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ABSTRACT

This memorandum describes the conversion of deferred-GRAFPAC/FR80 from a FORTRAN version to a version written in the C programming language, thus allowing GRAFPAC function calls from within a C program. Both the FORTRAN and C versions run on a PDP-11/45 under the UNIX Time-Sharing System, and they provide a means for generating microfilm plots by producing a 9-track magnetic tape which can be input to the FR80 microfilm Recording System.

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subject: GRAFPAC/FR80 - A C Version of
Deferred-GRAFPAC Under the
UNIX Time-Sharing System
FC 3934-41, CC 3939⁴

date: September 23, 1974

from: G. K. Swanson

TM 74-1353-6

MEMORANDUM FOR FILE

All of the user-callable GRAFPAC subroutines that are available in the FORTRAN version of deferred-GRAFPAC for the FR80 are now available as C¹ functions which can be invoked in a C graphics program. After the C program containing calls to the various GRAFPAC line-drawing functions is written and compiled, a load module can be constructed from the graphics program object module and the C deferred-GRAFPAC library. This load module represents activity 1 of deferred-GRAFPAC, and its execution results in the creation of a disc file, in the current directory, named "defgrf." Then, file "defgrf" is normally input to activity 2 of deferred-GRAFPAC which reads the file, calls the real GRAFPAC subroutines, and generates an FR80 tape (see Reference 2 and references contained therein for a complete description of deferred-GRAFPAC).

Using the C version of activity 1 of the deferred mode can result in considerable core savings because of the elimination of a large FORTRAN run-time environment (a savings of 10,000 bytes was realized in one test program). However,

the FORTRAN version of activity 2 of deferred mode has not been rewritten and it still takes a large amount of core (approx. 35,000 bytes). Nevertheless, certain programming features of the C language which are not available under UNIX FORTRAN make the C version of the deferred mode much more enjoyable to use than the FORTRAN version.

There is one difference between the UNIX FORTRAN version of activity 1 and the C version - the address of the "amodes" array is not required as an argument to "modesg()" in the C version. As in the UNIX FORTRAN version, the optional arguments("amodes" address and device code) available in some of the GRAFPAC function calls (see "GRAFPAC User's Manual") are ignored. Should one wish to modify one of the parameters in the "amodes" array, the C program should include

```
extern float amodes[39]
```

or its equivalent. Also, it should be remembered that, when addressing the "amodes" array, indexing starts at 0 in C and 1 in FORTRAN. The C dummy GRAFPAC functions of activity 1 return no value.

On the Department 1353 PDP-11/45 system, the deferred-GRAFPAC C library for activity 1 is not an archive file of several object modules as was done for the UNIX FORTRAN deferred version. Instead, it is a single object module compiled from

one C source file which contains all the code for the C, dummy GRAFPAC functions of activity 1. A small amount of core savings can be realized by breaking up the source code into the individual functions and creating an archive file to be used in the creation of the load module for activity 1 of deferred-GRAFPAC. Figure 1 illustrates (1) the size of the C source code file for the GRAFPAC functions of activity 1, (2) the size of the object module obtained from compilation of the source, (3) a sample "shell" command file which can be used to generate a FR80 tape when the graphics program is written in C, and (4) the calling sequence for the sample shell command file. Figure 2 illustrates the calling sequence for the GRAFPAC plotting functions in the C version, and it gives a brief description of the purpose of each function. Figure 3 illustrates a sample GRAFPAC program written in C and Figure 4 shows the output generated by the FR80.

G. K. Swanson

G. K. Swanson

HO-1353-GKS-ms

Att.

References 1-2

Figures 1-4

REFERENCES

1. Ritchie, D. M., "C Reference Manual," TM 74-1273-1.
2. Swanson, G. K., "GRAFPAC/FR80 for the PDP-11/45
Running Under the UNIX Time-Sharing System,"
TM 74-1353-4, 7/5/74.

- (1) `ls -l c-defer.c`
`-rw-rw-rw- 1 gks 10432 Sep 25 12:34 c-defer.c`
`%`
- (2) `ls -l /usr/lib/c-defer.o`
`-rw-rw-rw- 1 gks 9720 Sep 25 12:35 /usr/lib/c-defer.o`
`%`
- (3) `cat /usr/bin/c-dgrf`
`echo pass 1 :`
`cc $1 $2 $3 $4 $5 /usr/lib/c-defer.o`
`strip a.out`
`ls -l a.out`
`a.out`
`rm a.out`
`ls -l defgrf`
`echo pass 2 :`
`ls -l /usr/lib/gr.go`
`/usr/lib/gr.go`
`%`
- (4) `c-dgrf file.o x1.o x2.o x3.o x4.o`

`c-defer.o` = object module from the compilation of the C source code for activity 1 of deferred-GRAPAC.

`c-defer.c` = C source code for activity 1 of deferred-GRAPAC.

`defgrfdefgrf` = disc file created in current directory as a result of executing activity 1 load module 'a.out'.

`gr.go` = fixed-length load module for activity 2 of deferred-GRAPAC.

`c-dgrf` = '/usr/bin' shell command file for C version of deferred-GRAPAC.

`file.o` = C-compiled program containing GRAPAC function calls.

`x?.o` = optional object modules/archive libraries to be included in activity 1.

```

advance(d) ; /* advance microfilm by 'd' frames */
              (float d ; )

cirarc(xc,yc,rad,st,arcln) ; /* draw circular arc with center at
                              (xc,yc), radius 'rad' user units, starting angle
                              of 'st' degrees, and 'arcln' degrees of arc */
                              (float xc,yc,rad,st,arcln ; )

endrpq() ; /* end repeat loop */

finisq() ; /* terminate graphics activity - last function called */

framerq() ; /* output current plot, with label, and advance 1 frame */

frcmdq(cmd,nbyte) ; /* move 'nbyte' bytes of user-supplied F280
                    commands, starting at location 'cmd', to the
                    GRAFPAC-generated command stream */
                    (char *cmd ; int nbyte ; )

frintq(inten) ; /* reset intensity values(0-7) corresponding to
                 the eight spot-size values */
                 (int inten[8] ; )

haxesq(y,k,xb,xt) ; /* draw 'k' horizontal lines with end
                    coordinates (xb,y[1]) and (xt,y[1]) */
                    (float y[1],xb,xt ; int k ; )

identq(a1,a2) ; /* write two 43-byte strings of text to the
                F280 operator */
                (char *a1 , *a2 ; )

legndq(x,y,tst,k) ; /* output text string on plot, where string
                    starts at 'tst' and length is 'k' bytes - center
                    of 1st character in string is at coordinates
                    (x,y) */
                    (float x,y ; char *tst ; int k ; )

linesq(x,y,k) ; /* draw connected line segments given by 'k'
                 x-y pairs in arrays 'x' and 'y' */
                 (float x[1],y[1] ; int k ; )

miclab(lbl,code) ; /* a required function call where 'lbl' is the
                    starting location of 24 characters of label
                    information which is output to F280 operator and
                    also put on microfilm as label information - 'code'
                    is a microfilm code indicating comic, cine, 16mm,
                    35mm, cutmarks, etc. */
                    (char *lbl ; int code ; )

modesq() ; /* must be 1st GRAFPAC function called - initializes
            'amodes' array and internal values */

```

Figure 2a. User-Callable GRAFPAC Functions.

```

objecg(xmin,xmax,ymin,ymax) ; /* define output space to be used
    (object space) by specifying fractional portion
    of x and y axes to be used, where
    0.0 ≤ xmin,xmax,ymin,ymax ≤ 1.0 */
    (float xmin,xmax,ymin,ymax ; )

ointg(x,y,k) ; /* plot character in 'amodes[14]' at each of
    'k' points given by coordinates (x[],y[]) */
    (float x[],y[] ; int k ; )

repetg(dx,dy,k) ; /* start 'repeat' loop of 'k' repetitions,
    where 'dx' and 'dy' are x and y increments to be
    added to x and y arguments of GRAFPAC functions
    contained within the repeat loop - x and y
    incrementing is done at end of each pass through
    loop */
    (float dx,dy ; int k ; )

scaled(xc,yc,scale) ; /* define own scaling, where (xc,yc)
    is lower-left corner of plotting area in raster
    units and 'scale' is a scaling factor (raster units
    per user units) */
    (float xc,yc,scale ; )

segmtr(xb,yb,xt,yt,k) ; /* draw 'k' unconnected line
    segments, where line end points are given
    by (xb[],yb[]) and (xt[],yt[]) */
    (float xb[],yb[],xt[],yt[] ; int k ; )

subjecg(xmin,xmax,ymin,ymax) ; /* define limits of users'
    coordinate values which will be used as
    arguments in GRAFPAC function calls */
    (float xmin,xmax,ymin,ymax ; )

vaxesg(x,k,yb,yt) ; /* draw 'k' vertical lines with end
    coordinates (x[],yb) and (x[],yt) */
    (float x[],yb,yt ; int k ; )

```

```

extern float amodes[39] ;
int i ;
char id[24] "SWANSON,bin 1558,7254 " , *cp , orm[12] " TEST orient" ;
char cmess[16] "THIS IS a CIRCLE" , zk[4] "K " ;
float px[8](20.0,100.0,180.0,260.0,340.0,420.0,500.0,580.0) ;
float yx[2](5.0,995.0) , vx[2] (5.0,995.0) , bordrx[5] (0.0,1023.0,1023.0,
0.0,0.0) ;
float bordry[5] (0.0,0.0,1023.0,1023.0,0.0) , xsb[8] (20.0,525.0,20.0,525.0,
20.0,20.0,975.0,975.0) ;
float xst[8] ( 425.0,975.0,425.0,975.0,20.0,20.0,975.0,975.0 ) , ysb[8] (
20.0,20.0,930.0,980.0,20.0,525.0,20.0,525.0 ) ;
float yst[3] ( 20.0,20.0,980.0,980.0,425.0,980.0,425.0,975.0 ) ;

```

```
main()
```

```

modesq() ;
miclab(id,40) ;

```

```

subjq(0.0,1023.0,0.0,1023.0) ;
objecq(0.0,1.0,0.0,1.0) ;

```

```

amodes[7] = 1.0 ;
linesq(bordrx,bordry,5) ;
amodes[7] = 2.0 ;
objecq(0.1,0.9,0.1,0.9) ;
linesq(bordrx,bordry,5) ;
amodes[7] = 3.0 ;
objecq(0.2,0.8,0.2,0.8) ;
linesq(bordrx,bordry,5) ;
amodes[7] = 4.0 ;
objecq(0.3,0.7,0.3,0.7) ;
amodes[7] = 5.0 ;
objecq(0.4,0.6,0.4,0.6) ;
linesq(bordrx,bordry,5) ;

```

```

advanq(1.0) ;
amodes[8] = 0.5 ;
amodes[7] = 2.0 ;
subjq(0.0,1000.0,0.0,1000.0) ;
objecq(0.0,1.0,0.0,1.0) ;
cirarq(500.0,500.0,498.0,0.0,360.0) ;
amodes[7] = 4.0 ;
cirarq(500.0,500.0,490.0,0.0,180.0) ;
amodes[8] = 3.0 ;
cirarq(500.0,500.0,490.0,180.0,180.0) ;
amodes[7] = 3.0 ;
amodes[8] = 0.0 ;
cirarq(500.0,500.0,480.0,180.0,-180.0) ;
amodes[8] = 3.5 ;
cirarq(500.0,500.0,480.0,-180.0,180.0) ;
amodes[15] = 2.0 ;
amodes[17] = 1.0 ;
leondq(100.0,500.0,cmess,16) ;

```

```

framen() ;
amodes[4] = 2.0 ;

```

```

amodes[7] = 3.0 ;
haxesq(yx,2,5.0,995.0) ;
vaxesq(vx,2,5.0,995.0) ;
segmtc(xsb,ysb,xst,yst,8) ;
cp = &amodes[14] ;
for (i = 0 ; i < 4 ; i++) *cp++ = zk[i] ;
for (i = 0 ; i < 8 ; i++)
( amodes[15] = i ;
  pointc(&px[i],&py[i],1) ;
)

advanc(1.0) ;
amodes[17] = 2.0 ;
amodes[15] = 3.0 ;
amodes[8] = 2.0 ;
for (i = 0 ; i < 8 ; i++)
( amodes[13] = (i * 45.0) ; legendj(500.0,500.0,orm,12) ; )

finisq() ;

```

HEAD

job name 050
SWANSON,bin 1558,7254
date Tue Oct 22 09:12:23 1974
page no 000

Figure 4a. 'tst4' PR80 Output.

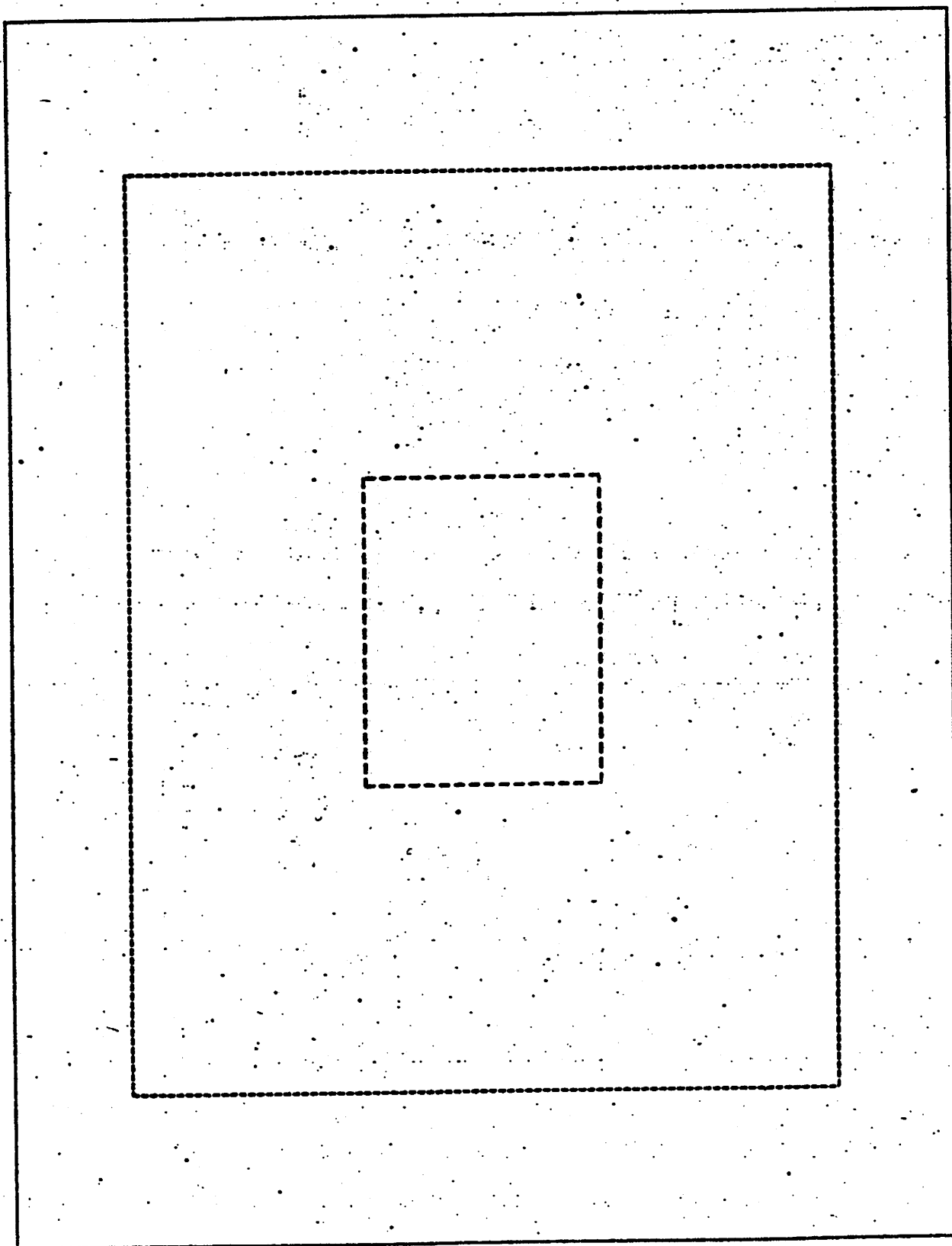


Figure 4b. Test 14 PR30 output.

Job name 050
SHANSON, bin 1558.7254
date Tue Oct 22 09:12:23 1974
page no 001

THIS IS A CIRCLE

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Figure 4e. 'tst4' FR50 Output.

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