

How to Use Git with Your SAS Projects

Chris Hemedinger, Director of SAS User Engagement



What You'll Learn

- What is Git™?
- Getting started with Git commands
- Using Git with SAS tools
 - SAS Studio (SAS Viya and SAS v9.4)
 - SAS Enterprise Guide
 - Visual Studio Code with SAS Extension
- Git functions in SAS programming language
- DevOps opportunities: collaboration and continuous integration
- Where to learn more

Prerequisites and Setup

These tools/services will help you get the most from this hands-on session:

- Git client: Install from <https://www.git-scm.org/>
- GitHub account: free at <http://www.github.com/join>
- SAS OnDemand for Academics account (for some exercises)
- SAS Viya for Learners (for some exercises)
- Optional: SAS Enterprise Guide 8.2 or later with access to SAS
- Optional: VS Code with SAS extension
- Optional: SAS Studio 3.8 with access to SAS

Materials...on GitHub!

<https://github.com/sascommunities/git-workshop>



Credit: *Professional Git*

By Brent Laster (long-time SAS colleague)

- Extensive Git reference, explanations, and examples
- First part for non-technical
- Beginner and advanced reference
- Hands-on labs

 Amazon Customer

★★★★★ I can't recommend this book more highly

February 12, 2017

Format: Kindle Edition

Brent Laster's book is in a different league from the many print and video sources that I've looked at in my attempt to learn Git. The book is extremely well organized and very clearly written. His decision to focus on Git as a local application for the first several chapters, and to defer discussion about it as a remote application until later in the book, works extremely well.

Laster has also succeeded in writing a book that should work for both beginners and people with a fair bit of experience with Git. He accomplishes this by offering, in each chapter, a core discussion followed by more advanced material and practical exercises.

I can't recommend this book more highly.

★★★★★ Ideal for hands-on reading and experimentation

February 23, 2017

Format: Paperback | **Verified Purchase**

I just finished reading *Professional Git*, which is well organized and clearly presented. It works as both a tutorial for newcomers and a reference book for those more experienced. I found it ideal for hands-on reading and experimentation with things you may not understand at first glance. I was already familiar with Git for everyday use, but I've always stuck with a convenient subset. It was great to be able to finally get a much deeper understanding. I highly recommend the book.

Professional Git 1st Edition

by Brent Laster (Author)

★★★★★ 7 customer reviews

[Look inside](#) ↓

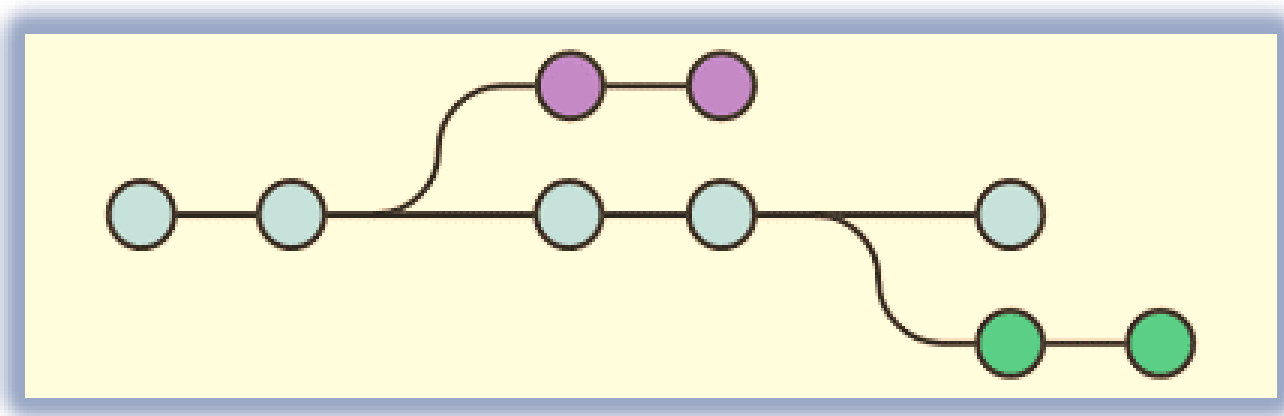


What is Git?

Git is a distributed version control system

- **Distributed** – each developer has a “clone” of the code repository
- **Workflows** – feature-based, experiment branches, prod/test/dev, patch/cherry-pick
- **Open source** – Git software is free and open source.

Several commercial systems (GitHub, GitLab, Bitbucket, and more) add features and enterprise-readiness.



Benefits of using Git with SAS

Version control

Author: Mike Henderson | Date: 4/29/2020 15:54:21 | Commit hash: a059de1248793e17b9ff00ea8b194ecfb81f384e

flexible number of ISOChangeDate and SocialDistancingChange

- ISOChangeDate is now a string delimited by : that can handle none, sing
- SocialDistancingChange is now a string delimited by : that can handle no
- Break - If the file run_scenarios.csv has a column added it will not be use

CCF/COVID19.sas

```
7
8 %macro EasyRun(Scenario,Incubatio
9 - SocialDistancing,
10 - ISOChangeDate3,So
11 + SocialDistancing,
12 MarketShareParam
```

Collaboration

Start Page covid-19-sas x

master Pull Push

Commit (95) History

Graph	Message	Author	Date	Comm
	new cc templates	Mike Henderson	4/30/2020 15:10:2	9161c
	Merge pull request #6 from sassoftware/Social-Distanc	Mike Henderson	4/30/2020 13:17:2	d4e09
	origin/Social-Distancing-Shifts Adjusted to handle	Mike Henderson	4/30/2020 13:05:1	6ec13
	Added supporting documentation	Chris Hemedinger	4/30/2020 11:45:2	8980c
	rebuild: change in Sigma default in keyword paramete	Mike Henderson	4/30/2020 10:48:3	65969
	Add SAS programs to fetch public COVID-19 data	Chris Hemedinger	4/30/2020 10:37:3	ee08ba9
	✓ master Add SAS code to fetch public COVID-1!	Chris Hemedinger	4/30/2020 10:11:1	d2e382c
	progress	Mike Henderson	4/30/2020 09:46:2	379c816
	flexible number of ISOChangeDate and SocialDistancir	Mike Henderson	4/29/2020 15:54:2	a059de1
	Update orchestrate.sas	Andrew Williams	4/29/2020 11:04:3	9be4870
	remove extra variables from model_final	Mike Henderson	4/28/2020 11:30:3	e5ae023

DevOps/automation

GitHub Maintainers > sassoftware org ...

Conversations Files Wiki +

GitHub 5/1 12:36 PM

Pull request closed: "fix a bug in load_weights\(\)"

kesmit13

5/1/2019 12:36 PM (UTC-05:00)

The push fixes a bug in load_weights(). The issue happens when load caffemodel.h5 as a model and model weights. The path option is a server-side path. 'if os.path.isfile(path):' is intended to check if the file exists but it is operating on client-side. I don't think we have a method to check server-side file by client python, so I remove the outer if statement.

Repository: sassoftware/python-dlpy

Pull request #: 133

Add a comment

View in GitHub

Branch: — 2s No changes

Commit: — a few seconds ago Started by user Gate Demo078

Start List Environment variables Run SAS program End

✓

✓

Copyright © SAS Institute Inc. All rights reserved.

Git has its own lingo

Clone

- Create a local copy of a repository

Fork

- Make a local copy of a repo where you don't have push access

Pull request

- Open a discussion with proposed code changes to be merged to upstream repo

Branch

- A logical location to divert from the “main line” of code to stage changes

Blame

- Annotated code listing with revision/author for each line

Commit

- Record a set of changes to the local repo

Commit History

- Log that shows chronological list of changes to the repo

Push / Pull

- Update a remote repo with local changes, or sync/merge local repo with remote changes

SAS tools that integrate with Git

SAS
Enterprise
Guide

SAS Studio

SAS
programming

SAS Data
Integration
Studio

VS Code
with SAS ext

And more!
SAS Viya
integrations

SAS Enterprise Guide with external repo

The screenshot displays the SAS Enterprise Guide (MIS 9.4) interface with the 'sas-youtube-api' repository selected. The left sidebar shows 'Git Repositories' and 'Servers'. The main window is divided into three panes: a commit history table, a merge details pane, and a code editor.

Commit History Table:

Graph	Message	Author	Date	Commit ID
	✓ main origin/main origin/master Catch up work	sasrh	8/12/2020 21:29:5	e5d63c7
	Merge branch 'master' of gitlab.sas.com:sasrh/sas-youtube-api	Chris Hemedinger	5/7/2020 16:27:07	e416ef5
	Add support for Brightcove SASGF videos	Chris Hemedinger	5/7/2020 16:24:27	daa1702
	Add README.md	Chris Hemedinger	5/1/2020 14:50:27	e274846
	Add shell script to run	Chris Hemedinger	5/1/2020 14:25:58	3b12157
	Add SAS programs to pull data from YouTube	Chris Hemedinger	5/1/2020 14:14:01	70424d2

Merge Details: Author: sasrh | Date: 8/12/2020 21:29:51 | Commit hash: e5d63c7994af2dbdbaba66af63f3f6c78a6d361b

Files to Merge:

- adhoc_plots.sas
- adhoc_plots2.sas
- bc_prep.sas
- bc_sasgf_monthly.sas
- youtube.sh
- yt_sasgf_meta.sas
- yt_sasuserschannel_buildvatable.sas
- yt_sasuserschannel_countries.sas
- yt_sasuserschannel_groups.sas
- yt_sasuserschannel_uploads.sas

Code Editor (adhocplots.sas):

```
1 diff --git a/adhoc_plots.sas b/adhoc_plots.sas
2 new file mode 100644
3 index 0000000..8d0a130
4 --- /dev/null
5 +++ b/adhoc_plots.sas
6 ----- Difference (@@ -0,0 +1,27 @@) -----
7 +ods html5(id=eghtml) gtitle;
8 +title "SAS User YouTube views";
9 +proc sgplot data=yt.youtube_sasuser_va;
10 + vbar month / response=views dataskin=matte;
11 + where level="CHANNEL";
12 + format views comma12.;
13 + yaxis grid display=(nolabel);
14 + xaxis label="Monthly views";
15 +run;
16 +
```

Git integration with SAS Studio

☰

SAS® Studio - Develop Code and Flows

🔍 🔔 🔄

New Options View 📁 Open 💾 Save All

SAS Studio compute context

📄 Git Repositories

📄 Clone 📁 Add

Current Repository

🔗 wordle-sas
✓ main

Other Repositories

🔗 sas-netflix-git

🔗 sas-microsoft-graph-api

Start Page

🔗 wordle-sas x +

🔗 wordle-sas
Current repository

🔗 main
Current branch

📄 Pull main
Last pulled: Mar ...

📄 Push main
Last pushed: Mar 27, 2...

👤

🔄

Commit History

	Message	Author	Date	Commit ID
✓ main origin/main	Clean up a few t...	Chris Hemedinger	Mar 18, 2022, 11:10:...	0685848
⋮	fix yet another typo in README	Chris Hemedinger	Mar 17, 2022, 2:25:0...	c8ae053
⋮	fix another typo in README	Chris Hemedinger	Mar 17, 2022, 9:49:1...	a5844b2
⋮	fix typo in README	Chris Hemedinger	Mar 16, 2022, 8:14:0...	323b187
⋮	add Twitter poll image	Chris Hemedinger	Mar 16, 2022, 3:44:4...	6d3f74d
⋮	change to using DATA step object for g...	Chris Hemedinger	Mar 16, 2022, 2:56:2...	ea54b2b
⋮	add example showing SASViya	Chris Hemedinger	Mar 16, 2022, 12:52:...	97babaf
⋮	add more instructions and example ima...	Chris Hemedinger	Mar 16, 2022, 12:39:...	f08361a
⋮	initial commit for Wordle in SAS	Chris Hemedinger	Mar 16, 2022, 10:45:...	d7b73cf

Author: Chris Hemedinger

Mar 18, 2022, 11:10:15 AM

0685848427054bdf11fdc680bb66aec58... — □

Clean up a few things I found while writing the blog

Parent: c8ae053

🔗 wordle-sas.sas

diff --git a/wordle-sas.sas b/wordle-sas.sas index 9c5e857..d2b735c 100644 --- a/wordle-sas.sas +++ b/wordle-sas.sas

@@ -59,7 +59,7 @@ supply 'seed' value to set the word explicitly, good for testing

run;

%end;

data status;

- array check{5} \$ 8 checked1-checked5;

+ array check{5} \$ 1 checked1-checked5;

length status \$ 5;

stop;

run;

@@ -67,6 +67,6 @@ supply 'seed' value to set the word explicitly, good for testing

wordle-sas (0) (0)

Recover (1) Submission (0)

Copyright © SAS Institute Inc. All rights reserved.



New Git functions in SAS language

Functions added in SAS 9.4 Maint 6 and SAS Viya

New SAS functions that mirror most of the Git commands that users are familiar with.

Select functions - All documented by searching [“Git functions”](#) on support.sas.com.

GIT_CLONE	Clones a Git repository (for example, from GitHub) into a directory on the SAS server.
GIT_COMMIT	Commits staged files to the local repository
GIT_DIFF	Returns the number of diffs between two commits in the local repository and creates a diff record object for the local repository.
GIT_PUSH	Pushes the committed files in the local repository to the remote repository.
GIT_NEW_BRANCH	Creates a Git branch

Connecting SAS to Git

SSH or HTTPS

SAS Studio

Supports SSH or HTTPS

Edit Profile

SSH HTTPS

Profile name: *

Chris (GitHub)

User name: *

cjdinger

Email: *

Public SSH file path:

/ssh/id_ed25519.pub

Private SSH file path:

/ssh/id_ed25519

OK Cancel

SAS Enterprise Guide 8.4

Supports HTTPS (or SSH with special config)

Manage Git Connections

Git Repositories

Profiles Repositories

GitLab

Edit Profile

Profile name: *

GitHub

User name: *

cjdinger

Email: *

Password:

.....

OK Cancel

SAS GIT* functions


Supports SSH or HTTPS

```
/* Fetch latest code from GitHub */  
data _null_;  
  rc = gitfn_clone(  
    "git@github.com:sascommunities/sas-dummy-blog.git",  
    "&repoPath.",  
    "cjdinger", ""  
    "/u/sasrh/.ssh/id_rsa.pub",  
    "/u/sasrh/.ssh/id_rsa");  
  put rc=;  
run;
```

Register SSH key

GitLab example

GitLab settings

 GitLab Projects Groups More Search or jump to...

User Settings > SSH Keys

SSH Keys

SSH keys allow you to establish a secure connection between your computer and GitLab.

Add an SSH key

To add an SSH key you need to [generate one](#) or use an [existing key](#).

Key

Paste your public SSH key, which is usually contained in the file '~/.ssh/id_ed25519.pub' or '~/.ssh/id_rsa.pub' and begins with 'ssh-ed25519' or 'ssh-rsa'. Don't use your private SSH key.

```
ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAQGCzG7/O3Do7+qSxUg2b1Yh5DH+8TZQNTuLS3h
F3THpRcKFKthdtdHuTAvr8sHCCwtgmcKdWrdt3+K9u3se5G+QaEFLSath2+KLIVB/75kcG9
...
IyVZ7/PmQ6cvzqu3psaLMOWvZGmi+CNpP3wVL8Zf6cInqoYUuQptUtxFuws6x8++n86KI
eVaWhZMkh3Ese82Xaosla/KdimOxFrD0Oqc8hPSuFdK1JZwSZatf4ZObkKWXH94YptmD/Tq
```

Title

Expires at

chris.hemedinger@sas.com mm/dd/yyyy

Give your individual key a title. This will be publically visible.

Add key

Your SSH keys (4)

chris.hemedinger@sas.com	2 63:1a:dd:b8:98:6f:5d:d3:29:3b:3e:80:de:76:d0:42
Last used: 17 hours ago	Expires: Never Created 17 hours ago

SAS Studio settings

Edit Profile

Profile name: *

GitLab

User name: *

sasrh

Email: *

chris.hemedinger@sas.com

Public SSH file path:

/viyafles/sasrh/ssh/id_rsa_gh2.pub

Private SSH file path:

/viyafles/sasrh/ssh/id_rsa_gh2

OK Cancel

Generate an access token for HTTPS

Required for single-signon (SSO) or 2-factor auth

- HTTPS access requires username and password
- Instead of account password, use access token
- Access tokens convey specific permissions (`api`, `read_repository`, `write_repository`, etc.)
- Protect your access token!

Creating a personal access token

You should create a personal access token to use in place of a password with the command line or with the API.

Personal access tokens (PATs) are an alternative to using passwords for authentication to GitHub when using the [GitHub API](#) or the [command line](#).

If you want to use a PAT to access resources owned by an organization that uses SAML SSO, you must authorize the PAT. For more information, see "[About authentication with SAML single sign-on](#)" and "[Authorizing a personal access token for use with SAML single sign-on](#)."

As a security precaution, GitHub automatically removes personal access tokens that haven't been used in a year.

From GitHub doc

GitLab example

GitLab settings

User Settings > Access Tokens

Personal Access Tokens

You can generate a personal access token for each application you use that needs access to the GitLab API.

You can also use personal access tokens to authenticate against Git over HTTP. They are the only accepted password when you have Two-Factor Authentication (2FA) enabled.

Add a personal access token

Enter the name of your application, and we'll return a unique personal access token.

Name

Expires at

YYYY-MM-DD

Scopes

☐ api

Grants complete read/write access to the API, including all groups and projects, the container registry, and the package registry.

☐ read_user

Grants read-only access to the authenticated user's profile through the /user API endpoint, which includes username, public email, and full name. Also grants access to read-only API endpoints under /users.

☐ read_api

Grants read access to the API, including all groups and projects, the container registry, and the package registry.

☐ read_repository

Grants read-only access to repositories on private projects using Git-over-HTTP or the Repository Files API.

☐ write_repository

Grants read-write access to repositories on private projects using Git-over-HTTP (not using the API).

Create personal access token

SAS Studio settings

Edit Profile

SSH HTTPS

SSL Certification:

Profile name: *

GitHub

User name: *

cjdingner

Email: *

chris.hemedinger@sas.com

Password:

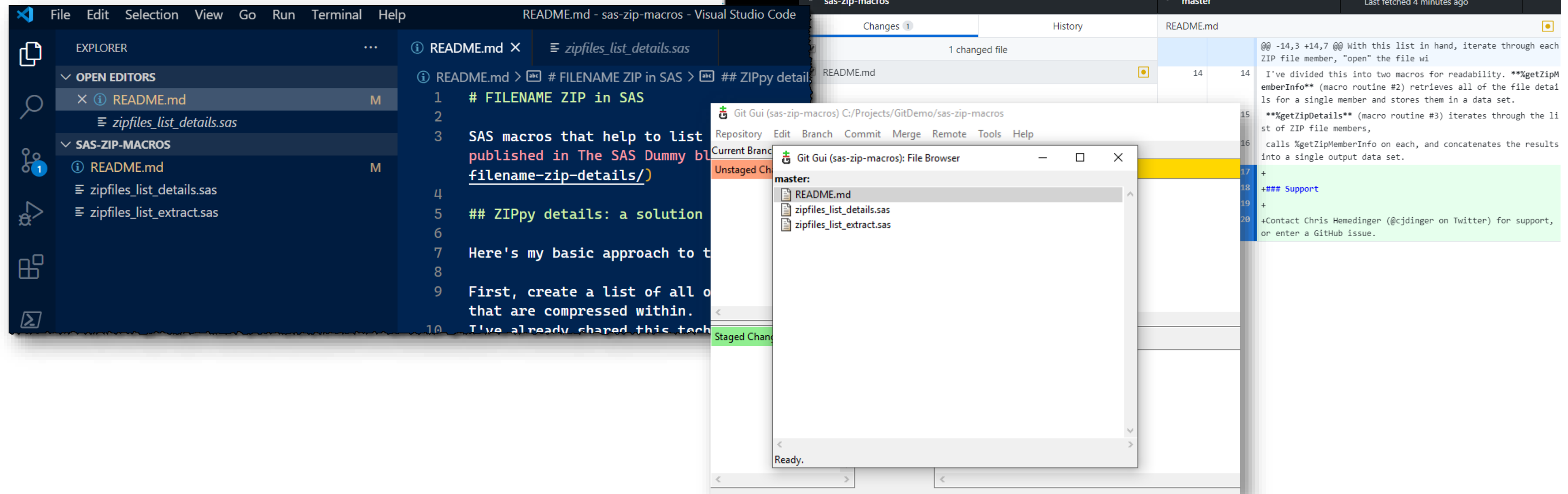
.....

personal access token

OK Cancel

Use other tools alongside SAS

- Git Bash (CLI)
- Git GUI or GitHub Desktop
- VS Code



How to organize your SAS projects in Git

Read the blog article

- Don't create one huge repo
- Don't organize based on dept org structure
- Design with collaboration in mind
- Re-use 👍 , Ownership 👎
- Work **with** Git features, not against them

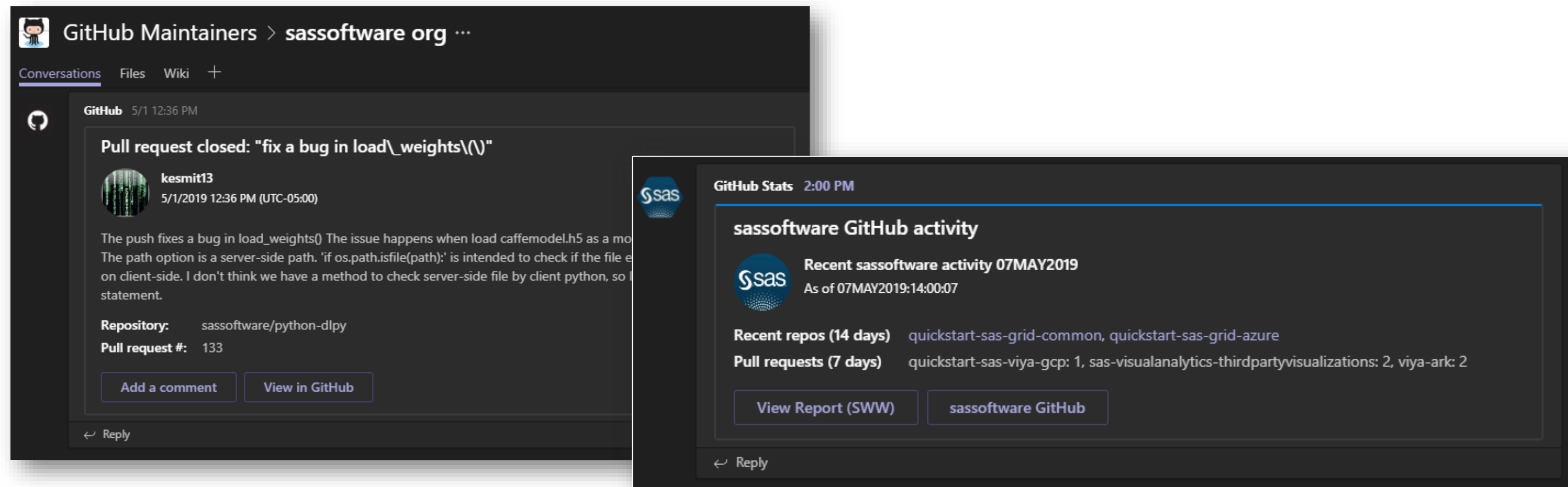


<https://blogs.sas.com/content/sasdummys/sas-projects-git/>

Git integration is just the beginning

From there, trigger other operations

- Gerrit for code review
- Jenkins or Travis CI for build, deployment, and other continuous integration
- Trigger notifications/alerts in Slack, Microsoft Teams



Learn more

- [Using Git with SAS](#) (SAS Users YouTube)
- [Git & SAS Workshop](#) (GitHub project)
- [Git functions in SAS 9.4 and SAS Viya](#) (doc)
- [Using Git in SAS Enterprise Guide](#) (doc)
- [Git with SAS Studio and SAS Enterprise Guide](#) (video)
- [SAS Software on GitHub](#)
- [Using built-in Git operations in SAS](#) (blog)
- [How to organize your SAS projects in Git](#) (blog)
- [DevOps with SAS 9: SAS code, GitLab, and Jenkins](#) (community)
- [developer.sas.com](#) for SAS app development
- [Pro Git](#) by Scott Chacon and Ben Straub, free online book about Git

```
git commit -m “Questions?”
```

