Software Heritage
Our Software Commons, Forever

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Software Heritage
THE GREAT LIBRARY OF SOURCE CODE

(Free/Open Source) Software is everywhere

Software source code is *special*

Harold Abelson, Structure and Interpretation of Computer Programs

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

Quake 2 source code (excerpt)

```c
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
can be removed

	return y;
}
```

Net. queue in Linux (excerpt)

```c
/*
 * SFB uses two B[l][n] : L x N arrays of bins (L levels, N bins per level)
 * This implementation uses L = 8 and N = 16
 * This permits us to split one 32bit hash (provided per packet by rxhash or
 * external classifier) into 8 subhashes of 4 bits.
 */
#define SFB_BUCKET_SHIFT 4
#define SFB_NUMBUCKETS	(1 << SFB_BUCKET_SHIFT) /* N bins per Level */
#define SFB_BUCKET_MASK (SFB_NUMBUCKETS - 1)
#define SFB_LEVELS	(32 / SFB_BUCKET_SHIFT) /* L */

/* SFB algo uses a virtual queue, named "bin" */
struct sfb_bucket {
	u16		qlen; /* length of virtual queue */
	u16		p_mark; /* marking probability */
};
```

Len Shustek, Computer History Museum

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

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)

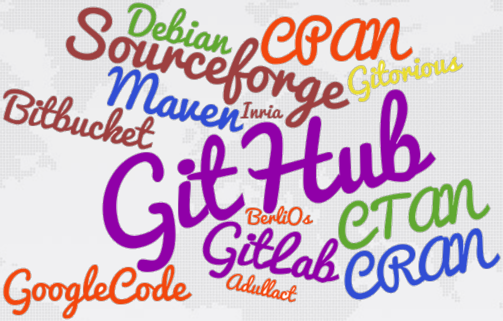
The software commons consists of all computer software which is available at little or no cost and which can be altered and reused with few restrictions. Thus *all open source software and all free software are part of the [software] commons.* [. . .]

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

Source code is *a precious part* of our commons

are we taking care of it?

Software is 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

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)
- for obsolete code: physical media decay (data rot)

Software lacks its own research infrastructure

A wealth of software research on crucial issues…

- safety, security, test, verification, proof
- software engineering, software evolution
- big data, machine learning, empirical studies

If you study the stars, you go to Atacama…

… where is the *very large telescope* of source code?

The Software Heritage Project

Software Heritage

THE GREAT LIBRARY OF SOURCE CODE

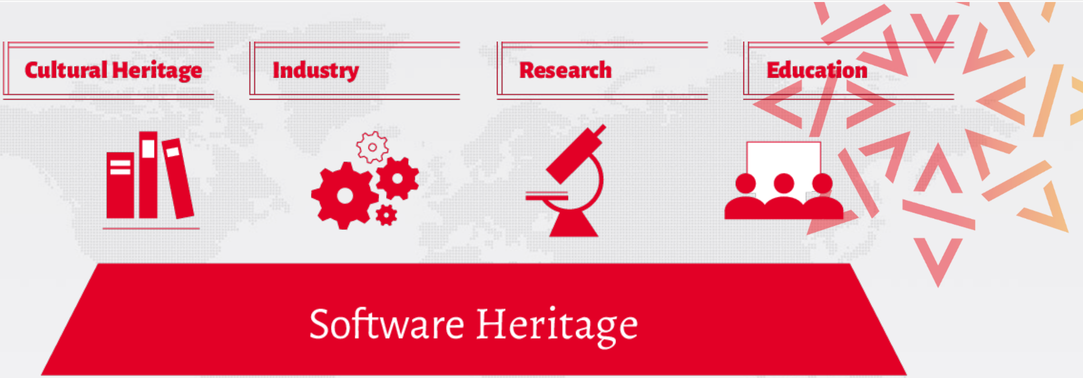
Our mission

Collect, preserve and share the *source code* of *all the software* that is publicly available.

Past, present and future

Preserving the past, *enhancing* the present, *preparing* the future.

Our principles



Cultural Heritage

Industry

Research

Education

Software Heritage

Open approach

- 100% FOSS
- transparency

In for the long haul

- replication
- non profit

Archiving goals

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

We DO archive

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

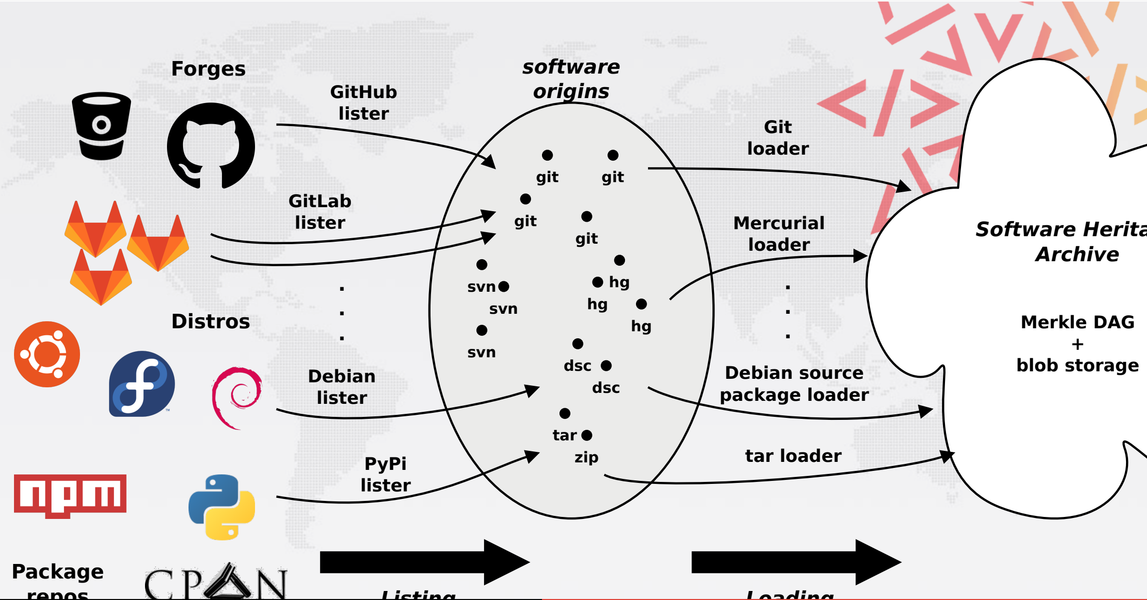
… in a VCS-/archive-agnostic canonical data model

We DON'T archive

- 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

software origins

git git git git svn svn svn hg hg hg dsc dsc tar zip

Git loader

Mercurial loader

Debian source package loader

tar loader

Software Herita
Archive

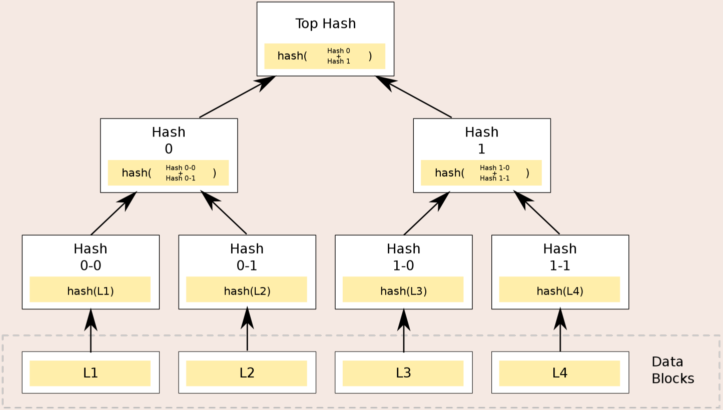
Merkle DAG + blob storage

Listing

Loading

Merkle trees

Merkle tree (R. C. Merkle, Crypto 1979)



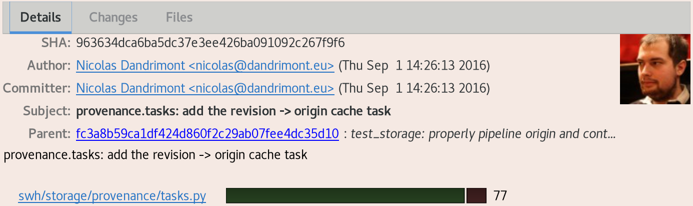
Combination of

- tree
- hash function

Classical cryptographic construction

Example: a Software Heritage revision

Revisions



SHA: 963634dca6ba5dc37e3ee426ba091092c267f9f6

Author: Nicolas Dandrimont <nicolas@dandrimont.eu> (Thu Sep 1 14:26:13 2016)

Committer: Nicolas Dandrimont <nicolas@dandrimont.eu> (Thu Sep 1 14:26:13 2016)

Subject: **provenance.tasks: add the revision -> origin cache task**

Parent: fc3a8b59ca1df424d860f2c29ab07fee4dc35d10 : *test_storage: properly pipeline origin and cont...*

provenance.tasks: add the revision -> origin cache task

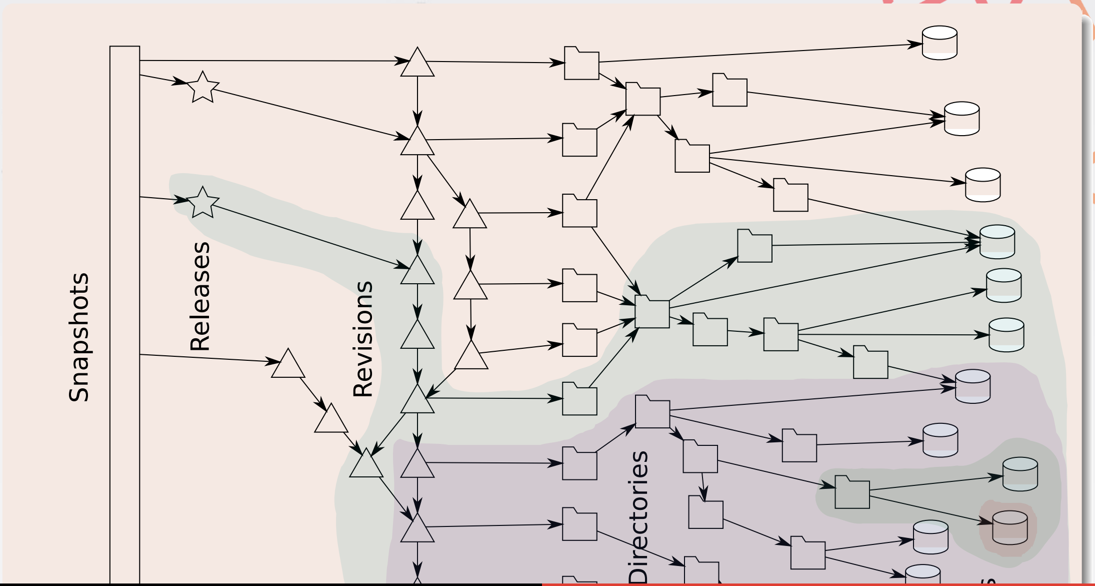
swh/storage/provenance/tasks.py 77

```
tree 515f00d44e92c65322aaa9bf3fa097c00ddb9c7d
parent fc3a8b59ca1df424d860f2c29ab07fee4dc35d10
author Nicolas Dandrimont <nicolas@dandrimont.eu> 1472732773 +0200
committer Nicolas Dandrimont <nicolas@dandrimont.eu> 1472732773 +0200

provenance.tasks: add the revision -> origin cache task
```

id: 963634dca6ba5dc37e3ee426ba091092c267f9f6

The archive: a (giant) Merkle DAG

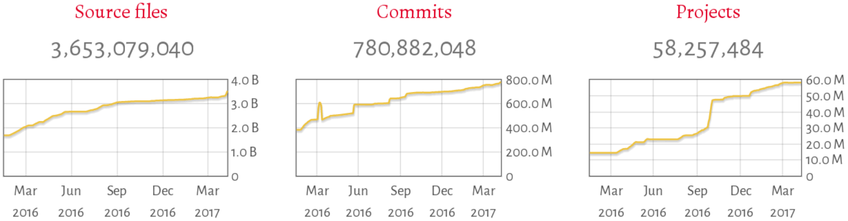


Archive coverage

Our sources

- GitHub — full, up-to-date mirror
- Debian, GNU — one shot ingestion experiment (up to Aug 2015)
- Gitorious, Google Code — processing (Archive Team & Google)
- Bitbucket — WIP

Some numbers



150 TB blobs, 5 TB database (as a graph: 7 B nodes + 60 B edges)

Web API

Fresh from the oven: first public version of our Web API
`https://archive.softwareheritage.org/api/`

Features

- pointwise browsing of the Software Heritage archive
  - … releases ⟶ 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?*

Complete endpoint index

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

A tour of the Web API — origins & visits

```
GET https://archive.softwareheritage.org/api/1/origin/ \
      git/url/https://github.com/hylang/hy
{ "id": 1,
  "origin_visits_url": "/api/1/origin/1/visits/",
  "type": "git",
  "url": "https://github.com/hylang/hy"
}


GET https://archive.softwareheritage.org/api/1/origin/ \
      1/visits/
[ ...,
  { "date": "2016-09-14T11:04:26.769266+00:00",
    "origin": 1,
    "origin_visit_url": "/api/1/origin/1/visit/13/",
    "status": "full",
    "visit": 13
  }, ...
]
```

A tour of the Web API — snapshots

```
GET https://archive.softwareheritage.org/api/1/origin/ \
   1/visit/13/
{ ...,
 "occurrences": { ...,
  "refs/heads/master": {
   "target": "b94211251...",
   "target_type": "revision",
   "target_url": "/api/1/revision/b94211251.../"
  },
  "refs/tags/0.10.0": {
   "target": "7045404f3...",
   "target_type": "release",
   "target_url": "/api/1/release/7045404f3.../"
  }, ...
 },
 "origin": 1,
 "origin_url": "/api/1/origin/1/",
 "status": "full",
 "visit": 13
}
```

A tour of the Web API — revisions

```
GET https://archive.softwareheritage.org/api/1/revision/ \
      6072557b6c10cd9a21145781e26ad1f978ed14b9/
{
  "author": {
    "email": "tag@pault.ag",
    "fullname": "Paul Tagliamonte <tag@pault.ag>",
    "id": 96,
    "name": "Paul Tagliamonte"
  },
  "committer": { ... },
  "date": "2014-04-10T23:01:11-04:00",
  "committer_date": "2014-04-10T23:01:11-04:00",
  "directory": "2df4cd84e...",
  "directory_url": "/api/1/directory/2df4cd84e.../",
  "history_url": "/api/1/revision/6072557b6.../log/",
  "merge": false,
  "message": "0.10: The Oh f*ck it’s PyCon release",
  "parents": [ {
     "id": "10149f66e...",
     "url": "/api/1/revision/10149f66e.../"
```

A tour of the Web API — contents

```
GET https://archive.softwareheritage.org/api/1/content/ \
      adc83b19e793491b1c6ea0fd8b46cd9f32e592fc/
{
  "data_url": "/api/1/content/sha1:adc83b19e.../raw/",
  "filetype_url": "/api/1/content/sha1:.../filetype/",
  "language_url": "/api/1/content/sha1:.../language/",
  "length": 1,
  "license_url": "/api/1/content/sha1:.../license/",
  "sha1": "adc83b19e...",
  "sha1_git": "8b1378917...",
  "sha256": "01ba4719c...",
  "status": "visible"
}
```

Caveats

- rate limits apply throughout the API
- blob download available for selected contents

Roadmap

Features. . .

- (done) lookup by content hash
- browsing: "wayback machine" for archived code
  - (done) via Web API
  - (todo) via Web UI
- (todo) download: `wget` / `git clone` from the archive
- (todo) provenance information for all archived content
- (todo) full-text search on all archived source code files

. . . and much more than one could possibly imagine

all the world's software development history in a single graph!

You can help!

Coding

- www.softwareheritage.org/community/developers/
- forge.softwareheritage.org — our own code

Current development priorities

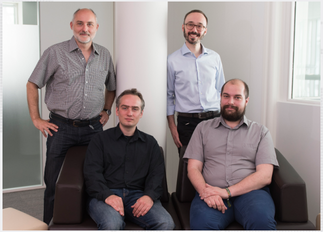
★★★	listers for unsupported forges, distros, pkg. managers
★★★	loaders for unsupported VCS, source package formats
★★	Web UI: eye candy wrapper around the Web API
★	content indexing and search

… *all* contributions equally welcome!

Join us

- www.softwareheritage.org/jobs — job openings
- wiki.softwareheritage.org — internships

The Software Heritage community



Inria as initiator

- .fr national CS research institution
- strong FOSS culture, W3C founding partner

Sponsors and Supporters

Société Générale, Microsoft, Intel, Huawei, Nokia, DANS, Univ. Bologna, ACM, Creative Commons, Eclipse, Engineering, FSF, Gandi, GitHub, IEEE, OIN, OSI, OW2, Software Freedom Conservancy, SFLC, Document Foundation, Linux Foundation, ...

Conclusion

Software Heritage is

- a *reference archive* of *all* FOSS ever written
- a unique *complement* for *development platforms*
- an international, open, nonprofit, *mutualized infrastructure*
- at the service of our community, at the service of society

Come in, we're open!

`www.softwareheritage.org` — *sponsoring, job openings*
`wiki.softwareheritage.org` — *internships, leads*
`forge.softwareheritage.org` — *our own code*

Questions?

Q: how about SHA1 collisions?

```
create domain sha1 as bytea
  check (length(value) = 20);
create domain sha1_git as bytea
  check (length(value) = 20);
create domain sha256 as bytea
  check (length(value) = 32);

create table content (
  sha1      sha1 primary key,
  sha1_git  sha1_git not null,
  sha256    sha256 not null,
  length    bigint not null,
  ctime     timestamptz not null default now(),
  status    content_status not null default ’visible’,
  object_id bigserial
);

create unique index on content(sha1_git);
create unique index on content(sha256);
```