Streamline Your Workflow: Integrating SAS, LaTeX, and R into a Single Reproducible Document

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GO HEELS

Figure 1: #GDTBATH

Background

Goals

easy to implement

Goals

easy to implement

minimizes errors

Goals

easy to implement

minimizes errors

collaborators can understand & contribute

Background

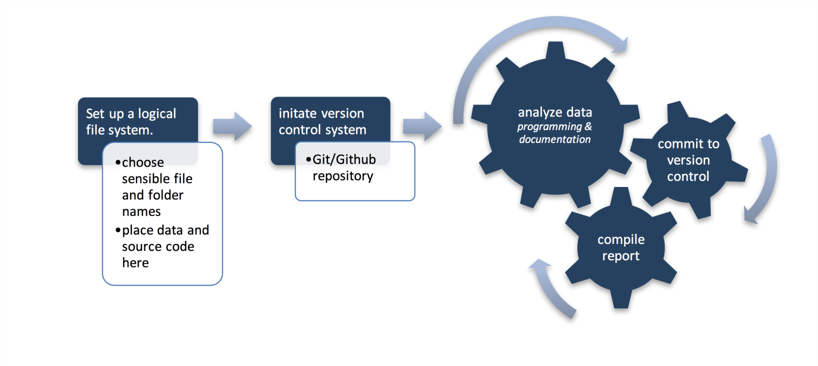

Figure 2: Streamlined workflow summary

Definitions

`shell`: This can be referred to as the terminal, bash, Command Prompt, etc. We will be navigating to different folders and running commands here.

Definitions

`chunk`: A section of a programming language, in this case `SAS` or `R`.

Definitions

`Git`: A version control system for tracking file changes

`GitHub`: Web based Git repository

Definitions

LaTeX: A type-setting system designed for scientific documentation.
Pronounced lah-tek

Best Practices

File Organization

Consistent file organization is key. I prefer the following setup:

🗁project-name

↳🗁code

↳🗁data

↳🗁reports

File Organization

↓ All lower case

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Separated by underscores (_) for field separation and

dashes (-) for term/word separation (*for example, 2017-01-01_new-years-resolutions*).

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(*this ensures easy sorting*)

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Avoid things like

analysis_final_final_this-is-really-final_2.tex

Version Control

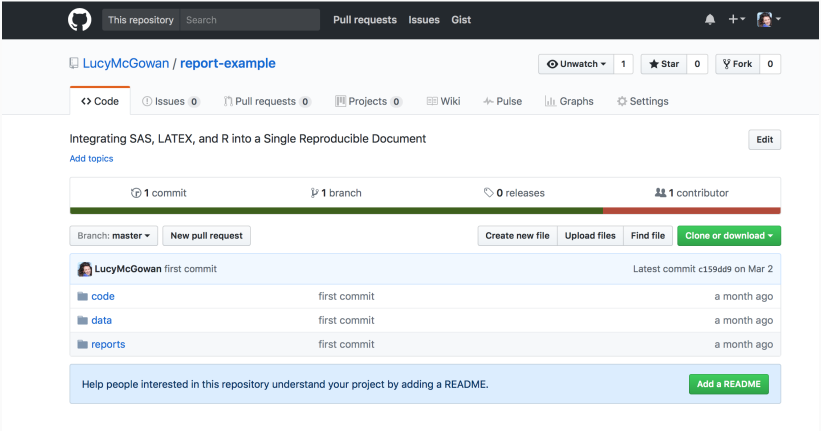
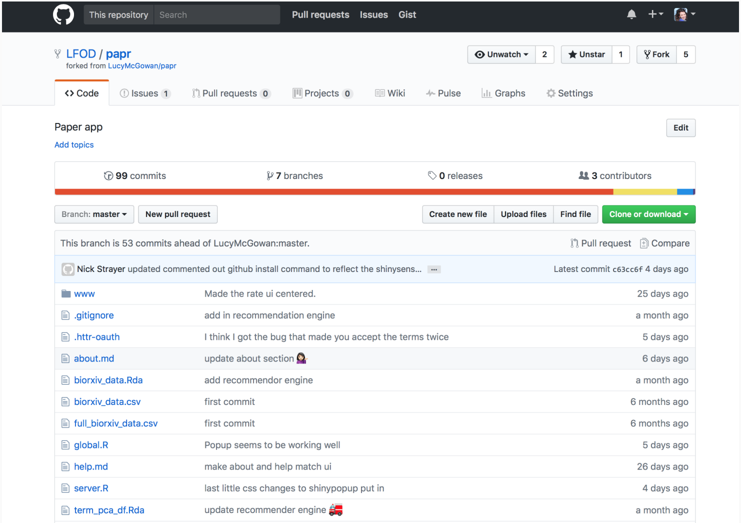


Figure 3: Follow along:
`https://github.com/LucyMcGowan/report-example`

Version Control

Motivation



Motivation

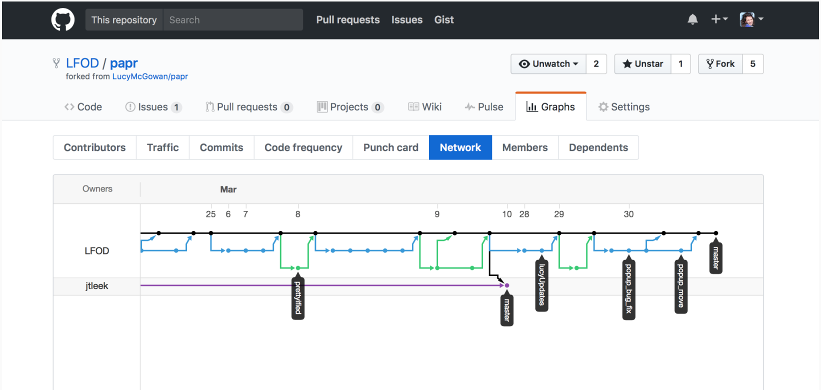


Figure 5: Github branching example

Version Control

GitHub

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2. In the shell, navigate to your project-name folder and type (or copy and paste) the following, changing your-user-name to your GitHub username and project-name to your project name

Version Control

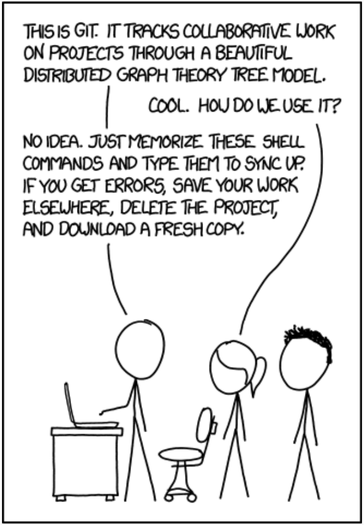


Figure 6: Git as told by xkcd.com/1597

Version Control

```
git init
git add .
git commit -m "first commit"
git remote add origin
    https://github.com/your-user-name/project-name.git
git push -u origin master
```

Version Control

Every time you make a change to a file, repeat the following commands in the shell

```
git add filename
git commit -m "describe your file change here"
git push -u origin master
```

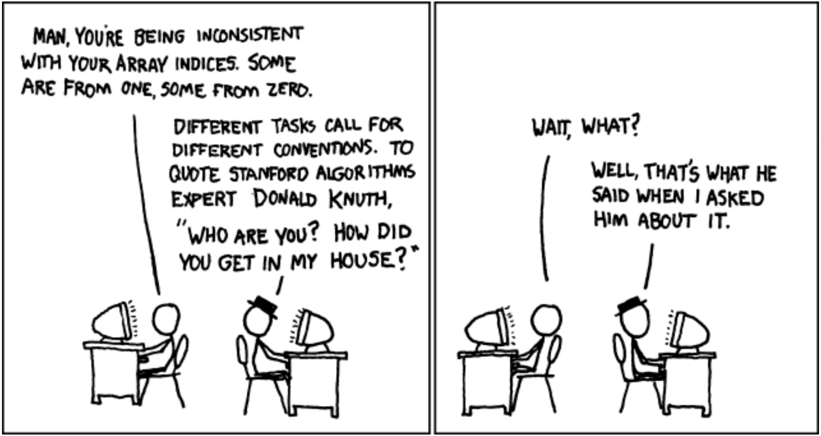
Version Control

Figure 7: Git Commits as told by xkcd.com/1296

GitHub Resources

1. Hu, J. (2013). The Hitchhiker's Guide to Github: SAS Programming Goes Social. SESUG. URL `http://analytics.ncsu.edu/sesug/2013/PA-04.pdf`.
2. Philp, S. (2012). An Introduction to Git Version Control for SAS Programmers. WUSS. URL `http://www.wuss.org/proceedings12/94.pdf`.
3. Bryan, J. (2017). Happy Git and GitHub for the useR. URL `http://happygitwithr.com/`

Literate Programming



Literate Programming

"I believe that the time is ripe for significantly better documentation of programs, and that we can best achieve this by considering programs to be works of literature. Hence, my title: "Literate Programming." Let us change our traditional attitude to the construction of programs: Instead of imagining that our main task is to instruct a computer what to do, let us concentrate rather on explaining to human beings what we want a computer to do." (Knuth 1984).

explanation + `code`

Setup

Setup

- LaTeX
- SAS University Edition
- R

pdflatex (version 1.3 or later)

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StatRep

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- open-source software project

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- reads the code and markup & creates a SAS program

StatRep

- open-source software project
- reads the code and markup & creates a SAS program
- results that are displayed in your document

StatRep

http://support.sas.com/rnd/app/papers/statrep.html

1. Copy the StatRep macros to a local directory. *Remember where you are saving these macros, you will need this filepath soon.*

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2. Install the LATEX package

SAS University Edition

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SAS University Edition

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4. Add project folder to SAS University Edition

SAS University Edition

1. Install `https://www.sas.com/en_us/software/university-edition.html`
2. Create a folder with the title of your project, mine will be called report-example
3. Within that folder create 3 folders: **data**, **code**, **reports**
4. Add project folder to SAS University Edition
5. Add macro folder to SAS University Edition

SAS University Edition

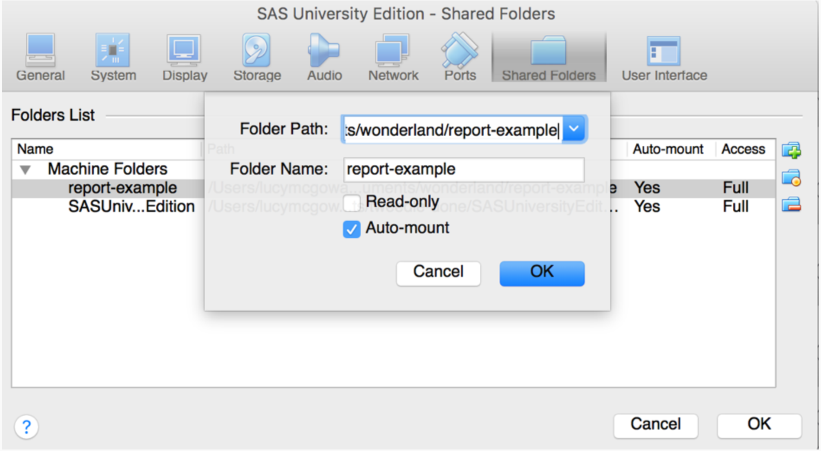


Figure 8: Add a Shared Folder to SAS University Edition

SAS University Edition

`/folders/myshortcuts/report-example/`

R

1. Download R (`https://www.r-project.org`)
2. Install the `knitr` package:

```
install.packages('knitr')
```

Methods

Methods

1. Document Setup

Methods

1. Document Setup
2. Programming and Documentation

Methods

1. Document Setup
2. Programming and Documentation
3. Rendering

Document Setup

`analysis.Rnw`

Document Setup

```
\documentclass{article}
\usepackage{statrep}
\usepackage{parskip,xspace,hyperref}
\def\SRrootdir{/folders/myshortcuts/report-example/code}
\def\SRmacropath{/folders/myshortcuts/statrep_macros.sas}
\title{Your title}
\author{Your name}
\date{\today}
\begin{document}
\maketitle

[we will add code here]

\end{document}
```

Recap

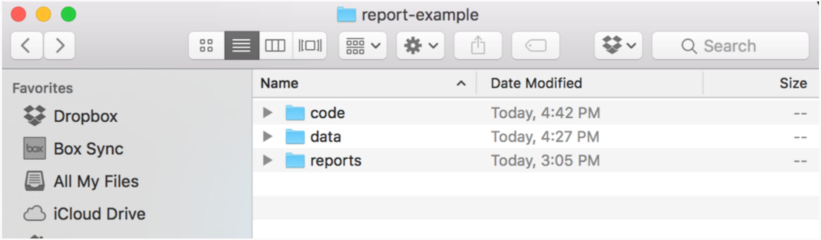


Figure 9: File setup demonstration: project-name

Recap

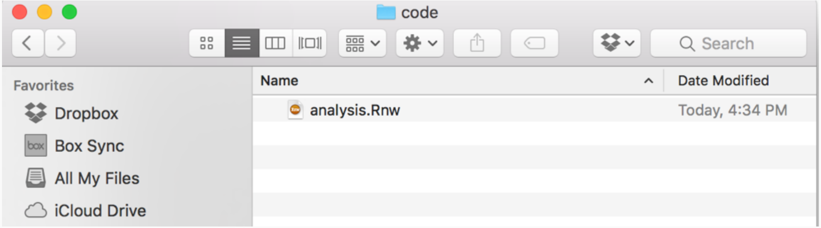


Figure 10: File setup demonstration: code folder

Recap

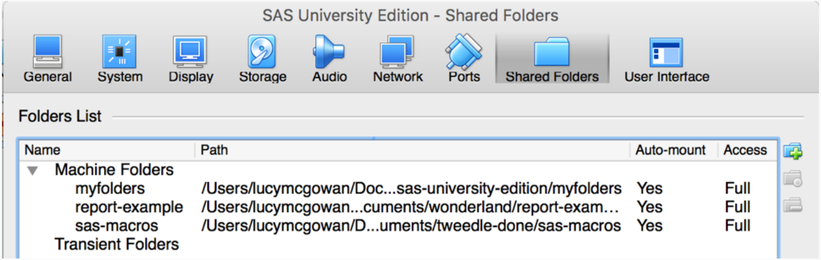


Figure 11: File setup demonstration: SAS University Edition shared folders

data

Programming and Documentation

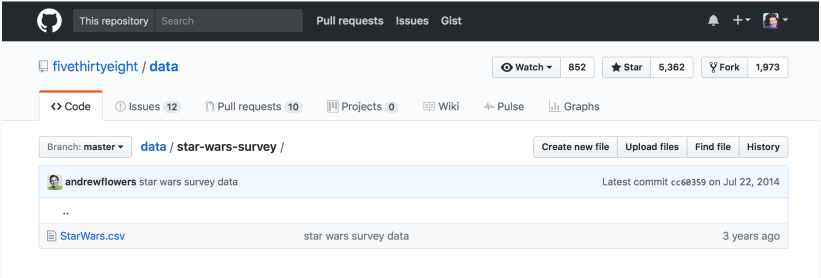


Figure 12: Five Thirty Eight Star Wars Survey Data

Programming and Documentation

🗑 `[we will add code here]`

Programming and Documentation

SAS Chunk

```
\begin{Sascode}

/* SAS CODE HERE */

\end{Sascode}
```

Programming and Documentation

R Chunk

```
<<>>=

#R CODE HERE

@
```

Figure 13: Han shot first (1977)

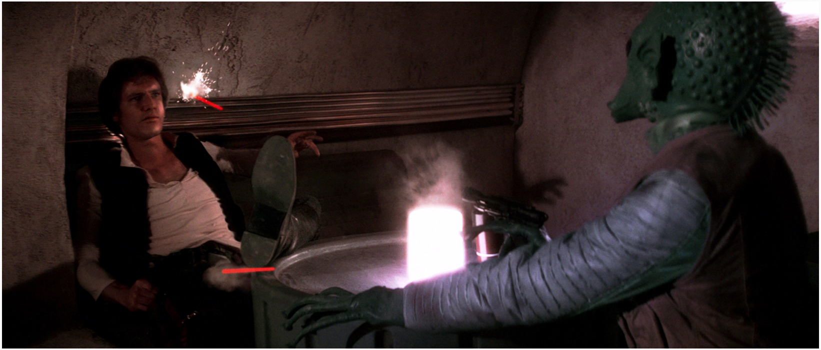


Figure 14: Greedo shot first (1997)

Programming and Documentation

Importing

```
I obtained data from a 538 Star Wars Survey
and will read it into SAS in order to analyze whether
age, gender, education level, or whether the individual
is a Star Trek fan are associated with incorrectly
believing that Greedo shot first.

\begin{Sascode}
libname data "/folders/myshortcuts/report-example/data";

filename reffile
   '/folders/myshortcuts/report-example/data/data.csv';
```

Importing

```
proc import datafile=reffile
    dbms=csv
    out=data.starwars;
    getnames=yes;
run;
\end{Sascode}
```

Modeling

```
\begin{Sascode}[store = logistic]
ods graphics on;

proc logistic data = data plots = oddsratio;
 class age (ref = FIRST) gender college star_trek_fan;
 model wrong (event = "1") = age gender college
    star_trek_fan;
run;

ods graphics off;
\end{Sascode}
```

Results

```
\Listing[store = logistic,
objects = OddsRatios,
caption = {Wrong about who shot first OR}]{logisticOR}
```

Results

The LOGISTIC Procedure

Odds Ratio Estimates

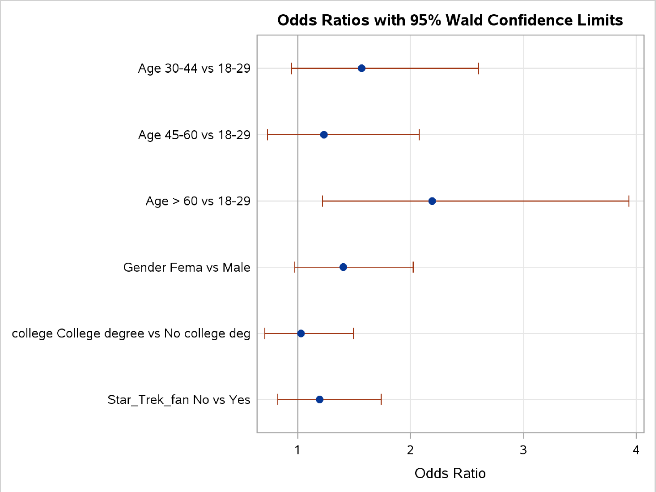
Effect		Point Estimate	95% Wald Confidence Limits	
Age	30-44 vs 18-29	1.566	0.941	2.605
Age	45-60 vs 18-29	1.232	0.730	2.079
Age	> 60 vs 18-29	2.190	1.218	3.936
Gender	Fema vs Male	1.402	0.970	2.026
college	College degree vs No college deg	1.027	0.705	1.497
Star_Trek_fan	No vs Yes	1.194	0.818	1.742

Figure 15: Wrong about who shot first Odds Ratios

Results

```
\Graphic[store=logistic,
   objects=ORPlot,
   caption={Wrong about who shot first plots}]{ORplot}
```

Results


Odds Ratios with 95% Wald Confidence Limits
Age 30-44 vs 18-29
Age 45-60 vs 18-29
Age > 60 vs 18-29
Gender Fema vs Male
college College degree vs No college deg
Star_Trek_fan No vs Yes
1
2
3
4
Odds Ratio

Export

```
\begin{Sascode}
proc export data=data.starwars
   outfile =
     '/folders/myshortcuts/report-example/data/data_.csv'
   replace
   dbms = dlm;
   delimiter = ',';
run;
\end{Sascode}
```

Programming and Documentation

R Code

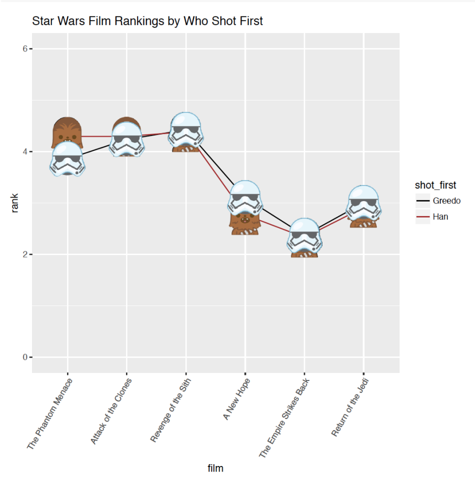
```
<<>>=
filename = "../data/starwars_sasedit.csv"
if (file.exists(filename)){

starwars <- read.csv(filename)

# more R code here
}
@
```

Programming and Documentation

R



Rendering

1. Compile the `.Rnw` file. This is completed using knitr. In the shell, navigate to your code folder where analysis.Rnw is located and submit: `RScript -e "library(knitr); knit('analysis.Rnw')"`

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3. Run the SAS code. Open SAS University Edition. Navigate to your code folder (it will be under Server Files and Folders). Open and run analysis_SR.sas.

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References

1. Arnold, T., & Kuhfeld, W. F. (2012). Using SAS and LATEX to Create Documents with Reproducible Results. URL `http://support.sas.com/resources/papers/proceedings12/324-2012.pdf`.
2. Arnold, T. (2015). The StatRep System for Reproducible Research: A Note for SAS University Edition Users. URL `http://support.sas.com/rnd/app/papers/statrep/statrepUE.pdf`.
3. Bryan, J. (2017). Happy Git and GitHub for the useR. URL `http://happygitwithr.com/`
4. FiveThirtyEight. (2014). America's Favorite 'Star Wars' Movies (And Least Favorite Characters). URL `https://fivethirtyeight.com/datalab/americas-favorite-star-wars-movies-and-least-favorite-`
   Data found at: `https://github.com/fivethirtyeight/`

References

5. Hu, J. (2013). The Hitchhiker's Guide to Github: SAS Programming Goes Social. SESUG. URL `http://analytics.ncsu.edu/sesug/2013/PA-04.pdf`.
6. Knuth, D. E. (1984). Literate programming. The Computer Journal, 27(2), 97-111.
7. Philp, S. (2012). An Introduction to Git Version Control for SAS Programmers. WUSS. URL `http://www.wuss.org/proceedings12/94.pdf`.
8. Wickham, H. (2015). R packages. O'Reilly Media, Inc.

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