

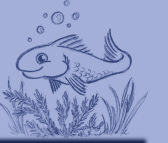
Katja Glass
Consulting

Continuous Integration & Delivery for SAS Macros

Automate Processes



Agenda



- Introduction
 - Use Case
 - Processes
 - Additional Use Cases
 - Opportunities & Summary
-



Introduction



➤ Definition

“Continuous integration (CI) is the practice of merging all developers' working copies to a shared mainline several times a day”

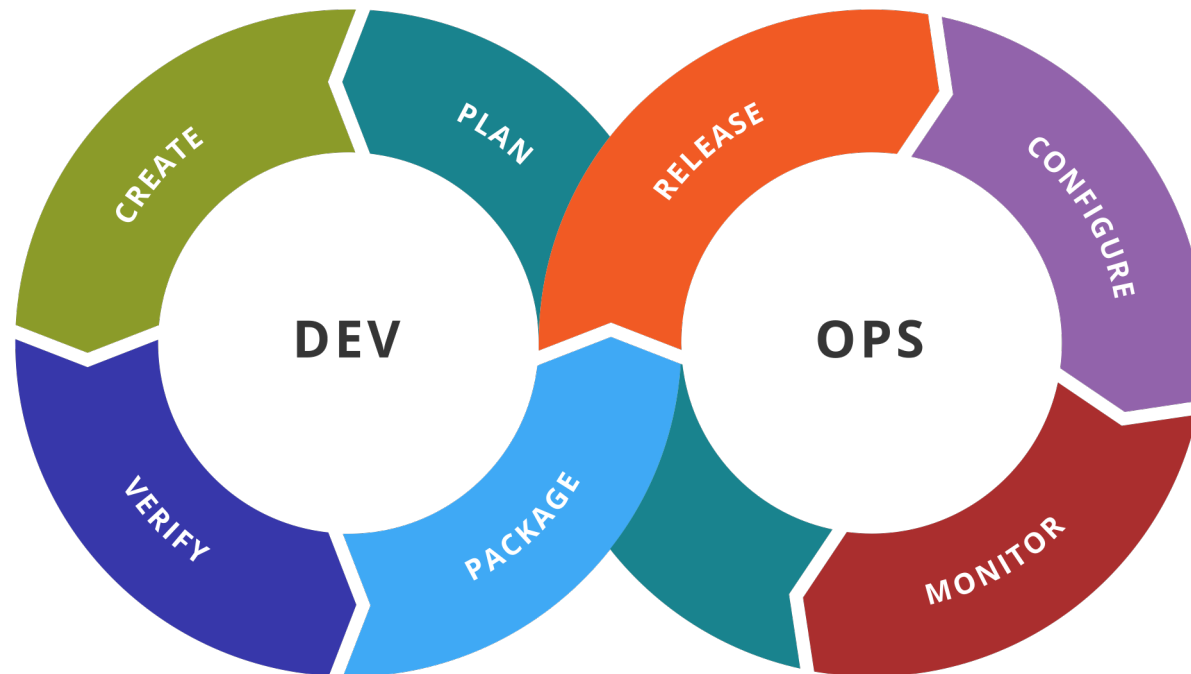
“Continuous delivery (CD) [...] produce software in short cycles, ensuring that the software can be reliably released at any time and, when releasing the software, without doing so manually.”

Introduction



Continuous
Integration

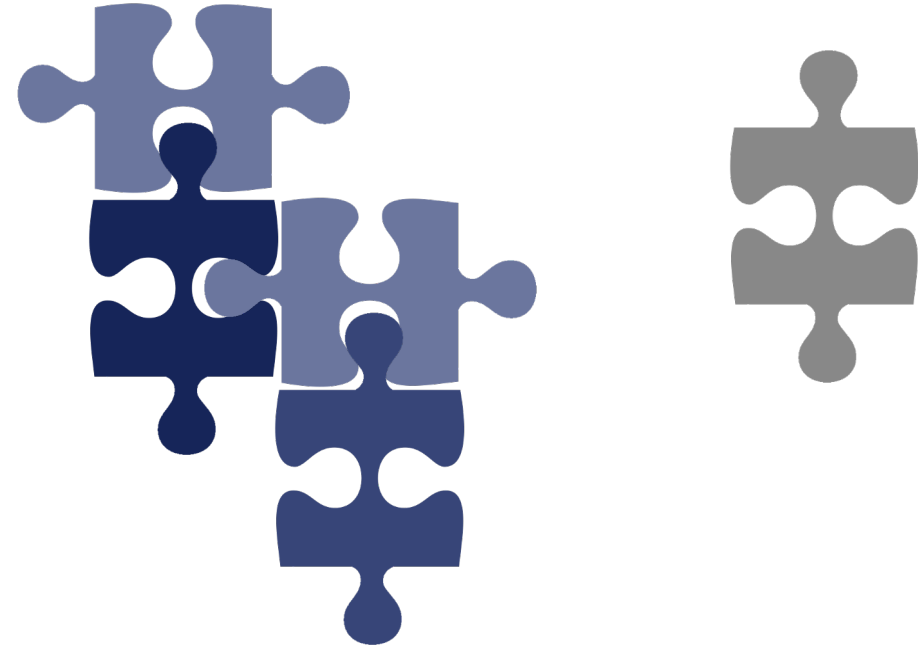
Continuous
Delivery



Introduction



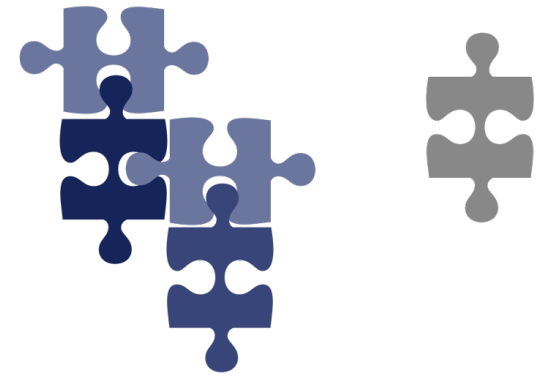
- Practices
 - Code repository
 - Automatic build pipeline
 - Self-testing
 - Automate deployment



Introduction



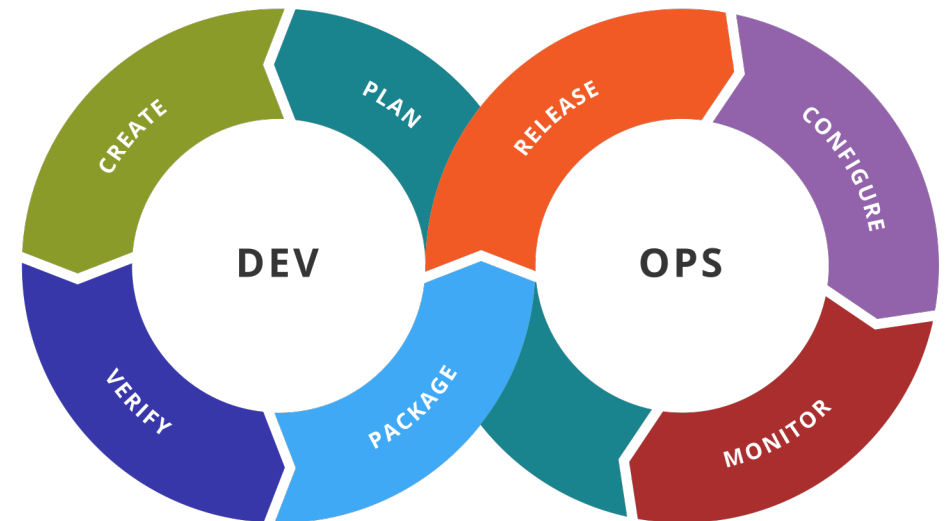
- CI/CD for SAS Processes?
 - Typically independent small components (standalone macros)
 - Rarely “huge” system with cross-dependencies
 - Often not 1:1 usable
- Use for Complex tools
 - SAS huge applications
 - R-Shiny etc.



Introduction



- Automation for SAS Processes?
 - CI/CD comes with principles and rules
 - Advantages for “simple” SAS development
- Advantages
 - Version Control (Git)
 - Automated tests
 - Automated documentation
 - Automated deployment
 - Pipelines!



Pipelines



➤ Pipelines for various tasks

Automated Data Flow



Continuous integration pipeline (CI)



Continuous development pipeline (CD)



Setup Study Flow



Pipelines



- Pipeline support
 - Trigger Pipeline to start
 - Processes to run a pipeline
 - Rules what on issues / states
 - Tools supporting / running pipeline
- GitHub and GitLab great pipeline support

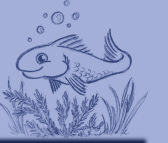
Continuous integration pipeline (CI)



Continuous development pipeline (CD)



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Use Cases



- SMILE – Smart SAS Macros (open-source macros)
 - Create flat PDF files, Merge PDF files, Read PDF Bookmarks ...

- Macros development
- Example programs
- Documentation
- Publication

SMILE - Smart SAS Macros

TEST_SMILE_ODS_DOCUMENT_FLAT_LABEL

Example program for macro calls of %smile_ods_document_flat_label

- Author : Katja Glass
- Creation : 2021-02-18
- SAS Version: SAS 9.4
- License : MIT

Initialize macros

```
%LET root = <path>;
OPTIONS SASAUTOS=(SASAUTOS, "&root/macros");
```

set options for nice layout

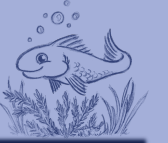
```
OPTIONS NODATE NONUMBER NOCENTER ORIENTATION=landscape;
TITLE;FOOTNOTE;
OPTIONS PS=35;
```

Example 1 - empty ODS Document - warning expected

Table of contents

- Example 1 - empty ODS Document - warning expected
- Example 2 - not existing ODS Document - error expected
- Example 3 - create flat navigation PDF using one ODS DOCUMENT
- Example 4 - create flat navigation PDF using multiple ODS DOCUMENT - with re-labeling
- Example 5 - create flat navigation PDF using multiple ODS DOCUMENT
- Example 6 - create flat navigation PDF using multiple ODS DOCUMENT - no entry for some items
- Example 7 - create flat navigation PDF using multiple ODS DOCUMENTS with custom TOC
- Example 8 - create flat navigation PDF using multiple ODS DOCUMENTS - many outputs

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-



Processes



- Develop open-source SAS macros
 - SAS macros (+ documentation in header)
 - SAS example programs (+ documentation in comments)
 - Documentation website
 - Source release

 **SMILE - Smart SAS Macros**

SMILE - Smart SAS Macros
Overview
Macros
smile_attrc
smile_attrn
smile_attr_var
smile_ods_document_flat_label
smile_pdf_merge
smile_pdf_read_bookmarks
smile_replace_in_text_files
smile_url_check
smile_url_download
Example Programs
smile_attrc

TEST_SMILE_PDF_MERGE

Example program for macro calls of %smile_pdf_merge

- Author : Katja Glass
- Creation : 2021-02-18
- SAS Version: SAS 9.4
- License : MIT

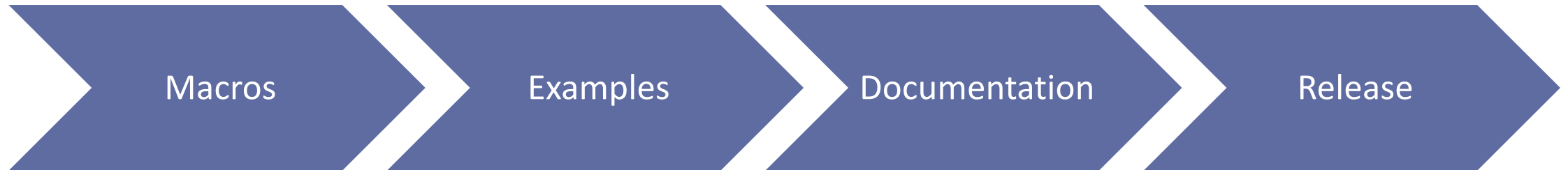
Initialize macros and variables

```
%LET root = <path>;  
%LET out = &root/results;  
%LET libPath = &root/lib;
```

Processes



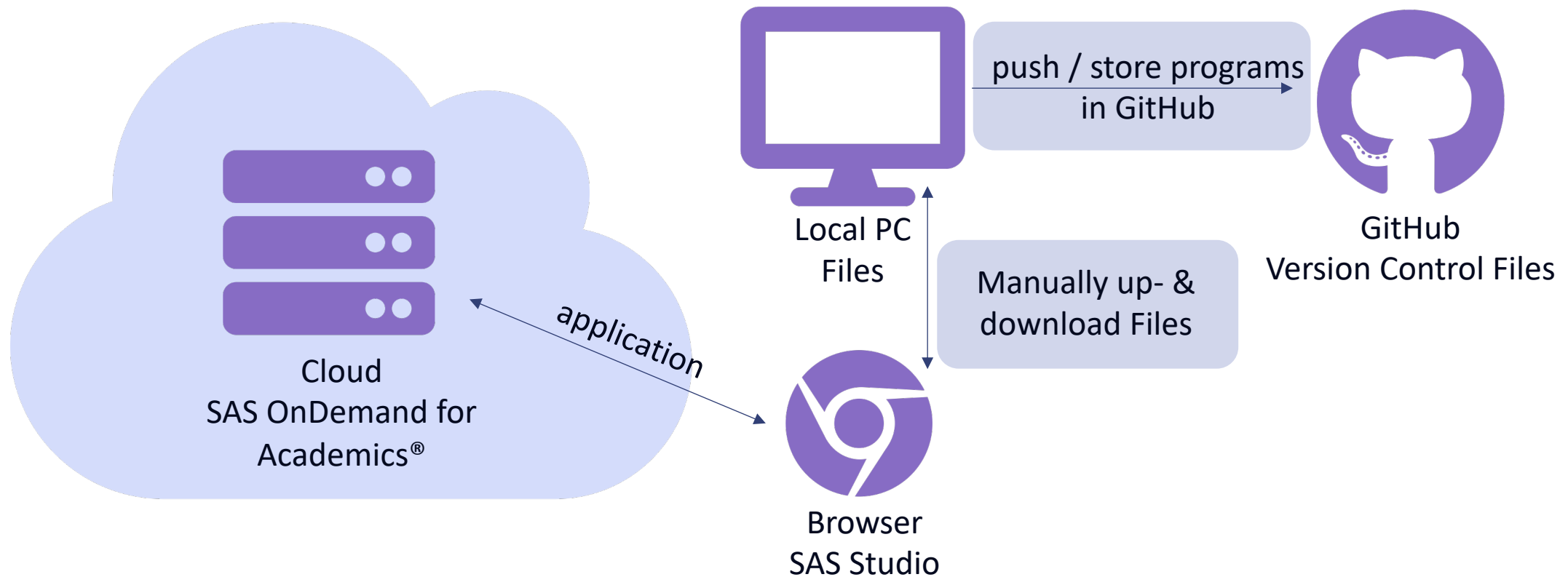
- Develop open-source SAS macros
 - SAS macros (+ documentation in header)
 - SAS example programs (+ documentation in comments)
 - Documentation website
 - Source release



Environment



➤ Cloud SAS OnDemand for Academics®

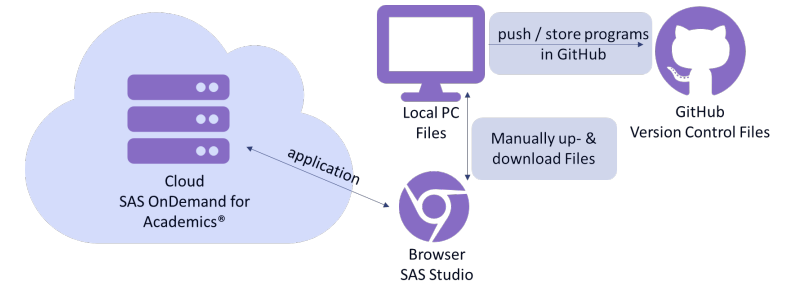


Environment



➤ SAS Development Environment (OnDemand)

- Disgusting file handling
- Automation required!



➤ **Upload** Pipeline

- (pull files from GitHub)
- push files to cloud

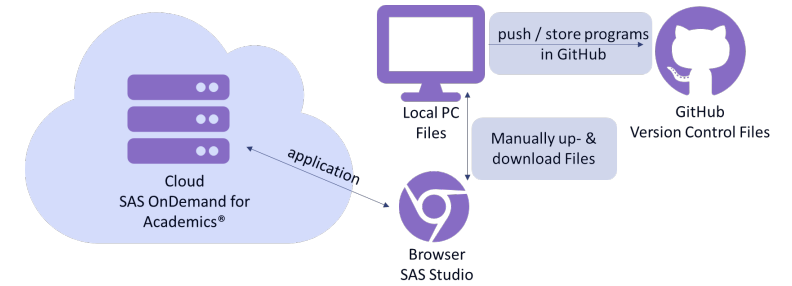
➤ **Download** Pipeline

- (pull files from cloud)
- push files to GitHub

Environment



- SAS Development Environment (OnDemand)
 - Disgusting file handling
 - Automation required!

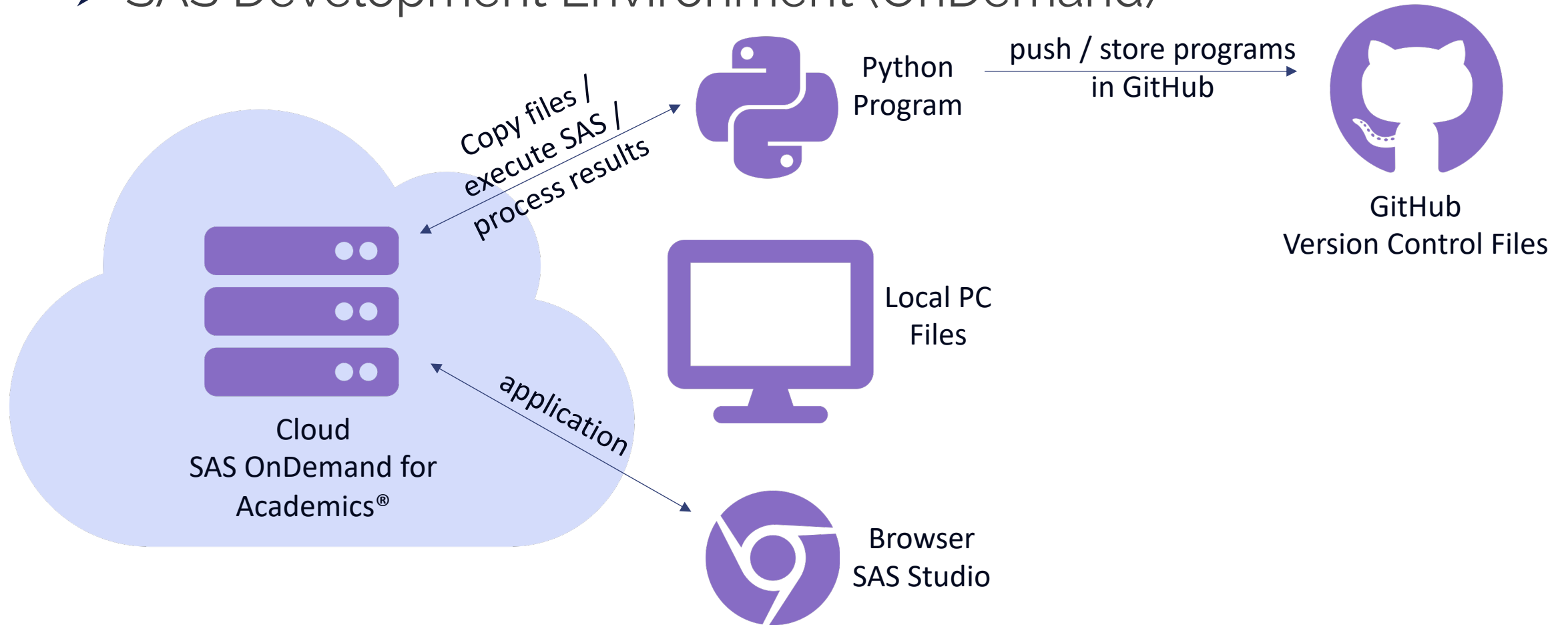


SASPy

Environment



➤ SAS Development Environment (OnDemand)



Environment



- [SASPy](#)
 - Interface to SAS!
 - SAS 9.4 or above (for learning SAS OnDemand for Academics)
 - Python 3.x or above

Up-/Download
Files & Data

Run SAS
snippets

...

Execute SAS
programs

Mix SAS &
Python

Processes



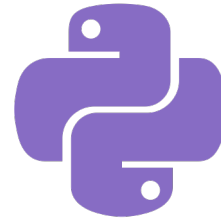
➤ Macro Update Processes

➤ Upload

- Create a *.zip backup
- Overwrite files

➤ Download

➤ (Push to GitHub)



Python
Program

➤ Develop in SAS Studio



Browser
SAS Studio

Macros

Processes



➤ Python Upload

- Zip all “overwrite” files (use SASJs open-source zip macro)

```
ll = sas.submit("""
filename mc url "https://raw.githubusercontent.com/sasjs/core/main/all.sas";
%inc mc;
%mp_zip(in      = /home/u00000000/smile/macros,
        type    = directory,
        outname  = 2021-04-21-macros,
        outpath  = /home/u00000000/smile/);
""")
```

Macros

Processes



- Python Upload
 - Upload all files in folder

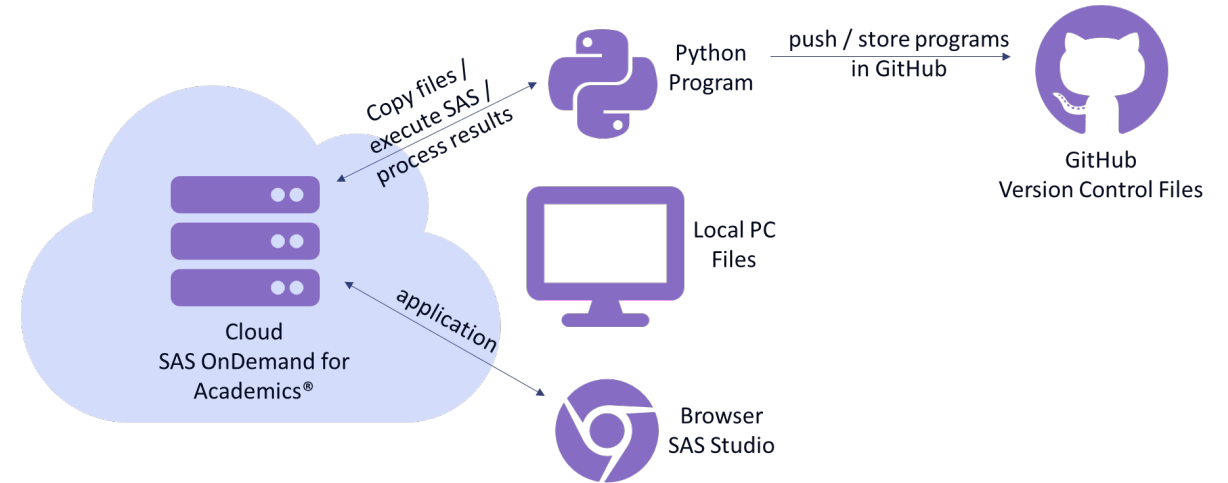
```
def upload_files_from_path(from_path, to_path):  
    myFiles = [f for f in listdir(from_path) if isfile(join(from_path, f))]  
    for file in myFiles:  
        print("upload file to SAS: " + file)  
        sas.upload(join(from_path, file), to_path + "/" + file)  
  
upload_files_from_path("C:\\smile\\macros", "/home/u000000000/smile/macros")
```

Macros

Processes



- Examples Development
 - Same approach
 - Upload/download files
 - Version control in GitHub
 - Working in SAS Studio



Macros

Examples

Processes



➤ Documentation

Microsoft Word® ?

Web !



Macros

Examples

Documentation

Processes



➤ Documentation

Manually ?

Framework !



Macros

Examples

Documentation

Processes



➤ Documentation



Repeat ?

Reuse !

Macros

Examples

Documentation

Processes



➤ Web Documentation

➤ Creating Webpage

- Use tools, e.g. SASJs (Doxygen) or MKDocs

➤ SASJs (open-source)

- Auto-documentation
- Requires SASJs Header
- Mainly Macro documentation



➤ Host Webpage

- Along with Code -> GitHub Pages!

<https://github.com/KatjaGlassConsulting/SMILE-SmartSASMacros>

<https://katjaglassconsulting.github.io/SMILE-SmartSASMacros/>

Macros

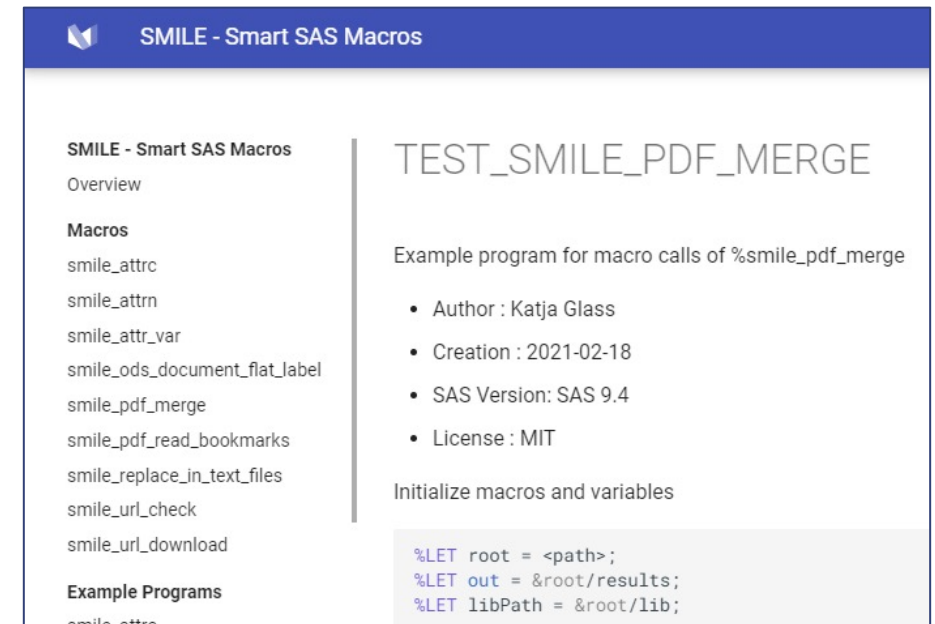
Examples

Documentation

Processes



- Web Documentation
 - Header (own format)
 - Additionally Example documentation
 - MKDocs Framework (Material)
 - Create **markdown** pages
 - Compile to webpage
 - Pipeline to compile / host in GitHub Pages



Macros

Examples

Documentation

Processes



- Markdown creation
 - Text file format
 - Core information available
 - Header information
 - Comments in examples
- Markdown automatization!
 - Scan files
 - Create documentation

```
1  # SMILE - Smart SAS Macros
2
3  SMILE stands for <b>S</b>mart SAS <b>M</b>acros - an <b>I</b>nterface
4
5  The macros could easily be made available in any SAS environmen
6
7  ```sas
8  FILENAME macros URL "https://raw.githubusercontent.com/Kat
9  %INCLUDE macros;
10 ```
11
12 ## Macro Overview
13
14 The following macros are available in the SMILE - Smart SAS
15
16 Macro | Description
17 ---|---
18 smile_attr_var |Function-style macro to return a variable
19 smile_attrc |Function-style macro to return a character at
20 LABEL, LIB, MEM, MODE, MTYPE, SORTEDBY, SORTLVL, SORTSEQ,
21 smile_attrn |Function-style macro to return a numeric attr
```

Macros

Examples

Documentation

Processes



- Information Extraction
 - File processing with SAS
([Paper in German available](#))
 - Examples should contain outputs / logs / datasets
 - Scan
 - Execute
 - Retrieve content for documentation
 - Store in markdown
 - Screenshots to take manually

Call macro to merge documents, additionally store GROOVY program

```
%smile_pdf_merge(  
  data          = content  
  , outfile     = &out/pdf_merge_output1.pdf  
  , pdfbox_jar_path = &libPath/pdfbox-app-2.0.22.jar  
  , sourcefile   = &out/pdf_merge_program1.sas  
  , run_groovy   = YES  
);
```

Desired PDF file has been created

The screenshot shows a PDF viewer window titled 'Lesezeichen' (Bookmarks) on the left and a table titled 'Table 1: By Group Report about shoes' on the right. The table has a header 'Region=Canada' and two columns: 'Product' and 'Total Sales'.

Region=Canada	
Product	Total Sales
Boot	\$17,720
Men's Dress	\$12,775
Sandal	\$2,886
Slipper	\$5,676

Macros

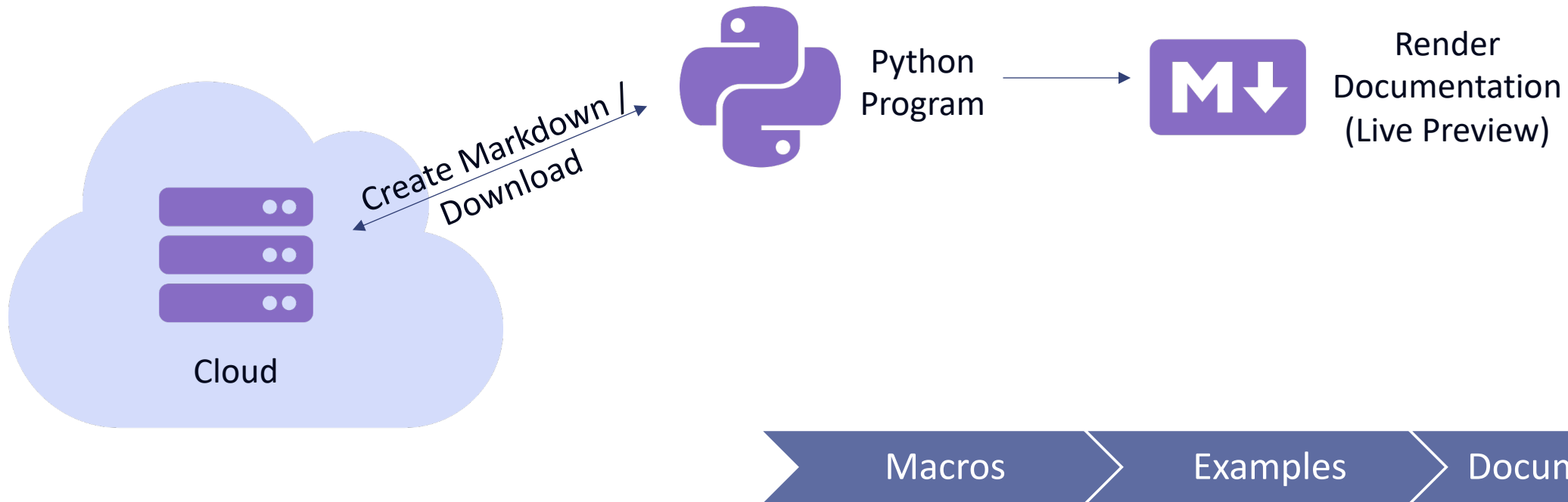
Examples

Documentation

Processes



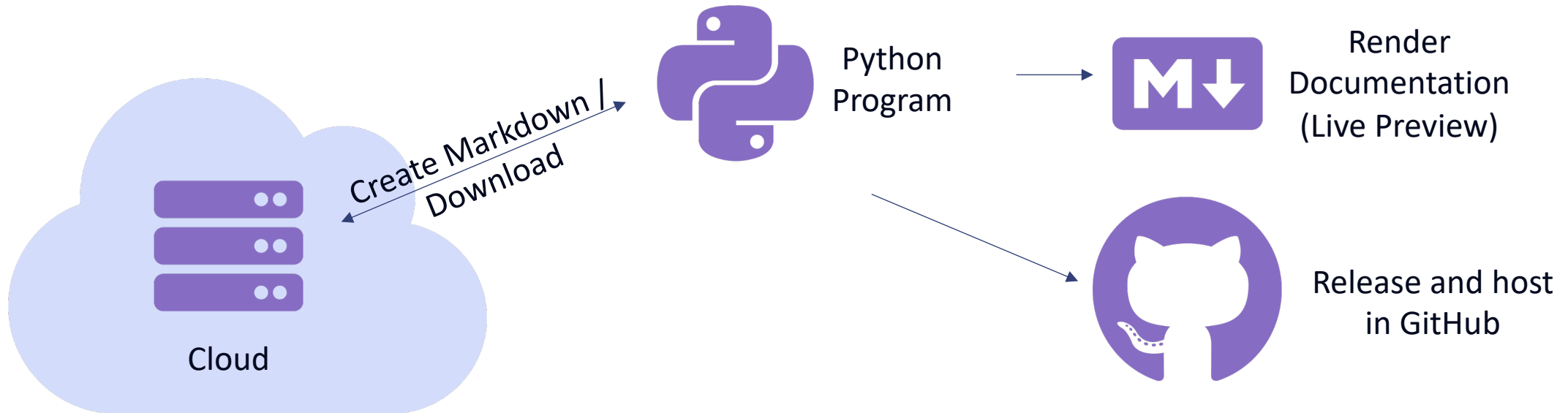
- Documentation flow
 - SAS Macros to create documentation
 - Execute then through Python



Processes



➤ Release!



Macros

Examples

Documentation

Release

Processes



- Fluent Development

- Automation, easy additional development and release!



- Low effort for new features -> quick release cycles

- Testing (automation)
 - Documentation (automation)

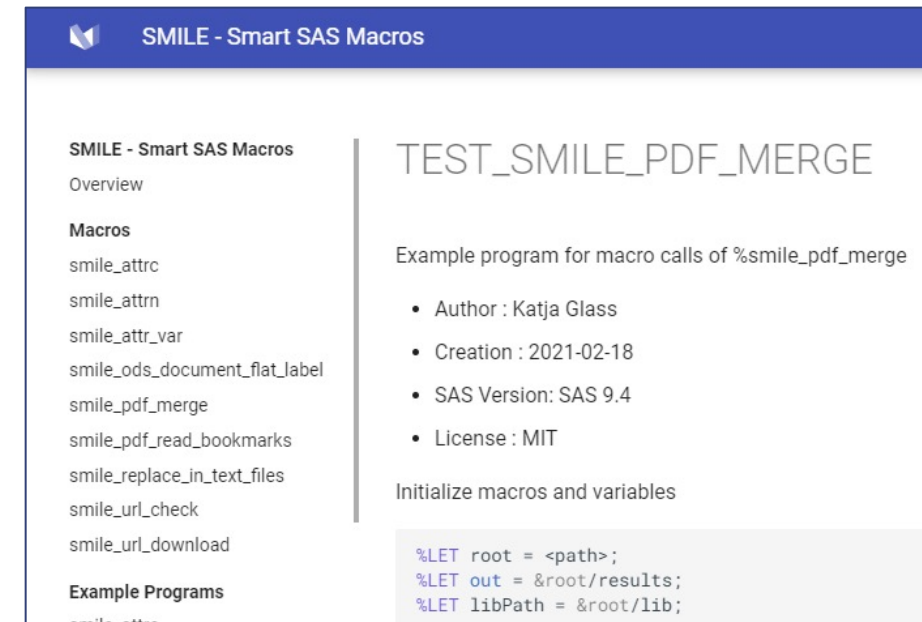
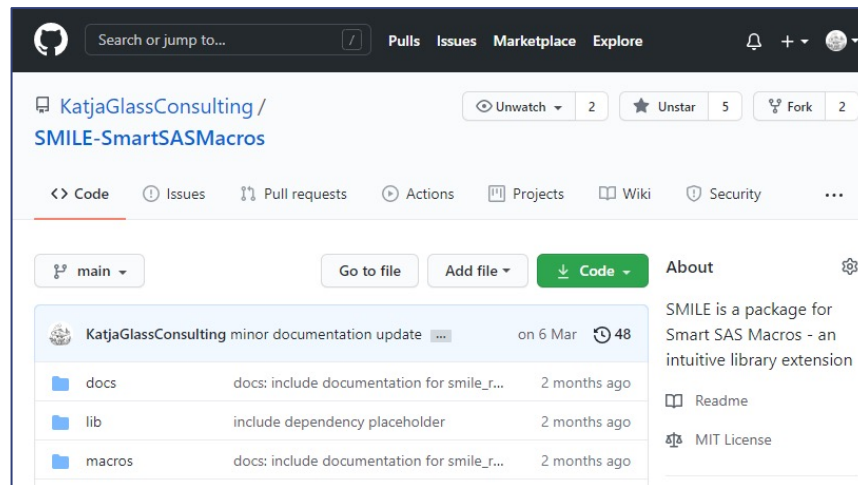
Processes



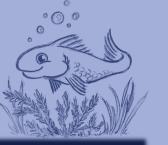
➤ Tools

- SAS Studio®
- MKDocs + Material
- GitHub + Pages

```
1 %*****  
2 %* Project   : SMILE - SAS Macros, Intuitive Library Ex  
3 %* Macro     : smile_pdf_merge  
4 %* Parameters : DATA          - Input dataset containi  
5 %*                                     INFIL containing sing  
6 %*                                     BOOKMARK containing th  
7 %*                                     OUTFILE          - Output PDF file (not i
```



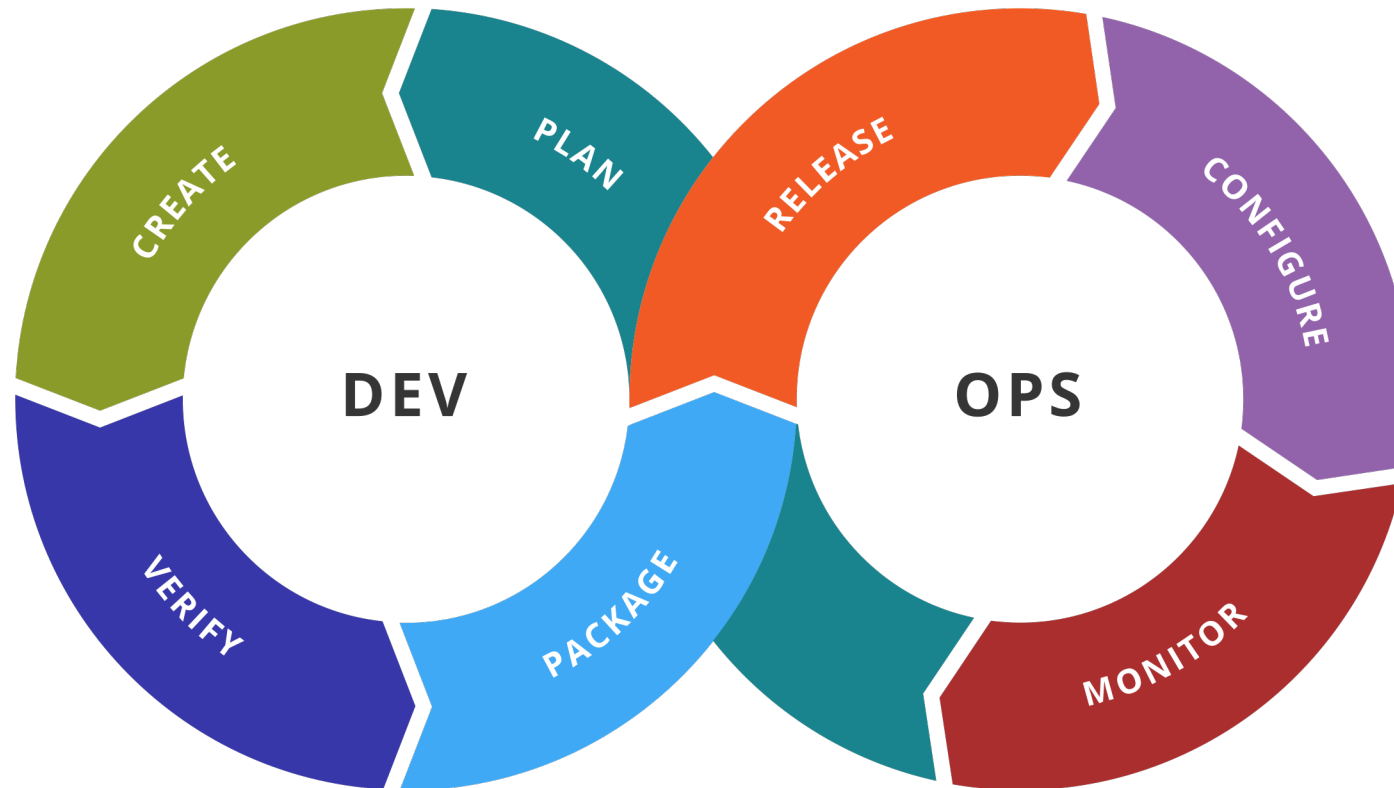
Agenda



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 - Opportunities & Summary
-



Additional Use Cases



Additional Use Cases



- **Open Source Portal** for Clinical Study Evaluations ([Web](#))
 - Collection of open source tools, scripts & macros, APIs, links, ...

 Katja Glass Consulting							
Home Overview Programs More ▾ Info							
Tool	Name	Description	Type	Class	Lang...	Mod Date	Lineno.
SMILE ▾			Show A ▾	Show A ▾	SI ▾		
SMILE	smile_attr_var	Function-style macro to return a variable attribute of a dataset. The following attributes are available: VARTYPE, VARLEN, VARLABEL, VARFMT and VARINFMT	Macro	Utility	SAS	2021-02-19	33
SMILE	smile_attrc	Function-style macro to return a character attribute of a dataset. The following attributes are avail-	Macro	Utility	SAS	2021-02-19	33

Additional Use Cases



➤ Collect macro information

➤ Scan SAS Headers (SAS)

➤ Get timestamps GitHub (Python)

➤ Merge & export to JSON (SAS)

➤ Embed JSON in webpage (Python, copy from SAS server to local)

➤ Version control (private GitLab)

Katja Glass Consulting							
Home Overview Programs More ▾ Info							
Tool	Name	Description	Type	Class	Lang..	Mod Date	Lineno.
SMILE ▾			Show ▾	Show ▾	SI ▾		
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SMILE	smile_attrc	Function-style macro to return a character attribute of a dataset. The following attributes are avail-	Macro	Utility	SAS	2021-02-19	33

➤ **Conference Video Search** (PHUSE, RinPharma, Rstudio - [Web](#))



Katja Glass Consulting

Conference Videos

Group

Playlist

Video

Title

Author

Company

Date

Dura...

View...

Likes

Search...

Search...

Search...

PHUSE	PHUSE Educatio...	🔗	Strategic Minds...			2021-04-06	9	136	6
PHUSE	PHUSE Educatio...	🔗	Introducing the ...			2021-04-08	3	12	1
PHUSE	PHUSE Basel S...	🔗	FAIR Data Princi...	Huw Mason	Roche	2020-09-15	26	160	1
PHUSE	PHUSE Basel S...	🔗	Creating ARM U...	Dmitry Kolosov	Parexel	2020-09-15	30	119	0
PHUSE	PHUSE Basel S...	🔗	FAIR for Source ...	Katja Glass	Katja Glass Cons...	2020-09-15	28	85	4
PHUSE	PHUSE Basel S...	🔗	Constructive Fe...	Chiara Bin & Ligi...	MSD	2020-09-15	29	79	2
PHUSE	PHUSE Boston ...	🔗	Era of Mandator...			2020-08-17	45	54	0
PHUSE	PHUSE Boston ...	🔗	Preparing Legac...	Ajay Yalwar, Pra...	Covance	2020-08-17	33	87	1
PHUSE	PHUSE Boston ...	🔗	Embracing CDIS...	Bhargav Koduru	Sarepta Therape...	2020-08-17	28	56	0

Contact | Impressum / Legal Disclosure | Datenschutz / Privacy Policy

Use Cases



- **Conference Video Search** (PHUSE, RinPharma, Rstudio - [Web](#))
 - Python – gather YouTube information
 - Python – gather from PHUSE Engagement Hub
 - Python – Export information to JSON, store to web-area
 - React WebPage - embed JSON in webpage
 - private GitLab
 - Option: GitHub + Pages

 Katja Glass Consulting Conference Videos										
Group	Playlist	Vi...	Title	Author	Company	Date	D...	Vi...	Li...	
			Search...	Search...	Search...					
PHUSE	PHUSE Educati...	🔗	Strategic Mindset – PHUSE Education Video Podcast Series			2021-04-...	9	136	6	
PHUSE	PHUSE Educati...	🔗	Introducing the PHUSE Education Video Podcast Series			2021-04-...	3	12	1	
PHUSE	PHUSE Basel S...	🔗	FAIR Data Principles	Huw Mason	Roche	2020-09...	26	160	1	
PHUSE	PHUSE Basel S...	🔗	Creating ARM Using Visual Define XML Editor	Dmitry Kolosov	Parexel	2020-09...	30	119	0	
PHUSE	PHUSE Basel S...	🔗	FAIR for Source Code	Katja Glass	Katja Glass Con...	2020-09...	28	85	4	
PHUSE	PHUSE Basel S...	🔗	Constructive Feedback Statistical Programming Case Study	Chiara Bin & Ligi...	MSD	2020-09...	29	79	2	

Use Cases



➤ Option: GitHub + Pages

➤ Pipeline

- Start on file update (e.g. JSON - updated “likes”, “views”)
- Compile WebApplication
- Publish in GitHub Pages

 Katja Glass Consulting Conference Videos										
Group	Playlist	Vi...	Title	Author	Company	Date	D...	Vi...	Li...	
			Search...	Search...	Search...					
PHUSE	PHUSE Educati...	🔗	Strategic Mindset – PHUSE Education Video Podcast Series			2021-04-...	9	136	6	
PHUSE	PHUSE Educati...	🔗	Introducing the PHUSE Education Video Podcast Series			2021-04-...	3	12	1	
PHUSE	PHUSE Basel S...	🔗	FAIR Data Principles	Huw Mason	Roche	2020-09-...	26	160	1	
PHUSE	PHUSE Basel S...	🔗	Creating ARM Using Visual Define XML Editor	Dmitry Kolosov	Parexel	2020-09-...	30	119	0	
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PHUSE	PHUSE Basel S...	🔗	Constructive Feedback Statistical Programming Case Study	Chiara Bin & Ligi...	MSD	2020-09-...	29	79	2	

Use Cases



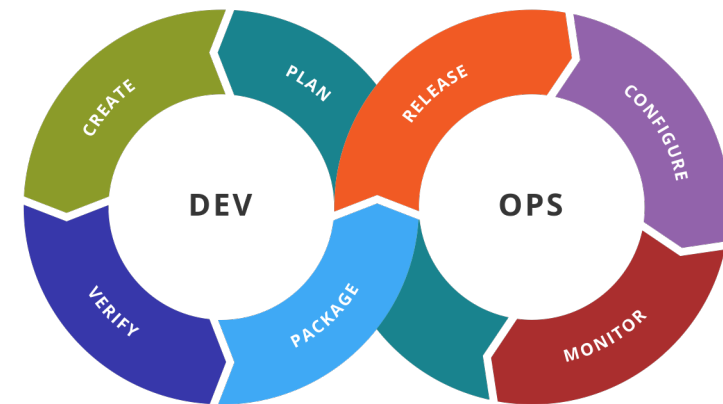
- Option: GitHub + Pages
 - Pipeline
 - Run daily
 - Execute Python to create/update JSON
 - Compile Web Application
 - Publish in GitHub Pages

 Katja Glass Consulting Conference Videos										
Group	Playlist	Vi...	Title	Author	Company	Date	D...	Vi...	Li...	
			Search...	Search...	Search...					
PHUSE	PHUSE Educati...	🔗	Strategic Mindset – PHUSE Education Video Podcast Series			2021-04-...	9	136	6	
PHUSE	PHUSE Educati...	🔗	Introducing the PHUSE Education Video Podcast Series			2021-04-...	3	12	1	
PHUSE	PHUSE Basel S...	🔗	FAIR Data Principles	Huw Mason	Roche	2020-09-...	26	160	1	
PHUSE	PHUSE Basel S...	🔗	Creating ARM Using Visual Define XML Editor	Dmitry Kolosov	Parexel	2020-09-...	30	119	0	
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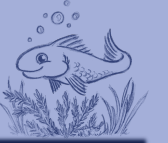
Use Cases



- Tool for domain mapping
 - Person A -> DM
 - Person B -> AE
 - Common macros with regular updates (enhancements)
 - Tests that no “old” functionality is broken
 - Iterative tool development + test + release for immediate benefit
 - Iterative new features



Agenda



- Introduction
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 - **Opportunities & Summary**
-



Opportunities & Summary



- Look at pipelines and options
 - Cherry Picking
- Apply automation where ever possible
 - Version Control
 - Automated Tests
 - Automated Documentation
 - Pipelines



Opportunities & Summary



- Pipelines from “outside” / interface to SAS
 - SASPy
 - SAS Stored Processes (e.g. through SASJs)
 - ...



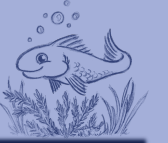
Opportunities & Summary



- Cherry Pick Open-Source Solutions
 - Checkout the Open Source Portal for Clinical Study Evaluations
 - SMILE – Smart SAS Macros
 - SASJs – Java Script Framework for SAS (using stored processes)
- Look at DevOps processes (CI/CD)
- Apply those that fits
- For “huge” tools, agile approach with CI/CD
- Pipeline can be triggered from “outside” of SAS



Questions?



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www.glacon.eu/portal
