Towards a Software Pillar for Open Science

from policy to implementation

Roberto Di Cosmo

Chair, Software Chapter, National Committee for Open Science
Director, Software Heritage
Inria and Université de Paris Cité

September 9th 2022

Software Heritage

THE GREAT LIBRARY OF SOURCE CODE

Outline

Open Science: what it is, and why we want it

Open Science (Second National Plan for Open Science, France, 2021)

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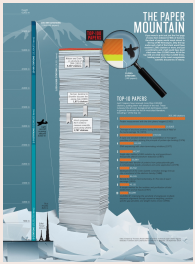
Yuval Noah Harari (on COVID 19)

"The real antidote [to epidemic] is scientific knowledge *and* global cooperation."

Software is a pillar of Open Science

Software powers modern research



[…] software […] essential in their fields.
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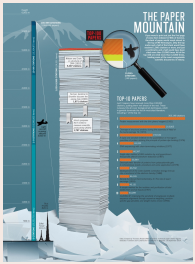

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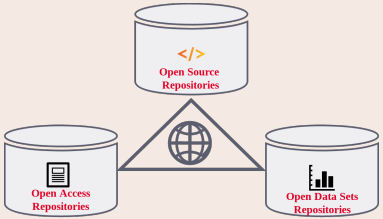

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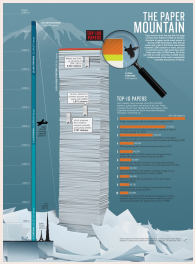

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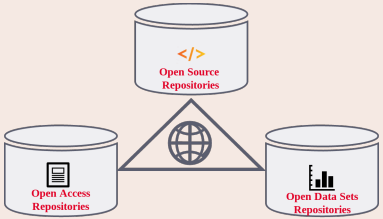

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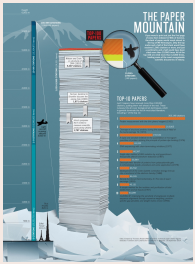

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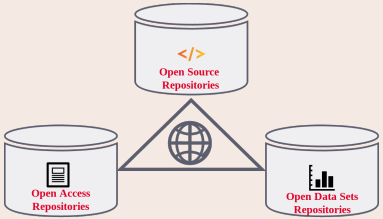

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Nota Bene

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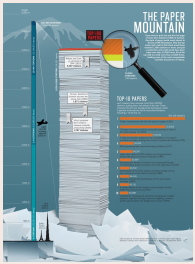

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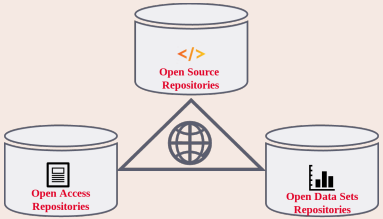

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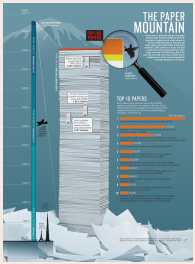

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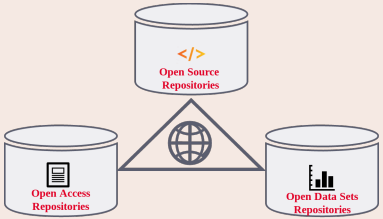

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Preserving (the history of) source code is necessary for *reproducibility*

Software *Source Code* is Precious Knowledge

Harold Abelson, Structure and Interpretation of Computer Programs (1st ed.) 1985

"Programs must be written for people to read, and only incidentally for machines to execute."

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Apollo 11 source code (excerpt)

```
P63SPOT3        CA      BIT6            # IS THE LR ANTENNA IN POSITION 1 YET
                EXTEND
                RAND    CHAN33
                EXTEND
                BZF     P63SPOT4        # BRANCH IF ANTENNA ALREADY IN POSITION 1

                CAF     CODE500         # ASTRONAUT:    PLEASE CRANK THE
                TC      BANKCALL        #               SILLY THING AROUND
                CADR    GOPERF1
                TCF     GOTOPOOH        # TERMINATE
                TCF     P63SPOT3        # PROCEED       SEE IF HE'S LYING

P63SPOT4        TC      BANKCALL        # ENTER         INITIALIZE LANDING RADAR
                CADR    SETPOS1

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Quake III source code (excerpt)

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float Q_rsqrt( float number )
{
    long i;
    float x2, y;
    const float threehalfs = 1.5F;

    x2 = number * 0.5F;
    y = number;
    i = * ( long * ) &y; // evil floating point bit level hacking
    i = 0x5f3759df - ( i >> 1 ); // what the fuck?
    y = * ( float * ) &i;
    y = y * ( threehalfs - ( x2 * y * y ) ); // 1st iteration
// y = y * ( threehalfs - ( x2 * y * y ) ); // 2nd iteration, this
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    return y;
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Len Shustek, Computer History Museum 2006

"Source code provides a view into the mind of the designer."

Outline

International highlights

Paris Call on Software Source code (2019, UNESCO)

40 international experts call to *"promote software development as a valuable research activity, and research software as a key enabler for Open Science/Open Research, [...] recognising in the careers of academics their contributions to high quality software development, in all their forms"*

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UNESCO recommendations for Open Science, 2018-2021

"The source code must be included in the software release and […] the license must allow modifications, derivative works and sharing […]"
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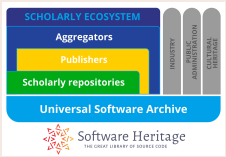

- connect scholarly ecosystem via Software Heritage
- use open non profit infrastructures
- open source first: *"all research software should be made available under an Open Source license by default"*

French National plan for Open Science, 2021-2024

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DE L'ENSEIGNEMENT
SUPÉRIEUR,
DE LA RECHERCHE
ET DE L'INNOVATION

Liberté
Égalité
Fraternité

SECOND FRENCH PLAN FOR OPEN SCIENCE

Generalising open science in France 2021-2024

1

Launch on 6 July 2021 by Frédérique Vidal, Minister for Higher Education, Research and Innovation

- Multiplying the **levers for change** in order to **generalise open science practices**
- Structuring the **policy for opening up or sharing research data**
- New commitments to the **opening of source code** produced by research
- **European and international inclusion** in the context of the French Presidency of the European Union
- **Disciplinary and thematic variations**: open science policies must be adapted to disciplinary specificities

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Path Three :

Opening up and promoting source code produced by research

7 **Recognize and support the dissemination under an open source license of software** produced by publicly funded research programmes

8 **Highlight the production of source code** from higher education, research and innovation

9 Define and promote an **open source software policy**

« The opening of software source code is a major challenge for the **reproducibility** of scientific results. »

« Distribution of software products under **open source licence** will be preferred. »

3

MINISTÈRE
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Define and promote an open source software policy

- Produce a **National Charter for Open Source Software** coming from higher education, research and innovation
- Develop the **link between data and software** through a network of **Chief Data Officers** in the various universities and research performing organisations.
- Develop the **economic models of open source software** and make them known within commercialization services
- **Support Software Heritage** and recommend it for the archiving and referencing of source code

Recognise source code as a contribution to research

- Create an **open source research software prize**
- **Provide greater recognition** for software production in the career of researchers, research support staff

Build an ecosystem that connects code, data and publications

- Develop **proper coordination** between software forges, open publication archives, data repositories and the scientific publishing sector.

4

Software Chapter in the CoSO

Five action lines

- Identifying and highlighting research software production
- Technical and social tools and best practices
- Valorization and sustainability
- Liaison and animation at national, European, and international levels
- Recognition and careers

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- Collaboration with DINUM, Eclipse Foundation, OW2, …

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The Open Science award for Open Source research software

See the official page at MESRI

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What is at stake

ARDC

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- Reference for identification (*reproducibility*)
- Describe for discovery and reuse
- Cite/Credit for credit and evaluation

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Let's focus on ARDC and infrastructures

Forges are *not* archives!

2015: the first big bad news

Google Code and Gitorious.org shutdown: ~1M endangered repositories

- broken links in the web of knowledge (my papers too)

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Preserving our heritage, enabling better software and better science for all

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Research infrastructure

enable analysis of all software source code

The largest software archive, a shared infrastructure

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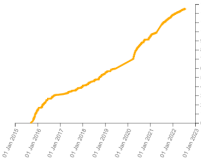
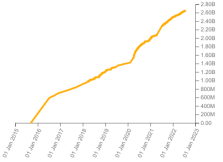
Cultural Heritage | Industry | Research | Public Administration

Software Heritage

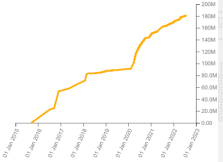
Source files
12,538,666,608



Commits
2,654,066,174



Projects
181,249,577



Directories
10,342,140,231

Authors
48,778,458

Releases
33,580,610

Sharing the vision

And many more ...

www.softwareheritage.org/support/testimonials

Sharing the vision

United Nations Educational, Scientific and Cultural Organization

And many more ...

www.softwareheritage.org/support/testimonials

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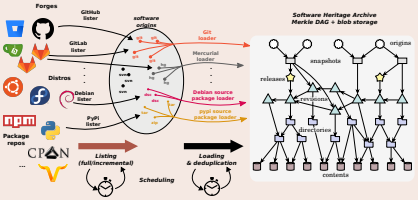
Addressing the four needs (see ICMS 2020 for details)

Archive (12B+ files, 170M+ projects)



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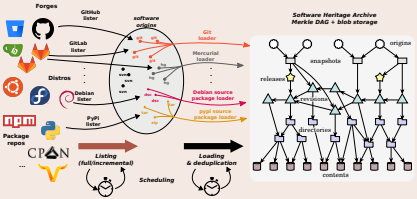

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Addressing the four needs (see ICMS 2020 for details)

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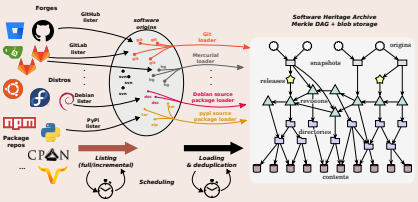

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Reference (20 billion SWHIDs)

Intrinsic, decentralised, cryptographically strong identifiers, SWHIDs

Now supported in SPDX 2.2, Wikidata etc.

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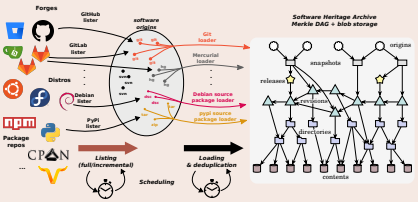

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Describe

- *Intrinsic metadata* from source code
- Contributed the Codemeta generator

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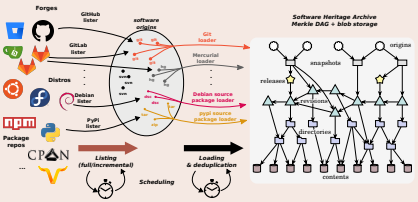

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Describe

- *Intrinsic metadata* from source code
- Contributed the Codemeta generator

Cite/Credit

- Contributed *software citation* style biblatex-software, v 1.2-2 now on CTAN

Outline

Open Science is growing, and Software is part of it

A working agenda for the Software Pillar of Open Science

- avoid proprietarisation: set the default to open
  - *publicly funded research software should be open source*, exceptions must be justified
  - set up institutional support
  - build common knowledge base for technology transfer offices
- establish intelligent and effective incentives
  - count quality software contributions in careers, avoid purely numerical indicators, keep the human in the loop (mind Goodhart's law)
- avoid balkanisation, support mutualised common infrastructures
  - build on common, shared, open, non profit infrastructures, like Software Heritage
  - acknowledge the predominant human component of digital infrastructures
    - recurrent funding of their cost
    - proper evaluation of their service

Learn more

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