

TECHNICAL STUDY

DIGITAL TWINS

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DATA ANALYSIS

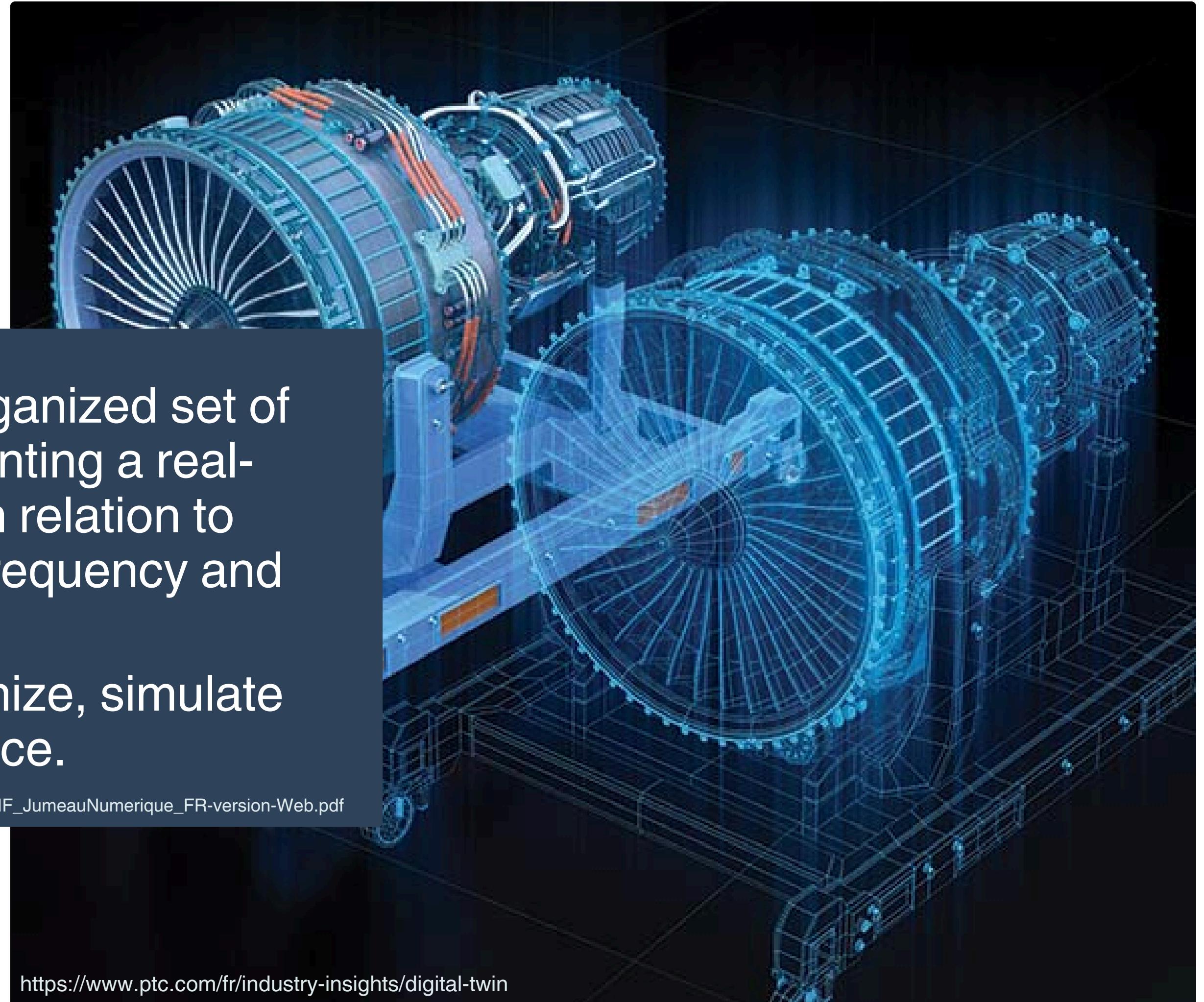
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CONCLUSION

What is a digital twin?

A Digital Twin is an organized set of digital models representing a real-world entity updated in relation to reality at an adapted frequency and precision.

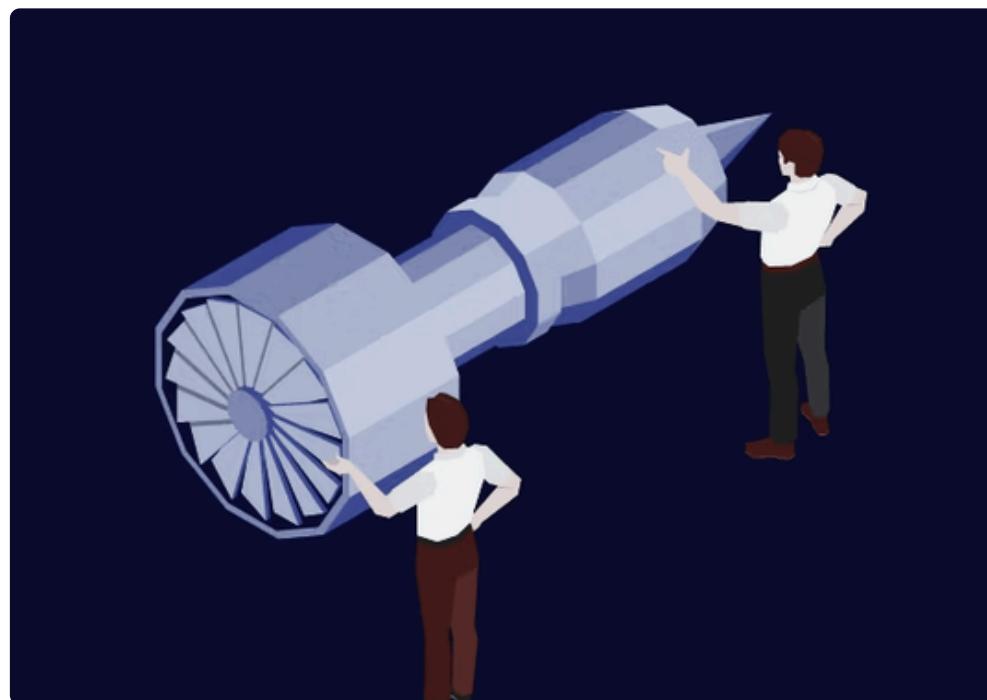
It can be used to optimize, simulate and predict performance.



AIF - http://www.industrie-dufutur.org/content/uploads/2023/05/AIF_JumeauNumerique_FR-version-Web.pdf

What is a digital twin?

THREE KEY POINTS



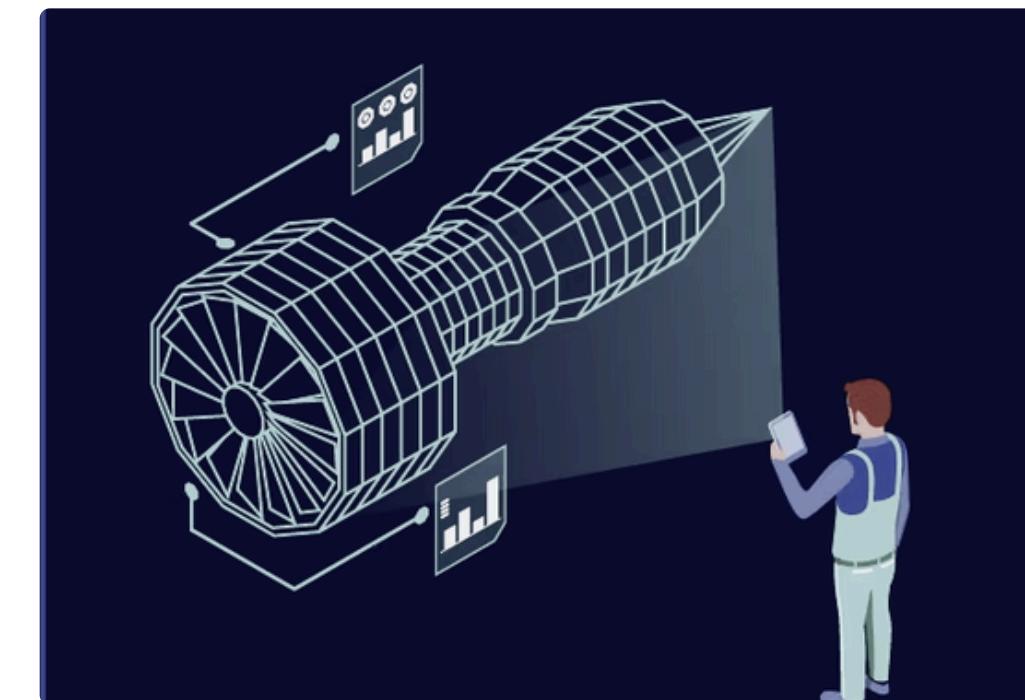
Real physical object

Industrial machine, building, vehicle,
human body...
+
IoT sensors that collect data
continuously.



Real-time data connection

IoT sensors and communication networks
+
Big Data and AI for predictions and
decisions



Digital twin

Computer model (2D, 3D or based on
advanced simulations)
+
Updated in real time with real-world data
+
Control action on real object

Example:

Submarine drone

A topical and particularly interesting subject

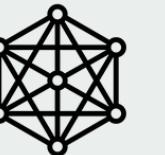


PHYSICAL OBJECT

Extreme/dangerous condition
that limits communication

+

Complex and costly
technology



DATA CONNECTION

A lot of complex metrics
+
Connection that depend
from context



DIGITAL TWIN

Many possible scenarios
when contact is lost
+
Several different usage
contexts



<https://www.indaily.com.au/news/science-and-tech/2023/12/19/the-devilishly-difficult-needs-of-naval-drones>

BENEFITS

Economy and safety

- Predictive maintenance
- Reducing downtime
- Optimizing resources

Advanced simulations

- Virtual tests
- Accelerated development

CHALLENGES

Complexity and cost

- Massive data volumes
- High initial investment
- Specialized skills required

Need for standardization

- Interoperability issues
- Lack of reference architecture

Aim of the technical study

FIND AND DEFINE THE FOUNDATIONS OF A COMMON BASE
FOR EMERGING DIGITAL TWIN TECHNOLOGY

Our objectives :

- ✓ **Create a database of existing projects**
 - ✓ Scrap repositories from GitHub
 - ✓ Scrap repositories from Software Heritage
 - ✓ Merge and synchronize the resulting data

- ✓ **Complete and analyze the data retrieved**
 - ✓ Identify and target important data
 - ✓ Use analytical resources to process our data
 - ✓ Identify trends in the development of digital twins

Repository scrapping

1 - GitHub

📌 Search GitHub repositories

- “digital twin” request
- Retrieves up to 1000 results
(GitHub limitation)

📌 Save data as CSV

- 1000 GitHub URL



Requests
http for humans

GitHub



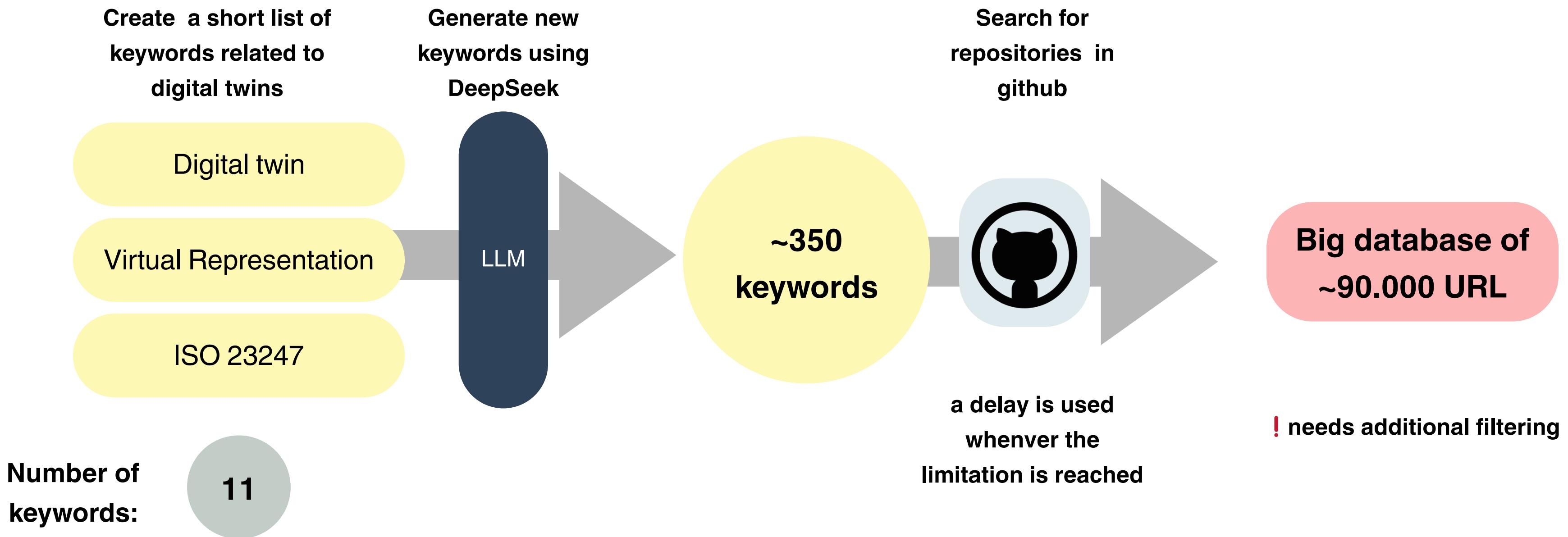
Rest API V3

 **pandas**



Repository scrapping

1.2 - tackle GitHub difficulties



Repository scrapping

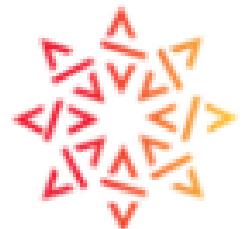
2 - Software Heritage (SH)

📌 Search SH repositories

- “digital twin” request on meta-data
- No result limitation

📌 Save data as CSV

- 1400 SH URL



Software Heritage



Repository scrapping

3 - Merge and synchronize the resulting data

📌 Identify duplicates between GitHub and Software Heritage

- 22 joint projects between the two databases

📌 Extracting GitHub URL from Software Heritage projects

- Retrieving GitHub URL
- Check that repositories are still accessible
- 740 new GitHub repositories recovered and added to the CSV



Data analysis

1 - Identify and target important data

- URL
- Name
- Description
- Stars
- Forks
- Contributors
- Commits
- Open Issues
- Language



GitHub

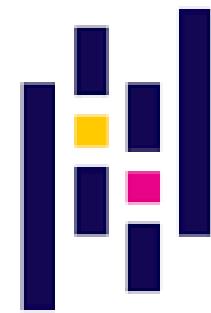


Rest API V3

	A	B	C	D	E	F	G	H	I
1	URL	Name	Description	Stars	Forks	Contributors	Commits	Open Issues	Language
2	https://github.com/facechain	FaceChain	is a	9277	868	30	30	14	Jupyter Notebook
3	https://github.com/meta2djs	The meta2d.js		835	251	13	30	20	TypeScript
4	https://github.com/ditto	Eclipse Ditto	â„“	715	232	30	30	84	Java
5	https://github.com/RoboTwin	RoboTwin: Dual		596	75	3	30	7	Python
6	https://github.com/luos/luos_engine	Open-source a		521	57	13	30	31	C
7	https://github.com/floor3d/floor3d	Your Home Digi		512	73	5	30	21	TypeScript

Data analysis

2 - Use analytical resources to process our data



pandas

matplotlib



seaborn

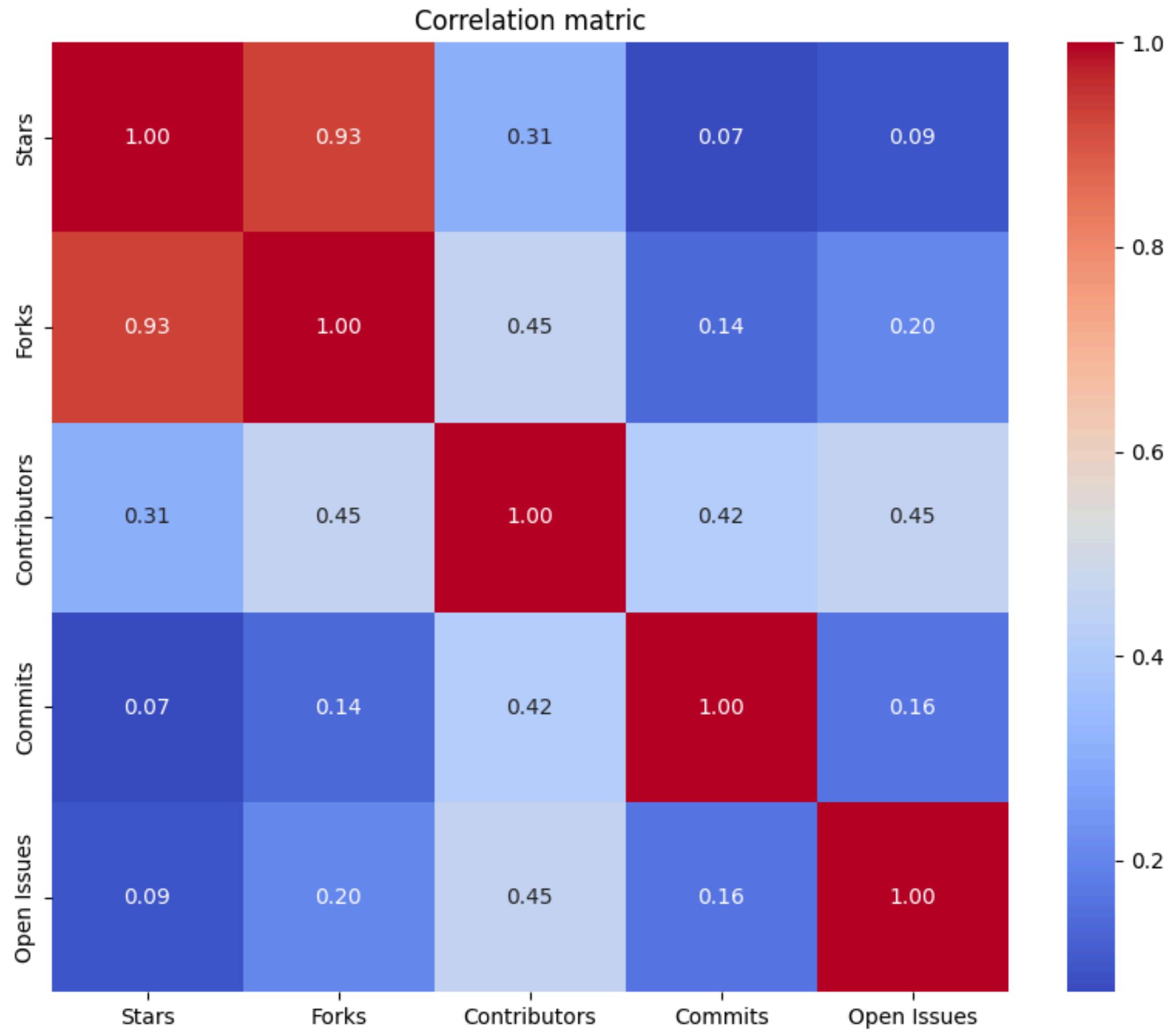
Data analysis

3 - Results

	Stars	Forks	Contributors	Commits	Open Issues
Count	1740.0	1740.0	1740.0	1740.0	1740.0
Mean	12.8	2.9	1.9	13.2	1.7
Std Dev	226.1	23.8	2.7	11.7	7.8
Min	0.0	0.0	0.0	0.0	0.0
25%	0.0	0.0	1.0	2.0	0.0
50%	1.0	0.0	1.0	8.0	0.0
75%	3.0	1.0	2.0	29.0	0.0
Max	9277.0	868.0	30.0	30.0	170.0

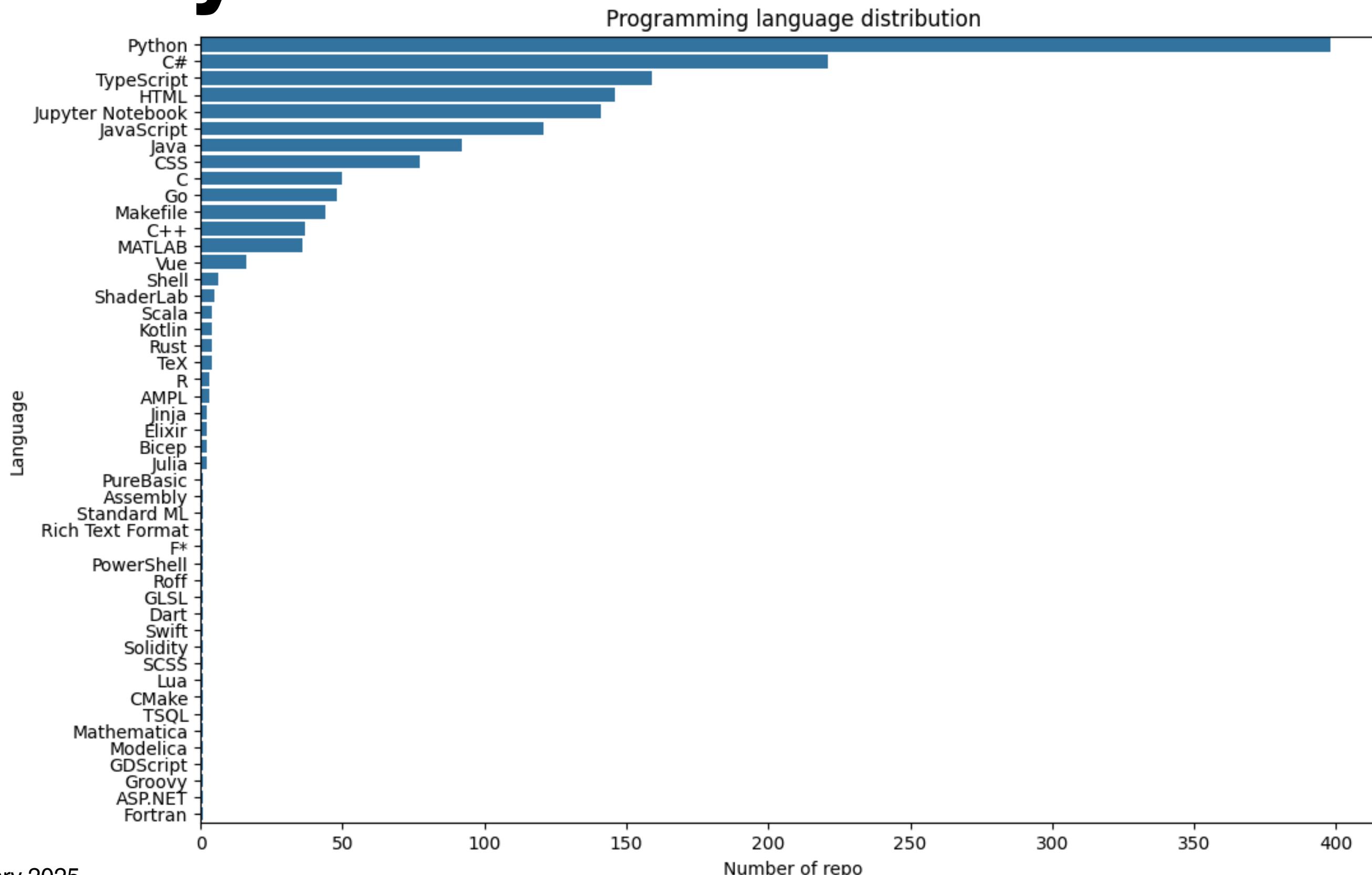
Data analysis

3 - Results



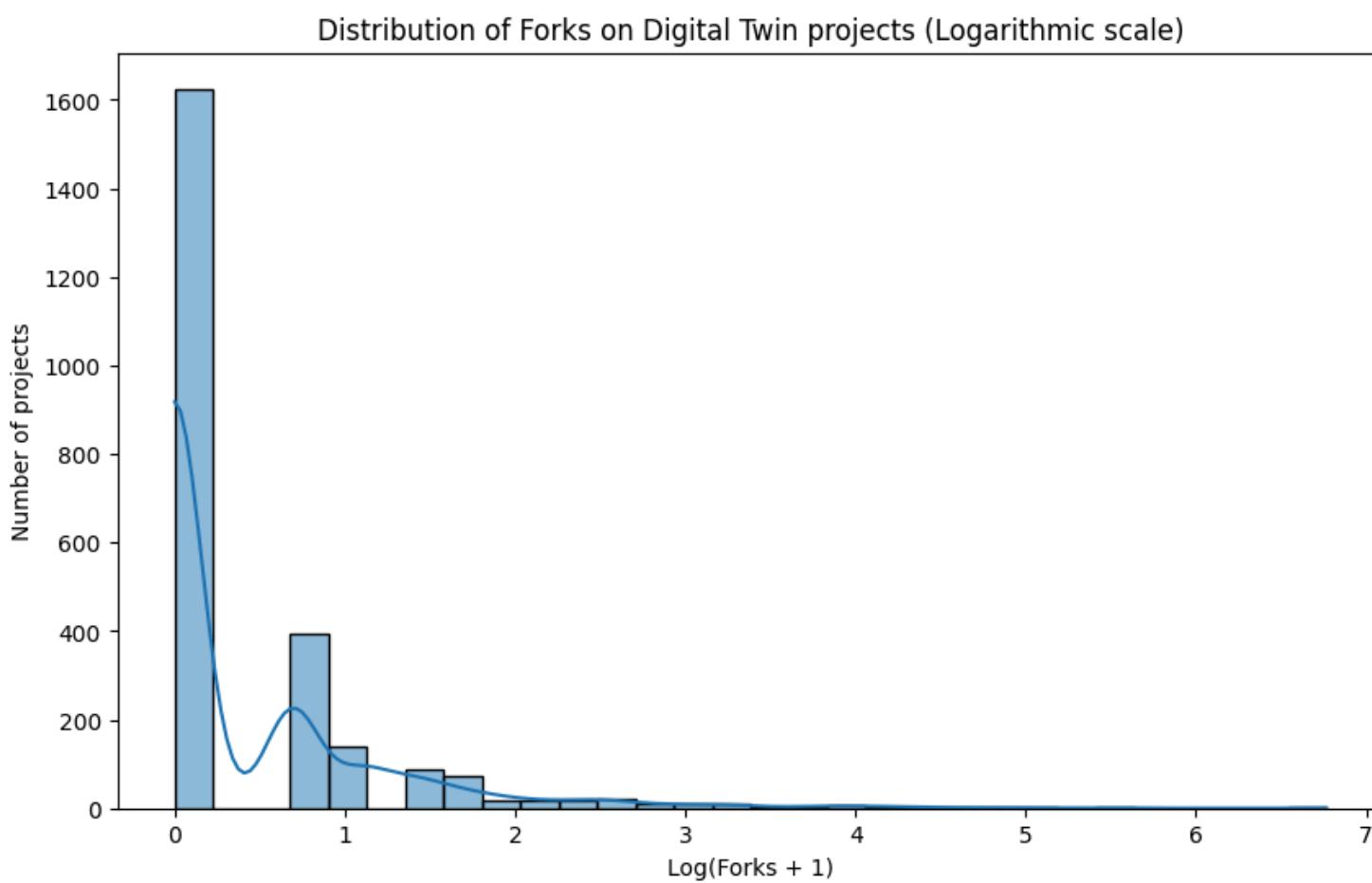
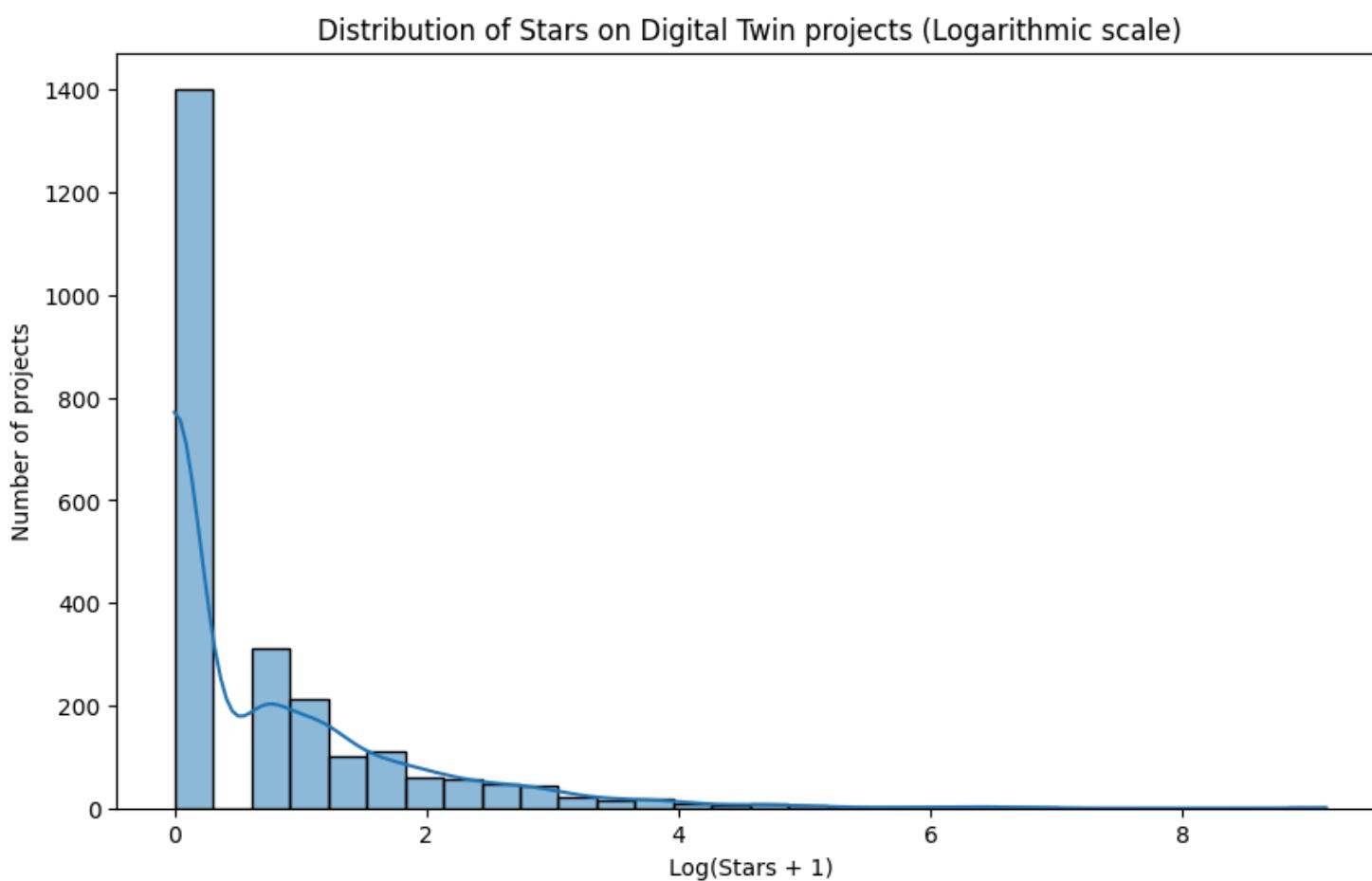
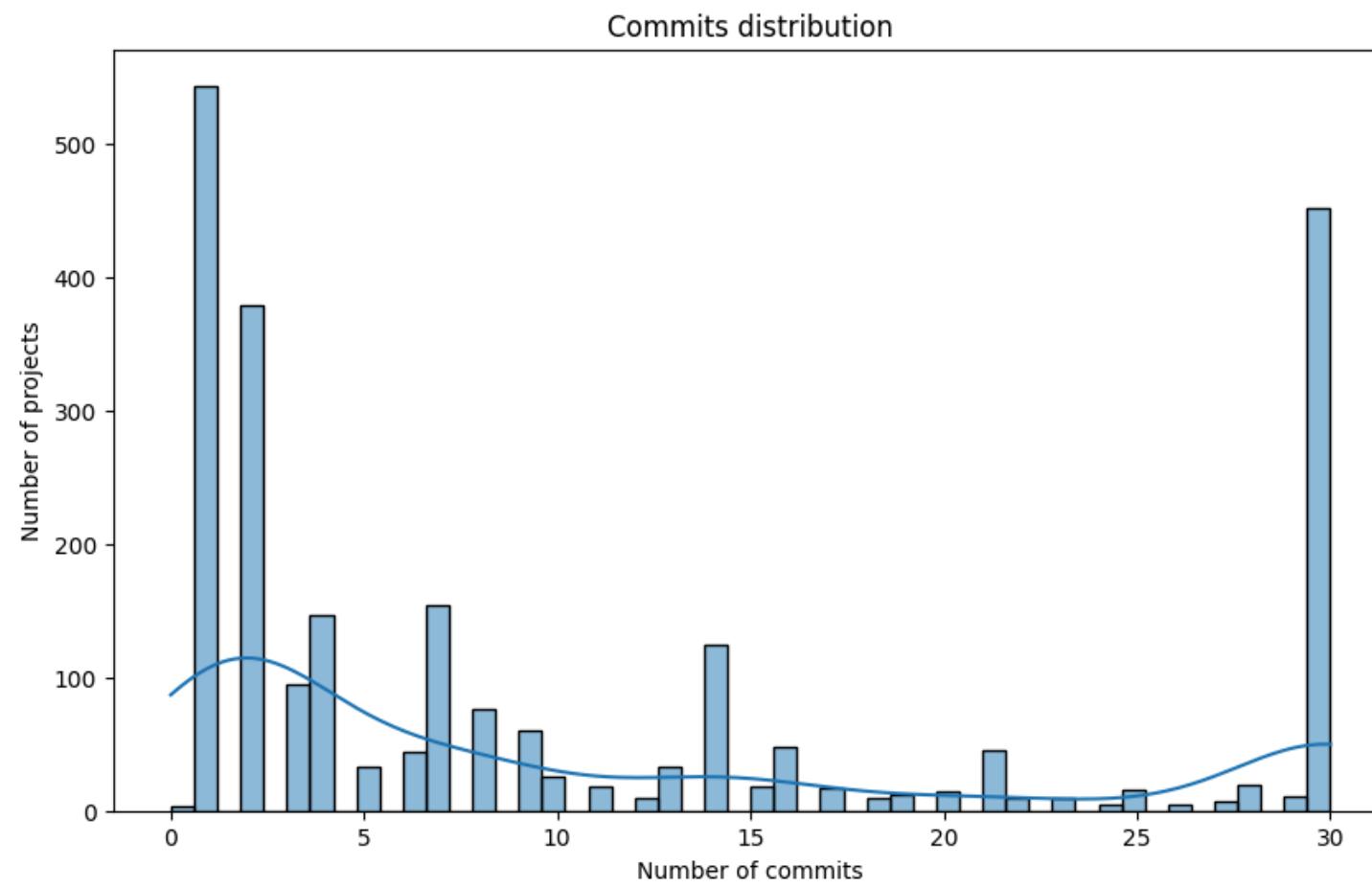
Data analysis

3 - Results



Data analysis

3 - Results



Conclusion

RESULTS

Create a database of existing projects

- ✓ Scrap repositories from GitHub
- ✓ Scrap repositories from Software Heritage
- ✓ ! Merge and synchronize the resulting data

Complete and analyze the data retrieved

- ✓ ! Identify and target important data
- ✓ Use analytical resources to process our data
- ✗ Identify trends in the development of digital twins

Conclusion

OUTLOOKS

- Get more data from GitHub
 - from more repositories
 - tags, type of contributor...
- Find a way to standardize projects to make them comparable
 - convert to DTDL

Azure/opendigitaltwins-dtdl

Digital Twins Definition Language

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Contributors

32

Issues

499

Stars

168

Forks