

Research Data Management

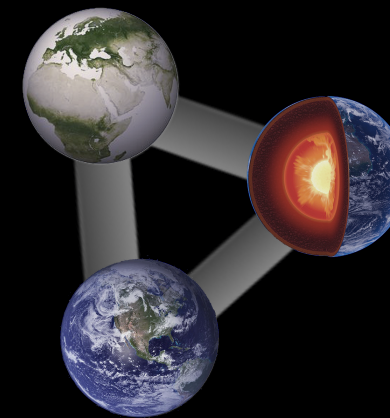
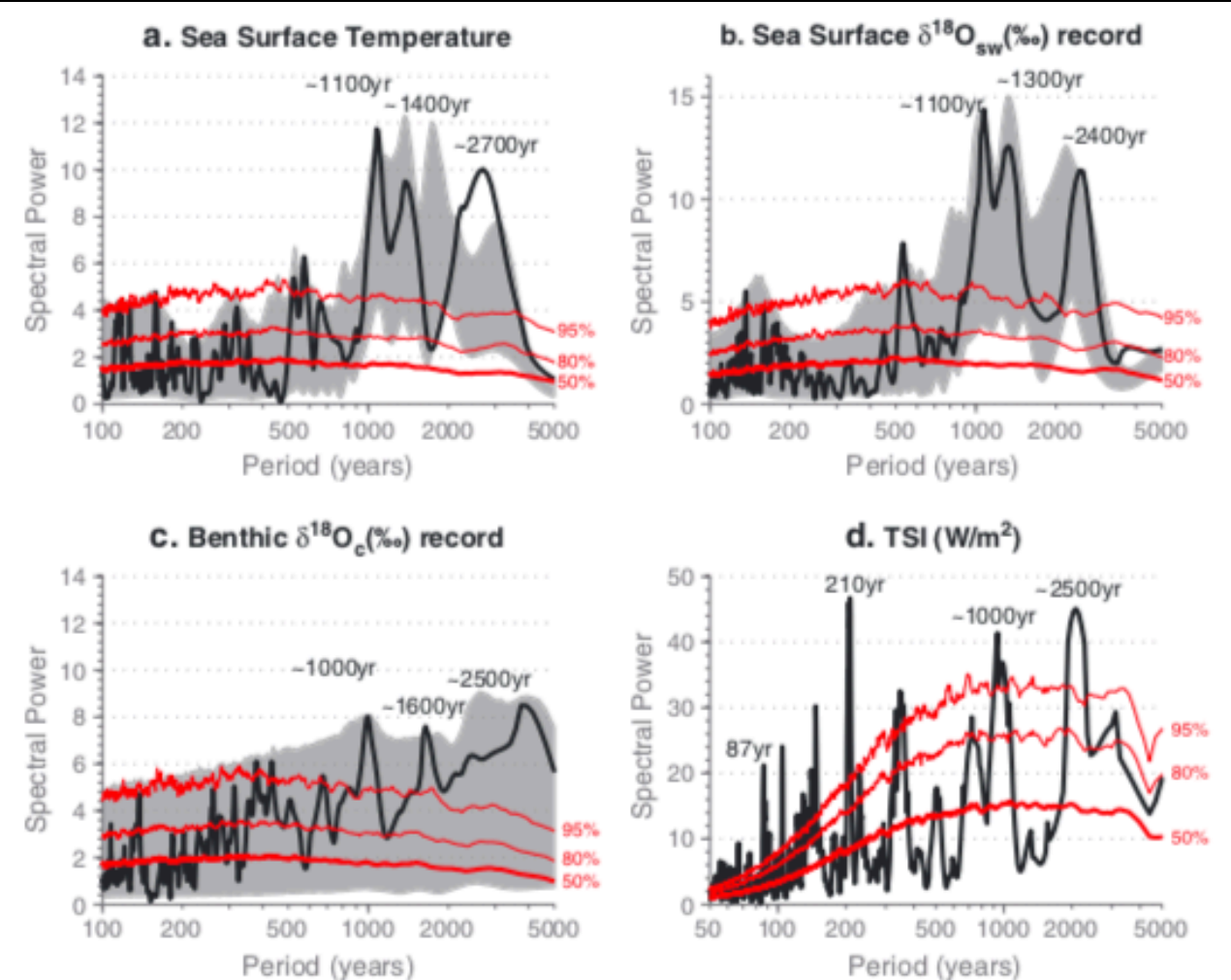
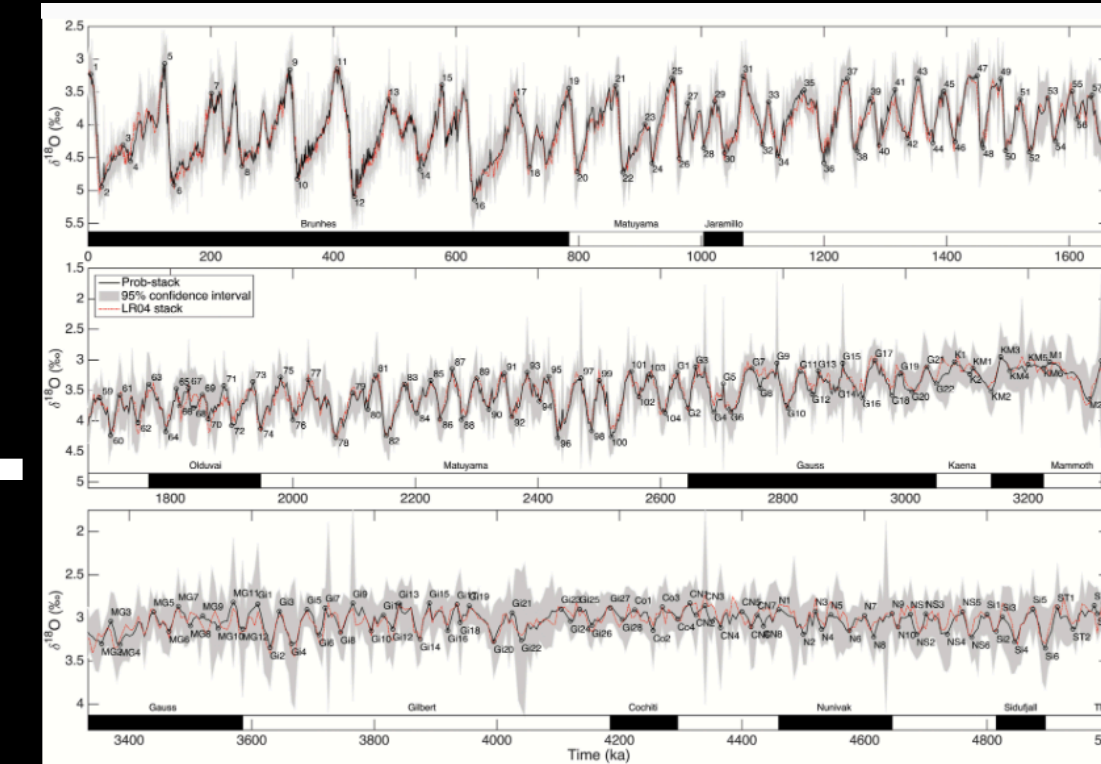
Deborah Khider



USC

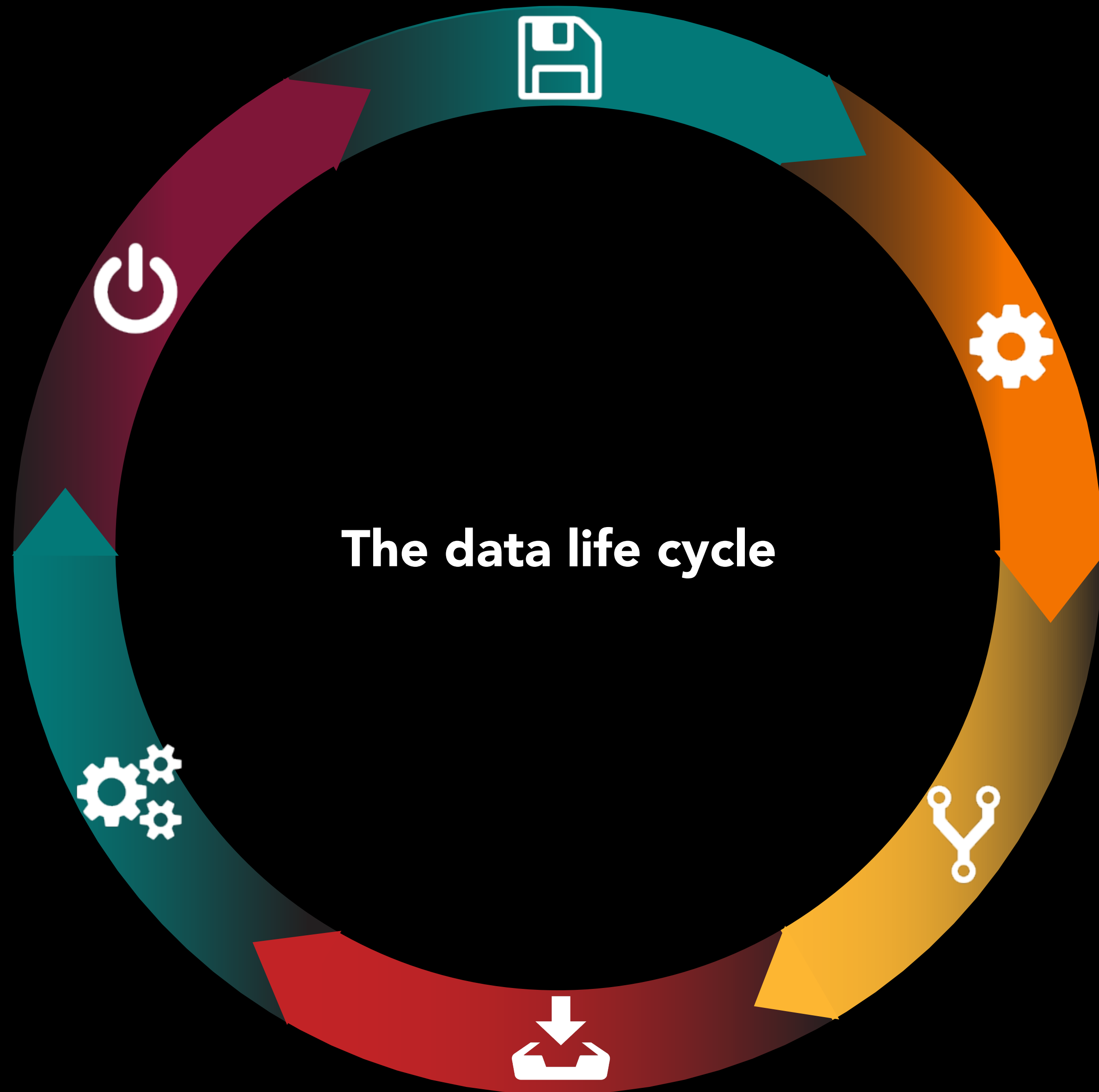


My Data Journey

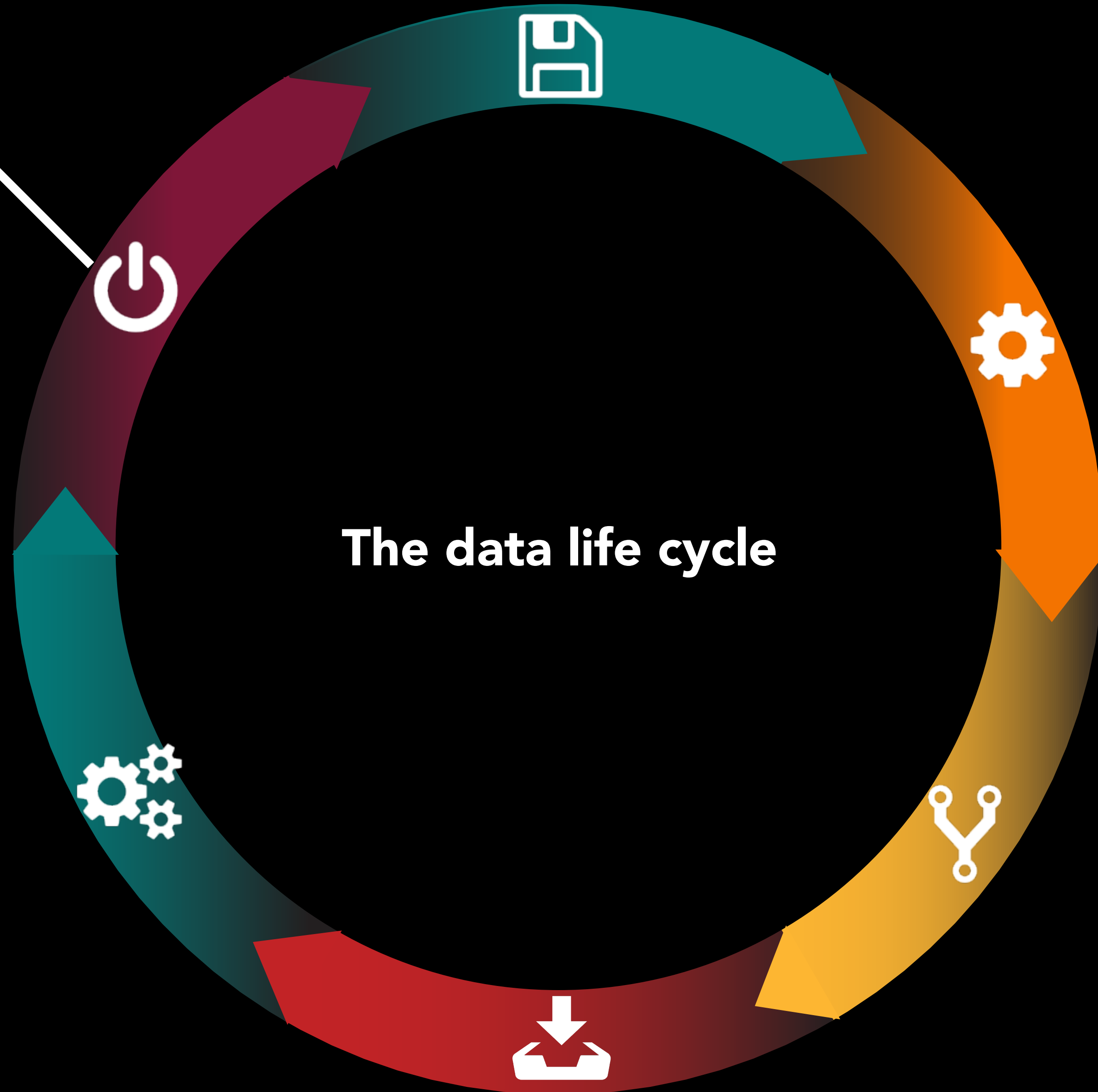


LinkedEarth

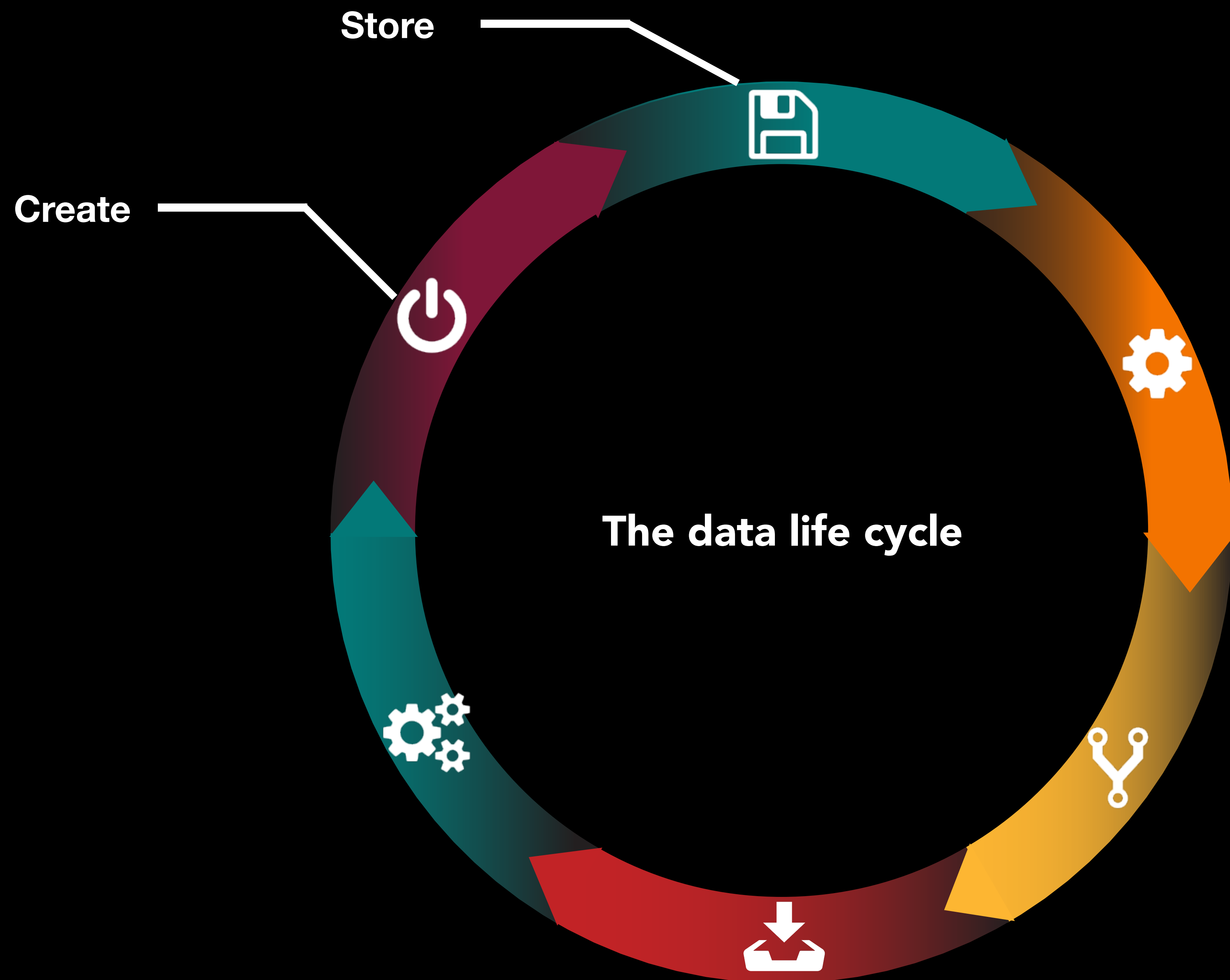


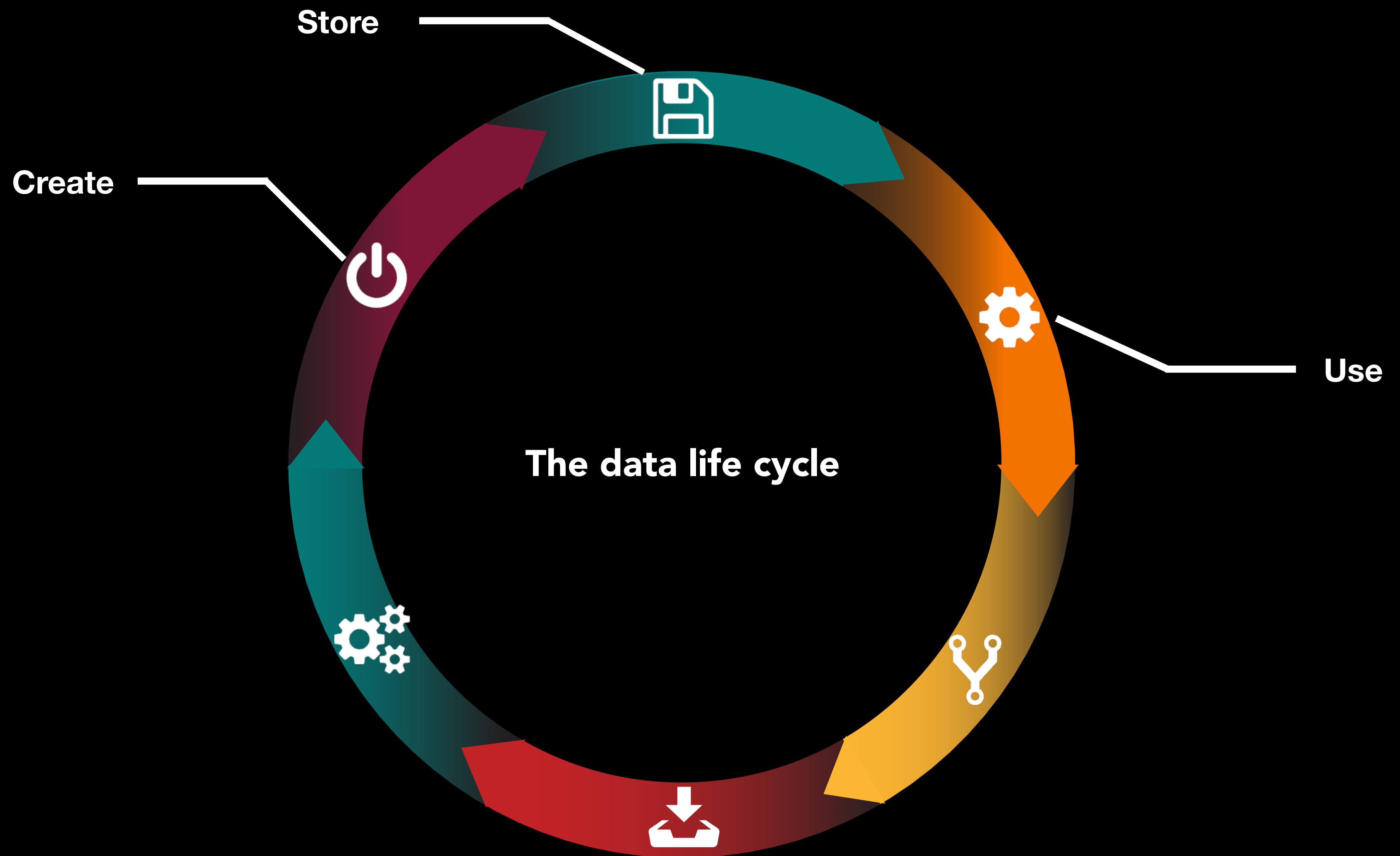


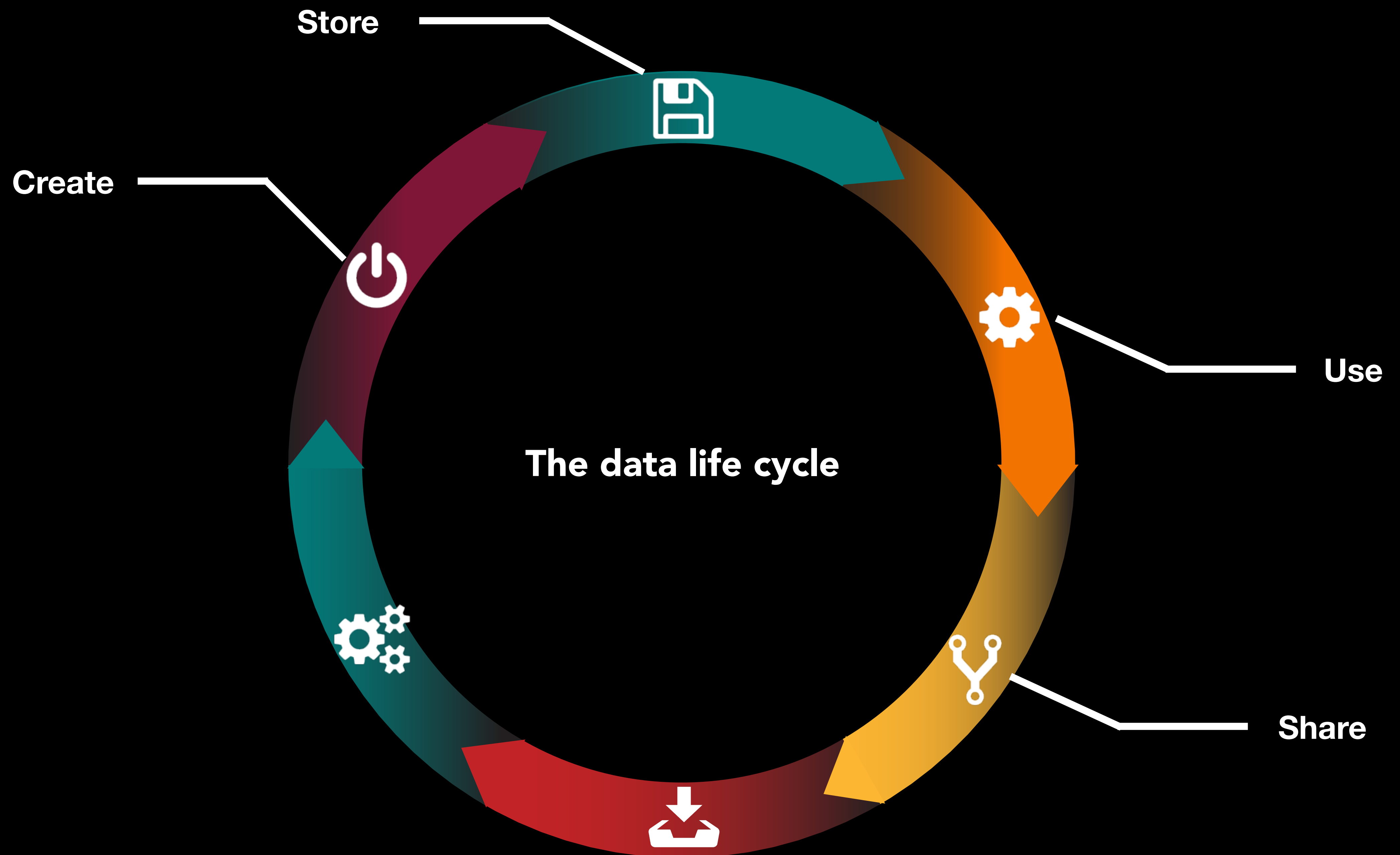
Create

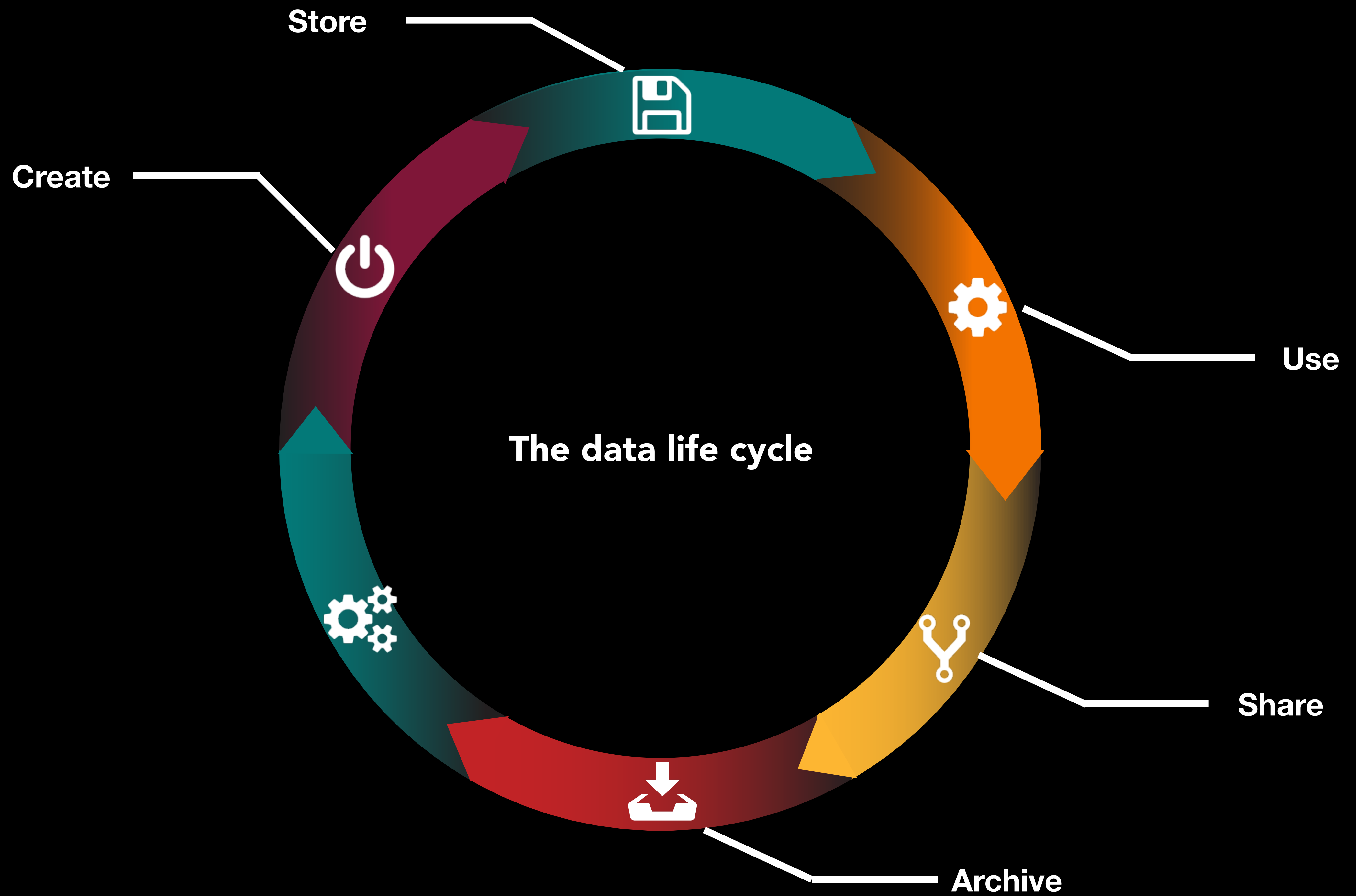


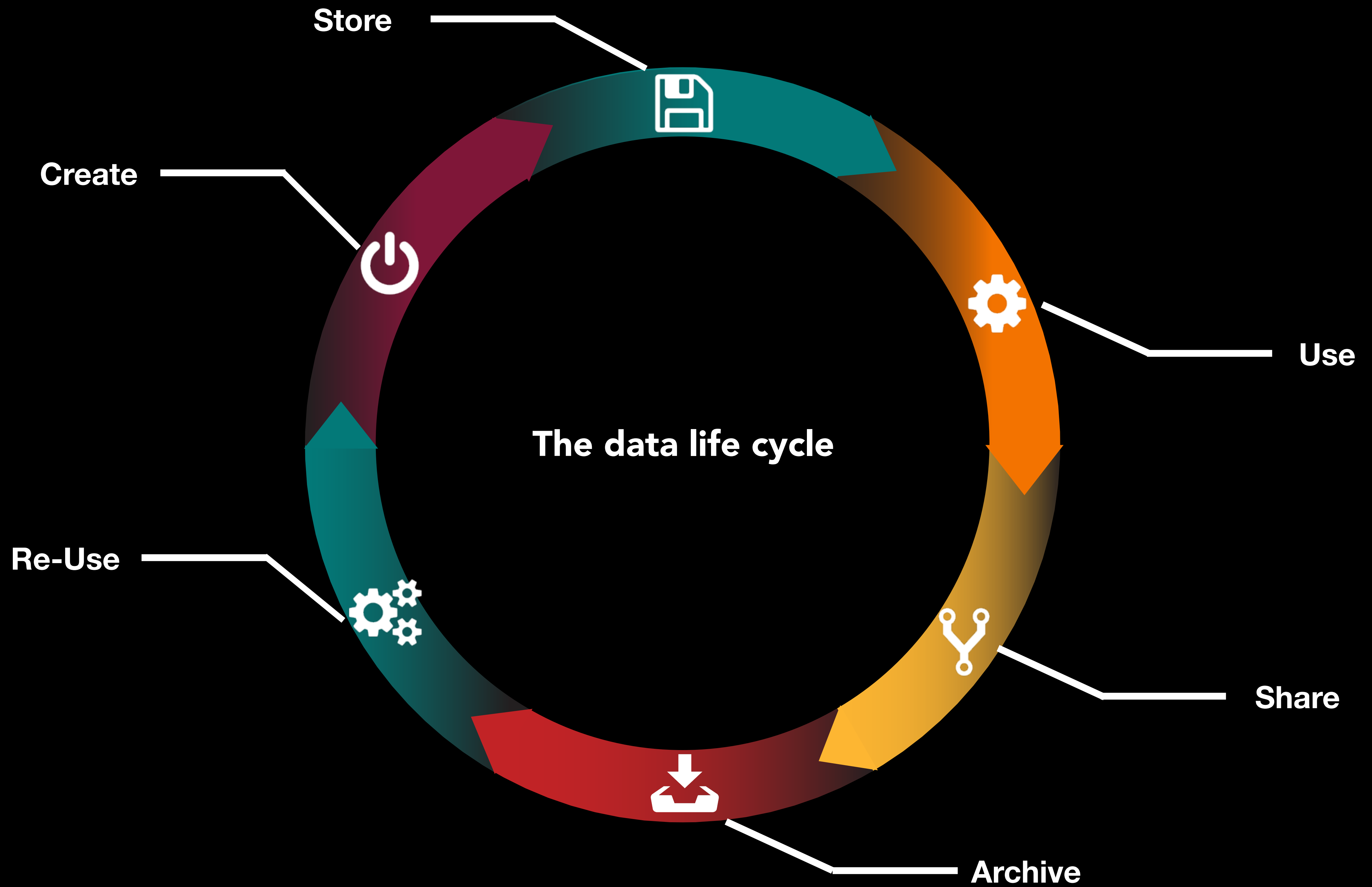
The data life cycle









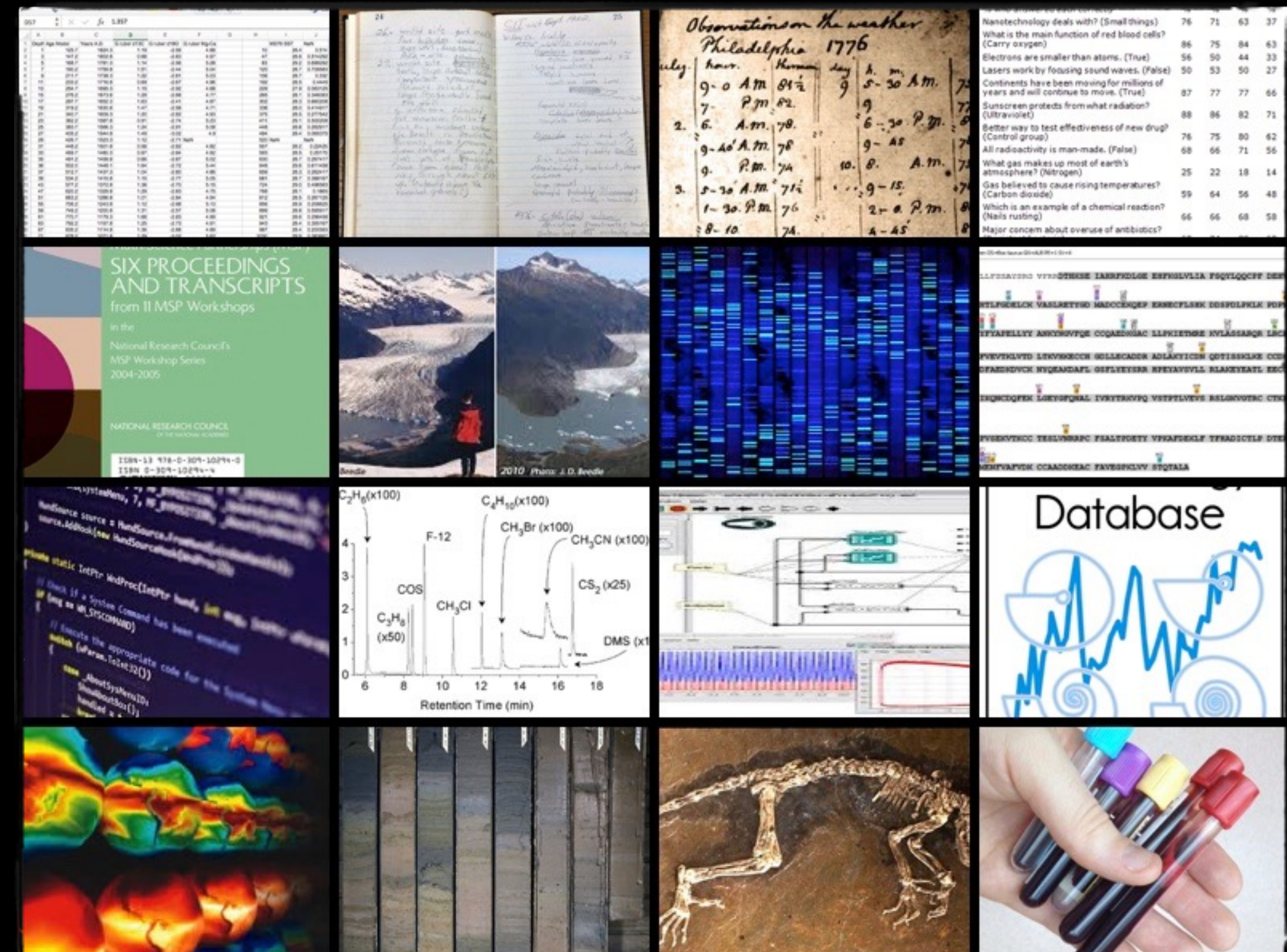


DATA:

"...THE RECORDED FACTUAL
MATERIAL COMMONLY ACCEPTED
IN THE SCIENTIFIC COMMUNITY AS
NECESSARY TO **VALIDATE**
RESEARCH FINDINGS."

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METADATA:

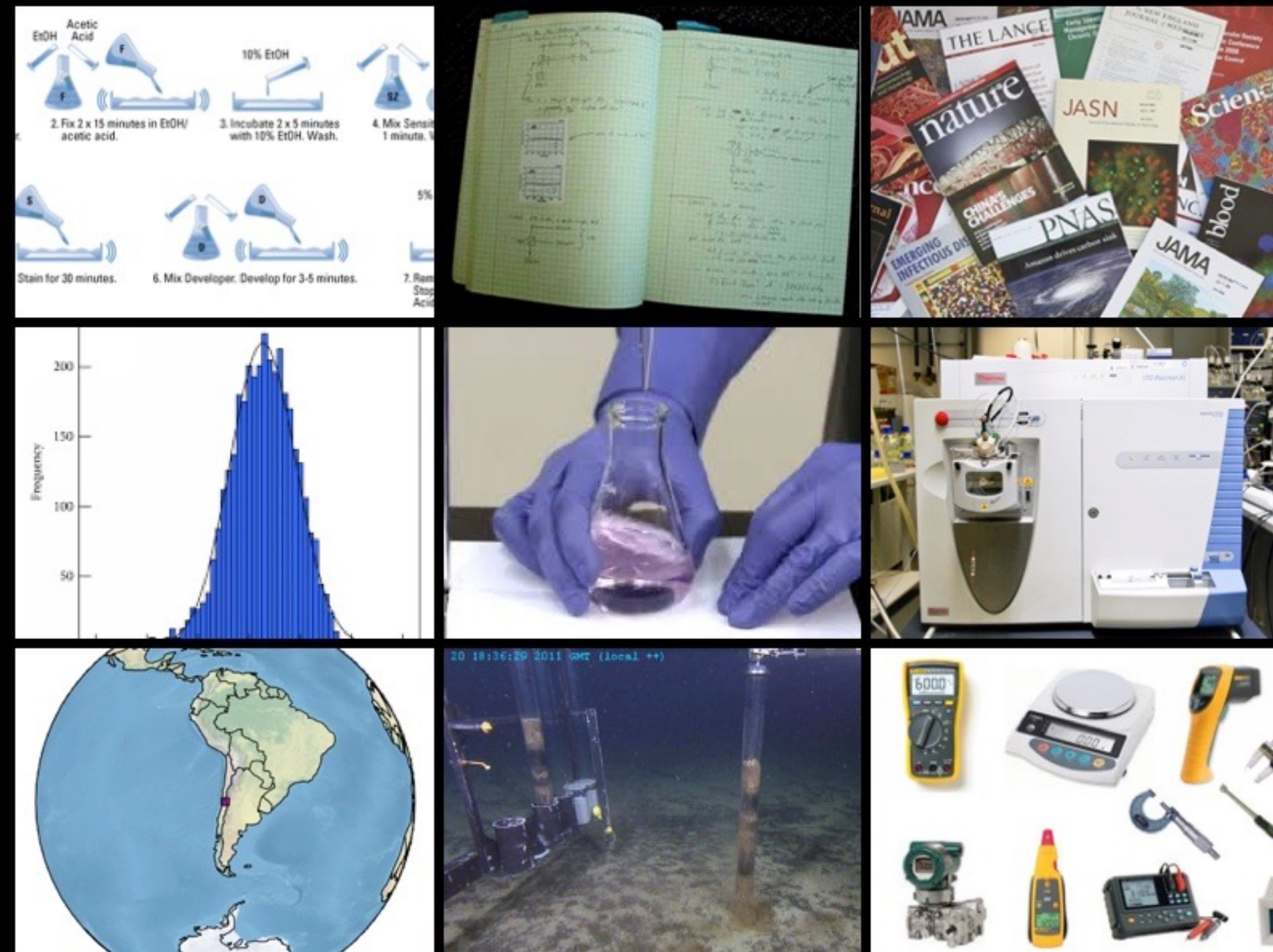
METADATA IS INFORMATION ABOUT THE DATA THAT PROVIDES CONTEXT KEY TO **UNDERSTAND** WHAT THE DATA REPRESENTS.

DATA:

"...THE RECORDED FACTUAL MATERIAL COMMONLY ACCEPTED IN THE SCIENTIFIC COMMUNITY AS NECESSARY TO **VALIDATE** RESEARCH FINDINGS."

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METADATA IS INFORMATION ABOUT THE DATA THAT PROVIDES CONTEXT KEY TO **UNDERSTAND** WHAT THE DATA REPRESENTS.



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METADATA:

METADATA IS INFORMATION ABOUT THE DATA THAT PROVIDES CONTEXT KEY TO **UNDERSTAND** WHAT THE DATA REPRESENTS.

DATA MANAGEMENT:

ACTIONS THAT CONTRIBUTE TO EFFECTIVE **STORAGE, PRESERVATION,** AND **REUSE** OF DATA AND METADATA THROUGHOUT THE RESEARCH LIFECYCLE.

Why do you need to know about data management?

- Scientists are changing

Why do you need to know about data management?

- Scientists are changing

Open Data



Open Access



Open Publications

Open Source



Why do you need to know about data management?

- Scientists are changing
- Publishers are changing

Statement of Commitment:

Today, a research publication is much more than a manuscript on a web site or in print. All scholarly publications represent a network of interconnected resources and information that are essential to the integrity, reusability, and value of that output for both scientific and societal uses. Often, the data, software, experimental protocols and physical samples connected to a publication provide additional and even greater value in their own right.

In the Earth, space, and environmental sciences, much data represent recordings of events or the state of the Earth or solar system in time and space that can never be repeated. Increasingly, these data, models, software, and samples provide essential societal, economic, and research benefits. Given these connections, we recognize that ensuring the quality, value, and integrity of the data and other resources connected to scholarly publications are essential.

Leading principles and practices have been developed over the past few years to meet these goals. Foremost among these are the FAIR Data Principles: that data should be Findable, Accessible, Interoperable, and Reusable not only for people, but also for machines. Under these principles, as a minimum, data must have unique and persistent identifiers and metadata appropriate to assist discovery and be cited in a form equivalent to other scholarly outputs. The data should be accessible through a standard, web-based protocol. Provenance information and a clear usage license must be provided such that the data are technically and semantically interoperable and can be reused with confidence and clarity. The data must also be well curated, persistently accessible, and linked securely to associated publications and other resources. Similar standards have emerged for information about authors, software, and samples.



bit.ly/FAIRCommitment

Why do you need to know about data management?

- Scientists are changing
- Publishers are changing
- Funders are changing



The screenshot shows the White House website header with the text "the WHITE HOUSE PRESIDENT BARACK OBAMA" and navigation links "Contact Us" and "Get Email Updates". Below the header is a blue navigation bar with the White House seal and links: "BRIEFING ROOM", "ISSUES", "THE ADMINISTRATION", "PARTICIPATE", and "1600 PENN". A search icon is also present.

HOME · BLOG

Expanding Public Access to the Results of Federally Funded Research


FEBRUARY 22, 2013 AT 12:04 PM ET BY MICHAEL STEBBINS

Summary: The Obama Administration is committed to the proposition that citizens deserve easy access to the results of research their tax dollars have paid for. That's why, in a policy memorandum released today, OSTP Director John Holdren has directed Federal agencies with more than \$100M in R&D expenditures to develop plans to make the results of federally funded research freely available to the public—generally within one year of publication.

Why do you need to know about data management?

- Scientists are changing
- Publishers are changing
- Funders are changing
- Universities are changing

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Managing your publications

-  We'll scan the web for publications you've authored.
-  Log in (at left) to review what we've found.
-  Claim publications that are yours; reject those that aren't.
-  Upload your manuscript for public display on [eScholarship](#).

Resources and support

Learn more about the [UC Open Access Policy](#).

Get answers to [Frequently Asked Questions](#).

Find out who to contact for [additional support](#).


Logout notice

To protect your accounts from unauthorized access, please lock your workstation or exit your browser after logging out of this site.

Why do you need to know about data management?

- Sharing your data is not only required but it also helps you!

Sharing Detailed Research Data Is Associated with Increased Citation Rate

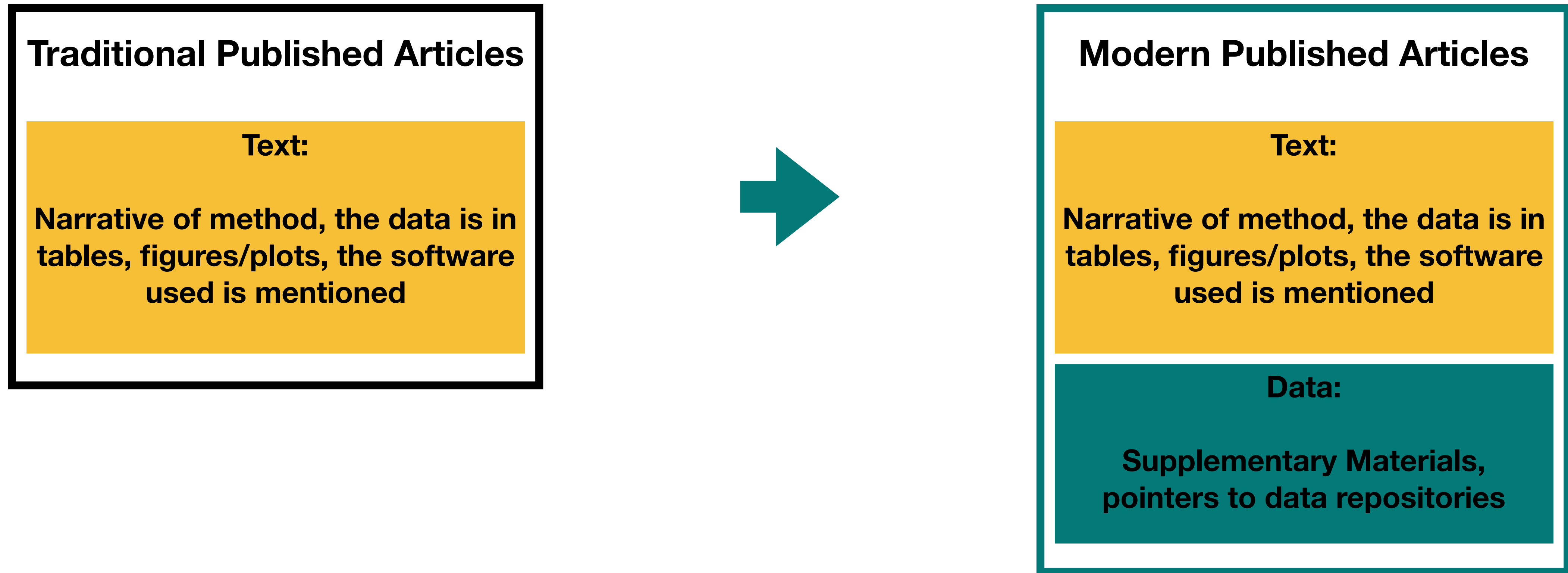
Heather A. Piwowar , Roger S. Day, Douglas B. Fridsma

Published: March 21, 2007 • DOI: 10.1371/journal.pone.0000308 • Featured in PLOS Collections

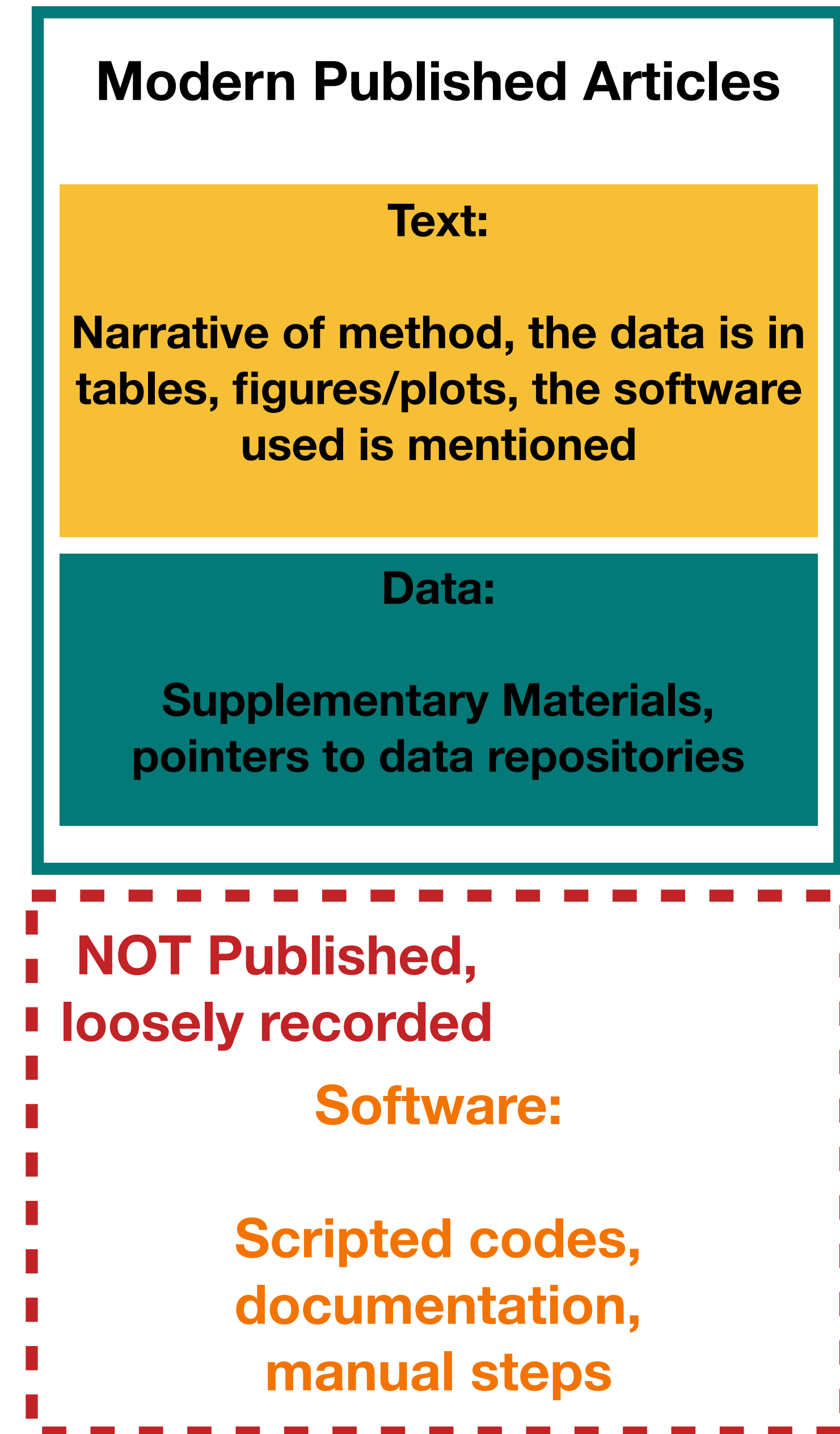
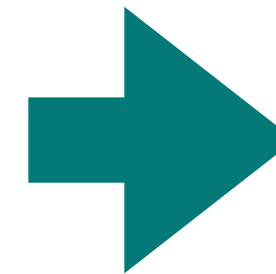
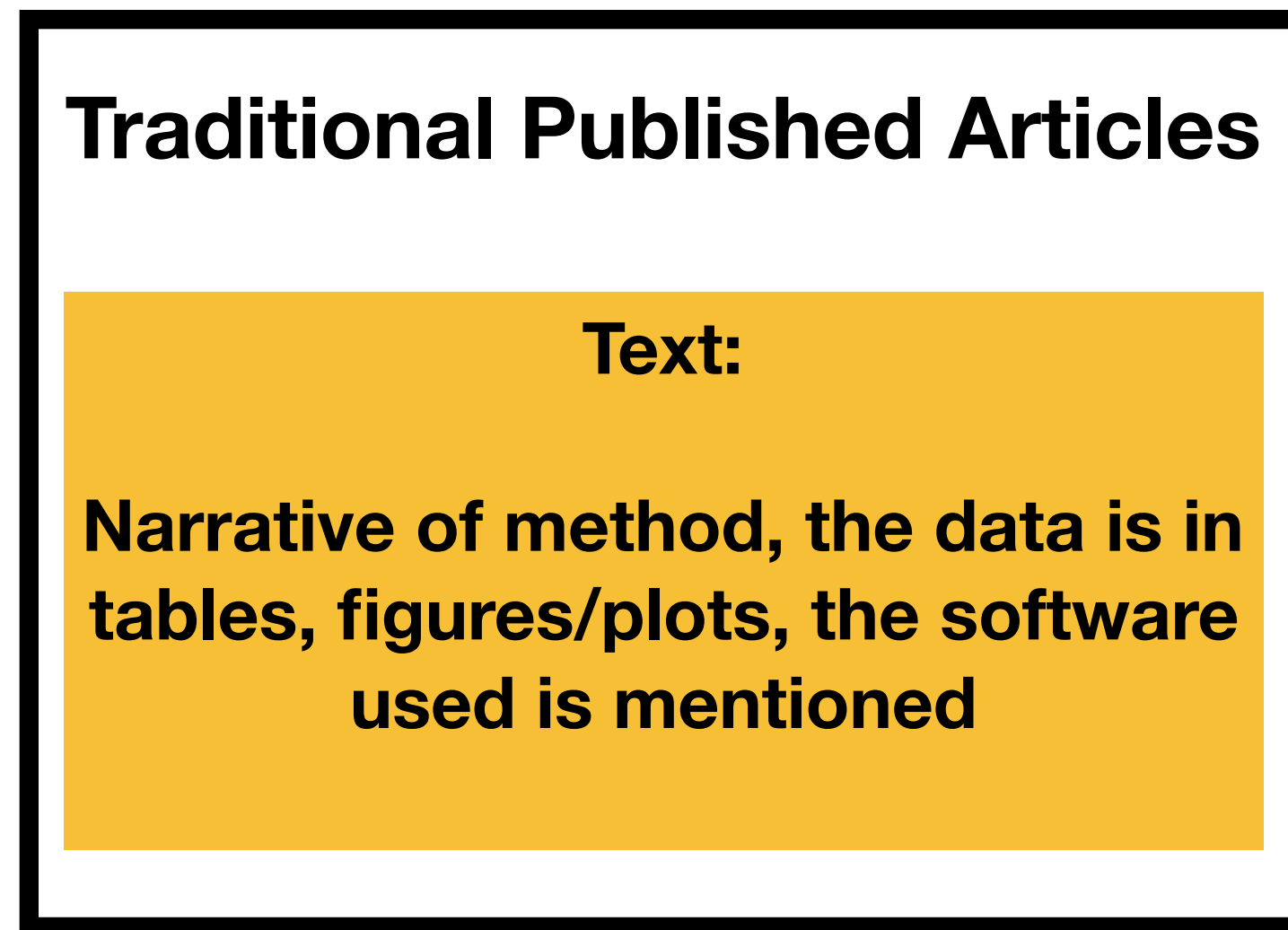
Principal Findings

We examined the citation history of 85 cancer microarray clinical trial publications with respect to the availability of their data. The 48% of trials with publicly available microarray data received 85% of the aggregate citations. Publicly available data was significantly ($p = 0.006$) associated with a 69% increase in citations, independently of journal impact factor, date of publication, and author country of origin using linear regression.

Modern Scientific Articles



Modern Scientific Articles



Scientific Paper of the Future

Modern Paper

Text:

Narrative of the method, some data is in tables, figures/plots, and the software used is mentioned

Data:

Include data as supplementary materials and pointers to data repositories

Reproducible Publication

Software:

For data preparation, data analysis, and visualization

Provenance and methods:

Workflow/scripts specifying dataflow, codes, configuration files, parameter settings, and runtime dependencies

Open Science

Sharing:

Deposit data and software (and provenance/workflow) in publicly shared repositories

Open licenses:

Open source licenses for data and software (and provenance/workflow)

Metadata:

Structured descriptions of the characteristics of data and software (and provenance/workflow)

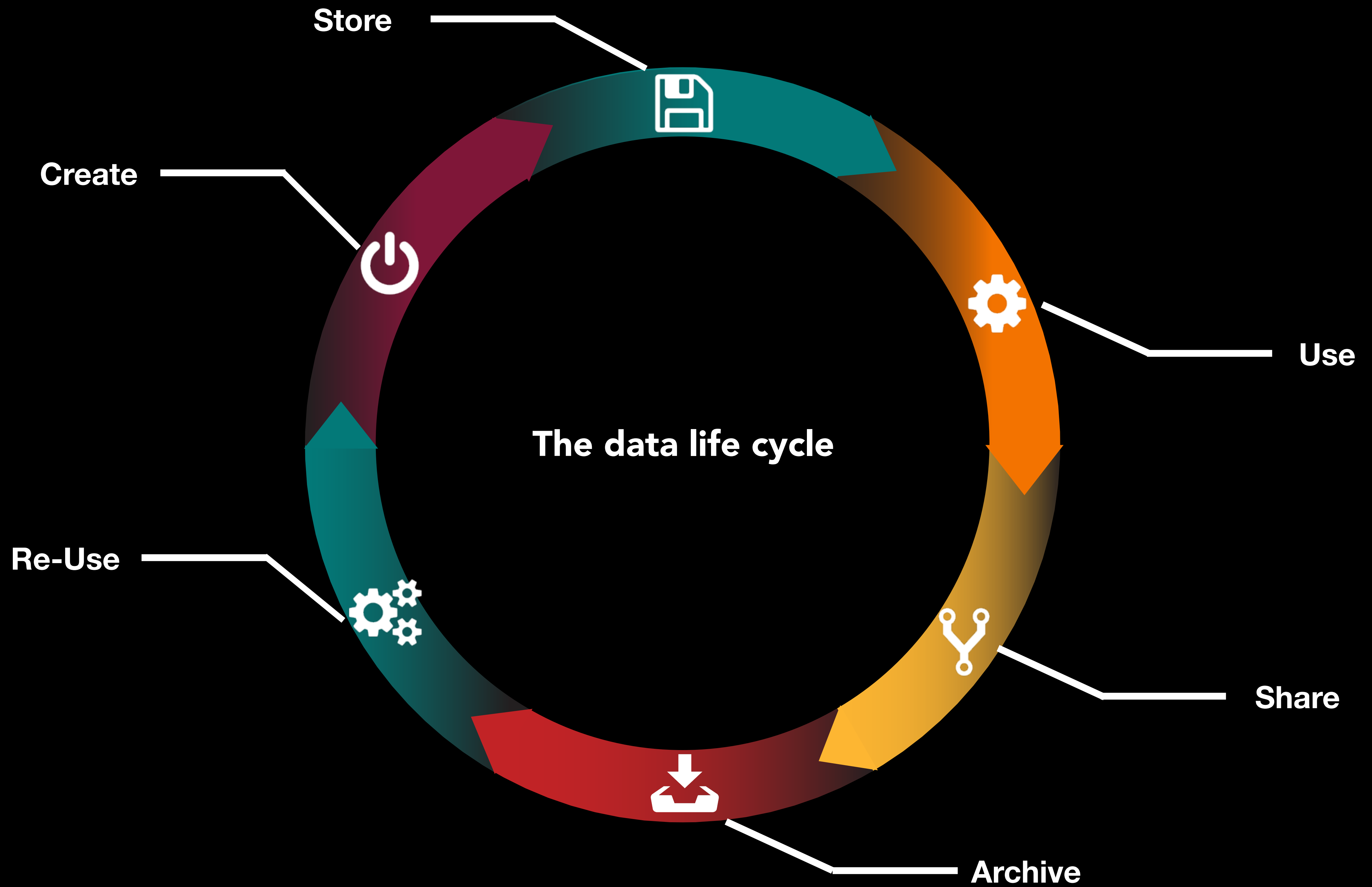
Digital Scholarship

Persistent identifiers:

For data, software, and authors (and provenance/workflow)

Citations:

Citations for data and software (and provenance/workflow)





Store





AND





Store



AND





AND





Store



AND





Store



AND

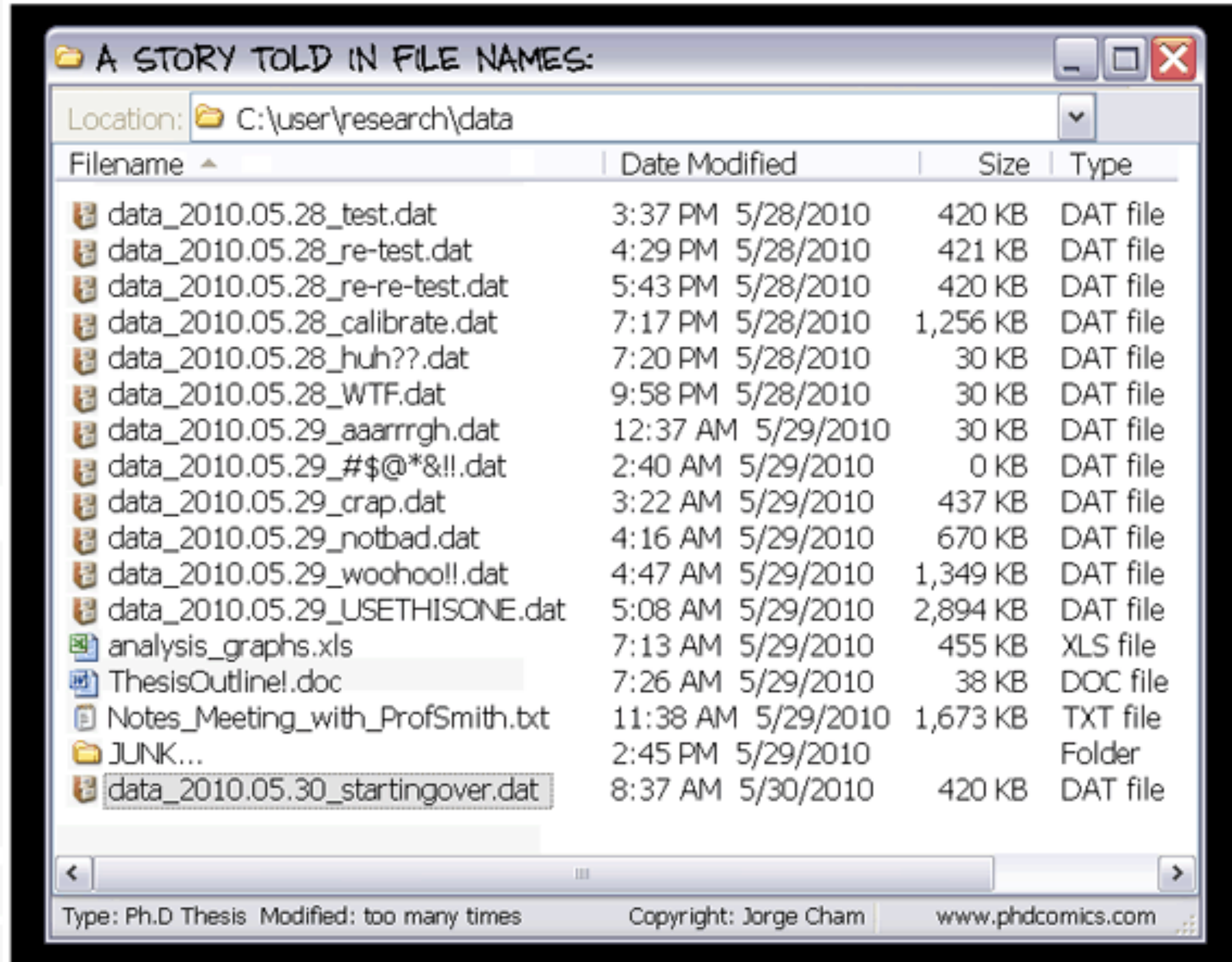


Keep in mind:

1. Some data backup is better than none
2. Automated backups are better than manual
3. Your data is only as safe as the last backup



File Name and Organization





File Name and Organization



Morgan Edwards

@mangoedwards

[Follow](#)

I can't send you the original data because I don't remember what my excel file names mean anymore [#overlyhonestmethods](#)

9:11 AM - 8 Jan 2013



130



77



File Name and Organization



Project_Date_Description

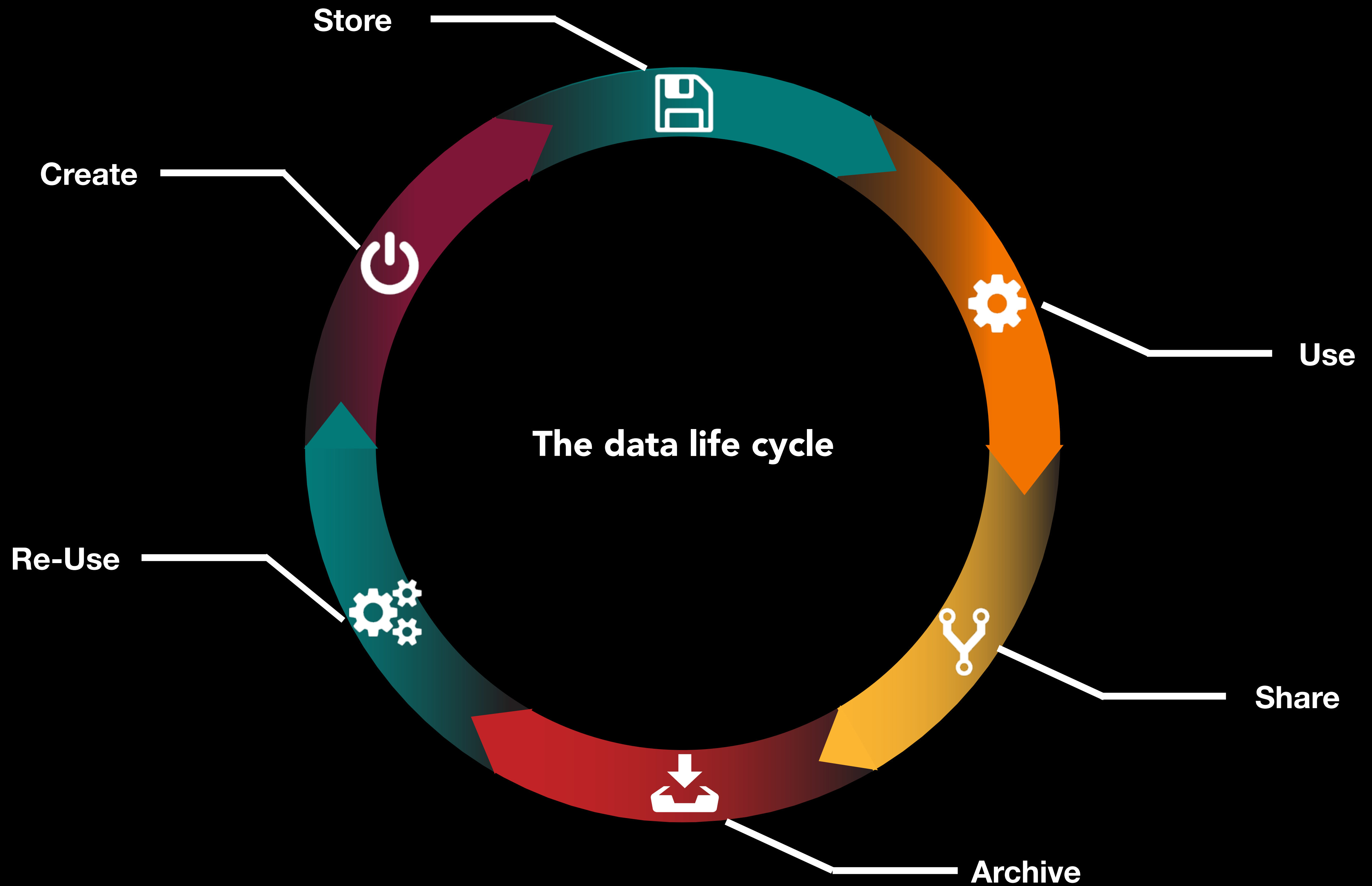


File Name and Organization



KEEP A FILE ABOUT YOUR FILES

► **ReadMe:** Description of what the files/folders contain





KEEP YOUR RAW DATA RAW!

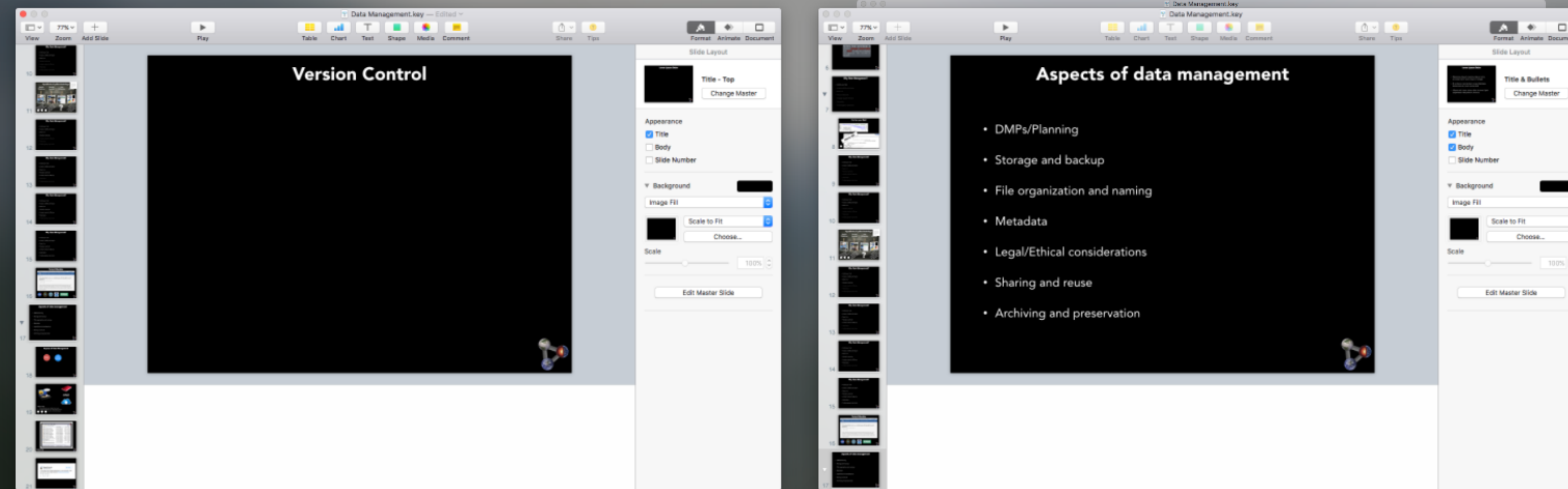
- ▶ Always keep the original data as raw as possible. Create new versions of dataset if you perform any data cleaning.
- ▶ Even more important when calibrating datasets or applying normalization, filters,...



Version Control



Version Control



Current Document

Done

Restore

Today at 2:16 PM

May 2016

Today

Built into Pages, Numbers, Keynote on the Mac...



Version Control

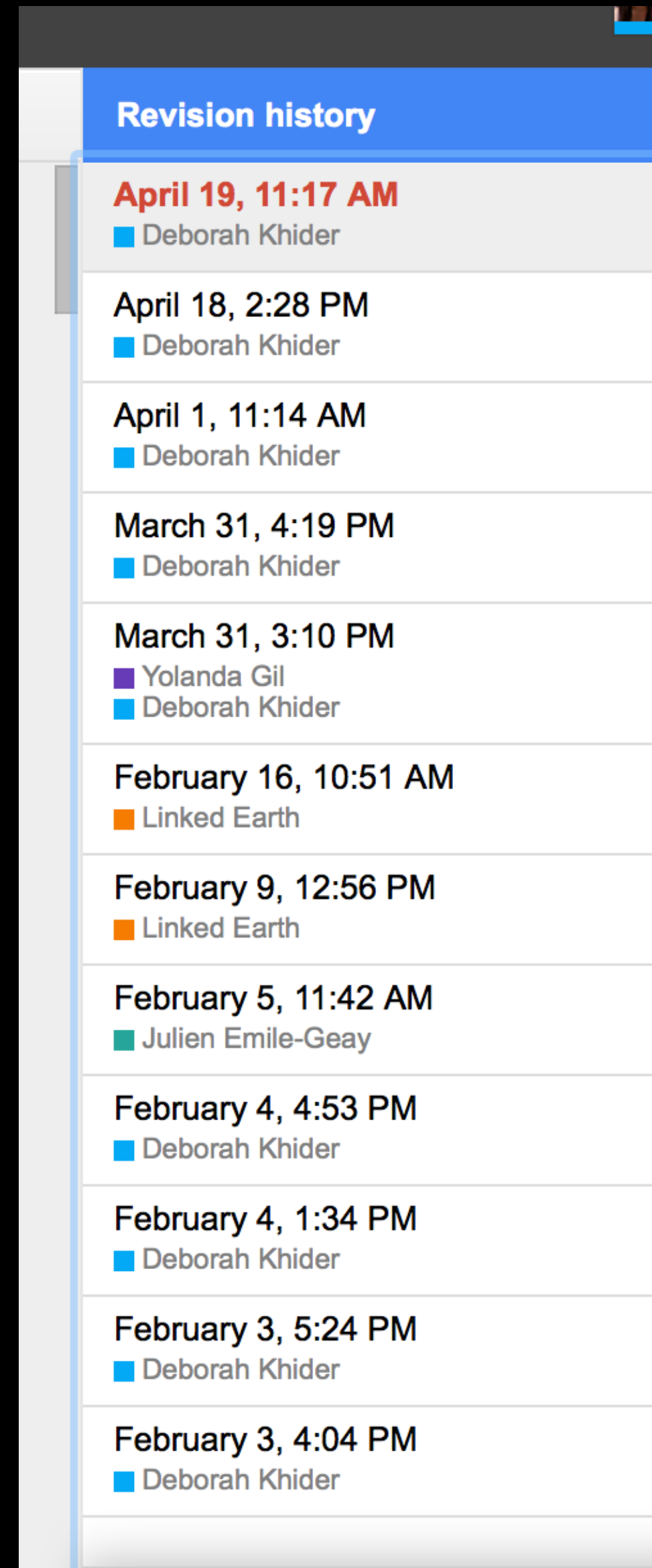
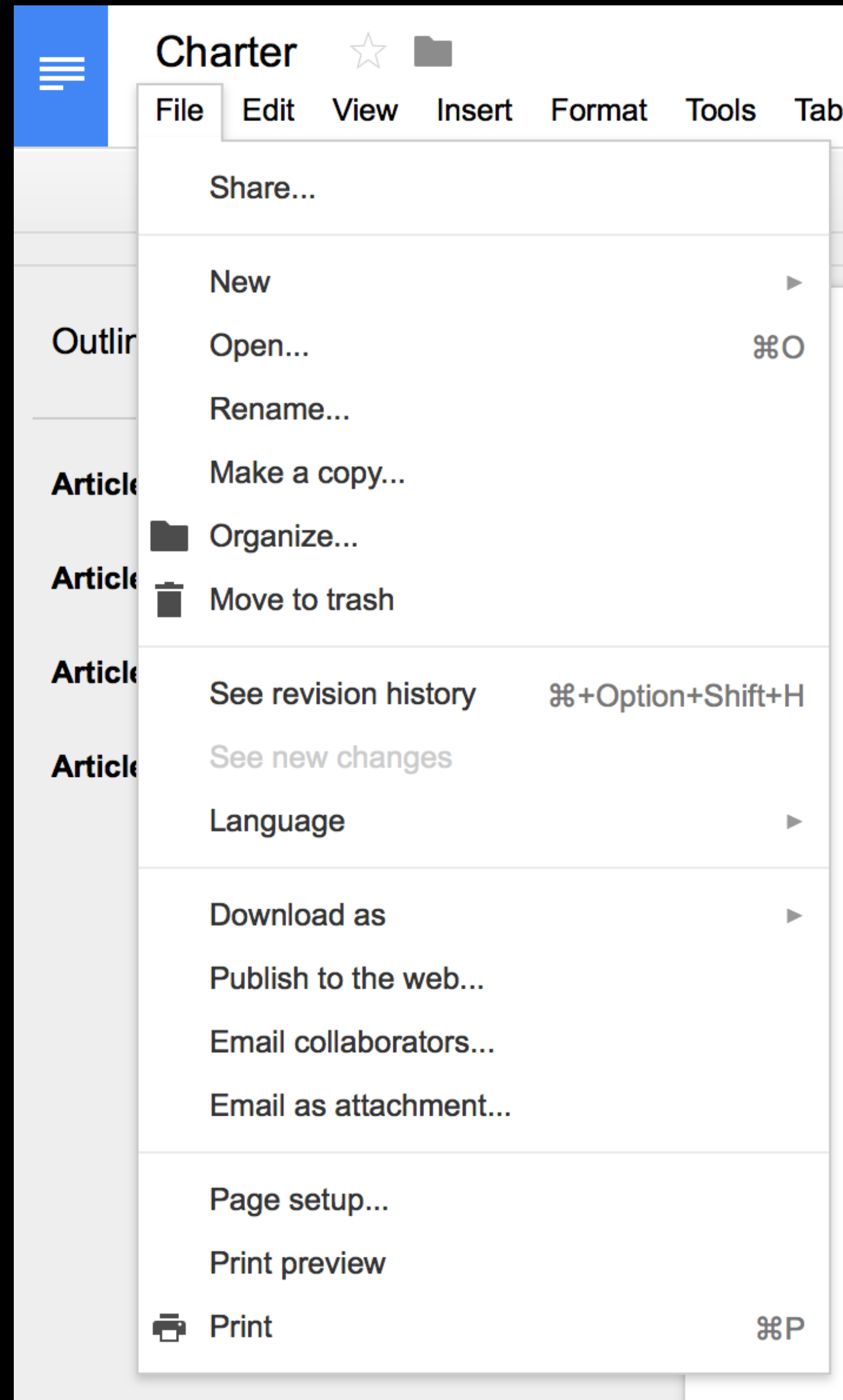
The screenshot displays the Google Docs interface for a document titled "Charter". The "File" menu is open, showing options such as "Share...", "New", "Open...", "Rename...", "Make a copy...", "Organize...", "Move to trash", "See revision history" (with keyboard shortcut ⌘+Option+Shift+H), "See new changes", "Language", "Download as", "Publish to the web...", "Email collaborators...", "Email as attachment...", "Page setup...", "Print preview", and "Print". The "Revision history" panel is also visible on the right, showing a list of revisions with timestamps and author names.

Revision history	
April 19, 11:17 AM	Deborah Khider
April 18, 2:28 PM	Deborah Khider
April 1, 11:14 AM	Deborah Khider
March 31, 4:19 PM	Deborah Khider
March 31, 3:10 PM	Yolanda Gil Deborah Khider
February 16, 10:51 AM	Linked Earth
February 9, 12:56 PM	Linked Earth
February 5, 11:42 AM	Julien Emile-Geay
February 4, 4:53 PM	Deborah Khider
February 4, 1:34 PM	Deborah Khider
February 3, 5:24 PM	Deborah Khider
February 3, 4:04 PM	Deborah Khider

... as well as Google apps



Version Control



... as well as Google apps



Version Control

The screenshot displays the GitHub web interface for the repository 'LinkedEarth/Pyleoclim_util'. The top bar shows '4 Uncommitted Changes' and a 'History' tab. The left sidebar lists repositories: JAGS_MgCa, Ontology, and Pyleoclim_util (selected). The main content area shows a list of commits on the left and a detailed diff view on the right. The diff view shows changes to the 'setup.py' file, including updates to the version number from '0.1.5' to '0.1.6' and modifications to the README generation logic.

Commit history (left):

- update to setup.py (38 minutes ago by LinkedEarth)
- update to pipit (52 minutes ago by LinkedEarth)
- update to setup.py (2 hours ago by LinkedEarth)
- update to setup.py (2 hours ago by LinkedEarth)
- update to setup.py (3 hours ago by LinkedEarth)
- Update to ReadMe file (4 hours ago by LinkedEarth)
- update setup.py (5 days ago by LinkedEarth)
- Submit to PyPI (5 days ago by LinkedEarth)
- Update setup.py / remove cap P (5 days ago by LinkedEarth)
- Update version in setup (5 days ago by LinkedEarth)

Diff view (right):

```
@@ -4,10 +4,12 @@ import sys
import io
import path
- version = '0.1.5'
+ version = '0.1.6'

# Read the readme file contents into variable
- os.system('pandoc README.md -f markdown -t rst -s -o README.txt')
+ if sys.argv[-1] == 'publish' or sys.argv[-1] == 'publishtest':
+     os.system('pandoc README.md -f markdown -t rst -s -o README.txt')
+
readme_file = io.open('README.txt', encoding='utf-8')
# Fallback long_description in case errors with readme file.
```



Use GitHub (code)

Don't Forget the Metadata!!!

TYPES OF METADATA

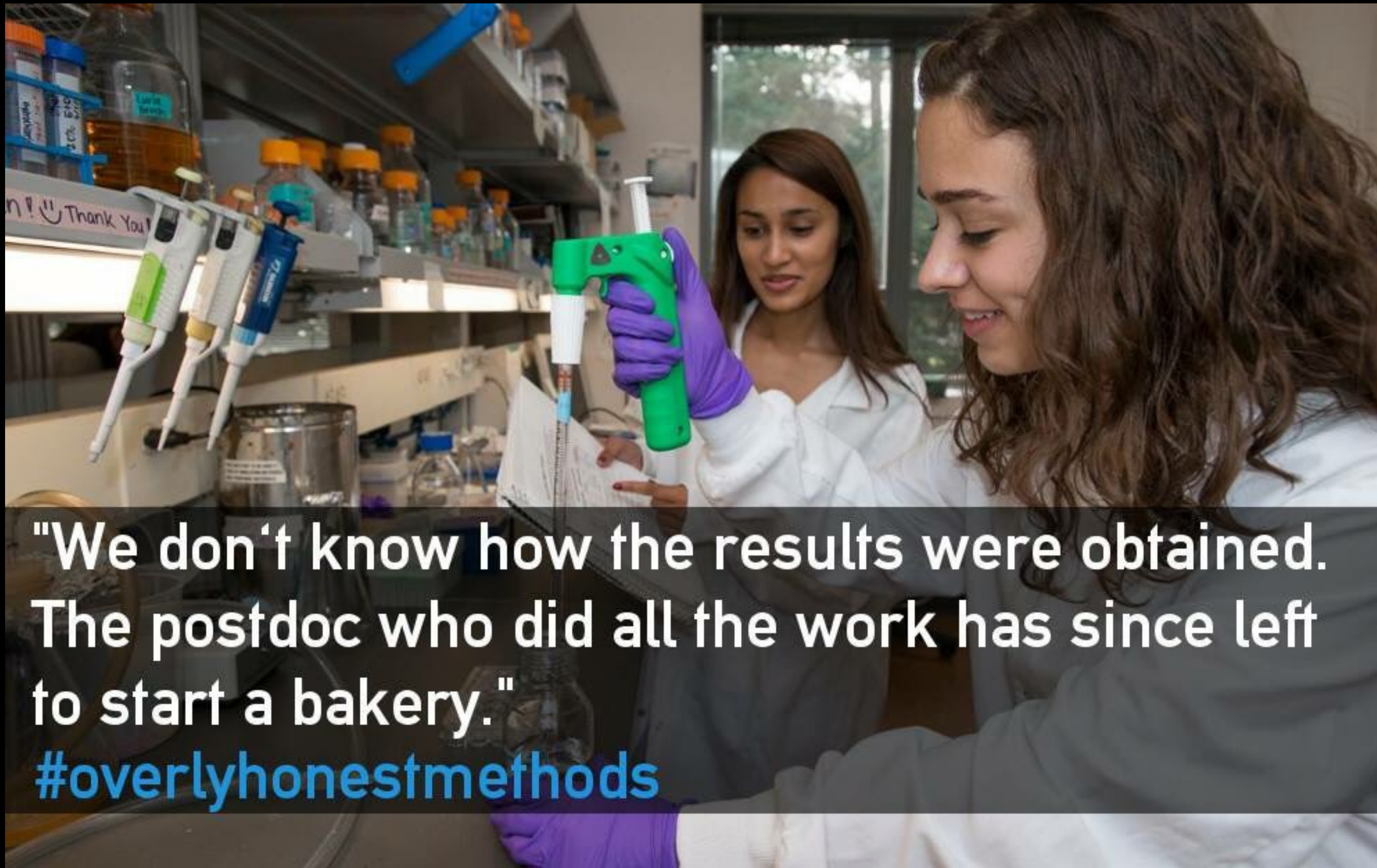
- ▶ **Descriptive Metadata:** Location, collection frequency, object, etc...
- ▶ **Data Characteristics:** Size, statistical properties,...
- ▶ **Provenance metadata:** Instrument, Method/Software, Parameters...



Don't Forget the Metadata!!!

USE OF METADATA

- **Facilitate** reuse by others



"We don't know how the results were obtained. The postdoc who did all the work has since left to start a bakery."

[#overlyhonestmethods](#)



Don't Forget the Metadata!!!

USE OF METADATA

- ▶ **Facilitate** reuse by others
- ▶ Support **queries** on data repository

```
In [4]: import json
import requests

url = "http://wiki.linked.earth/store/ds/query"

query = """PREFIX core: <http://linked.earth/ontology#>
PREFIX wiki: <http://wiki.linked.earth/Special:URIResolver/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT distinct ?a
WHERE {
{
    ?dataset wiki:Property-3AArchiveType ?a.
}UNION
{
    ?w core:proxyArchiveType ?t.
    ?t rdfs:label ?a
}
}"""

response = requests.post(url, data = {'query': query})
res = json.loads(response.text)

print("The following archive types are available on the wiki:")
for item in res['results']['bindings']:
    print ("*" + item['a']['value'])
```

```
The following archive types are available on the wiki:
*marine sediment
*coral
*lake sediment
*glacier ice
*tree
*documents
*speleothem
*sclerosponge
*borehole
*hybrid
*bivalve
*Rock
```

Don't Forget the Metadata!!!

USE OF METADATA

- ▶ **Facilitate** reuse by others
- ▶ Support **queries** on data repository
- ▶ **Explain a data analysis** by providing context for the data





Don't Forget the Metadata!!!

USE OF METADATA

- ▶ **Facilitate** reuse by others
- ▶ Support **queries** on data repository
- ▶ **Explain a data analysis** by providing context for the data
- ▶ Enable **automated data integration**



Use

THE BIGGEST LIE I TELL
MYSELF IS "I DON'T
NEED TO WRITE THAT
DOWN I'LL REMEMBER."

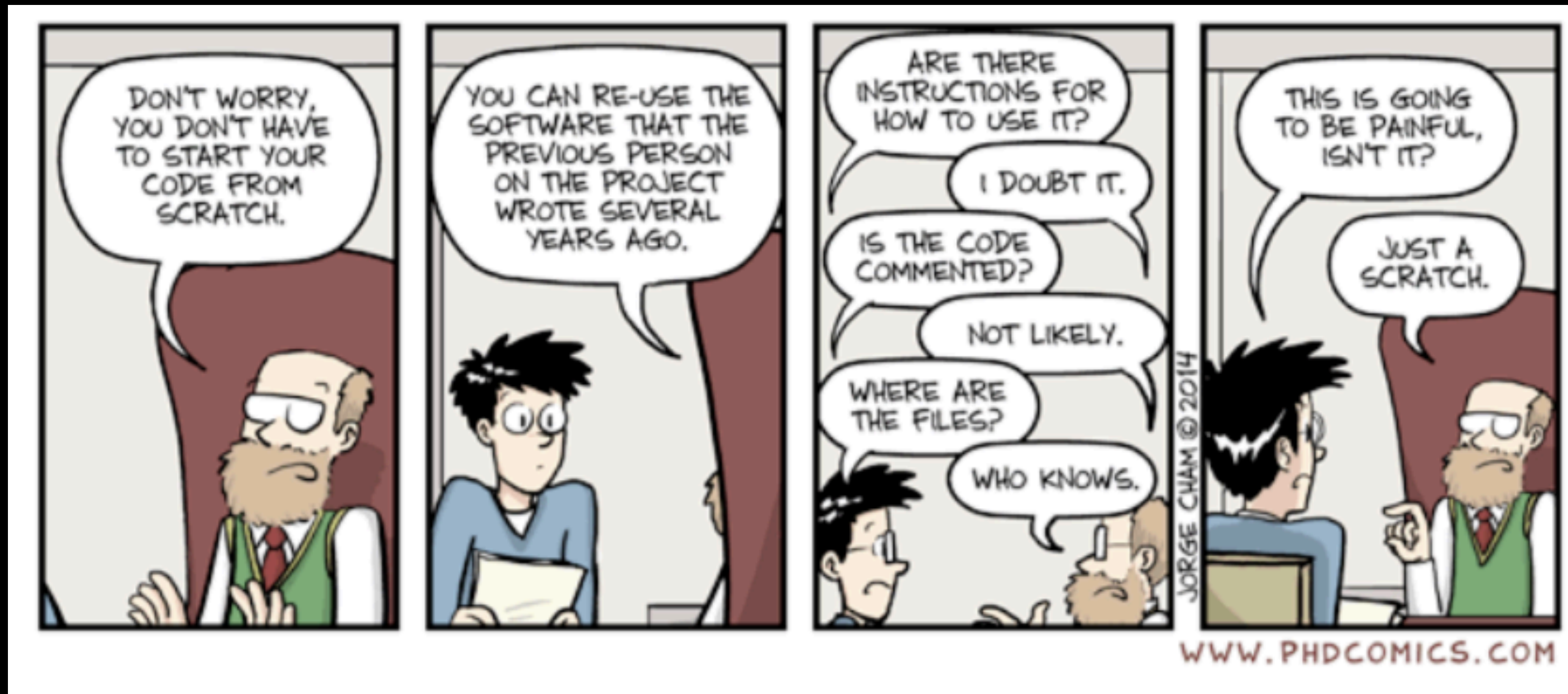
Everyone at some point in their life.



Use

WRITE IT DOWN!

- **Methods:** Laboratory, statistics, data cleaning...
- **Comment your code:** 1 line of code = 1 line of comment
- **Meeting notes**





Keep code and explanation together!



Notebook

jupyter spectrogram (autosaved)



File Edit View Insert Cell Kernel Help

Python 3

Save + Cut Copy Paste Undo Redo Markdown CellToolbar

Simple spectral analysis

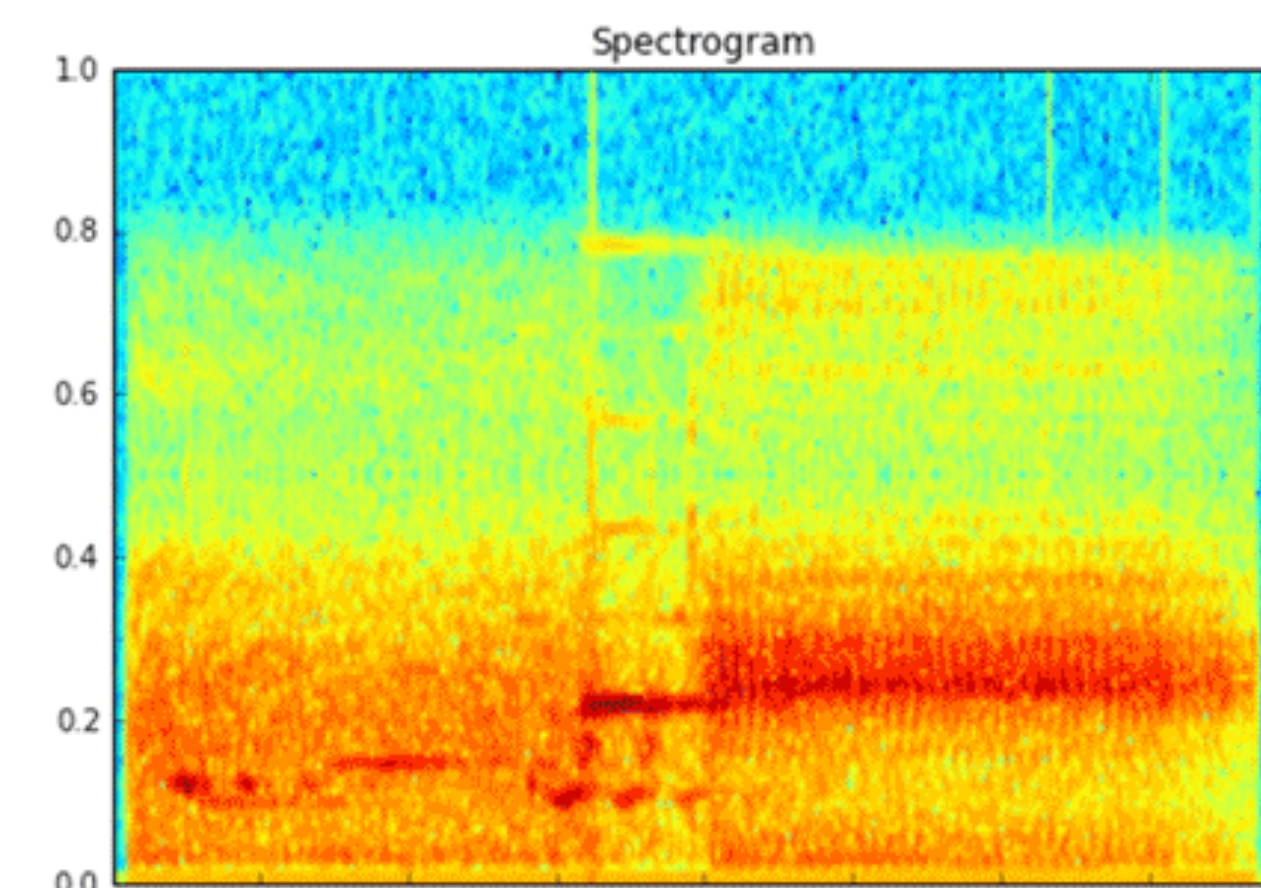
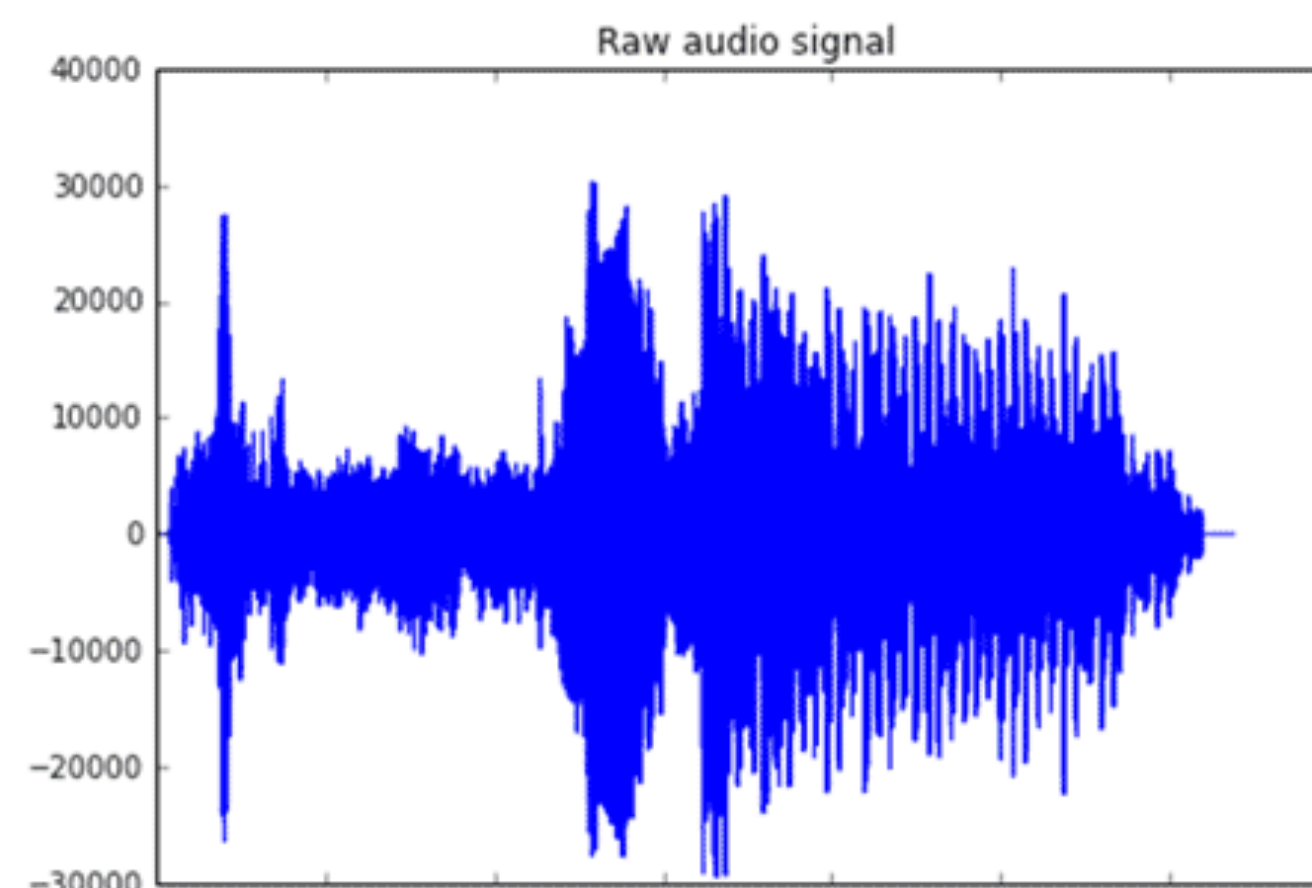
An illustration of the [Discrete Fourier Transform](#)

$$X_k = \sum_{n=0}^{N-1} x_n \exp\left(\frac{-2\pi i}{N} kn\right) \quad k = 0, \dots, N-1$$

```
In [2]: from scipy.io import wavfile
rate, x = wavfile.read('test_mono.wav')
```

And we can easily view it's spectral structure using matplotlib's builtin specgram routine:

```
In [5]: fig, (ax1, ax2) = plt.subplots(1,2,figsize(16,5))
ax1.plot(x); ax1.set_title('Raw audio signal')
ax2.specgram(x); ax2.set_title('Spectrogram');
```





Keep code and explanation together!



R Markdown

from R Studio

The screenshot shows the RStudio application window. The top toolbar includes icons for file operations and a 'Go to file/function' search bar. The file explorer shows several open files: 'LE-Neo_UseCase.Rmd', 'FLDAS.R', 'DownloadFLDAS.R', and 'intro_data_prob_project.Rmd'. The editor pane displays an R Markdown document with the following content:

```
1 ---
2 title: "Exploring the BRFSS data"
3 output:
4   html_document:
5     fig_height: 4
6     highlight: pygments
7     theme: spacelab
8 ---
9
10 ## Setup
11
12 ### Load packages
13
14 ```{r load-packages, message = FALSE}
15 library(ggplot2)
16 library(dplyr)
17 ```
18
19 ### Load data
20 Load the BRFSS data into the workspace.
21
22 ```{r load-data}
23 load("brfss2013.RData")
```

The status bar at the bottom indicates the current line is 1:1 and the document title is '# Exploring the BRFSS data'.



Keep code and explanation together!



R Markdown

from R Studio

```
1 ---
2 title: "Exploring the BRFSS data"
3 output:
4   html_document:
5     fig_height: 4
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17 ```
18
19 ### Load data
20 Load the BRFSS data into the workspace.
21
22 ```{r load-data}
23 load("brfss2013.RData")
24
25 # Exploring the BRFSS data
```

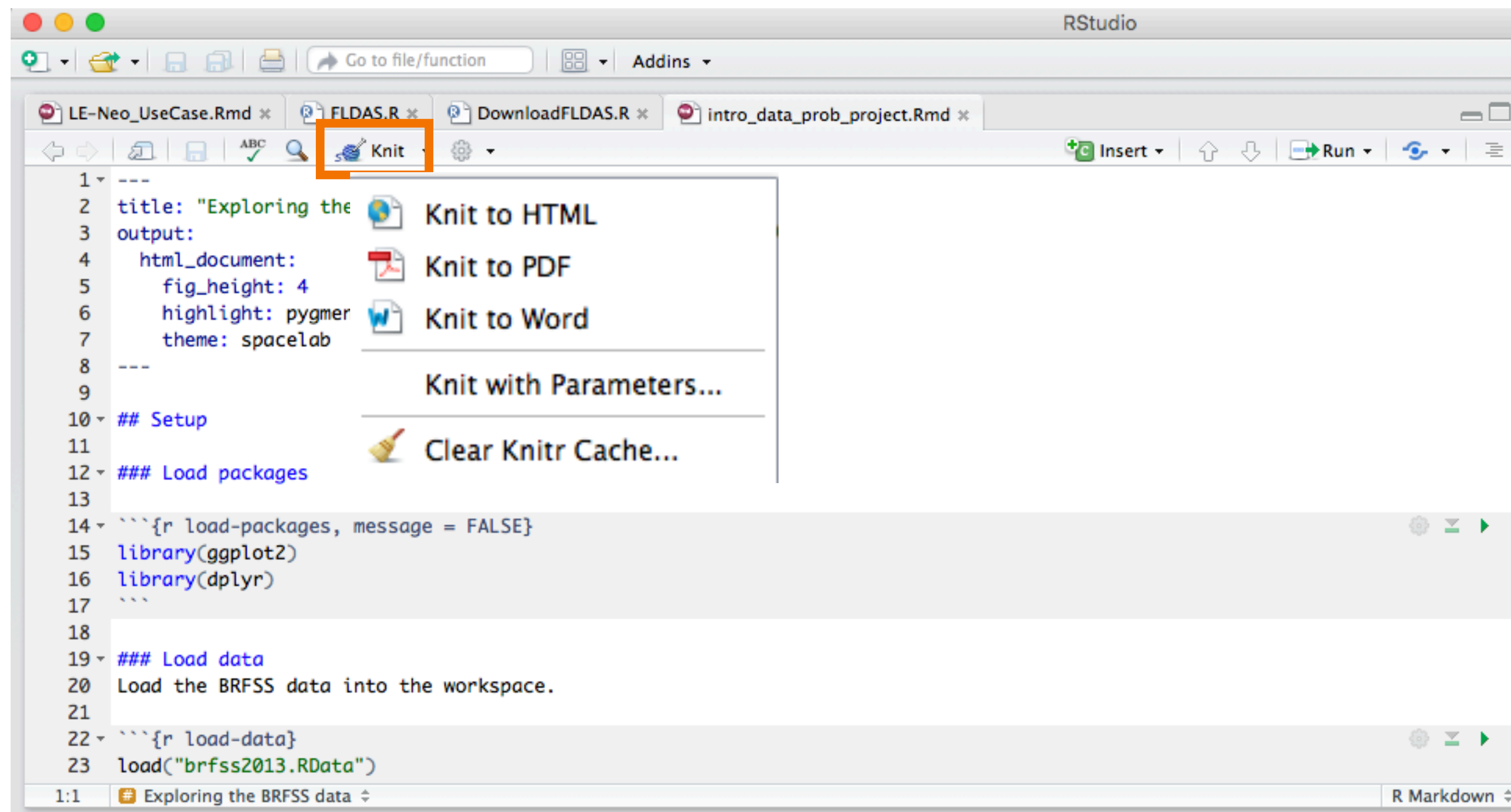


Keep code and explanation together!



R Markdown

from R Studio





Keep code and explanation together!



Notebook

R Markdown

from  Studio

Part 3: Exploratory data analysis

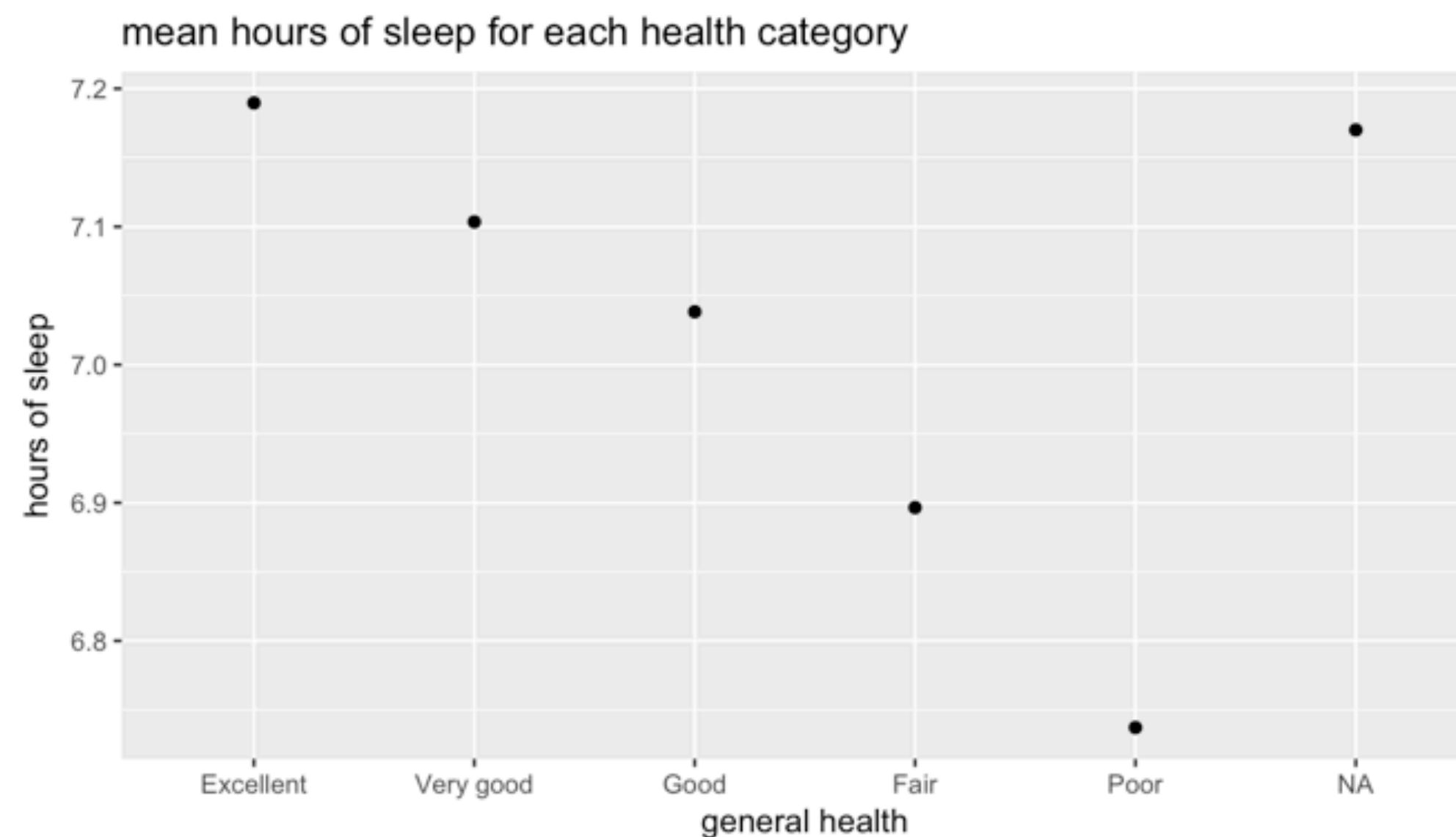
Research question 1: Relationship between sleep and general health

```
#Remove outliers (can't really sleep more than 24hours)
sleeptime <- filter(brfss2013, sleptiml<=24)
```

```
## Warning: package 'bindrcpp' was built under R version 3.2.5
```

```
# Summarize the data
healthSleep <- sleeptime %>%
  group_by(genhlth) %>%
  summarise(meanSleep = mean(sleptiml))

#Plot the general health/mean of sleep time
ggplot(healthSleep, aes(genhlth, meanSleep)) + geom_point(aes(genhlth, meanSleep)) +
  labs(title="mean hours of sleep for each health category", x = 'general health', y='hours of sleep')
```



From the plot above, there appears

to be a general correlation between health and the amount of sleep.



Keep code and explanation together!



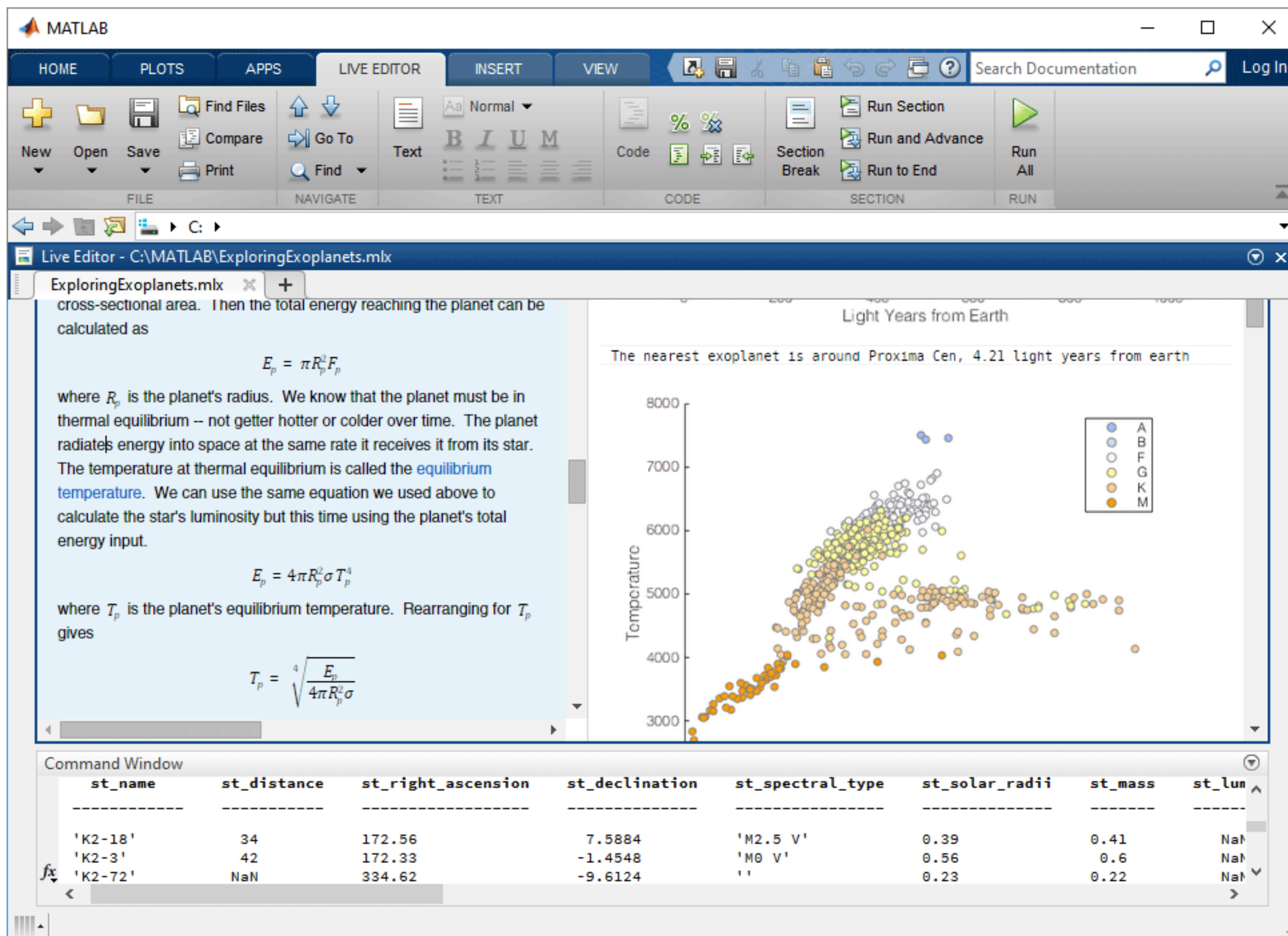
Notebook

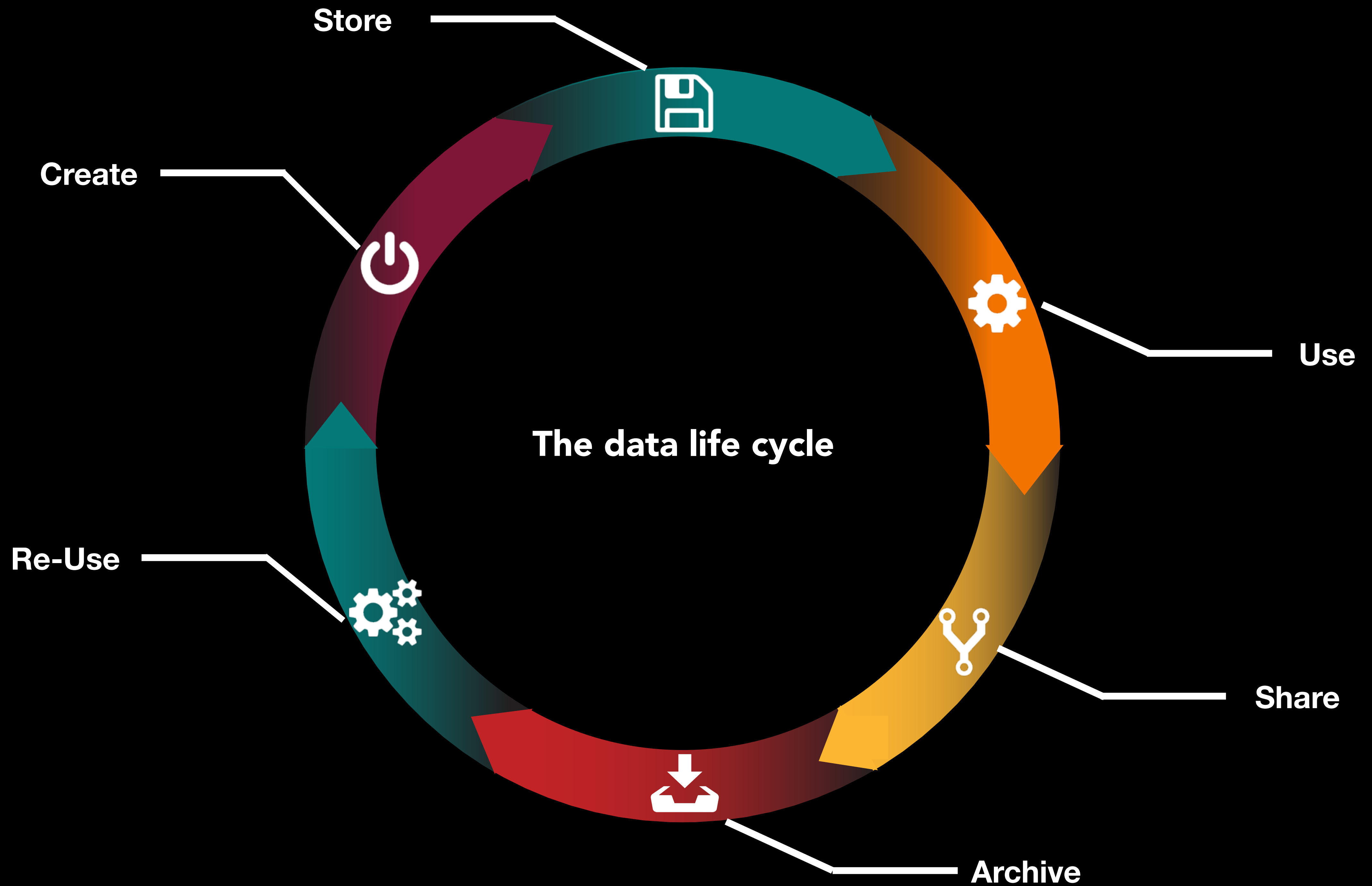
R Markdown

from R Studio



MATLAB Live Editor







INTERNATIONAL GEO SAMPLE NUMBER: IGSN

- ▶ Globally unique and persistent identifier for physical samples in the Earth Sciences
- ▶ To obtain a number, go to <http://www.geosamples.org/>
- ▶ Record and register quality metadata for your samples
 - ▶ At a minimum: Location, contact, access restrictions, lithology
- ▶ Use IGSNs in your publications: text, data tables,...

IGSN: DSR00050U




IGSN:	DSR00050U
Sample Name:	VM28-328A
Other Name(s):	
Sample Type:	Core
Parent IGSN:	Not Provided



Share: Data

1. Publication in a shared repository

 [figshare.com/](#)

Highly connected drug file

Tretinoin	257	46	Rv1155, aroG, Rv1264, mscL, thyX, gmk, glnA1, Rv1264, thyX, glnA1, trpD, leuA, blaI, ethR, Rv0223c, lipJ, Rv1264, ephG, blaI, ethR, sigC, b
Levothyroxine	173	36	25 cyp130, Rv1264, lppX, gpml, ligA, nirA
Methotrexate	156	32	TB31.7, Rv1264, mscL, lppX, coaA, pcaA, Rv3676, t
4-Hydroxytamoxifen	115	115	fabG1,
Estradiol	98	20	mmaA4, bphD, Rv1264, mscL, thyX, lppX, mmaA2, ptl
Amantadine	79	1	TB31.7, cyp130, aroG, Rv1264, secA1, trpD, nirA
Rifampin	78	13	pth, ethR, clpP, glbN, inhA,
Raloxifene	75	18	pknD, lipJ, fabH, Rv1941, Rv3361c, Rv1264, lppX
Propofol	54	5	mmaA4, Rv1264, groEL, lppX, secA1, glmU, nusA, R
Indinavir	51	14	mmaA4, Rv1264, thyX, lppX, secA1, serA1, Rv3529c
Penicillamine	44	10	pepD, Rv1264, thyX, ethR, trxB2,
Daunorubicin	44	12	pknD, pepD, fabH, Rv1941, devB, ppp, ftsZ, cyp12
Triclosan	42	5	
Darunavir	40	15	

[Enlarge to see the rest of the document](#)

[Enlarge](#) [Download](#)

Categories

- Computational Biology

Authors


Daniel Garijo
Lei Xie
Yinliang Zhang
Yolanda Gil
Li Xie
Sarah Kinnings
Phil Bourne

Tags

[results](#) [tb-drugome](#)

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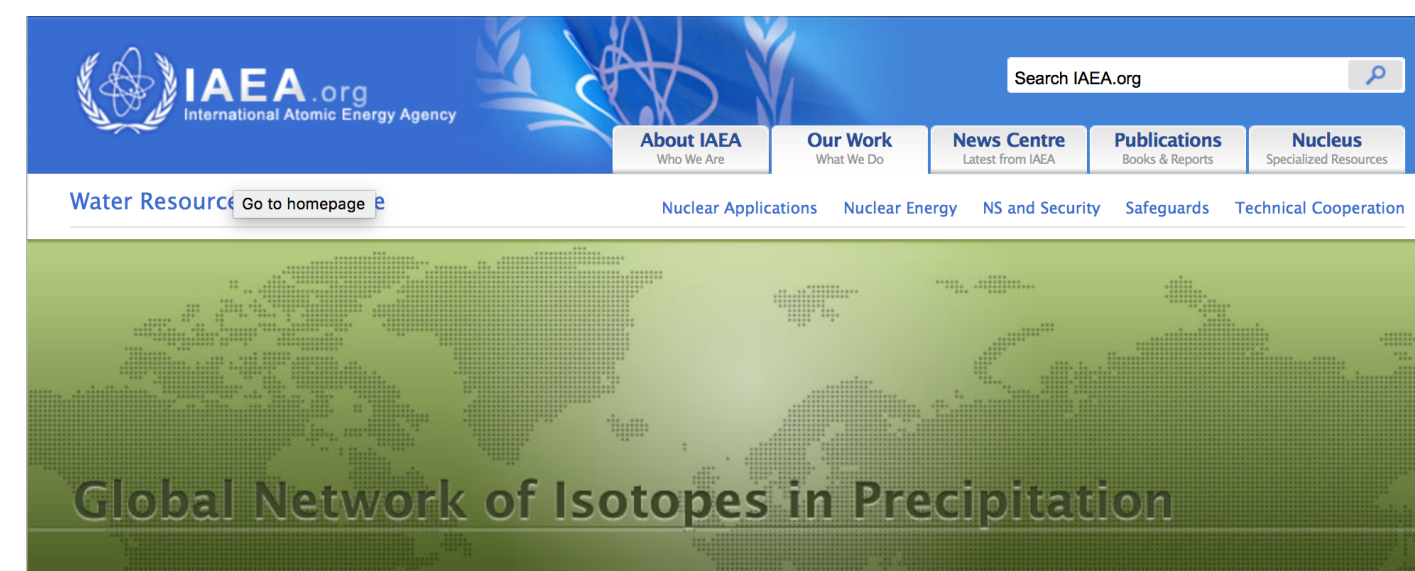
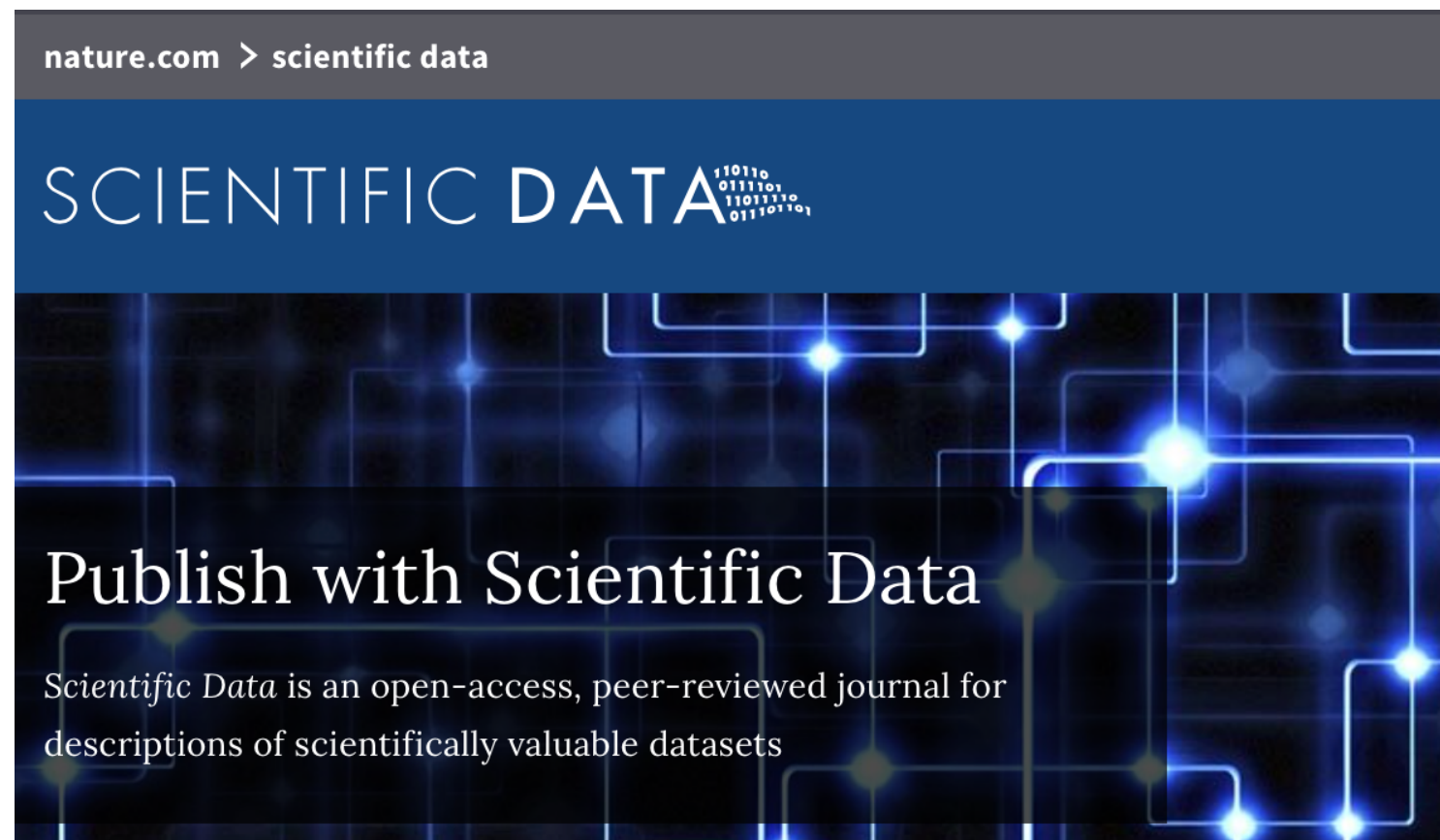
Highly connected drug file obtained as a result of the TB-Drugome Workflow.

Links

- <http://purl.org/net/tb-drugome-run>



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Highly connected drug file

Tretinoin	257	46	Rv1155, aroG, Rv1264, mscL, thyX, gmk, glnA1, Rv1264, thyX, glnA1, trpD, leuA, blaI, ethR
Levothyroxine	173	36	Rv0223c, lipJ, Rv1264, ephG, blaI, ethR, sigC, b
Methotrexate	156	32	25 cyp130, Rv1264, lppX, gpml, ligA, nirA
4-Hydroxytamoxifen	115	115	TB31.7, Rv1264, mscL, lppX, coaA, pcaA, Rv3676, fabG1,
Estradiol	98	20	mmaA4, bphD, Rv1264, mscL, thyX, lppX, mmaA2, ptl
Amantadine	79	1	TB31.7, cyp130, aroG, Rv1264, secA1, trpD, nirA
Rifampin	78	13	pth, ethR, clpP, glbN, inhA,
Raloxifene	75	18	pknD, lipJ, fabH, Rv1941, Rv3361c, Rv1264, lppX
Propofol	54	5	mmaA4, Rv1264, groEL, lppX, secA1, glmU, nusA, R
Indinavir	51	14	mmaA4, Rv1264, thyX, lppX, secA1, serA1, Rv3529c
Penicillamine	44	10	pepD, Rv1264, thyX, ethR, trxB2,
Daunorubicin	44	12	pknD, pepD, fabH, Rv1941, devB, ppp, ftsZ, cyp12
Triclosan	42	5	
Darunavir	40	15	

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Yolanda Gil
Li Xie
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Phil Bourne

Tags

- results
- tb-drugome

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Methotrexate	156	32	25 cyp130, Rv1264, lppX, gpml, ligA, nirA
4-Hydroxytamoxifen	115	115	TB31.7, Rv1264, mscL, lppX, coaA, pcaA, Rv3676, fabG1,
Estradiol	98	20	mmaA4, bphD, Rv1264, mscL, thyX, lppX, mmaA2, ptl
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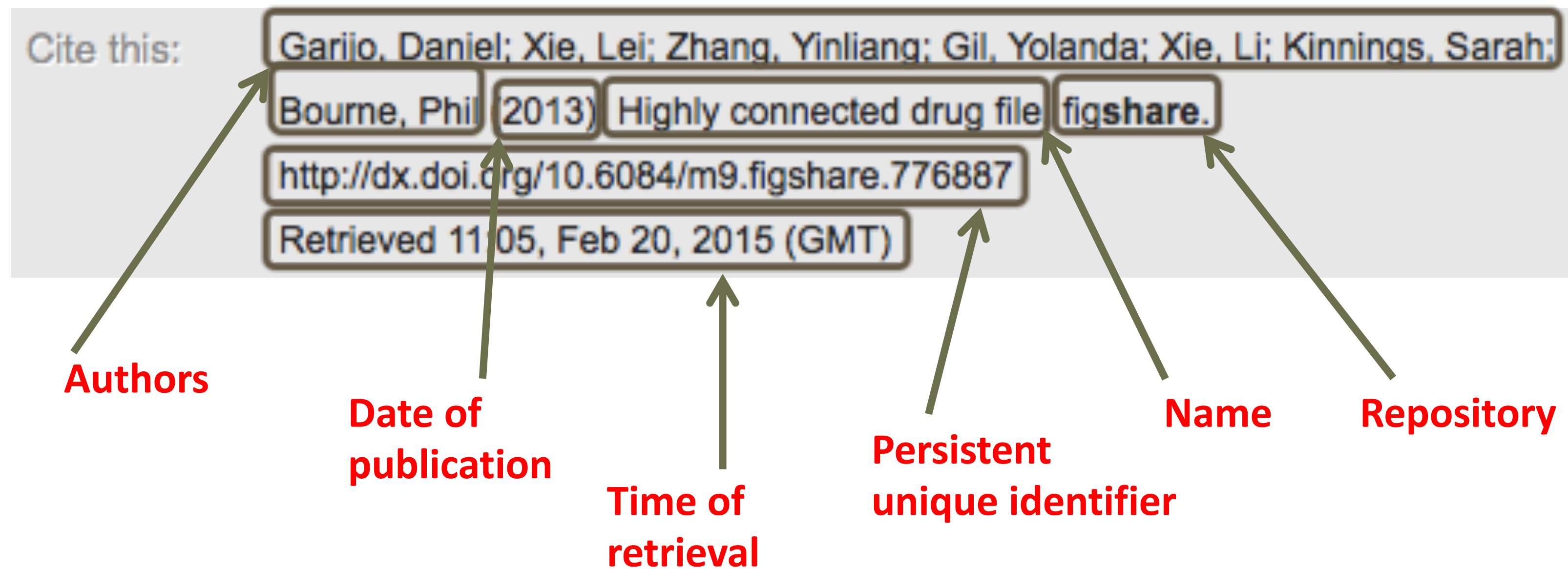
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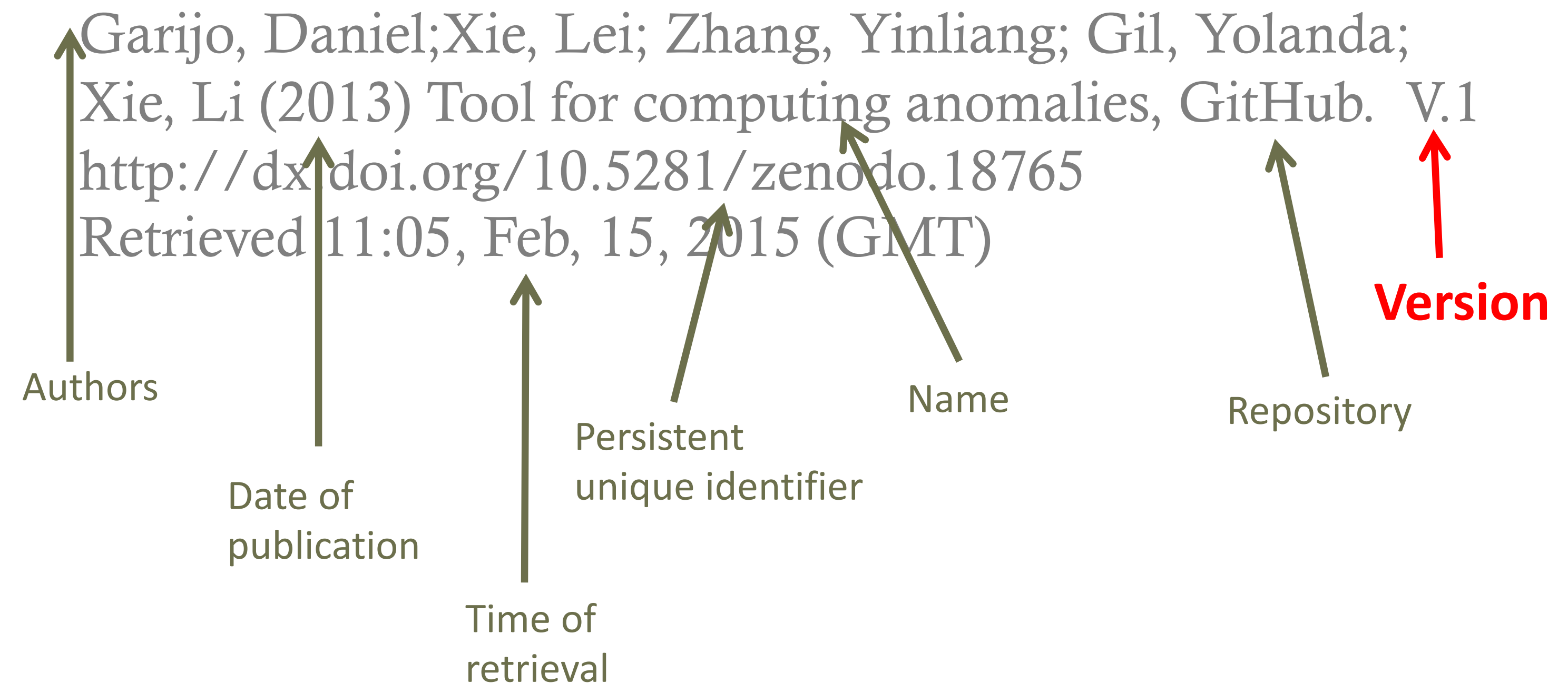
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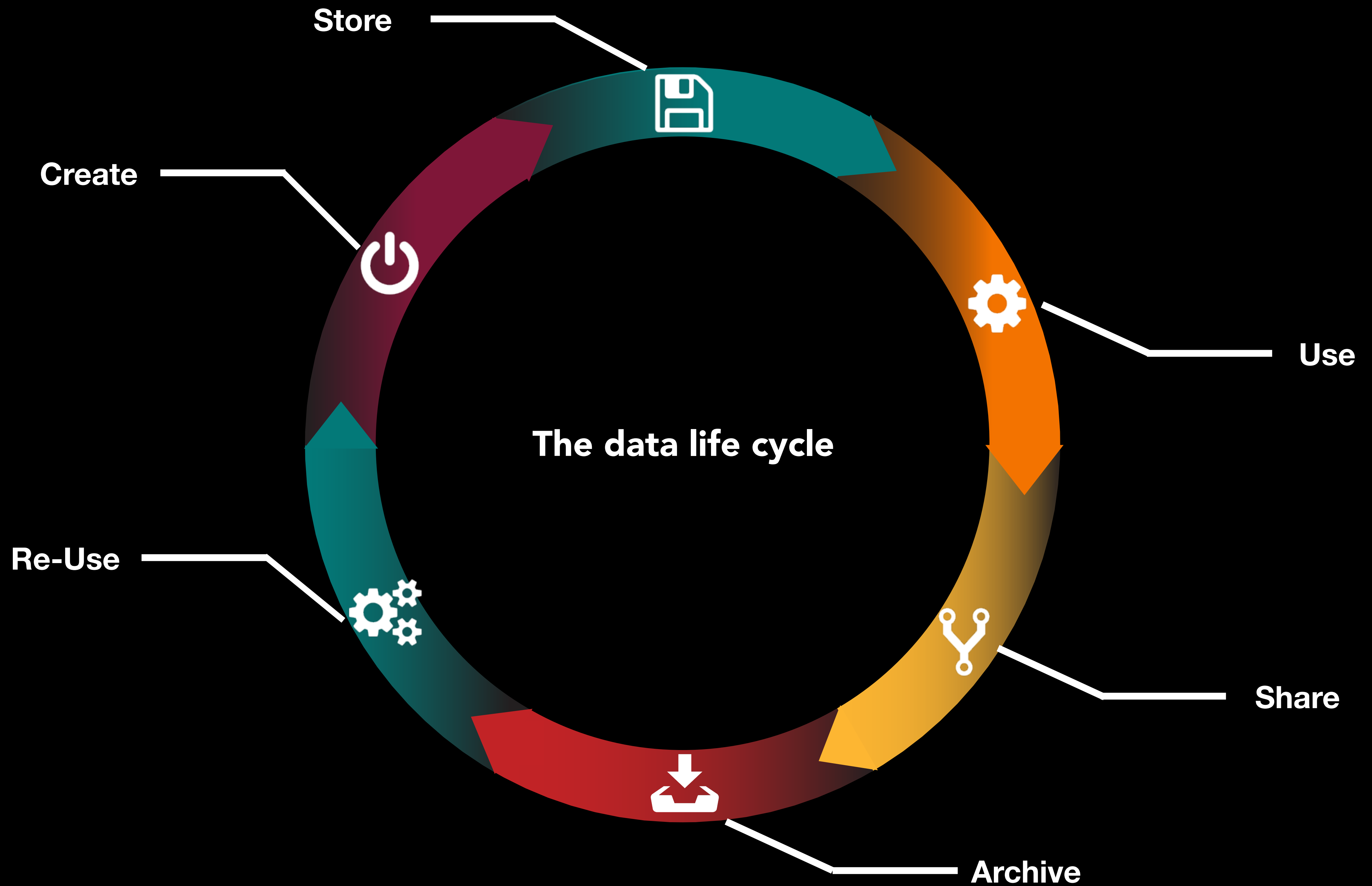
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- Geoscience Paper of the Future:
 - Gil, Y., & . (Ed .) .. (2016, April 17). The Geoscience Paper of the Future: OntoSoft Training (Version 9). figshare. <https://doi.org/10.6084/m9.figshare.1586773.v9>

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