INTRODUCTION

Only a few years ago a professional or manager who needed data and graphs for an important meeting in the morning had to do without them. To get both he would have had to make a request to both central DP and the Graphics department, a process that easily required a turn-around time of days, if not weeks. No more. The advent of microcomputers changed all that. Managers who have micros at their desktop now have control over their data. And since these machines are multifunctional, managers tend to do a lot of things with them—even wrong ones. And that is the point. Although some people consider micros to be the greatest things since sliced bread there are some aspects of computing that are better left to a mainframe computer.

Today, micros have at least one major shortcoming—its as-yet immature software base. The immaturity of micro software comes in two forms: (1) easy-to-use software does not always mean easy-to-learn software primarily because many otherwise excellent micro software systems suffer from below-par documentation; indeed, software documentation has long been regarded as the "armpit of the microcomputer industry"; (2) due mostly to memory limitations many of today's micro software pale in comparison to those available in mainframes such as SAS and SAS/GRAPH.

This paper describes GRAF/S, a system that brings the power of mainframe computers available to micro users by providing an optimal mix that takes advantage of the strengths of both machines. Although GRAF/S provides a hook to SAS/GRAPH, its design philosophy is general enough that hooks to other mainframe software, otherwise unavailable in micros, can be made easily.

OVERVIEW OF GRAF/S

Imagine a manager or professional who maintains one or more data bases on a micro. He needs summary information on his data bases in the form of charts for an important meeting in the next few hours. He knows that the office has a microcomputer graphics package but he cannot use it due to one or more of the following:

- He does not have the time to learn how to use it
- It does not quite do the job; he needs more than the usual pie and bar charts
- It requires another program that someone has to write to convert his data from the data base to a form that the graphics software can understand.

This manager is ripe for GRAF/S.

GRAF/S is a software package, mostly written in dBASE II, that writes a SAS and SAS/GRAPH program from menu screens filled in by the user. The SAS program contains all of the desired data extracted from the micro-resident dBASE II data base. The system dials up a host mainframe (IBM MVS under our implementation), uploads the SAS program and invokes a TSO Clist that executes the uploaded program. If the user's micro has a graphics console or an attached X-Y plotter, the graphs generated by SAS/GRAPH appear there. The TSO Clist allows the user to suspend the execution of SAS/GRAPH; at this point the user may elect to move to a regular host-connected graphics terminal and reconnect from there or continue the execution at some later time. Control normally returns to GRAF/S when the user terminates the mainframe session.

The communications program that has the responsibility for dialing up and logging the user on the mainframe reads a microcomputer disk file containing the user's logon sequence including password. The user performs two keystrokes on his micro to initiate the logon procedure and another to activate the TSO Clist.

BASIC FEATURES OF GRAF/S

GRAF/S was written under the design philosophy that a micro user should be able to take advantage of the strengths of both micros and mainframes to solve a problem without having to write a single line of program code. Indeed, the chain of events that culminate with the user-specified graphs showing on the user's microcomputer console is initiated by a single command to the micro. And that command consists of only two words. All that GRAF/S requires is that the user be familiar with his problem and his data base.

GRAF/S presents the user with a sequence of formatted screens. The number of screens that he sees depends on how much control he wants to exercise over the data to be extracted from the data base and the graphs that will be drawn. The menu screens consistently contain a selection for obtaining additional help. The user needs only to key in a question mark to access the appropriate HELP screens.

With GRAF/S the user may create U.S. maps, pie, star, vertical bar, horizontal bar, block and line graphs with all the trimmings that powerful SAS/GRAPH allows. Selections on colors, fonts, page and text characteristics, plotting symbols and hatching patterns are all supported. The user may specify up to nine titles and nine
footnotes. The user may also elect to include in the uploaded program only those data base records that satisfy the selection criteria that he specifies. This is particularly useful if the data base is quite large and only a limited number of records is needed to draw the graphs. The user also has the facility to define new data elements from old ones and assign labels to all data elements.

GRAY/S contains extensive error checking of user input to formatted screens to insure that the generated SAS code is completely bug-free.

**Requirements**

The system requires a micro, either 8-bit or 16-bit, running the CP/M operating system and a user data base that resides in dBASE II, considered by many as the de facto standard in micro DBMS. Although the ideal configuration would be for the micro to have an auto-dial modem, a SAS/GRAPH-compatible graphics display screen or an attached X-Y plotter, GRAF/S will still operate without any of these.

If the micro is outfitted with a regular outboard modem, the user has to manually dial the host mainframe. If the micro is not capable of displaying SAS/GRAPH pictures, the user can still suspend SAS execution while he moves to a suitably equipped workstation. Indeed, this feature allows GRAF/S to be initiated at a field office or a remote location with the final graphs drawn at the central office or another remote location so long as all stations involved are tied into the host.

**GRAF/S IN DETAIL**

A data base on which the system was used was one that keeps track of research projects funded by a Federal agency. This data base originally was a SYSTEM 2000 data base on the mainframe that was downloaded to the micro and converted to a dBASE II file. The entire downloading and conversion process took less than one hour.

The agency, as well as Congress, is always interested in the funding activity during this and other fiscal years. A valid congressional inquiry might be how project monies are being expended by state — a good candidate for a U.S. map display.

The data base has the schema shown in Figure 1.

The system is invoked using the command:

dbase graf/s

at the CP/M prompt level. The user is then presented the system's Quick Main Menu shown in Figure 2. If the user responds with "Y" he obtains detailed information on all available options. Choice 0 is the only way out of the system (other than abnormal abort with the ESC key); selecting this option causes program control to transfer to the communications module which connects the micro to the mainframe and uploads the GRAF/S-created SAS program.

**Figure 1. Schema of the PROJECT data base**

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<th>TYPE</th>
<th>WIDTH</th>
<th>DEC</th>
</tr>
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<td>NAME</td>
<td>C</td>
<td>030</td>
<td></td>
</tr>
<tr>
<td>002</td>
<td>DEPT</td>
<td>C</td>
<td>020</td>
<td></td>
</tr>
<tr>
<td>003</td>
<td>INST</td>
<td>C</td>
<td>030</td>
<td></td>
</tr>
<tr>
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<td>C</td>
<td>020</td>
<td></td>
</tr>
<tr>
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<td>ZIP</td>
<td>C</td>
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<td></td>
</tr>
<tr>
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</tbody>
</table>
**TOTAL** | 00346 |

A. **Simple Graph Mode**

If the user selects the simple graph mode, GRAF/S sets all global options to default values including plotting device and baud rate. He is then asked if he wants to preselect the data. If he answers in the affirmative, he is presented the screen shown in Figure 3. In this, and other screens like it, all protected areas are in highlight video and the unprotected areas (where user input is expected) appear in normal video bounded by a pair of colons. In this screen, the user need not spell out the selection criteria values completely. Any data base record that matches any substrings specified will be extracted. At this point, GRAF/S will have written all SAS codes needed in the DATA step.

GRAF/S then presents the user with the Simple Graph Menu shown in Figure 4. This screen is repeatedly shown to the user (allowing for the eventual creation of many different graphs) until the user signifies that he is done by his leaving the first field, i.e., "Graph Type" blank. The system writes all the codes needed by a SAS/GRAPH PROC from each filled-in screen. When he is finished with this screen he is back to the Main Menu from where he can exit with Choice 0. At that point the communications
module takes over, terminating only after the last picture drawn by the mainframe's SAS/GRAPH appears on the user’s screen.

**B. Enhanced Graph Mode**

If the user elects to go into enhanced graph mode he is first presented the menu shown in Figure 5. Each of the choices may cause the presentation of one or more screens. Space constraints do not permit our showing all GRAF/S screens here. Figures 6-9 show some sample screens that give various levels of detail.

Figure 10 is a sample SAS/GRAPH source code produced by GRAF/S, and Figure 11 shows one result of that program’s execution.

**SUMMARY**

The strength of GRAF/S lies in its ability to give a user access to all resources offered by a mainframe computer without his learning the details of how that software, mainframe or micro, works.

GRAF/S can be extended easily to allow a micro user to get any mainframe software to massage his micro-resident data. With only few modifications, for example, the GRAF/S user can have all the powerful statistical and data analysis tools provided by SAS on a mainframe.

As more and more people get involved with computers in these strangest of times (when, incredibly, one finds Timex and IBM competing in the same marketplace), systems like GRAF/S can only help put computing in the hands of those who truly need it the most.

**REFERENCE**

CP/M is a trademark of Digital Research; dBASE II is a trademark of Ashton-Tate.
Please enter a number (0-4), or 6 for HELP.

FIGURE 5. Enhanced graph menu of GRAP/S

Title/Fontnote Number (Enter 0 to QUIT) 7

T I T L E
Post (e.g., COMPLEX, T R I P L E X, I T A L I C, O U T L I N E)
Height in character units (i=normal) 7
Other 7

FO NT N O T E
Post (e.g., COMPLEX, T R I P L E X, I T A L I C, O U T L I N E)
Height in character units (i=normal) 7
Other 7

FIGURE 6. Screen where user specifies titles and footnotes. The screen is presented repeatedly up to nine cycles or until the user enters a '0' for Title/Fontnote number

FIGURE 7. Menu from which the user may preview data base records, define new data elements from old ones, and assign data element labels
FIGURE 10. Sample SAS/GRAPH code produced by GRAF/S

Sample Graph from GRAF/S-Generated Code

FIGURE 11. Sample graph produced by the code in Figure 10