

Software Heritage

preserving our software commons

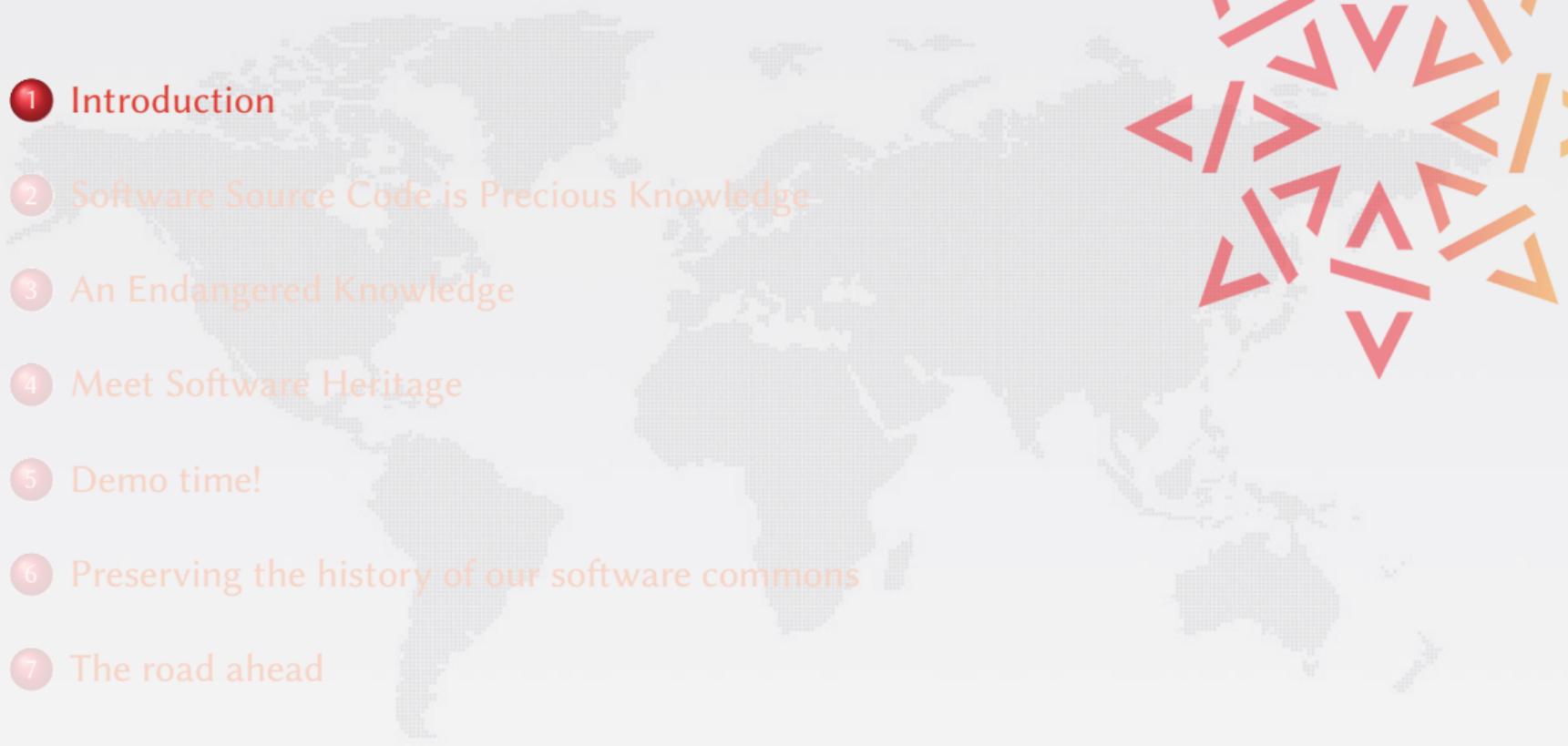
Roberto Di Cosmo
Inria and Université de Paris

18 June 2021
RESAW 2021 Keynote



Software Heritage

THE GREAT LIBRARY OF SOURCE CODE

- 
- 1 Introduction
 - 2 Software Source Code is Precious Knowledge
 - 3 An Endangered Knowledge
 - 4 Meet Software Heritage
 - 5 Demo time!
 - 6 Preserving the history of our software commons
 - 7 The road ahead



Short Bio: Roberto Di Cosmo

Computer Science professor in Paris, now working at INRIA

- 30 years of research (Theor. CS, Programming, Software Engineering, Erdos #: 3)
- 20 years of Free and Open Source Software
- 10 years building and directing structures for the common good



1999 *DemoLinux* – first live GNU/Linux distro

2007 *Free Software Thematic Group*

150 members 40 projects 200Me

2008 *Mancoosi project* www.mancoosi.org

2010 *IRILL* www.irill.org

2015 *Software Heritage* at INRIA

2018 *National Committee for Open Science*, France



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What is *Source Code*?



"The source code for a work means the preferred form of the work for making modifications to it."

GPL Licence

Hello World

Program (excerpt of binary)

```
4004e6: 55  
4004e7: 48 89 e5  
4004ea: bf 84 05 40 00  
4004ef: b8 00 00 00 00  
4004f4: e8 c7 fe ff ff  
4004f9: 90  
4004fa: 5d  
4004fb: c3
```

Program (source code)

```
/* Hello World program */  
  
#include<stdio.h>  
  
void main()  
{  
    printf("Hello World");  
}
```

Software *Source Code* matters

Key mediator for accessing all information (c) Banski



Information is a main pillar of our modern societies.

Absent an ability to correctly interpret digital information, we are left with [...] "rotting bits" [...] of no value.

Vinton G. Cerf IEEE 2011

Software is an essential component of modern scientific research



[...] the vast majority describe experimental methods or software that have become essential in their fields.

Top 100 papers (Nature, October 2014)

Sometimes, if you dont have the software, you dont have the data

Christine Borgman, Paris, 2018

Sofware embodies our Knowledge and Cultural Heritage

Software *Source Code* is part of our cultural heritage

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.”

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

TC       POSTJUMP    # OFF TO SEE THE WIZARD ...
CADR     BURNBABY
```

Quake III source code (excerpt)

```
float Q_rsqrt( float number )
{
    long i;
    float x2, y;
    const float threehalves = 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 * ( threehalves - ( x2 * y * y ) ); // 1st iteration
    // y = y * ( threehalves - ( x2 * y * y ) ); // 2nd iteration, this
    can be removed

    return y;
}
```

Len Shustek, Computer History Museum

“Source code provides a view into the mind of the designer.”

Definition (Commons)

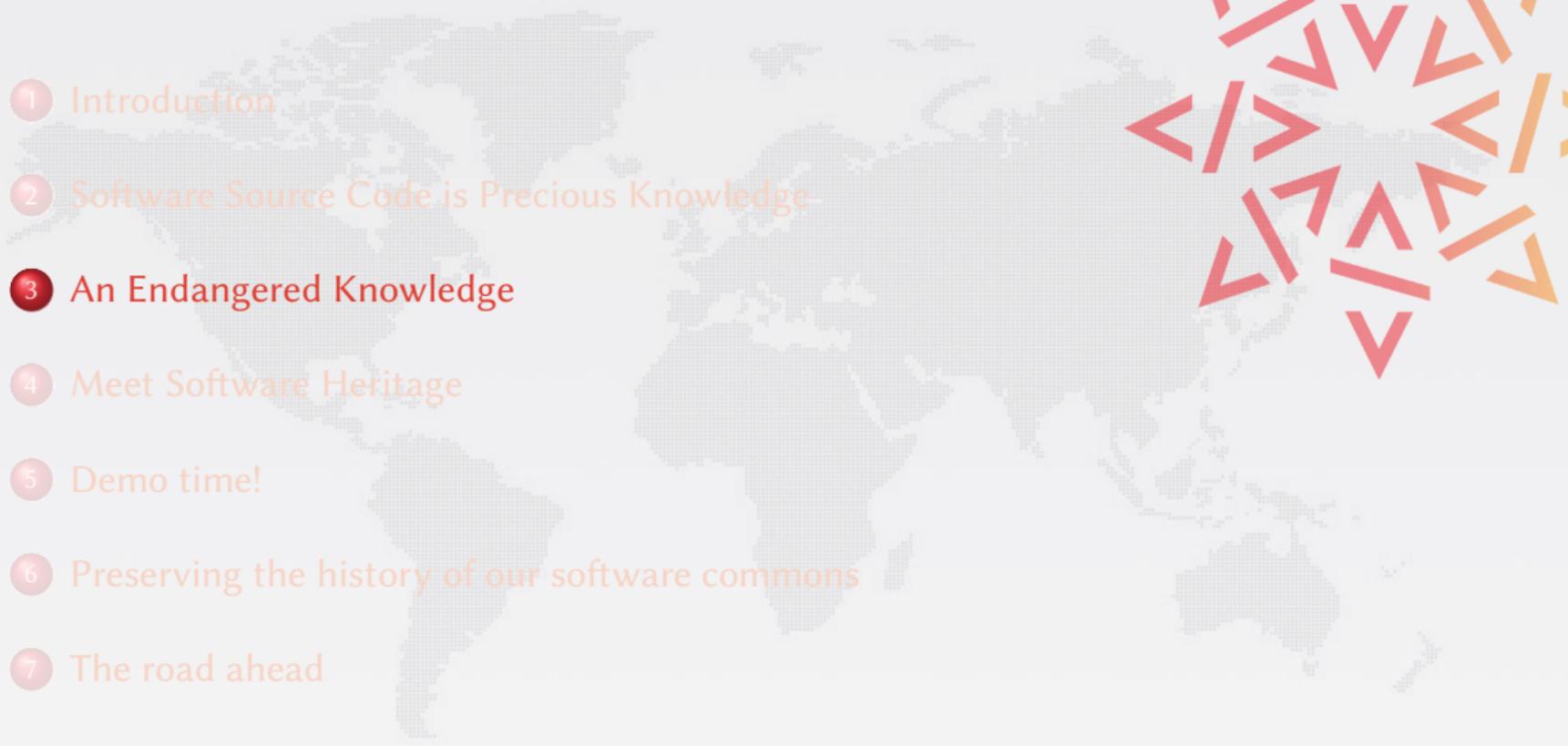
The **commons** is the cultural and natural resources accessible to all members of a society, including natural materials such as air, water, and a habitable earth. These resources are held in common, not owned privately. <https://en.wikipedia.org/wiki/Commons>

Definition (Software Commons)

The **software commons** consists of all computer software which is available at little or no cost and which can be altered and reused with few restrictions. Thus *all open source software and all free software are part of the [software] commons.* [...]

https://en.wikipedia.org/wiki/Software_Consmons

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Spread all around



Fashion victims

- many disparate development platforms
- a myriad places where distribution may happen
- projects tend to migrate from one place to another over time

One place...

... where can we find, track and search *all* source code?



Like all digital information, FOSS is fragile

- inconsiderate and/or malicious code loss (e.g., Code Spaces)
- business-driven code loss (e.g., Gitorious, Google Code, Bitbucket)
- for obsolete code: physical media decay (data rot)

If a website disappears you go to the Internet Archive...

where do you go if (a repository on) GitHub or GitLab goes away?
and what about all the landmark legacy source code that is rotting away?

We are at a turning point

Looking at the past

- a lot of old software misplaced, lost, or behind barriers, but...
- most founding fathers are still here, and willing to share
- **urgent** to collect their knowledge

Only a few years left.

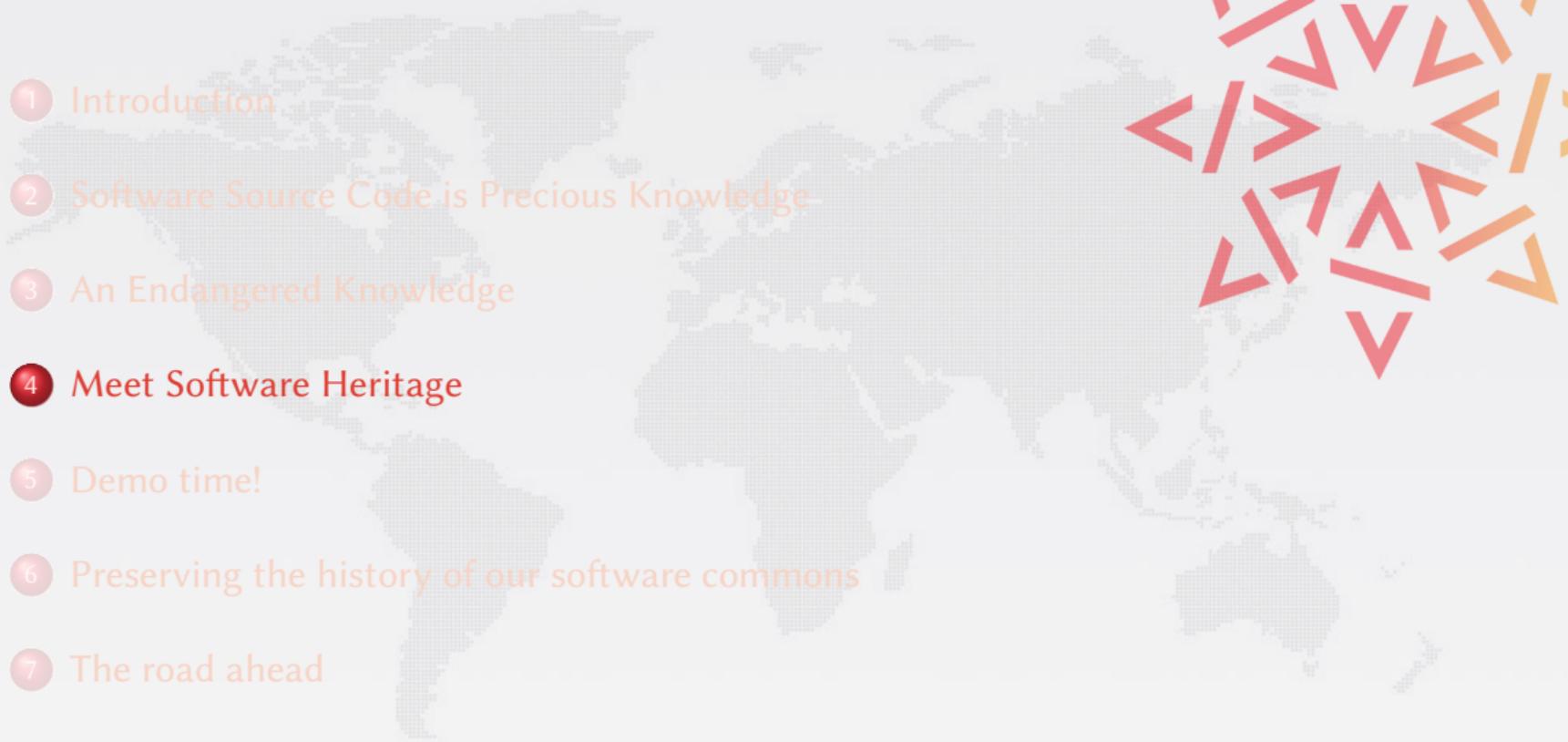
Looking at the future

- software development and use skyrockets: more programmers, and more code!
- **essential** to provide a **universal** platform for all the future software source code

Every year that goes by makes the problem worse.

it is **urgent** to take action!

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Software Heritage

THE GREAT LIBRARY OF SOURCE CODE

THE GREAT LIBRARY OF SOURCE CODE



Collect, preserve and share *all* software source code

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

Reference catalog



find and reference all
software source code

Universal archive

media
aging
tear
attack
malicious
obsolete
dependencies

damage
disaster
dangling
reference
deletion
weak
corruption
encryption
format

**preserve all software
source code**

Research infrastructure



enable analysis of all
software source code

Sharing the vision



United Nations
Educational, Scientific and
Cultural Organization



And many more ...

www.softwareheritage.org/support/testimonials

Donors, members, sponsors



Platinum sponsors



Gold sponsors



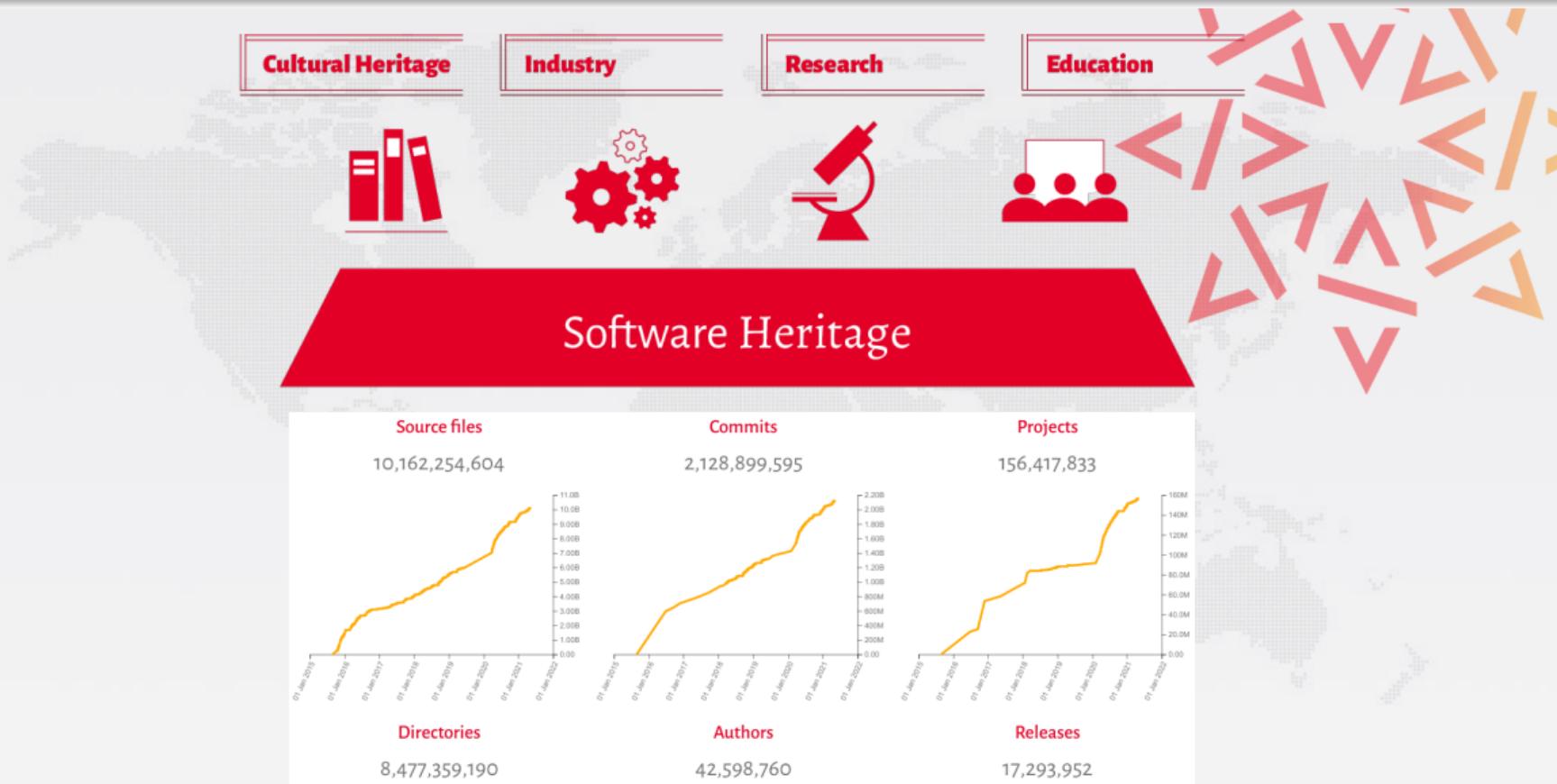
Silver sponsors



Bronze sponsors



The largest software archive, a shared infrastructure



Growing adoption in Academia (selection)

HAL software curated deposit workflow

Curated Archiving of Research Software Artifacts

International Journal of Digital Curation, 2020

IPOL (image processing)



- archive (deposit)
- reference
- BibLaTeX

eLife (life sciences)



- archive (save code now)
- reference

Policy: France



National Plan
Open Science

Policy: Europe



EOSC SIRS report

- SWHIDs
- archive

Reference archive for swmath.org



See *code* links, e.g.
SemiPar package

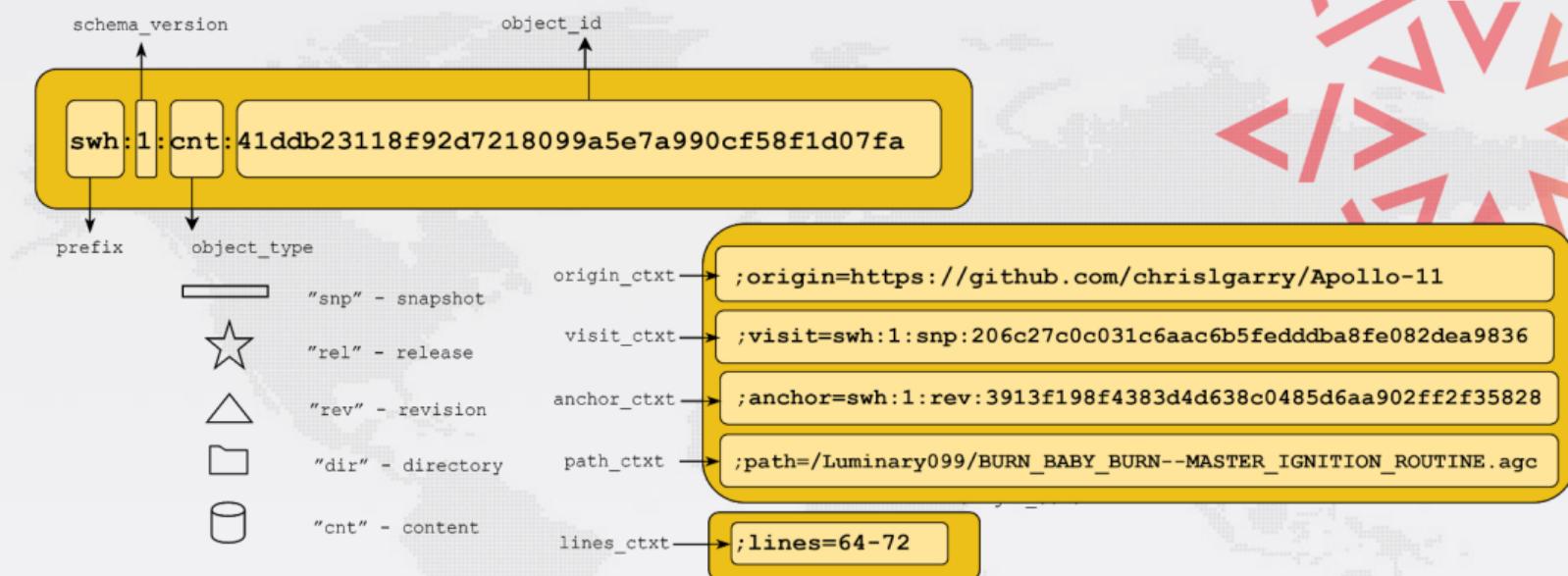
JTCAM (Mechanics)

- instructions for authors
- biblatex-software in journal L^AT_EX class

Guidelines



- 1 Prepare your public repository
README, AUTHORS & LICENSE files
- 2 Save your code
<http://use.softwareheritage.org/>
- 3 Reference your work
(in repository, specific version or code fragment)



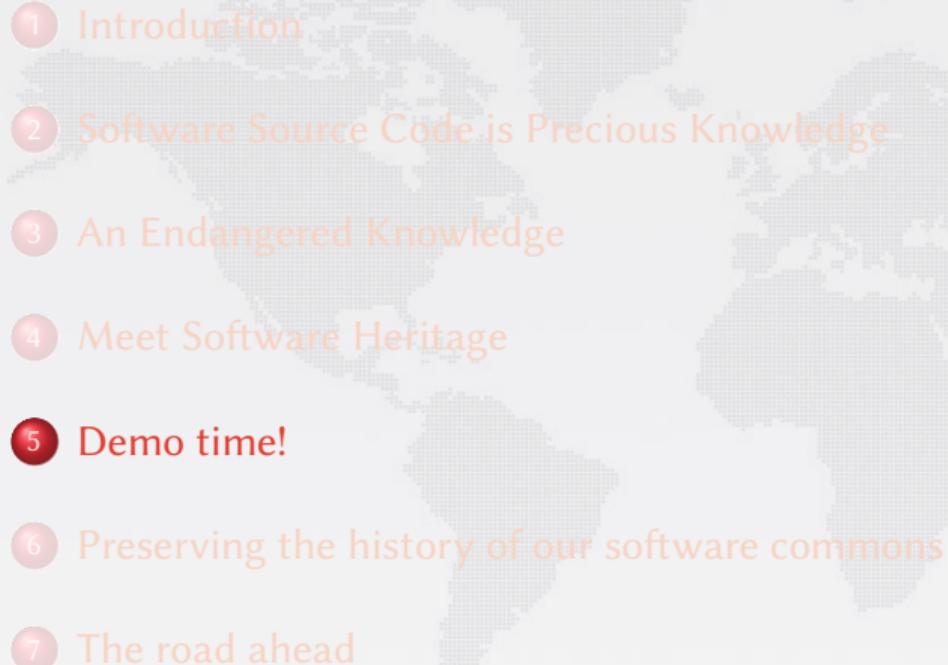
An emerging standard

- in Linux Foundation's SPDX 2.2
- IANA registered, WikiData property P6138

Examples:

- Apollo 11 AGC excerpt,
- Quake III rsqrt

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Focus on Archive and Reference

- The [Apollo 11 AGC source code example](#)
- Browse the archive
- Trigger archival of your preferred software in a breeze
- Get and use SWHIDs ([full specification available online](#))
- Example use in a research article: compare Fig. 1 and conclusions
 - in the 2012 version
 - in the updated version using SWHIDs and Software Heritage
- Cite software with the [biblatex-software style](#) from CTAN
- Example in a real journal: an article from IPOL



Recent news, and a lesson to be learned

Saving 250.000 endangered repositories...

- summer 2019: BitBucket announce Mercurial VCS phase out
- fall 2019: Software Heritage teams up with Octobus (funded by NLNet, thanks!)
- july 2020: BitBucket erases 250.000 repositories
- august 2020: bitbucket-archive.softwareheritage.org is live

... preserving the web of knowledge

(Tweet is here)



Gabriel Altay
@gabrielaltay

Just realized [@Bitbucket](#) disabled all mercurial repositories when the [@asclnet](#) informed me that a link associated with an old paper of mine was down. Thought all was lost, but someone archived all the repos! very classy move by [@octobus_net](#) and [@SWHeritage](#).

[Traduire le Tweet](#)

1:48 AM · 31 août 2020 · Twitter Web App

Bottomline

explicit deposit is important, ...

... and we must promote it...

... but will never be enough.

(think also of all software dependencies!)

Summing up: a revolutionary infrastructure *designed for source code*



Software Heritage



www.softwareheritage.org

global source code archive

Library of Alexandria of source code



- harvest *all* software source code
- *on demand harvesting* and *curated deposit*

universal intrinsic identifiers

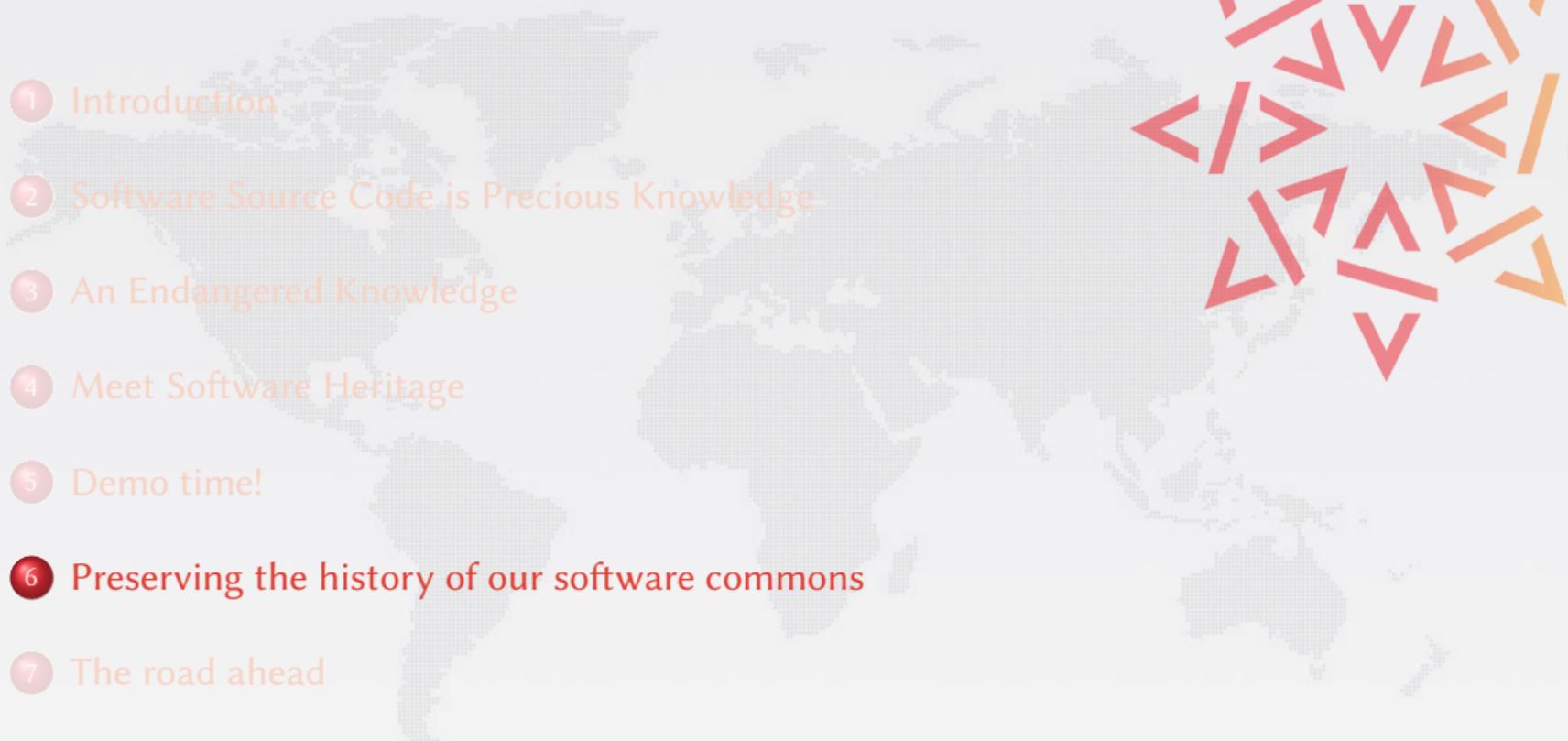
SWHID standard is independent of version control systems

uniform data model, full graph of development history

enables large scale, big code research

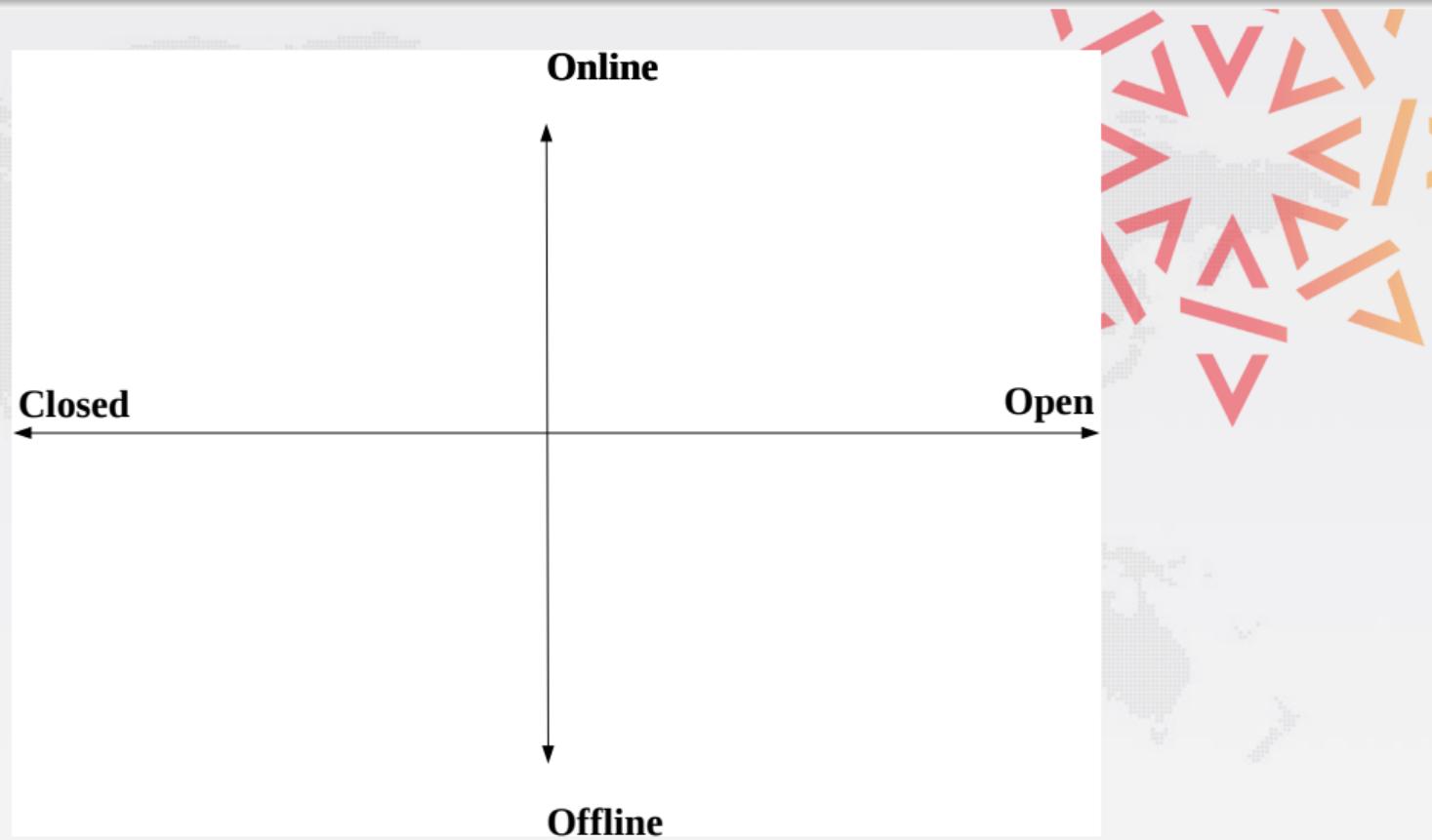
infrastructure for Open Science

base layer for software source code in the *Open Science architecture*

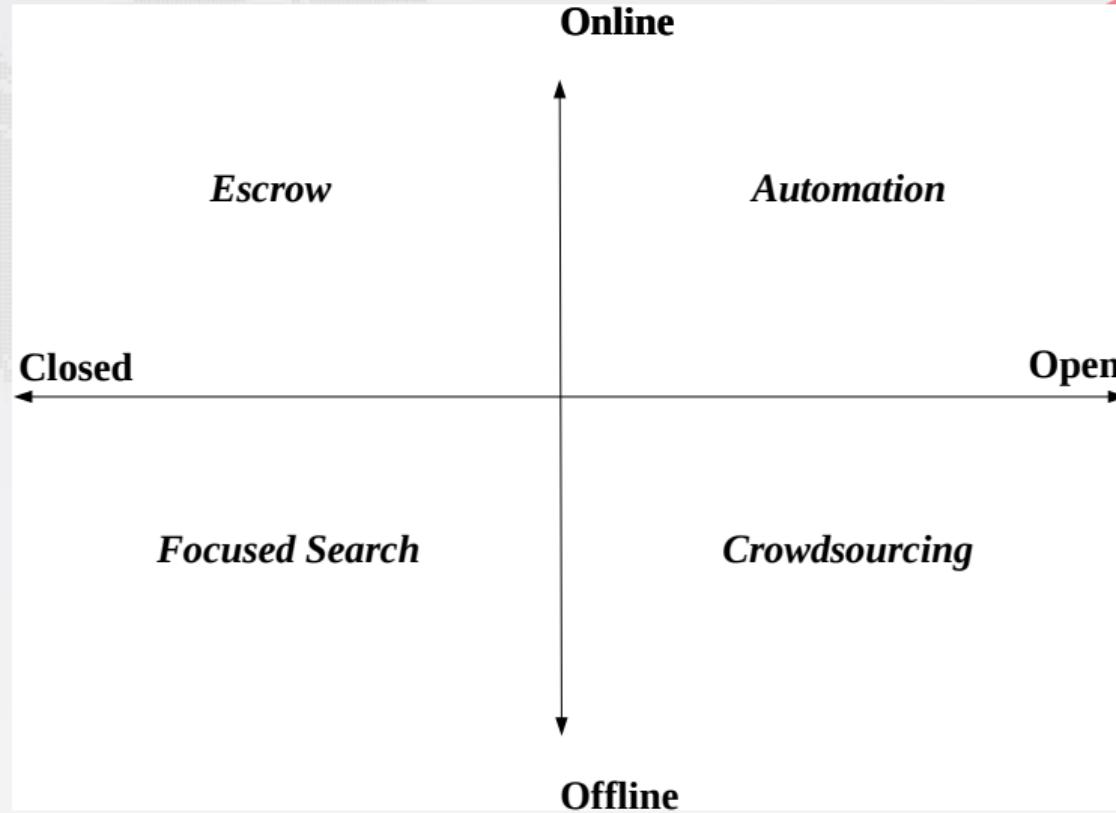
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All the source code!

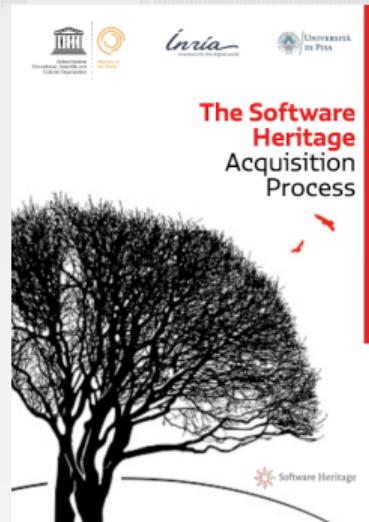


All the source code: strategy



Paris Call on Software Source Code

“[We call to] support efforts to gather and preserve the artifacts and narratives of the history of computing, while the earlier creators are still alive”



- **Rescue** Legacy Software from different media
- **Curate** the code
 - reconstruct the development history
 - *Software Heritage - GitHub* work on fixing git
 - collect the metadata
- **Archive** in Software Heritage

UNESCO, UniPi and Software Heritage collaboration

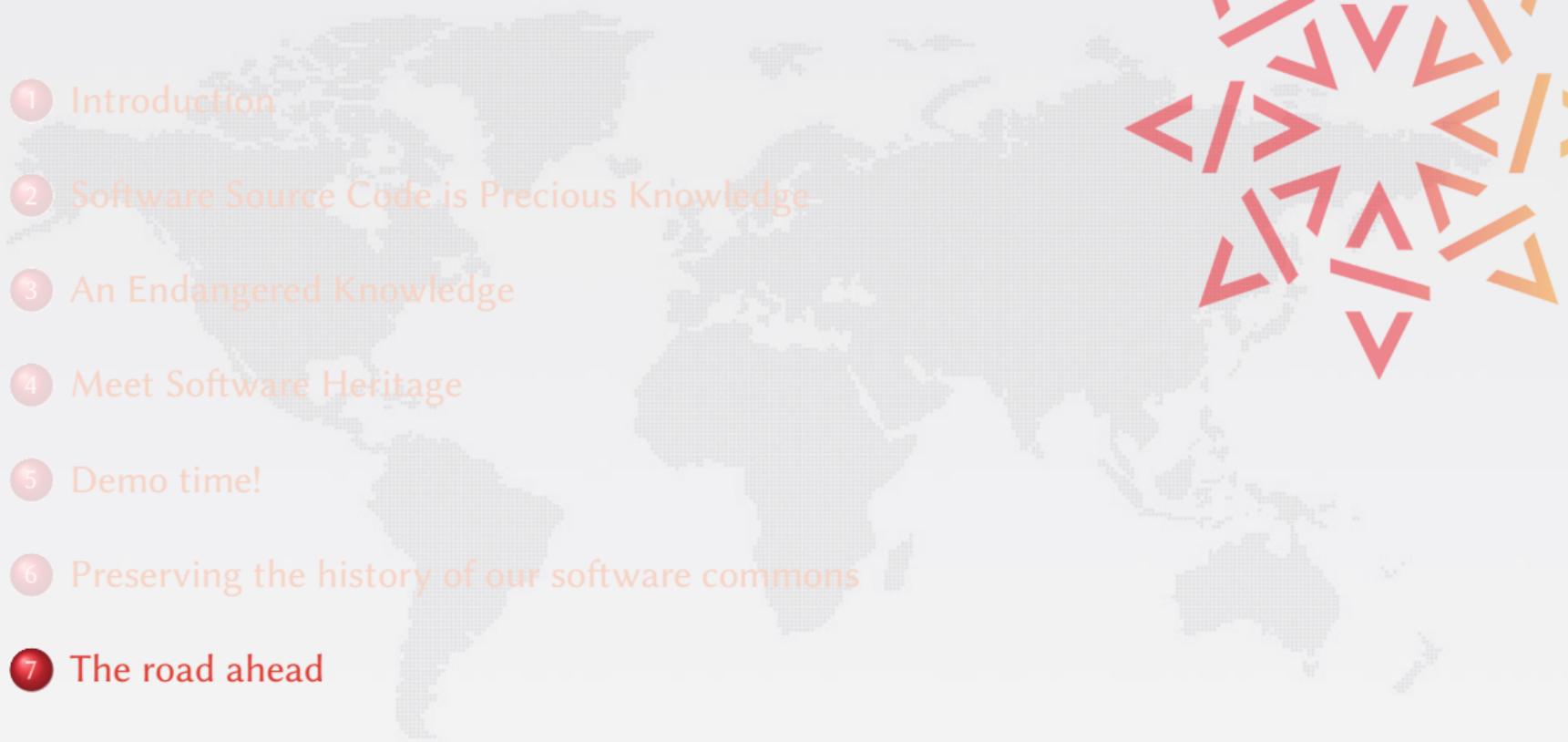
worldwide scope

An example: TAUmus, from Pisa (70's)

GERENZIAMENTO DI DOPPIOCIONE
LIBRERIA PER LA CORREZIONE DELLE SUEONI
FORTRAN IV MODEL 44 PS VERSION 3, LEVEL 3 DATE 70240

```
0001      SUBROUTINE CALMUS
0002      COMMON FRT,    RS, THIZ, IRIN, TPAS, IDENT(23), RATS, PCRD, H8, KS,
0003      ALB, DURA, NIN, TP, KONT
0004      EQUIVALENCE (THIZ(1:100), T1(1:100)), (RS(1:100), T2(1:100)),
0005      (TP(1:100), T3(1:100)), (KONT(1:100), T4(1:100))
0006      REAL KFTERI
0007      READ(5,10) N
0008      10 FORMAT(1I6)
0009      N=4
0010      LN=1
0011      KK=0
0012      KONT=0
0013      L=0
0014      KP=0
0015      R=0
0016      11 K=N+1
0017      TFKL,LF,NIGO TO 12
0018      LN=L+1
0019      12 TFLN,GT,5100 TO 50
0020      / GO TO 8
0021      13 DO 15 N=1,K
0022      15 I=MJ+1
0023      16 DO 18 J=1,K
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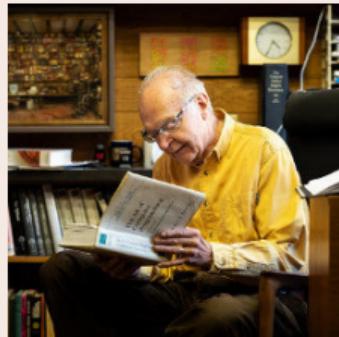
Outline

- 
- 1 Introduction
 - 2 Software Source Code is Precious Knowledge
 - 3 An Endangered Knowledge
 - 4 Meet Software Heritage
 - 5 Demo time!
 - 6 Preserving the history of our software commons
 - 7 The road ahead



Calling for more History of Computer Science

Communications of the ACM, February 2021



"Telling historical stories is the best way to teach. It's much easier to understand something if you know the threads it is connected to."

Let's Not Dumb Down the History of Computer Science

Donald E. Knuth, Len Shustek

<https://doi.org/10.1145/3442377>

A unique opportunity

- most of the creators are still here: we can talk to them!
- Software Heritage provides a key infrastructure for software historians

Stay tuned

great news for software stories in a few months...

You may help!

Foster adoption and best practices

- archive and reference relevant source code (save code now, and deposit),
- rescue and preserve landmark legacy source code with SWHAP,
- use Software Heritage in articles, journals, and books

Engage with Software Heritage as an individual

- the ambassador program is open:
 - learn directly from the core team, share with your community

Engage with Software Heritage as an organization

- join as a member/sponsor
- contribute to the preservation mission

Questions?

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