VOLUME XI, NUMBER 2 JULY/AUGUST 1989

FORTH DIMENSIONS

EGGS, OVALS EASY

FILLING ALGORITHMS

ACCESS EXTENDED MEMORY

TWO ASSEMBLERS ARE BETTER THAN ONE

FORTH
D I M E N S I O N S

EDITORIAL

Forth Dimensions
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Call for Articles:

FORTH HARDWARE

Creative Solutions' Don Colburn was recently attending a developers conference where he met, by chance, one of the Forth Interest Group's directors. He suggested *Forth Dimensions* pay for articles about a particular theme announced by the editor. I'm usually in favor of paying authors, so I passed the idea to FIG for consideration along with some other items. We didn't end up with a fixed policy, but we will try it and let the results do the talking.

Therefore, we are happy to offer payments of $450, $300, and $225, respectively, to the three authors whose articles are chosen as best suited for the upcoming theme issue about "Forth Hardware." The issue is currently scheduled for *FD* XI/6. *We need your theme-related submission by November 1, 1989 to be included in this offer.*

I will work closely with our technical reviewers to choose articles that merit payment and publication in the theme issue, and those decisions will be final. If an article of high quality and interest is not among the three selected, *Forth Dimensions* may ask to publish it later under our standard terms: payment in the form of peer recognition, technical feedback, and a couple of free copies. Along with, of course, the satisfaction that comes from making a contribution to our growing body of common knowledge.

Now is the time to jot down your article idea, and maybe a brief outline from which to work. Deadlines lurch up unexpectedly fast, especially when you want to track down the last idea you had while polishing that "final" draft and it's time to prettify the code for publication.

I look forward to hearing from you!

*   *   *

If you haven't rushed out to write about Forth hardware yet, you probably have a few minutes to peruse the rest of this issue. Dust off your graphics vocabulary and dig into "Eggs, Ovals Easy" (my nomination for best original title) and "Filling Algorithms." The last is by one of our authors in Poland, where several items have been published about Forth. We have very few details, and can only speculate about how Forth is being used there and how well it is regarded.

In fact, I received a couple of manuscripts from Poland at about the time Jack Woehr's Chapter Coordinator column pointed out that Forth interest overseas is far from on the wane. Another two articles from Spain showed up in the mail that same week—one appears in this issue titled, "Expert Systems Toolkit." We appreciate the efforts of these far-flung fellow Forth users, many of whom will be key to the future of Forth development around the world. We welcome each of them to our community—may we learn a great deal from one another.

—Marlin Ouverson
Editor

Forth Dimensions welcomes editorial material, letters to the editor, and comments from its readers. No responsibility is assumed for accuracy of submissions.

Subscription to *Forth Dimensions* is included with membership in the Forth Interest Group at $30 per year ($42 overseas air). For membership, change of address, and to submit items for publication, the address is: Forth Interest Group, P.O. Box 8231, San Jose, California 95155. Administrative offices and advertising sales: 408-277-0668.

About the Forth Interest Group

The Forth Interest Group is the association of programmers, managers, and engineers who create practical, Forth-based solutions to real-world needs. Many research hardware and software designs that will advance the general state of the art. FIG provides a climate of intellectual exchange and benefits intended to assist each of its members. Publications, conferences, seminars, telecommunications, and area chapter meetings are among its activities.

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LETTERS

Wish List
Dear FIG,

One comment I want to give is that we should adopt the Modula-2 *definition module* for specifying all Forth abstract data types. This would allow standard libraries to be developed from Forth *implementation modules* by using the vocabulary structure. Definition modules are readily available for lists, priority queues, binary search trees, AVL trees, records, B trees, sets, polynomials, and graphs.

Also, I want to see more written about using a Forth Prolog interpreter for conversions between regular expressions, deterministic and nondeterministic finite automata, push-down automata, context-free grammars, and Turing machines.

Some discussion about the limits of computability and the Chomsky Hierarchy would help set the diverse Forth community on common ground for an even more productive future.

John Howard
627 N.E. Terrace Drive
Kansas City, Missouri 64116

Curious About Code With Class
Dear Marlin,

A significant reward for being published is the comfort derived from knowing that your interests are shared by others. I now know that Dr. Ayman Abu-Mostafa shares my interest in object-oriented Forth (OOF). For this I am thankful and relieved. Before seeing his letter, I was worried that the audience of *Forth Dimensions* may not really be interested in this topic. While that possibility remains, at least I have found one voice willing to speak up in support of OOF.

I am overjoyed to hear Forth programmers support object-oriented Forth programming. By taking the role of devil's advocate and criticizing OOF, I hoped to motivate readers to develop better object-oriented Forths than have been offered so far in the Forth journals. At least some of my whines were considered legitimate, such as the mixing of postfix and prefix notation while manipulating data ("It's a bad design"). By the way, Rick Hoselton managed to get the syntax correct on the first try (See "Object-Oriented Forth" in *Forth Dimensions* X/2).

Clear progress is being made to overcome all the obstacles to OOF. Still, it's hard to express an educated opinion regarding OOF without more published works to draw upon. If I had access to as-yet unpublished works, I might only have positive things left to say about object-oriented Forth (OOF).

As further explanation of my point of view, realize that the guidance offered in my series of articles [*FD* X/2–5]was the design of data structures, not how to best produce object-oriented Forth. However, to the extent that I observed how well the object-oriented programming model resulted in more portable and reusable designs, I felt compelled to acknowledge OOP and to encourage its study.

Now back to my provocations: I am extremely curious about the implementations Abu-Mostafa has come up with to support postfix messaging, private and public methods, and inheritance.

Of extreme interest is the embodiment of several data and colon-definition declarations within a structure that looks like a super colon definition (delimited by `:CLASS` and `;CLASS`). What change does this make to the Forth landscape?

I assume that each instance of a class is created by honoring each of the data declarations in the hierarchy of classes. For example, `FIXED-STACK` creates an instance object by creating the `BOS` and `TOS` instance variables inherited from the `STACK` class, followed by the `MAXSIZE` instance variable directly declared in the `FIXED-STACK` class, followed by space for the stack itself. Wow! Presumably the name fields, such as `TOS` and `BOS`, aren't recreated with each instance object. Rather, those names should become shared addressing methods for `FLOAT` and `STACK` classes (as well as any of their descendent classes).

Less inspirationally, there remains the need for programmer-supplied typing of objects. Abu-Mostafa has provided his object-oriented method of taking the average of two numbers:

```
USE FLOAT
A @
B @
+ 2/
C !
```

The introductory phrase `USE FLOAT` should not be necessary in an object-oriented language. Because objects such as `A` and `B` are known to be of a given class, the methods for fetching and adding them should be automatically predetermined. Only those methods owned by an object should be available for use, and the use of any other methods should result in error messages.

I will stand by my description of standard Forth as having a two-stack architec-

(Continued on page 35.)

EGGS, OVALS EASY

ROBERT GARIAN - ARLINGTON, VIRGINIA

The method for drawing ovals described here was found in the course of a project I was working on that required drawing arrows on the screen. An oval is, technically, a closed curve bounding a convex domain. It applies to curves shaped like footballs, ellipses, or eggs. Ovals have a certain aesthetic appeal that I find a relief from all the straight lines and rectangles we usually see on computer screens.

Figure One shows the underlying structure of the method. An oval is taken to be generated by three radii R1, R2, and R3. The figure shows the classes of oval objects that can be generated by varying just these radii. The key word in the source code is `BARC`. `BARC` stands for biradial arc; i.e., it draws an arc specified by two lengths, R1 and R2. If R1=R2 the arc will be circular. As R2 increases, so does the curvature of the arc.

Closed curves bounding convex domains...

We can define the `OVAL` function as follows:

OVAL(R1,R2,R3) = {BARC(R1,R2),BARC(R1,R3)}

where the separate `BARC`s sweep out the northern and southern hemiovals.

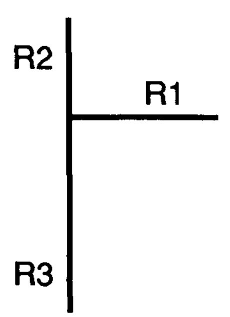
Figure Two shows the typical egg shape defined by `OVAL(40,90,50)`. (In this demo program, all parameters are positive integers.) Figure Three shows a family of a dozen eggs sorted by their point height. Figure Four shows a nest of eggs of varying girths and point heights. You might like to experiment with the source code and modify it for applications. It is easy to draw filled ovals just by replacing the `PIX!` function with the corresponding `LINE` function. You may also want to experiment with the explicit form of the `OVAL` function, which can be obtained as follows: solve the following parametric equations of an ellipse for T.

$Y=R2\ COS(T)+C$
$X=R1\ SIN(T)+D$

Take the cosine of both sides, and apply the identity:

$COS(SIN^{-1}(T)) = \sqrt{1-T^2}$
to get

$Y=R2\sqrt{1-[(X-D)/R1]^2} + C$




```
R1=R2=R3=0 ............Point
R1=R2=R3>0 ............Circle
R2=R3 R1>0 ............Symmetrical oval
R2,R3>0 R2<>R3 R1>0 ...Egg oval
```

Figure One. Relationship of three radii to geometrical shapes.`OVAL(R1,R2,R3)`

(Text continued on page 35, Figures continued on page 8.)

Glossary

Special Terms

biradial arc
: A circular arc is swept out by a single radius around a point; a biradial arc is swept out by a varying-length line segment arrived at using the values of two fixed radii. A biradial arc becomes a circular arc only when the two radii are equal.

convex
: A plane curve is convex if any straight line cuts the curve in just two points.

hemioval
: The northern or southern part of a generalized oval, divided by the equator.

oval
: A closed curve bounding a convex domain.

pole
: The point at which the height of a hemioval is maximum or minimum.

HS/Forth Words

`FIND <word> 0= ?( ... )`
: Similar to `IF THEN` and used to load extension modules as needed, i.e. if <word> wasn't found.

`VAR`
: A word created by VAR has three possible actions: return a stored number, store a number, or return the address where a number is stored. VARs are a hybrid between constants and variables. If `X` is a var, then `10 IS X` will store 10 at the address of `X`, and `X` alone will simply leave 10 thereafter.

`FI`
: A loop index used by the coprocessor, similar to `I`.

`FSIN`, `FCOS`, `F+`, `F-`, `F*`
: Math functions directed toward the coprocessor.

`S->F` and `F->S`
: Convert single numbers to and from floating-point numbers on the respective stacks.

`%`
: Precedes a number to be put on the floating-point stack.

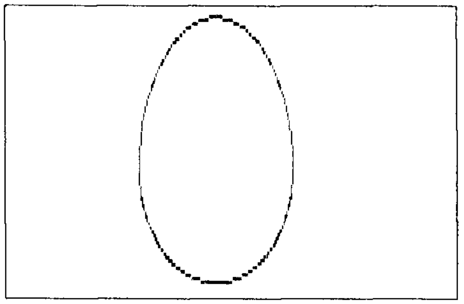


Figure Two. Typical egg shape.

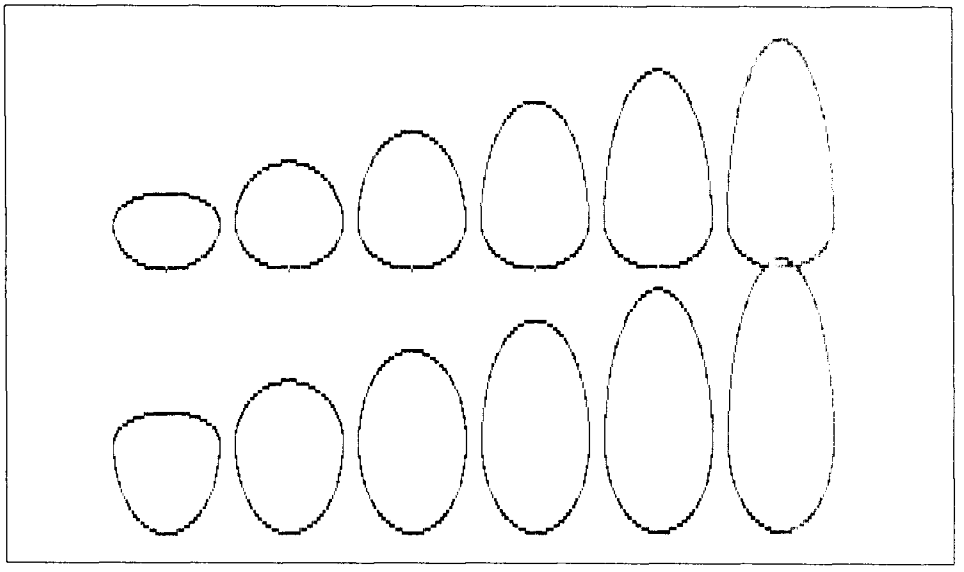


Figure Three. Eggs of increasing point height.

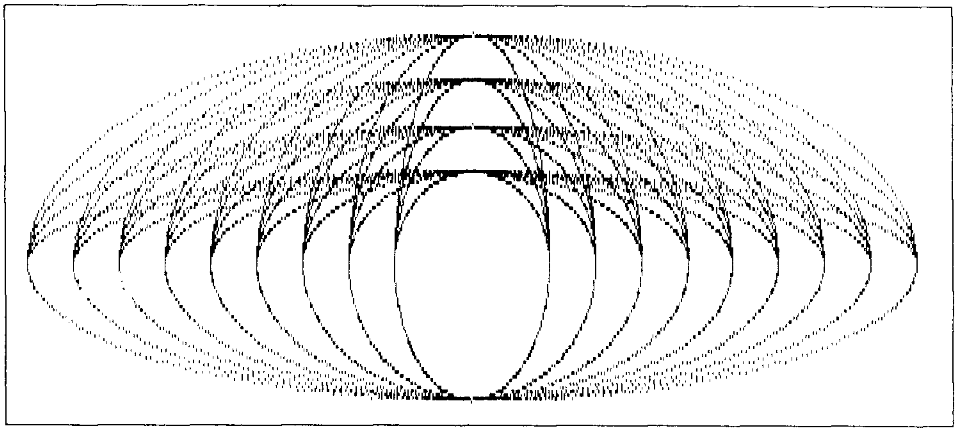


Figure Four. Nested eggs of varying point heights and equatorial radii.

```
FOR X=D-R1 TO D+R1 STEP .03
Y1=R3 * SQR(1-((X-D)/R1)^2) + C
Y2=R2 * -SQR(1-((X-D)/R1)^2) + C
PSET(X,Y1),1
PSET(X,Y2),1
NEXT X
```

Figure Five. The explicit oval function written in BASICA.

```
\ Source code for "Eggs, ovals easy." by  Robert Garian, 24Dec88
\ Written in Harvard Softworks' HS/Forth 3.4 for IBM PC and compatibles
\ Uses Math Coprocessor.

FIND DG->RD 0= ?( FLOAD TRIG ) DECIMAL    \ Floating pt. & Trig. ftns.
FLOATS
FINIT                                       \ Initialize coprocessor
DEGREES                                     \ Compute in degrees
BW640                                       \ High resolution mode

0 VAR C                                     \ See Fig.1
0 VAR D                                     \
0 VAR R1                                    \ radius 1
0 VAR R2                                    \ radius 2
0 VAR R3                                    \ radius 3
0 VAR STP                                   \ step size
1 VAR KOLOR                                 \ Erase=0 Draw=1

: ORIGIN  99 IS C  319 IS D ;               \ centers oval at (99,319)

: BARC ( TO-ANGLE FROM-ANGLE -- )          \ Note: .4166667=5/12=aspect
  DO FI FDUP                                \ next angle
  FSIN R2 S->F % .4166667 F* F*  F->S C +   \ compute corresp. row
  FCOS R1 S->F             F*  F->S D +    \ compute corresp. col
  KOLOR PIX! ) LOOP ;                       \ set pixel


: OVAL ( -- )
  361 181 BARC                              \ draw northern arc
  R3 IS R2                                  \ cross equator
  181 0  BARC ;                             \ draw southern arc

: NEST-OF-EGGS WIPE   ORIGIN
CR ." Equatorial radius is increasing"
  90 IS R3                                  \ fixed R3
  30 IS STP
  300 50 DO I IS R1                         \ new R1
           50 150 DO I IS R2                \ new R2
                     OVAL                   \ draw the oval
                STP -1 * +LOOP
        STP +LOOP ;

: ONE-EGG                               \ draw an egg to specifications
ORIGIN
CR  ." Use whole numbers between 10 and 200. Typical egg is 50 100 75."
CR  ." Enter radius at equator: "    #IN IS R1
CR  ." Enter height of NORTH pole: " #IN IS R2
CR  ." Enter height of SOUTH pole: " #IN IS R3
WIPE  OVAL ;


6 VAR #COLS
2 VAR #ROWS
0 VAR HJUMP                     \ horizontal spacing
0 VAR VJUMP                     \ vertical spacing
20 VAR F1                                  \ stretch factor
30 VAR F2                                  \ stretch factor
```

(Code continued on page 37.)

FILLING ALGORITHMS

ZBIGNIEW SZKARADNIK - BYTOM, POLAND

Algorithms making use of a stack for storing data are quite often applied in practice. However, if a high-level language is used, it is usually hard to implement a stack efficiently. This does not concern Forth, of course, which is specially suited to such algorithms. Filling algorithms are very applicable here.

The task of filling an area may be defined as follows:

- Filling an area of known contour (not necessarily regular).
- Filling the interior of a polygon (not necessarily convex) whose vertices' coordinates are known.

> ***"Forth is specially suited to such algorithms."***

Let us begin with the first algorithm, realized as the word `Fill` in Listing One. The algorithm assumes that the closed contour of an area is stored in video memory, and that the coordinates of a point lying within the contour are known. This point is called the seed, and its coordinates are pushed onto the stack. In the next step, the seed point is displayed at a given position and intervals connecting it with the contour to the right and left are drawn. At that time, the coordinates of the extreme points `Xleft` and `Xright` of the contour are calculated. Next `(Scan)` is called, which investigates the line above and the line below the plotted interval (limited by `Xleft` and `Xright`). The investigation's effect is to find new seeds, whose coordinates are pushed onto the stack. The described actions, as shown in Figure One, are repeated until the stack is empty. The `Dot` word—used by `Fill`—allows displaying a point at coordinates X,Y while `Point` checks to see if the point is displayed.

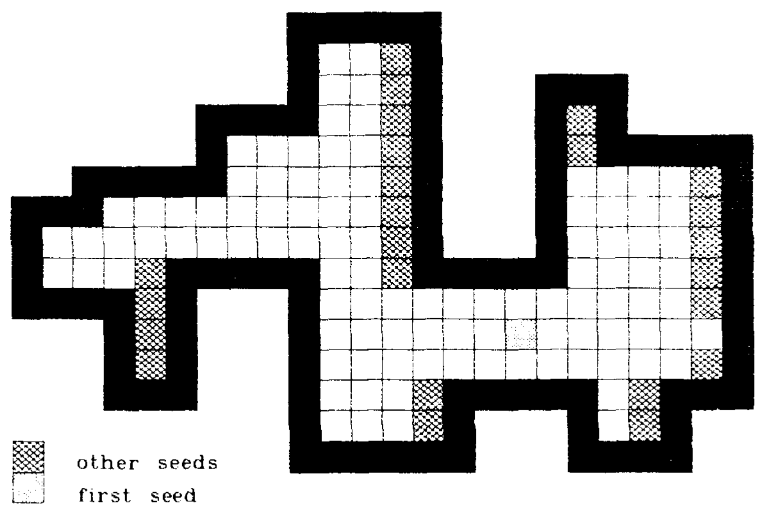


Figure One.

The second filling algorithm, realized as the word `Area` in Listing Two, requires that the coordinates of the vertices of a filled polygon be determined. The algorithm does not need a bit map of the image, so this method is used by some plotters. The contour must be closed (i.e., the coordinates of the first vertex must be identical with those of the last). First, the contour is drawn using `Line`. Next, the minimum and maximum values of coordinate Y are found by searching through all the vertices' coordinates. This is done by `MaxY` and `MinY`. Now, for each line Y falling within the determined interval, the X coordinates of the intersections with all the intervals of the contour are found. It can be proven that, for a closed contour, the number of intersections with line Y=const is even. To fill a contour like that, the found points must first be adequately connected, as shown in Figure Two.

The problem in this case is that the X coordinates of the intersections are not de-

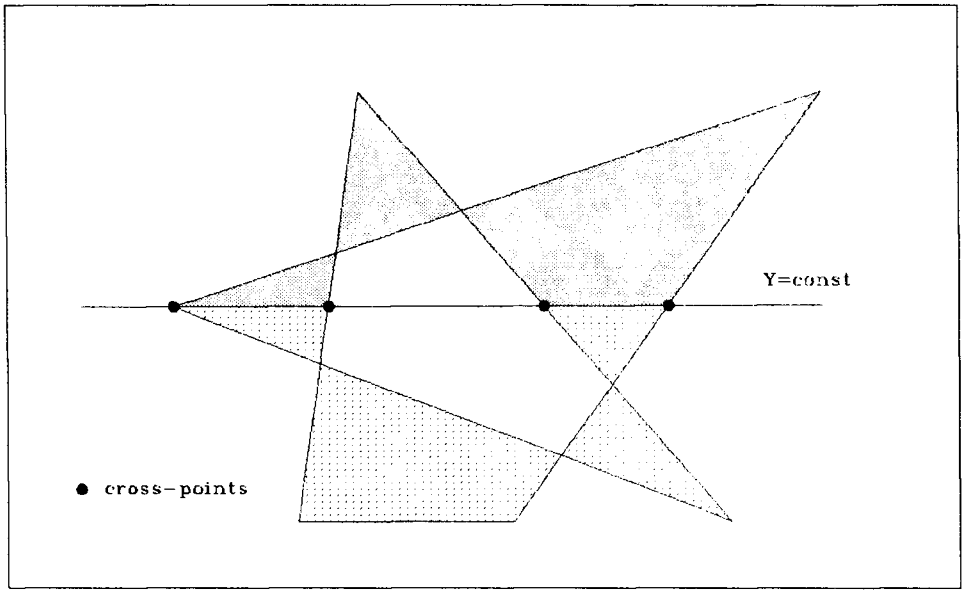


Figure Two.

Listing One.

```
variable  xleft              variable  xright
variable  xr                 variable  yr

: right>                 ( --- )
  1 xr +! begin
          xr @ yr @ point 0= while
          xr @ yr @ dot 1 xr +!
        repeat xr @ 1- xright ! ;

: left>                  ( --- )
  -1 xr +! begin
           xr @ yr @ point 0= while
           xr @ yr @ dot -1 xr +!
         repeat xr @ 1+ xleft ! ;

: (scan)                 ( --- x y ... )
  begin xr @ xright @ <= while
    0 flag ! begin
      xr @ yr @ point 0= xr @ xright @ <= and while
      1 flag ! 1 xr +! repeat
    flag @ if
      xr @ yr @ point 0= xr @ xright @ = and if
        xr @ yr @ else xr @ 1- yr @ then then
    xr @ begin
      xr @ yr @ point xr @ xright @ < and while
      1 xr +! repeat
    xr @ = if 1 xr +! then
  repeat ;
```

rived in order. Thus, the coordinates must be sorted before the points can be connected. However, we usually do not know *a priori* how many intersections will be obtained. Thus, it is best to store the subsequent X coordinates on the stack, which is sorted by `Sort` each time a new number is pushed onto it. To make the stack sorting process more effective, the return stack has been applied. The sorting operation is realized by insertion. The idea of the process is that all coordinates smaller than the one to be inserted are popped from the stack and temporarily stored on the return stack. Then the inserted coordinate is pushed onto the stack and all the coordinates on the return stack are pushed back to the stack. After all the intersections are derived and sorted, `Drawscan` connects the points whose coordinates are stored on the stack, thus filling the polygon. `Draw` (called by `Area`) draws a line to the point X,Y while `Plot` just moves to the point.

(Listing One, continued.)

```
variable stack

: fill                  ( x y --- )
  sp@ 4 + stack !
  begin
    yr ! xr !
    xr @ yr @ dot
    xr @ right> xr ! left>
    xleft @ xr ! 1 yr +! (scan)
    xleft @ xr ! -2 yr +! (scan)
sp@ stack @ = until ;
```

Listing Two.

```
: points         ( yn xn ... y1 x1 n --- )
  create 0 do , , loop does> ;

: .x             ( adr n --- x [n] ) 2* 2* + @ ;

: .y             ( adr n --- y [n] ) 2* 2* 2+ + @ ;

: line           ( adr n --- )
  swap dup dup 0 .x swap 0 .y plot
  swap 1 do
        dup dup i .x swap i .y draw
      loop drop ;

variable pts   variable vert

: sort           ( xn ... x1 xi --- xn . xi . x1 )
  xmin @ begin sp@ stack @  <> while
                             2dup < if swap then >r repeat
  begin dup xmin @ <> while r> repeat drop ;

: maxy           ( --- maxy )
  ymin @ vert @ 0 do pts @ i .y max loop ;

: miny           ( --- miny )
  ymax @ vert @ 0 do pts @ i .y min loop ;

: drawscan        ( ys --- )
  >r begin sp@ stack @ <> while r@ plot r@ draw repeat r> drop ;

: area           ( adr n --- )
  2dup line vert ! pts !
  sp@ stack ! maxy 1+ miny do
               vert @ 1- 0 do
                 pts @ i .y pts @ i 1+ .y
                 2dup min j < rot rot 2dup max j >= rot rot
                 <> and and if
                   j pts @ i .y -
                   pts @ i 1+ .x pts @ i .x -
                   pts @ i 1+ .y pts @ i .y -
                   */mod swap drop pts @ i .x + sort
                 then
               loop i drawscan
             loop ;
```

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PDE FULL-SCREEN EDITOR

FRANS VAN DUINEN - TORONTO, ONTARIO

This article is about PDE, a program editor for Forth (F83 flavour). Yet another editor? Yes, but with a few differences.

The PDE (Program Development Environment) editor is a derivative of the Henry Laxen WS-like screen editor[1], and provides many added capabilities, including most of those in VED and FSED[2], two other editors derived from the original Laxen editor.

Over the years, I had adapted the Laxen editor to a variety of computers (TRS-80, Osborne, IBM PC), and had built in a considerable number of features for testing and debugging. Using that as the backbone, I incorporated the best of FSED and VED and a whole slew of further enhancements. The result is PDE.

"It is integrated and easy to use."

PDE provides:

- editing any number of files
- copying screens or parts thereof between files
- step-wise execution of on-screen word definitions, with inspection and modification of the stack
- inspection of word definitions (built-in SEE and VIEW), with nesting of VIEWs and return to screen being edited
- LOAD part of screen
- upper/lower case and numeric base conversion
- screen insert and delete
- two-window support, one for screen being edited and one scrolling, as for DEBUG output

```
.\ W2-SCROLL  INSTALL
 : W2-SCROLL (S -- )
      0 12 AT -LINE  0 18 AT #OUT OFF  ;

 : INSTALL     [`] W2-SCROLL IS CR  ;
```

Figure One. Scrolling window on lower part of screen

```
 : USCAN        (S  addr len c — addr' len' )
   CAPS @  OVER  ?ALPHA  AND         \ Can case matter?
   IF     DUP 20 XOR 2OVER ROT  SCAN  \ yes - scan 2 ways
     >R >R  SCAN R> R>  DUP 3 PICK < IF 2DROP ELSE
     ROT DROP ROT DROP  THEN
   ELSE  SCAN  THEN  ;               \ no - simple scan
 ( USCAN - Case insensitive scan)

.\ INSTRING - Find string S within string B - fast
: INSTRING       (S  sadr slen  badr blen —>  blen' | 0 )
    2OVER >R C@ >R              \ slen & c to >R
    ROT - 0 MAX  DUP IF         \ Only if blen >= slen
      1+                        \ Length to scan (blen-slen+1)
      BEGIN   R@                \ sadr badr  blen'  c
        USCAN . DUP  IF         \ sadr badr' blen'
          R> 2OVER R@  COMPARE  \ 0=equal, +1 or -1 for not eql
          SWAP  >R              \ c back to >R
        ELSE 0 THEN             \ Fix # of parms on stack
      WHILE  1  -1  D+  REPEAT  \ Step past matching char
    THEN  R> R>  2DROP          \ saddr baddr' blen'
    -ROT 2DROP ;                \ blen' - length not searched
```

Figure Two. SEARCH for substring, case insensitive.

```
 : INS-STR     (S  addr len Pos --  )
   DUP >R  2DUP + DUP CHARS-TO-EOL/B  BUF-MV  \ Make space (len)
   R>  BADDR  SWAP  MOVE  E-UPD ;

 : REPL        (S  R-addr R-len Pos D-len --  )
   OVER DEL-CHARS INS-STR  ;
```

Figure Three. Text insert and replace.

• multi-screen search capability and more...

This article describes some of the more interesting techniques used in PDE to allow others to tinker with and enhance PDE. Only a few of the 80-plus screens are covered here.

PDE is in the public domain (non-commercial use) and its source code is available on the East Coast Forth Board *[see "Reference Section"]*, Canada Remote Systems (416-231-0538) and "other fine bulletin boards." That version of PDE (ver 1.02+) is specific to Laxen and Perry's F83 and to the IBM PC. PDE is virtually all high-level code and can be readily adapted to other systems.

PDE includes ideas and code from a number of public-domain sources, and I'll give credit to those sources in the following.

```
: STEP    (S  -- )      ( Executes one word & displays stack )
   EXTRACT-WD  SET-TIB          \ Start addr of word in buff
   EXEC-WD                      \ copy word & execute
   0  MV-CURS       ;           \ Restore cursor in CRT screen

: 2STEP   (S -> )       ( Executes 2 words & display stack )
   EXTRACT-WD  SET-TIB          \ Start addr of word in buff
   EXTRACT-WD  ADD-TIB          \ Addr of next word in buff
   EXEC-WD                      \ copy word & execute
   0  MV-CURS       ;           \ Restore cursor in CRT screen
```

Figure Four. Execute one or two on-screen words.

```
: DO-WD      (S  caddr -- ?? )
   EXTRACT-WD  SET-TIB          \ Get word pointed to in screen
   @W2AT  (EXEC-WD)   ;         \ Go do words

 : SEE-WD      (S  --  )
     ['] SEE  DO-WD   ;         \ Execute SEE against TIB
   ( SEE-WD issues SEE against word pointed to)

 : DEBUG-WD      (S  --  )
     ['] DEBUG  DO-WD   ;       \ Execute DEBUG against TIB

 : (EVIEW)   [']  '  DO-WD ((EVIEW)) NXT-SCR-FILE ;
```

Figure Five. Operate on word under cursor. •

```
: EXTRACT-WD   (S  -- addr len )
   BPOS                        \ Start addr of word in buff
   MV-RIGHT-WD  DUP +CPOS      \ Step to next word in buff
   -TRAILING  1+ ;             \ But return length+1 only

: PROC-WD   (S   exec-addr -- ) \ Process word under cursor
   >R  CPOS                    \ For DISPL-TO-EOL
   EXTRACT-WD                  \ Start addr of word in buff
   R>  EXECUTE                 \ Go process - addr len ->  -
                               \ Must set E-UPD as reqd
   DISPL-TO-EOL/S  ;           \ Restore cursor on CRT screen

: LWCASE   (S -- )    ( LWCASE converts one word to lowercase)
   [']  LOWER                  \ Convert to lower case
   PROC-WD  E-UPD  ;           \ Apply LOWER to current word

: UPCASE   (S -- )    ( UPCASE converts one word to uppercase)
   [']  UPPER                  \ Convert to upper case
   PROC-WD  E-UPD  ;           \ Apply UPPER to current word
```

Figure Six. Get a word on the screen and operate on it.

```
: (GET-FILE)    (s  fcb -- )
    DUP FILE @ <> OVER OR  IF       \ only if fcb diff and <>0
      SAVE-BUFFERS [ DOS ] !FILES OPEN-FILE
    ELSE  DROP  THEN ;

: MARK-UPD   (S  -- )
   &UPD  @  IF                     \ Any changes made?
     SCR @ BLOCK DROP              \ Make block current
     &SET-ID @ IF  STAMP  THEN     \ Set datestamp if wanted
     1 BUFFER# 4 + @ &BADDR @ <> ABORT" Buffer error"  .\ test
     UPDATE  &UPD OFF  THEN     ;  \ Set updated flags
```

Figure Seven. Multi-file editing made easy.

```
: ((EVIEW))   (S  code-addr -- file curs scr )
   @VIEW  ?DUP                     \ Get word's VIEW field
   IF   2* VIEW-FILES + @ 2+       \ scr # & FCB addr
   ELSE  [ DOS ]  FCB1  THEN
   0 ROT  ;                        \ Set to cursor loc 0

: (EVIEW)   [']  '  DO-WD ((EVIEW)) NXT-SCR-FILE ;

: FIX '  ((EVIEW))  OTH-INIT  (NXT-SCR-FILE)  (E) ;
```

Figure Eight. View/edit screen where word is defined.

```
: (eSOURCE)
    BLK @ IF  GET-SUB-BLK DROP  ELSE  TIB  #TIB @  THEN  ;

: eLOAD       (S  --  )
   @W2AT  [']  (eSOURCE)  IS SOURCE
   FILE @ >R   BLK @ >R    >IN @ >R
   2 TAG@ BLK ! >IN !  DROP  RUN
   R> >IN !   R> BLK !  R> [ DOS ]  !FILES
   FIX-SOURCE   ;
```

Figure Nine. LOAD partial screen from within editor.

```
: GET-CUR-ADDR (S  curpos Scr# fcb -- addr >in )
    FILE @ >R  (GET-FILE)  BLOCK
    R> (GET-FILE)  ;       \ Assumes multiple block buffers

: GET-SUB-BLK  (S  -- addr len >in )
    2 TAG@  ROT GET-CUR-ADDR
    3 TAG@  DROP NIP ROT  ;
```

Figure Ten. Get sub-block's address, make sure it's in memory.

Self-Contained Editor

PDE is self contained and does not need the traditional F83 `EDITOR` vocabulary. Instead, screens 5B–5E (all numbers in hex) are adapted from F83[3] screens 0C–1B of the file UTILITY.BLK. From there comes the scrolling window, where the top 12h lines of the CRT display the screen under test, while the lower portion scrolls to allow debug output, etc.

Figure One shows the two words that take care of scrolling, `W2-SCROLL` and `INSTALL`, which installs `W2-SCROLL` as `CR`. `W2-SCROLL` (adapted from `EDITOR`'s `. ALL` on screen 13), uses `-LINE` to delete the top line of the second window, causing everything below it to scroll up.

Note that this form of windowing works by preempting the PC's ROM routines from scrolling the whole screen. As long as `CR` is used to force a new line, we're okay. When we output a line of more than 50h characters, or one that includes characters 0D or 0A, the whole screen scrolls and our windowing gets messed up. That is one reason I'm using a version of `.S` that only displays the top six items on the stack, and thereby avoids line wrap on the display. (This `.S` also handles stack underflow—it is found in screen 5A.)

The other words from `EDITOR` are cursor addressing and `GET-ID`, etc. `GET-ID` (screen F) uses the system clock; it does not require a hardware clock. Simply set the PC's system date using the usual DOS command. Most of the supporting code on screen five is lifted from `FSED`.

Search Capability

The original Laxen editor used `SCAN+` and `SCAN-` for forward and backward scanning to find a character; `SCAN+<>` and `SCAN-<>` to scan for the first occurrence of anything other than the character. These were high-level definitions and, given their frequent use, kind of slow.

F83, of course, has a machine code `SCAN` and `SKIP`, which are the same as `SCAN+` and `SCAN+<>` respectively, though with some stack differences. Screens six through eight implement a machine-language version of `SCAN-` and `SKIP-` for both 8086 and 8080 assembler.

Also included in screens nine and 0A are `USCAN` and `INSTRING` (Figure Two), which together are a faster version of `SEARCH`. Both `INSTRING` and `SEARCH` can do a case-insensitive search (where upper-case and lower-case characters are acceptable).

`SEARCH` uses `COMPARE` against every possible substring. For instance, if looking for a five-character string within a 400h character block, it would compare the search string against characters one through five of the block, then against two through six, then three through seven, etc. More than a thousand times!

`INSTRING` goes on the basis that we first look for the first character of the search string, then see if the rest matches. Since the machine-language `SCAN` is so much faster than a high-level loop, we gain. Of course, if we're looking for a string starting with a blank in a screen that's 75 percent blanks, we don't gain all that much.

For an even faster `SEARCH`, look at the machine-language version published in *Forth Dimensions*.[4] That version is case-sensitive, however. It also returns the absolute memory address where the substring was found, rather than the offset in the block as returned by the F83 `SEARCH`. `INSTRING` returns the length "not searched," i.e., the offset relative to the end of the block. Hence the different name: it is not identical to `SEARCH`.

`INSTRING` is used by the multi-screen search capability (^QF in good WordStar fashion), the heart of which are `QF1` and `QF` in screen 41. Not implemented is a search-and-replace function (^QA), even though the primitives exist (`INS-STR` and `REPL` in screen 26; see Figure Three).

`INS-STR` uses `CHAR-TO-EOL/B` to determine the number of characters to the end of the line or block. (When you insert a string, the text to the right of the insertion point has to be moved over, with truncation occurring at the end. Similar to deletion, padding occurs at the end.) PDE will support truncation/padding at either the end of the line, or at the end of the block (or any number in between; see `&PAGEL`, `LINE-MODE`, and `BLOCK-MODE` in screen 12). The Laxen editor supported only end-of-line truncation. Thus, if text was bumped past the end of the line, it was lost.

By supporting end-of-block truncation, anything bumped off one line gets carried over to the next. It does mean, however, that the entire rest of the screen may change and need to be re-displayed, which makes this mode too slow for normal use.

Execution of Words on the Screen

One of the powerful features of PDE is that it can take words off the screen, move them to TIB (the keyboard input buffer), and then interpret them. The idea for this originally came from Tom Blakeslee[5], whose code I had adopted as-is; when I started factoring his code into smaller words, it became really interesting!

`STEP` (screen 45) was the original word (see Figure Four). The basic process is:

`EXTRACT-WD`
: Get the memory address and length of the word (character string) where the cursor is at on the screen, and skip past it.

`SET-TIB`
: Copy that string to the TIB and set `#TIB` accordingly.

`EXEC-WD`
: Issue `INTERPRET` to handle the text string now in TIB, showing the stack afterwards.

Now, by factoring `EXEC-WD` into an `(EXEC-WD)` that can execute words other than `INTERPRET`, we can easily do some interesting stuff, such as `SEE` a word, `VIEW/FIX` or `DEBUG` a word—see Figure Five. Note that the approach taken is *not* to redirect `SOURCE`, since any errors would "hang" the system—see `eLOAD` below.

Similarly, `EXTRACT-WD`, which returns the memory address and length (minus trailing blanks) of the word (text string) under the cursor (and moves the cursor to the next word), makes it easy to implement other transformations, such as `LWCASE`, `UPCASE` and `NUM>NUM`, for case or number base conversion; see Figure Six.

`PROC-WD` sets everything up, then executes the word whose code field address (CFA) is passed and re-displays the screen (from the original cursor position). Note the use of `DISPL-TO-EOL/S` in `PROC-WD` to allow for actions that affect more than just the current screen line.

The word `LOWER` in `LWCASE` is similar to the F83 code word `UPPER`, except it changes alphas to lower case.

Multi-File Editing

F83 maintains its block buffers by using a list of buffer headers that describe where in memory the block is, etc. The buffer header also contains a pointer to the FCB (File Control Block) for the file that contains this block.

`BLOCK`, the word to read a specified block, passes to `(BLOCK)`—the primitive that actually brings in the wanted block (or locates it, if already in a buffer)—the address of the FCB to use (from the pointer `FILE`).

That made it very easy to implement multi-file capability. Simply set `FILE` to point to a different FCB, make sure the file is open (`OPEN-FILE`), and issue `BLOCK`. `(GET-FILE)` in screen 34 and Figure Seven does that.

Well, almost that easy. If the current block was changed, `UPDATE` has to be executed before issuing `BLOCK` again, because it always applies to the current block—the one in the first position in the buffer header list.

There appears to be yet another problem. At least some updates to a block would not be written out when switching between files. The `SAVE-BUFFERS` in `(GET-FILE)` and the extra code in `MARK-UPD` (Figure Seven) should not be necessary, but seem to have fixed the problem.

Another place where multi-file capability had an impact was in the `TAGS`. `FSED` used five to six fields to note a specific screen and line number, e.g., to mark a spot for fast return, or to mark a block or range of lines for copying. PDE extends this in two ways. Firstly, every `TAG` includes the FCB for that block; secondly, every tag includes the exact cursor location at the time the tag was noted.

PDE also maintains a circular `TAG` list of the last ten screens edited. This allows us to quickly revisit screens or to return from inspecting definitions of words (`EVIEW`).

A very powerful capability in PDE is on-screen `VIEW` (`EVIEW`, screen 47, Figure Eight). While `(EVIEW)` is simply an adaptation of F83's `VIEW`, it is important because it is integrated and easy to use.

Say you're writing a new definition that uses `SEARCH`, but don't remember what `SEARCH` needs/leaves on the stack. Simply position the cursor at the start of the word `SEARCH` on the screen (which you had typed as part of the definition you're creating), press ^F5 and, presto, you're looking at the screen on which `SEARCH` is defined (screen 0A in UTILITY.BLK), including the comment that describes its stack effect. Use ^PgDn to get to its shadow.

If you want more detail, such as about the word `\STRING` that `SEARCH` uses, point, press ^F5 again, and you're looking at screen 3F of KERNEL86.BLK. A repeated ^F6 gets you back where you were.

Of course, all of this supposes that the words you're looking up (`SEARCH` and `\STRING`, in our example) are "visible" in a context vocabulary, and that you used `VIEWS`, etc. when originally loading those definitions. And, yes, it supposes you have a hard disk to have all your permanent source files on line. If not, get one; this feature alone makes it worthwhile: on-line documentation for your entire Forth environment!

Load from the Editor

Occasionally you want to `LOAD` only part of a screen, such as when you're correcting the second or third definition on a screen. PDE has the ability to mark the beginning and end of a section of a block (^F6, ^F8) and then issue the `eLOAD` command (see Figure Nine).

`eLOAD` works by setting the `SOURCE` that F83 uses (for `LOAD` as well as for `INTERPRET`). `(eSOURCE)` is similar to the regular `(SOURCE)` in that it can accept input from TIB as well. While `eLOAD` never uses input from that source (it sets `BLK`), it is very important.

If there were an error in the (sub) block being loaded, F83 would `ABORT/QUIT` and reset for keyboard input. It would not reset `SOURCE`, however, but would look to `(eSOURCE)` for input. If `(eSOURCE)` did not allow for keyboard input, you'd have F83 waiting for keyboard input without ever seeing any.

`(eSOURCE)` uses `GET-SUB-BLK` and `GET-CUR-ADDR` (Figure Ten) to return the address and length of the marked section, where `2 TAG@` and `3 TAG@` define the screen number, FCB, and cursor for the start and end of the section. Note how `GET-SUB-BLK` and `GET-CUR-ADDR` return an address in two components: start of block address and offset of start of sub-block within that block. That drastically simplified the implementation of `(eSOURCE)`, since it allows us to use `>IN` to tell F83 "we've already processed that portion of the block."

Miscellaneous

A few other techniques are of note:

`eKEY` in screen four handles the PC's peculiarity of returning certain keystrokes as two characters (the "extended" keys,

(Continued on page 35.)

ACCESSING 80286 EXTENDED MEMORY

RICHARD F. OLIVO - NORTHAMPTON, MASSACHUSETTS

Although the 80286 processor is capable of addressing up to 16 Mb of memory in its protected mode, MS-DOS—for reasons of downward compatibility—was written for the processor's "real" mode. That mode has an absolute limit of 1 Mb of address space, which is further limited by a PC architecture that reserves the upper 384 Kb for special purposes. As a result, MS-DOS programs have access to a maximum of 640 Kb of address space. Even though one can plug so-called extended memory cards with addresses above 1 Mb into a PC/AT, a program under MS-DOS cannot directly read from or write to such memory. This is, of course, not a good thing.

The ROM BIOS in a PC/AT does, however, provide a way out. A service at interrupt 15 (hex), function 87 moves blocks of data between extended memory and DOS-accessible memory. Prior to calling this function, a Global Descriptor Table (GDT) that lists the source and destination addresses must be set up in memory, and the table's own address must be placed in the 80286's registers. I describe here some Forth words that use interrupt 15 to access extended memory. My own need for this code arose while working with a video digitizer (Data Translation's DT2851 frame grabber) in an application where I wanted to manipulate an image directly. The digitizer has two on-board image buffers, each 256 Kb in size and each capable of holding a 512 x 512 x 8-bit image. Obviously, this total of 512 Kb of image memory cannot readily be placed in MS-DOS' measly 640 Kb, since that would leave essentially no memory for the operating system and programs. In fact, the digitizer's default address settings put the two image buffers at (hex) A0 0000 and A4 0000—well above 10 0000, the 1 Mb boundary. To be able to inspect and manipulate images, move them to disk, and do other operations that require direct access to the digitized image, it was necessary first to move part of the image down into DOS-accessible memory. (This is the same technique used by standard software for extended memory cards.) The largest block of data that interrupt 15 can move is one segment, or 64 Kb; thus, a 256 Kb image would have to be treated as at least four separate segments. However, I actually found it more efficient to move one video line at a time (512 bytes). The main reason is that in our implementation of Forth-83 (Uniforth from Unified Software Systems), it is much easier to perform subsequent operations on data that is held in the same memory segment as the Forth dictionary, rather than to use the more cumbersome and time-consuming procedures that manipulate data held in other segments. Consequently, the application examples described below all work with single video lines.

> ***"The same technique is used for memory cards."***

The most generic of my Forth words are shown on screens 1 and 2. `GDT` is a 48-byte array that will hold the Global Descriptor Table. `MAKE-GDT` sets up the descriptor table, based on 32-bit double addresses for the source and destination, and a 16-bit count of the number of bytes to be moved. (The table actually requires 24-bit addresses but, for convenience, 32-bit operators are used and the highest-order byte is later overwritten.) The addresses are calculated by subsequent words in the listings. The code word `INT15`, written in assembly language, calls the BIOS interrupt to move the data. `INT15` requires 16-bit addresses for the start of the descriptor table and the table's segment, and for the number of words (not bytes) to be moved. (In Uniforth's 8086 assembler, unlike Intel's assembler, the syntax of instructions like `AX SI MOV` follows the Forth practice of first giving the source, then the destination, then the action.) Both `MAKE-GDT` and `INT15` are general-purpose words that can be used to move any batch of data in any direction.

The use of these words is illustrated in excerpts from an imaging application on screens three through nine. A 512-byte array (`VIDLINE`) is created in the Forth dictionary to hold one video line. Absolute 32-bit addresses for this array and for the image buffers, required by `MAKE-GDT`, are calculated by words in screens three, four, and six. (Some of the defining words, like `DSEG` and `SEG>ADR`, are specific to Uniforth.) New Forth words that move single video lines are `DICT>VLINE` (screen five), which copies the `VIDLINE` array from the dictionary to the image buffer; and `VLINE>DICT` (screen six), which copies video line Y from the image buffer to the array. These words are typically used in the opposite order from which they are presented: a video line is moved from the image to the dictionary, manipulated, and then moved back to the image. Since a video line is usually replaced at the same location it was taken from, `DICT>VLINE` does not automatically recalculate the Y-value address. (This lack of symmetry was adopted for speed, but it strikes me as a potentially risky programming style.) A few words that act on images are shown as examples in screen seven. `!PIXEL` and `@PIXEL` access a single pixel (picture element); when one considers how much hidden work these words invoke, screen seven may also be taken as a commentary on the disastrous architecture of Intel processors. Nevertheless, filling the screen (`VFILL`) takes only about a second.

Transferring images to and from disk (screens eight and nine) is an example of the more general task of moving data between a disk and extended memory. The "save" routines utilize a loop that copies each of an image's 480 lines into the `VIDLINE` array, from which the line is written to disk. (The disk-handling words are from Uniforth.) The real work of copying images is carried out by the intermediate-level words `IMAGE>DISK` and `DISK>IMAGE`; the high-level words `SAVE` and `RESTORE` handle the additional tasks of specifying filenames, and opening and closing files.

(Screens on next page.)

Richard F. Olivo, a neurobiologist, is a professor at Smith College. He uses Forth for laboratory-oriented imaging and analog data acquisition. He is currently programming a PC/AT data acquisition system with drop-down menus, dialog boxes, and other Macintosh-like tools. He wishes Forth had standard extensions to make such efforts unnecessary.

```
SCR # 0
\ ACCESS TO 80286 EXTENDED MEMORY UNDER MS-DOS.

Uses interrupt 15, function 87:
   Swaps block of data between PC/AT's extended memory
   (addresses above 1 MB), and DOS-accessible memory below 640K.
   Based on James T. Smith, IBM PC AT Programmer's Guide (1986)
   section 10.4: "Using extended memory."

Written in Uniforth implementation of Forth-83
   (Unified Software Systems, PO Box 21294, Columbus, OH 43221)

         Prof. Richard F. Olivo
         Department of Biological Sciences
         Smith College
         Northampton, Massachusetts 01063


SCR # 1
\ WRITE GLOBAL DESCRIPTOR TABLE  (GDT)
decimal
create GDT  48 allot  \ Global descriptor table for INT15

: MAKE-GDT    ( src-daddr  dest-daddr  #bytes    --    )
\ daddr: uses 32 bit address, eg. source 00A0 0000
\ #bytes: bytes moved can be up to 64K (1 segment)
    GDT 48 erase        \ Fill entire table with 00
    dup GDT 16 + !      \ Store source length, #bytes
        GDT 24 + !      \   & destination length, #bytes
    GDT 26 + 2!         \ Store destination address
    GDT 18 + 2!         \   & source address
    147 GDT 21 + c!     \ Store access-rights byte  $93,=147 dec
    147 GDT 29 + c! ;   \   in two places in GDT
->


SCR # 2
\ INTERRUPT 15 CODE: moves data, using GDT
hex
code INT15 ( gdt.addr  segment  #words  --  status | 0=success)
    CLI,             \ disable interrupts (time of day clock)
    BX CX MOV,       \ #words from top-of-stack (=BX)  to CX
    AX POP,          \ GDT's (=dictionary's) segment
    AX ES MOV,       \ GDT segment into ES
    SI DX MOV,       \ save SI, Uniforth's interpreter pointer
    AX POP,          \ GDT's address (=offset in segment)
    AX SI MOV,       \ GDT offset into SI
    00 # AL MOV,  87 # AH MOV,     \ function # $87 to AH
    15 INT,          \ call interrupt 15
    DX SI MOV,       \ restore SI
    AH BL MOV,       \ put status code on tos
    00 # BH MOV,     \ clear high byte, tos; restore intrupts
    STI, NEXT, END-CODE        decimal ->
```

```
SCR # 3
\ APPLICATION: Copy to/from video frame-grabber (DT2851)
\   CONSTANTS, ARRAYS & VARIABLES
\ Frame-grabber has 2 buffers, each 256KB, starting at address
\ 00A0 0000 in extended memory.  We will access these one video
\ line at a time (512 bytes/line).
decimal
    512 constant PIXELS/LINE      \ In Forth dictionary, make
create VIDLINE pixels/line allot  \ array to hold 1 video line
\ GDT requires 32-bit addresses, =>double constants & variables
\ Absolute address of vidline array in Forth dictionary:
    dseg vidline seg>adr    \ Segment & offset of vidline array,
    2constant VIDLINE(DADR) \ converted to 32-bit(daddr) const.
-->

SCR # 4
\ CONSTANTS & VARIABLES: ADDRESSES FOR DT2851 IMAGE BUFFERS
hex
\ Absolute 32-bit addresses of DT2851 image buffers 0 & 1:
    00A0 0000        2constant BUFFER0    \ daddr of buffer0
    buffer0 4 0 d+   2constant BUFFER1    \ daddr of buffer1
2variable CURRENT-VLINE             \ daddr of active video line
\ Automatic calculation of active buffer's address:
( ?out-buf returns 0 or 1 to indicate active output buffer)
: CURRENT-BUFFER    ( -- daddr )      \ active image buffer
    ?out-buf 4 *    0   buffer0   d+ ;
: OTHER-BUFFER      ( -- daddr )      \ inactive image buffer
    buffer1  ?out-buf 4 *     0    d- ;
-->

SCR # 5
\ COPY ONE VIDEO LINE FROM FORTH DICTIONARY SPACE TO IMAGE
\ Requires previous calculation of current-vline (next screen).
decimal
: DICT>VLINE      ( -- )       \ Move one line up to image.
    vidline(dadr)              \ source: constant daddr of vidline
    current-vline 2@           \ destination: prev calc'd daddr
    pixels/line                \ #bytes: pixels on one line
    make-GDT                   \ write GDT
    GDT dseg pixels/line 2/    \ gdt addr & segment, #words
    int15                      \ call int15
    dup not if drop            \ then test status: 0=ok, drop code
    else ." Error:" . quit     \ if error, print code, & quit
    then ;
 -->
```

(Screens continued on page 28.)

Forth-83, fig-FORTH

EXPERT SYSTEM TOOLKIT

MARCOS CRUZ - MADRID, SPAIN

SISIFOrth is an environment in which to write expert systems. It is not a program to make expert systems, but a toolkit with which to make them. Once SISIFOrth has been loaded, we can make use of a set of new words to define the rules, questions, and answers. I will try to explain how.

Before writing an expert system, of course, we have to design it. When that is done, we can build it using SISIFOrth. There are three steps on the way: define the questions, the rules, and at last the order of the rules and the answers they lead to.

"We can think of SISIFOrth rules as Prolog sentences."

Each question of the expert system is stored in any line of any screen. To define a questions, the word `QUESTION` has to be used in this way:

```
sn ln QUESTION q_name
```

where `sn` is the screen number of the text of the question, `ln` is the line number on that screen where the question is found, and `q_name` is the question's name.

A rule is a number of conditions that, if all of them are true, leads to an answer. Each rule is just a word, defined in this way:

```
: rule_name
  (( question1
  & question2 )) ;
```

```
: TASK
;
128 CONSTANT QUESTIONS ( array lenght)
VARIABLE ANSWERS QUESTIONS ALLOT ( array)
VARIABLE N&
VARIABLE NQ
: .TITLE CR ." SISIFOrth environment V2.00 " .CPU
;
: SISIFORTH_OK
  ANSWERS QUESTIONS ERASE ( erases array)
  CLS .TITLE CR ." By: Marcos Cruz, 1988, SPAIN" CR
;
: Y/N                  ( --flag)
  CR
  BEGIN
    KEY                ( ascii)
    DUP DUP            ( ascii, ascii, ascii)
    83 =               ( ascii, ascii, ascii=83?)
    SWAP               ( ascii, ascii=83?, ascii)
    78 =               ( ascii, ascii=83?, ascii=78?)
    OR                 ( ascii, ascii=83 OR ascii=78?)
    NOT                ( ascii, ascii<>83 AND ascii<>78?)
  WHILE                ( ascii)
    DROP               ( )
  REPEAT
  ( Y or N typed)      ( ascii)
  83 = DUP             ( ascii=83?, ascii=83?)
  IF                   ( ascii=83?)
    ." >Yes"
  ELSE
    ." >No"
  ENDIF
  ABS ( converts flag 0/-1 to 0/1)
  CR
  ( If "Y" has been typed, flag=1)
  ( If "N" has been typed, flag=0)
;
: QUESTION
```

```
CREATE              ( screen, line)
  C,                ( screen)
  C,                ( )
  1 NQ DUP @        ( 1, NQ address, NQ content)
  ,                 ( 1, NQ address)
  +!                ( )
  ( Each word created by QUESTION stores:)
  ( line of its text, in pfa)
  ( screen of its text, in pfa+1)
  ( number of question, in pfa+2 and pfa+3)


 DOES>              ( pfa--answer)
   DUP              ( pfa, pfa)
   2+               ( pfa, pfa+2)
   @                ( pfa, question_no)
   DUP              ( pfa, question_no, question_no)
   ANSWERS          ( pfa, question_no, question_no, answers_adr)
   +                ( pfa, question_no, question_flag_adr)
   C@               ( pfa, question_no, flag)
   ?DUP
   ( If flag=0)     ( pfa, question_no, flag)
   ( If flag=1)     ( pfa, question_no, flag, flag)
   IF
     ( The question was answered before)
                    ( pfa, question_no, flag)
     1 -            ( pfa, quesion_no, answer)
     ROT            ( question_no, answer, pfa)
     ROT            ( answer, pfa, question_no)
     2DROP          ( answer)
   ELSE
     ( The question has never be made)
                    ( pfa, question_no)
     SWAP           ( question_no, pfa)
     DUP            ( question_no, pfa, pfa)
     C@             ( question_no, pfa, line)
     SWAP 1+        ( question_no, line, pfa+1)
     C@             ( question_no, line, screen)
     CR
     .LINE          ( question_no)
     Y/N            ( question_no, answer)
     ( If "Y" was typed, answer=1)
     ( If "N" was typed, answer=0)
     DUP 1+         ( question_no, answer, answer+1)
     ROT            ( answer, answer+1, question_no)
     ANSWERS        ( answer, answer+1, question_no, answers_adr)
     +              ( answer, answer+1, question_adr)
     C!             ( answer)
   ENDIF
;
: ((
  0 N& !
; IMMEDIATE
: &
  1 N& +!
  [COMPILE] IF
; IMMEDIATE
: ()))              ( screen, line, flag--)
  IF                ( screen, line)
    CR
    SWAP            ( line, screen)
    .LINE           ( )
    CR
    QUIT

  ELSE              ( screen, line)
```

There can be any number of questions inside a rule.

If the answer to any question must be false, we can add NOT after the name of the question:

```
: rule_name
  (( question1
  & question2 NOT
  & question3 )) ;
```

It is possible to use AND or OR to link two or more questions:

```
: rule_name1
  (( question1
  question2 AND )) ;

: rule_name2
  (( question1
  question2 OR ;
```

But there are some problems if we do this. If we use AND both questions will be asked of the user, even if the answer to `question1` is false.

Instead of AND, we should use the word & (the ampersand):

```
  : rule_name1
    (( question1
    & question2 )) ;
```

Now if the answer to `question1` is "not," `question2` will not be asked.

The OR case is not so important, because there is no difference between `rule_name2` above and the next two rules.

```
: rule_name2.1
  (( question1 )) ;

: rule_name2.2
  (( question2 )) ;
```

We have questions and rules; now we order the rules inside a Forth word (the main word of the expert system) in the following way:

```
: expert_system_name
  SISIFORTH_OK
  ." Starting message"
  sn1 ln1 rule_name1
  sn2 ln2 rule_name2
  (etc....)
```

```
." Message if no rule was true"
  ;
```

For each rule, sn and ln are the screen number and line number where the text of the answer has been typed. So, if the rule is true, line ln of screen sn will be printed and SISIFOrth will stop.

The order of the rules is very important, because SISIFOrth will stop whenever it finds a true rule. So, for example, if there are two rules like:

```
: rule1
  (( question1
  & question2
  & question3 )) ;

: rule2
  (( question1
  & question3 )) ;
```

then `rule2` should always be after `rule1`. If not, and if `question1` and `question3` are both true, SISIFOrth would stop in `rule2` before examining `rule1`.

SISIFOrth Words

I think SISIFOrth will be easy to understand, because only a few words do all the work. The power of SISIFOrth is the way it does the dirty work; we have nothing to do but tell it the rules and where the text is located.

`QUESTIONS`

A constant that holds the maximum number of questions ever used. It has to be changed as needed.

`ANSWERS`

An array that holds the answers made by the user. Answers are stored as 0 for 'question not answered,' 1 for 'question answered false,' and 2 for 'question answered true.'

`N&`

Counter of how many times `&` is found within a rule, used to compile the correct number of `ENDIF`s at the end of the rule.

`NQ`

Counter of how many questions were created by `QUESTION`.

`.TITLE`

```
    2DROP            ( )
  ENDIF
;
: ))
  COMPILE ()))
  N& @               ( &_no)
  ?DUP
  ( If &_no=0)       ( &_no)
  ( If &_no<>0)      ( &_no, &_no)
  IF
    0                ( &_no, 0)
    DO
      [COMPILE] ENDIF
    LOOP
  ENDIF
; IMMEDIATE
: BLK+               ( --screen)
  32 WORD            ( address)
  NUMBER             ( number, 0)
  DROP               ( number)
  +BLOCK             ( screen)
  ( +BLOCK adds current screen number to the number on TOS)
  STATE @            ( screen, compiling?)
  IF                 ( screen)
    ( BLK+ is being used inside a definition)
    [COMPILE] LITERAL
  ENDIF
; IMMEDIATE
```

```
Screen # 2
 0 ( SISIFOrth, vehicles expert)
 1 ( Questions:)
 2 BLK+ 1 5 QUESTION MONEY
 3 BLK+ 1 6 QUESTION PASSENGERS
 4 BLK+ 1 7 QUESTION BAGGAGE
 5 BLK+ 1 8 QUESTION SPEED
 6 BLK+ 1 9 QUESTION SPORT
 7 ( Rules:)

 8 : SUBWAY (( MONEY NOT )) ;
 9 : CAR (( PASSENGERS BAGGAGE OR )) ;
10 : MCYCLE (( SPEED )) ;
11 : C5 (( SPORT NOT )) ;
12 : BIKE (( SPORT )) ;
13 -->
14
15

Screen # 3
 0 ( SISIFOrth, vehicles expert, continued)
 1 : SISIFORTH_VEHICLES SISIFORTH_OK
 2 ." Vehicles Expert System" CR BLK+ 0 11 SUBWAY BLK+ 0 12
 3 CAR BLK+ 0 13 MCYCLE BLK+ 0 14 C5 BLK+ 0 15 BIKE ; ;S
 4 ( Texts of questions:)
 5 Have you got money enough?
 6 Are you carring passengers?
 7 Are you carring baggage?
 8 Do you like speed?
 9 Do you like sport?
10 ( Texts of answers:)
11 Go to the subway, silly!
12 Buy a car, sure.
13 Buy a speedy motorcycle, then.
14 Well, buy a electric Sinclair C5 tricicle!
15 Better buy a bike, my friend.
```

```
Screen # 6
( SISIFOrth, library manager)
BLK+ 3 01 QUESTION COMPUTER_LANGUAGES
BLK+ 3 02 QUESTION FORTH_LANGUAGE
BLK+ 3 07 QUESTION FORTH-79_LANGUAGE
BLK+ 3 08 QUESTION FORTH-83_LANGUAGE
BLK+ 3 09 QUESTION MMS-FORTH_LANGUAGE
BLK+ 3 10 QUESTION FIG-FORTH_LANGUAGE
BLK+ 3 03 QUESTION PASCAL_LANGUAGE
BLK+ 3 12 QUESTION UCSD-PASCAL_LANGUAGE
BLK+ 3 11 QUESTION TURBO-PASCAL_LANGUAGE
BLK+ 3 04 QUESTION BASIC_LANGUAGE
BLK+ 3 05 QUESTION C_LANGUAGE
BLK+ 3 06 QUESTION PARTICULAR_VERSION
-->

Screen # 7
( SISIFOrth, library manager, continued)
: NO_SHELVING (( COMPUTER_LANGUAGES NOT )) ;
: SHELVING_01 (( FORTH_LANGUAGE
                 & PARTICULAR_VERSION NOT )) ;
: SHELVING_02 (( FORTH_LANGUAGE & PARTICULAR_VERSION
                 & FORTH-79_LANGUAGE )) ;
: SHELVING_03 (( FORTH_LANGUAGE & PARTICULAR_VERSION
                 & FORTH-83_LANGUAGE )) ;
: SHELVING_04 (( FORTH_LANGUAGE & PARTICULAR_VERSION
                 & MMS-FORTH_LANGUAGE )) ;
: SHELVING_05 (( FORTH_LANGUAGE & PARTICULAR_VERSION
                 & FIG-FORTH_LANGUAGE )) ;
: SHELVING_06 (( BASIC_LANGUAGE )) ;
: SHELVING_07 (( C_LANGUAGE )) ;
-->

Screen # 8
(SISIFOrth, library manager, continued)
: SHELVING_08 (( PASCAL_LANGUAGE
                 & PARTICULAR_VERSION NOT )) ;
: SHELVING_09 (( PASCAL_LANGUAGE & PARTICULAR_VERSION
                 & TURBO-PASCAL_LANGUAGE )) ;
: SHELVING_10 (( PASCAL_LANGUAGE
                 & UCSD-PASCAL )) ;
: SISIFORTH_LIBRARY SISIFORTH_OK ." Let's start!"
BLK+ 2 11 NO_SHELVING
BLK+ 2 01 SHELVING_01 BLK+ 2 02 SHELVING_02
BLK+ 2 03 SHELVING_03 BLK+ 2 04 SHELVING_04
BLK+ 2 05 SHELVING_05 BLK+ 2 06 SHELVING_06
BLK+ 2 07 SHELVING_07 BLK+ 2 08 SHELVING_08
BLK+ 2 09 SHELVING_09 BLK+ 2 10 SHELVING_10
." Sorry, I can't help you." ;
;S

Screen # 9
( SISIFOrth, library manager, continued)
Are you interested on computer languages?
Are you interested on Forth language?
Are you interested on Pascal language?
Are you interested on BASIC language?
Are you interested on C language?
Are you interested on any particular dialect?
Are you interested on Forth-79?
Are you interested on Forth-83?
Are you interested on MMS-Forth?
Are you interested on fig-Forth?
Are you interested on Turbo Pascal?
Are you interested on UCSD-Pascal?
```

Prints titles.

`SISIFORTH_OK`

Clears `ANSWERS` and the display, to start execution of rules.

`Y/N ( -- flag )`

Waits for a "Y" or "N" to be typed, and leaves a flag.

`QUESTION ( sn ln -- )`

A word to create other words. Stores `sn` and `ln` at the PFA of the new word, with the content of `NQ`, and increments the content of `NQ`. When the new word is executed, it checks its flag in `ANSWERS` and, if it is 1 or 2 (which would mean the question has already been answered by the user), decrements it and leaves in on top of the stack. If the flag is 0, it calls `Y/N` to get the answer from the user. In any case, the word created by `QUESTION` leaves a flag (i.e., the answer) when executed.

`((`

Resets the content of `N&` when a rule is compiled.

`&`

Increments the content of `N&` and compiles an `IF`.

`()))`

The shadow word compiled at the start of `))`. It checks to see if the rule is true; if so, it writes the answer and ends execution of SISIFOrth.

`))`

Compiles `()))` and the needed `ENDIF`s to complete the rule structure, using the value stored in `N&`.

`BLK+`

This makes the expert system source code relocatable among screens. Instead of using absolute screen numbers to indicate where an answer or questions has been typed, we can use `BLK+ rs` where `rs` stands for 'relative screen,' the offset from the actual compilation screen. Thus, `BLK+ 0` denotes the screen currently being compiled, `BLK+ 1` means the next screen, etc.

Conversion to fig-SISIFOrth

To convert this code to run on a fig-FORTH system, just add 0 before any occurrence of the word `VARIABLE`. Then, in the word `))`, use `-DUP` in place of `?DUP`. The word `ABS` at the end of the definition of `Y/N` could be deleted. In the definition of `BLK+`, use `WORD HERE` instead of simply `WORD`. If necessary, use `<BUILDS` instead of `CREATE` at the start of `QUESTION`.

Simple Examples

Screens two and three show a simple example. To get it working, just compile the screen where it starts, then type `SISIFORTH_VEHICLES`. You will have to answer some questions before SISIFOrth gives an answer. Try again, changing your answers, to see what happens.

I know this example is very simple, but if the way SISIFOrth works has been understood, it should be clear that very complex expert systems can be written in this way, not based on probabilities but "hard rules" expert systems.

Screens six through ten show another example. As can bee seen, the only problem in building an expert system is designing it!

```
Screen # 10
(SISIFOrth, library manager, continued)
Please, look at shelving 1
Please, look at shelving 2
Please, look at shelving 3
Please, look at shelving 4
Please, look at shelving 5
Please, look at shelving 6
Please, look at shelving 7
Please, look at shelving 8
Please, look at shelving 9
Please, look at sehlving 10
Sorry, we have only computer languages books.
```

We can also think of SISIFOrth rules as Prolog sentences, where there are conditions to make the rule true. With that idea in mind, as you can see in the last example, it is as easy to write an intelligent data base using SISIFOrth as it would be using Prolog.

One more thing: if the order of the rules inside the main word is chosen with care, some questions of some rules can be saved. But it is better to write every question needed in every rule, it is surer. And the final message should not be needed if the rules have been thought out properly, but it is better to keep it there while debugging an expert system.

About the Name

In Greek mythology, Sisifo *[Sisyphus in most English translations]* was sentenced by Zeus to roll a big stone up a mountain; but when he arrived, the stone dropped back down and Sisifo had to go down and start again... and so on, again and again, forever. Do you understand?

Marcos Cruz joined the Forth Interest Group last year, and reports that the few Forth users he knows in Spain mostly use 68000-based computers such as the Sinclair QL, Commodore Amiga, and Atari ST. SISIFOrth was originally written for a Sinclair ZX Spectrum with a fig-FORTH from Melbourne House; that was improved upon and translated for a Sinclair QL running a Forth-83 from Computer One. The author welcomes mailed suggestions or improvements at Acacias 44, 28023 Madrid, Spain.

(Screens continued from page 22.)

```
SCR # 6
\ COPY VIDEO LINE FROM IMAGE TO FORTH DICTIONARY SPACE

: !CURRENT-VLINE   ( Y-val  --     )  \ Calc. address in image.
    ( For active image, calc 32-bit address of video line Y,)
    ( and save the address in double variable.)
    pixels/line uss*d     \ unsigned mult w.32-bit prod: Y*px/l
    current-buffer d+     \ added to start.addr = line address
    current-vline 2! ;    \ stored as daddr in variable.

: VLINE>DICT       ( Y-val  --     )  \ Copy one line (Y) down.
    !current-vline  current-vline 2@   \ source daddr to stack
    vidline(dadr) pixels/line make-GDT \ + dest & #bytes ->GDT
    GDT dseg pixels/line 2/        \ gdt addr & segment, #words
    int15    dup not if drop       \ call int15, test status
    else ." Error:" . quit then ;  \ if error, print code.
->


SCR # 7
\ STORE & FETCH SINGLE PIXELS AT X,Y; FILL IMAGE WITH 1 VALUE

: !PIXEL    ( n x y  --     )    \ Replace pixel X,Y with value n.
    vline>dict                   \ Bring video line Y from image,
    vidline  +  c!               \ address pixel X, modify it,
    dict>vline ;                 \ and send line back to image.

: @PIXEL    ( x y  --    n  )    \ Fetch value n of pixel X,Y.
    vline>dict                   \ Y-coord specifies one line;
    vidline  +  c@ ;             \ address pixel X, find value.

: VFILL    ( n  --  )            \ Fill entire image with byte n.
    freeze                       \ End live video, hold image
    vidline pixels/line rot fill  \ set up video line
    480  0  do i !current-vline   \ address 480 lines of image
    dict>vline   loop ;  ->    \ & copy same array into each.


SCR # 8
\ SAVE AN IMAGE TO DISK FILE
decimal
: HANDLE# ( -- n )  fcb @ c@ ;  \ Get current file handle.

: IMAGE>DISK  (  --  )        \ Move video image to an open file.
    480 0 do                  \ For 480 lines of a video image,
    i vline>dict             \ move each line from image to array,
    vidline  512  handle#  \ set address, count & file-handle
    write-bytes  drop        \ write array to disk, drop status,
    loop ;                   \ and do next line.

: SAVE  ( filename)  (  --  )   \ Save image in new disk file.
    close  freeze            \ Close any open file, freeze image;
    ."   Saving image "      \ tell user something is happening;
    make ( filename)        \ open a file using filename supplied
    image>disk close ; -> \ copy image, and close file.
```

(Screens continued on page 34.)

Forth-79

TWO ASSEMBLERS ARE BETTER THAN ONE

DARRYL C. OLIVIER - NEW ORLEANS, LOUISIANA

The Forth assembler is handy for writing short pieces of code to access the hardware or to speed up a loop, but it can be cumbersome for large routines. A full-fledged macro assembler with all the bells and whistles is ideal for larger routines, but it would be very messy to implement as a Forth vocabulary. Fortunately, this is not necessary. It is possible to write a routine using a regular macro assembler, then to incorporate the resultant binary file as a Forth word. I will describe a way to do this for a PC-type segmented memory structure. Forth-79 is used, along with the Microsoft Macro Assembler under MS-DOS.

"This makes practical a library of binary routines..."

The assembler routine to be adopted into Forth must be written or modified to conform to certain restrictions. It must be in the COM format, with all code and data in the same segment. The instruction `ORG 100h`—usually included in a COM program—is not used, because we want the routine to begin at offset zero within its segment. (Alternately, keep the `ORG 100h` instruction and subtract 10h from the segment value in the Forth defining word.) A stack segment is not defined, and `SS` is not used in the `ASSUME` statement. Input and output parameters will be passed via the Forth stack. When the routine executes, the top two elements on the stack will be the segment and offset of the Forth re-entry

```
SCR #1
\ Two Assemblers Are Better than One     D. C. Olivier  3-6-89

VARIABLE  SIZE             \ Size of file to be loaded
VARIABLE  BINSEG           \ Segment
VARIABLE NAME$ 11 ALLOT    \ File name string
DVARIABLE REGS             \ Holds register contents

CODE CSEG   \ Leaves contents of the CS register on the stack.
  CS PUSH
  NEXT JMP END-CODE
SCR #2
\ Two Assemblers Are Better than One     D. C. Olivier  3-6-89
CODE CALLBIN
  #  REGS , BP MOV      \  Save registers
  #  REGS 2+ , SI MOV   \  used by Forth.
  203 C,     \ Intersegment return instruction for 8088
  END-CODE

CODE REENTRY
  AX, CS MOV
  DS, AX MOV          \ Restore DS register
  BX, # REGS MOV
  BP, [BX] MOV        \ Restore registers
  BX INC   BX INC     \ used by Forth
  SI, [BX] MOV        \
  NEXT JMP END-CODE
SCR #3
\ Two Assemblers Are Better than One     D. C. Olivier  3-6-89

: READBIN   .....   ;

EXIT

The name of the binary file is at NAME$ as a counted string.
Use your own DOS file interface to open the file, determine and
store its size in SIZE, read the file from disk to BINSEG:0,
close the file, do any appropriate error checking.

SCR #4
\ Two Assemblers Are Better than One     D. C. Olivier  3-6-89
: BINFILE
  >IN @                       \ Saves input stream pointer
  BL WORD DUP                 \ Reads next word from input stream
  C@ 1+ NAME$ SWAP CMOVE      \ Moves word to variable NAME$
  >IN !                       \ Restores imput stream pointer
  CREATE                      \ Reads same word, creates header
  HERE 16 / 1+ DUP            \ # of paragraphs to HERE, + 1
  CSEG + BINSEG !             \ Segment for binary routine
  READBIN                     \ Read file from disk to BINSEG:0
  16 * SIZE @ + DP !          \ Allot dictionary space
  DOES>                       \ PFA on stack at run time
  CSEG   ' REENTRY            \ Segment and offset of reentry point
  ROT 16 / 1+ CSEG + 0        \ Segment and offset of binary routine
  CALLBIN ;                   \ Intersegment RET instruction
```

point. These should be saved in variables and restored before the final RET instruction. Define the routine as a FAR procedure, so that the final RET instruction will be assembled as an intersegment return.

Figure One is a trivial example that takes two numbers from the stack, adds them, and places the result on the stack before returning to Forth. Assemble the source code and LINK as usual; use the EXE2BIN utility to convert to binary format, then rename the file if you like. Its Forth name will be the same as its filename.

BINFILE in screen four is the defining word. The syntax is:

```
BINFILE <name>
```

where <name> is the name of the binary file on disk. On line two, we save the value of the input stream pointer on the stack. On line three, we read the next word from the input stream, which is <name>. Line four moves <name> to a variable. Line five restores the original value of the input stream pointer so that CREATE can read <name> also. Line six creates a dictionary header for <name>.

The binary routine must start on the first paragraph boundary within the parameter field. (A paragraph boundary is any address evenly divisible by 16.) On line seven, we calculate the number of paragraphs from the beginning of the Forth segment to the parameter field. Line eight adds the value in the CS register to this number and places the result in the variable BINSEG. On line nine, READBIN reads the file whose name is in NAME$ from disk to BINSEG:0. Line ten allots dictionary space for the definition.

Line 12 begins the run-time part of the defining word. It places on the stack the address of the Forth re-entry point to be used by the final RET instruction in the binary routine. Line 13 places the address of the beginning of the binary routine on the stack. At first glance it might seem that this is simply BINSEG:0, but if the Forth program has been compiled as a turnkey system, it may be executed from a different segment that the one in which it was compiled. That is why this address must be calculated at run time. Line 14 executes an intersegment RET instruction, which takes the segment and offset from the stack and jumps to it.

This technique makes practical a commercial or public-domain library of binary routines to be incorporated into Forth programs. These could be sorts, searches, graphic routines, math functions, transforms, etc. Of course, such a library would not be portable across CPUs, but it would be portable across Forth dialects. Any implementation dependencies would be hidden in the defining word BINFILE. Such a library could greatly increase the productivity of Forth programmers. Why spend time coding a quicksort routine in Forth, for example, when you could buy a canned assembly language version that had been optimized, tested, and debugged? It is even conceivable that, for some applications, Forth could be used as "glue" to hold together packaged routines that did most of the work.

```
TITLE PLUS
;
ASEG SEGMENT PARA PUBLIC
ASSUME CS:ASEG,DS:ASEG,ES:ASEG
;
START:
JMP ADDUP
RET_ADDR1 DW ?
RET_ADDR2 DW ?
ADDUP PROC FAR
;
; Code and data in same segment.
MOV AX,CS
MOV DS,AX
;
; Save the Forth re-entry point.
POP RET_ADDR1
POP RET_ADDR2
;
; Perform the operation.
POP AX      ; Get arguments from stack
POP BX
ADD AX,BX   ; Add them.
PUSH AX     ; Put result on the stack.
;
; Put the segment and offset of the
; Forth re-entry point on the stack.
PUSH RET_ADDR2
PUSH RET_ADDR1
;
; Jump to the re-entry point.
RET
ADDUP ENDP
ASEG ENDS
END START
```

Figure One. An assembly routine can perform its task and return to Forth.

THE BEST OF GENIE

GARY SMITH - LITTLE ROCK, ARKANSAS

As promised in the last issue, I will continue with recent on-line conferences that featured George Shaw, Mike Perry, Randy Dumse, and Wil Baden. As before, I will feature the guests' opening remarks from their respective conferences. These remarks set the tone and direction of the conference, and they serve that purpose well. I hope most readers will note they also serve to acquaint the attendees of the conference—and now the readers of this column—with the guests' personal philosophies.

This is no accident. When I have approached a prospective guest, I have always asked what they wish to talk about. What is their personal point of wisdom they wish to share? Without exception, those who have accepted the invitation have also accepted the opportunity to share their personal point of view, as opposed to some general subject. It is clear that we all benefit from this unselfishness. I again wish to thank all these gracious people for sharing their insight as they have.

Now, on to the recaps.

George Shaw
December 1988
Owner of Shaw Laboratories.

<[George]> We (myself and others) started the ACM SIG to bring Forth into the professional computing arena. ACM is very visible in the universities and colleges, and is very well respected around the world. We felt that having a SIG would give Forth a large boost in image as a language for serious use by professionals.

Thanks to Alan Furman for starting the whole thing and analyzing the situation to give us direction and goals. I have a list of our initial projects :

Education: Moving Forth into the universities and colleges to create an awareness of Forth and a better supply of Forth programmers.

Forthics: Research to create a basic set of Forth programming ethics as well as management metrics to increase the success of Forth projects.

Market: A study of the job requirements and the Forth programming skills available to determine trends in the Forth job marketplace and skills required for the future.

"The immediacy is lost, but the words remain."

Successes/Failures: A study of the historical applications of Forth to create an awareness of Forth's widespread use and to determine what the characteristics and causes are for successes and failures.

ANS Forth: Participate through your SIGForth representative in the ANS Forth committee to produce an American National Standard for Forth that everyone can use.

State of the Industry: SIGForth periodically compiles surveys of the Forth industry to evaluate the status of the Forth product market, job market, workplace, education availability, job requirements, etc. Participate in these surveys and be one of the first to reap their benefits through their publication in the SIGForth newsletter.

Mike Perry
January 1989
Owner of Even-Odd Designs.

<[mike]> I have benefitted enormously from the work of many other people. I have come to believe strongly in the value of open systems. I want, and even need, to have complete control over my tools. Sharing code and avoiding secrets are essential for productivity.

I am convinced that Forth will continue to be interesting because so many new techniques and ideas are explored here; that is possible, in large part, because we share our code and ideas.

Remember, we will only lose control of our machines if we give it away.

Randy Dumse
February 1989
Owner of New Micros, Inc.

<[DUMSE]> Being somewhat isolated here in Texas has its disadvantages. The availability of other informed people to bounce ideas off is limited, so most of my opportunities for such interaction occur at most twice a year: at FORML or Rochester. On the other hand, not having anyone to give guided direction to your thinking can allow original thought to take some interesting directions. How useful these thoughts are often cannot be determined by the originator. It's a little like the male complex where no baby is ever pretty—until it's his own!

So it is with ideas: they are much like the only child a male can bear, and therefore look pretty darn cute to Dada. It can be a bit hard to be objective when there is that feeling of self-investment in the thoughts.

(Continued on page 34.)

REFERENCE SECTION

Forth Interest Group

The Forth Interest Group serves both expert and novice members with its network of chapters, *Forth Dimensions*, and conferences that regularly attract participants from around the world. For membership information, or to reserve advertising space, contact the administrative offices:

Forth Interest Group
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Recognition is offered annually to a person who has made an outstanding contribution in support of Forth and the Forth Interest Group. The individual is nominated and selected by previous recipients of the "FIGGY." Each receives an engraved award, and is named on a plaque in the administrative offices.

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On-Line Resources

To communicate with these systems, set your modem and communication software to 300/1200/2400 baud with eight bits, no parity, and one stop bit, unless noted otherwise. GEnie requires local echo.

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- Forth RoundTable *(ForthNet link*)*
  Call GEnie local node, then type M710 or FORTH
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- Computer Language Magazine Conference
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Unix BBS's with Forth conferences (ForthNet links)*

- WELL Forth conference
  Access WELL via CompuserveNet or 415-332-6106
  Fairwitness: Jack Woehr (jax)
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  415-753-5265
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PC Board BBS's devoted to Forth (ForthNet links)*

- East Coast Forth Board
  703-442-8695
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  303-278-0364
  SysOp: Jack Woehr

Other Forth-specific BBS's

- Laboratory Microsystems, Inc.
  213-306-3530
  SysOp: Ron Braithwaite

This list was accurate as of March 1989. If you know another on-line Forth resource, please let me know so it can be included in this list. I can be reached in the following ways:

Gary Smith
P. O. Drawer 7680
Little Rock, Arkansas 72217
Telephone: 501-227-7817
Fax: 501-228-0271
Telex: 6501165247 (store and forward)
GEnie (co-SysOp, Forth RoundTable): GARY-S
BIX (Bytenet): GARYS
Delphi: GARY_S
MCIMAIL: 116-5247
CompuServe: 71066,707
Wetware Diver. (Fairwitness, Forth Con ference): gars
Usenet domain.: gars@well.UUCP *or* gars@wet.UUCP
Internet: well!gars@lll-winken.arpa
WELL: gars

**ForthNet is a virtual Forth network that*

(Continued from page 29.)

There isn't even a mother on which to blame half of the genes.

With those thoughts, I begin.

Forth as a Standalone Operating System

Both the R65F11 and F68HC11 single-chip computers have been designed as standalone computer systems. They use Forth as their operating system. In this regard, they follow in the tradition of micros like the KIM-1, SYM-1, and the AIM-65. Each of these had a built-in monitor to allow user interaction with the system. Similarly, other systems used BASIC as their power-on operating system, such as the (if my memory serves) OSI, TRS-80, and Apple.

Something to keep in mind: "operating system" hasn't always meant "disk operating system."

As most of us have heard, Forth is nearly its own operating system. In fact, it is often stated that Forth is difficult to install under an existing operating system because it is not well behaved. These comments really have nothing to do with Forth as a general language, but come out of the difficulty of doing blocks under another OS.

Wil Baden
March 1989
Owner of Paleotaurus, Inc.

<[Wil]> Let's stop kidding ourselves. Forth deserves its reputation as a write-only language. 99 percent of published Forth programs prove this. Until Forth improves its reputation, it will be *scorned*. Tonight I want to investigate the evil forces that cause this and discuss six necessary but insufficient rules for more readable programs.

1. The stack state must be given for every line.
2. Formatting must show logical structure.
3. Use short definitions, short lines, short phrases.
4. Don't mumble—your program should pass your spelling checker.
5. Mix upper and lower case—all lower case is just as bad as all upper.
6. Write comments in the English language.

Are there better rules? What else must be done?

* * *

If you are grinding your teeth and wishing you had participated in one of these terrific guest conferences, all is not lost. The immediacy is lost forever, but the words remain for you to capture and study at your leisure. They are posted in the GEnie Forth RoundTable, Library 1.

(Screen continued from page 28.)

```
SCR # 9
\ RESTORE AN IMAGE FROM DISK FILE
decimal

: DISK>IMAGE    ( -- )    \ Copy an open disk file to video.
   480 0 do               \ For 480 lines of a video image,
   vidline 512 handle#    \ set up array's address, size, file;
   read-bytes  drop       \ load array from file, drop status;
   i !current-vline       \ find address in image of this line,
   dict>vline loop ;      \ and move the line to image buffer.

: RESTORE ( filename)  ( -- )    \ Open & load file to video.
   freeze  open ( filename)      \ Stop live video, open file;
   disk>image  close ;           \ copy file, close it.
```

such as 00 3B for function key one). Using this trivial definition makes it much easier to avoid such problems as the user pressing an extended key after "Press any key ..."

`%QUIT` in screen 33, in conjunction with the main editor loop `(E)` in 57, shows how to force an exit, regardless how many levels of calling words (return addresses on the return stack) there are.

In the mainline word `(E)`, we note the position of the return stack (`RP@`), which we save in our variable `&RP0`. This notes the point on the return stack with the address to which we ultimately want to exit.

Then, when a word like `ABANDON` or `EXIT-SAVE` wants to exit PDE, it uses `%QUIT` to reset `RP` (`&RP0 @ RP!`) and then returns to that higher-level return address. This approach is more general than a series of `R> DROP`s, particularly when you consider that `ABANDON` is nested four levels deep when invoked through ^Z, but only three when Alt-F1 is used.

Footnotes

1. "Screen-Oriented Editor in Forth," by Henry Laxen. *Dr.Dobb's Journal*, vol. 6, no. 9, pg. 27.
2. `VED` (Craig Lindley) and `FSED` (Gene Czarcinski), September 1986. Credit also to John A. Peters and R.F. Buchanan.
3. F83 is a public-domain implementation of Forth-83 by Henry Laxen and Michael Perry, with many, many fine added features. F83 is available on disks from SIGM (154) or, better yet, from Laxen and Perry's No Visible Support Software for $25. Go ahead, make their day.
4. "Fast SEARCH for F83," by Bill Zimmerly. *Forth Dimensions* VIII/4, pg. 5. *[Also IX/2,4, and X/1. —Ed.]*
5. "Debugging from a Full-Screen Editor," by Tom Blakeslee. *Forth Dimensions* V/2, pg. 30.

Frans van Duinen is regional manager of Micro-expertise Inc., a custom software house that specializes in networked database systems. A slightly more recent version of the code may be downloaded from GEnie and from Canada Remote System (416-629-0136) as PDE202.ARC.

(Eggs, continued from page 6.)

where D-R1 ≤ x ≤ D+R1. The equivalent (unoptimized) BASICA program for the explicit oval function might be written as shown in Figure Five.

If you try both approaches, you will find the latter explicit method unsatisfactory for drawing ovals without some modifications for angles close to the horizontal axis. The OVALS.HSF demo can be downloaded from the GEnie Forth RoundTable and from the East Coast Forth Board *[see Reference Section. —Ed.]*.

Robert Garian is a technical information and language specialist at the Library of Congress, specializing in Soviet computing. He has written an AI program called Block Solver that rearranges one multistack configuration of blocks into a specified goal configuration under constraints; and he has worked on automating both software verification and code generation. His current interests include simulation of complex systems, cellular automata, and genetic algorithms.

(Letters, continued from page 5.)

ture. When someone adds another stack, they enter the realm of extended—rather than standard—Forth, even though the standard does not explicitly disallow extra stacks. However, I personally favor extensions such as extra stacks, particularly if I don't have to manipulate the extra stacks while they give me the features of an OOL.

While it may be better to implement the features of an OOF in assembly language, the Forth community is better served by first offering algorithms expressed in Forth so the explanations that accompany the code can be more readily understood. Once care is taken to provide such information, assembly-language implementations might be appreciated.

I hope information about object-oriented languages piles up for *Forth Dimensions*. Aren't Forth programmers more likely to appreciate creative approaches to the problem of programming computers? Before C++ takes off, perhaps FORTH++ can step in.

Mike Elola
San Jose, California

It Rains—
Chapter Coordinator Muses

JACK WOEHR - 'JAX' ON GEnie

Here in the high-altitude desert that is Colorado on the eastern side of the Rockies, it is drizzling a drizzle that would do credit to the Pacific Northwest. The difference is that when the spring soddenness arrives in the Cascades, the air is heavy with a primeval green scent, whereas here in Golden, at the foot of the Foothills, there is the tangy aroma of fields of damp straw.

Soon the bull snakes will hatch and warm their coppery beauty in the sunshine of early June. Already it has become a questionable enterprise to climb North Table Mountain; unseasonable eighty-degree weather in late April has the rattlers already emerging from their hibernation to bedevil suburbanites engaged in lawn care in the upscale development injudiciously located on the side of that prominence.

Colorado is like the bull snake fresh from the shell, a coiled potency awaiting exercise. The end of the petroleum boom left many high and dry economically. Last year, mortgage foreclosures surpassed new mortgages for the first time. There is a sense of lack of permanence among the high-tech employed. Miniscribe, for instance, formerly the Boulder-area *wunderkind*, has been steadily cutting back.

Yet the improbable obtains: Colorado is a hotbed of Forth. Ball Aerospace is here, those arbiters of the final configuration of the RTX-2000. The red brick walls of IBM's city-sized fortress in Longmont reputedly conceal several ongoing Forth efforts. Applied Energy in Ft. Collins has periodically gone to great lengths to obtain qualified Forth assistance. Charles Johansen is working on finishing and foundrying an inexpensive Forth chip while Cliff King, president of Denver FIG, is in the process of releasing the first revision of his 32-bit AT&T DSP-chip Forth development system.

The local chapters of the Forth Interest Group have been only partially successful in tying together the disparate practitioners of Forth in a functioning fraternity. Boulder Forth Interest Group seems to have disappeared, its members swallowed but not digested by Denver FIG. The latter organization meets sporadically, usually when a speaker is in town. Since the meeting place moved to Golden, between Denver and Boulder, we have been more successful in "trapping" members of both communities at meetings.

> ***"This small event defies the mortality statistics."***

Our most successful recent meeting was at the National Institute of Standards and Technology at the Commerce Department facility in Boulder. We gathered from all over the state to see Dr. Jeffrey Fox demonstrate software he wrote in Forth on various architectures to demonstrate chaotic systems and the Monte Carlo method.

Subsequent to that meeting, we had another well-attended meeting in which we agreed to really get Denver FIG going again. There hasn't been a formal Denver FIG meeting since. Are we unusual?

Our Forth-83 class still meets once a week. Three to seven people attend to learn, gripe, bring incomplete and ailing Forth projects for the Forth Doctor to diagnose, show off fancy new toys such as the MC68HC11 with New Micros' Forth on board. Members will indeed gather if they can sense some purpose in doing so. In the case of the Forth class, for instance, some members' purpose is to get consultation help for $2.50 an hour that they used to pay $30 an hour to obtain. Isn't FIG for helping people not only with Forth in the abstract, but also with Forth in their specific application? In any event, this small weekly event has defied the mortality statistics of local chapter activity to run for about a year now, with only two blizzards and one Florida vacation having interrupted its continuity.

They still talk about the time three years back when Charles Moore came to town to show off the Novix [Forth chip]. One gets the sense that, more than anything, our chapter awaits the founding of a FIG Speaker's Bureau that would track Forthers willing to address local groups and to publish their travel itineraries for the benefit of interested chapters.

Speakers at FIG meetings do not have to be celebrities; a new face would be worth ten clever newsletters, in terms of drawing a crowd at Denver FIG. Fortunately for the continued vitality of our chapter, Gary Betts of the ANSI Forth Technical Committee (X3J14) is in the area and has agreed to address us. Charles Curley should be out for a visit sometime soon, and when Wil Baden comes to Colorado around January of next year there will be an eager and attentive audience awaiting his presentation. Any other Forthers visiting Colorado are invited to address the chapter on their doings; please give us some advance notice.

Our chapter bulletin board, the RCFB, is now on the ForthNet. ForthNet messages bounce around the continent from local BBS to local BBS, sometimes even coming back to reinsert themselves accidentally in the conversational threads of the board of origin. The Forth community has never had such a communications resource at its fingertips before. What is needed now is some creative use of same.

Wouldn't it be nice if every chapter had a BBS on the ForthNet? In such a situation, no formal Speaker's Bureau would be necessary. There is already a FIG Conference that is exchanged on the ForthNet. (Currently we are discussing just what *is* a FIG Chapter. You should log in just to see British Columbia FIG's electronic newsletter!) Forthers can post their travel dates in the ForthNet FIG Conference, or in a separate Speaker's Conference. We might actually get to meet one another. Hibernating chapters might have cause to dust off the gavel more often than quarterly.

But these are dreams one has only on rainy days...

(Code continued from page 9.)

```
: DOZEN-EGGS  35 IS R1   CR CR            \ Assumes R1 has been preset.
  WIPE ." Point height is increasing. Equatorial radius is " R1 .
  6 IS #COLS
  2 IS #ROWS
  R1 2* 10 + IS HJUMP
  200 #ROWS /  2/ 10 + IS VJUMP
  #COLS 1+  1 DO
     #ROWS 1+  1 DO
               HJUMP J * IS D
               VJUMP I * IS C
               F1 J * IS R2
               F2 I * IS R3
               OVAL
     LOOP
  LOOP ORIGIN ;

CASE: COMMANDS DOZEN-EGGS NEST-OF-EGGS ONE-EGG BYE ;CASE

: DEMO  ( -- )
BEGIN
CR ." 1 -- Dozen eggs "
CR ." 2 -- Nest of eggs "
CR ." 3 -- Draw an oval "
CR ." 4 -- Quit "
CR ." Your choice: " #IN 1- ABS 3 MIN 0 MAX
COMMANDS CR  ." Press any key " KEY DROP WIPE
AGAIN ;

.( Enter DEMO and a carriage return )

\ - - - - - - - - - - - - - - - - -


16 1024 * CONSTANT 16K

16K 10 + SEGMENT PICTURE                    \  set up a buffer

: CLRBUF                                   \ clear the buffer
  PICTURE DUP @ 0 OVER 2I@ 32 FILLL
  0 PICTURE 4I! ;

\ Take a snapshot of screen. Save it in TEMP.PIC
: SNAP    ( -- )
  16K PICTURE 4I!      \ make sure entire screen is saved
  C-OFF                               \ cursor off
  CRT-BASE 0 PICTURE @ 0 16K CMOVEL   \ SCREEN to PICTURE segment
  PICTURE $" TEMP.PIC" PUT-FILE C-2 ; \ PICT. to TEMP.PIC file, cursor
on

: QD PICTURE @ 0 CRT-BASE 0 16K CMOVEL ;   \ PICTURE to SCREEN

\ Look at snapshot kept in TEMP.PIC.
: LOOK    ( -- )
  CLRBUF
  PICTURE  $" TEMP.PIC" GET-FILE           \ TEMP.PIC to PICTURE
  QD  ;

\ Illustration

: DEMO2  NEST-OF-EGGS SNAP WIPE CR ." Screen saved."
  CR ." Press any key to display screen stored in file"  KEY DROP
  LOOK ;
```

FIG CHAPTERS

The FIG Chapters listed below are currently registered as active with regular meetings. If your chapter listing is missing or incorrect, please contact Kent Safford at the FIG office's Chapter Desk. This listing will be updated in each issue of *Forth Dimensions*. If you would like to begin a FIG Chapter in your area, write for a "Chapter Kit and Application." Forth Interest Group, **P.O. Box 8231, San Jose, California 95155**

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