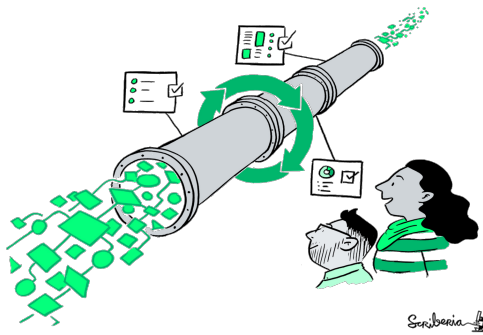
Training on Web Scraping Prices for CPI

Reproducible Analytical Pipelines

Christophe Bontemps & Serge Goussev

Why are Reproducible Analytical Pipelines good for you?

- It will make your (and your team's) (*working*) life easier.



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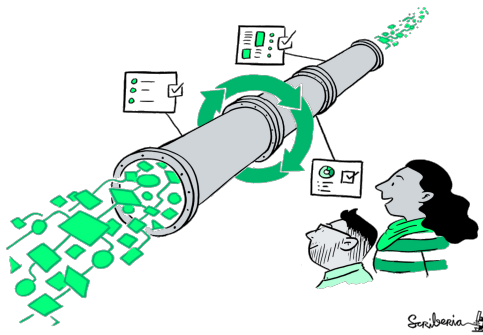
Lower cognitive load on day to day tasks!



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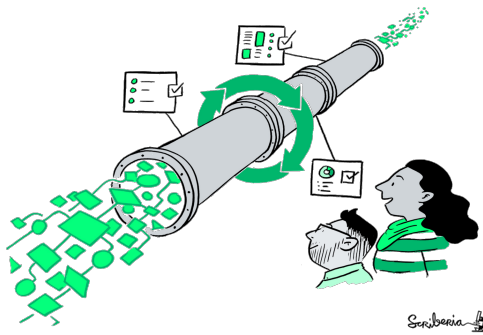
- It is an efficient way to work



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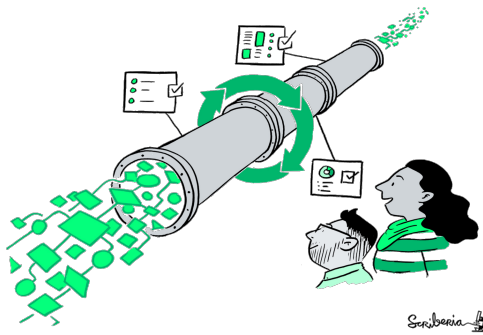

- It is an efficient way to work
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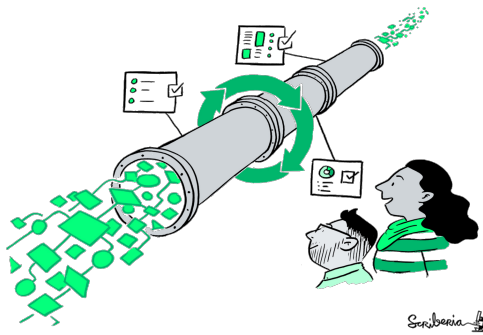

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- It helps make the process of making official statistics more robust!

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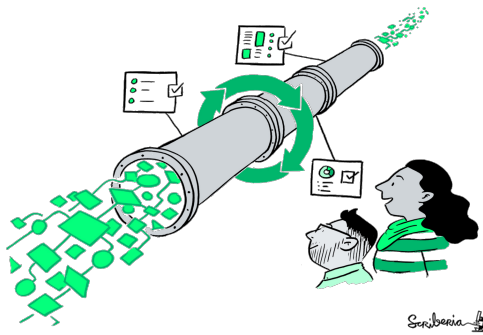

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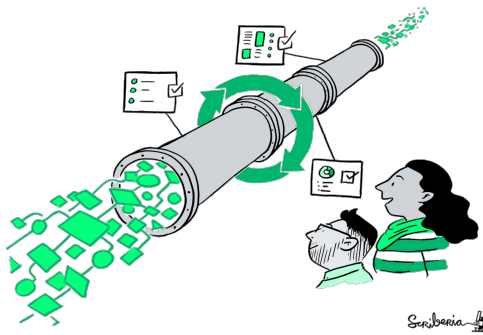
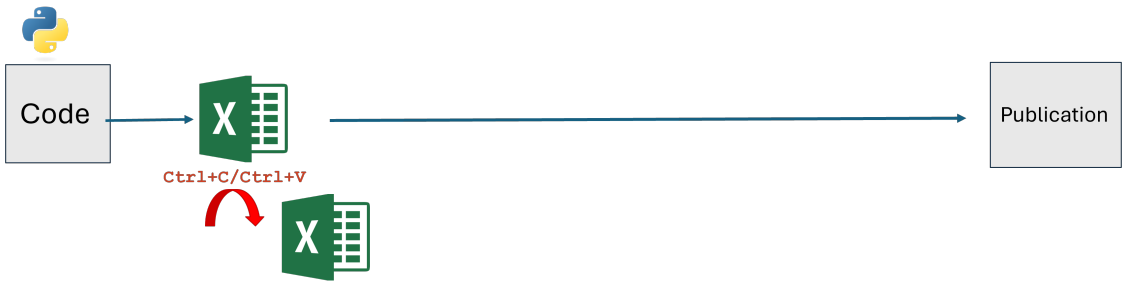
- It is an efficient way to work
- It helps work faster
- It helps make the process of making official statistics more robust!
- It makes it easy to efficiently collaborate
- It will enhance your skills (and perhaps make you famous in your organization!)



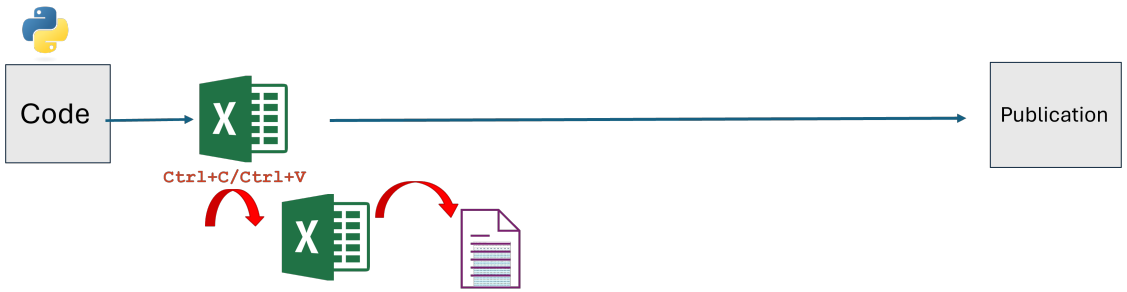
Usual practice: Theory vs reality

USUAL PRACTICE: THEORY VS REALITY



Send that file by email to your collaborators.

Usual practice: Theory vs reality



Someone in your team can start writing some insights.

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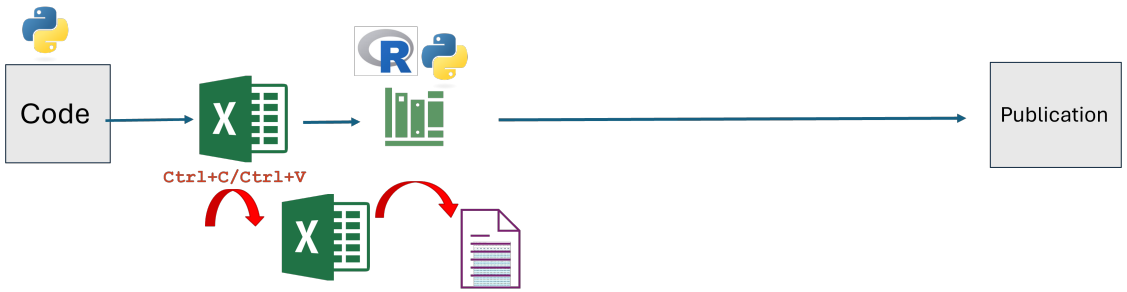

You, or someone else, start an alaysis ...

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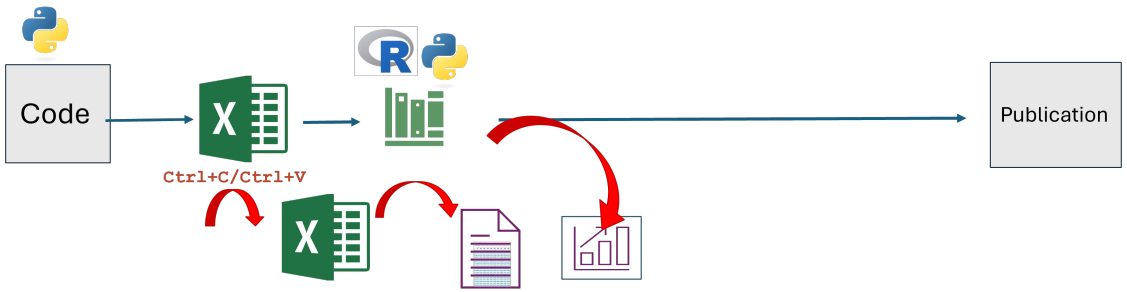

... producing some outputs (graphics, tables, etc..)

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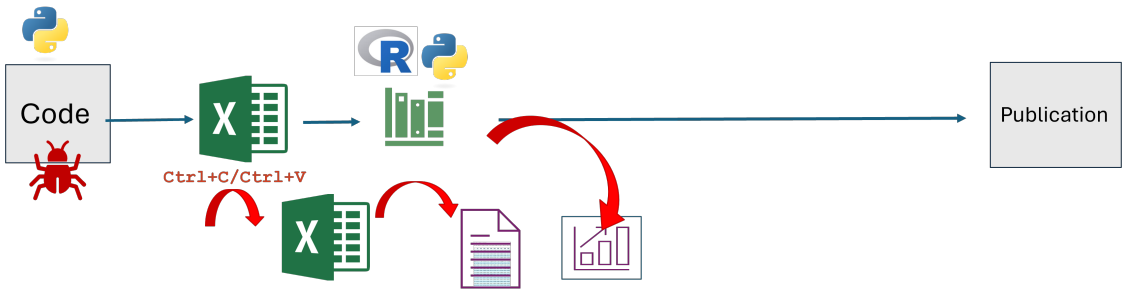
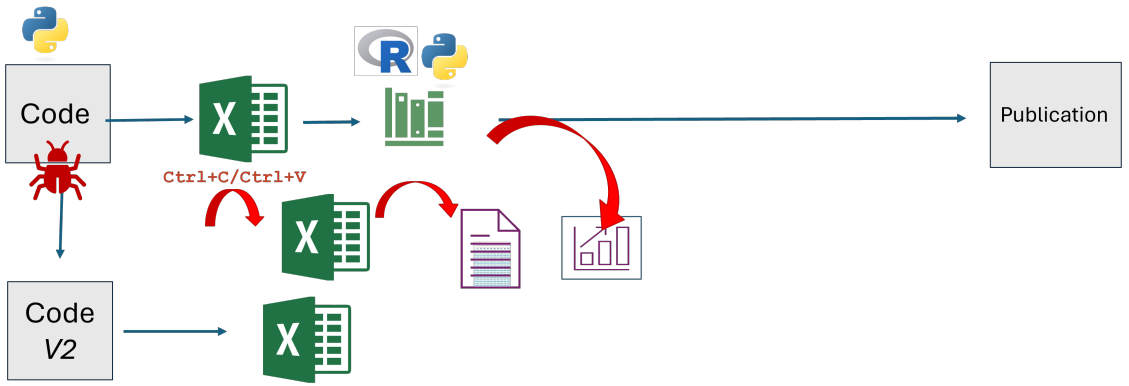


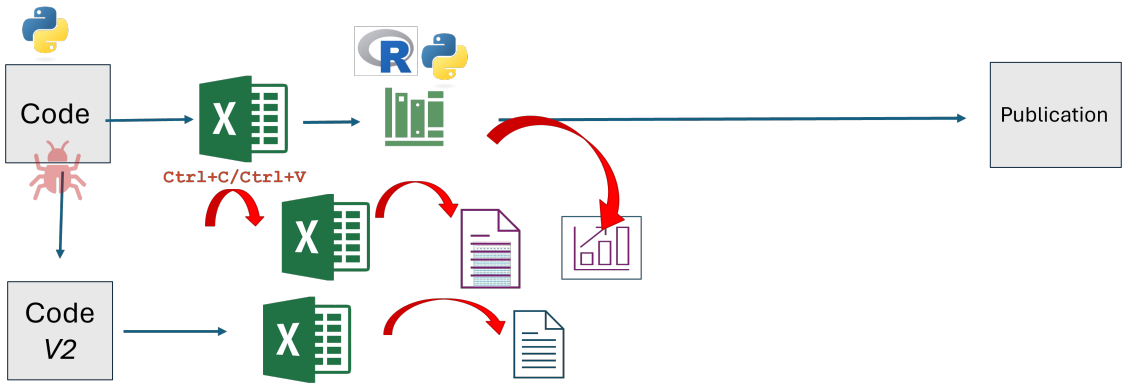
But wait... Oh no! There a bug in the code!

USUAL PRACTICE: THEORY VS REALITY



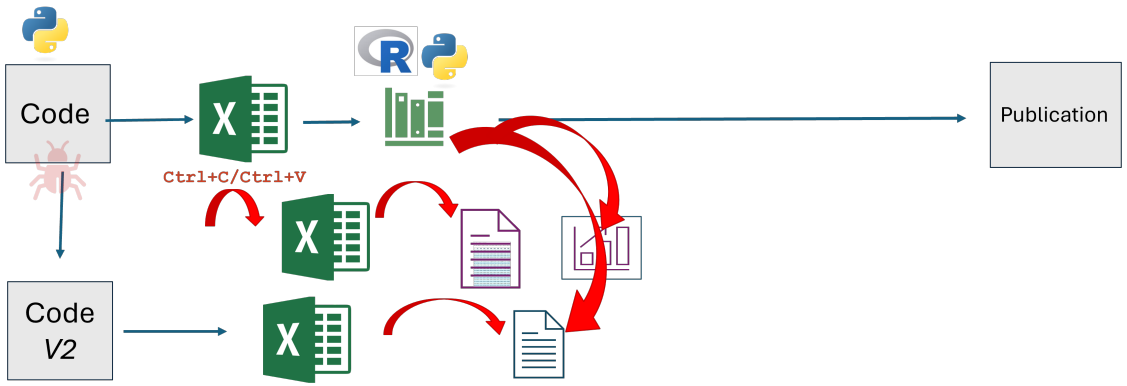
So here is version 2, and another Excel file

USUAL PRACTICE: THEORY VS REALITY



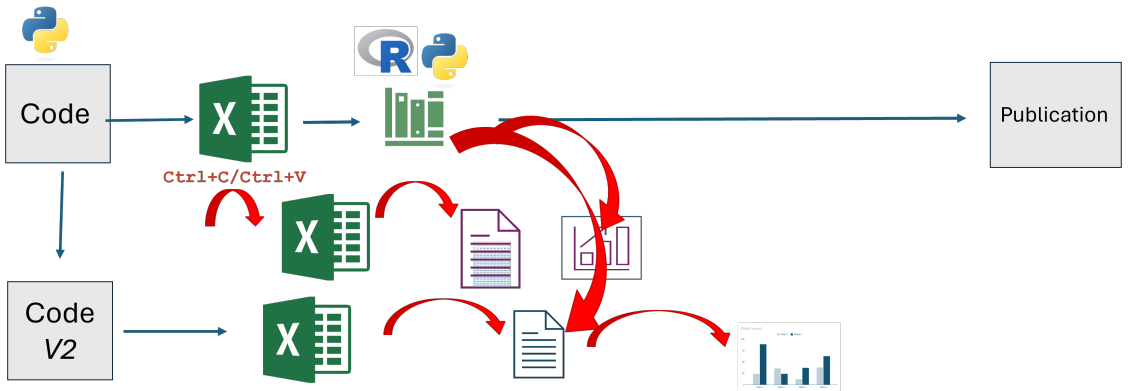
And new insights ...

USUAL PRACTICE: THEORY VS REALITY



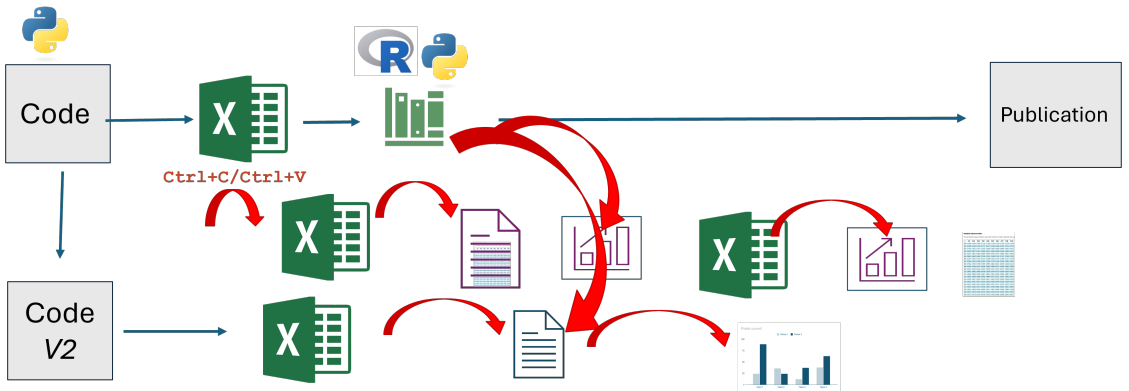
..and a new analysis based on the second Excell file

Usual practice: Theory vs reality



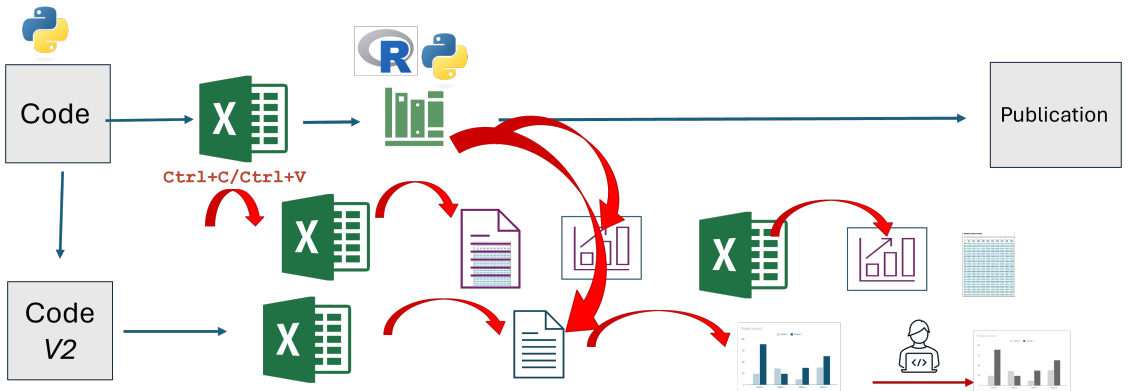
And new outputs, new graphics, etc.

USUAL PRACTICE: THEORY VS REALITY



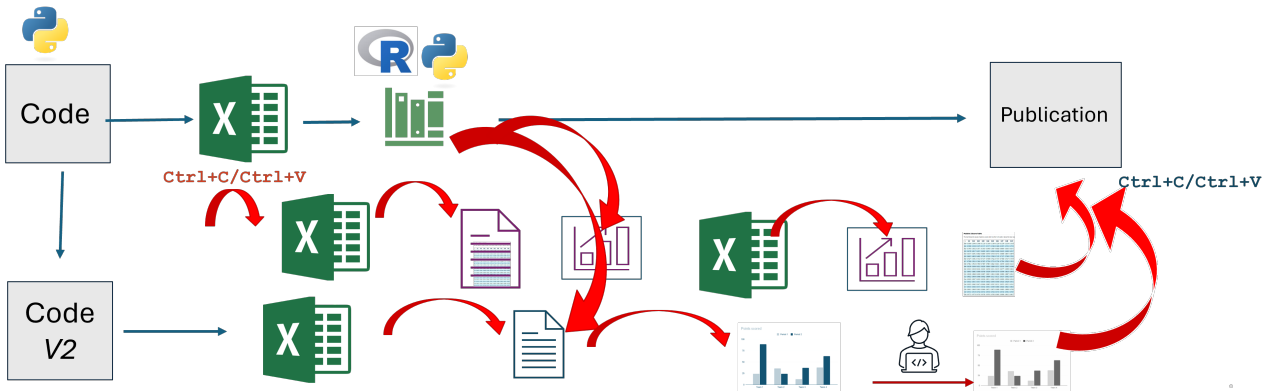
Also, using other data sets (classifications, scanner data)

Usual practice: Theory vs reality



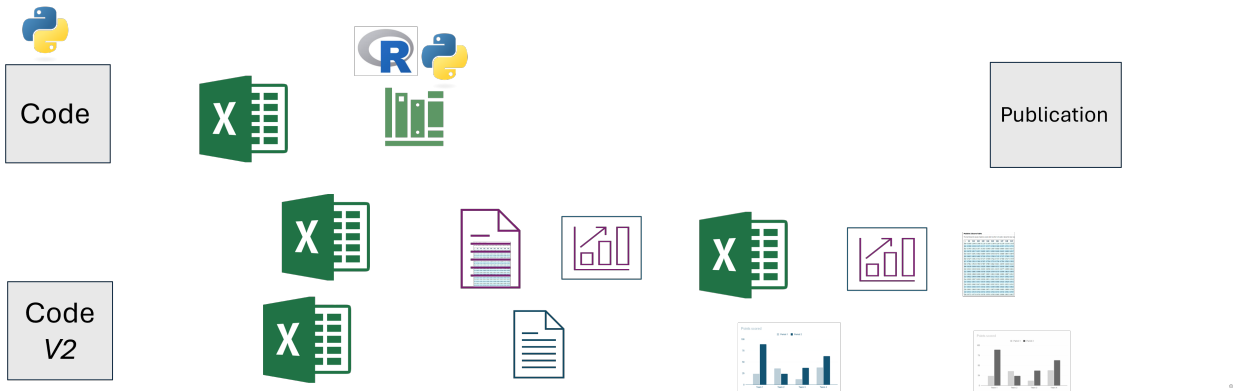
Maybe someone adapts graphics to NSO reports style

Usual practice: Theory vs reality



Finally, copy/paste everything into the final report

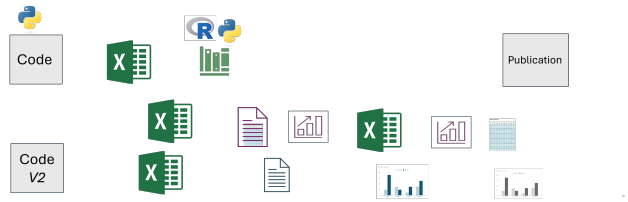
USUAL PRACTICE: THEORY VS REALITY



In the end, this what you have produced!

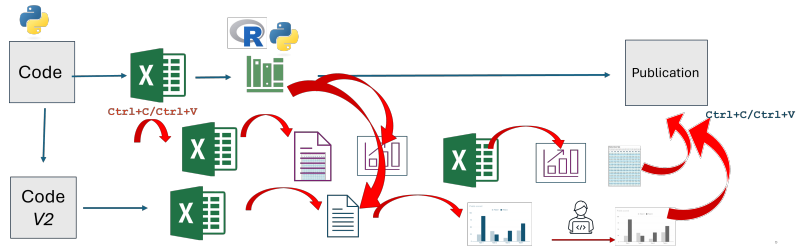
Usual practice: In the end

- Lots of files



Usual practice: In the end

- Lots of files
- Cut and paste is not a reliable, reproducible approach!



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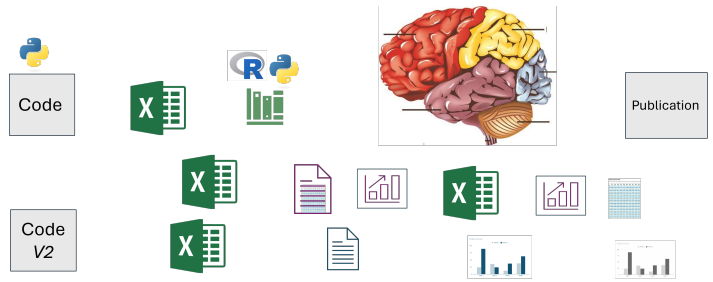
- Your brain may remember (likely not!)...



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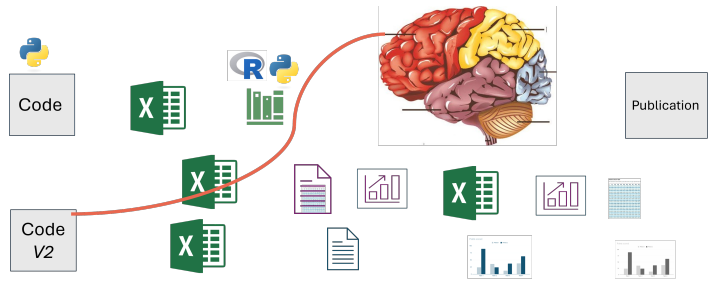

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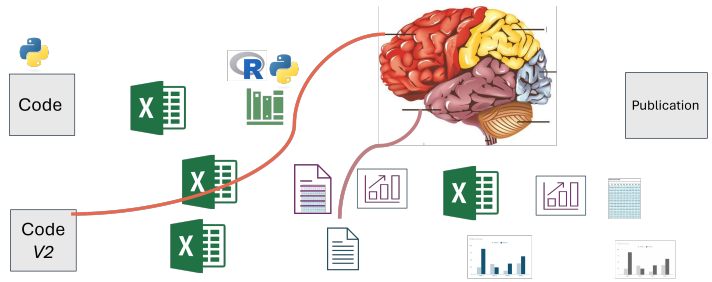
  .. in the right order..



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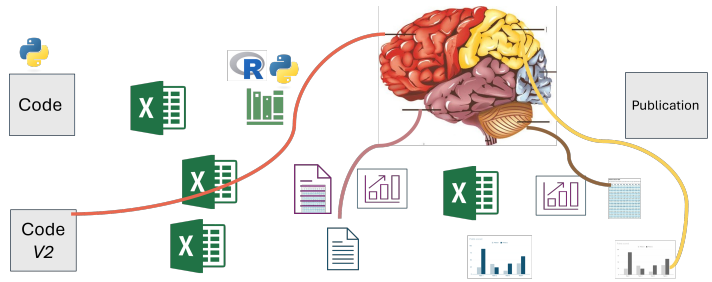

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- Cut and paste is not a reliable, reproducible approach!
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  ...all the steps...

  .. in the right order..

  ...all of them !
- Or use (bad) "*tools*"

What are the issues?

- Errors due to cut and paste

Excel: Why using Microsoft's tool caused Covid-19 results to be lost

By Leo Kelion
Technology desk editor

5 October 2020

The badly thought-out use of Microsoft's Excel software was the reason nearly 16,000 coronavirus cases went unreported in England.

And it appears that Public Health England (PHE) was to blame, rather than a third-party contractor.

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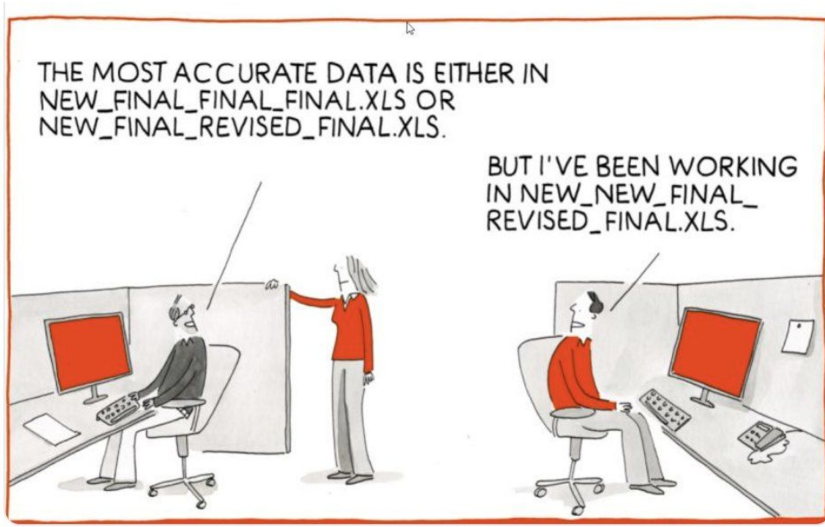

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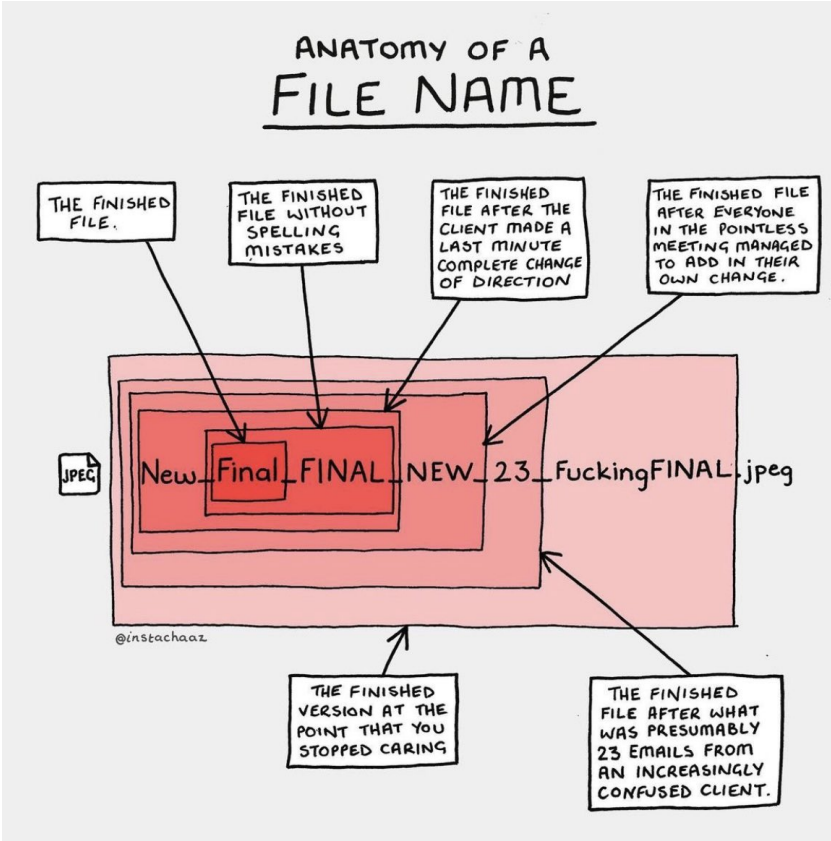
- Several versions of code may coexist



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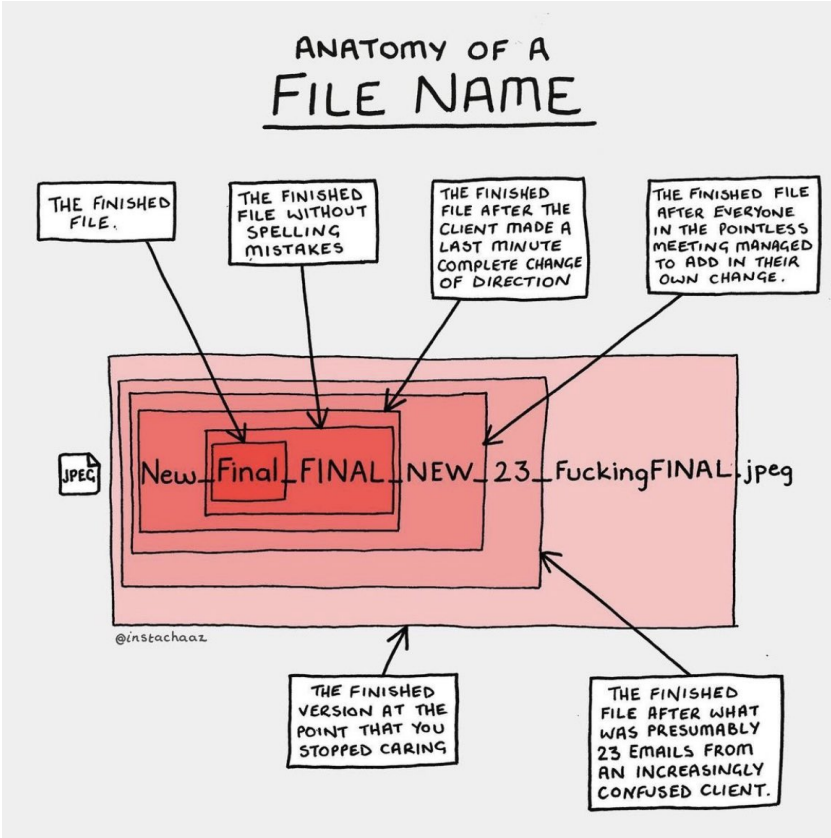

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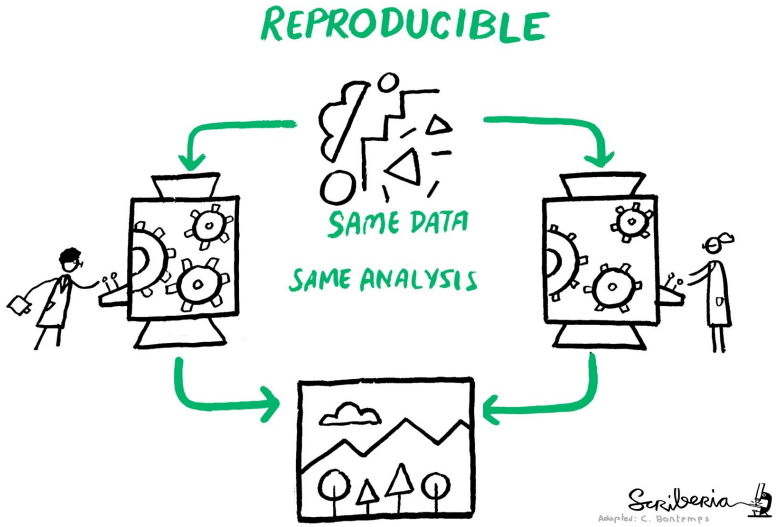
- The steps aren't recorded
- Reproducibility is not granted



Fundamental Principles of Official Statistics

- Clear mention of the **processes** used to produce statistics

Fundamental Principles of Official Statistics*

United Nations

For more information: unstats.un.org

The General Assembly,

Recalling recent resolutions[1] of the General Assembly and the Economic and Social Council highlighting the fundamental importance of official statistics for the national and global development agenda,

Bearing in mind the critical role of high-quality official statistical information in analysis and informed policy decision-making in support of sustainable development, peace and security, as well as for mutual knowledge and trade among the States and peoples of an increasingly connected world, demanding openness and transparency,

Bearing in mind also that the essential trust of the public in the integrity of official statistical systems and confidence in statistics depend to a large extent on respect for the fundamental values and principles that are the basis of any society seeking to understand itself and respect the rights of its members, and in this context that professional independence and accountability of statistical agencies are crucial,

Stressing that, in order to be effective, the fundamental values and principles that govern statistical work have to be guaranteed by legal and institutional frameworks and be respected at all political levels and by all stakeholders in national statistical systems,

Endorses the Fundamental Principles of Official Statistics set out below, as adopted by the Statistical Commission in 1994[2] and reaffirmed in 2013, and endorsed by the Economic and Social Council in its resolution 2013/21 of 24 July 2013:

* General Assembly Resolution 68/261 adopted on 29 January 2014. The "titles" of the Principles are not part of the original text.

[1] These include General Assembly resolution 64/267 on World Statistics Day and Economic and Social Council resolutions 2005/13 on the 2010 World Population and Housing Census Programme, 2006/6 on strengthening statistical capacity and 2013/21 on the Fundamental Principles of Official Statistics.

[2] For the original preamble used on the occasion of the initial adoption of the Fundamental Principles in 1994, see chapter V of the report of the Statistical Commission on its special session (*Official Records of the Economic and Social Council, 1994, Supplement No. 9* (E/1994/29)). More information on the Fundamental Principles and their history is available from the website of the Statistics Division.

Principle 1: ***Relevance, Impartiality, and Equal Access***
Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information.

Principle 2: ***Professional Standards, Scientific Principles, and Professional Ethics***
To retain trust in official statistics, the statistical agencies need to decide according to strictly professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of statistical data.

Principle 3: ***Accountability and Transparency***
To facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics.

Principle 4: ***Prevention of Misuse***
The statistical agencies are entitled to comment on erroneous interpretation and misuse of statistics.

Principle 5: ***Sources of Official Statistics***
Data for statistical purposes may be drawn from all types of sources, be they statistical surveys or administrative records. Statistical agencies are to choose the source with regard to quality, timeliness, costs and the burden on respondents.

Principle 6: ***Confidentiality***
Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.

Principle 7: ***Legislation***
The laws, regulations and measures under which the statistical systems operate are to be made public.

Principle 8: ***National Coordination***
Coordination among statistical agencies within countries is essential to achieve consistency and efficiency in the statistical system.

Principle 9: ***Use of International Standards***
The use by statistical agencies in each country of international concepts, classifications and methods promotes the consistency and efficiency of statistical systems at all official levels.

Principle 10: ***International Cooperation***
Bilateral and multilateral cooperation in statistics contributes to the improvement of systems of official statistics in all countries.

Fundamental Principles of Official Statistics

- Clear mention of the **processes** used to produce statistics
- *To retain trust in official statistics, the **statistical agencies need to decide** according to strictly professional considerations, including scientific principles and professional ethics, **on the methods and procedures** for the collection, processing, storage and presentation of statistical data.*

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Fundamental Principles of Official Statistics

- Clear mention of the **processes** used to produce statistics
- *To retain trust in official statistics, the **statistical agencies need to decide** according to strictly professional considerations, including scientific principles and professional ethics, **on the methods and procedures** for the collection, processing, storage and presentation of statistical data.*
- In short, **processes** are important!

Fundamental Principles of Official Statistics*

United Nations — For more information: unstats.un.org

The General Assembly,

Recalling recent resolutions[1] of the General Assembly and the Economic and Social Council highlighting the fundamental importance of official statistics for the national and global development agenda,

Bearing in mind the critical role of high-quality official statistical information in analysis and informed policy decision-making in support of sustainable development, peace and security, as well as for mutual knowledge and trade among the States and peoples of an increasingly connected world, demanding openness and transparency,

Bearing in mind also that the essential trust of the public in the integrity of official statistical systems and confidence in statistics depend to a large extent on respect for the fundamental values and principles that are the basis of any society seeking to understand itself and respect the rights of its members, and in this context that professional independence and accountability of statistical agencies are crucial,

Stressing that, in order to be effective, the fundamental values and principles that govern statistical work have to be guaranteed by legal and institutional frameworks and be respected at all political levels and by all stakeholders in national statistical systems,

Endorses the Fundamental Principles of Official Statistics set out below, as adopted by the Statistical Commission in 1994[2] and reaffirmed in 2013, and endorsed by the Economic and Social Council in its resolution 2013/21 of 24 July 2013:

* General Assembly Resolution 68/261 adopted on 29 January 2014. The "titles" of the Principles are not part of the original text.

[1] These include General Assembly resolution 64/267 on World Statistics Day and Economic and Social Council resolutions 2005/13 on the 2010 World Population and Housing Census Programme, 2006/6 on strengthening statistical capacity and 2013/21 on the Fundamental Principles of Official Statistics.

[2] For the original preamble used on the occasion of the initial adoption of the Fundamental Principles in 1994, see chapter V of the report of the Statistical Commission on its special session (*Official Records of the Economic and Social Council, 1994, Supplement No. 9* (E/1994/29)). More information on the Fundamental Principles and their history is available from the website of the Statistics Division.

Principle 1: ***Relevance, Impartiality, and Equal Access***
Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information.

Principle 2: ***Professional Standards, Scientific Principles, and Professional Ethics***
To retain trust in official statistics, the statistical agencies need to decide according to strictly professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of statistical data.

Principle 3: ***Accountability and Transparency***
To facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics.

Principle 4: ***Prevention of Misuse***
The statistical agencies are entitled to comment on erroneous interpretation and misuse of statistics.

Principle 5: ***Sources of Official Statistics***
Data for statistical purposes may be drawn from all types of sources, be they statistical surveys or administrative records. Statistical agencies are to choose the source with regard to quality, timeliness, costs and the burden on respondents.

Principle 6: ***Confidentiality***
Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.

Principle 7: ***Legislation***
The laws, regulations and measures under which the statistical systems operate are to be made public.

Principle 8: ***National Coordination***
Coordination among statistical agencies within countries is essential to achieve consistency and efficiency in the statistical system.

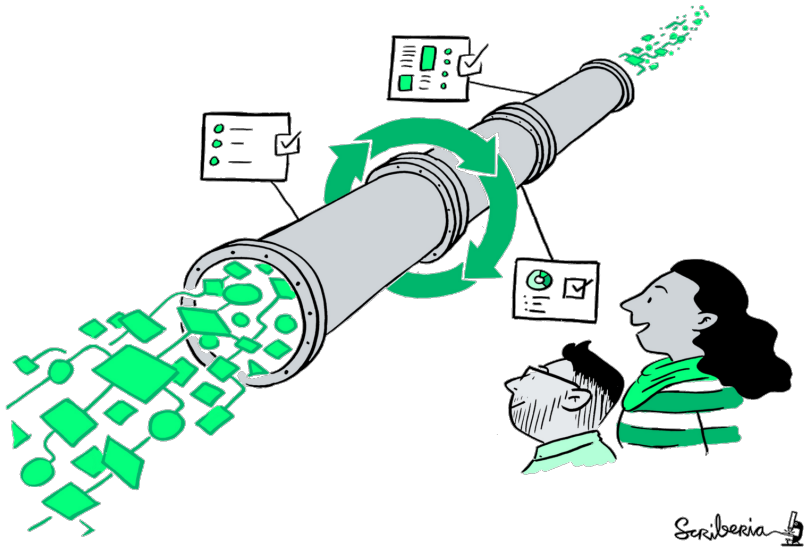
Principle 9: ***Use of International Standards***
The use by statistical agencies in each country of international concepts, classifications and methods promotes the consistency and efficiency of statistical systems at all official levels.

Principle 10: ***International Cooperation***
Bilateral and multilateral cooperation in statistics contributes to the improvement of systems of official statistics in all countries.

What is A Reproducible Analytical Pipeline?

RAP could be thought of as an approach to working – adopting a set of technical skills to learn and open-source best practices to adopt when creating a data output (which in our case is final or interim datasets)

- RAP is thus a robust process



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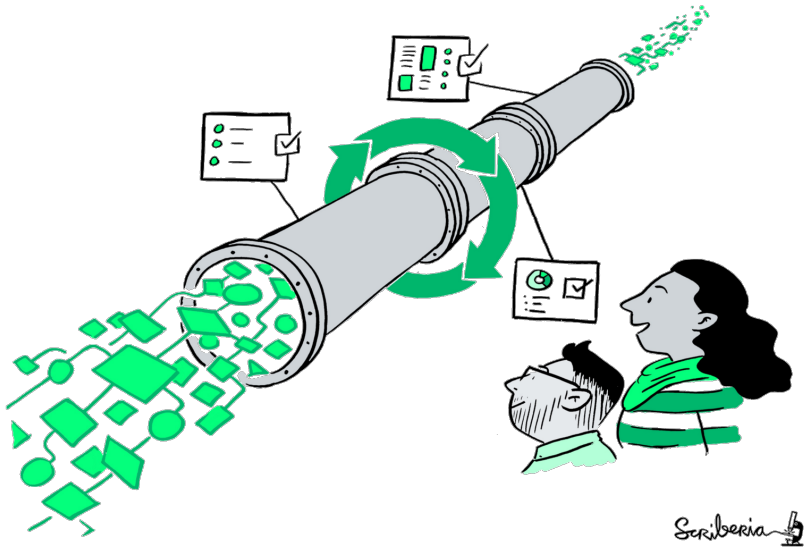

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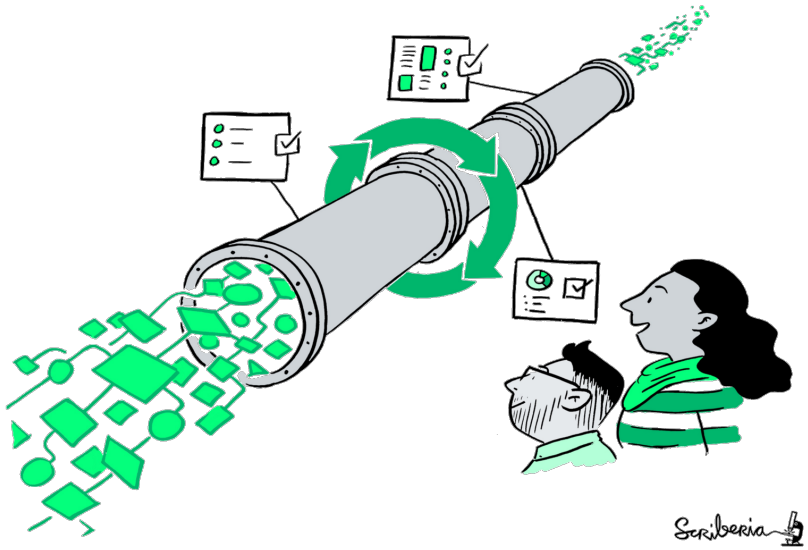

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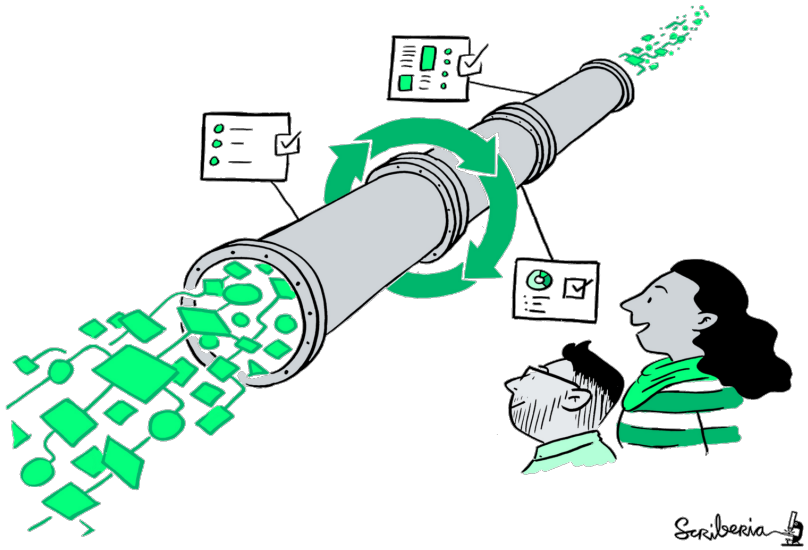

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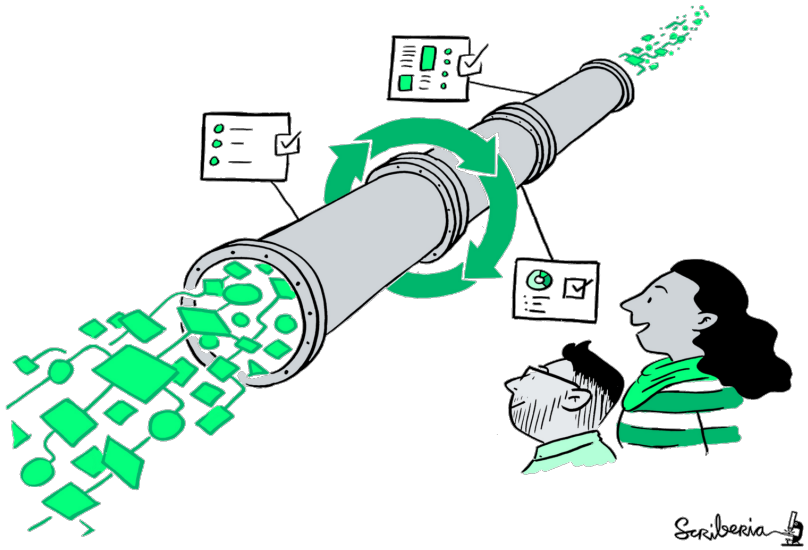

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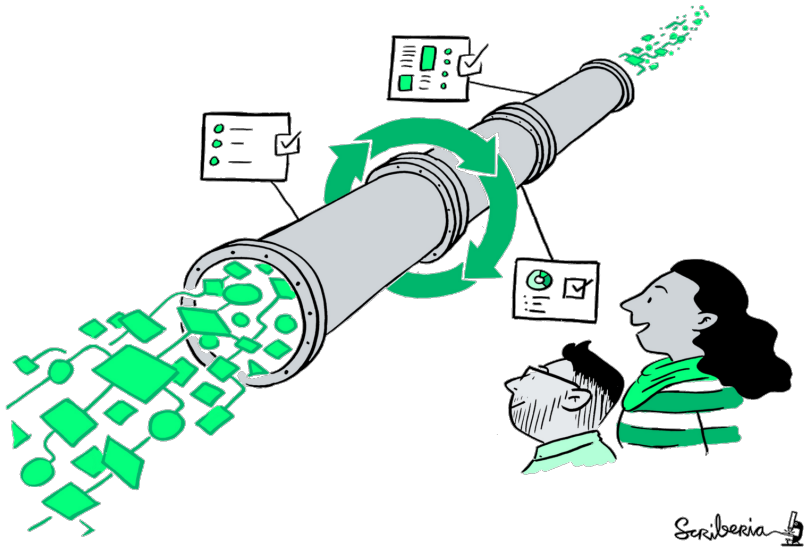
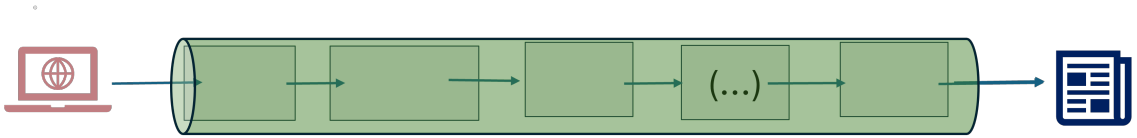


What does a RAP look like?

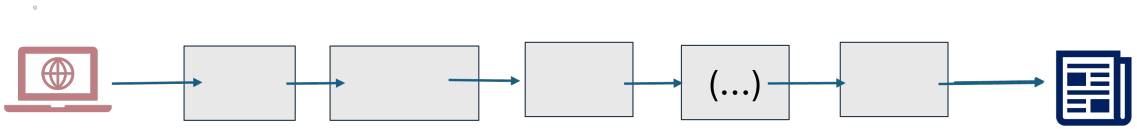
Idealy, Input (website) and output (report) are linked

What does a RAP look like?



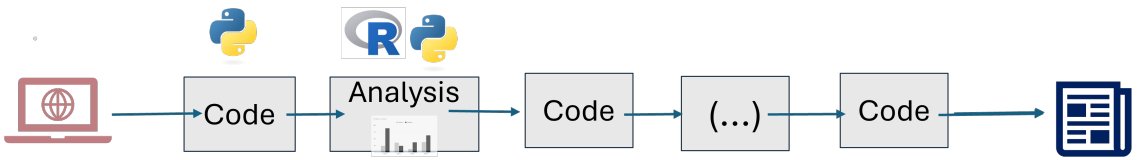
Many steps are needed to create a report

What does a RAP look like?



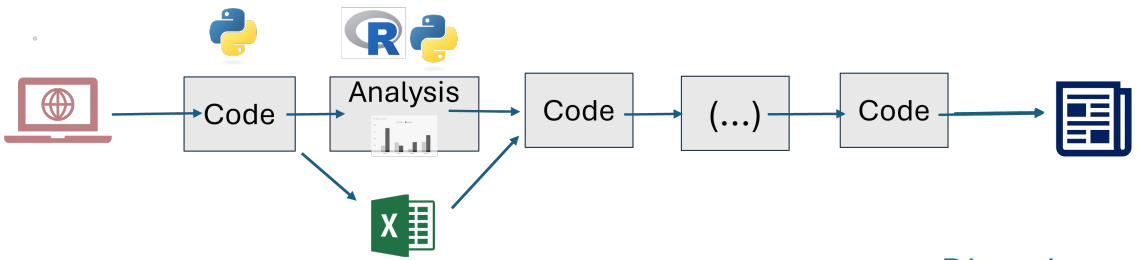
All steps should be linked in a structured process

What does a RAP look like?



And only through code (Python, R), no copy/paste

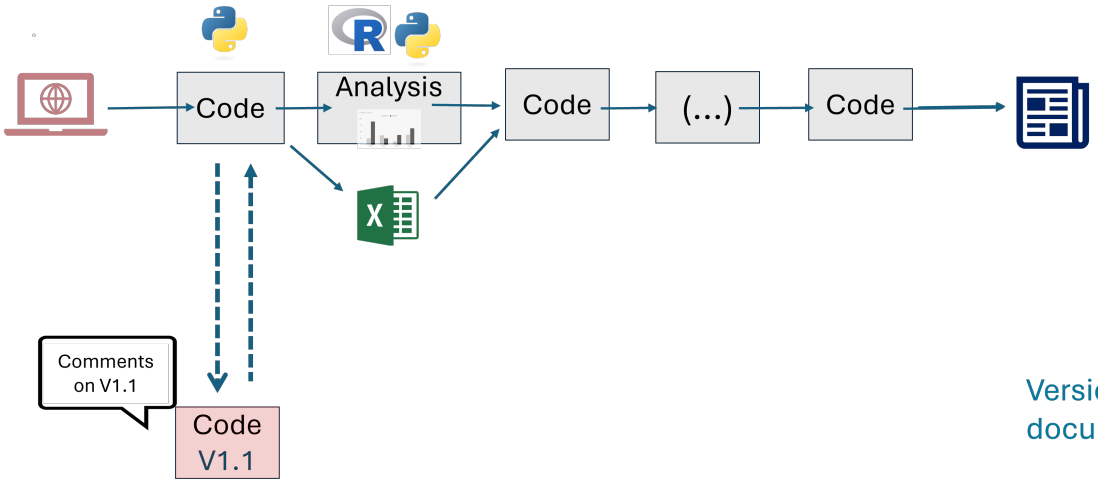
What does a RAP look like?



Direct input-output of data

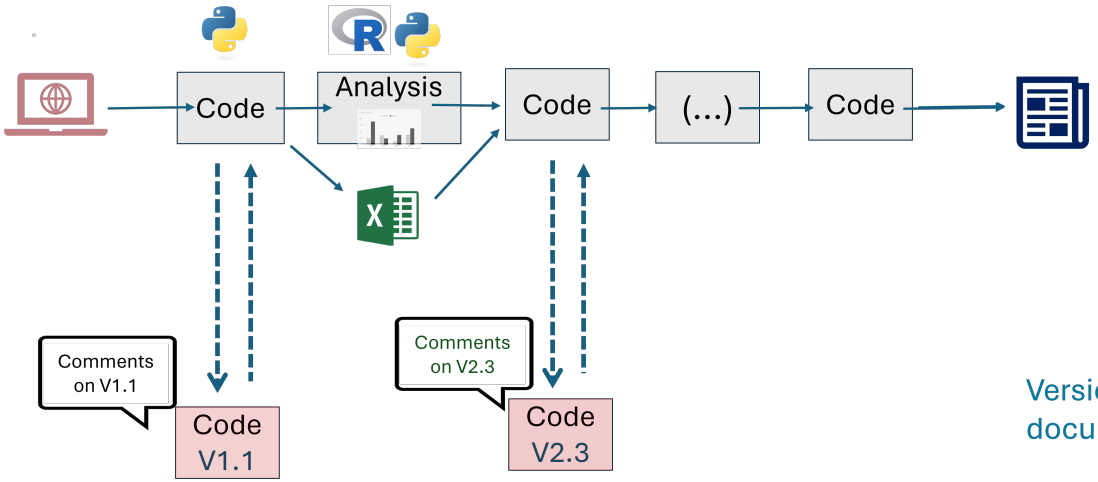
There may be side-products, but with explicit output-input links

What does a RAP look like?



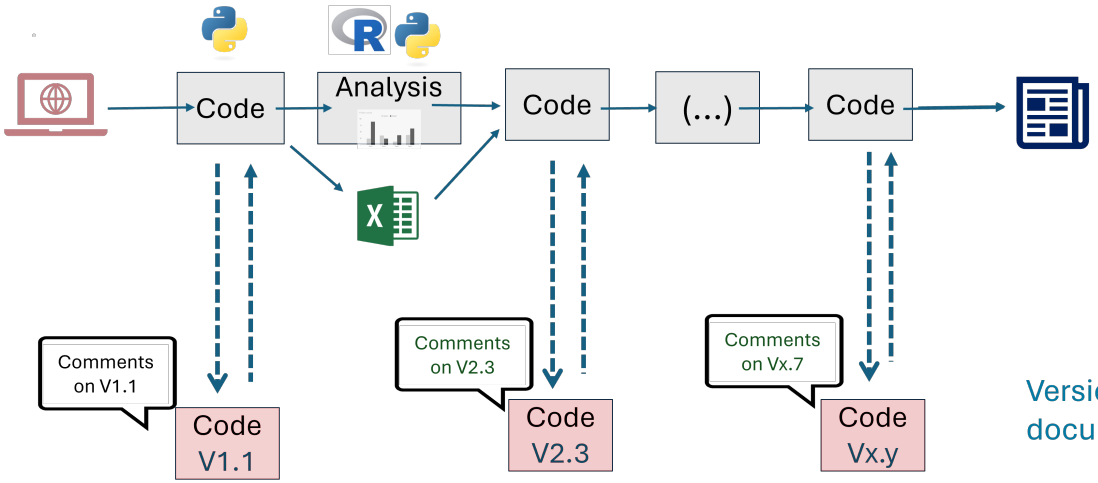
If needed, code can be updated (new versions)

What does a RAP look like?



And comments added for each change

What does a RAP look like?



Documentation on the process builds up with code changes

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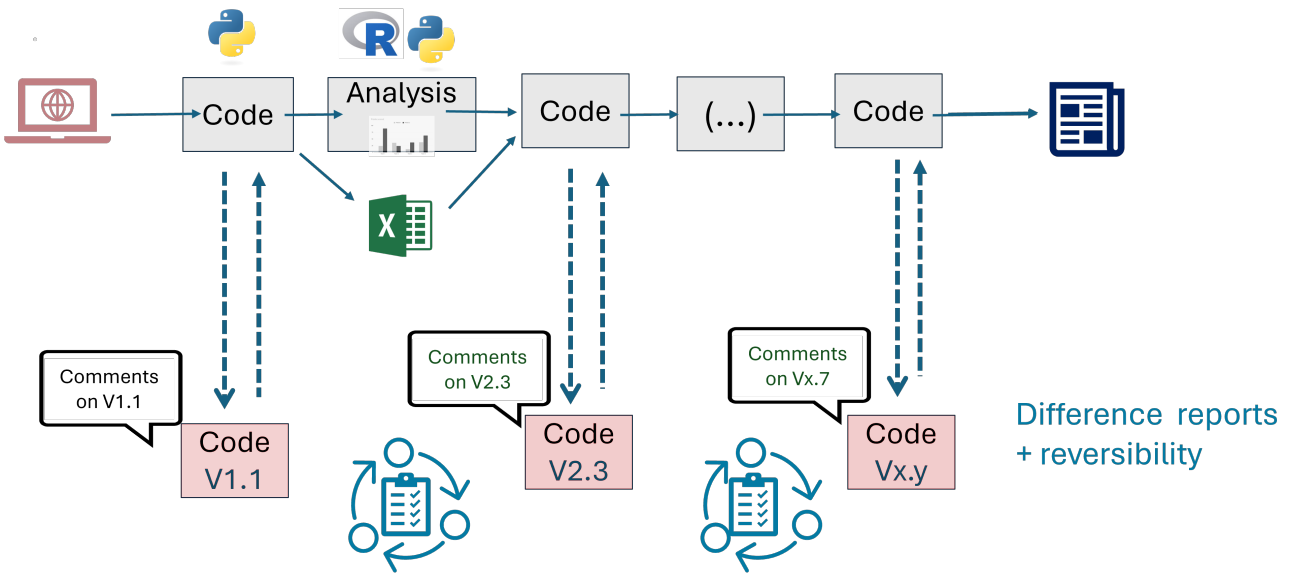

Other contributors are welcome!

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- Peer-review

RAP PRINCIPLES:

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These principles translate into:

Good Practices

+

Good Tools

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These principles translate into:

Good Practices

+

Good Tools

↪ We'll detail some of these practices and tools

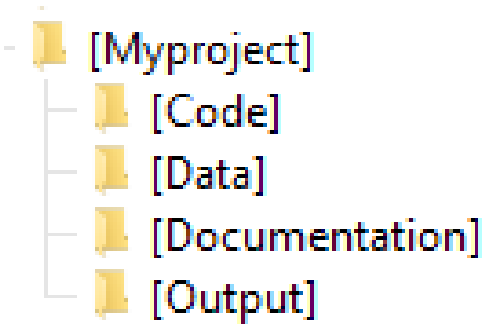
Good practices: Organize your work

Have a clear directory structure

GOOD PRACTICES: ORGANIZE YOUR WORK

Have a clear directory structure

- Separate files into data, code, docs, etc.

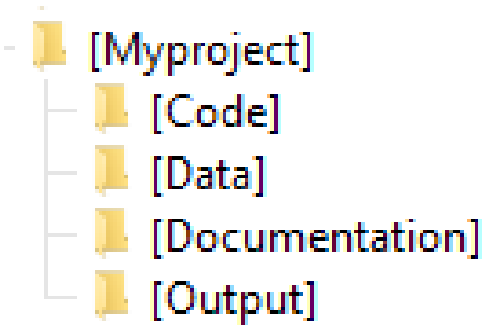


Example of a well-organized directory structure.

GOOD PRACTICES: ORGANIZE YOUR WORK

Have a clear directory structure

- Separate files into data, code, docs, etc.
- Make directories portable (relative path)



Example of a well-organized directory structure.

Usual

```
mydata =
pd.read_csv("c://ESCAP/Webscraping/Data/WebData.csv")
```

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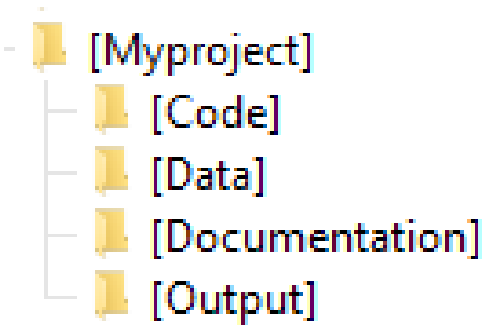


Example of a well-organized directory structure.

Usual
mydata = pd.read_csv("c://ESCAP/Webscraping/Data/WebData.csv")

Better
Assuming your code is in c://ESCAP/Webscraping/Code/
mydata = pd.read_csv("../Data/WebData.csv")

GOOD PRACTICES: ORGANIZE YOUR WORK

Use naming conventions:
For **files/code**

- Avoid lazy names

Usual

```
prog1.ipynb
prog2.ipynb
Stat.ipynb
progC.ipynb
progP.ipynb
```

GOOD PRACTICES: ORGANIZE YOUR WORK

Use naming conventions:
For **files/code**

- Avoid lazy names
- Meaningful files names

Usual	Better
`prog1.ipynb`	`Scraping_Data.py`
`prog2.ipynb`	`Cleaning_Data.py`
`Stat.ipynb`	`Stats_Tables.py`
`progC.ipynb`	`Classification.py`
`progP.ipynb`	`Price_CPI.py`

GOOD PRACTICES: ORGANIZE YOUR WORK

Use naming conventions:
For **files/code**

- Avoid lazy names
- Meaningful files names
- Order of execution

Usual	Even better
`prog1.ipynb`	`01_Scraping_data.py`
`prog2.ipynb`	`02_Cleaning_data.py`
`Stat.ipynb`	`03_Classification.py`
`progC.ipynb`	`04_Stats_Tables.py`
`progP.ipynb`	`04_Price_CPI.py`

GOOD PRACTICES: ORGANIZE YOUR WORK

Use naming conventions:

For **outputs**

- Avoid numbering

Usual

```
Table1.pdf
Table2.pdf
Graph.jpg
Model.csv
```

GOOD PRACTICES: ORGANIZE YOUR WORK

Use naming conventions:

For **outputs**

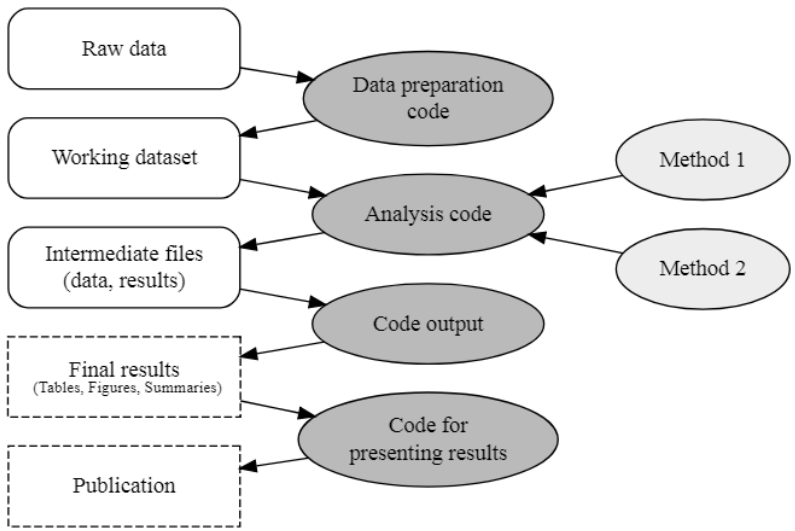
- Avoid numbering
- Explicit type of output

Usual	Better
`Table1.pdf`	`Stat_Desc_Table.pdf`
`Table2.pdf`	`Price_Stat_Table.pdf`
`Graph.jpg`	`Dress_Prices_Graphic.jpg`
`Model.csv`	`All_prices_Results.csv`

GOOD PRACTICES FOR AUTOMATION

Keep track of the workflow:

- Cut and paste should be avoided

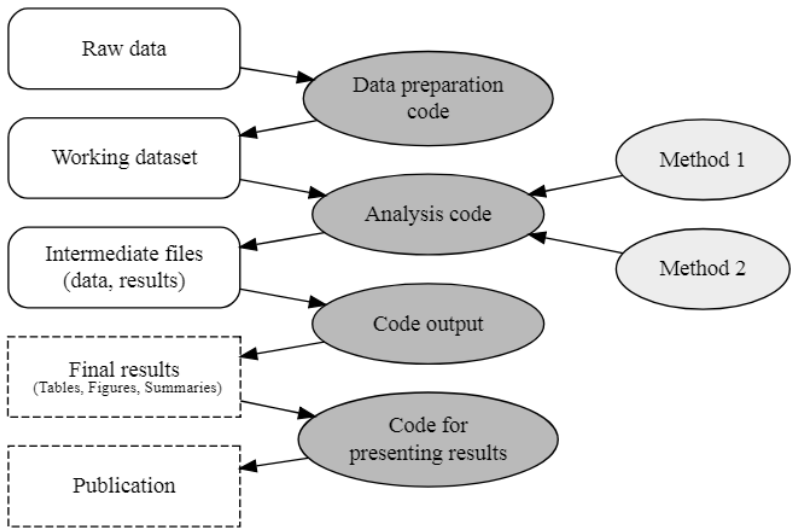


Example of a simple workflow.

GOOD PRACTICES FOR AUTOMATION

Keep track of the workflow:

- Cut and paste should be avoided
- Every step of the process is coded

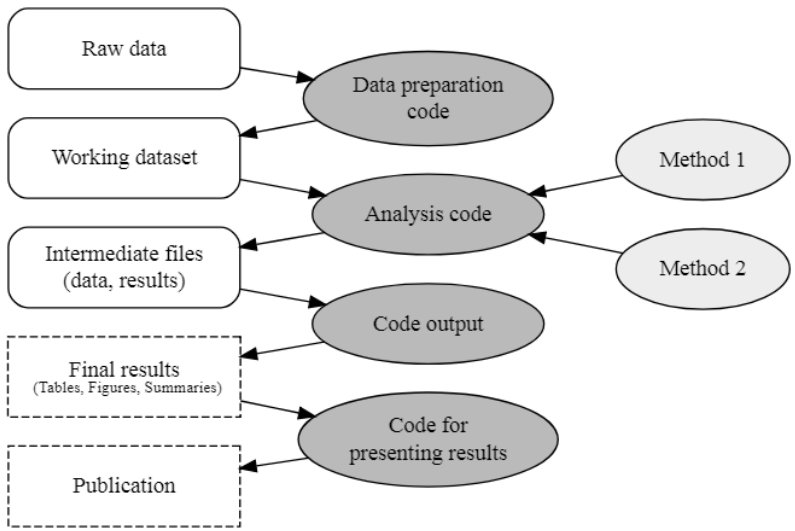


Example of a simple workflow.

GOOD PRACTICES FOR AUTOMATION

Keep track of the workflow:

- Cut and paste should be avoided
- Every step of the process is coded
- Manage (and draw) the workflow

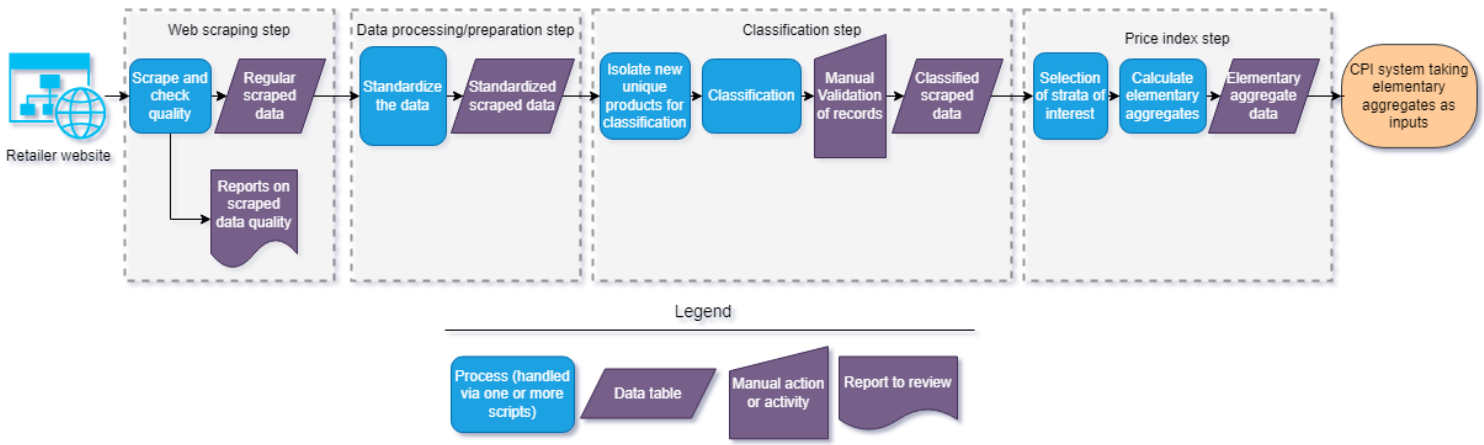


Example of a simple workflow.

GOOD PRACTICES FOR AUTOMATION

Keep track of the workflow:

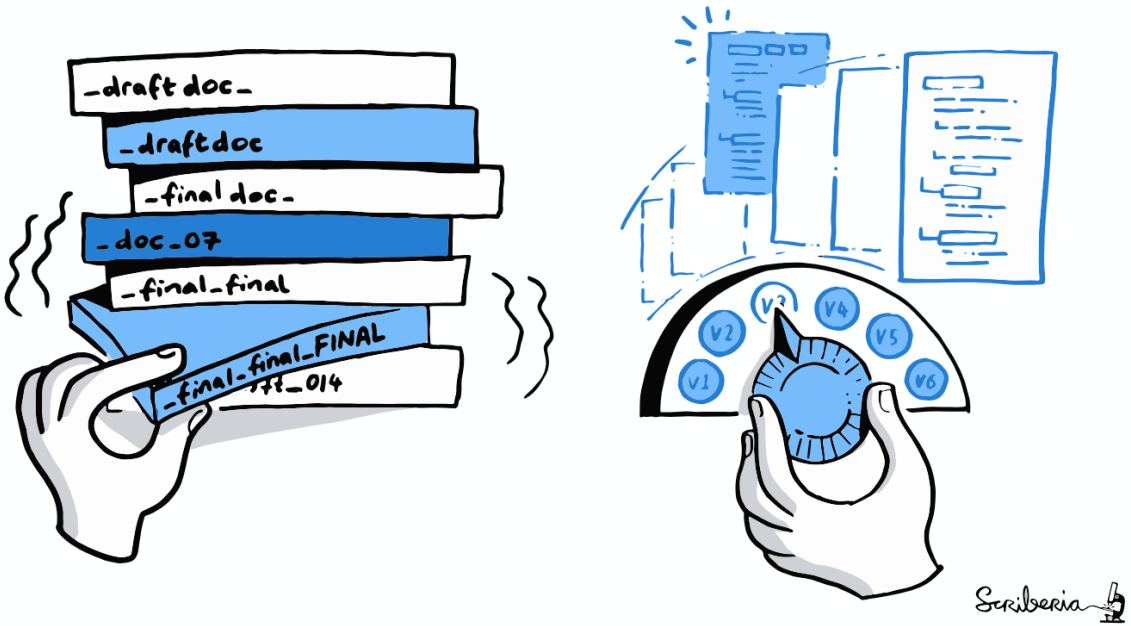
Here is a workflow from web scraping to elementary aggregate workflow. We'll cover it more next week!



Created by Serge Goussev.

VERY GOOD PRACTICES

Use a version control system (Git/GitHub)



More on Version Control later

Good coding practices: Code for others

Program with style:

Use *literate programming*

> *"Let us concentrate rather on explaining to humans what we want the computer to do"*
>
> D. Knuth (1984)

GOOD CODING PRACTICES: CODE FOR OTHERS

Program with style:

"(. . .) code is read much more often than it is written"

Guido van Rossum (2013 -PEP8)

PEP stands for *Python Enhancement Proposals*

GOOD CODING PRACTICES: CODE FOR OTHERS

Program with style:

Use conventions on layout (Comments, indentation,...)

Contents

PEP 8 – Style Guide for Python Code

Author: Guido van Rossum <guido at python.org>, Barry Warsaw <barry at python.org>, Alyssa Coghlan <ncoghlan at gmail.com>

Status: Active
Type: Process
Created: 05-Jul-2001
Post-History: 05-Jul-2001, 01-Aug-2013

▶ **Table of Contents**

Introduction

This document gives coding conventions for the Python code comprising the standard library in the main Python distribution. Please see the companion informational PEP describing style guidelines for the C code in the C implementation of Python.

This document and PEP 257 (Docstring Conventions) were adapted from Guido's original Python Style Guide essay, with some additions from Barry's style guide [2].

This style guide evolves over time as additional conventions are identified and past conventions are rendered obsolete by changes in the language itself.

Many projects have their own coding style guidelines. In the event of any conflicts, such project-specific guides take precedence for that project.

A Foolish Consistency is the Hobgoblin of Little Minds

One of Guido's key insights is that code is read much more often than it is written. The guidelines provided here are intended to improve the readability of code and make it consistent across the wide spectrum of Python code. As PEP 20 says, "Readability counts".

A style guide is about consistency. Consistency with this style guide is important. Consistency within a project is more important. Consistency within one module or function is the most important.

However, know when to be inconsistent – sometimes style guide recommendations just aren't applicable. When in doubt, use your best judgment. Look at other examples and decide what looks best. And don't hesitate to ask!

GOOD CODING PRACTICES: CODE FOR OTHERS

Program with style

- Avoid ambiguities

Usual

```
df['sex'] = np.where(df['gender'] ==
'1001', 1, 2)
```

Better

```
df['female'] = np.where(df['gender'] ==
'1001', 1, 0)
df['male'] = np.where(df['gender'] !=
'1001', 1, 0)
```

Good coding practices: Code for others

Program with style

- Avoid ambiguities
- Avoid changing units

Usual

```
df['gdp'] = df['gdp'] / 118.722
```

Good coding practices: Code for others

Program with style

- Avoid ambiguities
- Avoid changing units

Usual

```
df['gdp'] = df['gdp'] / 118.722
```

Better

```
df['gdp_US'] = df['gdp'] / 118.722
```

Good coding practices: Code for others

Program with style

- Avoid ambiguities
- Avoid changing units

Usual

```
df['gdp'] = df['gdp'] / 118.722
```

Even better

```
US_Vanu_exch_rate = 118.722
df['gdp_US'] = df['gdp']/
US_Vanu_exch_rate
```

Good practices: Modularity

Create reusable objects

- Store values

Usual

```
Current_Data = Mydata[Mydata['year'] == 2023]
```

Good practices: Modularity

Create reusable objects

- Store values
- Avoid repetitions

Usual

```
Current_Data = Mydata[Mydata['year'] == 2023]
```

Better

```
Current_year = 2023
Current_Data= Mydata[Mydata['year'] ==
Current_year]
```

GOOD PRACTICES: MODULARITY

Create reusable objects

- Store values
- Avoid repetitions

Usual

```
# - Exports for Beef -
data = Mydata[Mydata['export'] == 'Beef']
plt.plot(data['Year'], data['Value'])
plt.title('Export for Beef')
# - Also for Kava -
data = Mydata[Mydata['export'] == 'Kava']
plt.plot(data['Year'], data['Value'])
plt.title('Export for Kava')
# - Also for ...  -
```

GOOD PRACTICES: MODULARITY

Create reusable objects

- Store values
- Avoid repetitions
- Use functions

Better

```
# Defining a generic function
def plot_export(export_type):
 data = Mydata[Mydata['export'] ==
                                        export_type]
 plt.plot(data['Year'], data['Value'])
 plt.title(f'Export for {export_type}')
 plt.show()
# Run the function for several products
plot_export("Beef")
plot_export("Kava")
```

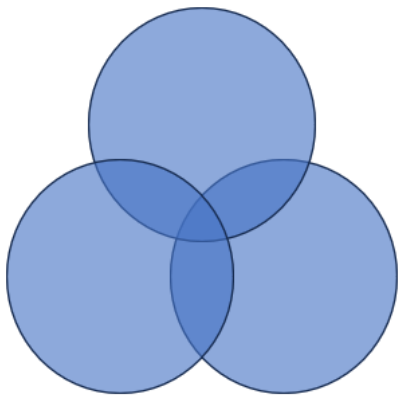
Good practices: Modularity

Create reusable objects

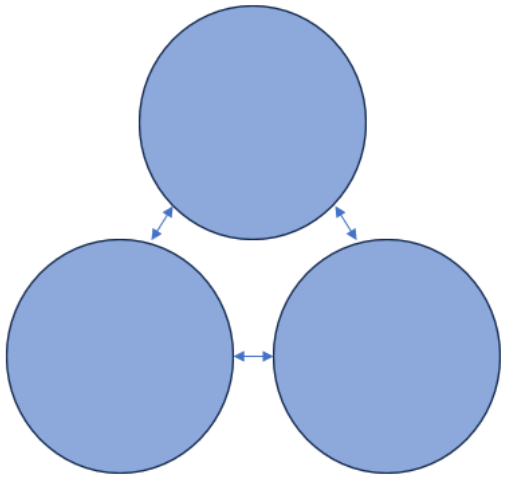
- Store values

  Avoid repetitions

- Use functions
- Use independent blocks



Tight Coupling



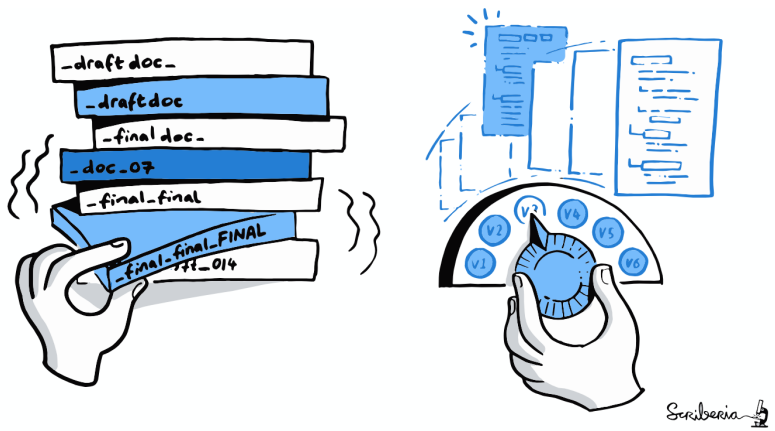
Loose Coupling

Source: NHS Community of Practice

VERSION CONTROL KEEPS TRACKS OF YOUR WORK

Tracking three **W** questions:

What changes?



Source: The Turing Way project

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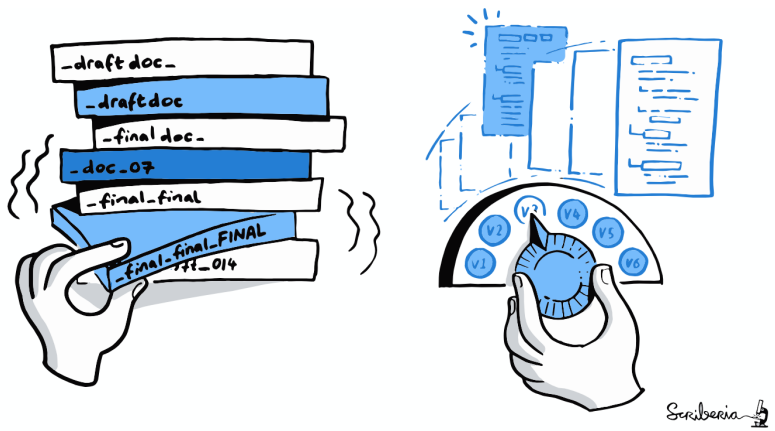
Who made the changes?



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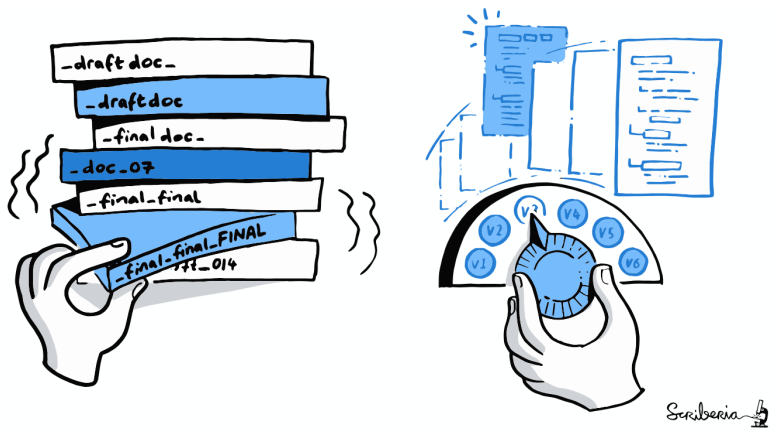

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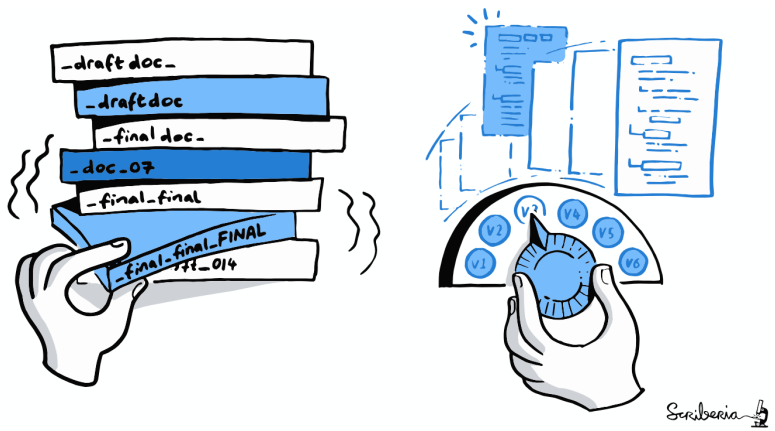

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Transparency, Accountability & Reproducibility

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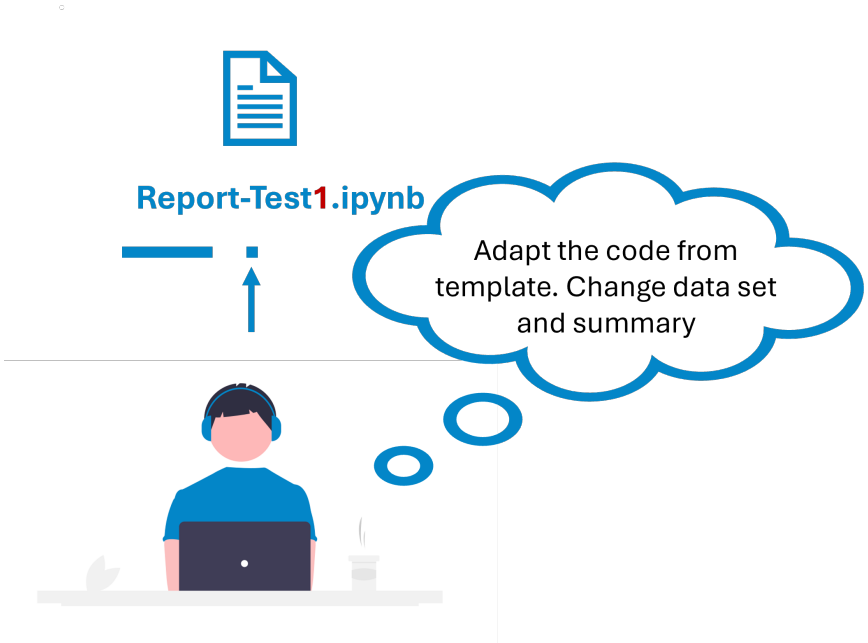
File evolution without Version Control



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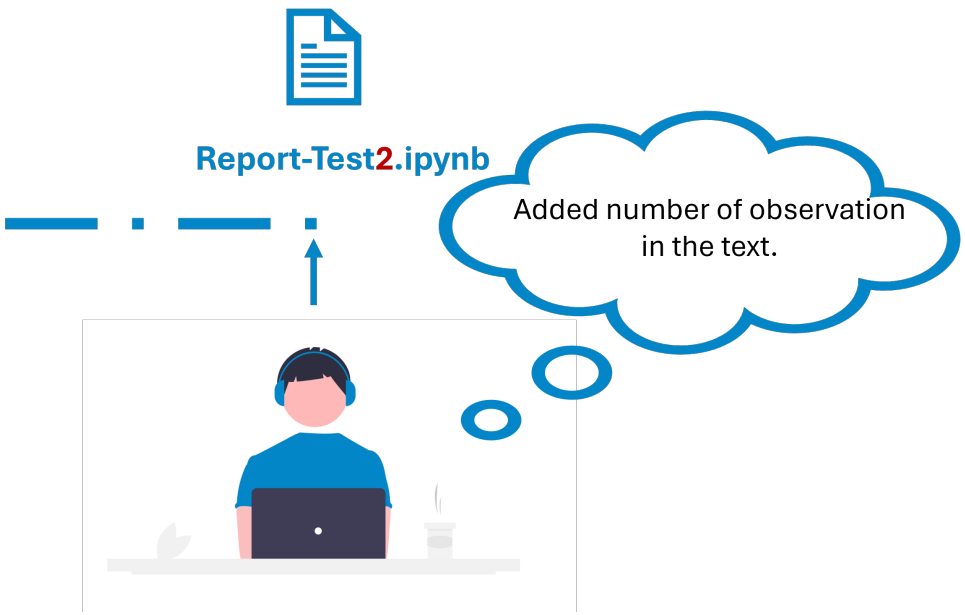

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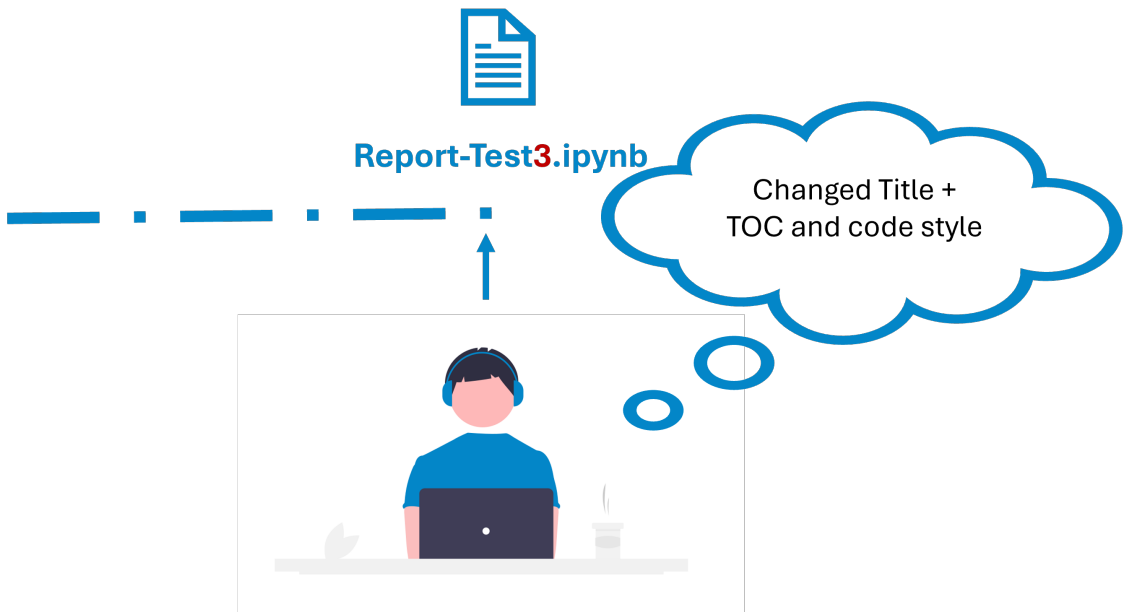

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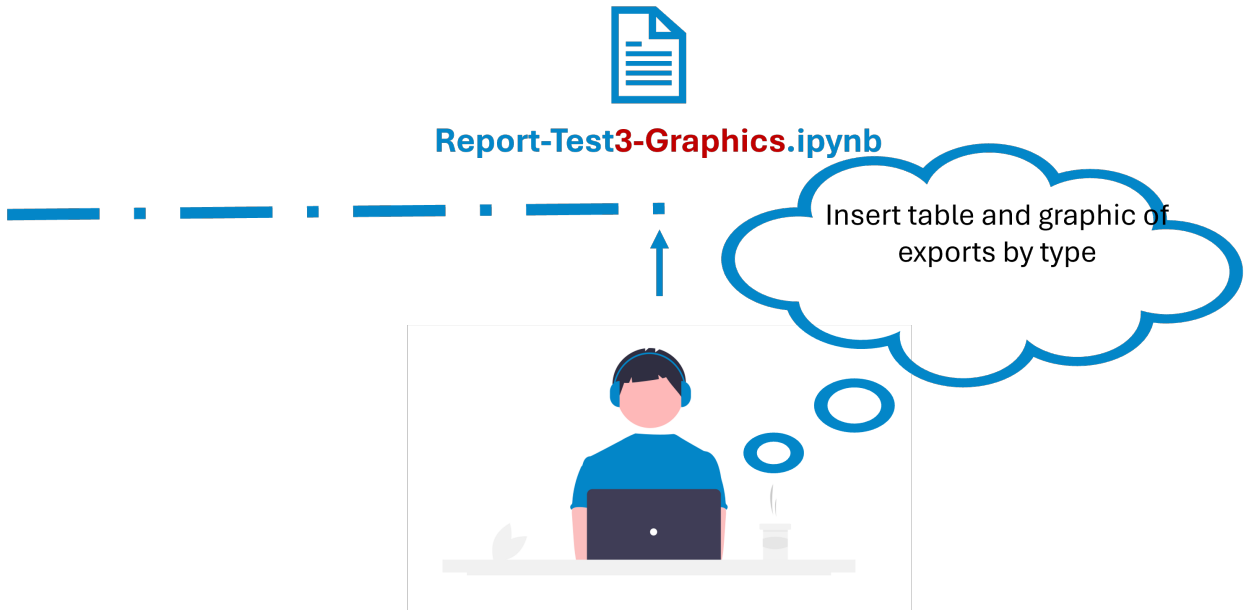

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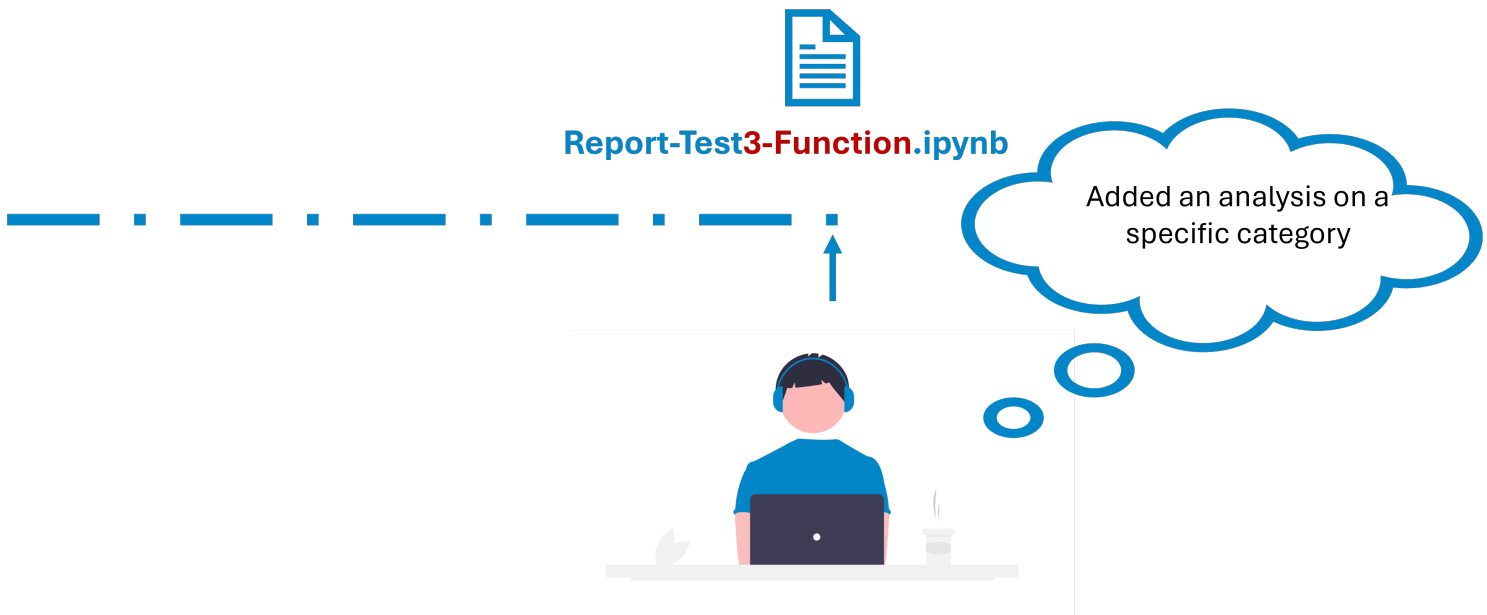

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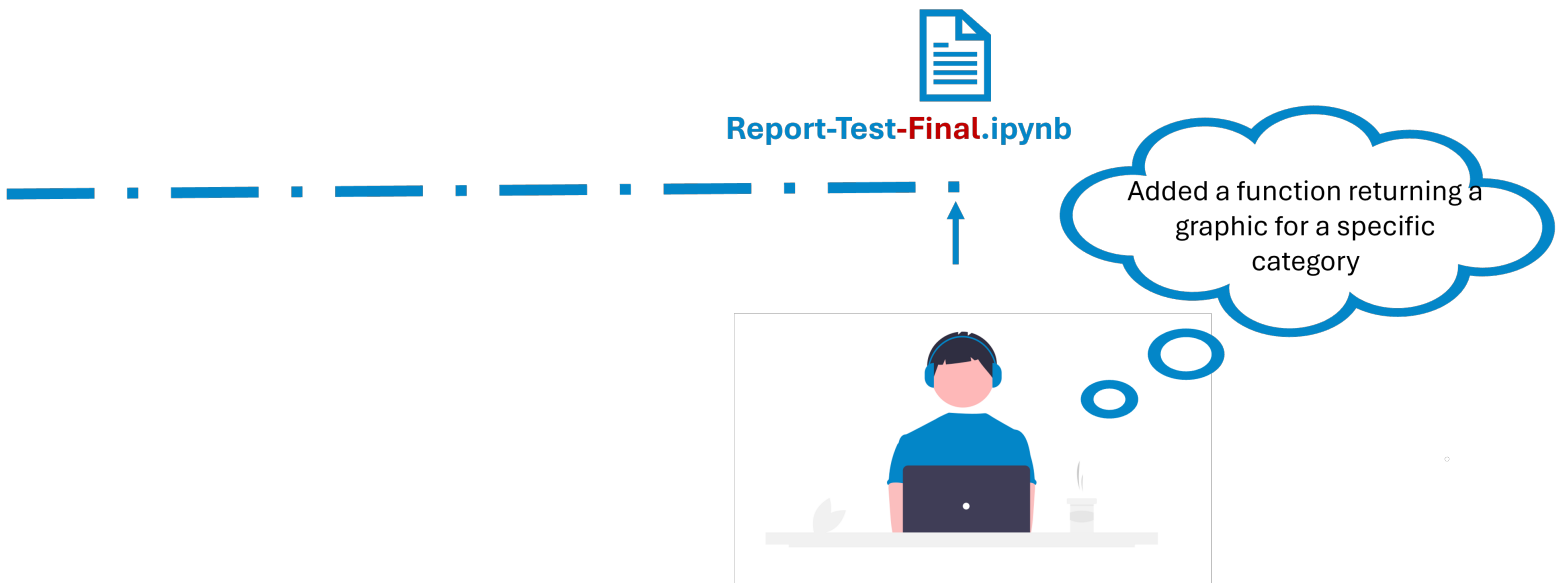

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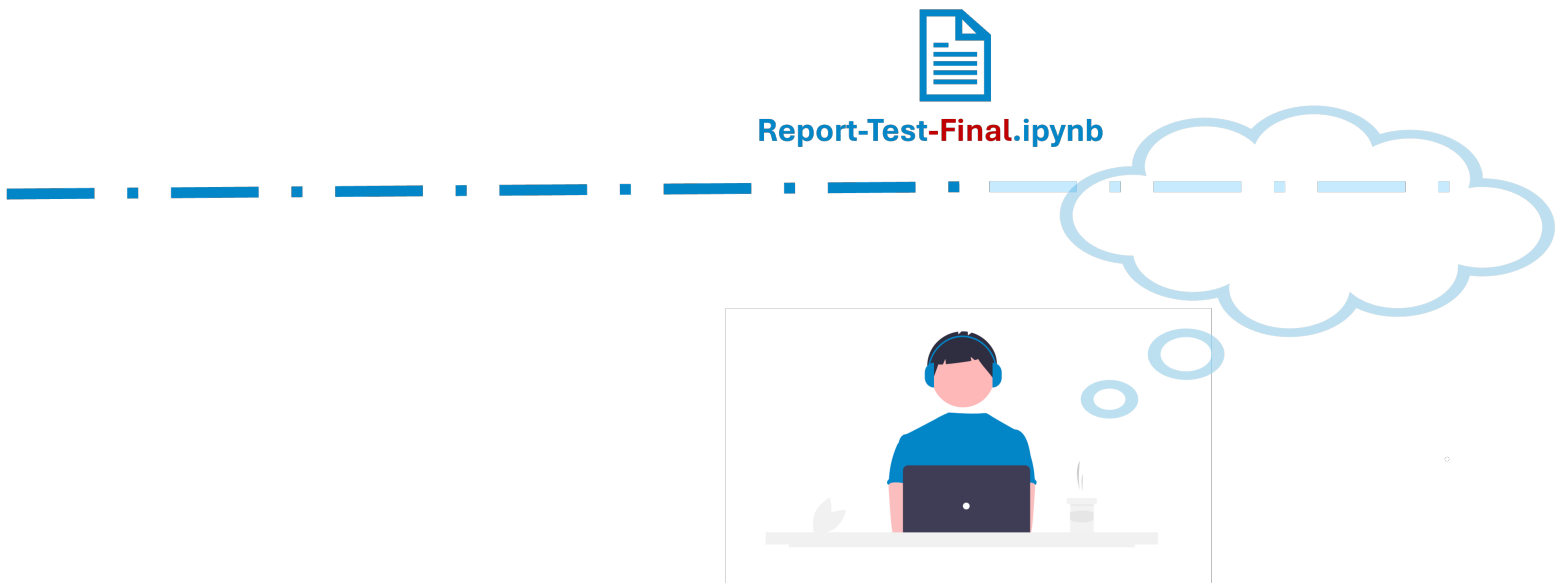

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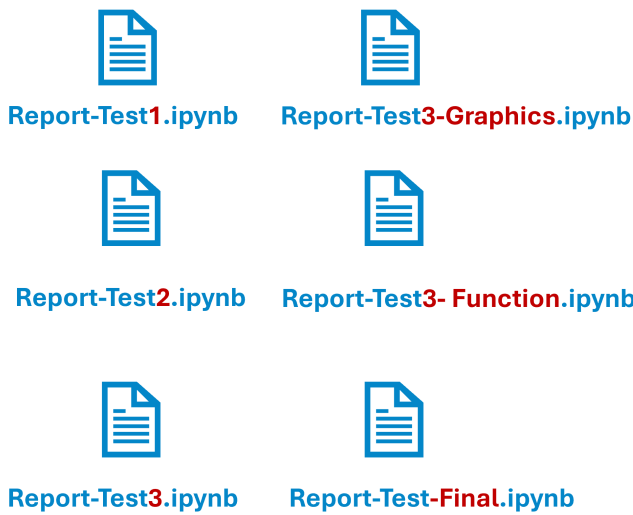

File evolution without Version Control

Usual ways to keep track of changes:

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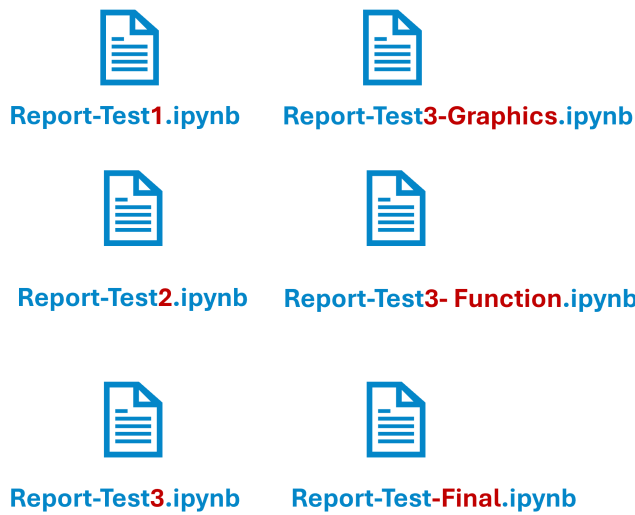
↪ Need to open each file to see the change



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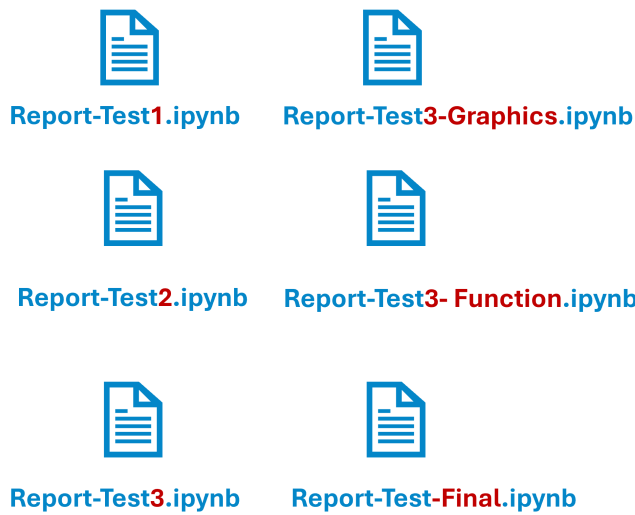

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Report-Test3-Graphics-Functions-Final-Chris.ipynb

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Usual ways to keep track of changes:

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- ↪ Need to open each file to see the change
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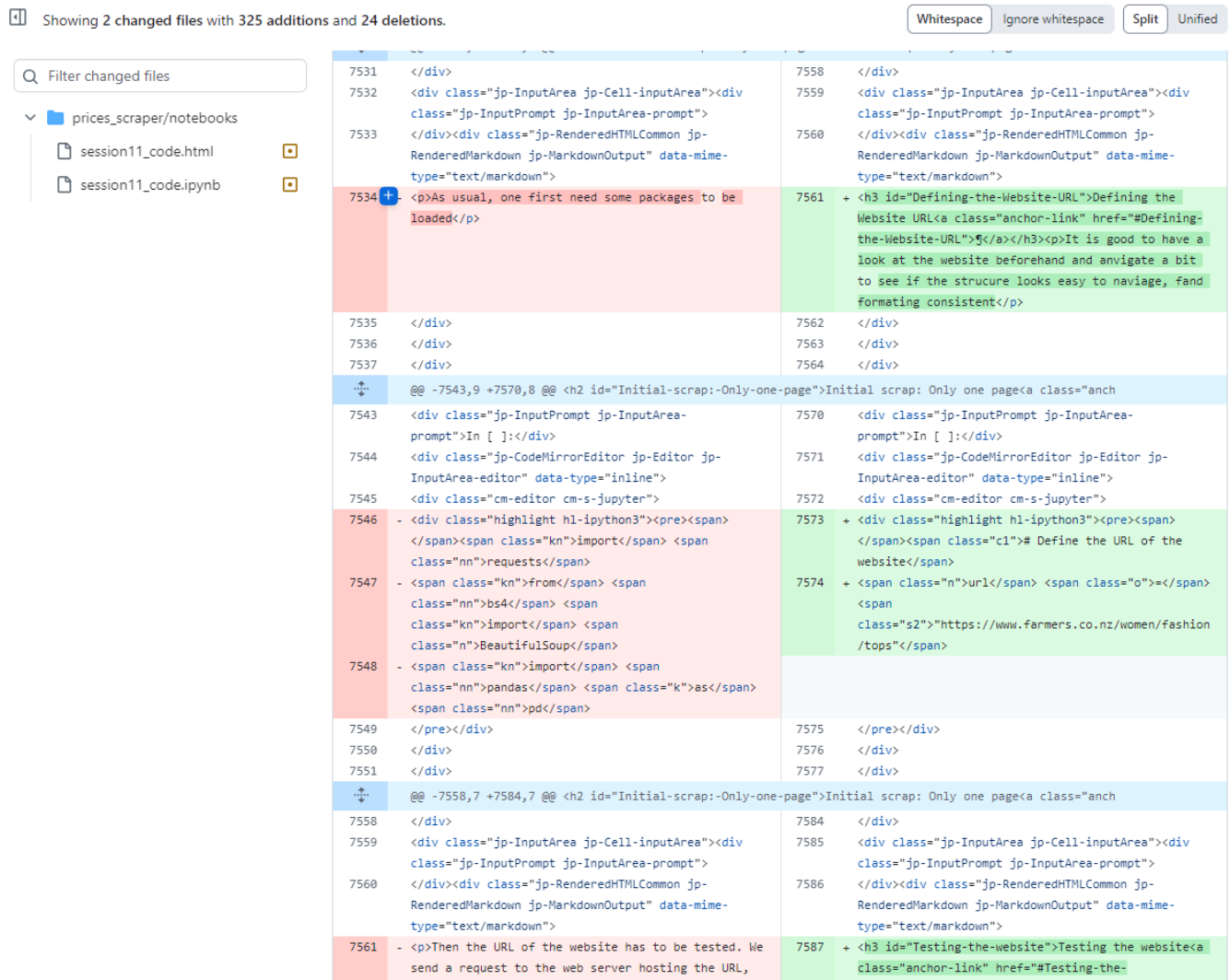
- Only the last file with lots of comments
- Not fulfilling the 3 **W**...

Report-Test3-Graphics-Functions-Final-Chris.ipynb

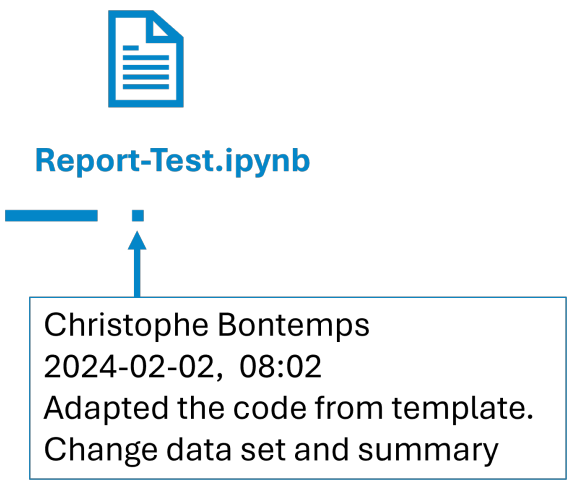
File evolution with Version Control

You can see exactly what has been going on!



File evolution with Version Control

Record a message (*commit*) for each change!



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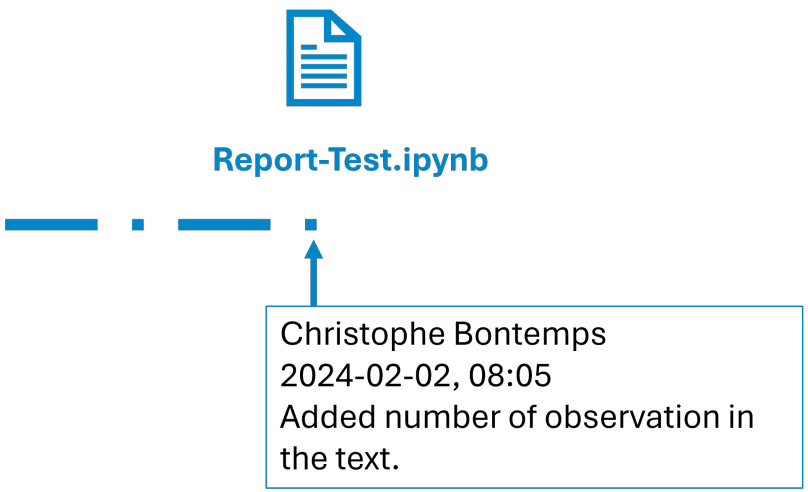

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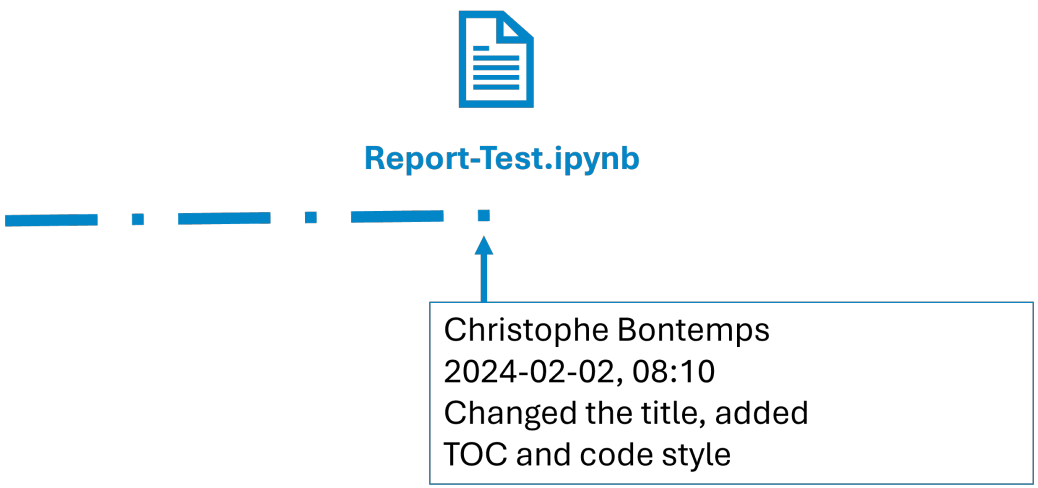

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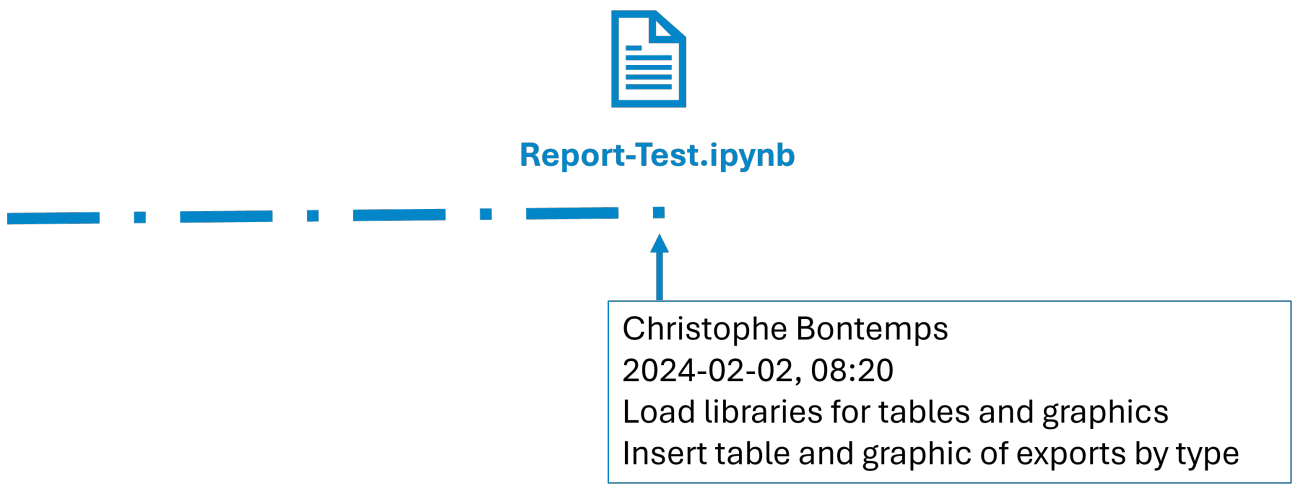

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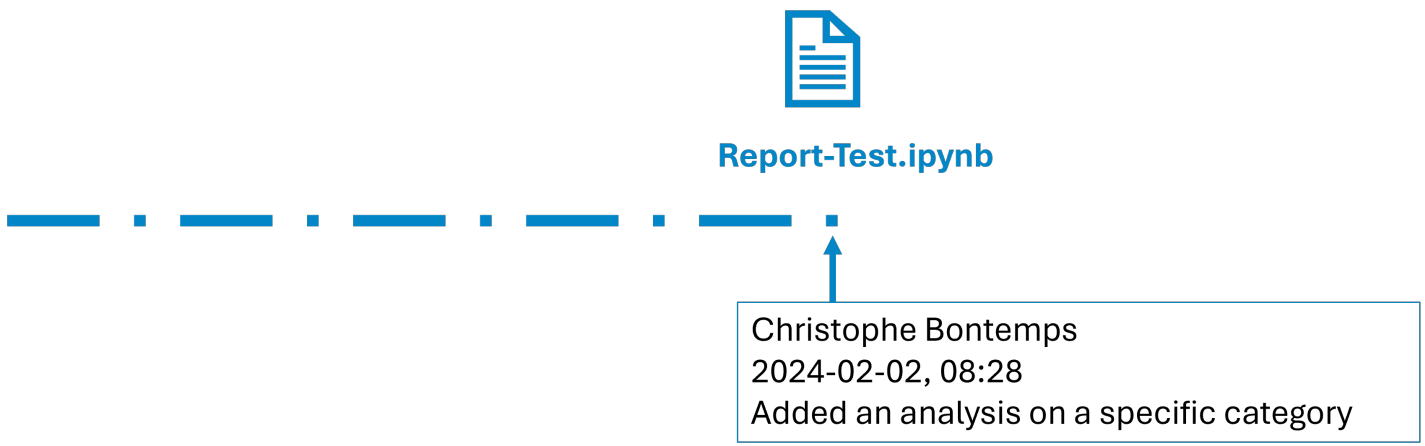

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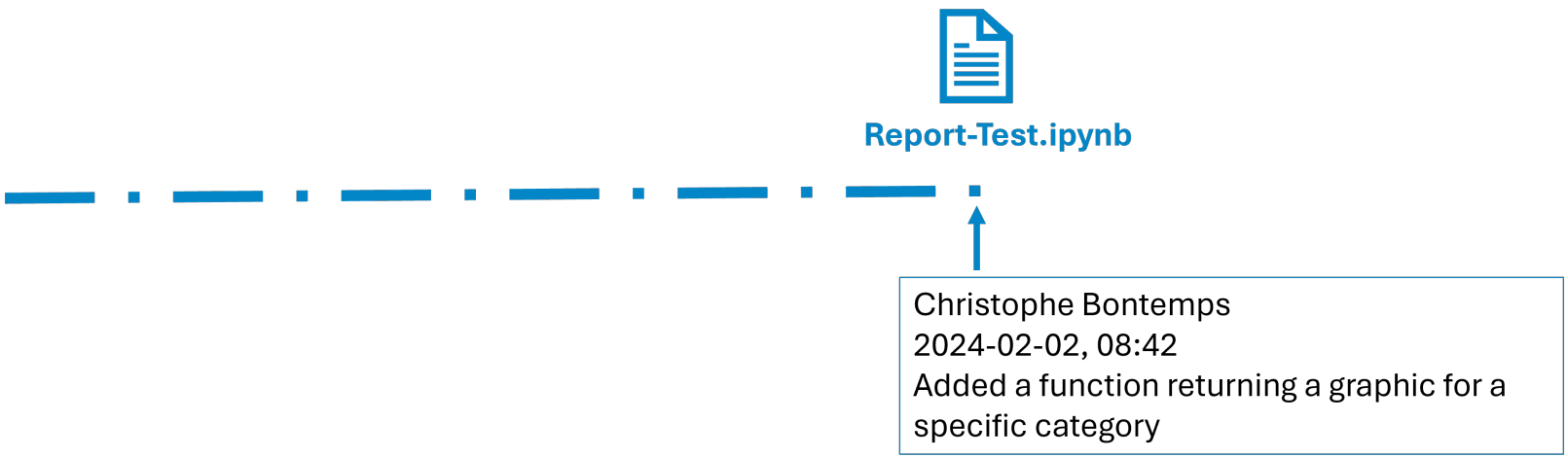

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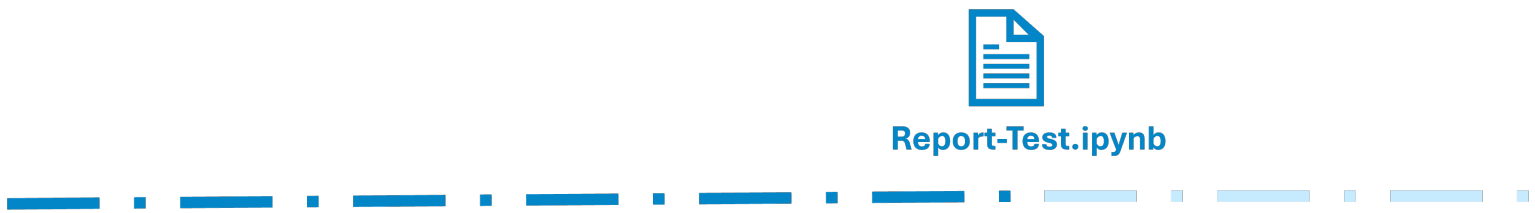

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Each version is documented (with *commits*)

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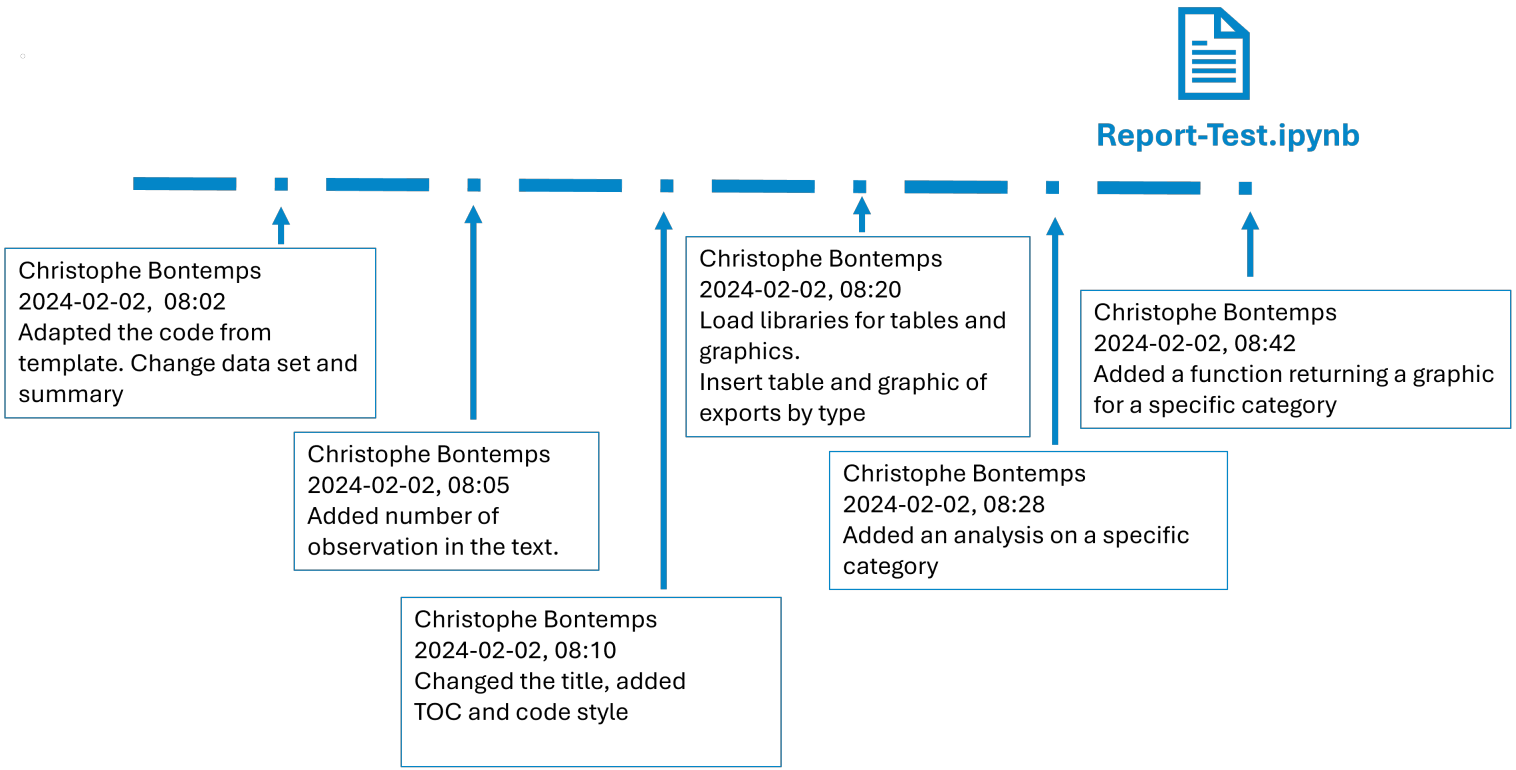
Each version embeds the full history!



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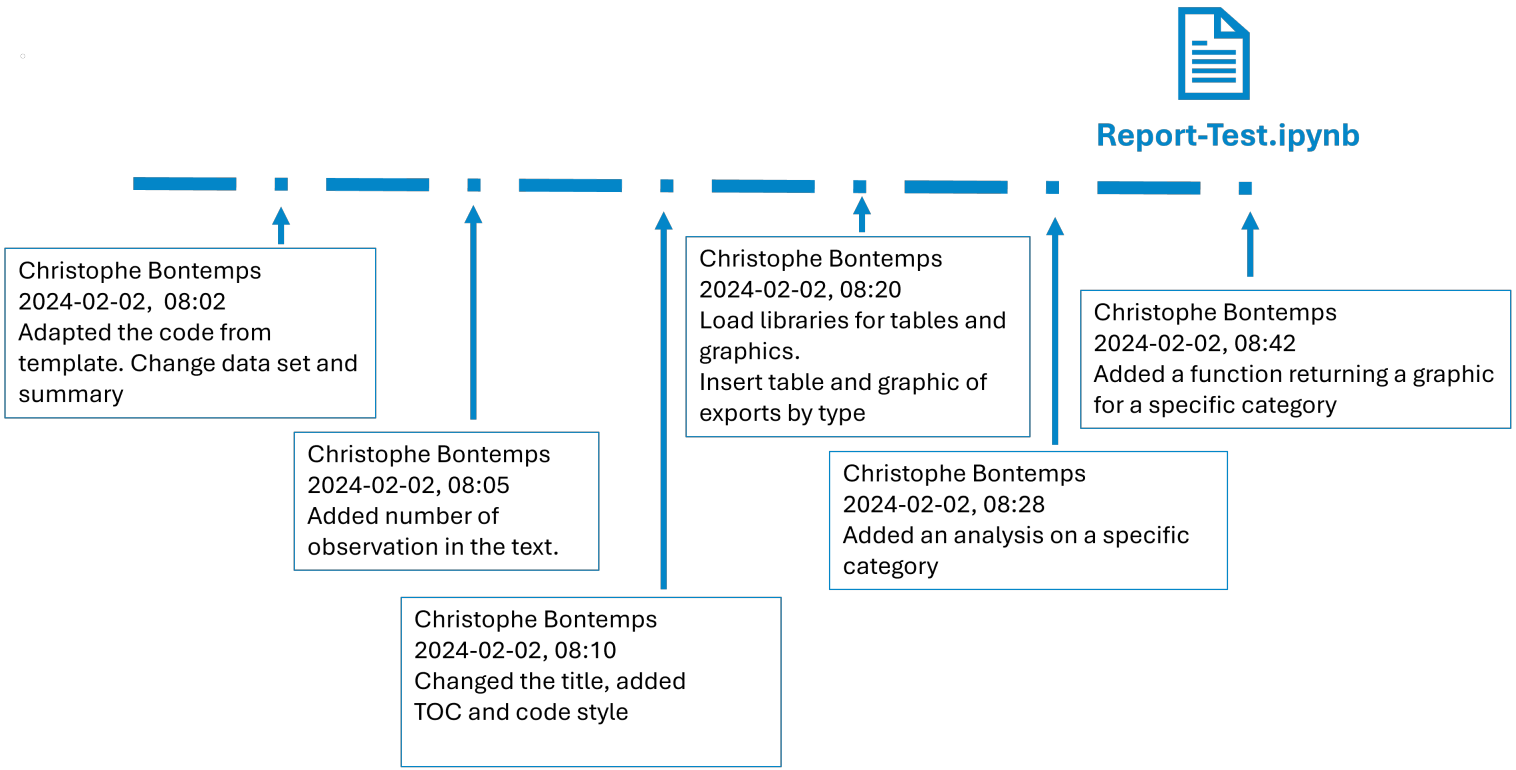
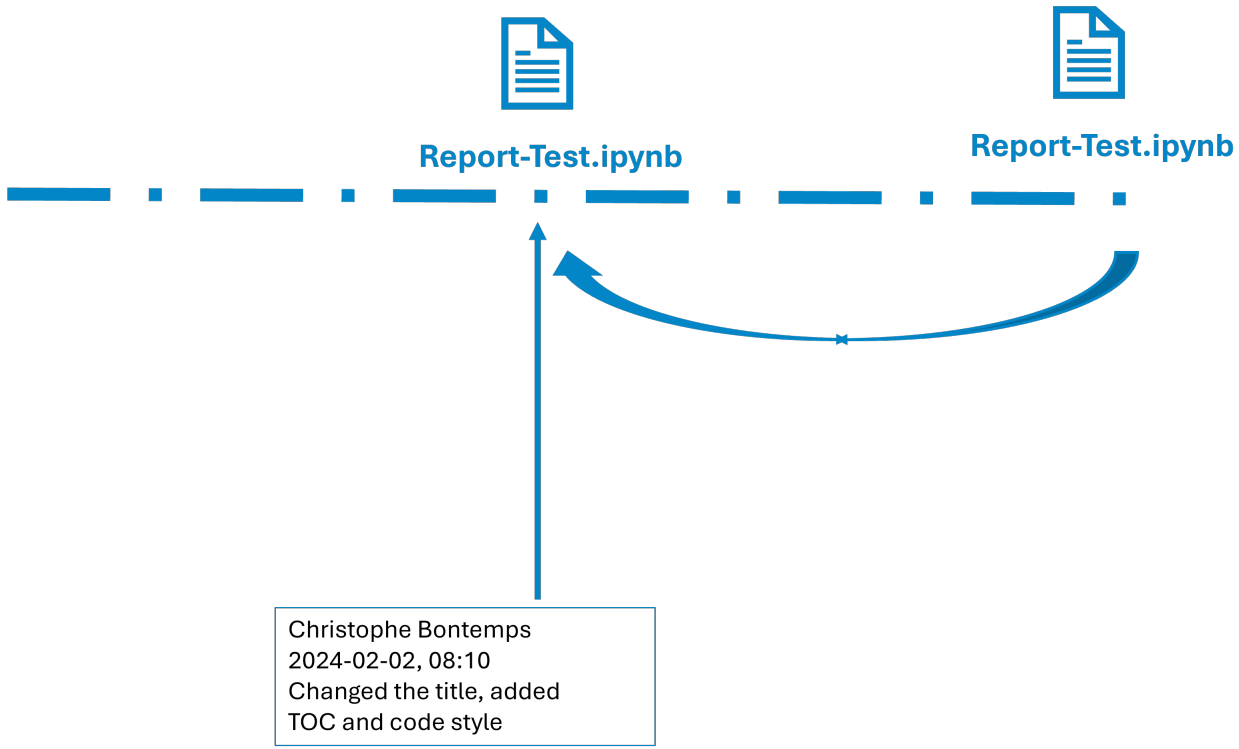


GOING BACK (*revert*) IS POSSIBLE

It is possible to review previous version...



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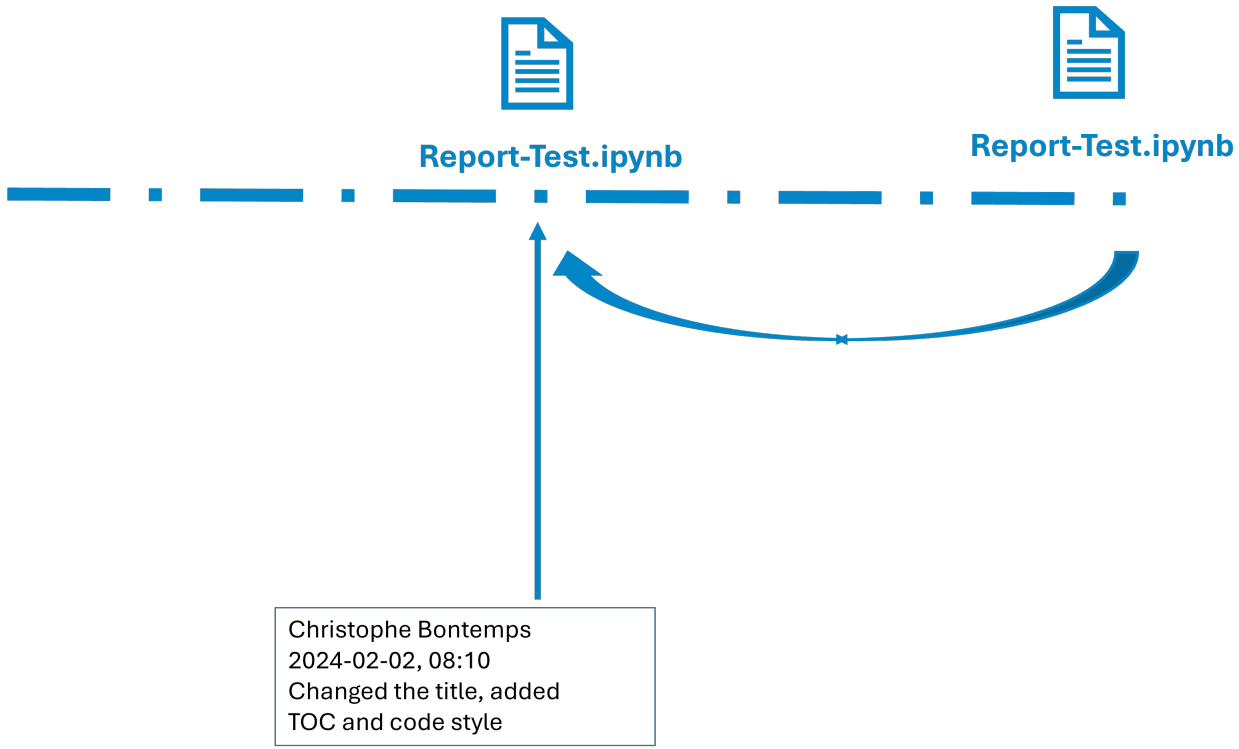

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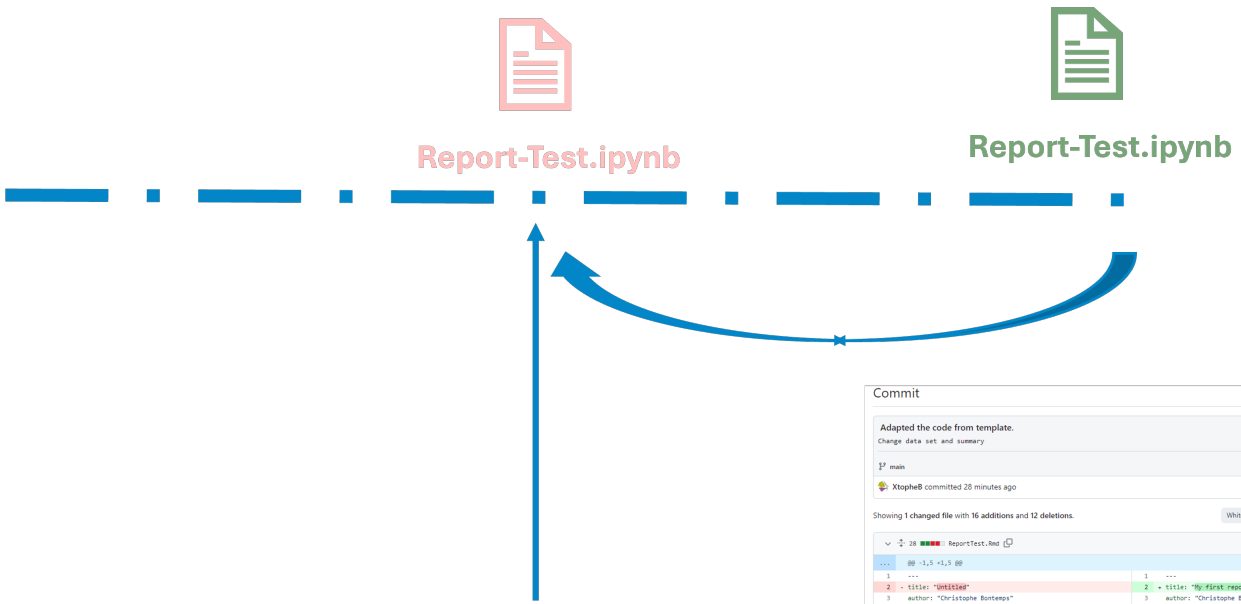

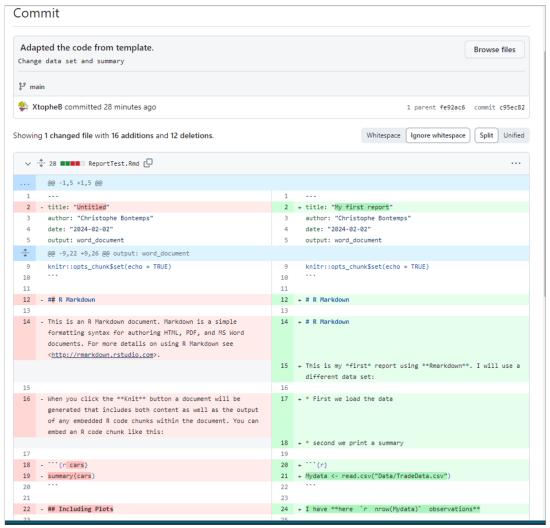

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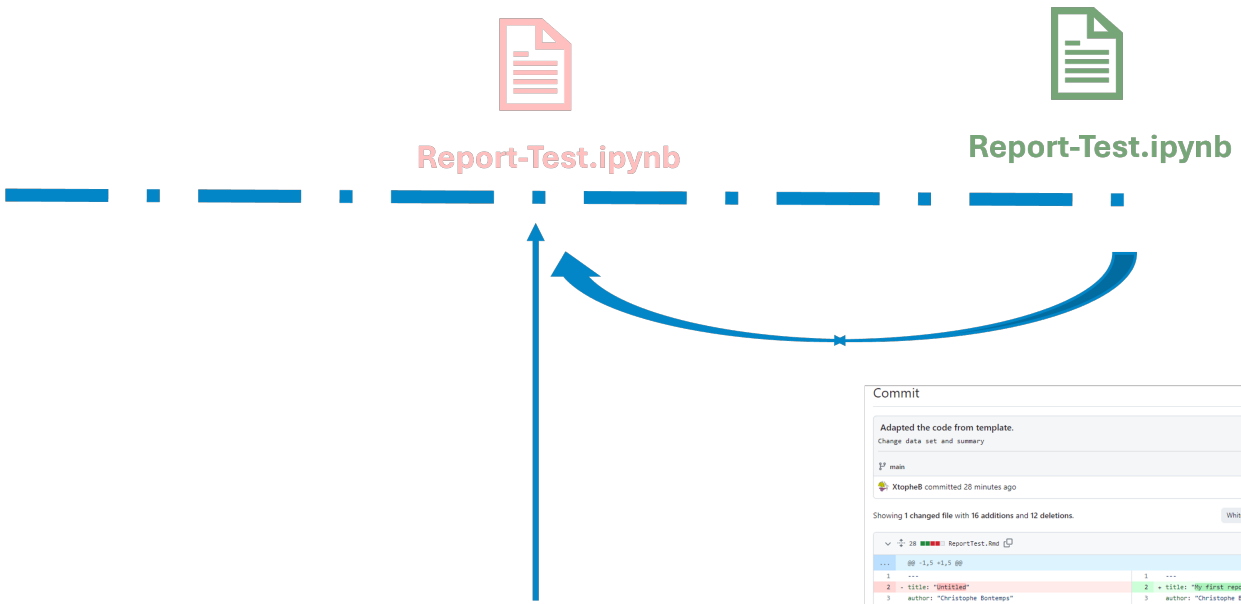

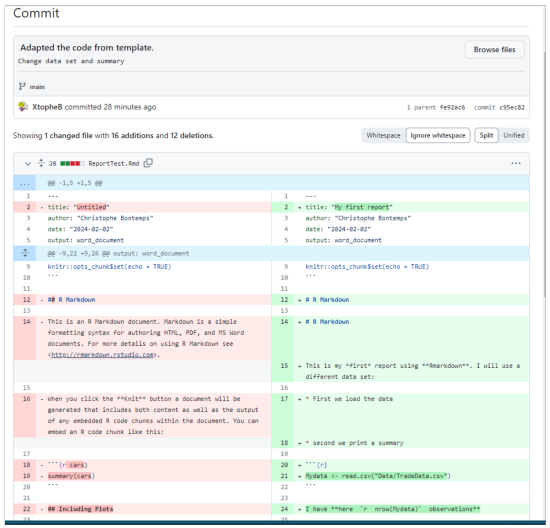

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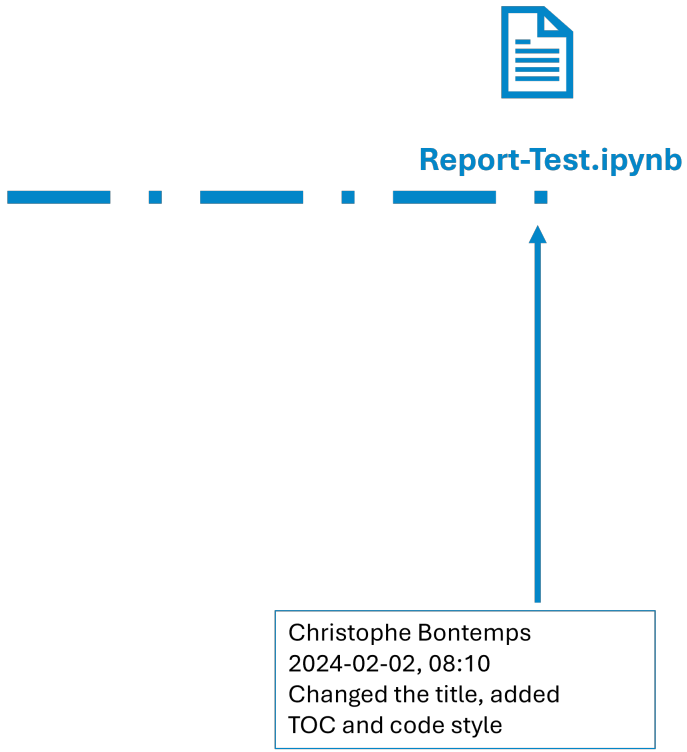

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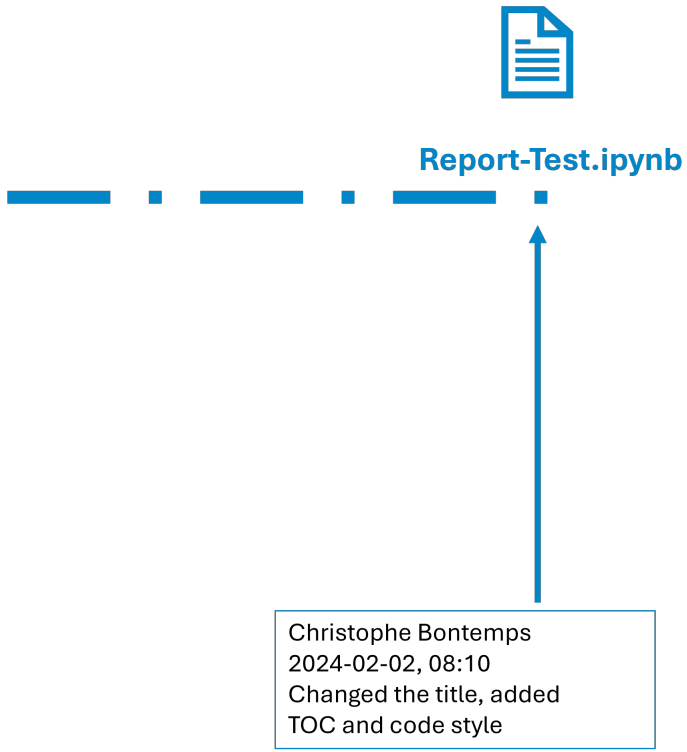

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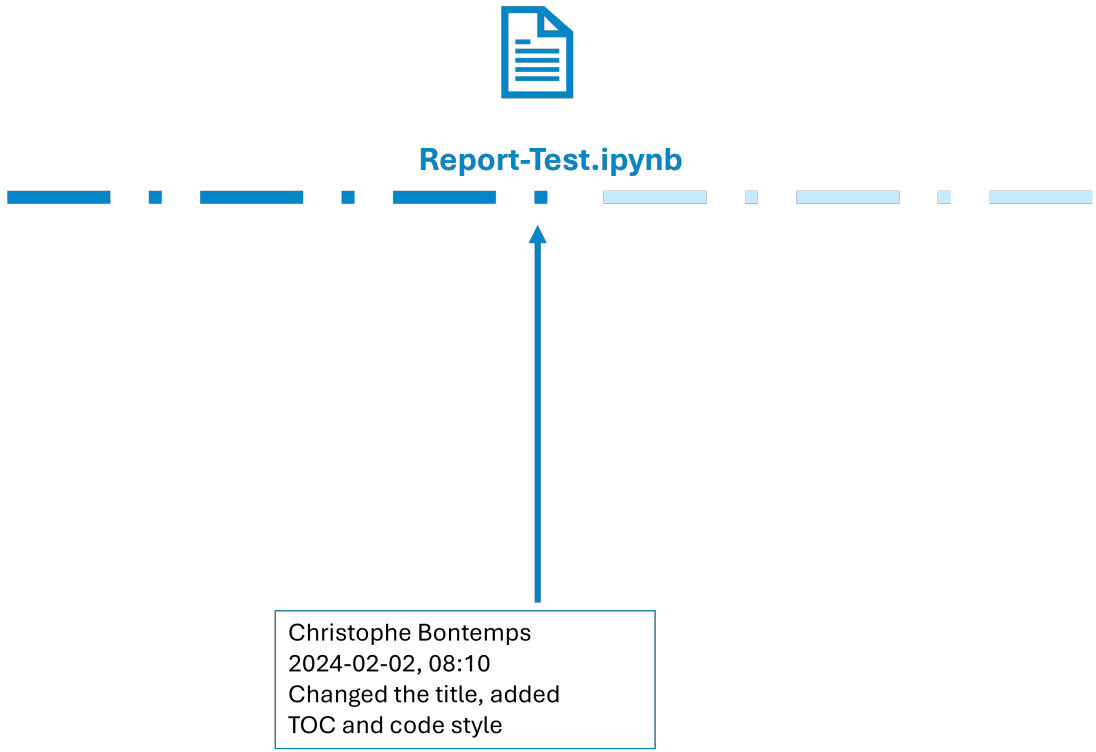

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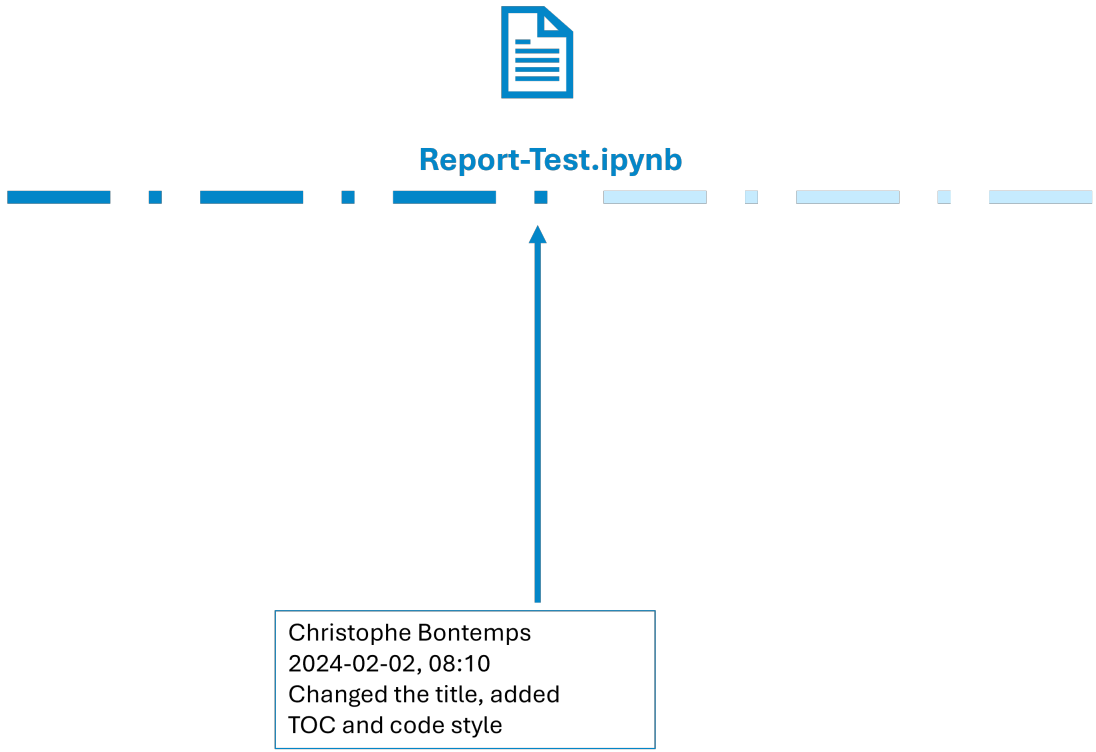

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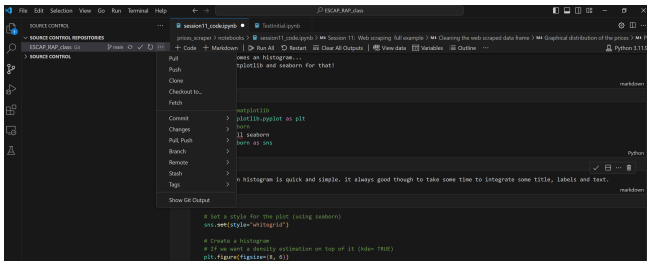

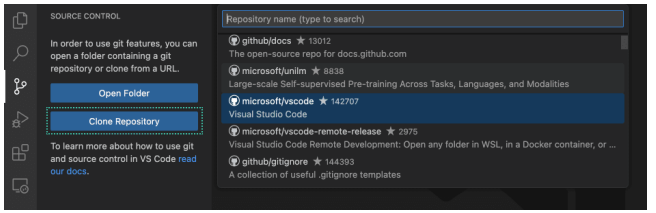

"Visual Studio Documentation"

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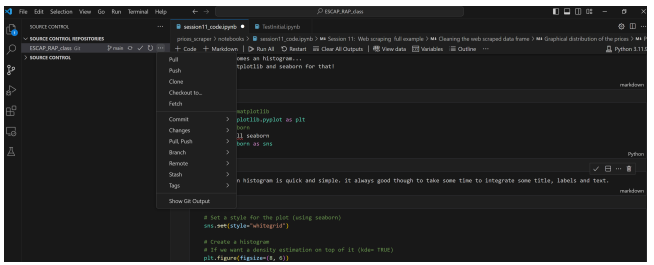

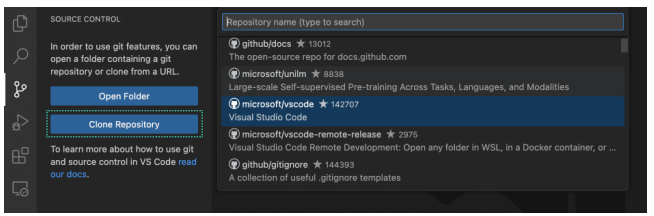

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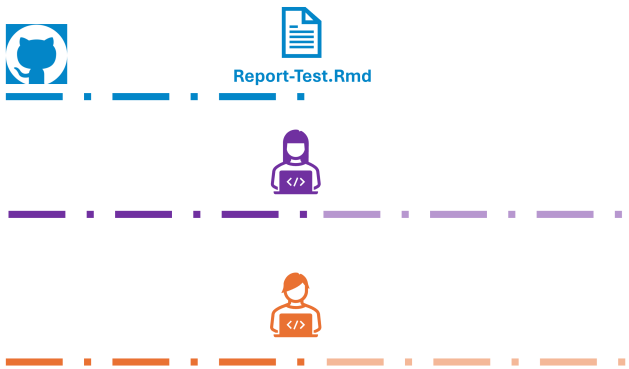

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- ↪ Simple operations are easy
- Collaborate on a project
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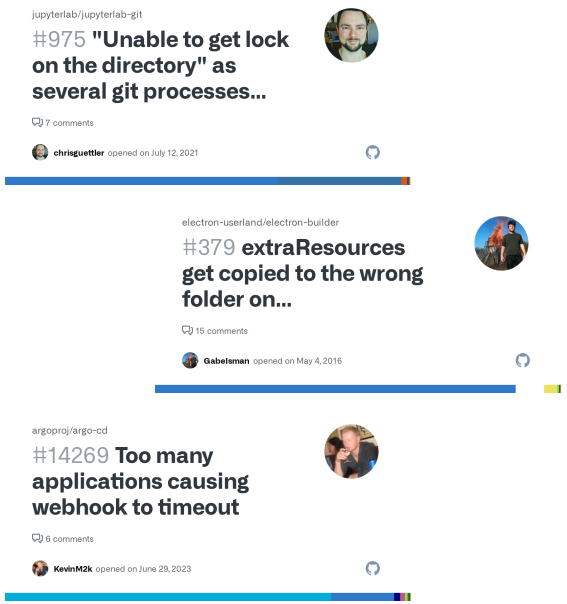

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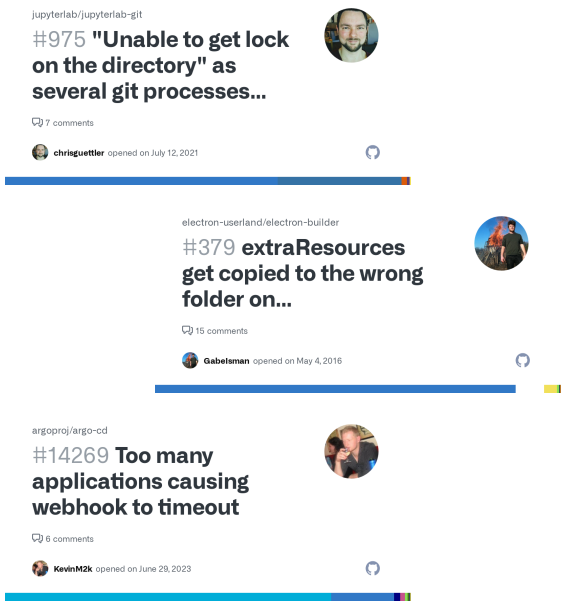

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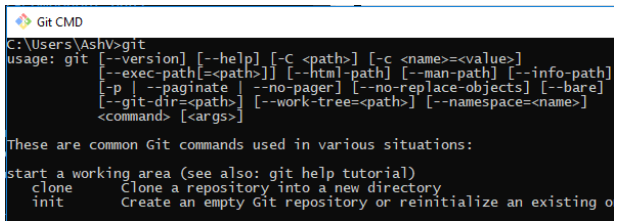

Ashish Vishwakarma

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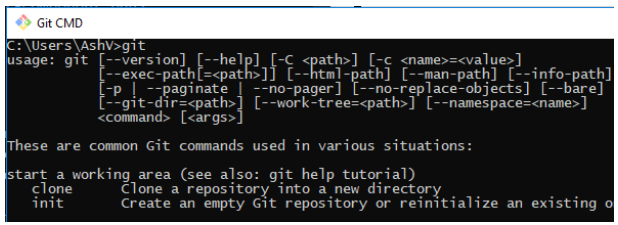

Ashish Vishwakarma

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GitHub logo

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Takeaways

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- Automate little by little
- Version control is a life-changer
- Building a RAP is a collective process

Useful resources

- NHS Community of Practice
- This course website (created by Serge Goussev)
- Vanuatu Bureau of Statistics implementation of RAP
- SIAP's (free) online RAP course
- The UK government RAP website.
- UK best practice documentation.
- A free RAP course to teach you all you need to know.
- How the Data Science Campus sets its coding standards.
- A new open-source book from the Alan Turing institute setting out how to do reproducible data science.