ABSTRACT
SAS® programs can be very I/O intensive. SAS data sets with inappropriate variable attributes can degrade the performance of SAS programs. Using SAS compression offers some relief but does not eliminate the issue of inappropriately defined SAS variables. This paper intends to examine the problems inappropriate SAS variable attributes can cause as well as a macro to tackle the problem of minimizing the footprint of a SAS Data Set.

INTRODUCTION
This paper intends to examine the problem of working with SAS Data Sets that have inappropriate variable attributes. This paper will also examine a SAS macro to remedy the situation by altering character variable attributes to only use as much storage space as necessary based on the variable values in the data. This paper does not address shortening the length of numeric variables as it could lead to problems in numeric precision.

THE PROBLEM
The focus on this paper is about character variables that are assigned storage lengths that are larger than needed. For example, there are times that data ends up in a database that have most of the character variables defined as a variable length character with a long storage length. i.e. gender stored as a varchar 500. Even though the database can handle this efficiently, when the file is being processed in SAS, it is treated as a fixed length character variable. As far as storage is concerned, one can turn on the compression option but the savings only occur during reading and/or writing the SAS data set to disk. During data processing, the variables are expanded and treated with their full storage length.

SAMPLE DATA SAS DATA SET WITH POORLY DEFINED VARIABLE ATTRIBUTES
The data set used for this paper is not very large compared to what is encountered in real projects. This data set has 500,000 records and 10 variables.

* option to show diagnostics.;
options fullstimer;

* turn on data set compression;
options compress=yes;

* set number of records for sample data set;
%let nobs=500000;

** Data set with unnecessarily long character fields.;
data with_long_vars;
  length gender race
city county state country
firstname lastname nickname
favoritocolor $500;
  do id=1 to &nobs.;
    output;
  end;
run;
NOTE: The data set WORK.WITH_LONG_VARS has 500000 observations and 11 variables.
NOTE: Compressing data set WORK.WITH_LONG_VARS decreased size by 99.44 percent.
    Compressed is 70 pages; un-compressed would require 12500 pages.
NOTE: DATA statement used (Total process time):
real time           2.22 seconds
user cpu time       1.77 seconds
system cpu time     0.10 seconds
memory              2113.53k
OS Memory           9344.00k
Timestamp           08/05/2015 08:48:50 AM
Step Count                        1  Switch Count  0

SAMPLE DATA SAS DATA SET WITH MORE APPROPRIATELY DEFINED VARIABLE ATTRIBUTES

data with_shorter_vars;
length gender $7
      race $40
      city $100
  county $100
      state $100
  country $100
    firstname $100
   lastname $100
      nickname $100
最喜欢color $40;
do id=1 to &nobs.;
   output;
end;
run;

NOTE: Compressing data set WORK.WITH_SHORTER_VARS decreased size by 97.51 percent.
Compressed is 154 pages; un-compressed would require 6173 pages.

NOTE: DATA statement used (Total process time):
real time           0.41 seconds
user cpu time       0.37 seconds
system cpu time     0.03 seconds
memory              580.68k
OS Memory           8932.00k
Timestamp           08/05/2015 08:49:12 AM
Step Count                        4  Switch Count  0

Notice in the above two examples that the data set with the more appropriately defined attributes is much more efficient. Even though compression is turned on, it is much less efficient to have character variables with storage lengths that are longer than necessary. The data set above is only 500,000 records and 10 variables. In practice data with millions of rows and hundreds of variables is very common.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Long Variables</th>
<th>Short Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>File Size</td>
<td>13.9MB</td>
<td>9.7MB</td>
</tr>
<tr>
<td>Real Time</td>
<td>2.22 seconds</td>
<td>0.41 seconds</td>
</tr>
</tbody>
</table>

THE SOLUTION

There are a few solutions to this problem of poorly defined SAS data set variable attributes.

1) Get the attributes changed in the source. This is the best case in that it is easiest for you. However, the entity providing you the data may not be willing, able, or have the time to make the changes.
2) Build a SAS view between the data source and your SAS data set environment.
3) Use the greenspace macro to minimize the footprint of your SAS data set(s)
BUILD A SAS VIEW AGAINST THE DATA SOURCE

One method to reduce the impact on processing is to build a SAS View in between the data source and your target data library. A view is a set of instructions on how to obtain the data. Every time you use the view, the data is pulled from the source.

```
proc sql;
  create view wlv_view as
  select id,
       gender length=7,
       race length=40,
       city length=100,
       county length=100,
       state length=2,
       country length=100,
       firstname length=100,
       lastname length=100,
       nickname length=100,
       favoritecolor length=40
  from with_long_vars;
quit;
```

THE GREENSPACE MACRO

In the interest of minimizing the footprint for a data set for your project data library, it would be best to have an automated process (macro) to calculate the minimal length necessary for storing the data in each of your character variables. The following is a high level overview of the steps that the greenspace macro carries out.

1) Reads the metadata for the input SAS data set and stores the variable names, types, lengths, formats, and labels into sequential macro variables.
2) Uses PROC SQL to read through the input SAS data set and store the maximum character value for each character variable. If the variable is numeric, it just uses the original length.
3) A SAS data step is used to write out the data set to the output data set designated in the macro parameter. The lengths from step 2 are used in a length statement prior to the set statement to force the new more efficient storage length. The format is also adjusted to match the new storage length for the character variables.
4) The informats are wiped out since they no longer serve a purpose.
5) PROC CONTENTS are run on the original input and new output SAS data sets for review.

The full documented code follows.

```sas
/*---------------------------------------------------------
Program: greenspace.sas
Programmer: Brian Varney
Date:
Purpose:
  Shorten the storage length of character variables to the longest value in that variable within the input data set.
Parameters:
  DSIN:  The input data set name. this can be a one or two level name.
  DSOUT: The output data set name. This can be a one or two level name.
Cautions:
```
I would not recommend making the output data set the same as the input data set. If something did not go as planned, you could lose the input data set.
If a character variable has a user defined format applied, it will be over written by a more generic format.
If there are indexes on the data set they will be removed when the data set is re-written.

---

%macro greenspace(dsin=,dsout=);

******************************************************************************;
** Keep as many macro variables local to the macro as possible. ***
******************************************************************************;
%local libn memn numvars i;

******************************************************************************;
** Split the input data set name into the two levels if appropriate. **
******************************************************************************;
%if %index(&dsin.,.)=0 %then
  %do;
    %let libn=WORK;
    %let memn=%upcase(&dsin.);
  %end;
%else %do;
    %let libn=%upcase(%scan(&dsin.,1,.));
    %let memn=%upcase(%scan(&dsin.,2,.));
%end;
%put &libn. &memn.;

******************************************************************************;
** Grab all of the variable information and put into macro variables. **
******************************************************************************;
proc sql noprint;
  select name, type, length, format, label
  into :name1-:name99999,
       :type1-:type99999,
       :length1-:length99999,
       :format1-:format99999,
       :label1-:label9999
  from dictionary.columns
  where libname="%upcase(&libn.)" and
       memname="%upcase(&memn.)"
  ; quit;
%let numvars=&sqlobs;

******************************************************************************;
** Calculate the maximum character value length for each variable and grab the current storage length for each numeric variable. **
******************************************************************************;
proc sql;
  create table &memn._maxlengths as
  select

%do i=1 %to &numvars.;
%if &&type&i.=char %then
%do;
  max(length(&&name&i.)) as &&name&i.
%end;
%else %do;
  &&length&i. as &&name&i.
%end;
%end;
%if &i ne &numvars. %then
%do;
,
%end;
%end;
from &dsin.;
;quit;

**********************************************************************;
** Transpose the data so we can load the desired variable storage lengths into macro variables. **;
**********************************************************************;
proc transpose data=&memn._maxlengths
out=&memn._maxlengthsv(rename=(col1=maxlength))
name=varname;
run;

**********************************************************************;
** Load the desired variable lengths into macro variables. **;
**********************************************************************;
proc sql noprint;
  select maxlength into :maxlength1-:maxlength99999
  from &memn._maxlengthsv;
quit;

**********************************************************************;
** Apply the new character variable storage lengths to the output data set. Also remove the informats from the character variables as they would not longer make sense with the storage length. If there was a user defined format applied to the variable, it will be updated with a generic character variable format. **;
**********************************************************************;
data &dsout.;
length
  %do i=1 %to &numvars.;
    &&name&i.
    %if &&type&i.=char %then
      %do; $&&maxlength&i. $end;
    %else
      %do; &&maxlength&i. $end;
    %end;
  %end;
set &dsin.;
format
  %do i=1 %to &numvars.;
    %if &&type&i.=char %then
      %do;
&&name&i. &&maxlength&i...
%end;
%end;
;
informat
%do i=1 %to &numvars.;
  %if &&type&i=char %then
    %do;
    &&name&i.
    %end;
  %end;
run;

******************************************************************************
** Examine the input and output data set attributes to ensure you are getting **
** what you are expecting. **
******************************************************************************
proc contents data=&dsin.;
title1 "Contents of &dsin. Before Greenspace"
run;

proc contents data=&dsout.;
title1 "Contents of &dsin. After Greenspace"
run;

******************************************************************************
** Reset the titles and footnotes. **
******************************************************************************
title1;
footnote1;
%mend greenspace;

CONCLUSION
Knowing your data attributes is important in addition to knowing your data content. By storing SAS data with appropriate variable attributes, poor performance and confusion can be avoided. There are times when this method could cause chaos. For example, if you need your variable attributes to be consistent as new data is added or removed, this approach may not be the best.

CONTACT INFORMATION
Your comments and questions are valued and encouraged. Contact the author at:

Brian Varney:
Experis
5220 Lovers Lane, Suite 200
Portage, Michigan 49002
Office: (269) 553-5185
Fax: (269) 553-5101
E-mail: brian.varney@experis.com
Web: www.experis.us/analytics

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