32512
48K	$BF00	—16640

Table I

The first version used the tape write routine at $FECD, which writes a 10 second header; therefore, the write took about 11 seconds, 10 for the header and 1 for the data. However, I noticed that at $FECD the instruction is LDA #$40 followed by JSR HEADR. Therefore when I want to write a record to tape, I load the accumulator with $20 and enter the monitor at $FECF. This causes the Apple to write a 5 second header, which means each record takes 6 seconds.

To use:

Load the routines into memory
Enter Integer Basic
Type "HIMEM:16128"
Press "RETURN"
Load the Program
Type in the following line:
  0 POKE 33,33:CALL 769:LIST:END
Type "RUN"
Set the recorder in record mode
Press "RETURN"

The program will now list to tape and the TV. When this has finished, the prompt (>) will reappear.

Now enter Applesoft
Rewind the Tape

Warning: Since the headers are only 5 seconds long, you must set the tape as close to the beginning of the first one as you can.

Type "HIMEM:16128"
Press "RETURN"
Type "CALL 772"
Start the recorder in play mode
Press "RETURN"

The program will come into Applesoft as if you had typed it in. When the Applesoft prompt (]) appears with just the cursor behind it, control is back at the keyboard.

Now what you have to do is change the things which are different between Applesoft and Integer. This will have to be done whether you use the disk or tape.

All "TAB" statements have to be changed to 'HTAB"
All computed "GOTO" and 'GOSUB" have to be changed to "ON" "GOTO" or "ON" "GOSUB".

Example:

Where N can vary from 1 to 4
```
 Integer
 GOTO 400 + N * 100

 Applesoft
 ON N GOTO 500,600,700,800
```

All multi statement "IF"s will have to be broken into two lines because of difference in the way Integer and Applesoft handle ifs.

Example:

```
100 IF A = B THEN A = A + 1:C = C + 1
```

In Integer C always has one added to it, whether or not A equals B. This same line in Applesoft will cause C to have 1 added to it only if A equals B. So for the program to work like the Integer program, the line will have to be broken into two lines.

```
100 IF A = B THEN A = A + 1
101 C = C + 1
```

The random number functions are different between Integer and Applesoft.

Example:

```
 Integer
 A = RND(16)

 Applesoft
 A = 16 * RND(1)
```

In Integer either "#" or "<>" can be used to mean not equal, in Applesoft only "<>" can be used.

Example:

```
 Integer
 IF A # B THEN 10

 Applesoft
 IF A<>B THEN 10
```

There is no "MOD" operation in Applesoft, so you have to calculate the modulus.

Example:

```
 Integer
 B = A MOD C

 Applesoft
 B = A - INT(A/C) * C
```

Variable names may have to be changed. In Integer all letters are significant; in Applesoft only the first 2 letters are significant. To Integer PAY1 and PAY2 are different; to Applesoft they are the same variable.

Example:

```
 Integer
 PAY1 = PAY2 + PAY3

  Applesoft
  P1 = P2 + P3
```

Another difference is the way strings are handled. In Integer "DIM A$(20)" means set up 1 string which can be up to 20 characters long. To Applesoft, it means set up 20 strings each of which can be up to 255 characters long. So all string dims should be removed from the program.

Also to get specific characters out of a string, you have to use the MID$ function in Applesoft.

Example:

```
 Integer
 B$ = A$(2,5)

 Applesoft
 B$ = MID$(A$,2,3)
```

The last difference that I have found is that all variables should be converted to Applesoft integer variables. This is not always needed, a lot of programs will run without this being done.

Example:

Integer	Applesoft
A = B	A% = B%

MEMORY SIZE	$30C	$322	$34D	$369	HIMEM
32K	$7F	$7E	$7F	$7E	32512
48K	$BF	$BE	$BF	$BE	—16640

Table II

```
                        1000 ********************************
                        1010 *                              *
                        1020 *       TAPE EXECUTE FILE      *
                        1030 *         CREATE & USE         *
                        1040 *                              *
                        1050 * MAIN USE TO CONVERT INTEGER  *
                        1060 *  PROGRAMS TO APPLESOFT II    *
                        1070 *                              *
                        1080 *              BY              *
                        1090 *         ALLEN J LACY         *
                        1100 *         AUGUST 1979          *
                        1110 *                              *
                        1120 ********************************
                        1130 ********************************
                        1140 *                              *
                        1150 * 256 BYTE BUFFER TO STORE TEXT *
                        1160 * FROM ADDRESS $3F00 TO $3FFF  *
                        1170 * CHANGE FOR LARGER APPLE II   *
                        1180 *                              *
                        1190 ********************************
                        1200 SAVE .EQ $3F00
                        1210 PT   .EQ $300
                        1220 KSW  .EQ $FD1B
                        1230 WR   .EQ $FECF
                        1240 RE   .EQ $FEFD
                        1250 COUT .EQ $FDD0
                        1260 XSAV .EQ $47
                        1270      .OR $301
                        1280 *
                        1290 ********************************
                        1300 *                              *
                        1310 * SET UP FOR OUTPUT OF FILE    *
                        1320 *                              *
                        1330 ********************************
0301- 4C 9E 03          1340 STP  JMP SP
                        1350 *
                        1360 ********************************
                        1370 *                              *
                        1380 * SET UP FOR INPUT OF FILE     *
                        1390 *                              *
                        1400 ********************************
0304- 4C 8D 03          1400 STK  JMP SK
                        1420 *
                        1430 ********************************
                        1440 *                              *
                        1450 *SUBROUTINE TO SET TAPE POINTERS*
                        1460 *                              *
                        1470 ********************************
0307- A9 00             1480 SET  LDA #SAVE
0309- 85 3C             1490      STA $3C
030B- A9 3F             1500      LDA /SAVE
030D- 85 3D             1510      STA $3D
030F- A9 FF             1520      LDA #SAVE+255
0311- 85 3E             1530      STA $3E
0313- A9 3F             1540      LDA /SAVE+255
0315- 85 3F             1550      STA $3F
0317- 60                1560      RTS
                        1570 *
                        1580 ********************************
                        1590 *                              *
                        1600 * BYTE OUTPUT ROUTINE          *
                        1610 *                              *
                        1620 ********************************
0318- 86 47             1630 PRT  STX XSAV       STORE X REG
031A- EE 00 03          1640      INC PT
031D- AE 00 03          1650      LDX PT
0320- 9D FF 3E          1660      STA SAVE-1,X   STORE BYTE
0323- C9 8D             1670      CMP #$8D       CR?
0325- F0 06             1680      BEQ CR
0327- A6 47             1690      LDX XSAV       RESTORE X REG
0329- 20 F0 FD          1700      JSR COUT
032C- 60                1710      RTS
032D- AD 00 03          1720 CR   LDA PT
0330- C9 01             1730      CMP #1
0332- F0 15             1740      BEQ NPT
0334- 20 07 03          1750      JSR SET
0337- A9 20             1760      LDA #$20       5 SEC HEADER
0339- 20 CF FE          1770      JSR WR         WRITE TO TAPE
033C- A6 47             1780      LDX XSAV       RESTORE XREG
033E- A9 8D             1790      LDA #$8D       OUTPUT CR
0340- 20 F0 FD          1800      JSR COUT
0343- A9 00             1810      LDA #0         RESET PT
0345- 8D 00 03          1820      STA PT
0348- 60                1830      RTS
0349- A9 8D             1840 NPT  LDA #$8D
034B- 8D 00 3F          1850      STA SAVE
034E- 20 07 03          1860      JSR SET
0351- A9 20             1870      LDA #$20
0353- 20 CF FE          1880      JSR WR         WRITE LAST REC
0356- A9 F0             1890      LDA #COUT      RESET PRINT
0358- 85 36             1900      STA $36
035A- A9 FD             1910      LDA /COUT
035C- 89 37             1920      STA $37
035E- 60                1930      RTS
                        1940 *
                        1950 ********************************
                        1960 *                              *
                        1970 * BYTE INPUT ROUTINE           *
                        1980 *                              *
                        1990 ********************************
035F- 86 47             2000 RED  STX XSAV       SAVE X REG
0361- EE 00 03          2010      INC PT
0364- AE 00 03          2020      LDX PT
0367- BD FF 3E          2030      LDA SAVE-1,X   GET BYTE
036A- C9 8D             2040      CMP #$8D       CR?
036C- D0 11             2050      BNE NCR
036E- AD 00 03          2060      LDA PT
0371- C9 01             2070      CMP #1
0373- F0 0D             2080      BEQ NKEY
0375- 20 AC 03          2090      JSR TR
0378- A9 00             2100      LDA #0
037A- 8D 00 03          2110      STA PT
037D- A9 8D             2120 RCR  LDA #$8D       LOAD CR
037F- A6 47             2130 NCR  LDX XSAV       RESTORE X REG
0381- 60                2140      RTS
0382- A9 1B             2150 NKEY LDA #KSW       GIVE CONTROL
0384- 85 38             2100      STA $38        TO KEYBOARD
0386- A9 FD             2170      LDA /KSW
0388- 85 39             2180      STA $39
038A- 4C 7D 03          2190      JMP RCR
038D- A9 5F             2200 SK   LDA #RED       GIVE INPUT
038F- 85 38             2210      STA $38        CONTROL TO
0391- A9 03             2220      LDA /RED       RED
0393- 85 39             2230      STA $39
0395- 20 AC 03          2240      JSR TR         READ 1ST REC
0398- A9 00             2250      LDA #0
039A- 8D 00 03          2260      STA PT
039D- 60                2270      RTS
039E- A9 18             2280 SP   LDA #PRT       GIVE OUTPUT
03A0- 85 36             2290      STA $36        CONTROL TO
03A2- A9 03             2300      LDA /PRT       PRT
03A4- 85 37             2310      STA $37
03A6- A9 00             2320      LDA #0
03A8- 8D 00 03          2330      STA PT
03AB- 60                2340      RTS
03AC- 20 07 03          2350 TR   JSR SET
03AF- 20 FD FE          2360      JSR RE
03B2- 60                2370      RTS
                        2380      .EN
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Why a PET, APPLE, 6502 BASIC Compiler? A Simple Explanation

BASIC, on almost all 6502 microcomputers, is run with an Interpreter. A more efficient method of running BASIC is through a Compiler. This article discusses what a Compiler is, how it works, and discusses a BASIC Compiler currently under development.

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Ontario, LON 1JO
Canada

A group of Canadian PET users are developing a compiler for the PET that will also be usable on the APPLE or any 6502 based computer. This may be a very significant step in regards to the usefulness of the PET.

This article answers the questions indicated in its sub-headings. So as not to waste your, the reader's, time, you should just go to those sub-headings to which you do not know the answer.

The Topics Being Covered are:

I. What is a compiler?

2. What is the difference between a compiler and an interpreter?

3. What is the difference between a direct compiler and a p-code compiler?

4. Why would a BASIC compiler be so useful on a PET?

5. What is the status of the CANPET BASIC compiler?

What is a Compiler?

A compiler is a computer program which takes a set of instructions, written according to some set of rules, and transforms it into a machine language computer program, a string of binary characters. This is the *real machine language*. Everything actually stored in the machine can be represented by a combination of 1 and 0 digits.

Early computers built in the 1950's were programmed with strings of binary numbers and it was extremely difficult to tell where an error had been made in a long binary string as, 10111010110101. There are convenient methods of converting binary numbers to other number bases such as octal, hexadecimal, or decimal. Thus programmers were able to use more recognizable numeric strings such as, 73 (Octal) or A2 (Hex) to represent their Instruction Code. Operations performed by a computer (such as add, subtract, or move data from one location to another) have specific operation codes assigned to them. Some computers have as many as four hundred different operations (op-codes) in their instruction set.

Because it was still easy for a programmer to become confused about what the numbers represent, a still more simplified method of representing programs was developed using what are called mnemonics (nuhh-monics). For example, the letters AD might be used for add, SB for subtract, and LDA for load register A. This method of writing programs is sometimes mistakenly called machine language programming; in fact, together with symbolic addressing, it is Assembler Language Programming.

A program has to be available that will recognize the mnemonics of the assembly language instructions, translate them into the appropriate op-codes, and allocate actual storage locations for those represented by the programmer as symbolic names. Such a program is called *an assembler*. If such a program (an assembler) is not available and the operating instructions are written using only numeric code, the program is said to have been "hand assembled".

More powerful assemblers keep track of address locations in programs and may provide various helpful debugging aids. However, even the most powerful assemblers still require an understanding of assembly language in order to use them; and more importantly still, the more powerful they are the more likely they are to be untransportable. That is to say they are unlikely to be able to move from one model of a machine to another because they usually gain their "macropower" from features inherent in a particular machine.

Because a great deal of skill and effort is required to write a program in assembly language, new languages called higher level languages were designed to make life easier. The first widely used such higher level language was FORTRAN (FOR-mula TRAN-slater) used mainly by the mathematically oriented. The FORTRAN compiler allowed the programmer to express his problem in rather conventional looking mathematical notation and then took the program *SEE BOX* and converted it into assembly language instructions or directly into Machine Code.

Another high level language, COBOL (Common Business Oriented Language), was developed for accountants and the business community which allowed these professionals to express their computer programs in expressions easily learned by them. The COBOL compiler (a program written in machine language) took the user's program written in COBOL and compiled it into an executable machine language program. Other well known languages which require compilation are "C", FORTH and PASCAL. Compilers have been or are being developed for the PET for the languages "C", FORTH and PASCAL, but to date there has been no compiler for the full BASIC language. The following discussion will point out the usefulness of such a compiler and tell you when and where one will be available.

What is the Difference Between a Compiler and an Interpreter?

The code which a programmer writes in a higher level language is called the source code and the output from the compiler, which processes that code, is called the object code. In the process of making the conversion a compiler may have to make several "passes", i.e., complete scans through the source code, so compilers are often distinguished as being single or multiple pass compilers. It usually takes a multiple pass compiler longer to compile than a single pass compiler but the multiple pass compiler might be preferable if, for example, the object code it generates is more efficient.

In any case, once the compiler has completed its task the object code can be saved and used over and over again without recompiling. Interpreters, such as the BASIC Interpreter found in the PET and other popular micro-computers, do not work in this manner. They take the user's source program, written in the higher level language (the BASIC statements), and analyze (interpret) each statement one at a time to determine its equivalent machine code, and then execute this code. Moreover, *and this is the chief drawback to interpreters,* they do not save the object code. The next time that BASIC statement is executed the machine again has to interpret that line of code. For example, if there is a FOR....NEXT loop in the program that contains six statements between the FOR and the NEXT and the loop is to be executed 100 times, then each of those six lines of code will be interpreted (translated) into machine language 100 times. This results in a total of 600 translations made by the interpreter, whereas the compiler would have made only six. In both cases, the machine code is performed 600 times; but in the interpretation, the analysis represents a significant overhead which is absent in the compiled version.

Purists may object that this is a somewhat simplified explanation because, in fact, the interpreter stores token (numbers) for the BASIC keywords, and often jumps to predefined specific runtime routines rather than assembling new code. However, in principal the interpreter works in this manner and for this reason interpreted programs are 10 to 100 times slower in execution than compiled programs. Another factor which often slows down an interpreter is that it must repeatedly do much error checking that a compiler does only one time.

The advantage of an interpreter, however, is that one need not wait for the compile to take place before execution. So long as high speed in program execution itself is not needed, an interpreted program may perform quite fast enough; and although there may be other reasons (some of which will be described later) that may make compilation desirable, it is apparent that an interpreter will reduce the time required for program development.

There are advantages to an interpreter besides convenience in programming. Source code requires much less memory than object code. A single concise BASIC statement such as:

```
If X = (Y * L) / M THEN R = X + (M - L),
```

expands through compilation into many machine language statements. Consequently a much longer program can be written in BASIC and stored in a small computer that interprets each line and "throws away" the object code immediately after it is used, than in a machine that has to store all the object code before execution begins.

Incidentally, there are many high level languages that are not general purpose programming languages. RPG's (Report Program Generators), for example, are high level languages used to format reports. There are also many DBM (Data Base Management) languages (such as ADABAS, MARK IV, etc.) that are used to access large files of data. On the surface these programs appear very similar to the languages processed by compilers as regards the syntactical rules they require for input. That is to say the user writes a "program" for his application that is in many ways like a computer program that he would write for a compiler. However, while these systems do what they are designed to do very well (i.e., access some particular data base), they are not general purpose languages and cannot be used efficiently for many purposes that a compiled language can.

To summarize then, a *compiler translates the source code* into object code one time which is then used over and over again; whereas an interpreter, such as PET's BASIC, "throws away" the object code after each execution and then must re-translate again from the source before an instruction can be used again. The advantage of using an interpreter is that it takes much less memory to store a whole program in source format rather than in object format, and execution takes place immediately rather than waiting for a complete new re-compile after each program change. However, among its other advantages, a compiled program can be executed at more than ten times the speed of an interpreter and this is often critical in certain applications.

What is the Difference Between a Direct Compiler and a P-Code Compiler?

A compiler then, takes the source language code of a particular high level language and translates it into object code--that is to say, into the machine language op-codes. Because a computer always automatically executes the next instruction following the one it is presently executing (unless there is a branch), it is much faster not to have any branches. However, code written without branches would usually require more memory than is available internally to the computer. Also, it would not take advantage of the "conditional" branching or decision making power of the computer which is the essence of a program.

Consequently, *one of the major design decisions* in designing a compiler is the trade-off between using memory-consuming repeating code "in-line" to save branches and increase speed, or making time-consuming repeated branching to the same sub-routines in order to conserve memory. A JSR (Jump-to-Sub-Routine) requires the computer to save from the PC (Program Counter) the next address it would have executed in sequence, and load instead in the program counter the address of the sub-routine instruction. On RTS (Return from Sub-routine) the instruction address that was originally saved must then be restored to the PC. If there were only a few *instructions* in the sub-routine, there will be no saving of memory and time will be wasted in going to the sub-routine. The computer instead simply could have processed the next couple of instructions. However, if the sub-routine contains many instructions, memory will be saved by going there at the expense of a little time for making the branches. It all depends on the relative value of speed and memory in a particular system.

A compiler designer soon finds that

certain large blocks of code are used repeatedly. Therefore, every time a source program requests a certain type of activity the compiler causes the object code to jump to the specified block of code that can handle that activity. Sometimes two activities are similar, although not identical; but if the code for each is very long and the differences are minor, it is frequently more efficient to *generalize* the code and then to distinguish between the differences of the activities within the block of code. Now again, there are some trade-offs most likely requiring some additional branches for each of the activities that would not be necessary if they had their own unique code. We are in fact "interpreting" at execution time some of the code within the compiler-generated code. This then is not true object code for what was the source statement but is in a very limited sense Pseudo Code (P-Code).

While this type of approach is present to some extent in almost all compilers, some compilers make heavy use of this approach. The generalized code that will interpret the specific statements generated as object code by the compiler amounts to an "overhead" in both usage of memory and in execution time.

Some FORTH and PLM compilers currently available for the PET are so heavily dependent on these techniques that the resulting object code executes as little as 3 times as fast as the BASIC Interpreter. These same compilers require several K overhead in memory for the specialized routines that consequently become a part of all programs, whether they are actually used or not. This can be very detrimental in some important situations.

It is possible to write a compiler that is resident in memory and interprets all of the code at execution time. In such a case we have come full circle and have what we started with--an interpreter. This is indeed why many of the so-called compilers perform little better than an interpreter.

How, then, can one tell whether or not they have a "true" direct compiler or a largely P-code simulator? The answer is by *benchmarking*. Because there are different design philosophies behind different compilers, one must take a compiler and compare it to the other alternatives (i.e., other compilers or the interpreter). One does this by writing a test program with statements similar to the type they use in actual applications. Perhaps for one user there are lots of loops and string handling. Another user may particularly use math functions and arrays. The particular test program is then run using both products and the results are compared. Only in this way will you know which of the two products will perform better in terms of compile-time and/or execution-time. Other important considerations may be maintenance, direct access to the object code to allow modification, types of statements available, ease of operation, documentation, support, expected improvement or obsolescence, etc.

To summarize this section then, a "direct-compiler" uses relatively less pseudo-code and executes faster than straight P-code compulers. Performance can only be determined by benchmarking for specific applications.

Why Would a Basic Compiler be So Useful on a PET?

Aside from the considerable speed improvement that can be obtained from a well compiled program, are there any other advantages to using a BASIC compiler? Most definitely, yes. However, before elaborating let us pursue the question of speed itself. For many applications the PET's BASIC interpreter's speed is entirely adequate. It is in real time applications (such as process control, where the PET is monitoring some other device attached to it through an interface such as the IEEE-488 Port, located on the back of the machine) that greater speed is needed. Since only the PET among popular personal microcomputers has the necessary IEEE Port for attaching many laboratory and technical devices, faster programs are also more significant to PET users.

There are a number of S-100 bus applications that could benefit from increased program speed and these can be implemented on the PET through available S-100 interface boards. Often only a few specific routines need the higher speed afforded by assembly language programming and this could be accomplished by writing those few routines in assembly language and doing a SYS call from the BASIC program to them. This latter approach, however, still requires that the programmer understand assembler language; whereas, by using a BASIC compiler, he needs only know BASIC.

Where a BASIC compiler can really shine is in the development of marketable systems. There are now available for less than $300, systems that interface directly with the PET that can be used for burning PROMS (programmable read only memories) and E-PROMS (ultra violet erasable proms). These chips will fit into socket holders inside the new 16K PETS, or the socket holders in the expansion boards on the old 8K PETS, and can hold a machine language program in readiness for a user, even when the computer is turned off--they are called non-volatile.

This makes it convenient for users still to be able to use their computer in just the same way as any other PET user. But at the same time, they are able to step up to a PET that contains a PROM programmed for a specific task and immediately access the special program without having to wait for it to load from a tape or disk. In addition to making the computer easier for the user to use, this is also a very convenient way for the developer to distribute his program and makes copying of it much more difficult than if it were on tape. The producer's incremental cost of duplicating programs for distribution using PROMS should be well under $20 each.

More importantly, we can go one step further and take a program that has been written on the PET in BASIC, compiled, and stored in PROM and use that PROM along with a 6502 microprocessor to build up an entirely separate device that no longer involves the PET at all. In this way the PET has become a *very powerful* development tool for the garage or basement inventor that is comparable to similar development systems that have been used in industry for the last several years but that have cost *many* thousands of dollars. A true BASIC direct compiler will therefore allow serious PET users to develop from PROMS, faster and more memory efficient object code *while using the power of the present PET BASIC interpreter* for rapid program development.

What is the Status of the CANPET BASIC Compiler?

In June 1979 work was begun on a PET BASIC direct one-pass compiler. The language supported by this compiler is intended to be identical with that supported by the PET BASIC interpreter with the exception of dynamic array declaration/allocation.

The Co-ordinators of the project, Mr. Bruce Beach and Mr. Brian Beswick, have retained the service of a Toronto-based consulting firm with nearly 15 years of software experience and expertise in compiler design. Assistance is also being given by interested and knowledgeable individuals in the Canadian PET community, such as Mr. Jim Butterfield.

The first pre-releases of the compiler should be available for use by the time this article appears in print. Initial users will be sought in a wide diversity of applications so that the compiler's performance can be critically evaluated. Any persons who feel they would like to participate in the early evaluation process are invited to contact the Author.

Article Summary

A BASIC direct compiler that makes minimal use of P-code is being developed for the PET and APPLE or any 6502 based computer by a private Canadian group. It is anticipated that the resulting object code will require more storage than the source BASIC provided to the interpreter but less than that generated by other presently available compilers.

The chief advantage of the new compiler is that its resulting code should execute many times faster than the speed obtained by using the PET or APPLE's BASIC interpreter.

The new compiler in combination with the present powerful PET and APPLE BASIC interpreters should greatly facilitate the development of new systems that take advantage of the PET's and APPLE's 6502 microprocessor and the PET's IEEE-488 Port compatabilities.

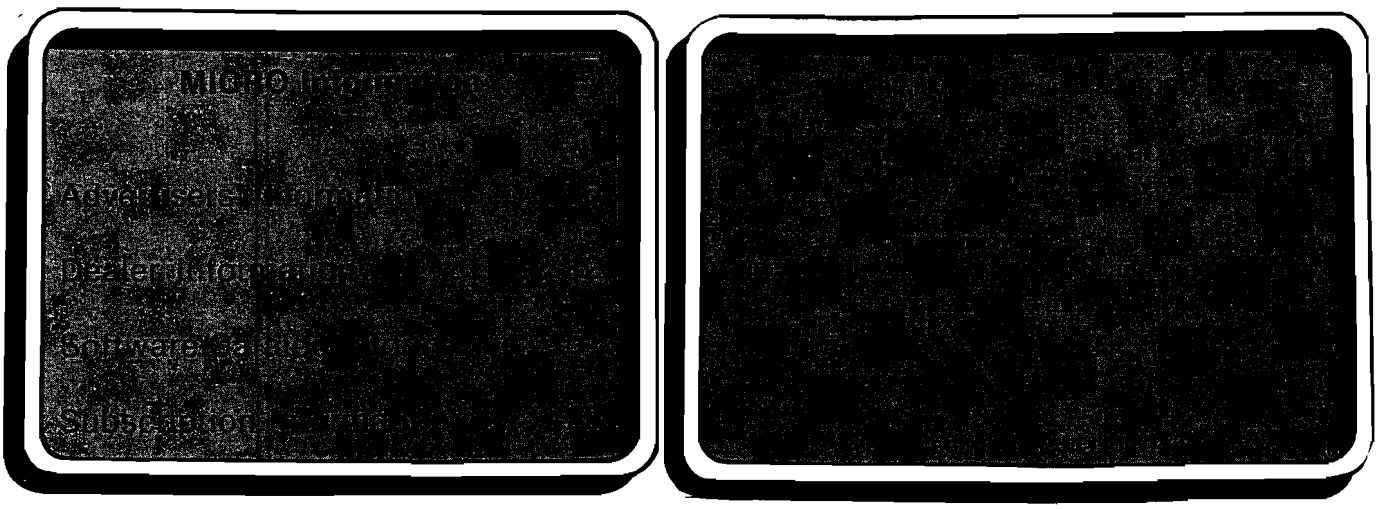
```
      DO 300 I=1,N
      IF (CR(I).EQ.0) GOTO 300
      IF (STRTSW(I).EQ.0) GOTO 407
      CR(I)=0
C CHECK IF INFORMATION COMING
      IF (STEP(I).GT.6) GOTO 301
      BFPTR(I)=BFPTR(I)-1
C YES INFOIRMATION
      T=STEP(I)
      DO 300 J=1.BFPTR(I)
      INFO(I,T,J)=BUFFER(I,J)
 300  CONTINUE
      STOP
      END
```

Figure 1: **Example of Fortran Routine**

Serious users who would be willing to help benchmark and critically evaluate the performance of this new BASIC compiler are invited to contact the author, Mr. Bruce M. Beach, Horning's Mills, Ontario L0N 1J0, Canada, (519)925-6035, or Mr. J. Brian Beswick, 1755 Rathburn Road, Unit 45, Mississauga, Ontario L4W 2M8 (416)624-5225.

```
    IF FEMALE GO TO WOMAN
    ELSE GO TO MAN.
WOMAN.  IF WEIGHT < MIN-FEMALE-WT (J)
    SUBTRACT WEIGHT FROM MIN-FEMALE-WT (J) GIVING LBS-U (NU)
    GO TO SKINNY.
    IF WEIGHT > MAX-FEMALE-WT (J) SUBTRACT MAX-FEMALE-WT (J)
    FROM WEIGHT GIVING LBS-OV (NOV)
    GO TO FAT.
    GO TO NORMAL.
MAN. IF WEIGHT < MIN-MALE-WT (J)
```

Figure 2: **Example of Cobol Routine**



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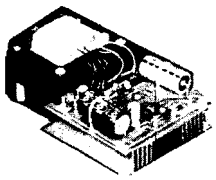

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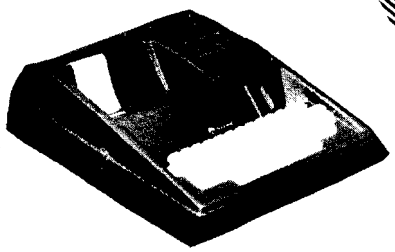

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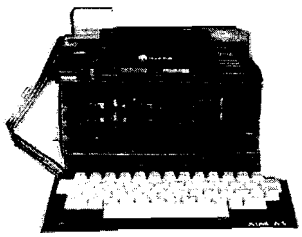

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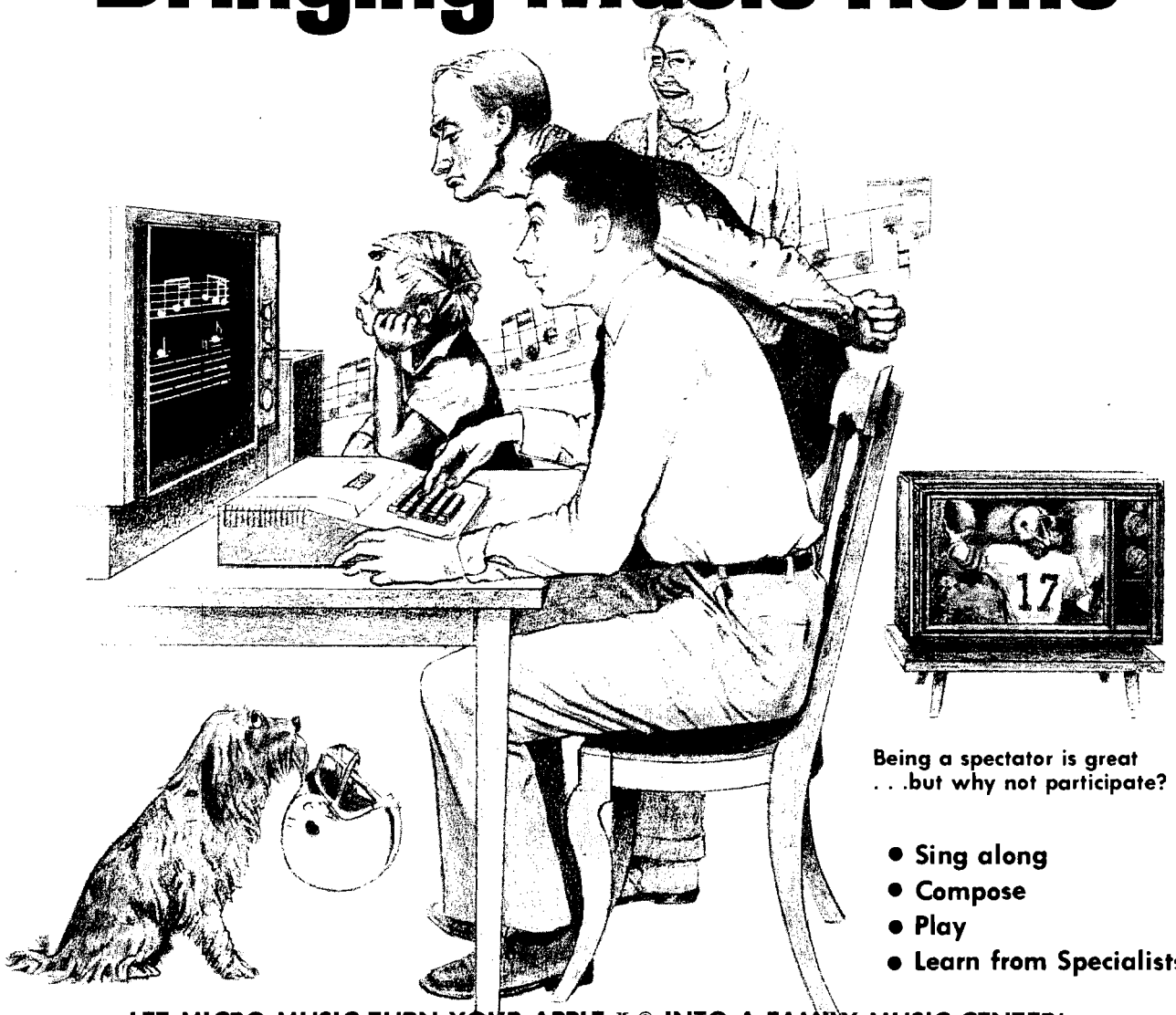

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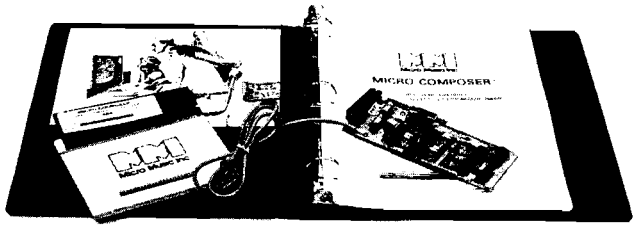

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Dr. L.S. Reich
3 Wessman Drive
West Orange, NJ 07052

Introduction

The focus of public interest in nutrition has changed markedly during the past decade. In the past, the emphasis was on eating more of everything. Increasingly, the message is to eat less. The reason for the turnabout is that many foods are believed to be factors in causing or promoting such degenerative diseases as heart disease, diabetes, etc. Diet is also involved in an especially prevalent disease, obesity (excessive weight).

Excessive weight is associated with cardiovascular and renal diseases, diabetes, degenerative arthritis, gout, etc. On the basis of life insurance statistics, the most nearly ideal weight to maintain throughout life is that which is proper at age 25 for one's height and body build. Thus, height-weight tables no longer indicate figures beyond ages of 25-30 years. A deviation of not more than 10 percent above or below the desirable weight for a given individual is not considered significant. The term overweight is applied to persons who are 10-20 percent above desirable weight; obesity is applied to persons about 20 percent or more overweight. Underweight generally applies to those individuals who are more than 10 percent below the established standards. Those who are more than 20 percent below such standards are considered to be seriously underweight.

Height-weight tables provide only approximations on the degree of fatness. More accurate measures of body fatness include measurements of thickness of subcutaneous tissue at designated body locations using calipers or by determination of body density by means of underwater weighing. It has been estimated that about one-half of all men over 30 are at least 10 percent overweight and that one-quarter are obese. The incidence is higher for women, about 40 percent being obese by the age of 40.

Generally, the percent water in lean individuals is higher than in obese persons. The opposite is true in regard to body fat. The human body generally consists of 55-60 percent of body weight as water, about 17 percent as lipids (which includes fats), about 15 percent as protein, and about 1 percent as carbohydrates, about 5 percent of other materials. The total body water relative to body weight is usually lower in females than in males. Also, the predicted total body water has been found to be closely related to predicted surface area. Generally, the higher the weight-% of body water, the lower the weight-% of body fat.

The Program

The program that follows indicates what a person should weigh based on height, body build and sex. The ideal weights given are generally for men and women of ages 25 and over. Besides ideal weights, this program estimates whether a person is obese, the percent that a person's weight is above the maximum ideal weight, the weight-% of body fat and of body water, and the body surface area. These physiological parameters are applicable to those over the age of 16.

Obesity is estimated by a critical obesity index based upon Quetelet's index (QI). This critical index is reached when the individual's weight is about 18 percent above the maximum ideal weight. Also, QI is used to estimate body fat (BF). The BF via QI is in good agreement with the value from weight-% water (BW) using the expression: 100-137*BW (however, another expression for BF is used in this program).

In the program listing that follows, REM statements are to be found in line numbers 20, 96, 100, 132, 138, 143, 148, 162, 200, and 490. Line numbers 500-600 contain height-weight data for females only while numbers 750-860 contain height-weight data for males only. In line number 50, W$(J,K) denotes an array for heights and weights corresponding to small, medium, and large body frames. Line numbers 97-99 and 137 express the program limitations for females (must not have height below 5'0" or above 5'10", and if body frame is small, physiological parameters will not be given); while, lines 197-199 and 237 express the program limitations for males (must not have heights below 5'4" or above6'3", and if body frame is small, physiological parameters will not be given). Line numbers 133 and 233 determine the percent that an individual's weight exceeds the maximum ideal weight and, numbers 145, 150-160, 245 and 250-260 calculate QI which is used to determine body fat and whether or not a person is obese.

Line numbers 165, 170, 175, 265, 270, 275 allow the estimation of body fat, body surface area, and body water both in men and women. Applesoft II BASIC in ROM was employed and the program required about 8.5K free bytes. (It may be noted here that a BASIC master command list has been published ((*Recreational Computing,* Sept-Oct, 1979)) which is applicable to SOL-20, PET 2001, APPLE II, and LEVEL II TRS-80 computers.)

PROGRAM LISTING

```
2  HOME
3  PRINT "THIS PROGRAM TELLS YOU WHAT YOU SHOULD WEIGH BASED ON
   DATA ADAPTED FROM THE BOOK (WEIGHTS IN THIS BOOK WERE SUBTRACTED
   BY 3 TO GIVE WEIGHTS IN BED CLOTHING, WHICH WERE USED IN THIS
   PROGRAM), 'NORMAL & THERAPEUTIC NUTRITION' (13TH EDITION), ";
4  PRINT "BY C.H. ROBINSON, 1972, P.848 (MACMILLAN). HEIGHT
   LIMITATIONS ARE, FOR WOMEN: 5-0 TO 5-10; FOR MEN: 5-4 TO 6-3
   (NO SHOES). IDEAL WEIGHTS GIVEN ARE FOR BED CLOTHING AND ARE
   FOR ";
5  PRINT "MEN AND WOMEN OF AGES 25 AND OVER (FOR GIRLS 18-25,
   SUBTRACT 1 POUND FOR EACH YEAR UNDER 25)."
6  PRINT "BESIDES IDEAL WEIGHTS, THIS PROGRAM ESTIMATES OBESITY,
   BODY FAT, BODY SURFACE AREA, AND TOTAL BODY WATER. THESE ARE
   APPLICABLE TO THOSE OVER THE AGE OF 16. GENERALLY, THE % TOTAL
   BODY WATER IS LOWER IN FEMALES THAN IN MALES. ";
7  PRINT: PRINT: PRINT "PRESS 'CONT' TO CONTINUE!"; :PRINT: STOP:
   PRINT
8  PRINT "FURTHER, THE % OF WATER IN LEAN PERSONS IS HIGHER THAN IN
   OBESE PERSONS. ABOUT 55-60% OF THE BODY WEIGHT IS WATER. A
   DEVIATION OF NOT MORE THAN 10% ABOVE OR BELOW THE DESIRABLE
   WEIGHT FOR AN INDIVIDUAL IS NOT ";
9  PRINT "CONSIDERED SIGNIFICANT. THE TERM 'OVERWEIGHT' IS GENERALLY
   APPLIED TO PERSONS WHO ARE 10-20% ABOVE THE DESIRABLE WEIGHT.
   'OBESITY' IS APPLIED TO PERSONS WHO ARE ABOUT 20% OR MORE OVER-
   WEIGHT. ";

10 PRINT "IN THIS PROGRAM, OBESITY IS DETERMINED BY A CRITICAL
   OBESITY INDEX BASED UPON 'QUETELET'S INDEX' (QI). THIS
   CRITICAL INDEX IS REACHED WHEN THE PERSON'S WEIGHT IS ABOUT
   18% ABOVE THE MAXIMUM IDEAL WEIGHT. ALSO, QI IS USED TO ";
11 PRINT "ESTIMATE BODY FAT (BF). THE BF VIA QI IS IN GOOD
   AGREEMENT WITH THE VALUE FROM TOTAL BODY WATER USING: %BF=100-
   (137* WT. WATER/BODY WT.).": PRINT: PRINT "PRESS 'CONT' TO
   CONTINUE!": STOP: PRINT
12 PRINT "MORE REFERENCES: HUME & WEYERS, J.CLIN.PATH., VOL. 24,
   PP. 234-238 (1971); JAMES, (A DHSS/MRC REPORT) HER MAJESTY'S
   STATIONERY OFFICE, LONDON, 1976 (ISBN 0 11 450034 7). REMARKS
   ARE TO BE FOUND IN LINE #'S 20, 96, 100, 132, 138, 143, 148, 162,
   200, 490."
```

```
13  PRINT: PRINT "PRESS 'CONT' TO CONTINUE!"; :PRINT: STOP
14  PRINT: PRINT
20  DIM W$(30,5): REM THIS IS AN ARRAY FOR HEIGHT & WEIGHTS
    CORRESPONDING TO SMALL, MEDIUM, & LARGE BODY FRAMES
30  FOR J=1 TO 30
40  FOR K=1 TO 4
50  READ W$(J,K)
60  IF W$(J,1) ="ZERO" THEN J=J-1: GOTO 80
70  NEXT K,J
80  PRINT "LIST YOUR SEX (FEMALE=1; MALE=2) ACCORDING TO NUMBERS;
    YOUR HEIGHT (NO SHOES) TO NEAREST INCH ";
81  PRINT "(E.G., 5-10); YOUR BODY FRAME(SMALL=1; MEDIUM=2; LARGE=3);
    & FINALLY YOUR WEIGHT (IN POUNDS, WITH BED CLOTHING):";

83  INPUT S, H$, F, WT
85  PW=WT
90  ON S GOTO 95,195
95  PRINT: PRINT "-------------------------------------":
    TV=VAL(MID$(H$,1,1))*12+VAL(MID$(H$,3))
96  REM LINE #'S 97-99 & 137 EXPRESS THE PROGRAM LIMITATIONS FOR
    FEMALES WHILE LINE #'S 197-199 & 237 EXPRESS THE PROGRAM
    LIMITATIONS FOR MALES
97  IF F<=1 AND TV<60 THEN PRINT: PRINT "BECAUSE YOUR FRAME IS
    ONLY 'SMALL' AND YOUR HEIGHT IS LESS THAN 5-0, THIS PROGRAM
    CAN OFFER YOU NO INFORMATION!": GOTO 180
98  IF F <=1 AND TV>70 THEN PRINT: PRINT "BECAUSE YOUR FRAME IS
    ONLY 'SMALL' AND YOUR HEIGHT IS MORE THAN 5-10, THIS PROGRAM
    CAN OFFER YOU NO INFORMATION!": GOTO 180
99  IF TV<60 OR TV>70 THEN PRINT: PRINT "BECAUSE OF HEIGHT
    LIMITATIONS, THIS PROGRAM CANNOT GIVE YOU YOUR IDEAL WEIGHT!":
    GOTO 140
100  FOR W =1 TO 11: REM THIS IS FOR FEMALES ONLY
110  L =1
120  IF W$(W,L) =H$ THEN PRINT: PRINT "YOUR IDEAL WEIGHT =";
     W$(W,F+1);: GOTO 133
130  NEXT
132  REM LINE #'S 133& 233 DETERMINE THE % THAT YOUR WEIGHT
     EXCEEDS YOUR MAXIMUM IDEAL WEIGHT
133  SS =VAL(MID$(W$(W,F+1), 5)): IF SS<PW THEN PRINT "---YOU ARE "
     INT(((PW-SS)*100/SS)*10+.5)/10" % ABOVE YOUR MAXIMUM IDEAL
     WEIGHT.";
134  GG =INT(((PW-SS)*100/SS)*10+.5)/10: IF GG>10 AND GG<18
     THEN PRINT "(YOU ARE CONSIDERED OVERWEIGHT)!"
136  PRINT
137  IF F<=1 THEN PRINT: PRINT "BECAUSE YOUR FRAME IS ONLY 'SMALL',
     ADDITIONAL INFORMATION ON BODY WATER, ETC. DOES NOT APPLY TO
     YOU!": GOTO 180
138  REM IN LINE #'S 140 & 240, 'H' DENOTES HEIGHT IN METERS &
     'WT' WEIGHT IN KILOGRAMS OF FEMALES & MALES, RESPECTIVELY
140  H =VAL(MID$(H$,1,1))*12 + VAL(MID$(H$,3)): H =H*.0254:
     WT = WT*.45359
143  REM IN LINE #'S 145 & 245, 'QI' DENOTES 'QUETELET'S INDEX'
     WHICH IS USED FOR FEMALES & MALES RESPECTIVELY, TO DETERMINE
     BODY FAT AND WHETHER A PERSON IS OBESE
145  QI = WT/(H*H)
148  REM LINE #'S 150-160 & 250-260 DETERMINE WHETHER OBESITY
     EXISTS FOR FEMALES & MALES, RESPECTIVELY
150  IF F=2 AND QI>27.0 THEN PRINT: PRINT "YOU ARE ALSO OVER THE
     CRITICAL OBESITY INDEX---START DIETING!": GOTO 165
155  IF F=3 AND QI>29.5 THEN PRINT: PRINT "YOU ARE ALSO OVER THE
     CRITICAL OBESITY INDEX---START DIETING!": GOTO 165
160  PRINT: PRINT "YOU ARE UNDER THE CRITICAL OBESITY INDEX---
     CONGRATULATIONS!"
162   REM LINE #'S 165 & 265 ALLOW DETERMINATION OF BODY FAT IN
      WOMEN & MEN, RESPECTIVELY; #'S 170 & 270 ALLOW DETERMINATION
      OF BODY SURFACE AREAS FOR WOMEN & MEN, RESPECTIVELY; #'S 175
```

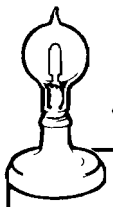
```
& 275 ALLOW DETERMINATION OF BODY WATER IN WOMEN AND MEN,
RESPECTIVELY
165 WF = 1.48*QI-7: PRINT: PRINT "YOUR BODY FAT = " INT(WF*10+.5)/10
" %"
170 BS = (.007185*WT^.425*(H*100)^.725): PRINT: PRINT "YOUR
BODY SURFACE AREA IS CA. " INT(BS*100 + .5)/100" SQ. METERS
(OR " INT ((BS*10.764)*10 + .5)/10" SQ. FT.)"
175 WW = .183809*WT + 34.4547*H-35.270121
177 PRINT: PRINT "YOUR TOTAL BODY WATER IS CA. " INT(WW*10 + .5)/10
" LITERS (CA. " INT ((WW*1000/453.6)*10 + .5)/10" LBS. WATER
---OR " INT((WW*1E02/WT)*10 + .5)/10"% BODY WT.)"
180 PRINT"----------------------------------": PRINT: GOTO 80
195 PRINT: PRINT"----------------------------------":
TV = VAL(MID$(H$,1,1))*12 + VAL(MID$(H$,3))
197 IF F<=1 AND TV<64 THEN PRINT: PRINT "BECAUSE YOUR FRAME IS
ONLY 'SMALL' & YOUR HEIGHT IS LESS THAN 5-4, THIS PROGRAM
CAN OFFER YOU NO INFORMATION!": GOTO 280
198 IF F<=1 AND TV>75 THEN PRINT: PRINT "BECAUSE YOUR FRAME IS
ONLY 'SMALL' & YOUR HEIGHT IS MORE THAN 6-3, THIS PROGRAM
CAN OFFER YOU NO INFORMATION!": GOTO 280
199 IF TV<64 OR TV>75 THEN PRINT: PRINT"BECAUSE OF HEIGHT
LIMITATIONS, THIS PROGRAM CANNOT GIVE YOU YOUR IDEAL WEIGHT!":
GOTO 240
200 FOR W = 12 TO 23 : REM  THIS IS FOR MALES ONLY
210 L=1
220 IF W$(W,L) = H$ THEN PRINT: PRINT"YOUR IDEAL WEIGHT = ";
W$(W,F+1);: GOTO 233
230 NEXT
233 SS = VAL(MID$(W$(W,F+1),5)): IF SS<PW THEN PRINT"---YOU ARE "
INT(((PW-SS)*100/SS)*10 + .5)/10 " % ABOVE YOUR MAXIMUM IDEAL
WEIGHT ";
234 GG = INT(((PW-SS)*100/SS)*10 + .5)/10: IF GG>10 AND GG<18
THEN PRINT"(YOU ARE CONSIDERED OVERWEIGHT)!"
236 PRINT
237 IF F<=1 THEN PRINT: PRINT"BECAUSE YOUR FRAME IS ONLY 'SMALL',
ADDITIONAL INFORMATION ON BODY WATER, ETC. DOES NOT APPLY
TO YOU!": GOTO 280
240 H = VAL(MID$(H$,1,1))*12 + VAL(MID$(H$,3)): H = H*.0254 :
WT = WT*.45359
245 QI = WT/(H*H)
250 IF F = 2 AND QI>27.5 THEN PRINT: PRINT"YOU ARE ALSO OVER
THE CRITICAL OBESITY INDEX---START DIETING!": GOTO 265
255 IF F = 3 AND QI>29.9 THEN PRINT: PRINT"YOU ARE ALSO OVER
THE CRITICAL OBESITY INDEX---START DIETING!": GOTO 265
260 PRINT: PRINT"YOU ARE UNDER THE CRITICAL OBESITY INDEX---
CONGRATULATIONS!"
265 MF = 1.281*QI-10.13 : PRINT: PRINT"YOUR BODY FAT = "
INT(MF*10 + .5)/10 " %"
270 BS = (.007185*WT^.425*(H*100)^.725): PRINT: PRINT"YOUR
BODY SURFACE AREA IS ABOUT "INT(BS*100 + .5)/100 " SQ.
METERS (OR " INT((BS*10.764)*10 + .5)/10 " SQ. FEET)"
275 MW = .296785*WT + 19.4786*H-14.012934
277 PRINT: PRINT"YOUR TOTAL BODY WATER IS ABOUT "INT(MW*10 + .5)/10
" LITERS (ABOUT " INT((MW*1000/453.6)*10 + .5)/10 " LBS.
WATER---OR " INT((MW*1E02/WT)*10 + .5)/10 " % BODY WEIGHT)"

280 PRINT"----------------------------------": PRINT: GOTO 80
490 REM LINE #'S 500-600 CONTAIN HEIGHT-WEIGHT DATA FOR FEMALES
ONLY WHILE #'S 750-860 CONTAIN HEIGHT-WEIGHT DATA FOR MALES
ONLY
500 DATA  "5-0", "99-107", "104-116", "112-128"
510 DATA  "5-1", "102-110", "107-119", "115-131"
520 DATA  "5-2", "105-113", "110-123", "118-135"
```

```
530  DATA  "5-3", "108-116", "113-127", "122-139"
540  DATA  "5-4", "111-120", "117-132", "126-143"
550  DATA  "5-5", "115-124", "121-136", "130-147"
560  DATA  "5-6", "119-128", "125-140", "134-151"
570  DATA  "5-7", "123-132", "129-144", "138-155"
580  DATA  "5-8", "127-137", "133-148", "142-160"
590  DATA  "5-9", "131-141", "137-152", "146-165"
600  DATA  "5-10", "135-145", "141-156", "150-170"
750  DATA  "5-4", "118-126", "124-136", "132-149"
760  DATA  "5-5", "121-130", "127-140", "135-153"
770  DATA  "5-6", "125-134", "131-144", "139-158"
780  DATA  "5-7", "129-138", "135-149", "144-163"
790  DATA  "5-8", "133-142", "139-153", "148-167"
800  DATA  "5-9", "137-147", "143-157", "152-171"
810  DATA  "5-10", "141-151", "147-162", "156-176"
820  DATA  "5-11", "145-155", "151-167", "161-181"
830  DATA  "6-0", "149-159", "155-172", "165-186"
840  DATA  "6-1", "153-164", "159-177", "170-191"
850  DATA  "6-2", "157-168", "164-182", "175-196"
860  DATA  "6-3", "161-172", "169-187", "179-201"
1000  DATA  ZERO
```

PROGRAM EXAMPLES

```
COMMAND:  'RUN'⟶ STATEMENTS IN LINE #'S 3-6 AND "PRESS 'CONT'
          TO CONTINUE!
          BREAK IN 7"
COMMAND:  'CONT'⟶STATEMENTS IN LINE #'S 8-11 AND "PRESS 'CONT'
          TO CONTINUE!
          BREAK IN 11"
COMMAND:  'CONT'⟶STATEMENT IN LINE # 12 AND "PRESS 'CONT' TO
          CONTINUE!
          BREAK IN 13"
COMMAND:  'CONT'⟶"LIST YOUR SEX (FEMALE = 1; MALE = 2) ACCORDING
          TO NOS.; YOUR HEIGHT (NO SHOES) TO NEAREST INCH
          (E.G., 5-10); YOUR BODY FRAME (SMALL = 1; MEDIUM = 2;
          LARGE = 3); & FINALLY YOUR WEIGHT (IN LBS.-WITH BED
          CLOTHING): ?"
RESPONSE: '2, 5-8, 2, 165'⟶
          "-------------------------------------
          YOUR IDEAL WEIGHT = 139-153---YOU ARE 7.8% ABOVE YOUR
          MAX. IDEAL WT.
          YOU ARE UNDER THE CRITICAL OBESITY INDEX---
          CONGRATULATIONS!
          YOUR BODY FAT = 22%
          YOUR BODY SURFACE AREA IS CA. 1.88 SQ. METERS
          (OR 20.3 SQ. FT.)
          YOUR TOTAL BODY WATER IS CA. 41.8 LITERS (CA. 92.2
          LBS. WATER---OR 55.9% BODY WT.)
          -------------------------------------
          LIST YOUR SEX (FEMALE = 1; MALE = 2) ACCORDING TO
          NUMBERS; YOUR HEIGHT (NO SHOES) TO NEAREST INCH
          (E.G., 5-10); YOUR BODY FRAME (SMALL = 1; MEDIUM = 2;
          LARGE = 3); & FINALLY YOUR WEIGHT (IN LBS.-WITH
          BED CLOTHING): ? "
RESPONSE: '1, 5-2, 2, 148'⟶
          "-------------------------------------
          YOUR IDEAL WEIGHT = 110-123---YOU ARE 20.3% ABOVE
          YOUR MAXIMUM IDEAL WEIGHT
          YOU ARE ALSO OVER THE CRITICAL OBESITY INDEX---
          START DIETING!
          YOUR BODY FAT = 33.1%
          YOUR BODY SURFACE AREA IS CA. 1.68 SQ. METERS
          (OR 18.1 SQ. FT.)
          YOUR TOTAL BODY WATER IS CA. 31.3 LITERS (CA. 69.1
          LBS. WATER---OR 46.7% BODY WT.)
          ------------------------------------- "
```



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Lifetime of a Non-Renewable Resource

One of the great problems facing the world today is the conservation of resources, particularly those which can not be readily renewed. The simple program is a good model of an interactive BASIC simulation.

Marvin L. DeJong
Dept. of Math & Physics
The School of the Ozarks
Point Lookout, MO 25726

Are you interested in doing something simple, serious, and of educational value with your computer? Estimating the lifetime of a non-renewable resource such as coal, oil, or natural gas is often a difficult calculation involving calculus and the use of exponential or logarithmic functions. The computer makes it short and super simple, as you will see. The results have serious implications. An editorial in our local paper claimed that we have enough coal to last for centuries. This may or may not be true. Read on.

Suppose there are R tons of coal still unmined. Also suppose that we use C tons of coal per year. At the end of one year we will have R – C tons left. The next year we subtract C tons again, and so on until our coal is gone. If we kept track of the number of subtractions, we would know how many years the coal would last. This is the lifetime of the resource.

However, we must take into account that, typically, the production and consumption of resources increases over time. Our demand for electrical power, fuel oil, natural gas, and gasoline grows. The gross national product, or GNP, increases in a healthy (?) economy. Growth implies increases in the consumption of resources, and this must be taken into account when calculating the lifetime of a resource.

Assume that consumption of a resource grows by G percent per year. If C tons of coal are consumed this year, then next year we will consume C tons of coal plus the increase, which is G/100 multiplied times C. Anyone who has calculated interest compounded annually knows how to do the arithmetic. A simple example may help. If we use 500 million tons of coal this year, and our growth rate in the consumption of coal is 10 per cent per year, then next year we will consume 500 million tons plus 10 per cent of 500 million tons.

The calculation of the lifetime of a resource is much the same as outlined above, except that C increases by G percent each year if the growth factor is taken into account. A flowchart of the entire process is shown in Figure 1, and

```
10  PRINT "THIS IS A PROGRAM TO CALCULATE HOW LONG A NON-RENEWABLE
    RESOURCE WILL LAST."
20  PRINT "TYPE IN THE ESTIMATED RESERVES OF THE RESOURCE."
30  PRINT "RESERVES=";
40  INPUT R
50  PRINT "TYPE IN THE ANNUAL RATE AT WHICH THE RESOURCE IS CONSUMED."
60  PRINT "CONSUMPTION RATE=";
70  INPUT C
80  PRINT "TYPE IN THE ANNUAL PERCENT INCREASE IN THE CONSUMPTION RATE."
90  PRINT "GROWTH RATE OF CONSUMPTION=";
100 INPUT G
110 G=G/100
120 Y=0
130 R=R-C
140 C=C+C*G
150 Y=Y+1
160 IF R > 0 THEN 130
170 PRINT "YOUR RESOURCE WILL LAST"; Y; "YEARS."
180 END
```

Table 1: **Resource Depletion Program**

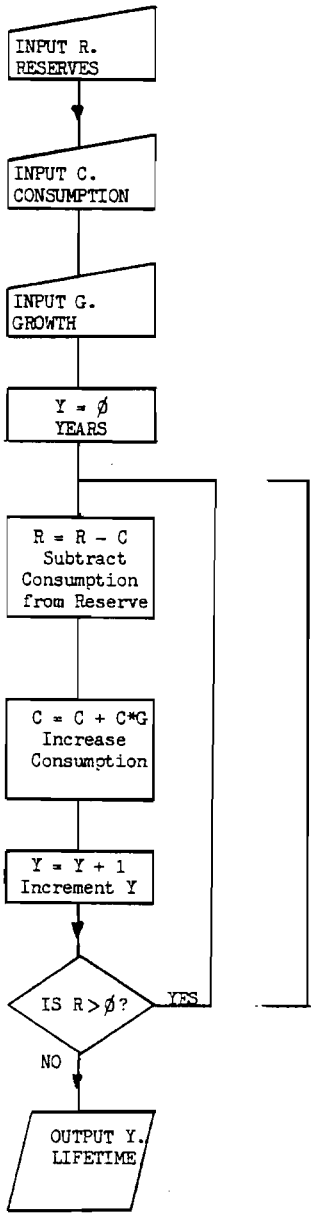

Figure 1: **Flowchart to calaulate the Lifetime of a Non-Renewable Resource**

the corresponding BASIC program is given here. There is only one approximation in the calculation. I assumed that the consumption changes abruptly at the end of a year, whereas it actually changes more or less continuously throughout the year, much like interest compounded daily. The approximation has little effect on the results. The error is usually less than a year or two.

Next we need some data to put into the computer. This can be a bit tricky because companies that sell the resource tend to overestimate the reserves, while conservationists are probably biased in the other direction. The truth is most likely somewhere in the middle. My data (and the inspiration for this project) came from an article by Professor Albert A. Bartlett in the September 1978 issue of the *American Journal of Physics*. The data, which I have taken the liberty to round off to one significant digit, appears in Table 1. Other references you might want to check are: Dr. M. King Hubbert, *A National Fuels and Energy Policy Study*, Serial 93—40 (92—75) Part I, U.S. GPO, Washington, D.C., 1973, $2.35; and Dr. M. King Hubbert, "Energy Resources of the Earth" in *Scientific American*, September 1971.

Almost any computer should take the simple BASIC program given here. Mine ran on my Microsoft BASIC for the KIM-1. Since almost every step is illustrated in the flowchart, no further explanation of the program is necessary. Load it and type in the data as they are requested. When the last item is entered, hit RETURN and wait for the answer.

Now experiment with the input data. Suppose the estimate of the reserve was half as large as it really is. How does this change the lifetime of the resource? Does doubling the reserve double the lifetime? Calculate the lifetime with a 0 per cent growth rate; a 10 per cent growth rate. Get data on natural gas, copper, or other non-renewable resources and run the program. What are the actual conditions under which coal will last for centuries?

Resource	Reserves	Current Consumption Rate	Growth
U.S. Coal	500 billion tons	0.7 billion tons per yr.	7%
U.S. Oil	100billion barrels	6 billion barrels per yr.	8%
World Oil	2000 billion barrels	20 billion barrels per yr.	7%

Table 2: **Data on Reserves, Consumption & Growth of 2 Resources**

More on page 37.

The Loneliness of the Microcomputer

While most of us would agree that the microcomputer is a pretty great device, it is not without potential problems. One of the possible drawbacks to the microcomputer which I have not seen discussed is that of its almost exclusive "one-on-one" utilization. Much has been said about this type of problem with television. Instead of getting together with friends, family or neighbors after dinner, how many people now just sit in front of the "boob tube"? How much human interaction has been given up in order to watch TV?

Microcomputers seem to be used in a mode very similar to TV watching. One person interacts with the microcomputer. Other people are not required and, unless you are showing off your latest program, are generally not wanted! Hardly a socialable device. Think about the things you do with your micro. How many of them involve another human? Balancing your check book, playing chess or life, solving equations ... the list goes on. Most of the programs which have been listed in the Micro Software Catalog and many of the programs presented in articles have been of the single individual variety.

Assuming you agree that it would be nice to make the micro more socialable, how can this be done? Some micro uses are inherently individual. You do not necessarily want a friend helping you balance your checkbook. Other areas can be modified to permit multi-individual use and interaction. The entire games area is open to the generation of games which several people play, not just one. In a multi-person game, the micro can be used to generate and maintain a very complex playing situation, can generate sophisticated environments and display them in a variety of forms, can be the score keeper and when necessary the arbiter, can inform and assist the players, can be a time keeper, and so forth. The micro is this type of game is not the opponent. I hope that we will see more games of this type in the near future.

Other multi-person micro applications are starting to appear. A number of systems are being set up which permit individuals to communicate with one another through their micros. There should be other areas developed which permit the multi-person utilization of micros. I feel that it is important for every computerist to occasionally question how he is using his equipment, and to determine what the secondary effects of the uses may be.

Robert M. Tripp

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Sweet-16 Programming Using Macros

Some very useful information is presented about Macros in general, the APPLE II Sweet-16 Interpreter, and how to use them together.

Richard C. Vile, Jr.
3467 Yellowstone Drive
Ann Arbor, MI 48105

The history of computer programming is replete with stories of the development of new tools. Assemblers were designed with the purpose of relieving the programmer of the tedium of programming in binary machine language. Over the course of the past twenty years, various features have been added to assembly languages to further ease the pain. Prime among these inventions has been the macro capability available in many assemblers. Macros provide means for extending the expressive capabilities of assembly language. Another software tool developed in recent years is the virtual machine. A virtual machine is emulated, imitated or interpreted by a program. It provides capabilities not directly available in the hardware of the real machine on which it is simulated. This article discusses the combined application of macro assembly and virtual machine interpretation on the APPLE II personal computer system.

Macro Assemblers

Macro assemblers extend the capabilities of ordinary assemblers by providing ways to abbreviate commonly used sequences of instructions. Often a programmer will use sequences of instructions that have identical opcodes and addressing modes, but differ only in the memory locations referred to. Consider the following:

```
        INC  LOC1L
        BNE  =+5
        INC  LOC1H
```

and

```
        INC  LOC2L
        BNE  =+5
        INC  LOC2H
```

where the symbol '=' is used to refer to the location of the instruction being assembled. These two sequences both have the same purpose: to cause the 16 bit quantity stored in two consecutive memory locations to be increased by one. For this example we have assumed that the locations are not in page zero and are directly addressed. A macro assembler will allow these sequences to be abbreviated using a new symbol, chosen by the programmer. The symbol must be formally declared in a *Macro Definition*, before it is used. Such a definition is shown below using the notation of the ASM/TED assembler of Carl Moser:

```
!!!INCD   .MD (WHERE)
          INC WHERE
          BNE =+5
          INC WHERE+1
          .ME
```

The symbol WHERE does not represent a specific memory location, but potentially many different memory locations. It is called, in assembler terminology, a *formal* or *dummy parameter*. Even though our example has only one formal parameter, macros in general may have many. The three exclamation marks preceding the name INCD indicate to the assembler that the label INCD is the name of a macro. '.MD' stands for *M*acro *D*efinition and '.ME' stands for *M*acro *E*nd. The sequence of instructions between .MD and .ME is called the *body* of the macro. Once a macro definition is written into a program, the macro may subsequently be *called* by using its name in an instruction, as if it were an opcode. More sophisticated macro assemblers allow macros to appear in any field of an instruction, rather than just the opcode field. When a macro is called, the programmer is obligated to supply *actual* parameters to replace the dummy parameters used in the definition. In the example given above, when INCD is called, it must be accompanied by the label associated with an actual memory location used by the program:

```
INCD  (COUNT)
```

The actual parameter is substituted for all occurrences of the dummy parameter in the macro body and the instructions in the macro body are assembled directly into the program at the point of the macro call. This is known as "expanding" the call:

```
        INC  COUNT
        BNE  =+5
        INC  COUNT+1
```

Another way of thinking about macros is to view them as small subroutines which are inserted directly into a program instead of being called. When a short sequence of instructions is commonly repeated, it may be cheaper to make a macro out of it than to make it into a subroutine. Part of the reason for this is that it costs extra instructions to pass parameters to a subroutine, especially on a micro such as the 6502, which has a limited number of registers. In this example, particularly, the difference is significant. In order to convert the INCD macro into a subroutine, we would need to figure out a way to pass the address of the first byte to be incremented. For example:

```
        LDA "Low byte of address of
             COUNT"
        LDX "High byte of address
             of COUNT"
        JSR INCD
             .
             .
             .
INCD    STA CL  Page Zero Loc
        STX CH  Next Page Zero Loc
        LDY #00   Assuming Y
        ;       available- otherwise
        ;       TAY-PHA first.
        INC (CL),Y
        BNE =+6
        INY
        INC (CL),Y
        RTS
```

This is surprisingly more complicated than the macro, which is why you probably never thought of making it into a subroutine before. In general, if a subroutine is short and if it involves manipulating addresses of parameters, then it may be worth converting to a macro.

Assemblers vary widely in the richness of features supported. One of the more desirable features to use in conjunction with the macro capability is that of *conditional assembly*. This enables a program to define instruction sequences and, in particular, macros, with much more flexibility. We shall see this in action when we discuss the Sweet-16 macros later. Conditional assembly directives allow the programmer to control the actions taken by the assembler.

Macros can be used to generate arbitrary bit patterns into the stream of object code produced by the assembly of a program. There may be subtle reasons for wishing to do this. One of those reasons forms the meat of our principal example: the bit patterns so generated may form interpretive code which can, via the macro capability, be interspersed with ordinary machine code. By using macros to generate the interpretive code, the programmer is freed from the odious task of hand assembly — a task which could discourage him from using the interpretive code in the first place.

Sweet-16

The 6502 microprocessor provides no direct capability for handling 16 bit quantities. In particular, the machine has no internal 16 bit registers, save for the PC. Thus, when it becomes necessary to do 16 bit arithmetic, or to manipulate pointers or 16 bit addresses, the programmer is forced to write instruction sequences to simulate the required operations. The APPLE II firmware contains a subroutine known as the SWEET-16 "dream machine," which does just that. It operates in an interpretive mode, taking the sequence of bytes following the instruction which calls it as virtual or interpretive code. Here's how it works.

When a JSR (*J*ump to *S*ub*R*outine) instruction is executed by the 6502 processor, the value of the program counter, which in that case will be the address of the last byte of the JSR instruction, is saved on the 6502 stack as two consecutive bytes. When a RTS (*Re*Turn from *S*ubroutine) instruction is executed within the called subroutine, that address increased by one will be restored from the stack to the PC, to enable the 6502 to continue executing instructions following the JSR instruction. (See Figure 1.) The fact that the "return" address is saved on the stack means that the called subroutine can, in fact, find out where it was called from. More than that, it can use the return address and the indirect addressing mode of the 6502 to actually retrieve the sequence of bytes following the calling instruction. That is precisely what the Sweet-16 subroutine does.

The Sweet-16 interpreter takes advantage of the fact that the return address is at the top of the 6502 stack. It pops the two bytes from the stack and transfers them to a pair of page zero locations which it then uses as an indirect address to locate the sequence of interpretive instructions following the JSR which called it.

Thus the return address of the Sweet-16 subroutine becomes the address of the first instruction to be executed by the Sweet-16 machine. As the Sweet-16 machine executes instructions, it updates this address to point to the next virtual instruction to be executed. When the Sweet-16 interpreter finds an interpretive instruction

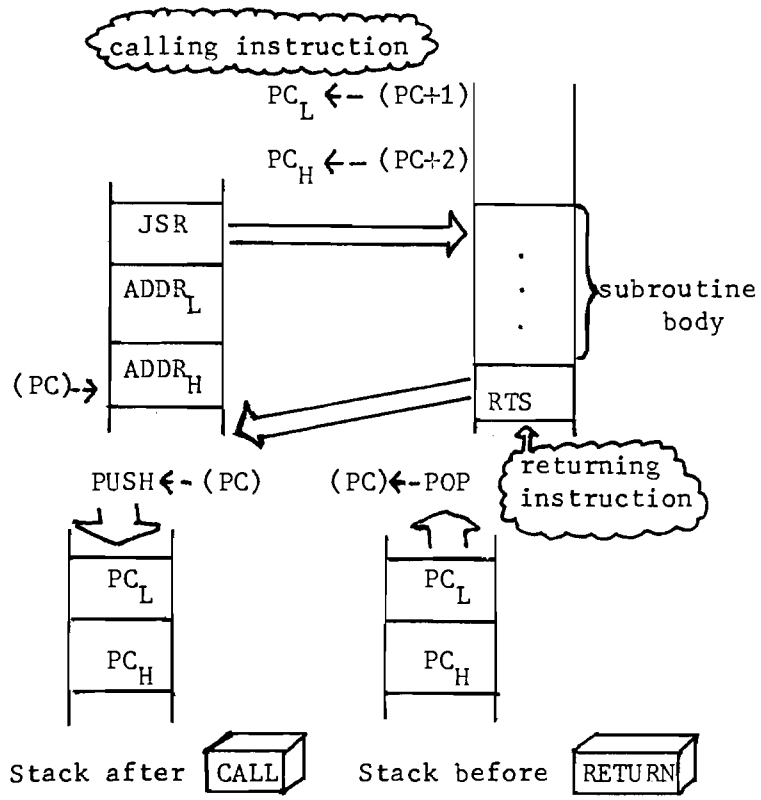

Figure 1: **6502 Subroutine Call and Return**

"return," it restores the address of that instruction to the stack and executes a real 6502 RTS. This causes the processor to continue execution of the machine code following. Thus, Sweet-16 code and real 6502 code may be mixed together in sequence, with Sweet-16 being called by a JSR instruction preceding each "chunk" of Sweet-16 code.

The Sweet-16 processor contains 16 registers, each simulated by two page zero locations. Register 15 doubles as the Sweet-16 program counter. As explained above, the actions of the various Sweet-16 instructions cause the contents of the virtual PC to be updated. The cycle of execution of the Sweet-16 machine is:

1. Fetch Opcode — LDY #00
LDA (R15),Y
2. Execute Opcode — Transfer control to the appropriate section of Sweet-16.
3. Repeat at 1. or Return to caller (if interpretive opcode was "return").

The following table briefly summarizes the opcodes which the Sweet-16 machine provides. The mnemonics used in the table are those chosen for the macro implementation discussed below. Further details and some examples may be found in the November 1977 issue of BYTE magazine.

Op	Mnemonic	Arguments	Effect
1n	SETR	(Rn,Constant)	Rn ← Constant
2n	LD	(Rn)	R0 ← Rn
3n	ST	(Rn)	Rn ← R0
4n	LD@	(Rn)	High byte of R0 ← 0 Low byte of R0 ← (Rn)
5n	ST@	(Rn)	(Rn) ← Low byte of R0
6n	LDD@	(Rn)	$R0_L$ ← (Rn); Rn ← Rn+1; $R0_H$ ← (Rn)
7n	STD@	(Rn)	(Rn)← $R0_L$; Rn ← Rn+1; (Rn) ← $R0_H$
8n	POP@	(Rn)	Rn ← Rn-1; $R0_L$ ← (Rn); $R0_H$ ← 0
9n	STP@	(Rn)	Rn ← Rn-1; (Rn) ← $R0_L$; Rn ← Rn-1; (Rn) ← $R0_H$
An	ADD	(Rn)	R0 ← R0 + Rn
Bn	SUB	(Rn)	R0 ← R0 - Rn
Cn	POPD@	(Rn)	Rn ← Rn-1; $R0_L$ ← (Rn); Rn ← Rn-1; $R0_H$ ← (Rn)
Dn	CPR	(Rn)	Set branch conditions as a result of R0 - Rn. Store result into R13.
En	INCR	(Rn)	Rn ← Rn + 1
Fn	DECR	(Rn)	Rn ← Rn - 1
00	RTN		Return to caller
01	BR	(addr)	Relative branch to addr. (Note: Argument is assembled as displacement. Source argument is absolute.)
02	BNC	(addr)	Branch if No Carry
03	BC	(addr)	Branch if Carry
04	BP	(addr)	Branch if prior result Plus
05	BM	(addr)	Branch if prior result Minus
06	BZ	(addr)	Branch if prior result Zero
07	BNZ	(addr)	Branch if prior result Non Zero
08	BM1	(addr)	Branch if prior result = -1
09	BNM1	(addr)	Branch if prior result ≠ -1
0A	BK		Execute 6502 Break instruction
0B	RS		Return from Sweet-16 subroutine
0C	BS	(addr)	Branch to Sweet-16 subroutine. addr must be in the range allowable for a relative branch. Return address is stored in a pseudo-stack whose address is contained in R12.

Table 1: **Sweet—16 Instruction Set Summary**

The Macros: How They Work

Listing 1. shows the Sweet-16 macros as defined for the Carl Moser ASM/TED macro assembler. The macros fall into two groups: the register and the non-register opcodes. The register opcodes are all assembled to values with a non-zero ($1 to $F) high nibble: e.g. LD@(R12) —$4C. The non-register opcodes all have a 0 value in the high nibble of the opcode byte. Most of the non-register opcodes have a second byte which indicates a relative branch displacement value, in the style of the 6502 itself. The most interesting part of the set of macro definitions involves the calculation of this displacement. Since the concept of relative branch displacement is common to all the branching operations, a separate macro is defined which is used to calculate the displacement. This macro then gets called in the body of each branching opcode to provide the desired value:

```
!!!RELBR  .MD   (LOC)
          I F P  =—LOC
          . B Y  LOC— =—1
          ***
          I F M  =—LOC
          . B Y  =—LOC+1
          ***

          .ME


! ! ! B R  .MD     (WHERE)
          .BY 1
          RELBR (WHERE)
          .ME
```

The RELBR macro uses the conditional assembly features of the macro assembler. Let us examine it line by line:

```
!!!RELBR  .MD   (LOC)
```

This line indicates to the assembler that a Macro Definition is being initiated. The name by which the macro may subsequently be called is RELBR and the argument which must be supplied when it is called is represented by the dummy symbol LOC. When the macro is expanded by a call, the actual argument which is supplied in the call will be substituted for each occurrence of 'LOC' in the body of the definition.

```
          I F P  =—LOC
```

This line contains one of the conditional assembly operations or *directives* of the assembler: IFP. The assembler is directed to evaluate the expression contained in the remainder of the line; in this case "=—LOC". If the result is a positive number (the mnemonic stands for *IF P*ositive), then the assembler will assemble all instructions following the current line until it encounters a line containing ***, which indicates the end of the scope of the IFP directive. If the expression evaluates to a negative number or zero, then the assembler will ignore all instructions following the current line until the matching ***.

The expression '=—LOC' is computed by subtracting the value of the actual parameter substituted for LOC in the call from the value of the assembler's *location counter*, represented in ASM/TED by the

character '='. The location counter represents the address of the instruction being assembled.

```
B Y  LOC— = —1
```

The directive .BY instructs the assembler to evaluate the expression following and to assemble a single *BY*te of code from the resulting value. The expression LOC— = —1 computes a value which is the distance from the symbol referenced by 'LOC' to the current location in the object code. This value is converted by the expression to a negative number and adjusted by 1 to account for the fact that the current byte of object has not yet been emitted by the assembler. Note that there is a bug in the definition: if the value LOC— = —1 is less than —128 then an erroneous value will be assembled. This means that the user of the macro set is responsible for avoiding relative branches that are out of range. Note also that the values computed by expressions are in 16 bit, twos complement representation. If such a value is assembled using a .BY directive, the assembler will use the least significant 8 bits (low byte) of the result.

```
* * *
```

This line marks the end of the scope of the IFP conditional assembly directive used earlier.

```
IFM = —LOC
```

This line has the same intention as the IFP line, except that it tests the result of the expression '= —LOC' for a negative or *M*inus value. It then does or does not assemble the instructions following the IFM line and up to the matching ***, depending on the outcome of the evaluation.

```
.BY     = —LOC + 1
***
```

These instructions are analogous to the corresponding instructions following the IFP directive. The reason for using *both* an IFP and an IFM directive is that the label or location referenced by the dummy argument 'LOC' may turn out to be either ahead of (minus result for = —LOC) or behind (positive result for = —LOC) the instruction which invokes the RELBR macro.

The remainder of the macro definitions are simple and straightforward. A couple of points to note are:

.Defining @SW16 as JSR SW16 makes the macro @SW16 looklike a "new" assembler directive. It says:
Please switch to Sweet-16

.Arithmetic may be performed on dummy arguments:

```
!!!LD    .MD    (REG)
         .BY  $20 + REG
         .ME
```

This fact is crucial to the success of the macros.

Sample Sweet-16 Program

The following program allows the second text page of APPLE II memory to be copied into the first text page. The assembled code is shown to the left.

```
20 89 F6     @SW16
15           SETR (5 $800)
00 08
14           SETR (4 $BFF)
FF 0B
16           SETR (6 $400)
00 04
45  MOVE     LD@ (5)
56           ST@ (6)
24           LD  (4)
D5           CPR (5)
04           BP     (MOVE)
FA
00           RTN
```

Sweet-16 can also be used more conveniently with this set of macros. They make the assembly source easier to read, and remove the burden of hand assembly from the Sweet-16 programmer.

The reader is urged to learn more about the macro capabilities of assemblers and the labor-saving uses to which they may be applied.

Listing 1.

```
0002 R0          .DE 0
0003 R1          .DE 1
0004 R2          .DE 2
0005 R3          .DE 3
0006 R4          .DE 4
0007 R5          .DE 5
0008 R6          .DE 6
0009 R7          .DE 7
0010 R8          .DE 8
0011 R9          .DE 9
0012 R10         .DE 10
0013 R11         .DE 11
0014 R12         .DE 12
0015 R13         .DE 13
0016 R14         .DE 14
0017 R15         .DE 15
0018             .ES
0019 !!!SETR     .MD (REG ADDR)
0020             .BY $10+REG
0021             .SE ADDR
0022             .ME
0023 !!!LD       .MD (REG)
0024             .BY $20+REG
0025             .ME
0026 !!!ST       .MD (REG)
0027             .BY $30+REG
0028             .ME
0029 !!!LD@      .MD (REG)
0030             .BY $40+REG
0031             .ME
0032 !!!ST@      .MD (REG)
0033             .BY $50+REG
0034             .ME
0035 !!!LDD@     .MD (REG)
```

```
0036                .BY $60+REG
0037                .ME
0038 !!!STD@        .MD (REG)
0039                .BY $70+REG
0040                .ME
0041 !!!POP@        .MD (REG)
0042                .BY $80+REG
0043                .ME
0044 !!!STP@        .MD (REG)
0045                .BY $90+REG
0046                .ME
0047 !!!ADD         .MD (REG)
0048                .BY $A0+REG
0049                .ME
0050 !!!SUB         .MD (REG)
0051                .BY $B0+REG
0052                .ME
0053 !!!POPD@       .MD (REG)
0054                .BY $C0+REG
0055                .ME
0056 !!!CPR         .MD (REG)
0057                .BY $D0+REG
0058                .ME
0059 !!!INCR        .MD (REG)
0060                .BY $E0 + REG
0061                .ME
0062 !!!DECR        .MD (REG)
0063                .BY $F0+REG
0064                .ME
0065 !!!RTN         .MD
0066                .BY 00
0067                .ME
0068 !!!RELBR       .MD (LOC)
0069                IFP =-LOC
0070                .BY LOC-=-1
0071                ***
0072                IFM =-LOC
0073                .BY =-LOC+1
0074                ***
0075                .ME
0076 !!!BR          .MD (WHERE)
0077                .BY 1
0078                RELBR (WHERE)
0079                .ME
0080 !!!BNC         .MD (WHERE)
0081                .BY 2
0082                RELBR (WHERE)
0083                .ME
0084 !!!BC          .MD (WHERE)
0085                .BY 3
0086                RELBR (WHERE)
0087                .ME
0088 !!!BP          .MD (WHERE)
0089                .BY 4
0090                RELBR (WHERE)
0091                .ME
0092 !!!BM          .MD (WHERE)
0093                .BY 5
0094                RELBR (WHERE)
0095                .ME
0096 !!!BZ          .MD (WHERE)
0097                .BY 6
0098                RELBR (WHERE)
0099                .ME
0100 !!!BNZ         .MD (WHERE)
0101                .BY 7
0102                RELBR (WHERE)
0103                .ME
0104 !!!BM1         .MD (WHERE)
0105                .BY 8
0106                RELBR (WHERE)
0107                .ME
0108 !!!BNM1        .MD (WHERE)
0109                .BY 9
0110                RELBR (WHERE)
0111                .ME
0112 !!!BRK         .MD
0113                .BY $A
0114                .ME
0115 !!!RS          .MD
0116                .BY $B
0117                .ME
0118 !!!BS          .MD (WHERE)
0119                .BY $C
0120                RELBR (WHERE)
0121                .ME
0122 !!!@SW16       .MD
0123                JSR $F689
0124                .ME
0999                .EN


LABEL FILE:  [ / = EXTERNAL ]


/R0=0000                    /R1=0001
/R3=0003                    /R4=0004
/R6=0006                    /R7=0007
/R9=0009                    /R10=000A
/R12=000C                   /R13=000D
/R15=000F
//0000,0200,0200            /R2=0002
                            /R5=0005
                            /R8=0008
                            /R11=000B
                            /R14=000E
```

Screen Write/File Routine

Here is a routine, both useful and instructive, which makes it simple to Edit the Apple Screen and Save the Screen Image on Disk.

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Rancho Palos Verdes, CA 90274

The screen write/file routine is a simple 73-byte device to take control away from the monitor and write directly to the screen. All of the escape editing capabilities are supported, so that it is very easy to enter and modify up to and including 21 lines of text. It is equally easy to then save the screen image to disk after completion of text entry.

The source code is straightforward and makes liberal use of monitor routines. Upon entry the cursor is homed and placed on line 1 (not zero). The block labeled KEY continually polls the keyboard and outputs characters through COUT (VIDOUT [$FBFD] could also be used if printer services are not wanted). The limited editing facilities of the monitor are invoked by typing (escape) followed by one of the command characters. Keyboard entry of (control) Q is used to exit the routine and return to BASIC via $3D0. Automatic exit is also obtained at line 22. Upon exit, the bell will sound and the BASIC prompt character will appear with the file parameters displayed at the end of the line. At this point the file must be saved using the command, (BSAVE File name) A$0400, L$03CF (RETURN). The parenthetical expressions must be typed by the user; that is, type BSAVE file name, then trace over the remainder of the line with the right arrow to place it into the keyboard buffer and at the end of the line press RETURN. Although I do not find it necessary, a monitor MOVE to page 2 could be set up and inserted at line 225 of the source listing. This would provide back-up in case the BSAVE command is messed up. The object code is assembled at $0350 and is $49 bytes long.

In summary, the usage commands are:

Entry to Routine

From BASIC	Call 848
From Monitor	$0350G

Exit to BASIC Mode

User	(Control) Q
Automatic	Line 22

Edit Screen (See APPLE Ref. Materials)

(Escape)	@: Home cursor (Clear text)
	A: Advance cursor
	B: Backspace cursor
	C: Move cursor down 1 line
	D: Move cursor up 1 line
	E: Clear from cursor to end of line
	F: Clear from cursor to end of screen

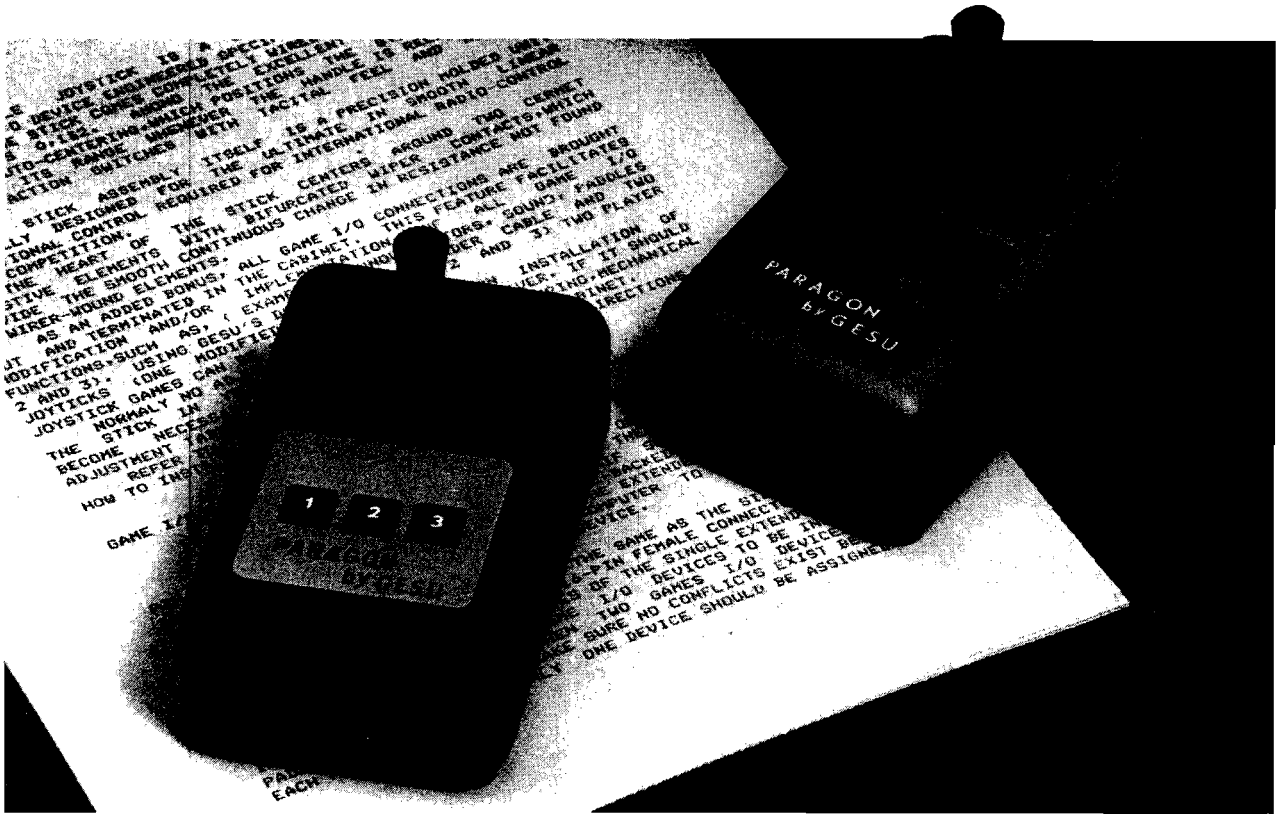
Save Screen Image

[BSAVE file name]A$0400,L$03CF[CR]

[ ] = typed by user

Of course it doesn't make much sense to idly write to the screen without some useful purpose. I use the routine to create instruction and documentation files. These files are especially valuable for object code utilities by providing ready access to usage and entry point information. Once the file has been created, it can be handled just like any other file. BLOADing (file name) will immediately display its contents on the screen without requiring any otherwise useful memory. Instruction/print statements in BASIC programs can therefore be eliminated; to be replaced by deferred execution BLOAD disk commands for a very efficient use of main memory.

```
0100: 0350                    ORG   $0350
0110: 0350           COUT     *     $FDED
0120: 0350           HOME     *     $FC58
0130: 0350           CV       *     $0025
0140: 0350           TABV     *     $FB5B
0150: 0350           RDCHAR   *     $FD35
0160: 0350           CROUT    *     $FD8E
0170: 0350           BELL     *     $FF3A
0180: 0350           POS      *     $0009
0190:
0200: 0350 20 58 FC          JSR   HOME
0210: 0353 20 8E FD          JSR   CROUT
0220:
0230: 0356 20 35 FD  KEY     JSR   RDCHAR
0240: 0359 C9 91             CMPIM $91
0250: 035B F0 0C             BEQ   QUIT
0260: 035D A6 25             LDXZ  CV
0270: 035F E0 16             CPXIM $16
0280: 0361 F0 06             BEQ   QUIT
0290: 0363 20 ED FD          JSR   COUT
0300: 0366 4C 56 03          JMP   KEY
0310:
0320: 0369 A9 16     QUIT    LDAIM $16
0330: 036B 85 25             STAZ  CV
0340: 036D 20 5B FB          JSR   TABV
0350: 0370 20 3A FF          JSR   BELL
0360: 0373 A9 E4             LDAIM $E4
0370: 0375 85 09             STA   POS
0380: 0377 A9 07             LDAIM $07
0390: 0379 85 0A             STA   POS     +01
0400: 037B A0 00             LDYIM $00
0410:
0420: 037D B9 8A 03  OUT     LDAY  DATA
0430: 0380 91 09             STAIY POS
0440: 0382 C8                INY
0450: 0383 C0 0F             CPYIM $0F
0460: 0385 D0 F6             BNE   OUT
0470: 0387 20 D0 03          JSR   $03D0
0480:
0490: 038A A0        DATA    =     $A0
0500: 038B C1                =     $C1     A
0510: 038C A4                =     $A4     $
0520: 038D B0                =     $B0     0
0530: 038E B4                =     $B4     4
0540: 038F B0                =     $B0     0
0550: 0390 B0                =     $B0     0
0560: 0391 AC                =     $AC     ,
0570: 0392 CC                =     $CC     L
0580: 0393 A4                =     $A4     $
0590: 0394 B0                =     $B0     0
0600: 0395 B3                =     $B3     3
0610: 0396 C3                =     $C3     C
0620: 0397 C6                =     $C6     F
0630: 0398 A0                =     $A0
ID=
```



ULTIMATE JOYSTICK FOR THE APPLE II

$49.95

The Apple Joystick is a quality crafted dynamic interactive I/O device engineered specifically for the apple computer. The stick comes completely wired for paddles 0 & 1 and switches 0, 1 & 2. Among the excellent features of the stick are auto-centering, which positions the stick in the center of its range whenever the handle is released, and positive action switches with tactile feel and audible feedback.

The stick assembly itself is a precision molded unit originally designed for the ultimate in smooth linear proportional control required for international radio-control model competition.

The heart of the stick centers around two cermet resistive elements with bifurcated wiper contacts, which provide the smooth continuous change in resistance not found in wire-wound elements.

As an added bonus, all game I/O connections are brought out and terminated in the cabinet. This feature facilitates modification and/or implementation of all game I/O functions, such as, (example: annunciators, sound, paddles 2 and 3). Using Gesu's double I/O extender cable and two joysticks (one modified for paddles 2 and 3) two player joystick games can be implemented.

Normally no adjustment is required upon installation of the stick in your Apple computer. However, if it should become necessary to adjust the centering, mechanical adjustment tabs are provided inside the stick cabinet.

Refer to the Apple II reference manual for directions on how to install the stick in your computer.

GAME I/O EXTENDER CABLES

SINGLE $10.00
DOUBLE $16.00

The single model consists of one foot of cable, one 16-pin male and one 16-pin female connector. The extender plugs into the game I/O and the female end if secured to the outside of the cabinet with the double-backed mounting tape provided. Installed in this fashion the extender eliminates the necessity of opening the apple computer to install or remove the stick or any other game device.

The double model is exactly the same as the single model with the addition of a second 16-pin female connector. This extender has the same advantages as the single extender plus allowing two sticks or game I/O devices to be installed simultaneously. Note: When two games I/O devices are installed simultaneously make sure no conflicts exist betwen paddle assignments. Only one device should be assigned to each paddle.

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THE HDE DISK SYSTEM.

HERE'S WHAT ONE USER HAS TO SAY . . .

REPRINTED BY PERMISSION FROM THE 6502 USER NOTES - ISSUE NO. 14

PRODUCT REVIEW of the HDE DISC SYSTEM by the editor.

A number of you have asked for details about the HDE full size disc system.

The system is based around the SYKES 8" drive with the 6502 based intelligent controller.

This drive is soft sectored, IBM compatible, and single density which lets you store about a quarter megabyte of data on a disc.

The system software, called FODS (File Oriented Disc System), manages sequential files on the disc much the same way files are written on magnetic tape – one after another. When a file is deleted, from a sequentially managed file system, the space that the file occupied is not immediately reallocated, as in some disc operating systems. As it turns out, this can be an advantage as well as a disadvantage since deleted files on the FODS system can be recovered after the file has been deleted. (This has saved my sanity more than once!) Of course when you want to recover some of the disc space taken up by a number of these deleted files, you can simply re-pack or compress the disc and all the active files will be shifted down until there are no deleted files hanging around using up space.

FODS has this ability to repack a disc.

When saving and loading in FODS you work with named files, not track and sector data or I.D. bytes. This makes life a lot easier. I've seen some disc systems where you have to specify track and sector info and/or I.D. bytes. What a pain that can be!

If you just want to save a source file temporarily, you can do that on what's known as "scratch-pads" There are two of these on a disc. "scratch-pad A" and "scratch-pad B", each of these temporary disc files can hold up to 16K or if "B" is not used, "A" can hold one file up to 32K in length. The only files that can be temporarily saved on scratch pad are files that have been built using the system text editor.

Being a dyed in the wool assembly language programmer, I really appreciate the FODS text editor! This line oriented editor is upwards compatible with the MOS/ARESCO editor but includes about everything you could ask for in a line editor. There is a full and semi-automatic line numbering feature, lines can be edited while they are being entered or recalled and edited later, strings can be located and substituted, the line numbers can be resequenced, the file size can be found, the hex address of a line can be known and comments can be appended to an assembly file after it has been found correct. Oops! I forgot to say lines can also be moved around and deleted. This isn't the complete list of FODS editor commands, just the ones that immediately come to mind.

Another very powerful feature of the system is the ability to actually execute a file containing a string of commands. For example, the newsletter mailing list is now being stored on disc. When I want to make labels, I would normally have to load each letter file and run the labels printing program. But with FODS, I can build up a "JOB" file of commands and execute it.

The job file in turn calls each lettered label file in and runs the label printer automatically. The way computers are supposed to operate right?

Here's a listing of the job file I use to print mailing labels:

```
:LIS PRTLBL
0005 LOD A:RUN %LABEL:LOD B:JMP.E000:
LOD C:JMP.E000:
0010 LOD D:JMP.E000:LOD E:JMP.E000:
LOD F:JMP E000:
0015 LOD G:JMP.E000:LOD H:JMP.E000:
LOD I:JMP.E000:
0020 LOD J:JMP.E000:LOD K:JMP .E000:
LOD L:JMP E000
0025 LOD M:JMP E000:LOD MC: JMP.E000:
LOD N:JMP.E000:
0030 LOD O:JMP.E000:LOD P:JMP .E000:
LOD R:JMP.E000:
0035 LOD S:JMP.E000:LOD T:JMP .E000:
LOD V:JMP.E000:
0035 LOD S:JMP.E000.LOD T.JMP E000:
LOD V:JMP.E000:
0040 LOD W:JMP E000 LOD XYZ: JMP.E000:
0045 LOD EXCH:JMP.E000:LOD COMP:
JMP.E000:
```

Remember the MOS/ARESCO assembler I reviewed several issues ago? Well HDE went and fixed up all the problem areas that I mentioned in the review and then took it several steps further. The HDE assembler is an honest to goodness two-pass assembler which can assemble anywhere in memory using multiple source files from the disc. The assembler is an optional part of the system.

If you're the kind of person (as I am) who enjoys having the ability to customize, modify, and expand everything you own – you'll enjoy the system expansion abilities FODS has to offer. Adding a new command is as simple as writing the program, giving it a unique three letter name and saving it to disc. Whenever you type those three letters the system will first go through its own command table, see that its not there and then go out and read the disc directory to see if it can find it. If it's on the disc it will read it in and execute it. Simple right? I've added several commands to my system and REALLY appreciate having this ability. Some of the things I've added include a disassembler, an expanded version of XIM (the extended machine language monitor from Pyramid Data), Hypertape, and a number of system utilities which make life easier. By the way, to get back to the system, all you need to do is execute a BRK instruction.

HDE also provides a piece of software that lets you interface Microsoft 9 digit BASIC to their disc system. The software allows you to load the BASIC interpreter itself from disc as well as saving and loading BASIC Programs to and from the disc. This particular version of the software doesn't allow for saving BASIC data but HDE mentioned that this ability may be possible with a future version.

The first thing I do with a new piece of software after I get used to using it is try to blow it up. I did manage to find a weak spot or two in the very first version of FODS (a pre-release version) but the later, release version has been very tight.

The standard software that is included with the system consists of the disc driver software, the system text editor and the BASIC software interface. Several command extensions may also be included. All the necessary stuff like a power supply, the KIM-4 interface card, and all cables and connectors are included. It took me about 45 minutes to get things up and running the first time I put the system together.

Admittedly, a dual full size disc system from HDE is probably beyond the means of most hobbyists but if you or your company is looking for a dynamite 6502 development system, I would recommend this one. I've used the Rockwell System 65 while I was at MOS and feel that dollar for dollar, feature for feature, the HDE system comes out on top. The only place the HDE system falls short when stacked up next to the System 65 is in the area of packaging. At this point, there is no cabinet for the disc drives available from HDE.

So far, I've got nothing but good things to say about HDE and their products. Everything I've received from them has been industrial quality. That includes their documentation and product support. I'm very impressed with what I've seen from this company so far and quite enthusiastic over what my KIM has become since acquiring the disc system and its associated software.

ERIC

THANK YOU MR. REHNKE!

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SYM-1 Tape Verification

One of the problems with using audio cassettes on any system is knowing whether or not the data has been recorded properly. By the time you find the data did not get recorded properly, it is usually too late to do anything about it. Here is a technique and program to verify the tape dump on a SYM-1.

Jack Gieryic
2041 138th Avenue, N.W.
Andover, MN 55303

Do any of you other SYMMERS ever wonder if your tape save has executed successfully? This "problem" began to haunt me more and more as my tape library grew. A fair amount of time would be lost if the data on my tape was in error. It is possible (even though remotely) two bits could be in error such that they would "cancel" each other out in the checksum verification at the end of tape read. With all this floating through my mind I decided to write the following tape verification program.

After executing a tape save (high speed format only) this program will read the data back and compare it byte for byte, to the data in the memory which you just saved. This program needs no external information (parameters) from the user. The beginning and ending addresses of the data in memory is extracted from the tape. At the end, the checksum is also verified. All the user need do is rewind the tape after a high speed format save, execute this program and then start the tape unit in the read mode.

The program is relocatable to any point in the memory. No alterations are necessary. This makes it easy to move the program into any area of memory via the MOV command. Just remember to avoid placing any part of the program near the top of page one or within the data you just saved on tape. Please note that this program is compatible with monitor version SY1.0.

```
0010:
0020:                 SYM - 1  TAPE VERIFICATION
0030:                    BY  JACK GIERYIC
0040:                    JULY, 1979
0050:
0060: 0200                    ORG   $0200
0070:
0080:                 MONITOR SUBROUTINES
0090:
0100: 0200            ACCESS *     $8B86
0110: 0200            CHKT   *     $8E78
0120: 0200            MONITR *     $8000
0130: 0200            OUTBYT *     $82FA
0140: 0200            RDBYTH *     $8DE2
0150: 0200            RDBYTX *     $8E28
0160: 0200            RDCHTX *     $8DDE
0170: 0200            START  *     $8DB6
0180: 0200            SYNC   *     $8D82
0190:
0200:                 CONSTANTS
0210:
0220: 0200            CLKCON *     $1F
0230: 0200            SYN    *     $16
0240:
0250:                 MONITOR STORAGE
0260:
0270: 0200            BUFADH *     $00FF
0280: 0200            BUFADL *     $00FE
0290: 0200            CHKH   *     $A637
0300: 0200            CHKL   *     $A636
0310: 0200            DDRIN  *     $A002
0320: 0200            DISBUF *     $A640
0330: 0200            EAH    *     $A64B
0340: 0200            EAL    *     $864A
0350: 0200            LATCHL *     $A004
0360: 0200            MODE   *     $00FD
```

Messages

If the tape agrees with the data in memory and the checksum is correct then the message "good" appears on the LED's. If the checksum is in error (even though the data compared correctly) then the message "CSUM" appears on the LED's. If any data is in error then the address of the first compare error appears on the LED's and the program terminates without checking the remainder of the data on tape.

Programming Hints

I'd like to pass along a few suggestions to you SYMMERS just getting into programming. Begin your program's (code) at location '200 (page two). Do not put anything (code, preset constants) into page one. Any constants you need in page zero should be initialized by your program. Do not set constants in page zero and then store them on tape along with your code. Do not use spare system RAM for code, constants, or temporary data storage. Begin all tape saves at location '200. Avoid saving page one on tape. I urge you to follow these suggestions as it will make your programmi tasks just a bit easier.


```
0370: 0200           VIAACR *     $A00B
0380: 0200           VIAPCR *     $A00C
0390:
0400: 0200 20 86 8B  BEGIN  JSR   ACCESS
0410: 0203 A0 80            LDYIM $80     SET MODE = HIGH SPEED
0420: 0205 20 B6 8D         JSR   START   INITALIZE
0430: 0208 AD 02 A0         LDA   DDRIN      SET INPUT PORT
0440: 020B 29 BF            ANDIM $BF
0450: 020D 8D 02 A0         STA   DDRIN
0460: 0210 A9 00            LDAIM $00
0470: 0212 8D 0B A0         STA   VIAACR
0480: 0215 A9 1F            LDAIM CLKCON     SET UP CLOCK
0490: 0217 8D 04 A0         STA   LATCHL        STORE IN LO LATCH
0500: 021A 20 82 8D  LOADA  JSR   SYNC    GET IN SYNC
0510: 021D 20 DE 8D  LOADB  JSR   RDCHTX  READ CHARACTER
0520: 0220 C9 2A            CMPIM $2A     IF NOT START OF DATA
0530: 0222 F0 06            BEQ           LOADC
0540: 0224 C9 16            CMPIM SYN     THEN IF NOT IN SYNC
0550: 0226 D0 F2            BNE   LOADA      THEN RESTART SYNC SEARCH
0560: 0228 F0 F3            BEQ   LOADB      ELSE KEEP LOOKING FOR *
0570:                                        ELSE START OF DATA
0580:
0590: 022A A5 FD     LOADC  LDA   MODE    CLEAR NOT IN SYNC BIT
0600: 022C 29 BF            ANDIM $BF
0610: 022E 85 FD            STA   MODE
0620: 0230 20 28 8E         JSR   RDBYTX  READ PAST ID
0630: 0233 20 28 8E         JSR   RDBYTX  GET SAL FROM TAPE
0640: 0236 20 78 8E         JSR   CHKT       ADD TO CHECKSUM
0650: 0239 85 FE            STA   BUFADL     SAVE
0660: 023B 20 28 8E         JSR   RDBYTX  GET EAL FROM TAPE
0670: 023E 20 78 8E         JSR   CHKT       ADD TO CHECKSUM
0680: 0241 85 FF            STA   BUFADH     SAVE
0690: 0243 20 28 8E         JSR   RDBYTX  GET EAL FROM TAPE
0700: 0246 20 78 8E         JSR   CHKT       ADD TO CHECKSUM
0710: 0249 8D 4A 86         STA   EAL        SAVE
0720: 024C 20 28 8E         JSR   RDBYTX  GET EAH FROM TAPE
0730: 024F 20 78 8E         JSR   CHKT       ADD TO CHECKSUM
0740: 0252 8D 4B A6         STA   EAH        SAVE
0750:
0760: 0255 20 E2 8D  LOADD  JSR   RDBYTH  GET NEW BYTE
0770: 0258 A6 FE            LDX   BUFADL  IF NOT END - OF - DATA +01
0780: 025A EC 4A 86         CPX   EAL
0790: 025D D0 07            BNE   LOADE
0800: 025F A6 FF            LDX   BUFADH
0810: 0261 EC 4B A6         CPX   EAH
0820: 0264 F0 11            BEQ   LOADF
0830:
0840: 0266 20 78 8E  LOADE  JSR   CHKT    THEN UPDATE CHECKSUM
0850: 0269 A0 00            LDYIM $00        IF BAD COMPARE
0860: 026B D1 FE            CMPIY BUFADL
0870: 026D D0 3D            BNE   LOADG      THEN ISSUE ERROR MESSAGE
0880: 026F E6 FE            INC   BUFADL     ELSE INC COMPARE ADDRESS
0890: 0271 D0 E2            BNE   LOADD
0900: 0273 E6 FF            INC   BUFADH
0910: 0275 D0 DE            BNE   LOADD      LOOP
0920:                               ELSE CHECK FOR / CHARACTER
0930: 0277 C9 2F     LOADF  CMPIM $2F        IF NOT /
0940: 0279 D0 43            BNE   LOADH      THEN ERROR
0950: 027B 20 28 8E         JSR   RDBYTX      ELSE IF CHECKSUM IS GOOD
0960: 027E CD 36 A6         CMP   CHKL
0970: 0281 D0 3B            BNE   LOADH
0980: 0283 20 28 8E         JSR   RDBYTX
0990: 0286 CD 37 A6         CMP   CHKH
1000: 0289 D0 33            BNE   LOADH
1010:                                  THEN EXIT OK
1020: 028B A2 CC            LDXIM $CC              STOP TAPE
1030: 028D 8E 0C A0         STX   VIAPCR
1040: 0290 A9 6F            LDAIM $6F              ISSUE OK MESSAGE
```

```
1050: 0292 8D 41 A6          STA   DISBUF +01        "GOOD"
1060: 0295 A9 5C             LDAIM $5C
1070: 0297 8D 42 A6          STA   DISBUF +02
1080: 029A A9 5C             LDAIM $5C
1090: 029C 8D 43 A6          STA   DISBUF +03
1100: 029F A9 5E             LDAIM $5E
1110: 02A1 8D 44 A6          STA   DISBUF +04
1120: 02A4 A9 00             LDAIM $00
1130: 02A6 8D 45 A6          STA   DISBUF +05
1140: 02A9 4C 00 80          JMP   MONITR
1150:
1160: 02AC A5 FF      LOADG  LDA   BUFADH DISPLAY COMPARE ERROR MESSAGE
1170: 02AE 20 FA 82          JSR   OUTBYT    ADDRESS
1180: 02B1 A5 FE             LDA   BUFADL
1190: 02B3 20 FA 82          JSR   OUTBYT
1200: 02B6 A9 00             LDAIM $00
1210: 02B8 8D 41 A6          STA   DISBUF +01
1220: 02BB 4C 00 80          JMP   MONITR EXIT TO MONITOR
1230:
1240: 02BE A9 39      LOADH  LDAIM $39    CHECKSUM ERROR MESSAGE
1250: 02C0 8D 42 A6          STA   DISBUF +02
1260: 02C3 A9 6D             LDAIM $6D
1270: 02C5 8D 43 A6          STA   DISBUF +03
1280: 02C8 A9 3E             LDAIM $3E
1290: 02CA 8D 44 A6          STA   DISBUF +04
1300: 02CD A9 37             LDAIM $37
1310: 02CF 8D 45 A6          STA   DISBUF +05
1320: 02D2 A9 00             LDAIM $00
1330: 02D4 8D 46 A6          STA   DISBUF +06
1340: 02D7 4C 00 80          JMP   MONITR EXIT TO MONITOR
1350:
ID=
```

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Microbes and Miscellanea

R. M. Mottola from Boston, MA writes:

It has been brought to my attention that my Screen Dump Software (14:27) will not work with a printer that can handle more than 40 columns. To correct this, please make the following changes:

580 NEXT:PRINT "":REM Null $

585 NEXT:NEXT

These changes will provide the carriage return that 40 column printers add automatically.

I'd also like to thank William Luebbert for his APPLE II memory map. It is the most valuable article I've read in a long time.

Jack Gieryic of Andover, MN found a disturbing bit of information in the July 1979 issue of MICRO, Nicholas Vritis' article "The First Book of KIM—on a SYM":

Mr. Vrtis recommended a hardware modification to remove the jumper enabling system RAM write project, jumper MM-45. His alternative to this modification is to insert a JSR ACCESS in order to remove the write protect.

I strongly urge all SYM owners to use the JSR ACCESS to free up system RAM prior to code which writes into system RAM and, if possible, the JSR NACCES after your code to once again write protect system RAM. Do not remove jumper MM-45.

I have two reasons for urging avoidance of the hardware change. First, your program may contain a bug elsewhere which inadvertantly writes into some or all of system RAM. Permanently removing the write protect feature will make this bug more difficult to trace. Instead of "missing data" in some buffer or variable (a problem relatively easy to "see" and figure out) you may have memory alterations which could be impossible to view as a critical element of system RAM was destroyed.

The second reason looks to the future a bit. If Synertek ever does add a disk option to the SYM, I wouldn't be surprised if critical information relating to the disk driver were located in the system RAM. If so, a bug which alters this memory could also cause your disk data to be destroyed. This supposition does assume quite a bit but is not outside the realm of possibility.

Philip L. Bryan suggests that in the article of Robert Carlson's, "Baudot Teletype Driver", in the Sept. issue, the op-code for RORA should be 6A, not 68.

Robert A. Peck of Sunnyvale, CA says:

I tried the SYMphony in Stereo program in June 1979 MICRO, and ran into some difficulties which I have fixed for my machine, and I wanted to let you know about the problems.

Problem A: Program goes from 0200-0278, data area overlaps—0270-03F2. *Actions:* Begin data area at 279, GO TO 3FB change 0004 to 79, 0005 to 38.

Problem B: Data for the starting tune addresses is picked up from the wrong locations. At 0219 and 0223, the instruction "B1 04" is used. This will pick up the data byted stored in locations 4 & 5, add the Y register contents, and use this as the effective address of the data to be loaded into location 0, then location 1. After execution, location zero contains "05" and location one will contain the contents of location 2F02. This combination XX05 does not match the starting address of the note table. *Actions:* Change 021A to "1D", change 0224 to "10", store "04" at 0010, and store '00" at 0011.

Problem C: Second half of tune (part 2 of table) never starts, always stays within first part. *Action:* Change instruction at 0239 to read:
0239 30 37 BMI 0272 GO TO BUMP.

Problem D: On completion of the tune, it goes back and repeats the second half only—on completion of a tune, any repeat should repeat the ENTIRE tune. *Action:* Change 0230 to "E2".

It works fine with these changes.

George Shirn of Williamstown, MA has this idea:

If you have updated your SYM—1 with the new monitor, MON 1.1, then John Gieryic's SYM—1 Tape Directory, (8:35) needs changing.

Change	From	To
0206	B6	A9
021B	82	52
021E	DE	E1
0231	28	26
0236	28	26
023B	28	26
0204	E2	E5
0245	E2	E5
02BC	0B	06

Then it works fine.

More MICROBES on following page...

From LeRoy Moyer of Charlottsville, VA:

MICRO contains many articles which I enjoy, particularly those that deal with machine language routines. In the November issue the Applesoft Renumbering program was a very useful addition. One modification that I made to the program that other readers may be interested in is to include a

```
CMP #BC
BEQ $6D20
```

This is put in the vicinity of $6CF7 to 6D01 and will then also do the LIST function.

Bob Bishop of Mountain View, CA has corrections for his article, "APPLE II Hires Picture Compression" (18:17):

On page 23, under listing 2, there should be at 0CC0:

```
A0, 00, 84, 03,
A2, 40, 86, 04,
98, 91, 03, C8,
D0, FB, E6, 04,
CA, D0, F6, 60.
```

Also in Listing 3 at 1280 Hexidecimal it should read:

```
8A, 48, 98, 48,
A5, 10, 8D, C1
83, A9, C2, 85,
OE, A9, 83, 85,
OF, A9, 00, 8D,
CO, 83, 85, 00,
85, 01, A5, 01,
4A, 09, 60, 85,
OD, A9, 00, 6A,
65, 00, 85, 0C,
A2, 08, A0, 00,
B1, 0C, 91, OE,
E6, OE, DO, 02,
E6, OF, 18, A5,
OD, 69, 04, 85,
OD, CA, DO, EC,
EE, CO, 83, A5,
00, C5, 07, DO,
06, A5, 01, C5,
08, FO, 10, E6,
00, A5, 00, C9,
28, DO, C3, A9,
00, 85, 00, E6,
01, DO, BB, 68,
A8, 68, AA, 60.
```

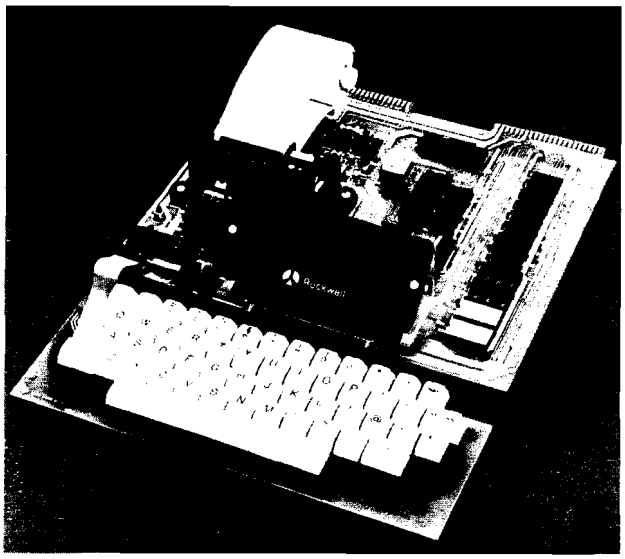
E.D. Morris of Midland, MI informs us that:

The article "Tokens" which appeared in the August issue of MICRO was actually co-authored by myself and Al Adams, 407 Rollcrest, Midland, MI 48640.

And Elsa Lewis from Chapel Hill, NC wonders about our illustrations...

The article on writing for MICRO (17:59) had some practical ideas. However, the one thing I found out of line was the etches! Maybe the person depicted should have been using a microcomputer, printer, and word processor to compose the article. Would anybody owning a micro still be plunking away at a typewriter?

AIM 65 BY ROCKWELL INTERNATIONAL



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Symbol Table Sorter/Printer for the AIM Assembler

Some information about the AIM Assembler, a program to print the Symbol Table - sorted alphabetically or numerically, and some other useful stuff.

Mel Evans
ERIM, P.O. Box 8618
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When the first Rockwell AIM showed up at the local computer store, mouths started watering. For a KIM user, to see an AIM is to want one. It is hard to resist that fine keyboard and display, the clever little printer, and sockets for Monitor, RAM, Assembler, and BASIC; or for 2716 EPROM with your own stuff on it. I've been running KIM with a Memory Plus board (8K RAM, 8K EPROM, 2716 programmer, and a 6522 VIA), mounted with power supply and I/O board in an attache case for portable use. This rig hasaccumulated a half-dozen 2716's full of KIM software, and I intend to continue working on KIM applications. Since AIM provides the same VIA, I bought one with the justification that it would help me develop more and better KIM software. If you write it and debug it on AIM, and move it over to KIM, you're done, right?

Well, yes. After a bit of learning about conversion from one memory map to another, it really does work that way. The mnemonic insert mode ("I" command) is a joy to use. There are no more op-code lookups and branch calculations and there are fewer typos. And the disassembler ("K" command) lets you check your work faster and more accurately. But for clean, patch-free object code, the assembler is the best of all. Six-character variable names! No line-number hassle! Six-character labels, such as "JMP NEXT," or "BEQ OUTCHR." And for easy transfer of object code from AIM to KIM, it's the assembler that really does it. It makes the writing of relocatable code almost automatic.

The AIM assembler lacks one feature; there is no command for printing the symbol table after an assembly. So here is a little program that fits on Page Zero and does just that. After assembling any program, load this one and start at 10. It prints two listings of the assembly symbol table; one sorted alphabetically by symbol name, and the other sorted numerically by symbol address. The first list is helpful when going through the assembly listing. The second is even more helpful when reading the output of the disassembler; it lets you know right away that the cryptic "JSR E9BC," for example, is a jump to subroutine OUTALL.

The source (assembly-language) version of the sort/print program is shown in Figure 1. The assembly listing, with absolute addresses, is shown in Figure 2. A disassembler listing is not shown; if you can't assemble this one, you don't need it!

The sorting algorithm is plain brute-force; it is desigbed to conserve memory space, not sorting time. But even so, it takes much less time to sort a list than it does to print it. The only tricky feature of the program is in its allocation of zero-page memory; in loading, it carefully avoids wiping out the six bytes that remember symbol-table size and location, because it will need them to know where to work when you hit "Go."

Figure 3 shows, as an example, the use of the assembled program on its own symbol table. Notice that you don't have to find and enter the location and size of the symbol table; the program finds these from the zero-page bytes that it conserved while loading.

One note of caution in case you don't read the following section. When you assemble this source program, don't direct the object code to memory. Direct it to tape. Then load it and start at 10.

AIM-to-KIM Software Conversion

The following assumes that you have more space in AIM RAM than you will need for KIM memory. It works well with a 4K AIM, and even better with 8K.

The idea is to use AIM for both assembly and running of the program during the debug phase. In the process of editing source, assembling, and running (and re-editing, re-assembling, re-running, re-editing, etc., etc.), much time can be saved by not having to load source from tape, dump object to tape, and reload object from tape for the next run. (If you have disc, this may be less of a problem. I wouldn't know.) So, build your source with the editor (the very good editor), assemble from memory, and direct object to memory — to any available memory, not necessarily where it will go in KIM. It will be easy to move later if you follow one rule: don't use fixed addresses except where really necessary.

Look at Figure 1 again. Observe that the only fixed addresses used are those

of the six zero-page bytes containing symbol-table location and size (STLO through NSYMHI), the four Monitor subroutines needed for printing (CLR through CRCK), the start of the scratch-pad block (★ = $00), and the start of the main program (★ = $10). All other addressing is either relative (★ = ★ + 1, ★ = ★ + 4) or by label (JSR SORT, JMP COMPAR, BNE SWAP), with absolute addresses and branch offsets assigned during assembly. Therefore, this whole program could be moved to KIM by simply changing the scratchpad start to any convenient spot in KIM zero-page, changing the program start to any appropriate spot in KIM RAM, and re-assembling, with object-output to tape in KIM format.

That last phrase, "output to tape in KIM format," is where we hit the first snag. The AIM User's Manual says the assembler will do this, but the manual is wrong. If you try OUT-OBJ = K, the poor thing locks up in a trance, and the only recovery is RESET. (If you would like an explanation from Rockwell on why this happens, call Dave Sawtelle, AIM Applications, 714-632-0975. This number is worth writing down; AIM Applications is a very competent and helpful group.)

So how do you output object to tape in KIM format? You have your choice of two ways. The simple way is to output object to tape in AIM format, load this back into AIM, and then DUMP it to tape in KIM format. This works fine, but it is slow. The faster way, if you have room in AIM RAM, is to send object to memory and then DUMP in KIM format. Before you do either, read on, or you may hit the second snag.

The above sort/print is a bad example of KIM-convertible code, for two reasons. The first is obvious; considering its function, KIM couldn't do anything with it. The second illustrates some further precautions.

The AIM editor and assembler use the top third (and some of the bottom) of Page Zero, and several pieces of Page One are used by tape I/O and monitor. Furthermore, you can't (yet) trust the memory map in the User's Manual. Rockwell is diligently fixing the mistakes and has already issued Revision 1, but it is still too new to be totally reliable. For example, look at the equate list in Fig. 1 again. Notice those zero-page addresses for STLO through NSYMHI? Does the memory map tell you they are used by the assembler? No, it doesn't. STLO, STHI, NSYMLO, and NSYMHI are mentioned in the chapter on the assembler (Section 5.2). I found ENLO and ENHI by accident!

In order to assemble to memory and run, try to avoid putting either program or data on either Page Zero or Page One, unless you want to discover, by trial and error, the undocumented portions of the memory map. It's okay to assign zero-page variables, but don't use the assembler to initialize them with data. The data may not survive the assembly.

Now, how about a program destined for Page Zero, such as the sorter/printer above? The final version (as listed above) must be assembled with object-output to tape, and can then be safely loaded and run. But during debug, the assemble-to-memory-and-run cycle can still be used by moving program and data to higher memory. For example, just before YTAB, change "★ = ★ + 1" to "★ = $200" (to move data to Page 2); and before START, change "★ = $10" to "★ = $300" (to move the program to Page 3). This changes some addressing modes from zero-page to absolute, but the assembler takes it in stride. Now assemble to memory and run. After it all works, move data and program down to Page Zero, and assemble to tape.

What if you need to use Page One? The push-down stack at the top of Page One is the same in AIM as in KIM, so there is no problem there. (Simply allow a bit more room for the deeper-pushing AIM monitor.) The AIM memory map shows eleven Page One bytes (106-107, 115-11D) used by tape I/O, and eight bytes (168-16F) used by the monitor. The tape I/O bytes can be handled like Page Zero bytes; i.e., avoid until assembling to tape. The eight monitor bytes should probably be permanently avoided; load them into KIM by hand after everything else is transferred. And as an extra precaution, check all of Page One for wipeouts before running in KIM.

Please do not let all these cautions scare you off. It really is fast and easy after a little practice. Most programs grow during debug, and much of the above only applies if your program has grown to the point where you are cramped for memory space.

Fig. 4 shows how simple it is when there is plenty of room. This is a general-purpose "move block" program that will go anywhere in memory (RAM or ROM), and it will move any size block from anywhere to anywhere. The assembly listing (Fig. 5) shows that it occupies 24 HEX bytes of memory, and uses six bytes of zero-page. Before moving it to KIM, change that "★ = $00" to the start of the six-byte block you want it to use in KIM. Don't bother to change the "★ = $200" starting address; after you have it in KIM, you can use the program to move itself to wherever you want to keep it. I keep two copies on tape, one that loads to zero-page and one to the top of RAM, plus one more in EPROM. With another copy in AIM, it can be used for general memory transfer in either direction; move blocks to $200-3FF, dump to tape, load to $200-3FF in the other machine, and move to wherever.

If all you want is the block-move code, Fig. 6 gives a disassembler listing and a hex dump. It can be put anywhere, but this version needs the bottom six bytes of zero-page for "From", "End", and "To".

Figure 1: **Source Listing, Sorter/Printer**

```
;SPSYM
;
;SORT & PRINT SYMBOL
;    TABLE AFTER
;   AIM ASSEMBLY
;
;EQUATE LIST
;
STLO=$3A
STHI=$3B
ENLO=$3C
ENHI=$3D
NSYMLO=$0C
NSYMHI=$0B
;
CLR=$EB44
OUTALL=$E9BC
NUMA=$EA46
CRCK=$EA24
;
*=$00
CNTLO
*=*+1
CNTHI
*=*+1
ADLO
*=*+1
ADHI
*=*+1
Y1
*=*+1
Y2
*=*+1
YLIM
*=*+1
YTAB
;
;YTAB DATA
.DBY $0008,$060E
;
;MAIN PROGRAM
;JUMP OVER 0B,0C
```

```
;  (TO $10)
*=$10
START
;SORT BY NAME
LDA #6
STA YLIM
LDX #0
JSR SORT
;SORT BY ADDRESS
LDA #8
STA YLIM
LDX #2.
JSR SORT
BRK
BRK
;
;SUBROUTINES
;
SORT LDA NSYMLO
STA CNTLO
LDA NSYMHI
STA CNTHI
SRT1 JSR SETADR
SRT2 LDA YTAB,X
STA Y1
LDA YTAB+1,X
STA Y2
;JUMP OVER 3A-3D
JMP COMPAR
*=*+4
;COMPARE CHAR. W/
;  CORRESP. CHAR. IN
;    NEXT LINE.
;  IF A<B, NEXT LINE
;  IF A>B, SWAP.
;  IF A=B, NEXT CHAR.
COMPAR LDY Y1
LDA (ADLO),Y
LDY Y2
CMP (ADLO),Y
BCC NXLINE
BNE SWAP
INC Y1
INC Y2
LDA Y1
CMP YLIM
BNE COMPAR
SWAP LDA #0
STA Y1
LDA #8
STA Y2
SWP1 LDY Y1
LDA (ADLO),Y
PHA
LDY Y2
LDA (ADLO),Y
LDY Y1
STA (ADLO),Y
PLA
LDY Y2
STA (ADLO),Y
INC Y1
INC Y2
LDA Y1
CMP #8
BNE SWP1
NXLINE JSR INCADR
BNE SRT2
;DECREMENT
;  LOOP COUNT
SEC
LDA CNTLO
SBC #1
STA CNTLO
BCS *+4
DEC CNTHI
LDA CNTHI
BNE *+4
LDA CNTLO
BNE SRT1
;PRINT SORTED LIST
JSR SETADR
JSR GAP
PRNT1 JSR CLR
LDY #4
PR1A LDA #$20
JSR OUTALL
DEY
BNE PR1A
LDY #0
PRNT2 LDA (ADLO),Y
JSR OUTALL
INY
CPY #6
BNE PRNT2
LDA #$20
JSR OUTALL
PRNT3 LDA (ADLO),Y
JSR NUMA
INY
CPY #8
BNE PRNT3
JSR CRCK
JSR INCADR
BMI PRNT1
BEQ PRNT1
JSR GAP
RTS
;
SETADR LDA STLO
STA ADLO
LDA STHI
STA ADHI
RTS

INCADR CLC
LDA ADLO
ADC #8
STA ADLO
BCC *+4
INC ADHI
LDA ADHI
CMP ENHI
BNE INAX
LDA ADLO
CMP ENLO
INAX RTS
;
GAP LDX #3
GP1 JSR CLR
LDA #$20
JSR OUTALL
JSR CRCK
DEX
BNE GP1
LAST RTS
;
.END
```

Fig. 2: **Assembly Listing, Sorter/Printer**

```
;SPSYM
;
;SORT & PRINT SYMBOL
;    TABLE AFTER
;  AIM ASSEMBLY
;
;EQUATE LIST
;
==0000 STLO=$3A

==0000 STHI=$3B

==0000 ENLO=$3C

==0000 ENHI=$3D

==0000 NSYMLO=$0C

==0000 NSYMHI=$0B

;
==0000 CLR=$EB44
```

```
==0000 OUTALL=$E9BC

==0000 NUMA=$EA46

==0000 CRCK=$EA24.

;
==0000
       *=$00
==0000 CNTLO
==0000
       *=*+1
==0001 CNTHI
==0001
       *=*+1
==0002 ADLO
==0002
       *=*+1
==0003 ADHI
==0003
       *=*+1
==0004 Y1
==0004
       *=*+1
==0005 Y2
==0005
       *=*+1
==0006 YLIM
==0006
       *=*+1
==0007 YTAB
;YTAB DATA
0008    DBY $0008,$0
60E
060E
;
;MAIN PROGRAM
;JUMP OVER 0B,0C
;  (TO $10)
==000B
       *=$10
==0010 START
;SORT BY NAME
A906   LDA #6
8506   STA YLIM
A200   LDX #0
202400 JSR SORT
;SORT BY ADDRESS
A908   LDA #8
8506   STA YLIM
A202   LDX #2
202400 JSR SORT
==0022
00     BRK
00     BRK
;SUBROUTINES
;
==0024 SORT
A50C   LDA NSYMLO
8500   STA CNTLO
A50B   LDA NSYMHI
8501   STA CNTHI
==002C SRT1
20CC00 JSR SETADR
==002F SRT2
B507   LDA YTAB,X
8504   STA Y1
B508   LDA YTAB+1,X
8505   STA Y2
;JUMP OVER 3A-3D
4C3E00 JMP COMPAR
==003A
       *=*+4
;COMPARE CHAR. W/
;  CORRESP. CHAR. IN
;    NEXT LINE.
;  IF A<B, NEXT LINE
;  IF A>B, SWAP.
;  IF A=B, NEXT CHAR.
==003E COMPAR
A404   LDY Y1
B102   LDA (ADLO),Y
A405   LDY Y2
D102   CMP (ADLO),Y
9030   BCC NXLINE
D00A   BNE SWAP
E604   INC Y1
E605   INC Y2
==004E
A504   LDA Y1
C506   CMP YLIM
D0EA   BNE COMPAR
==0054 SWAP
A900   LDA #0
8504   STA Y1
A908   LDA #8
8505   STA Y2
==005C SWP1
A404   LDY Y1
B102   LDA (ADLO),Y
48     PHA
A405   LDY Y2
B102   LDA (ADLO),Y
A404   LDY Y1
9102   STA (ADLO),Y
68     PLA
A405   LDY Y2
==006C
9102   STA (ADLO),Y
E604   INC Y1
E605   INC Y2
A504   LDA Y1
C908   CMP #8
D0E4   BNE SWP1
==0078 NXLINE
20D500 JSR INCADR
D0B2   BNE SRT2
;DECREMENT
;  LOOP COUNT
38     SEC
A500   LDA CNTLO
E901   SBC #1
8500   STA CNTLO
B002   BCS *+4
C601   DEC CNTHI
==0088
A501   LDA CNTHI
D002   BNE *+4
A500   LDA CNTLO
D09C   BNE SRT1
;PRINT SORTED LIST
20CC00 JSR SETADR
20EB00 JSR GAP
==0096 PRNT1
2044EB JSR CLR
A004   LDY #4
==009B PR1A
A920   LDA #$20
20BCE9 JSR OUTALL
88     DEY
D0F8   BNE PR1A
A000   LDY #0
==00A5 PRNT2
B102   LDA (ADLO),Y
20BCE9 JSR OUTALL
C8     INY
C006   CPY #6
D0F6   BNE PRNT2
A920   LDA #$20
20BCE9 JSR OUTALL
==00B4 PRNT3
B102   LDA (ADLO),Y
2046EA JSR NUMA
C8     INY
C008   CPY #8
D0F6   BNE PRNT3
2024EA JSR CRCK
20D500 JSR INCADR
==00C4
30D0   BMI PRNT1
F0CE   BEQ PRNT1
20EB00 JSR GAP
60     RTS
;
==00CC SETADR
```

```
A53A   LDA STLO
8502   STA ADLO
A53B   LDA STHI
8503   STA ADHI
60     RTS
;
==00D5 INCADR
18     CLC
A502   LDA ADLO
6908   ADC #8
8502   STA ADLO
9002   BCC *+4
E603   INC ADHI
A503   LDA ADHI
C53D   CMP ENHI
D004   BNE INAX
==00E6
A502   LDA ADLO
C53C   CMP ENLO
==00EA INAX
60     RTS
;
==00EB GAP
A203   LDX #3
==00ED GP1
2044EB JSR CLR
A920   LDA #$20
20BCE9 JSR OUTALL
2024EA JSR CRCK
CA     DEX
D0F2   BNE GP1
==00FB LAST
60     RTS
;
       END
 ERRORS= 0000
```

Fig. 3: **Example Run showing Dual Sort**

```
<*>=10
<G>/
```

```
ADHI   0003
ADLO   0002
CLR    EB44
CNTHI  0001
CNTLO  0000
COMPAR 003E
CRCK   EA24
ENHI   003D
ENLO   003C
GAP    00EB
GP1    00ED
INAX   00EA
INCADR 00D5
LAST   00FB
NSYMHI 000B
NSYMLO 000C
NUMA   EA46
NXLINE 0078
OUTALL E9BC
PR1A   009B
PRNT1  0096
PRNT2  00A5
PRNT3  00B4
SETADR 00CC
SORT   0024
SRT1   002C
SRT2   002F
START  0010
STHI   003B
STLO   003A
SWAP   0054
SWP1   005C
Y1     0004
Y2     0005
YLIM   0006
YTAB   0007

CNTLO  0000
CNTHI  0001
ADLO   0002
ADHI   0003
Y1     0004
Y2     0005
YLIM   0006
YTAB   0007
NSYMHI 000B
NSYMLO 000C
START  0010
SORT   0024
SRT1   002C
SRT2   002F
STLO   003A
STHI   003B
ENLO   003C
ENHI   003D
COMPAR 003E
SWAP   0054
SWP1   005C
NXLINE 0078
PRNT1  0096
PR1A   009B
PRNT2  00A5
PRNT3  00B4
SETADR 00CC
INCADR 00D5
INAX   00EA
GAP    00EB
GP1    00ED
LAST   00FB
OUTALL E9BC
CRCK   EA24
NUMA   EA46
CLR    EB44
```

Fig. 4: **Source Listing, Block—Move Program**

```
;COPY
;
;COPIES ANY-SIZE
; BLOCK OF MEMORY
; TO ANYPLACE IN RAM
;
;BEFORE RUNNING,
; PUT START OF
; BLOCK IN "FROM",
; END OF BLOCK IN
; "END", AND FIRST
; DESTINATION IN
; "TO".
;
;EQUATE LIST
*=$00
FRLO
*=*+1
FRHI
*=*+1
ENLO
*=*+1
ENHI
*=*+1
TOLO
*=*+1
TOHI
;
;MAIN PROGRAM
*=$200
START
;INCREMENT "END"
INC ENLO
BNE *+4
INC ENHI
LDY #0
MOVE
LDA (FRLO),Y
STA (TOLO),Y
;INCREMENT "FROM"
```

```
INC FRLO
BNE *+4
INC FRHI
;INCREMENT "TO"
INC TOLO
BNE *+4
INC TOHI
;CHECK IF DONE
SEC
LDA FRLO
SBC ENLO
LDA FRHI
SBC ENHI
BCC MOVE
;ALL DONE
BRK
LAST
BRK
 END
```

Fig. 5: **Assembly Listing, Block—Move Program**

```
==0000
;COPY
;
;COPIES ANY-SIZE
;  BLOCK OF MEMORY
;  TO ANYPLACE IN RAM
;
;BEFORE RUNNING,
;  PUT START OF
;  BLOCK IN "FROM",
;  END OF BLOCK IN
;  "END", AND FIRST
;  DESTINATION IN
;  "TO".
;
;EQUATE LIST
==0000
        *=$00
==0000 FRLO
==0000
        *=*+1
==0001 FRHI
==0001
        *=*+1
==0002 ENLO
==0002
        *=*+1
==0003 ENHI
==0003
        *=*+1
==0004 TOLO
==0004
        *=*+1
==0005 TOHI
;
;MAIN PROGRAM
==0005
        *=$200
==0200 START
;INCREMENT "END"
E602    INC ENLO
D002    BNE *+4
E603    INC ENHI
A000    LDY #0
==0208 MOVE
B100    LDA (FRLO),Y
9104    STA (TOLO),Y
;INCREMENT "FROM"
E600    INC FRLO
D002    BNE *+4
E601    INC FRHI
;INCREMENT "TO"
E604    INC TOLO
D002    BNE *+4
E605    INC TOHI
==0218
;CHECK IF DONE
38      SEC
A500    LDA FRLO
E502    SBC ENLO
A501    LDA FRHI
E503    SBC ENHI
90E5    BCC MOVE
;ALL DONE
00      BRK
==0224 LAST
00      BRK
         END
 ERRORS= 0000
```

Fig. 6: **Block—Move, Disassembled and Hex Dump**

```
<K>*=200
/20
 0200 E6 INC 02
 0202 D0 BNE 0206
 0204 E6 INC 03
 0206 A0 LDY #00
 0208 B1 LDA (00),Y
 020A 91 STA (04),Y
 020C E6 INC 00
 020E D0 BNE 0212
 0210 E6 INC 01
 0212 E6 INC 04
 0214 D0 BNE 0218
 0216 E6 INC 05
 0218 38 SEC
 0219 A5 LDA 00
 021B E5 SBC 02
 021D A5 LDA 01
 021F E5 SBC 03
 0221 90 BCC 0208
 0223 00 BRK
 0224 00 BRK

<M>=0200 E6 02 D0 02
< > 0204 E6 03 A0 00
< > 0208 B1 00 91 04
< > 020C E6 00 D0 02
< > 0210 E6 01 E6 04
< > 0214 D0 02 E6 05
< > 0218 38 A5 00 E5
< > 021C 02 A5 01 E5
< > 0220 03 90 E5 00
< > 0224 00 45 4D 4F
```

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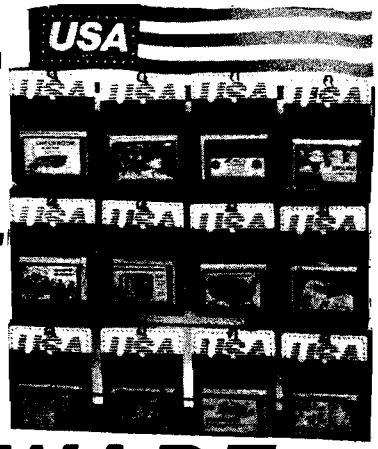

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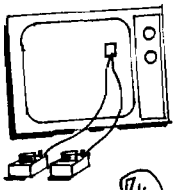

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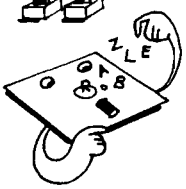

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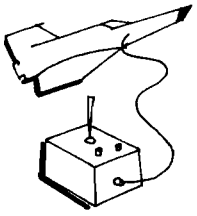

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Available from:
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405 Reflection Road
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Memory: **32K**
Language: **Integer Basic or Applesoft**
Hardware: **APPLE II, Disk II, and IDS 440G Printer**

Description: The paper tiger graphics software is a set of programs which allow printing of anything that can be displayed on the Apple II high resolution pages. Any picture, graph, text, or diagram which is displayed can be saved and dumped to the printer. Serial versions of the printing programs are listed on the diskette. The names of the programs indicate which language is used to execute the program. Pictures can be expanded to twice the size and can be inverted to give a black on white or a white on black picture.

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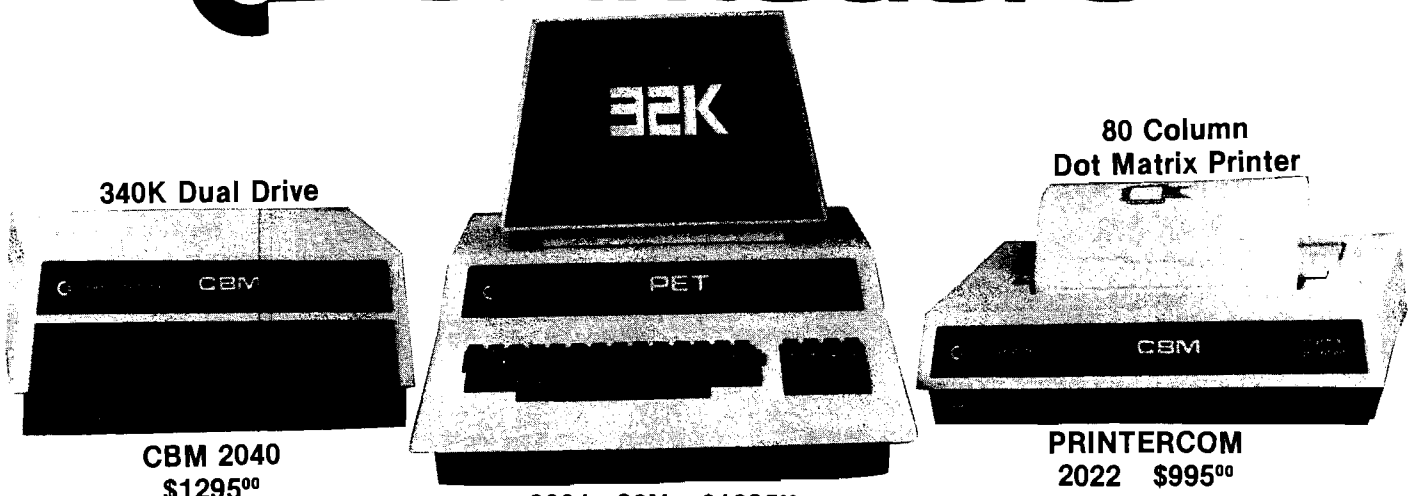

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Search/Change in Applesoft

It is often useful to be able to search a file for a particular string and then to change the string for a new one. This paper presents a Search/Change capability for Applesoft.

J.D. Childress
5108 Springlake Way
Baltimore, MD 21212

A program to produce a cross-reference table for all the variables in a program under development is a useful tool; such a table enables one to determine whether and where a variable label has been used. Unfortunately, a variable's cross-reference program in BASIC is not available in the literature although the development of one was recently reported by William and Alice Englander, *Nybbles: BASIC Cross-Reference Table Generator,* Byte, v4, 4:190 (April 79). About as useful in program development though not as neat for complete documentation purposes is the FIND program of Jim Butterfield, *Inside PET BASIC,* MICRO, 8:39, (December78-January 79). Butterfield's paper inspired the present SEARCH/-FIND program, one that does the same function as Butterfield's but also, allows one to change the found item (within limits).

SEARCH/CHANGE is about seven times as long (1.5 Kbytes) as Butterfield's FIND and runs at about half the speed. It takes about 2.5 minutes to search 8.5 Kbytes. On the plus side, the extra length and sacrifice in speed buys

1. the option not to search or only to search strings,
2. the option to have listed the lines that contain the sought item, and
3. the option to replace the sought item by anything of equal length.

Because of the limitation on length in the CHANGE function, this feature is not really a general purpose program editing tool. Nevertheless, it is quite useful in dressing up variable labels or changing, say, a real variable to an integer variable.

Demonstration

To do a search/change, the SEARCH/CHANGE program must be appended to the program to be searched. Either use the merge feature of the 3.2 DOS renumbering program or the machine language APPEND program and proceedure given by Chuck Carpenter, *Renumber Applesoft,* MICRO 12:45 (May 79). Once the programs are wed, enter the search item as line 1 and the change item, if any, as line 2. Then a RUN 63000 starts the works.

To demonstrate the workings of SEARCH/CHANGE, we use the rather nonsensical program listed in Figure 1. We enter the search item DOG as line 1 and run 63000. The print-out of this run is given in Fig. 2. Every appearance of the three consecutive letters D O G is listed. Had we asked for the lines to be listed, a given line would have been listed only once.

We can search for anything; Fig. 3(a) shows the result of a search for equal signs. However, we do have to be careful of Applesoft's reserved words. Figure 3(b) shows what happens if we try to search for CAT. Applesoft recognizes the reserved word AT in CAT. This makes clear the need of having the program list for verification the search and change items.

The reserved word problem is a relatively minor nuisance. A little ingenuity can get us around it. In the CAT case, we could search for CA; if that gave too many other items, we could then search for TS and only consider the lines that appear in both lists.

The CHANGE function, as well as the line listing feature, is demonstrated in Fig. 4. Again caution is wise. What if we had already used the DGS label in our program? There would be no way later that we could separate the old DGS from the new DGS. If in doubt in changing a label, first make a search to see if the new label is already being used.

In changing the variable label from DOG to DGS, we did not want to change the word DOG inside strings, hence did not search strings. The capability of not searching strings or only searching strings provides all the flexibility we ever need.

We note that we can only change an item to one equal in length (as APPLESOFT sees the length). Extra length in the change item entered as line 2 is ignored. If the replacement is shorter than

the search item, things go awry. The result is a muddle, correctable in general only by a start over from scratch.

Design

A few comments on the design of the SEARCH/CHANGE program are offered here in lieu of remark statements in the program itself.

First the program identifies the search item, FOR loop lines 63040-63070. Then it identifies the change item, if any, FOR loop line 63110 and preceeding line. The search is carried out by FOR loop lines 63130-63170. To get the best operating speed, we close the FOR loop within a single line (line 63130) if no byte of significance is found. Even so, the testing for up to three conditions takes time. If one of these conditions is not met, then the following lines either pass to subroutine line 63300 to complete the item identification test and make the item change (if one. is entered), or set the string's search flag, or strart the search of the next program line, whichever is indicated. Line 63120 determines that the search is over when line 62999 isreached and passes to output. The routine lines 63220-63290 accomplish the line listing feature. Note that the search for the LIST command is backwards from the end of the program (we know that the one we want is the last one). Also note that the line number has to be poked in so that there should always be five digits following LIST. After use of the program, the actual number that appears here when line 63270 is listed is the last number poked in. There should be leading zeros if that number had less than five digits. The Applesoft interpreter preserves these leading zeros whereas the 3.2 DOS renumbring program does not. If you want to renumber SEARCH/CHANGE, remember to check this line and, if you want to, change the 62999 in line 63120.

Figure 1: **Listing of Demonstration Program**

```
10  FOR I = 1 TO 5
20  PRINT "DOGS AND CATS FIGHT.
    ";: NEXT : PRINT : PRINT
30  INPUT "GIVE THE NUMBER OF CAT
    S  ";CTS: PRINT
40  INPUT "GIVE THE NUMBER OF DOG
    S  ";DOG: PRINT
50  IF CTS = 0 AND DOG = 0 THEN  END

60  PRINT : PRINT "THE PROBABLE W
    INNER IN A CAT-DOG FIGHT": PRINT
    "WITH ";DOG;" DOGS AND ";CTS
    ;" CATS WOULD BE"
70  IF DOG = 0 THEN  PRINT "*****
    CATS*****": END
80  IF CTS = 0 THEN  PRINT "*****
    DOGS*****": END
90  IF  RND (1) * CTS / DOG > .5 THEN
      PRINT "*****CATS*****": END

100  PRINT "*****DOGS*****": END
```

Fig. 2: **SEARCH Demonstration**

```
)1 DOG

)RUN 63000

1 DOG

PLEASE VERIFY IF THE COMPUTER TAKES
THIS AS YOU INTENDED. DO YOU WANT
TO CONTINUE (YES OR NO)? YES
DO YOU WANT TO SEARCH INSIDE STRINGS
(YES OR NO)? YES
DO YOU WANT TO SEARCH STRINGS ONLY
(YES OR NO)? NO


THE ITEM

1 DOG

IS FOUND IN THE FOLLOWING LINES:

20              40              40
50              60              60
60              70              80
90              100

 DO YOU WANT THESE LINES LISTED (YES OR NO)? NO

)
```

Fig. 3: **Other SEARCH Demonstrations**

```
     (a)  Search for equal signs
THE ITEM

1  =

IS FOUND IN THE FOLLOWING LINES:

10              50              50
70              80

 DO YOU WANT THESE LINES LISTED (YES OR NO)?  NO
    (b)  Attempt to search for CAT

)1 CAT

)RUN 63000

1 C AT

PLEASE VERIFY IF THE COMPUTER TAKES
THIS AS YOU INTENDED. DO YOU WANT
TO CONTINUE (YES OR NO)? YES
DO YOU WANT TO SEARCH INSIDE STRINGS
(YES OR NO)? YES
DO YOU WANT TO SEARCH STRINGS ONLY
(YES OR NO)? NO


THE ITEM

1 C AT

IS FOUND IN THE FOLLOWING LINES:

      NONE.
```

Fig. 4: **CHANGE Demonstration**

```
)RUN 63000

1 DOG
2 DGS

PLEASE VERIFY IF THE COMPUTER TAKES
THIS AS YOU INTENDED. DO YOU WANT
TO CONTINUE (YES OR NO)? YES
DO YOU WANT TO SEARCH INSIDE STRINGS
(YES OR NO)? NO
DO YOU WANT TO SEARCH STRINGS ONLY
(YES OR NO)? NO


THE ITEM

1 DOG

IS FOUND IN THE FOLLOWING LINES:

40              50              60
70              90

 DO YOU WANT THESE LINES LISTED (YES OR NO)?
   YES
THERE WILL BE A WAIT AFTER EACH LINE
UNTIL YOU HIT RETURN TO CONTINUE.


40  INPUT "GIVE THE NUMBER OF DOG
    S  ";DGS: PRINT

50  IF CTS = 0 AND DGS = 0 THEN  END

60  PRINT : PRINT "THE PROBABLE W
    INNER IN A CAT-DOG FIGHT": PRINT
    "WITH ";DGS;" DOGS AND ";CTS
    ;" CATS WOULD BE"

70  IF DGS = 0 THEN  PRINT "*****
    CATS*****": END

90  IF  RND (1) * CTS / DGS > .5 THEN
      PRINT "*****CATS*****": END
```

Fig. 5: **Listing of SEARCH/CHANGE Program**

```
62999  END
63000  DIM SEEK(100),NT(100),L(10
     0):START = 256 *  PEEK (104)
      +  PEEK (103):FINI = 256 *
      PEEK (106) +  PEEK (105)
63010  IF 256 *  PEEK (START + 3)
      +  PEEK (START + 2) <  > 1 THEN
      PRINT "YOU MUST ENTER YOUR
     SEARCH ITEM AS LINE": PRINT
     "1 BEFORE YOU RUN 63000.": END

63020  LIST 0,2: PRINT "PLEASE VE
     RIFY IF THE COMPUTER TAKES":
      PRINT "THIS AS YOU INTENDED
     . DO YOU WANT": INPUT "TO CO
     NTINUE (YES OR NO)? ";Y$: IF
     Y$ <  > "YES" THEN  END
63030  PRINT "DO YOU WANT TO SEAR
     CH INSIDE STRINGS": INPUT "(
     YES OR NO)? ";YY$: PRINT "DO
      YOU WANT TO SEARCH STRINGS
     ONLY": INPUT "(YES OR NO)? "
     ;YZ$: IF YZ$ = "YES" THEN SO
      = 1:YY$ = "NO"
63040  FOR I = 0 TO 255
63050 SEEK(I) =  PEEK (START + 4 +
     I)
63060  IF SEEK(I) = 0 THEN N = I -
     1: GOTO 63080
63070  NEXT
63080 M = START + N + 6
63090 CH = 0: IF 256 *  PEEK (M +
     3) +  PEEK (M + 2) <  > 2 THEN
     CH = 1: GOTO 63120
63100  IF N = 0 THEN NT(0) =  PEEK
     (M + 4): GOTO 63120
63110  FOR I = 0 TO N:NT(I) =  PEEK
     (M + 4 + I): NEXT
63120 LM = 256 *  PEEK (M + 3) +
      PEEK (M + 2): IF LM >  = 62
     999 THEN 63180
63130  FOR I = M + 4 TO M + 255: IF
      PEEK (I) <  > 0 AND  PEEK (
     I) <  > SEEK(0) AND  PEEK (I
     ) <  > 34 THEN  NEXT
63140  IF  PEEK (I) = 34 AND YY$ =
     "NO" THEN SO = SO + 1: IF SO
      = 2 THEN SO = 0
63150  IF  PEEK (I) = SEEK(0) AND
     SO <  > 1 THEN  GOSUB 63300
63160  IF  PEEK (I) = 0 THEN M =
     I + 1: GOTO 63120
63170  NEXT
63180  HOME : PRINT : PRINT : PRINT
     "THE ITEM": PRINT "  ";: LIST
     1: PRINT "IS FOUND IN THE FO
     LLOWING LINES:": PRINT : IF
     L(1) = 0 THEN  PRINT "
     NONE.": END
63190  FOR I = 1 TO K: PRINT L(I)
     ,: NEXT : PRINT
63200  PRINT : INPUT " DO YOU WAN
     T THESE LINES LISTED (YES OR
      NO)? ";Y$: IF Y$ = "NO" THEN
      END
63210  PRINT : PRINT "THERE WILL
     BE A WAIT AFTER EACH LINE": PRINT
     "UNTIL YOU HIT RETURN TO CON
     TINUE.": PRINT
63220  FOR I = 1 TO 1000:W = FINI
     - 2 - I: IF  PEEK (W) = 188
      THEN 63240
63230  NEXT
63240  FOR I = 1 TO K: IF L(I) =
     L(I - 1) THEN 63290
63250 L$ = "0000" +  STR$ (L(I)):
     L$ =  RIGHT$ (L$,5)
63260  FOR J = 1 TO 5: POKE W + J
```

```
     ,48 +  VAL ( MID$ (L$,J,1)):
      NEXT
63270  LIST 12345: INPUT "";Y$
63280  IF K < 2 THEN  END
63290  NEXT : END
63300  IF N = 0 THEN K = K + 1:L(
     K) = LM: IF CH = 0 THEN  POKE
     I,NT(0): RETURN
63310  IF N = 0 THEN  RETURN
63320  FOR J = 1 TO N: IF  PEEK (
     I + J) <  > SEEK(J) THEN  RETURN

63330  NEXT

63340 K = K + 1:L(K) = LM
63350  IF CH <  > 0 THEN  RETURN

63360  FOR J = 0 TO N: POKE I + J
     ,NT(J): NEXT
63370  RETURN
```

SYM-1 Staged Loading Technique for Segmented Programs

The SYM cassette tape I/O can not load continuously from 0000 on. The end of page zero and the end of page one can not be directly loaded. A program and technique are presented which simply get around this situation.

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The basic SYM-1 comes equipped with IK of user RAM, most of which can be used for program material. This RAM, however, because of usage by the system monitor, is not contained in a continuous block.

Specifically, the area from roughly 01D1 to 01FF is used as a stack area. Any data or return addresses pushed onto the stack during program (or monitor routine) execution will erase and replace any program material which one might attempt to store in these locations.

Likewise the SYM manual indicates that the page zero locations from OOFO to OOFF are used occasionally by the monitor program.

Using the SYM tape dump routines, we are able to dump a continuous block 0000 to 03FF to the tape but it is not possible to reload this block in the same manner because of the monitor usage of the areas specified above.

In order to make as full use of the memory space as possible then, we must segment the programs, storing one segment in the area from 0000 to 00EF, another from 0100 to 01CF and the third from 0200 to 03FF (or higher if additional memory is installed).

To store the complete program on tape, we must store the segments independently, since that is the only way we can properly retrieve them. Just as an example, let's say that the first segment has an ID byte of "02", covering 0000-00EF, the second segment an ID byte of "03" (0100-01CF) and third an ID of "04", (extending from 0200 to the end of the program).

Then to reload the program from tape, we must issue three sets of commands, specifically: Load 02 (CR), Load 03 (CR), Load 04 (CR). We must wait for the tape load in between entries. Then we must issue the command which starts the program. If the start location is 0200, we must enter: Go 200 (CR).

It would be much simpler if we were able to enter all of the commands at once and have the machine load all the segments in the right places and then to auto-jump to the start of the program on completion of the load.

Well there is an easy way to set this up with the SYM-I. A I6-byte program entered by the user into any 16 consecutive locations will act as the initial loader program. This is shown in Figure One.

This program would load a program with an ID equal to "01". Because we did a jump to the tape load routine rather than a "JSR", an interesting thing happens. When the tape load routine is done it executes an "RTS", a return from subroutine. This causes the last two bytes pushed onto the stack to be pulled back off and loaded into the program counter.

Therefore when we complete the load of program "0I", we will execute a jump to location 0200 because this is the two byte address we pushed onto the stack before the tape load routine was ordered. Program "0I" is, in this case, intended to be loaded into loctions 0200-02I0 and is shown in Figure Two, described below.

This program will load the segment "02" into locations 0-CI, then "03" into locations 100-1C1, and finally segment "04" into locations 0200-03FF. Note that program segment "04" writes over the area where program "0I" was loaded. However, since we were under control of the monitor program at the time, it did not matter at all. Besides this, once the third segment is fully loaded, we no longer need the loader program in memory.

After the load, we execute the RTS in the tape loader routine. Since we did not jump to it as a subroutine for the load of the last segment, all it does is to pull 0200 off the stack and uses this as the location of the next instruction to execute.

Therefore by loading those initial 16 bytes in the first program described, we cause the machine to load program 1 which began automatically to load in turn programs 2, 3, and 4. Then it began the execution of our loaded segmented program at location 0200.

The only cautionary note in using this type of sequenced loading is to be certain that the load control segment is located in the area of memory which is overlayed last by the final program segment to be loaded (04 in this case). Otherwise you will erase the loader before the entire group of segments is brought in.

The 16-byte setup program you will note is fully relocatable, and could eventually be linked as a part of your monitor routines. However to make it more general in that case, the instructions now specified at 020B could be, for example, A5 EE, or reference any other zero page location so that the ID byte could be preloaded there by the user and retrieved by this routine for use later. This also assumes that the user has committed this routine to ROM.

This sequenced loading technique has other uses as well, but that is another subject and may be the subject of a future article.

Figure 1: **The Bootstrap Program (Load and start Segment Loader)**

```
0200   20 86 8B     JSR ACCESS   ;UNPROTECT SYSTEM RAM
0203   A9 00        LDA #$00     ;STACK LO BYTE OF
0205   48           PHA          ;PROGRAM 01 START ADDR.
0206   A9 02        LDA #$02     ;STACK HI BYTE OF
0208   48           PHA          ;PROGRAM 01 START ADDR.
0209   A0 00        LDY #$00     ;TAPE MODE (80 IF HI SPD.)
020B   A9 01        LDA #$01     ;PROGRAM ID SEARCHED
020D   4C 78 8C     JMP LOADT    ;LOAD PROGRAM 01.
```

Figure 2: **The Segment Loader Program: Loads segments 02, 03, 04 then starts execution at location 0200.**

```
0200   20 86 8B     JSR ACCESS   ;UNPROTECT SYSTEM RAM
0203   A9 00        LDA #$00     ;STACK LO BYTE OF PROGRAM
0205   48           PHA          ;START ADDRESS
0206   A9 02        LDA #$02     ;STACK HI BYTE OF PROGRAM
0208   48           PHA          ;START ADDRESS
0209   A0 00        LDY #$00     ;KIM MODE (80 FOR HI SPD.)
020B   A9 02        LDA #$02     ;PROGRAM ID 02
020D   20 78 8C     JSR LOADT    ;JSR TO TAPE LOAD SUBROUTINE
0210   A0 00        LDY #$00     ;TAPE MODE
0212   A9 03        LDA #$03     ;ID 03
0214   20 78 8C     JSR LOADT    ;JSR TO TAPE LOAD
0217   A0 00        LDY #$00     ;TAPE MODE
0219   A9 04        LDA #$04     ;ID 04
021B   4C 78 8C     JMP LOADT    ;TAPE LOAD *JUMP* , BEGINS
                                 ;PROGRAM AT 0200 WHEN LOAD DONE.
```

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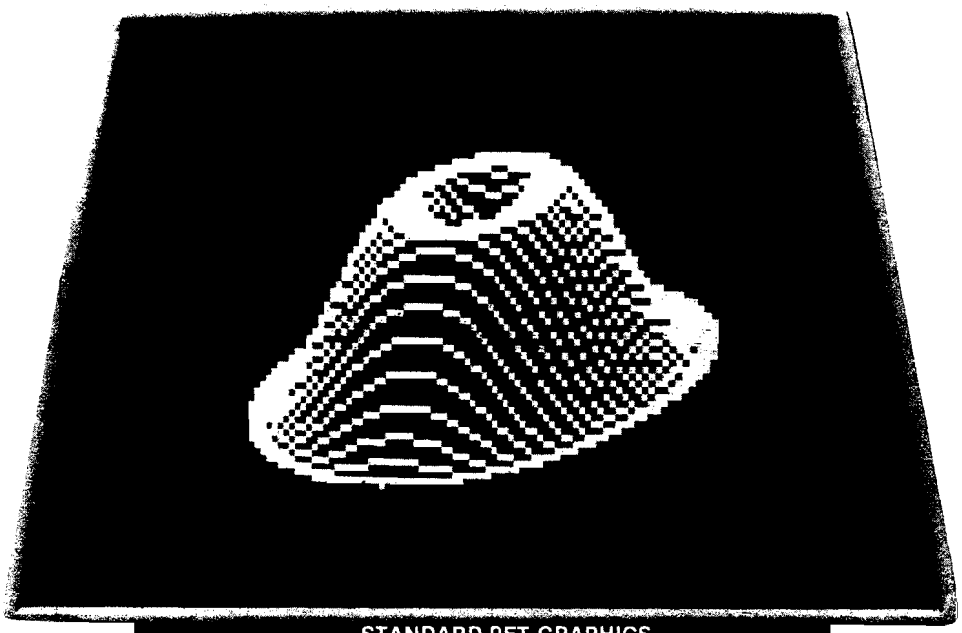

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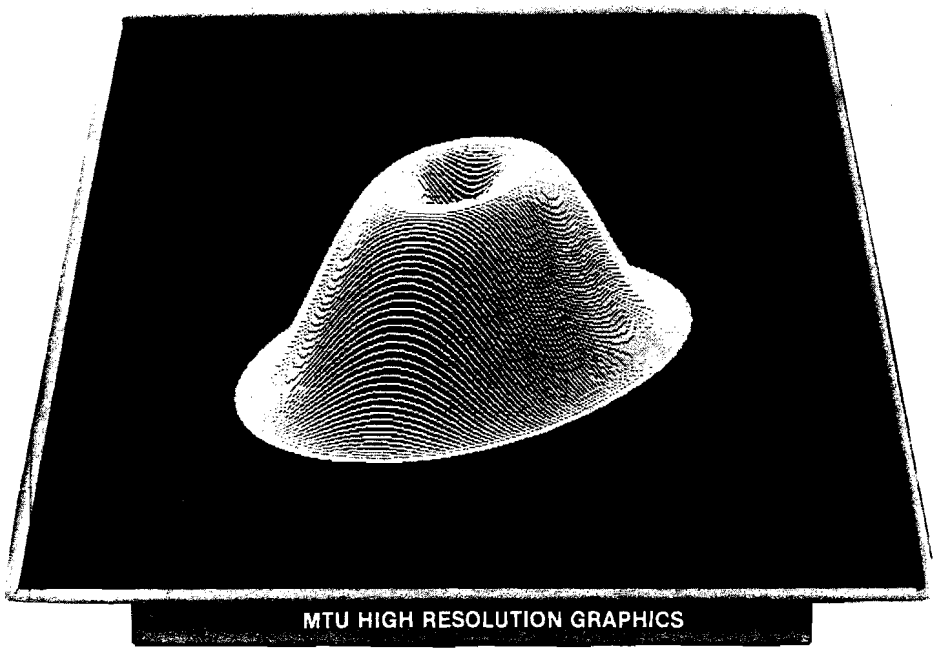

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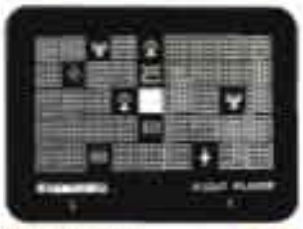

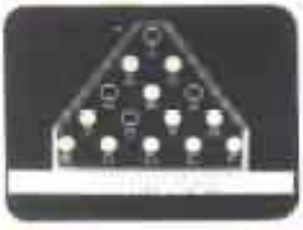

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