The SAS/AF software product is an interactive facility for application development using screens. SAS/AF provides the necessary tools using a full-screen terminal for screen design and for configuring those screens in a system or application. One application of SAS/AF, among others, is authoring and presenting computer-based training. This paper discusses the technical features of SAS/AF that support the instructional designer when authoring and presenting computer-based training.

Overview of SAS/AF

The SAS/AF software product consists of four procedure steps - BUILD, DISPLAY, CPORT and CIMPORT. The BUILD procedure provides the tools for creating, editing and configuring screens, in other words "authoring" the computer-based training course. The DISPLAY procedure is the "presentation" system. PROC DISPLAY presents or displays the information authored by PROC BUILD.

The CPORT procedure converts a library of screens into a sequential file in transport format for sharing with other operating systems.

The CIMPORT procedure converts a transport format sequential file created by CPORT into a library of screens in local or host-dependent format.

These latter two procedures, CPORT and CIMPORT, are utility procedures for unloading and loading screens created by PROC BUILD, and they will not be discussed in this paper.

File Structure

Screens that are edited with PROC BUILD reside in catalog data sets that can be stored in SAS data libraries. One or more screens may be stored in a catalog data set, and one or more catalogs may be stored in the same SAS data library.

A SAS catalog is not a SAS data set. The catalog contains screens, not observations, and has a different structure and access method from SAS data sets. However, catalogs can be stored in a SAS data library along with other SAS data sets.

A catalog data set can only be processed by procedures in SAS/AF or SAS/FSP software and several utility procedures in base SAS software.

Primary Menu

As screens are created and placed in a catalog, a directory for that catalog monitors the name of each screen, the type of screen, a description for the screen, and the date the screen was last edited.

From the directory, commands are available for selecting the screen for editing, renaming the screen or modifying its description, and for deleting screens, as well as creating new ones.

Screen Types

A computer-based training course consists of screens of information that are configured in such a way as to present information in a logical sequence and test that understanding. The function of the screen may be to present information to the learner, to query or test the learner's understanding, to provide help information to the learner, or to provide the learner with a menu of items from which to make a selection.

The BUILD procedure creates seven different screen types -MENU, CBT, PROGRAM, HELP, LIST, SYSTEM and FORM. Each of these seven screen types has certain functions.

MENU screens are used to present a menu of items from which to make a selection.
CBT screens are used to present instructional material and query the learner using either multiple choice or true/false question screens. Appropriate feedback can be provided depending on whether the learner’s answer is correct or incorrect. Other screens that support remediation or additional reinforcement can be linked to conditionally. The number of allotted tries to answer a question can also be set.

**Measures of Location**

Today’s lesson is about measures of location. Measures of location include the mean, the mode, and the median. These statistics describe the center of the distribution.

**MEAN**

The sample mean of a variable is the arithmetic average of all values of that variable in the sample, that is, the sum of all values divided by the total number of values.

For example, the mean of the four numbers 3, 5, 6, 8 is:

\[
\text{MEAN} = \frac{3 + 5 + 6 + 8}{4} = \frac{22}{4} = 5.5
\]

**MODE**

The mode is the value at which the density of the distribution is at a maximum. The sample mode is the value that occurs most often in the sample.

For example, the mode of the six numbers 1, 2, 4, 1, 5, 8 is 1 since that number occurs most often.

**Did you add the numbers?**

**Yes.** Try grouping numbers that are the same.

**Yes.** The number 1 is the mode since it occurs three times.

**Did you add the numbers?**

**Yes.** Try grouping numbers that are the same.

The SAS procedure that can calculate the mode of a distribution is:

- MEANS
- SUMMARY
- UNIVARIATE
- FREQ
- CHART

**Did you add the numbers?**

**Yes.** Try grouping numbers that are the same.

**Did you add the numbers?**

**Yes.** Try grouping numbers that are the same.
PROGRAM screens contain fill-in-the-blank screens that are passed to a SAS program that is actually submitted to the SAS System. When the program completes execution, the SAS log and SAS listing files are displayed. The learner can study these files before returning to the lesson. After returning to the lesson, the learner can continue the lesson or return to the program screen, recall the statement(s) just entered, modify it, resubmit the program to SAS and re-examine the SAS log and listing files.

```
* Title line is: "title1*.
proc means filename data=filename;
   varname varname ;
   title1 title1 ;
run;
```

Symbolic names are used to represent areas on the screens for the learner to key information in. The symbolic name may represent one of eight different field types.

The field type may be character, numeric, fixed, integer, a valid SAS format or informat specification, the name of a SAS data set, the name of variables in the data set, or an action field which denotes an option or parameter being turned on or off.

In addition to specifying the type of field, additional attributes are available for translating all characters to uppercase, for justifying or aligning the entry, for padding or filling the field, for protecting the field against any modification, for not displaying the field to the learner, for assigning a SAS informat or format to the field, for requiring an entry for the field, for listing valid values for the field, for specifying the name of a HELP screen that is to be displayed when the cursor is placed on that field and the HELP function key pressed, and for equating the field with the name of an associated SAS Macro variable.

A program screen consists of two sections which are separated by a dashed line. The area above the dashed line is what the learner sees when the program screen is displayed. The area below the dashed line is what the SAS System sees when the program is submitted for execution. Symbolic fields tie the upper and lower portion of the program screen together. Values assigned to the symbolic fields above the dashed line are transferred to the same symbolic field names below the dashed line.

Fields that are filled in or not filled in by the learner can be tested and unconditionally or conditionally pushed in the SAS program.

The versatility of the SAS program screen is even greater when the Macro language facility is used in the SAS program. For example, Macros have been written to provide pretesting, enroll a learner in the course, and monitor the learner's progress through the course. In addition, the Macro facility can be used to perform complex testing of field entries and generation of appropriate diagnostics.

The program screen differentiates the use of SAS/AF as a CBT authoring language from other available authoring languages. The PROGRAM screen directly interacts with the SAS software system. There are a number of advantages to this.

The course is automatically updated as the SAS System is enhanced. As procedure output formats, SAS error messages or even defaults change, new information is displayed immediately without any modifications to the course itself.

The output produced is automatically customized by your installation's default options for the SAS System. If you have left-aligned output as your default, that is how your output is displayed. Should you change your option to centered output, you see an immediate change in the output you view in the course, without any direct changes to the course itself.
You are not limited to learning only the specific statements and options within the course. Since the course is dynamically presented by the SAS System, the results of whatever you key in will be displayed.

HELP screens display the information the learner sees when the HELP key is pressed. HELP screens can be accessed from CBT screens and PROGRAM screens. When the HELP screen is released, control is typically returned to the screen from which the HELP screen was requested.

Available Commands and Keys

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEXT</td>
<td>Scrolls forward to the next screen</td>
</tr>
<tr>
<td>BACK</td>
<td>Scrolls backward to the previous screen</td>
</tr>
<tr>
<td>FRAME</td>
<td>Scrolls to the frame number</td>
</tr>
<tr>
<td>NEXT</td>
<td>Scrolls forward to the next screen</td>
</tr>
<tr>
<td>FRAME</td>
<td>Scrolls to the frame number</td>
</tr>
</tbody>
</table>

A HELP screen's only attributes are the name and type of its parent screen.

A MENU screen's attributes are its parent screen and any subpanels, which are also other screens.

A CBT screen's attributes are its parent screen and one child or subpanel screen.

Screen Attributes

When editing screens, attributes for the screen can be displayed using the attribute (ATTR) command. The form of the attribute screen depends on the type of screen being created.
A program screen’s attributes are the attributes of any symbolic fields in the program.

The information specified on the attribute screen is saved with the screen and can be changed any time.

Screen Editing

When editing screens, the text editing line and block commands used throughout the SAS System can also be used for editing the screens. Other screens can be copied, as well as other files not in catalog form.

Logical Pages or Frames

HELP, MENU, and PROGRAM screens consist of one frame or logical page of information. Although the PROGRAM screen consists of two pieces (one portion above the dashed line and one portion below the dashed line), only the portion above the dashed line is displayed to the learner and can be thought of as one frame of information.
Find the mean of these values: 1, 1, 3, 2, 4, 1

- 12
- 3
- 2
- 4
- 1

What is the mean of these values?

Good!
The mean is: \( \frac{1+1+3+2+4+1}{6} = \frac{12}{6} = 2 \).

Did you add the numbers and divide by the total number of values?

Good!
The mean is (1+1+3+2+4+1)/6 = 12/6 = 2.

Did you add the numbers?

Did you add the numbers and divide by the total number of values?

The mode is the value at which the density of the distribution is at a maximum. The sample mode is the value that occurs most often in the sample.

For example, the mode of the six numbers 1, 2, 4, 1, 3, 4 is 4 since that number occurs most often.

Find the mode of these values: 1, 1, 3, 2, 4, 1

- 12
- 3
- 2
- 1
- 4

Did you add the numbers?

Try grouping numbers that are the same.

That's right. The number 1 is the mode since it occurs three times.

Try grouping numbers that are the same.

Which SAS procedure can calculate the mode of a distribution?

- MEAN
- SUMMARY
- UNIVARIATE
- TRANSLATE
- COUNT

PROD.CBT

PROD.CBT

CHOOSE.MENU

PROD.CBT

PROC.CBT

PROC.CBT

PROC.CBT

PROC.CBT

Each frame can contain text, text and a question, or a single question. Portions of the frame can be paused at any time. A frame can also point to another screen to branch to before returning to the next frame in the same lesson.

Each question frame can ask either a multiple choice or true/false question. The correct answer to the question, the number of allotted tries allowed for getting the right answer, and appropriate feedback for each answer selection are programmed on the question frame. Feedback for an answer selection can be a branching to another screen.

When displaying CBT screens, commands are available for scrolling forwards, backwards, and moving to specific frame numbers within a CBT screen.

PROC DISPLAY

Screens that are edited with PROC BUILD are displayed with the DISPLAY procedure. Since all the screens are logically tied together through each screen's attributes, only one screen is specified when PROC DISPLAY is invoked. After that screen is displayed, control is then transferred to that screen's parent, child, subpanels, or a linked screen.

When a program screen linked to in a CBT lesson (in a CBT screen) is submitted for execution, a checkpoint record is written by PROC DISPLAY, remembering the location in the lesson to which the program screen was branched. To return to that location, the DISPLAY routine is executed without any screen identification given.

Summary

SAS/AF provides the instructional designer with the necessary tools for authoring and presenting computer-based training. The learner is dynamically using the SAS System without any simulation. This latter feature truly distinguishes the SAS/AF software product from all other available authoring languages.