

Katja Glass  
Consulting

# Continuous Integration & Delivery for SAS Macros

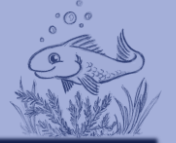
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Automate Processes



# Agenda

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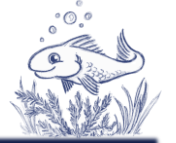


- Introduction
  - Use Case
  - Processes
  - Additional Use Cases
  - Opportunities & Summary
- 



# Introduction

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## ➤ 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.”*

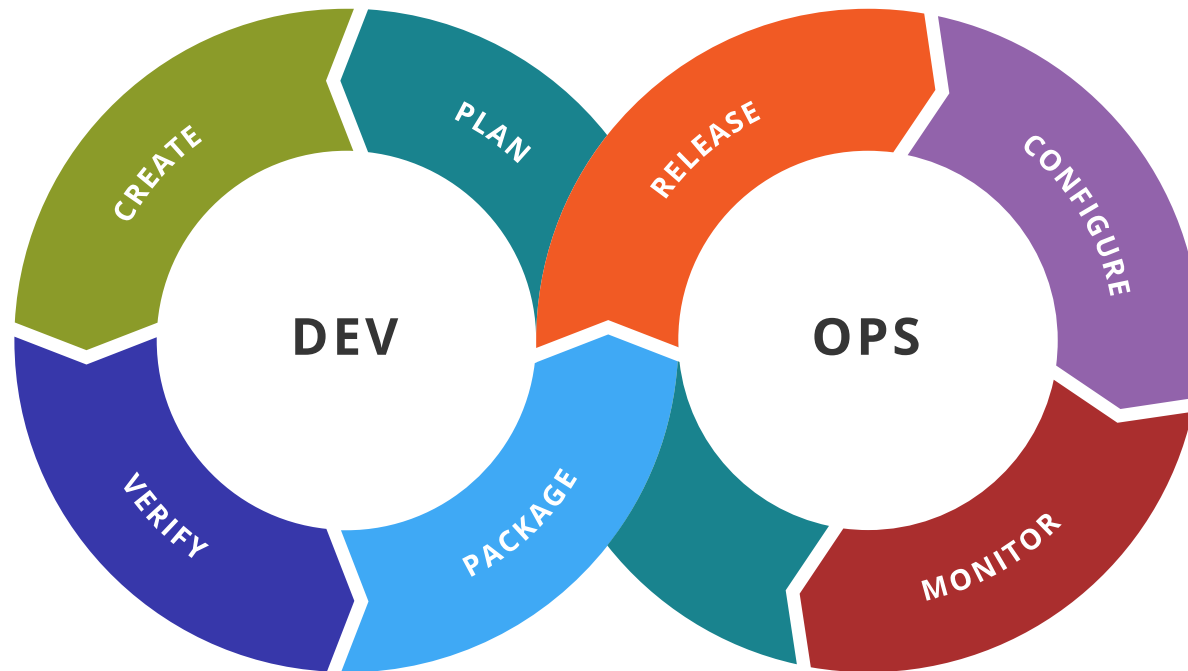
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# Introduction



Contineous  
Integration

Contineous  
Delivery

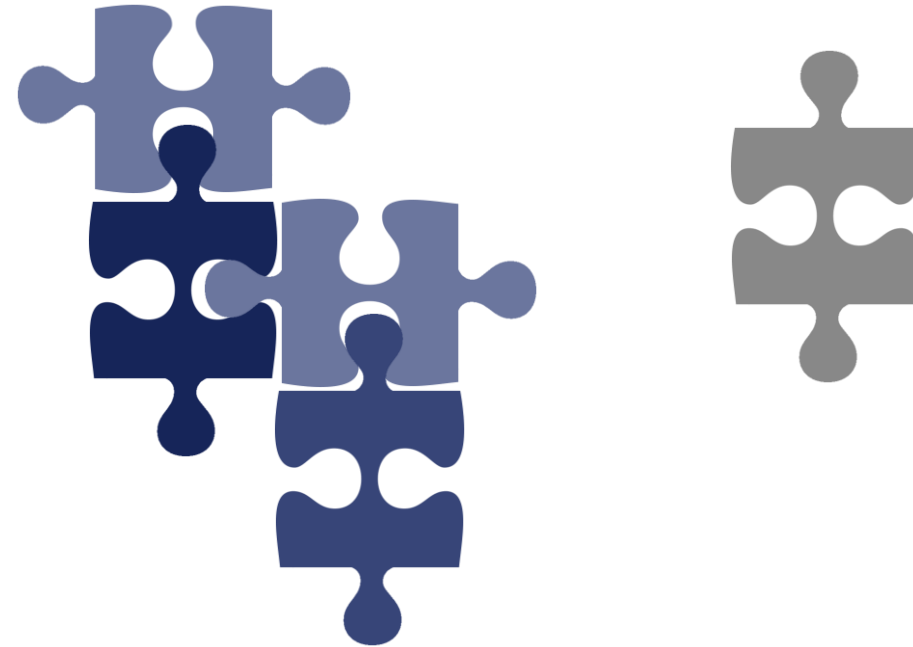


# Introduction

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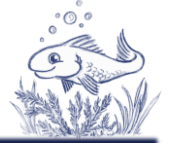


- Practices
  - Code repository
  - Automatic build pipeline
  - Self-testing
  - Automate deployment

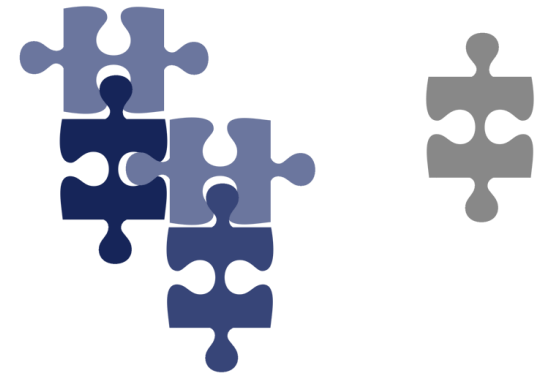


# Introduction

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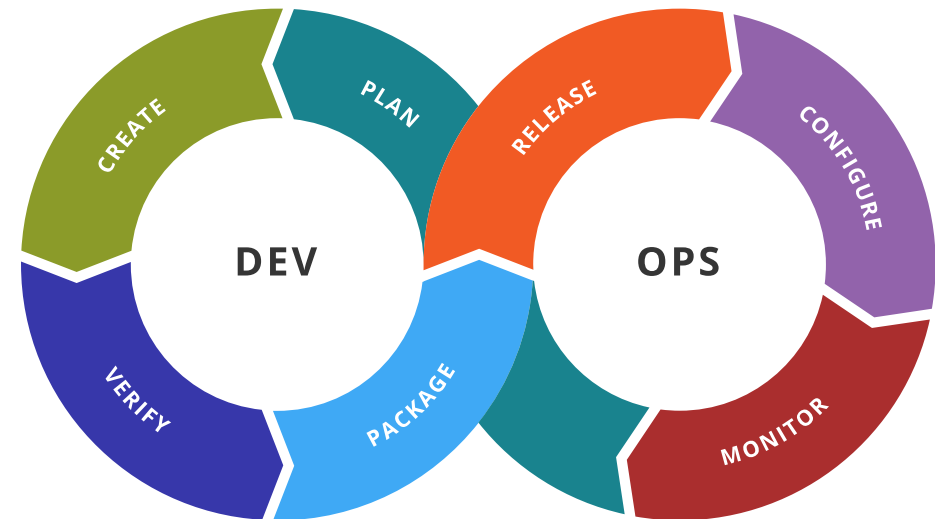
- CI/CD for SAS Processes?
  - Typically independent small components (standalone macros)
  - Rarely “huge” system with cross-dependencies
  
  - Often not 1:1 usable
  
- Use for Complex tools
  - SAS huge applications
  - R-Shiny etc.



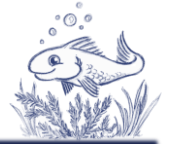
# Introduction



- 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



### Setup Study Flow



### Continuous integration pipeline (CI)



### Continuous development pipeline (CD)



# 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)

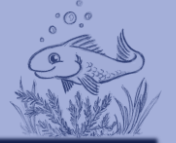


Continuous development pipeline (CD)



# Agenda

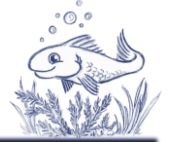
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- Introduction
  - **Use Case**
  - Processes
  - Additional Use Cases
  - Opportunities & Summary
- 



# 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

The screenshot shows the GitHub repository page for "SMILE - Smart SAS Macros". The repository has 5 stars and 2 forks. The main content area displays the file "TEST\_SMILE\_ODS\_DOCUMENT\_FLAT\_LABEL". The file's description is "Example program for macro calls of %smile\_ods\_document\_flat\_label". It lists the author as Katja Glass, the creation date as 2021-02-18, the SAS version as SAS 9.4, and the license as MIT. The file content includes code for initializing macros and setting options for a nice layout. A table of contents on the right lists eight examples, such as "Example 1 - empty ODS Document - warning expected" and "Example 8 - create flat navigation PDF using multiple ODS DOCUMENTS - many outputs".

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;
```

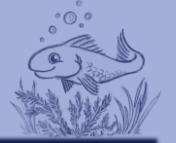
Example 1 - empty ODS Document - warning expected

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

# Agenda

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- Introduction
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  - **Processes**
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  - Opportunities & Summary
- 



# Processes



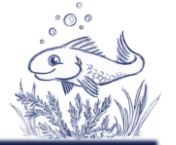
- Develop open-source SAS macros
  - SAS macros (+ documentation in header)
  - SAS example programs (+ documentation in comments)
  - Documentation website
  - Source release

The screenshot shows a web page for "SMILE - Smart SAS Macros". The page has a blue header with the project name and logo. On the left, there is a navigation menu with links for "Overview", "Macros", and "Example Programs". The "Macros" section lists various macro names, including "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", and "smile\_url\_download". The "TEST\_SMILE\_PDF\_MERGE" macro page is selected, showing its title and a description: "Example program for macro calls of %smile\_pdf\_merge". Below the description, there is a list of metadata: "Author : Katja Glass", "Creation : 2021-02-18", "SAS Version: SAS 9.4", and "License : MIT". At the bottom, there is a code block for "Initialize macros and variables" with the following SAS code: 

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

# Processes

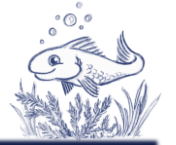
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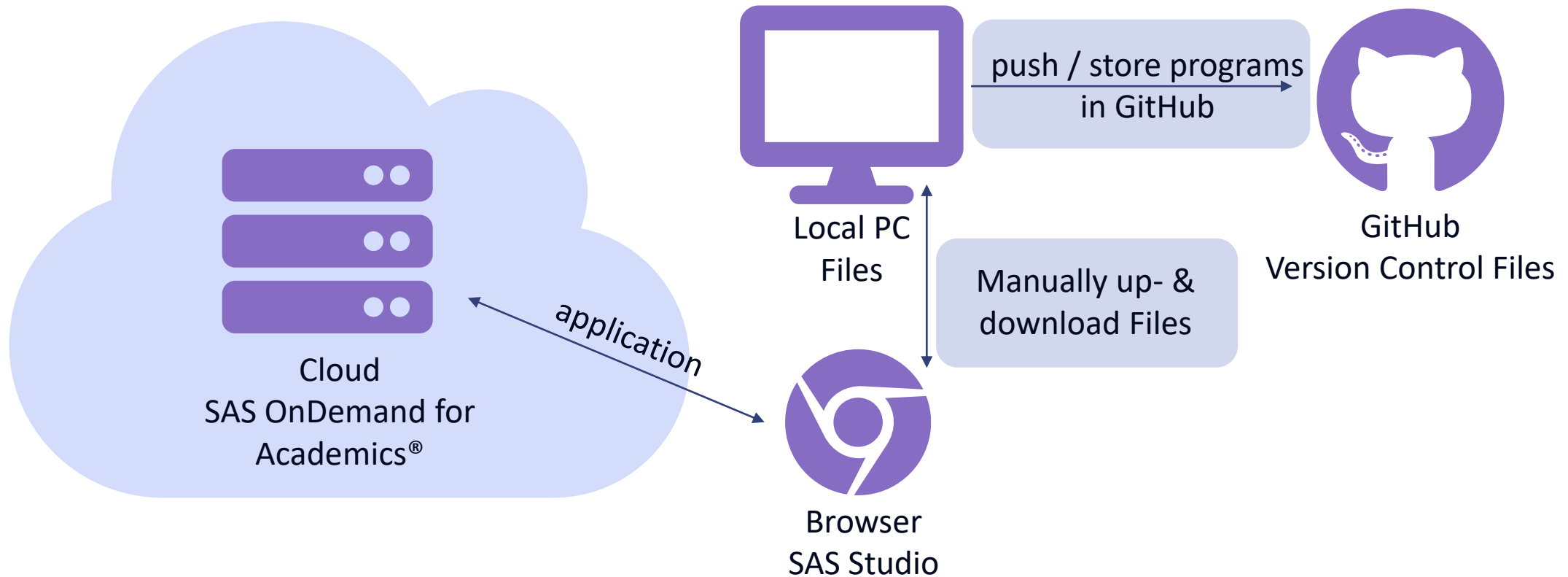
- Develop open-source SAS macros
  - SAS macros (+ documentation in header)
  - SAS example programs (+ documentation in comments)
  - Documentation website
  - Source release



# Environment



## ➤ Cloud SAS OnDemand for Academics®

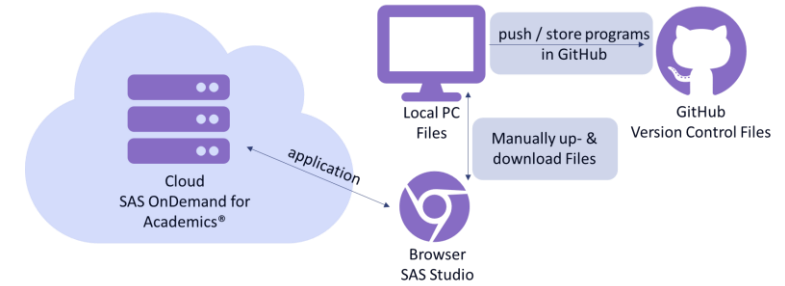


# Environment



## ➤ SAS Development Environment (OnDemand)

- Disgusting file handling
- Automation required!



## ➤ **Upload** Pipeline

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

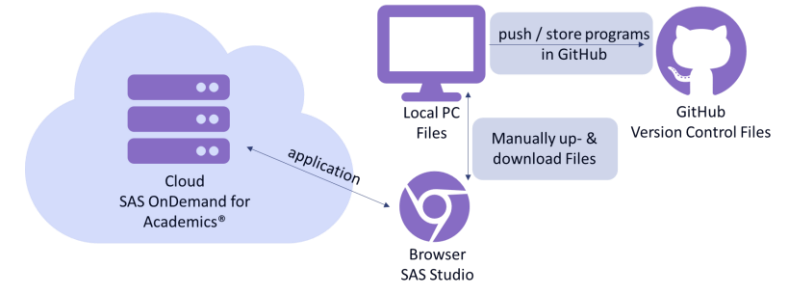
## ➤ **Download** Pipeline

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

# Environment

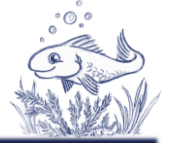


- SAS Development Environment (OnDemand)
  - Disgusting file handling
  - Automation required!

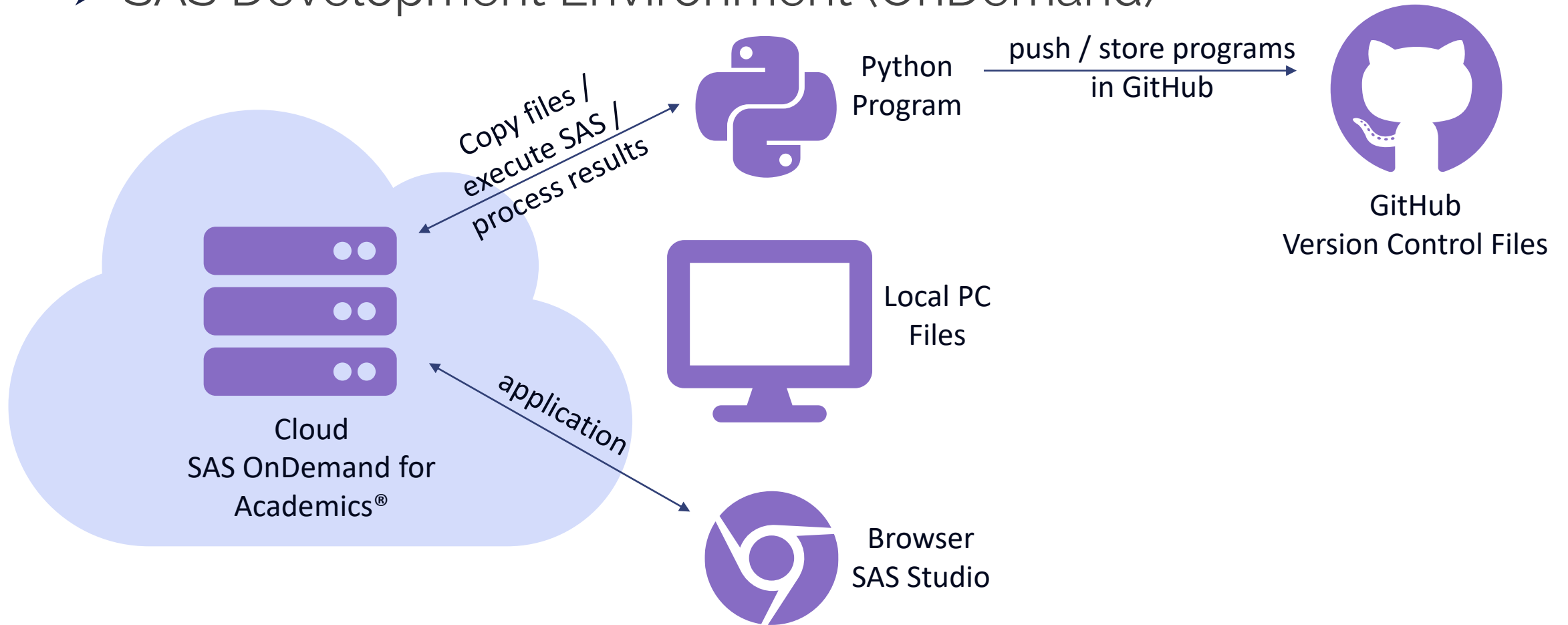


# SASPy

# Environment



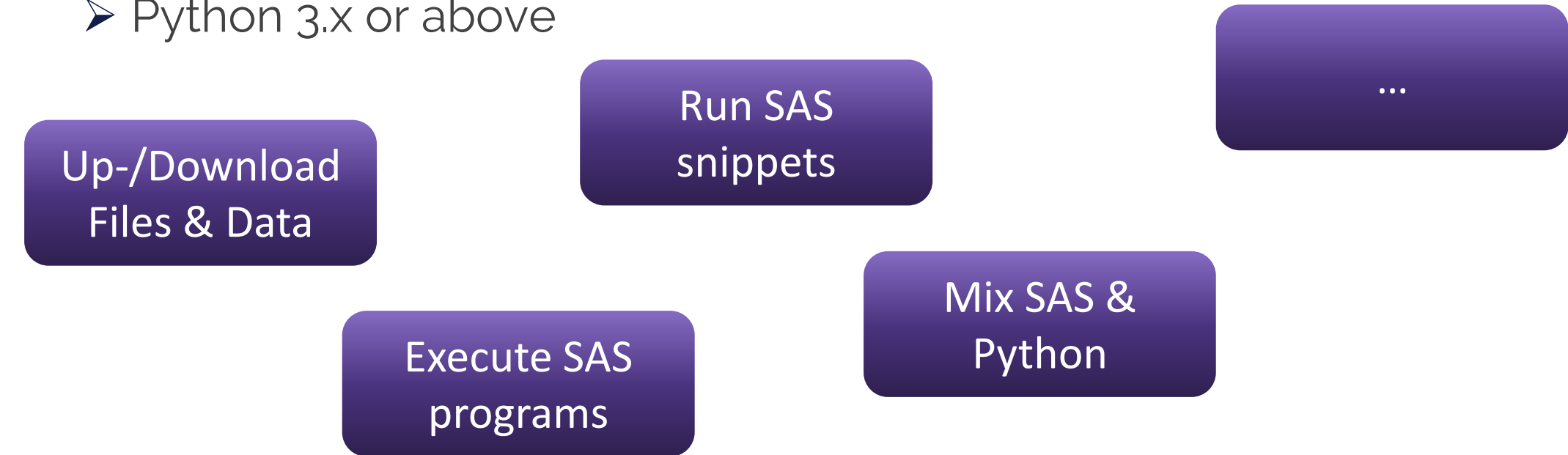
## ➤ SAS Development Environment (OnDemand)



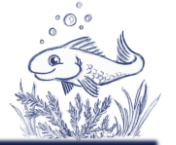
# Environment



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



# Processes



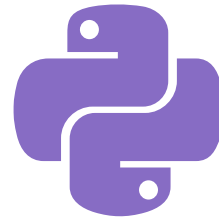
## ➤ Macro Update Processes

### ➤ Upload

- Create a \*.zip backup
- Overwrite files

### ➤ Download

### ➤ (Push to GitHub)



Python  
Program

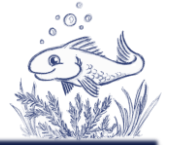
### ➤ Develop in SAS Studio



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

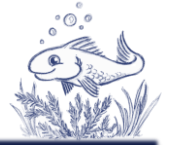


- Python Upload
  - Upload all files in folder

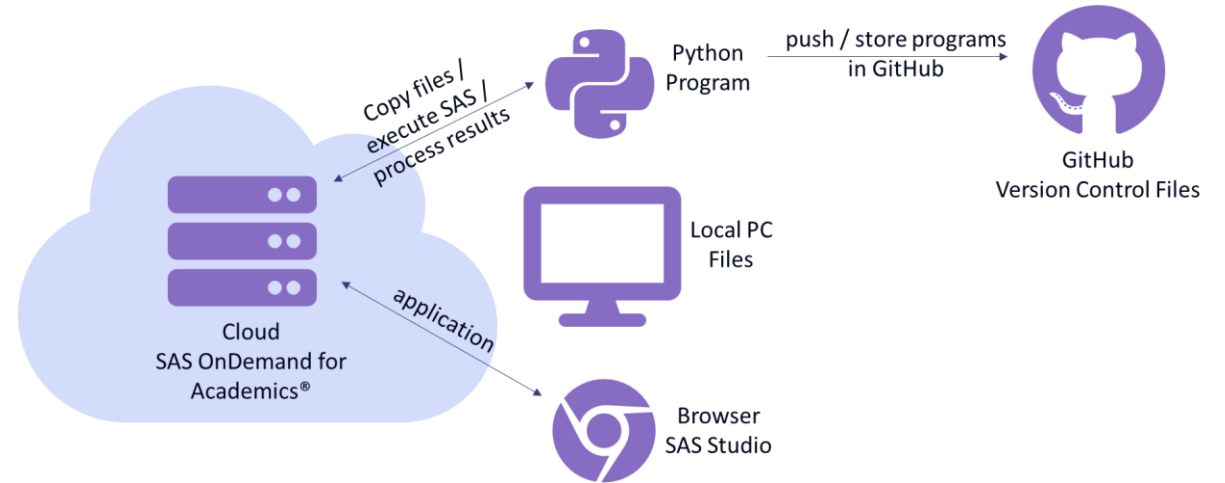
```
def upload_files_from_path(from_path, to_path):  
    myFiles = [f for f in listdir(from_path) if isfile(join(from_path, f))]  
    for file in myFiles:  
        print("upload file to SAS: " + file)  
        sas.upload(join(from_path, file),to_path + "/" + file)  
  
upload_files_from_path("C:\\smile\\macros",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

Macros

# Processes



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

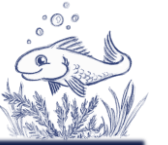


Macros

Examples

# Processes

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## ➤ Documentation



Microsoft Word® ?

Web !

Macros

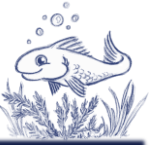
Examples

Documentation

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# Processes

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## ➤ Documentation



Manually ?

Framework !

Macros

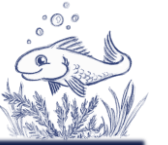
Examples

Documentation

---

# Processes

---



## ➤ Documentation



Repeat ?

Reuse !

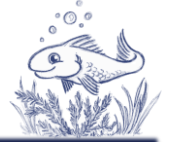
Macros

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>

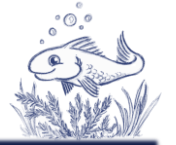
<https://katjaglassconsulting.github.io/SMILE-SmartSASMacros/>

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

SMILE - Smart SAS Macros

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

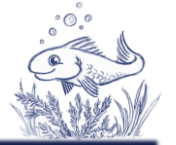
```
%LET root = <path>;
%LET out = &root/results;
%LET libPath = &root/lib;
```

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>
4
5 The macros could easily be made available in any SAS enviro
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 SA
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
    LABEL, LIB, MEM, MODE, MTYPE, SORTEDBY, SORTLVL, SORTSEQ,
20 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 is filtered for 'Region=Canada' and contains the following data:

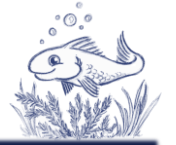
Product	Total Sales
Boot	\$17,720
Men's Dress	\$12,775
Sandtal	\$2,886
Slipper	\$5,676

Macros

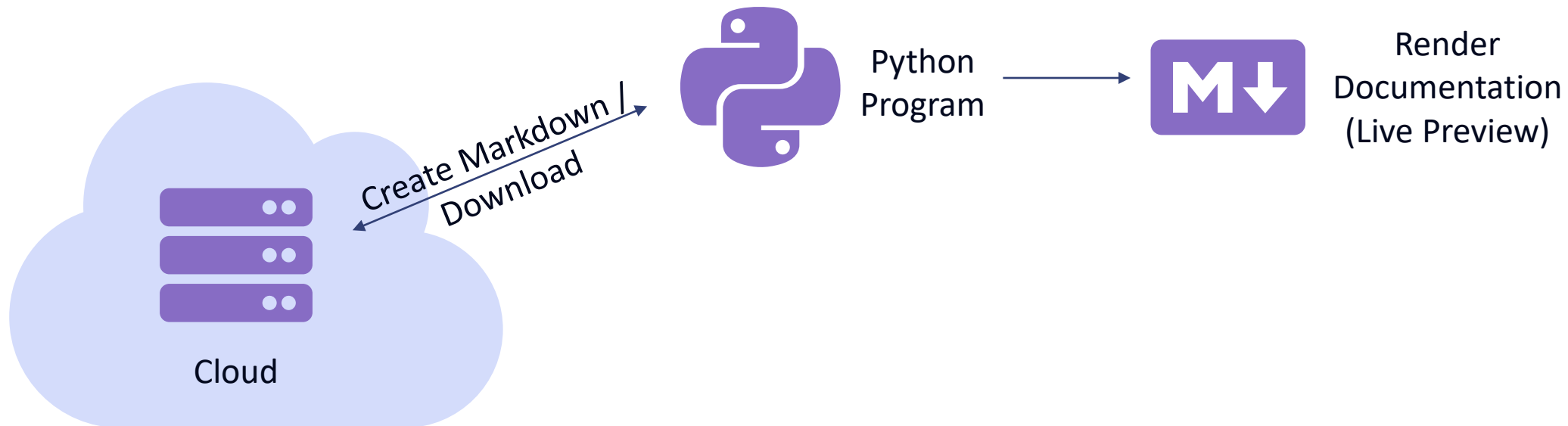
Examples

Documentation

# Processes



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

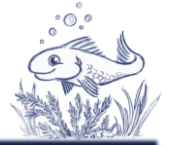


Macros

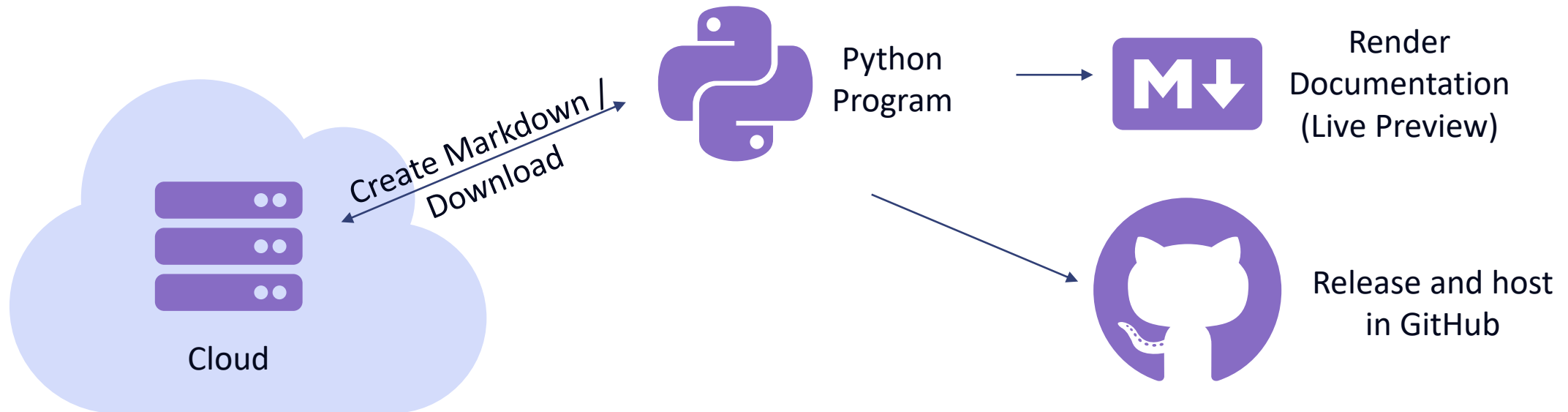
Examples

Documentation

# Processes



## ➤ Release!



# Processes

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- Fluent Development

- Automation, easy additional development and release!

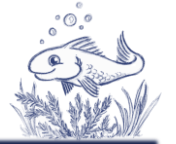


- Low effort for new features -> quick release cycles

- 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 %* INFILIB containing sing  
6 %* BOOKMARK containing th  
7 %* OUTFILE - Output PDF file (not i
```

KatjaGlassConsulting / SMILE-SmartSASMacros

Code Issues Pull requests Actions Projects Wiki Security

main Go to file Add file Code About

KatjaGlassConsulting minor documentation update on 6 Mar 48

docs	docs: include documentation for smile_r...	2 months ago
lib	include dependency placeholder	2 months ago
macros	docs: include documentation for smile_r...	2 months ago

SMILE is a package for Smart SAS Macros - an intuitive library extension

Readme MIT License

### 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

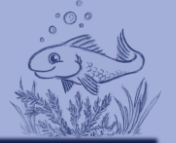
- Author : Katja Glass
- Creation : 2021-02-18
- SAS Version: SAS 9.4
- License : MIT

Initialize macros and variables

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

# Agenda

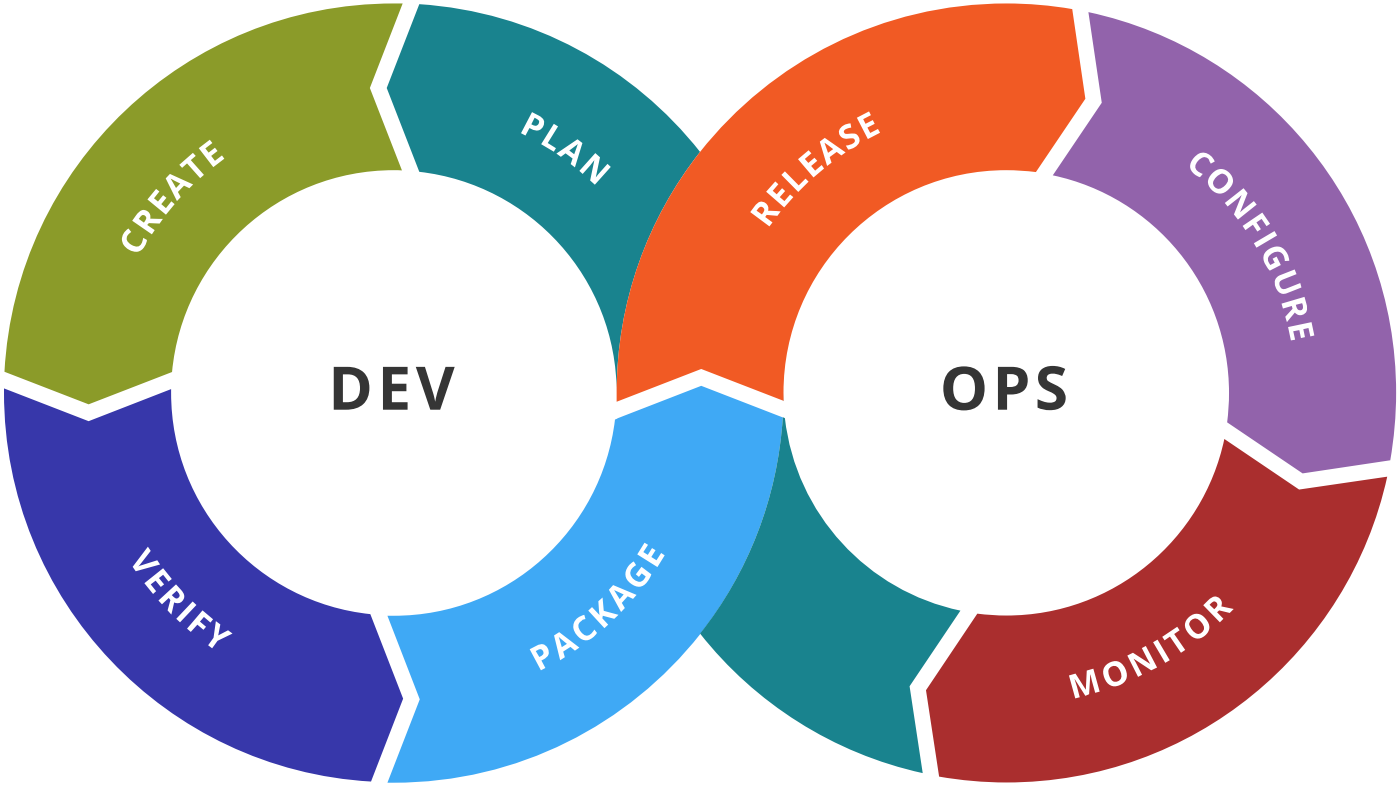
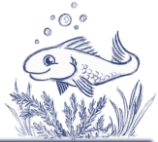
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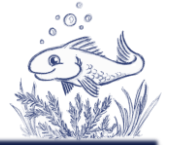
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# Additional Use Cases



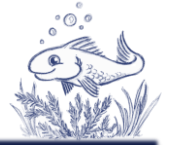
# Additional Use Cases



- **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	<a href="#">smile_attr_var</a>	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	<a href="#">smile_attrc</a>	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)

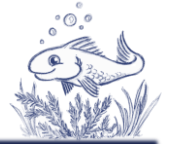
➤ Embed JSON in webpage (Python, copy from SAS server to local)

➤ Version control (private GitLab)

The screenshot shows the website for Katja Glass Consulting. The navigation bar includes links for Home, Overview, Programs, More, and Info. Below the navigation bar is a table with the following columns: Tool, Name, Description, Type, Class, Lang., Mod Date, and Lineno. The table contains two rows of macro information.

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

# Use Cases



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

Katja Glass Consulting									
Conference Videos									
Group	Playlist	Video	Title	Author	Company	Date	Dura...	View...	Likes
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PHUSE	PHUSE Educatio...	<a href="#">🔗</a>	Strategic Minds...			2021-04-06	9	136	6
PHUSE	PHUSE Educatio...	<a href="#">🔗</a>	Introducing the ...			2021-04-08	3	12	1
PHUSE	PHUSE Basel S...	<a href="#">🔗</a>	FAIR Data Princi...	Huw Mason	Roche	2020-09-15	26	160	1
PHUSE	PHUSE Basel S...	<a href="#">🔗</a>	Creating ARM U...	Dmitry Kolosov	Parexel	2020-09-15	30	119	0
PHUSE	PHUSE Basel S...	<a href="#">🔗</a>	FAIR for Source ...	Katja Glass	Katja Glass Cons...	2020-09-15	28	85	4
PHUSE	PHUSE Basel S...	<a href="#">🔗</a>	Constructive Fe...	Chiara Bin & Ligi...	MSD	2020-09-15	29	79	2
PHUSE	PHUSE Boston ...	<a href="#">🔗</a>	Era of Mandator...			2020-08-17	45	54	0
PHUSE	PHUSE Boston ...	<a href="#">🔗</a>	Preparing Legac...	Ajay Yalwar, Pra...	Covance	2020-08-17	33	87	1
PHUSE	PHUSE Boston ...	<a href="#">🔗</a>	Embracing CDIS...	Bhargav Koduru	Sarepta Therape...	2020-08-17	28	56	0

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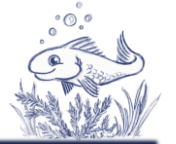
# Use Cases



- **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..	
			<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search..."/>					
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PHUSE	PHUSE Basel S..	<a href="#">🔗</a>	FAIR Data Principles	Huw Mason	Roche	2020-09-...	26	160	1	
PHUSE	PHUSE Basel S..	<a href="#">🔗</a>	Creating ARM Using Visual Define XML Editor	Dmitry Kolosov	Parexel	2020-09-...	30	119	0	
PHUSE	PHUSE Basel S..	<a href="#">🔗</a>	FAIR for Source Code	Katja Glass	Katja Glass Con..	2020-09-...	28	85	4	
PHUSE	PHUSE Basel S..	<a href="#">🔗</a>	Constructive Feedback Statistical Programming Case Study	Chiara Bin & Ligi..	MSD	2020-09-...	29	79	2	

# Use Cases



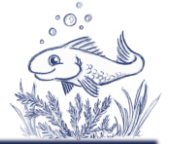
## ➤ Option: GitHub + Pages

### ➤ Pipeline

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

Katja Glass Consulting <b>Conference Videos</b>										
Group	Playlist	Vi..	Title	Author	Company	Date	D..	Vi..	Li..	
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# Use Cases



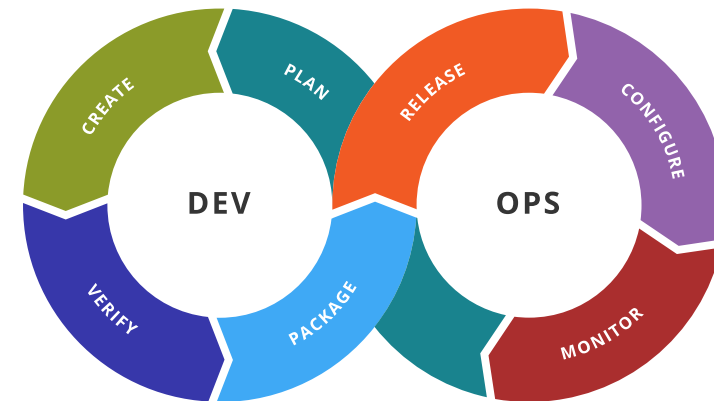
- Option: GitHub + Pages
  - Pipeline
    - Run daily
    - Execute Python to create/update JSON
    - Compile Web Application
    - Publish in GitHub Pages

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Conference Videos										
Group	Playlist	Vi..	Title	Author	Company	Date	D..	Vi..	Li..	
			<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search..."/>					
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# Use Cases

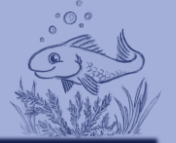


- Tool for domain mapping
  - Person A -> DM
  - Person B -> AE
  - Common macros with regular updates (enhancements)
  - Tests that no “old” functionality is broken
  - Iterative tool development + test + release for immediate benefit
  - Iterative new features



# Agenda

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



# Opportunities & Summary

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



# Opportunities & Summary

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



# Opportunities & Summary

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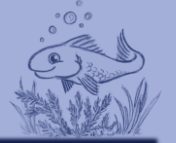


- Cherry Pick Open-Source Solutions
  - Checkout the Open Source Portal for Clinical Study Evaluations
    - SMILE – Smart SAS Macros
    - SASJs – Java Script Framework for SAS (using stored processes)
- Look at DevOps processes (CI/CD)
- Apply those that fits
- For “huge” tools, agile approach with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



# Questions?

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[www.glacon.eu/portal](http://www.glacon.eu/portal)

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