Software Heritage

The Great Library of Source Code

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Software Heritage
THE GREAT LIBRARY OF SOURCE CODE

Outline

Our Software Commons

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_Commons

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`https://en.wikipedia.org/wiki/Software_Commons`

Source code is *a precious part* of our commons

are we taking care of it?

Software is fragile

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)

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Where is the archive…

where do we go if (a repository on) GitHub or GitLab.com goes away?

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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

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find and reference all software source code

Universal archive

preserve all software source code

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find and reference all software source code

Universal archive

preserve all software source code

Research infrastructure

enable analysis of all software source code

Cultural Heritage | Industry | Research | Education




Software Heritage

Technology

- FOSS and transparency
- replicas all the way down

Content

- intrinsic identifiers
- facts and provenance

Organization

- non-profit
- multi-stakeholder

Archiving goals

Targets: VCS repositories & source code releases (e.g., tarballs, packages)

We DO archive

- file content (= blobs)
- revisions (= commits), with full metadata
- releases (= tags), ditto
- where (origin) & when (visit) we found any of the above

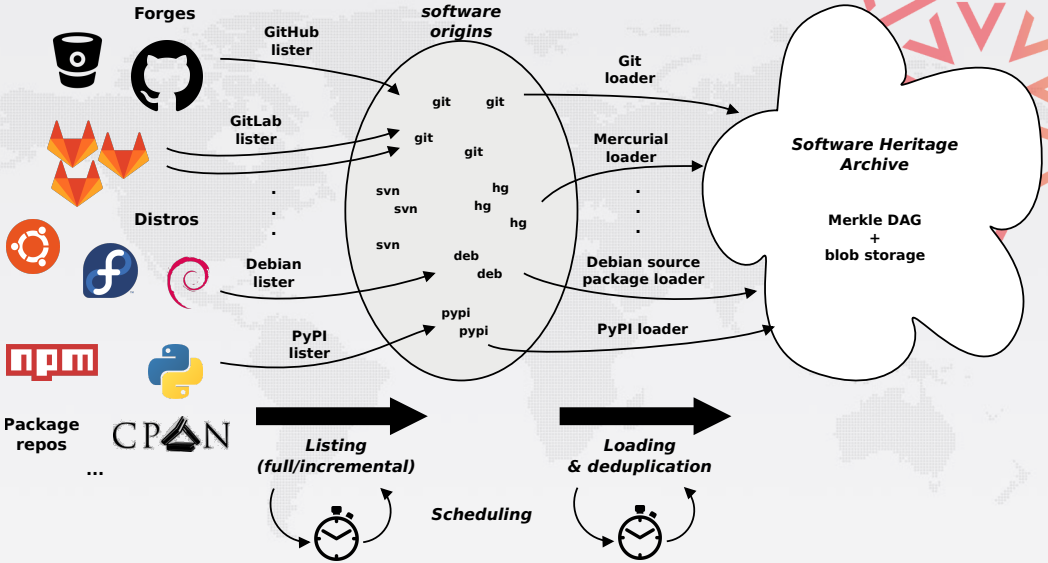
… in a VCS-/archive-agnostic canonical data model

We DON'T archive (yet)

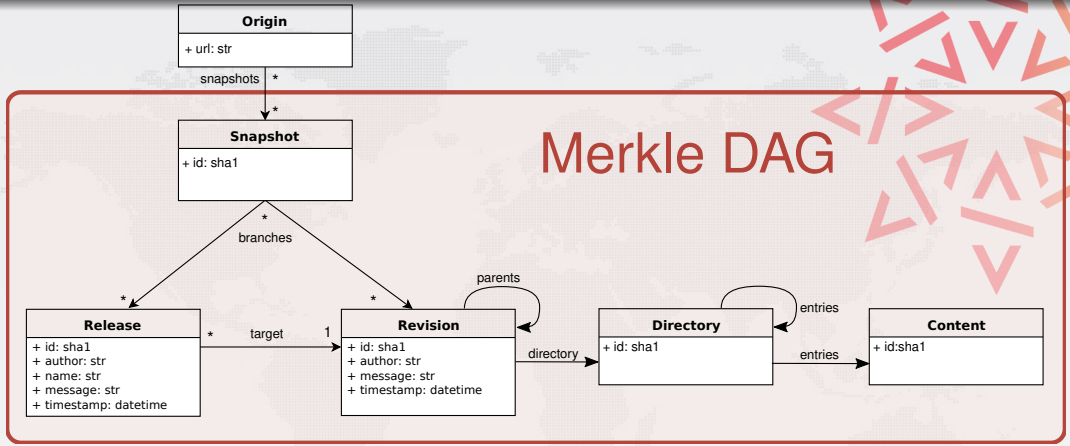
- homepages, wikis
- BTS/issues/code reviews/etc.
- mailing lists

Long term vision: play our part in a *"semantic wikipedia of software"*

Data flow


Forges
GitHub lister
GitLab lister
Distros
Debian lister
PyPI lister
Package repos
CPAN
...
software origins
git
git
git
git
svn
svn
svn
hg
hg
hg
deb
deb
pypi
pypi
Git loader
Mercurial loader
Debian source package loader
PyPI loader
Software Heritage Archive
Merkle DAG
+
blob storage
Listing (full/incremental)
Scheduling
Loading & deduplication

Data model



A global graph linking together fully deduplicated source code artifact (files, commits, directories, releases, etc.) to the places that distribute them (e.g., Git repositories), providing a unified view on the entire *Software Commons*.

Archive coverage — archive.softwareheritage.org

Bitbucket · R · debian · Framagit · GitHub · GitLab · GITORIOUS · Google code · GNU · Guix · HAL archives-ouvertes.fr · Inria · IPOL Journal · npm · NixOS · python

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- on disk: ~1 PiB (uncompressed); as a graph ~20 B nodes, ~200 B edges
- the largest public source code archive in the world (and growing!)

Outline

Web interface

archive.softwareheritage.org

DEMO TIME !

Web API

RESTful API to programmatically access the Software Heritage archive
`https://archive.softwareheritage.org/api/`

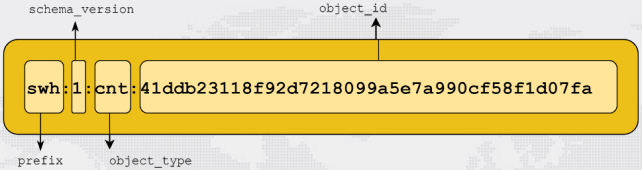
Features

- pointwise browsing of the archive
  - … snapshots → revisions → directories → contents …
- full access to the metadata of archived objects
- crawling information
  - *when have you last visited this Git repository I care about?*
  - *where were its branches/tags pointing to at the time?*

Endpoint index

`https://archive.softwareheritage.org/api/1/`

Software Heritage Identifiers (SWHIDs) (full spec)



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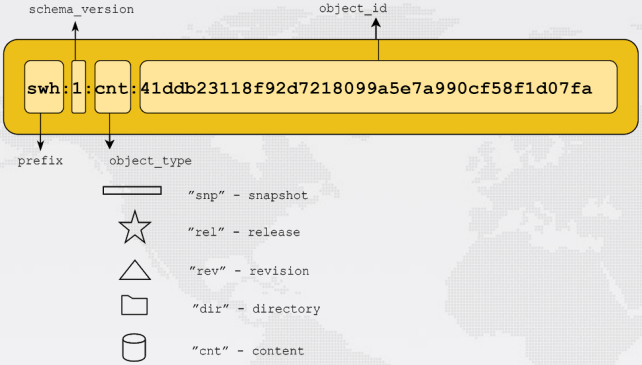

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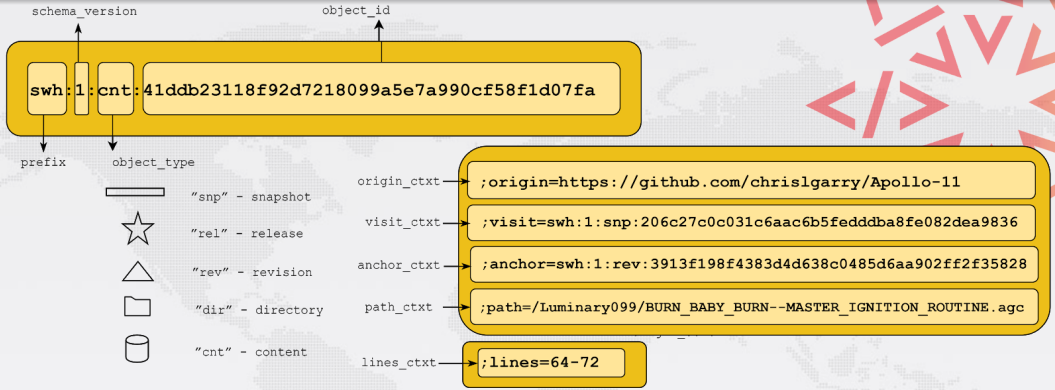

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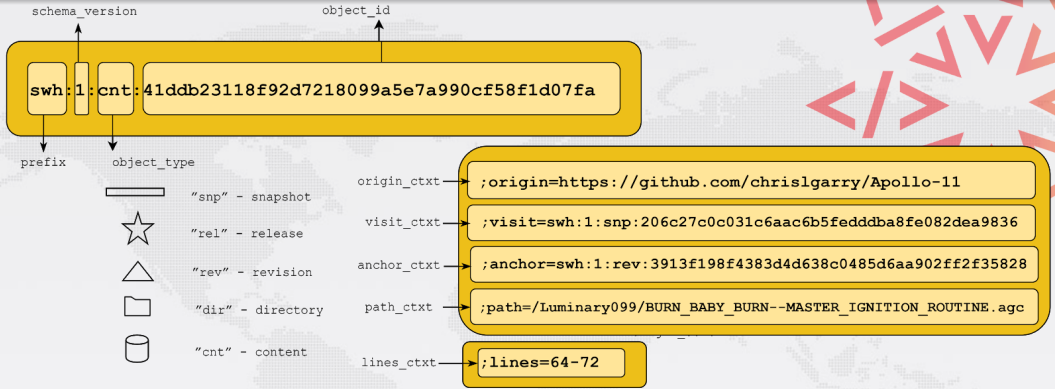

An emerging standard

- in Linux Foundation's SPDX 2.2
- IANA-registered "swh:" URI prefix
- WikiData property P6138

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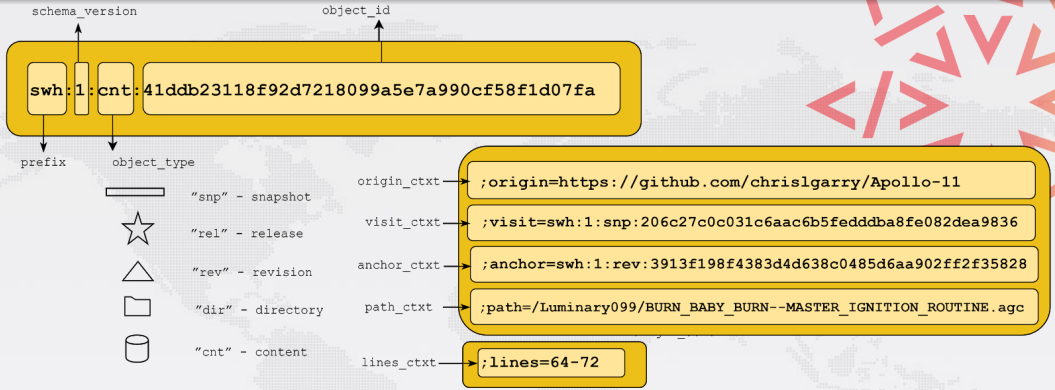

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Examples

- Apollo 11 AGC excerpt
- Quake III rsqrt

```
$ pip install swh-model[cli]

$ swh identify fork.c kmod.c sched/deadline.c
swh:1:cnt:2e391c754ae730bd2d8520c2ab497c403220c6e3  fork.c
swh:1:cnt:0277d1216f80ae1adeed84a686ed34c9b2931fc2  kmod.c
swh:1:cnt:57b939c81bce5d06fa587df8915f05affbe22b82  sched/deadline.c

$ swh identify --no-filename /usr/src/linux/kernel/
swh:1:dir:f9f858a48d663b3809c9e2f336412717496202ab

$ git clone --mirror \
    https://forge.softwareheritage.org/source/helloworld.git
$ swh identify --type snapshot helloworld.git/
swh:1:snp:510aa88bdc517345d258c1fc2babcd0e1f905e93  helloworld.git
```

Warning

If you expect *others* to be able to resolve the SWHIDs of source code you care about, you should make sure the corresponding software is archived in Software Heritage.

Software Heritage Filesystem (SwhFS)

The Software Heritage Filesystem (SwhFS) is a user-space POSIX filesystem that enables browsing parts of the Software Heritage archive as if it were locally available.

- code:
  `https://forge.softwareheritage.org/source/swh-fuse/`
- documentation:
  `https://docs.softwareheritage.org/devel/swh-fuse/`

Thibault Allançon, Antoine Pietri, Stefano Zacchiroli
The Software Heritage Filesystem (SwhFS): Integrating Source Code Archival with Development
ICSE 2021: The 43rd International Conference on Software Engineering
`https://arxiv.org/abs/2102.06390`

Software Heritage Filesystem (SwhFS) — Tutorial

```
$ pip install swh.fuse  # install SwhFS

$ mkdir swhfs
$ swh fs mount swhfs/  # mount the archive

$ ls -1F swhfs/  # list entry points
archive/  # <- start browsing from here
cache/
origin/
README
```

Software Heritage Filesystem (SwhFS) — Tutorial (cont.)

```
$ cd swhfs/

$ cat archive/swh:1:cnt:c839dea9e8e6f0528b468214348fee8669b305b2
#include <stdio.h>

int main(void) {
    printf("Hello, World!\n");
}
```

Software Heritage Filesystem (SwhFS) — Tutorial (cont.)

```
$ cd archive/swh:1:dir:1fee702c7e6d14395bbf5ac3598e73bcbf97b030

$ ls | wc -l
127

$ grep -i antenna THE_LUNAR_LANDING.s | cut -f 5
# IS THE LR ANTENNA IN POSITION 1 YET
# BRANCH IF ANTENNA ALREADY IN POSITION 1
```

Software Heritage Filesystem (SwhFS) — Tutorial (cont.)

```
$ cd archive/swh:1:rev:9d76c0b163675505d1a901e5fe5249a2c55609bc

$ ls -F
history/  meta.json@  parent@  parents/  root@

$ jq '.author.name, .date, .message' meta.json
"Michal Golebiowski-Owczarek"
"2020-03-02T23:02:42+01:00"
"Data:Event:Manipulation: Prevent collisions with Object.prototype ..."

$ find root/src/ -type f -name '*.js' | xargs cat | wc -l
10136
```

Software Heritage Filesystem (SwhFS) — Tutorial (cont.)

```
$ swh web search git-annex --limit 1
...
git://git.joeyh.name/git-annex.git \
  https://archive.softwareheritage.org/api/1/origin/git://git.joeyh.name/g
...

$ swh web search git-annex --url-encode | cut -f 1
git%3A%2F%2Fgit.joeyh.name%2Fgit-annex.git

$ cd origin/git%3A%2F%2Fgit.joeyh.name%2Fgit-annex.git
$ ls -F
2020-12-19/

$ ls 2020-12-19/snapshot/refs/heads/master/root/
Annex/                  COPYRIGHT           NEWS
Annex.hs                Creds.hs            P2P/
Assistant/              Crypto.hs           README
Assistant.hs            Database/           Remote/
Backend/                debian/             RemoteDaemon/
```

Outline

You can help!

Expanding archive coverage

- save.softwareheritage.org ← on-demand archival of source code you care about

Financially

- Donations: www.softwareheritage.org/donate/
- Sponsoring: www.softwareheritage.org/support/sponsors/

Coding

- Developer info: www.softwareheritage.org/community/developers/

Work with us

- Job openings: www.softwareheritage.org/jobs
- Internships: wiki.softwareheritage.org/wiki/Internships