Browsing the Free Software Commons

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Software Heritage
THE GREAT LIBRARY OF SOURCE CODE

Outline

(Free) 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)

```
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)

```
/*
 * 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

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Source code is *a precious part* of our commons

are we taking care of it?

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Fashion victims

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

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Where is the place …

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

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)

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Where is the archive…

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

Software lacks its own research infrastructure

A wealth of software research on crucial issues…

- safety, security, test, verification, proof
- software engineering, software evolution
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If you study the stars, you go to Atacama…

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

Outline

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.

Core principles

Core principles

Open approach

- 100% Free Software
- 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

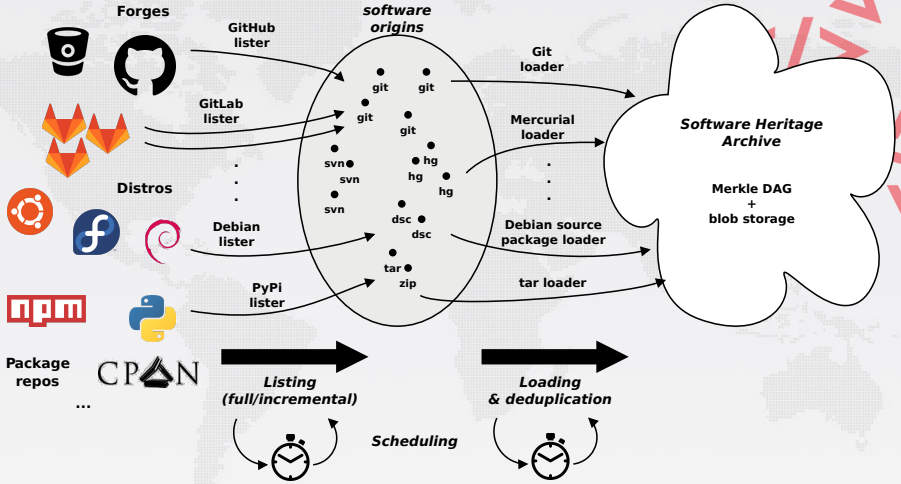
… in a VCS-/archive-agnostic canonical data model

We DON'T archive

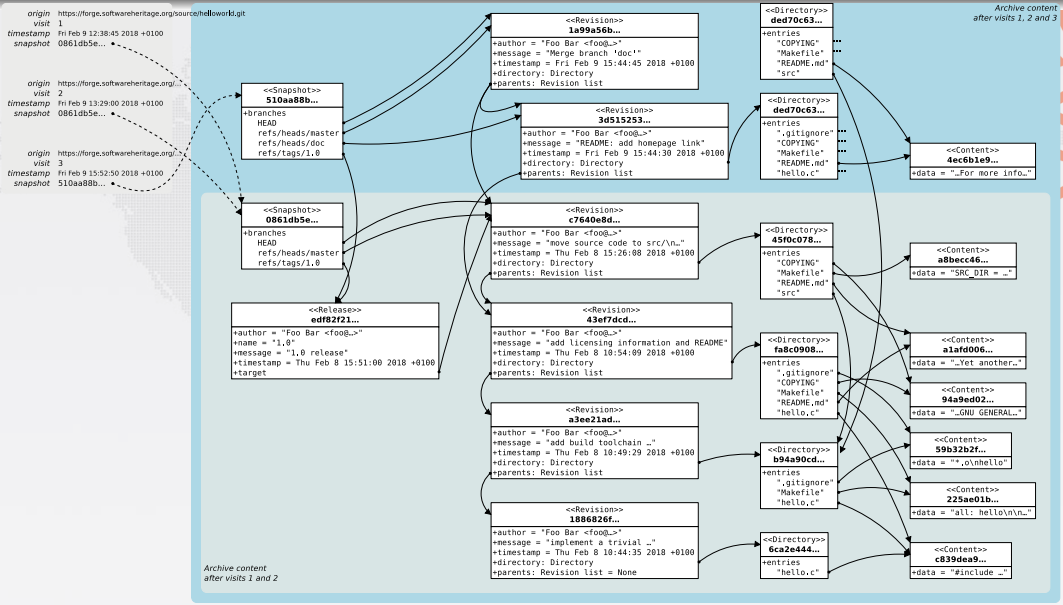
- homepages, wikis
- BTS/issues/code reviews/etc.
- mailing lists

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

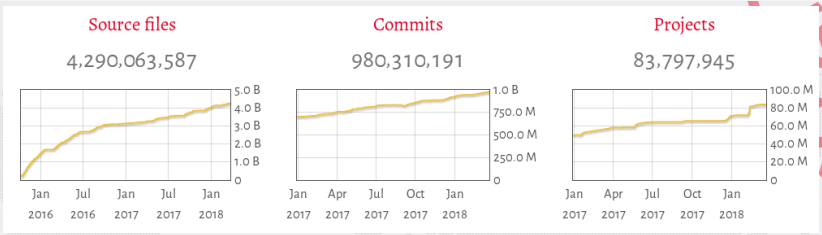
Data flow


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

The archive: a (giant) Merkle DAG



Archive coverage



Current sources

- live: GitHub, Debian
- one-off: Gitorious, Google Code, GNU
- WIP: GitLab, PyPI, Bitbucket

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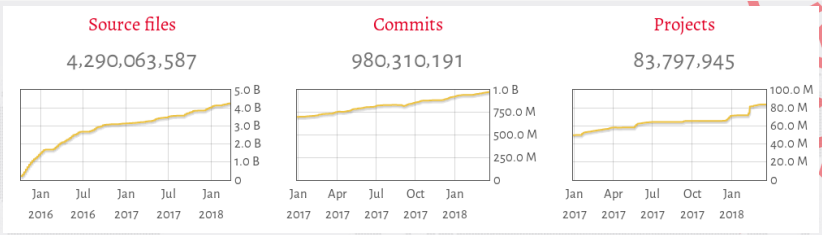

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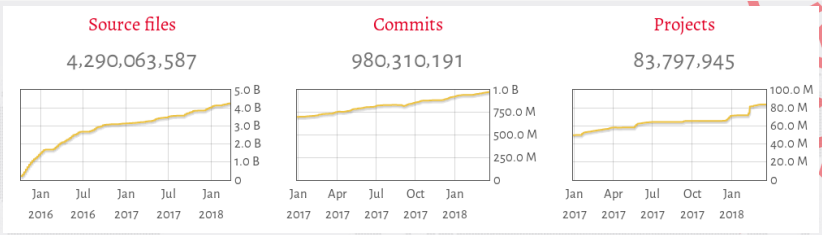

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The *richest* public source code archive, … and growing daily!

Outline

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/`

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"
}
```

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...",
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```

Caveats

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

Bulk download

Vault service

- source code is thoroughly deduplicated within the Software Heritage archive
- bulk download of large artefacts (e.g., a Linux kernel release) requires collecting millions of objects
- the Software Heritage Vault cooks and caches source code bundles for bulk download needs

Tech bits

- RESTful API to request downloads, notifications, and monitoring
- `docs.softwareheritage.org/devel/swh-vault`

Web user interface

Browser-based interface to browse the Software Heritage archive
https://archive.softwareheritage.org/browse/

Features

- all REST API features, but good looking :-)
  - browsing: snapshots → revisions → directories → contents ...
  - access to metadata and crawling information
- origin search, as full text indexing of origin URLs
- bulk download, via integration with the Vault

Outline

Roadmap

Features...

- (done) lookup by content hash
- (done) browsing: "wayback machine" for source code (API + UI)
- (early access) deposit of source code bundles directly to the archive
- (done) download: `wget` / `git clone` from the archive
- (todo) provenance lookup for all archived content
- (todo) full-text search on all archived source code files

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... and much more than one could possibly imagine

all the world's software development history at hand's reach!

You can help!

Coding

★★	Web UI improvements
★	loaders/listers for unsupported VCS/forges
★★★	developer documentation

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Community

★★★	spread the world, help us with sustainability
★★	document endangered source code

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Join us

- `www.softwareheritage.org/jobs` — job openings
- `wiki.softwareheritage.org/index.php?title=Internship` — internships

Conclusion

Software Heritage is

- a reference archive of all Free Software ever written
- an international, open, nonprofit, mutualized infrastructure
- now accessible to developers, users, researchers
- at the service of our community, at the service of society

Come in, we're open!

`www.softwareheritage.org` — general information
`wiki.softwareheritage.org` — internships, leads
`forge.softwareheritage.org` — our own code