

Exchange of SAS programs between local/server based SAS and the SAS Life Science Analytical Framework

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ABSTRACT

The ability to run SAS programs on a local/server based SAS environment and within the SAS Life Science Analytical Framework (LSAF) is not possible without changing SAS program code. In this paper a secure process and a macro framework will be presented to exchange SAS programs between a local/server based SAS environment and the SAS Life Science Analytical Framework (LSAF) without further required changes to the SAS program code. Furthermore in this paper a process will be presented, how to upload automatically the SAS program and the required LSAF job, which is created based on a dependency matrix.

INTRODUCTION

SAS Life Science Analytical Framework has been introduced as the central data repository which also has the possibility to store and execute SAS programs. The current SAS development environment is local/server based. In this project the central data repository has been expanded to incorporate the ability to store and execute the validated clinical analyses SAS programs together with the clinical study data. The program exchange between the local/server based SAS environment and the SAS Life Science Analytical Framework must ensure that the SAS code remains as originally created on the local/server based SAS environment. This will allow us to use the local/server based SAS as the development environment and the SAS Life Science Analytical Framework as our validation and productive environment.

BACKGROUND

The most common way of exchanging data, files, programs etc. between an local/server based SAS and the SAS Life Science Analytical Framework is the use of a WEBDAV client, the SAS Life Science Analytical Framework macros for download, or upload or the SAS Life Science Analytical Framework web frontend tools.

AVAILABLE OPTIONS

- **WEBDAV Client:**
A WEBDAV client software like Web Drive or the SDD (SAS Drug Development) Desktop Connector maps the SAS Life Science Analytical Framework Repository or SAS Life Science Analytical Framework User Workspace as a drive to Windows.
- **SAS Life Science Analytical Framework Macros:**
The two possibilities for the upload are the SAS Life Science Analytical Framework macros:
 - o **LSAF_CREATEFILE:** The macro uploads a file from the local/server based SAS to the SAS Life Science Analytics Framework repository.
 - o **LSAF_UPLOADANDEXPAND:** The macro uploads and expands the contents of a zip file into the specified folder location in the SAS Life Science Analytics Framework repository.The two possibilities for the download are the SAS Life Science Analytical Framework macros:
 - o **LSAF_DOWNLOADFILE:** The macro download a file from the SAS Life Science Analytics Framework repository to a local computer/server.
 - o **LSAF_DOWNLOADASZIP:** The macro downloads files or a folder along with its content from the SAS Life Science Analytics Framework repository to a local computer/server

LIMITATIONS WITH THESE OPTIONS

- **WEBDAV Client:**
 - o Official supported only for Windows operating systems
 - o SAS programs they are use WEBDAV for the data import only run under Windows
 - o Download very slow for large files

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- o Limited file size
- SAS Life Science Analytical Framework Macros:
 - o The macro LSAF_LOGIN have to run before you can use the download or upload macros.
 - o LSAF_LOGIN shows the cleartext password in the SAS log.
 - o Downloaded content is always stored on a drive before you can process further. Extract function is missing applies to the macro LSAF_DOWNLOADZIP.
 - o Download very slow for large files, applies to the macro LSAF_DOWNLOADFILE.

SOLUTION

A SAS program which should run in both environments must use the same SAS code and macros, this means that macros and catalogs must be present in both environments. A code change in a valid environment is not allowed. Furthermore, all macros must be able to determine in which environment they are executed.

THE SUPPORTIVE MACRO: WHERE AM I

A simple SAS macro which returns a macro variable with the information in which environment the code is executed. In the SAS Life Science Analytics Framework can the code run in the workspace or in the repository.

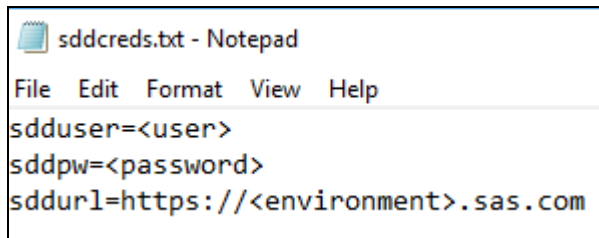
```
%LET _grtcdw_whereami=workspace;  
%LET _grtcdw_whereami=repository;  
%LET _grtcdw_whereami=windows;
```

SECURE SAS LIFE SCIENCE ANALYTICAL FRAMEWORK LOGIN

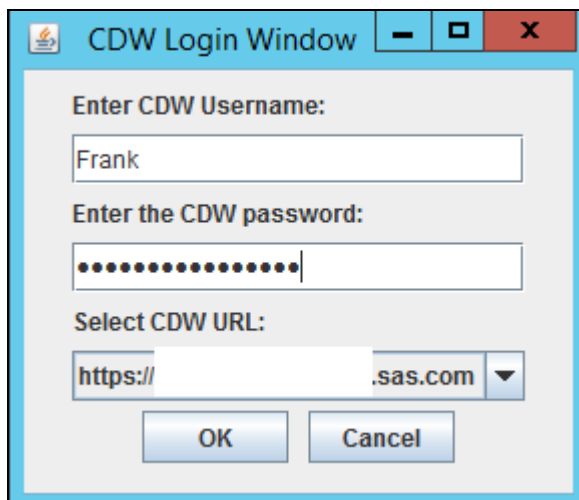
First, we should take care that the SAS Life Science Analytics Framework login information is not displayed in the SAS log and that all required macros do not need a separate login macro.

To get around that we have implemented the following steps:

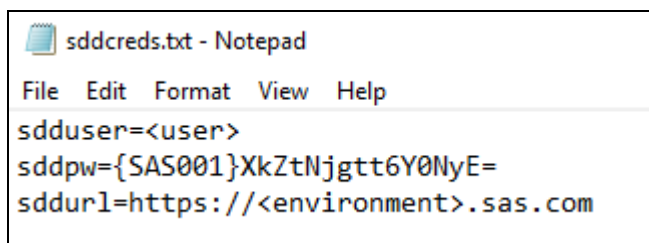
1. The SAS macro SASDRUGDEV_SESSIONLOGIN which is described in the SAS Problem Note 49562. is used.
2. The macro SASDRUGDEV_SESSIONLOGIN expects a text file which contains the SAS Life Science Analytics Framework login information.



3. To create the required text file we wrote a Java program. The program checks also if the user exists in the SAS Life Science Analytics Framework, if the account is not locked and if the password has not expired. Furthermore, the password is stored encrypted in the text file. The text file is stored directly in the user profile folder. The Java program uses classes of the SAS Life Science Analytics Framework Java APIs.



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```
sdduser=<user>
sddpw={SAS001}XkZtNjgtt6Y0NyE=
sddurl=https://<environment>.sas.com
```

4. The macro SASDRUGDEV_SESSIONLOGIN was extended with the function for decrypting the password variable.
5. We wrote a new SAS Life Science Analytics Framework login macro with the following functions:
 - The supportive macro grtc dw_whereami controls in which environment the macro is executed:
`%IF %grtc dw_whereami=windows %THEN %DO;`
 - Active sessions have to be stopped before you can log in again. Global macro variables must be deleted.
`%IF %SYMEXIST(sddsession) %THEN %DO;`
`%sasdrugdev_logout;`
`%SYMDEL sddsession sddcredfile;`
`%PUT Deleting macro variable SDDSESSION from scope GLOBAL.;`
`%PUT Deleting macro variable SDDCREDFILE from scope GLOBAL.;`
`%END;`
 - Create a macro variable that contains the path to the login file. Call the macro SASDRUGDEV_SESSIONLOGIN. Create the macro variable sddsession and set the value active.
`%GLOBAL sddcredfile sddsession;`
`%LET sddcredfile = C:\Users\&sysuserid\sddcreds.txt;`
`%sasdrugdev_sessionlogin();`
`FILENAME _all_ CLEAR;`
`%LET sddsession=active;`
`%END;`

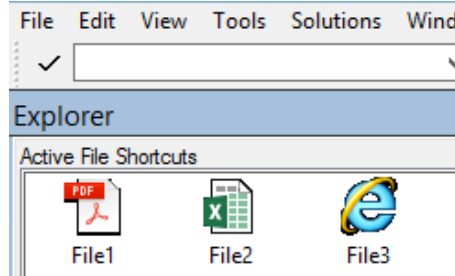
DATA AND FILE DOWNLOAD

The data and file download from the SAS Life Science Analytics Framework to our local/server based SAS environment has to be adapted to our requirements. To ensure that the code runs in both environments, SAS datasets and other files are only stored in the temporary SAS session folder. To realize this, we developed two new macros.

1. GRTCDW_DOWNLOAD
Macro for downloading SAS related files like SAS7BDAT, CPORT and XPORT.
 - The macro has the following input parameters
`cdwpath =`; SAS Life Science Analytics Framework data directory path
`dsetlist=_ALL_`; Dataset names without file extension. `_ALL_` = select all datasets
`dsetvers=`; Version of the dataset if empty the latest version will be downloaded
`libout=WORK`; Define a SAS libref default=work, only a valid SAS libref is required the macro creates a folder in the SAS temporary work directory and registers the library.
 - Login to the SAS Life Science Analytics Framework takes place in the macro with the help of the macro `%grtc dw_sessionlogin`;
 - SAS Transport datasets like XPORT and CPORT are automatically extracted.
 - Example call: three datasets with different version will be download.
`%grtc dw_download(cdwpath=/DUMMY/project/study/Files/current_data/analysis_data/xpt, dsetlist=adae addm adex, dsetvers=3.0 2.0);`
 - The macro also checks with the help of the supportive macro `%grtc dw_whereami` in which environment it runs. That has the following influence on the function of the macro:
`_grtc dw_whereami=windows`; Download the datasets
`_grtc dw_whereami=workspace or repository`; Synchronize the datasets
2. GRTCDW_FILEDOWNLOAD
Macro for downloading other file types like EXCEL, PDF, WORD, ASCI and so on, into the SAS temporary work directory.
 - The macro has the following input parameters
`cdwpath =`; SAS Life Science Analytics Framework data directory path
`filelist =_ALL_`; Filename + file extension. `_ALL_` = select all files except SAS related files from a directory.
`filevers=`; Version of the file if empty the latest version will be download

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- Login to the SAS Life Science Analytics Framework takes place in the macro with the help of the macro **%grtc dw_sessionlogin**;
- Downloaded files are displayed as shortcut in the SAS Display Manager.



- Example call: three files will be download:
%grtc dw_filedownload(cdwpath=/DUMMY/project/study/Files/current_data/sdtm/xpt, filelist=file1.pdf file2.xml file3.xlsx);
- The macro also checks with the help of the supportive macro **%grtc dw_whereami** in which environment it runs. That has the following influence on the function of the macro:
_grtc dw_whereami=windows; Download the datasets
_grtc dw_whereami=workspace or repository; Synchronize the files

DATA UPLOAD

The data and file upload from our local/server based SAS environment to the SAS Life Science Analytics Framework has to be adapted to our requirements. To cover our requirements we developed the new upload macro **%grtc dw_upload**.

- The macro has the following input parameters
cdwpath=; SAS Life Science Analytics Framework data upload path
subfolder=; Parameter to specify a subfolder the subfolder will be created under the data upload path
locallib=work; Data source library for the upload default=work
localfld=; Data source path for the upload, can be used if the variable locallib is not set and vice versa.
dsetlist=_ALL_; Specify the datasets or files for to upload. _ALL_ = upload all datasets/files from a source location
- Login to the SAS Life Science Analytics Framework takes place in the macro with the help of the macro **%grtc dw_sessionlogin**;
- A SAS dataset is automatically converted to a SAS transport file CPORT or XPORT.
- Example call a subfolder will be created a two files will be uploaded:
%grtc dw_upload(cdwpath=/DUMMY/_data_exchange/Files/import/project/study/current_data/analysis_data/xpt, subfolder=sub_analysis, locallib=in, dsetlist=adae addm);
- The macro also checks with the help of the supportive macro **%grtc dw_whereami** in which environment it runs. Data will be upload or stored only in our data exchange are irrespective in which environment the macro is called.

We develop some more supportive macros for the interaction between the local/server based SAS and the SAS Life Science Analytics Framework but these are not relevant for the described solution.

SAS LIFE SCIENCE ANALYTICS FRAMEWORK CHANGES

To avoid the specification of all macros in a SAS Life Science Analytical Framework job we have implement together with SAS a shared macro library in our SAS Life Science Analytics Framework. For the shared macro library a folder was created directly on the operating system afterwards in the SAS configuration file the variable SASAUTOS must be extended with the new path. We store all our global SAS macros and the SAS Life Science Analytics Framework connection macros in that folder.

Not every SAS Life Science Analytics Framework user can add or remove SAS macros from the shared macro folder. In order to ensure that, we create a new user CDWLM Clinical Data Warehouse Library Manger with special permissions.

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MOVE PROGRAMS TO THE SAS LIFE SCIENCE ANALYTICS FRAMEWORK

We developed for the move of SAS programs between the local/server based SAS and the SAS Life Science Analytics Framework four macros: `%_depmacros`, `%grtc dw_createjob`, `%grtc dw_createpackage` and `%grtc dw_executejob`.

The next section describes the macros more in detail.

MACRO: %_DEPMACROS

The macro `%_depmacros` collects all programs belonging to the current batch from the programming plan. Furthermore it determine which macros are used within the programs outlined in the programming plan.

Two macro types are distinguished: **generic (global) macros** which are available in the shared macro folder on the SAS Life Science Analytics Framework and in the global macro folder on the local/server based SAS Environment. These macro does need to be transferred. **Study specific macros** these macros need to be transferred.

Outcome is a dependency matrix:

Table	View									
	deptype	item	itempath	prgpath	outputpath	programe	mode	filename	filepath	prog_dtm
1	macros	_setting2	../04_macros	03_tfl	output	t-ibu-tab01	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
2	macros	g_create_tit_v0202	../04_macros	03_tfl	output	t-ibu-tab01	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
3	macros	g_titfoot_v0301	../04_macros	03_tfl	output	t-ibu-tab01	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
4	macros	g_wrappy_v0200	../04_macros	03_tfl	output	t-ibu-tab01	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
5	macros	grtc dw_download	../04_macros	03_tfl	output	t-ibu-tab01	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
6	macros	_setting2	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
7	macros	g_create_tit_v0202	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
8	macros	g_titfoot_v0301	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
9	macros	g_wrappy_v0200	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
10	macros	grtc dw_download	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
11	macros	sort	../04_macros	03_tfl	output	t-ibu-tab02	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
12	macros	_setting2	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
13	macros	g_create_tit_v0202	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
14	macros	g_titfoot_v0301	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
15	macros	g_wrappy_v0200	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
16	macros	grtc dw_download	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
17	macros	sort	../04_macros	03_tfl	output	t-ibu-tab03	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
18	macros	_setting2	../04_macros	03_tfl	output	t-ibu-tab04	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011
19	macros	g_create_tit_v0202	../04_macros	03_tfl	output	t-ibu-tab04	prg	H:\DEV\GRTV...	H:\DEV\GRTV...	29Sep2011

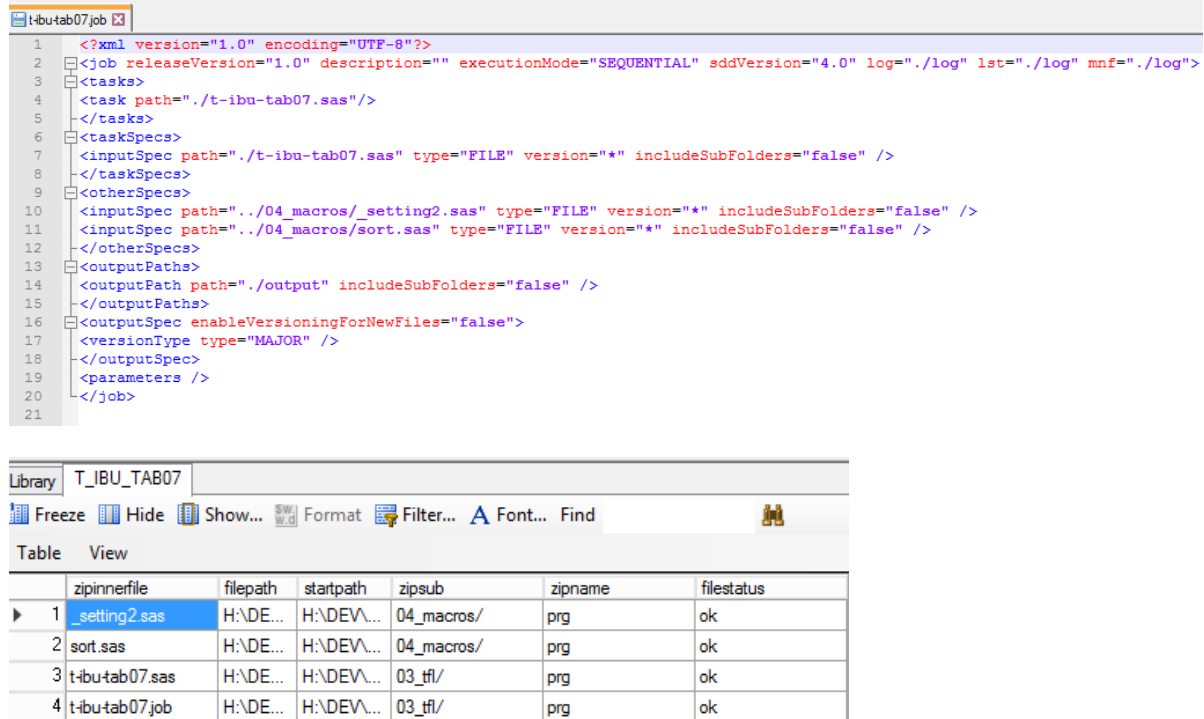
MACRO: %GRTCDW_CREATEJOB

The macro `%grtc dw_createjob` requires the dependency matrix dataset. It creates from the programs which are listed in the dependency matrix dataset one SAS Life Science Analytics Framework job and one metadata dataset per program.

- The macro has the following input parameters
`mdspath=`, directory where the dependency matrix dataset is stored
`mdds=`, dependency matrix dataset name
`mdprg=_all_`, specific program name or `_ALL_` = for all programs in the dependency matrix dataset are job files created.
- Example call create one SAS Life Science Analytics Framework job for the program t-ibu-tab07.
`%grtc dw_creatjob(mdspath=H:\DEV\DUMMY\project\study\Files\dev\metadata, mdds=depmatrix, mdprg=t-ibu-tab07);`

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- Example job file and the associated metadata file dataset



The screenshot displays the SAS Studio interface. The top pane shows the XML code for the job file `t-ibu-tab07.job`. The bottom pane shows the metadata dataset `T_IBU_TAB07` in table view.

```

1  <?xml version="1.0" encoding="UTF-8"?>
2  <job releaseVersion="1.0" description="" executionMode="SEQUENTIAL" sddVersion="4.0" log="./log" lst="./log" mnf="./log">
3    <tasks>
4      <task path="./t-ibu-tab07.sas"/>
5    </tasks>
6    <taskSpecs>
7      <inputSpec path="./t-ibu-tab07.sas" type="FILE" version="*" includeSubFolders="false" />
8    </taskSpecs>
9    <otherSpecs>
10     <inputSpec path="./04_macros/_setting2.sas" type="FILE" version="*" includeSubFolders="false" />
11     <inputSpec path="./04_macros/sort.sas" type="FILE" version="*" includeSubFolders="false" />
12   </otherSpecs>
13   <outputPaths>
14     <outputPath path="./output" includeSubFolders="false" />
15   </outputPaths>
16   <outputSpec enableVersioningForNewFiles="false">
17     <versionType type="MAJOR" />
18   </outputSpec>
19   <parameters />
20 </job>
21

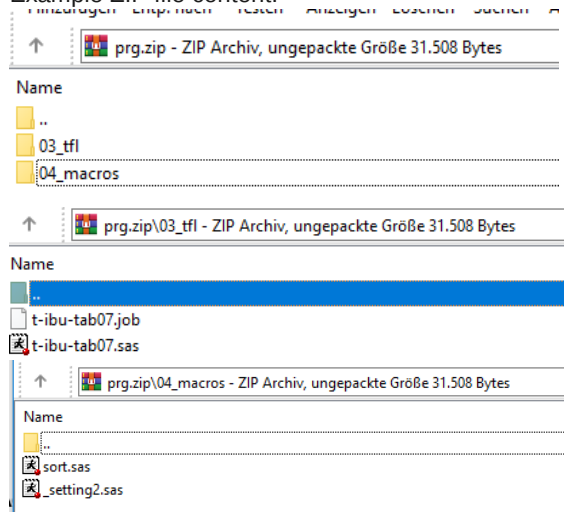
```

	zipinnerfile	filepath	startpath	zipsub	zipname	filestatus
1	_setting2.sas	H:\DE...	H:\DEV...	04_macros/	prg	ok
2	sort.sas	H:\DE...	H:\DEV...	04_macros/	prg	ok
3	t-ibu-tab07.sas	H:\DE...	H:\DEV...	03_tfl/	prg	ok
4	t-ibu-tab07.job	H:\DE...	H:\DEV...	03_tfl/	prg	ok

MACRO: %GRTCDW_CREATEPACKAGE

The macro `%grtc dw_createpackage` requires the metadata dataset which is created from the macro `%grtc dw_createjob`. It creates a ZIP file which contains the required folder structure and all files which are listed in the job metadata file.

- The macro has the following parameters:
`mdspath=`, directory where the job metadata dataset is stored
`mdds=`, job metadata dataset name
- Example call: create one zip file
`%grtc dw_createpackage(mdspace=H:\DEV\DUMMY\project\study\Files\dev\metadata, mdds=t_ibu_tab07);`
- Example ZIP file content:



The screenshot shows a Windows Explorer window displaying the contents of a ZIP file named `prg.zip`. The file is located at `H:\DEV\DUMMY\project\study\Files\dev\metadata`. The ZIP file contains the following structure:

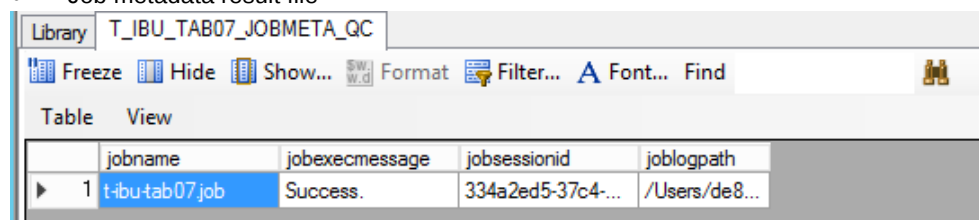
- `prg.zip` - ZIP Archiv, ungepackte Größe 31.508 Bytes
 - `03_tfl`
 - `t-ibu-tab07.job`
 - `t-ibu-tab07.sas`
 - `04_macros`
 - `_setting2.sas`
 - `sort.sas`

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MACRO: %GRTCDW_EXECUTEJOB

The macro %*grtcdw_executejob* uploads a zip file to the SAS Life Science Analytics Framework which is created by the macro %*grtcdw_createpackage*. Furthermore, it extracts the zip file and execute the job. The macro creates also the needed folder structure in the QC area and metadata for further processing.

- The macro has the following parameters:
cdwdir=, SAS Life Science Analytics Framework data upload path
zippackage=, directory + filename where the zip file is stored
cdwqcrun=**1**, Execute the job in the QC (default) or Productive area
- Example call: upload the package and execute the SAS Life Science Analytics Framework job in the QC area.
%grtcdw_executejob(cdwdir=/DUMMY/project/study/Files/dev/prg, zippackage=prg\prg.zip, cdwqcrun=1);
- Job metadata result file



The screenshot shows a SAS metadata table named T_IBU_TAB07_JOBMETA_QC. The table has four columns: jobname, jobexecmessage, jobsessionid, and joblogpath. The first row shows a job named 't-bu-tab07 job' with a status of 'Success.', session ID '334a2ed5-37c4-...', and log path '/Users/de8...'. The table is displayed in a 'Table' view within a SAS interface.

	jobname	jobexecmessage	jobsessionid	joblogpath
1	t-bu-tab07 job	Success.	334a2ed5-37c4-...	/Users/de8...

CONCLUSION

This programming framework enables the exchange of SAS programs between a local/server based SAS environment and the SAS Life Science Analytical Framework. No changes to SAS program code had to be made. The benefit is that no additional validation required after the transfer of the program to the SAS Life Science Analytical Framework. Furthermore, each programmer can continue their work with their favorite program editor. Our framework works via the SAS Display Manager, SAS Studio and together with the integrated SAS Life Science Analytics Framework Editor. To ensure that the framework is robust and integrity is maintained a process, good documentation and training are important.

REFERENCES

SAS Life Science Analytics Framework Macro API 1.5 User Guide

SAS Life Science Analytics Framework Java API 1.8.1 Documentation

SAS Macro SASDRUGDEV_SESSIONLOGIN:

http://support.sas.com/kb/49/addl/fusion_49562_8_sasdrugdev_sessionlogin.zip

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