Towards an Open Data and Open Source Code Scanner

for your Open Compliance

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Open Compliance Summit 2020
Virtual Event

Software Heritage
THE GREAT LIBRARY OF SOURCE CODE

About the speaker

- Associate Professor of Computer Science, Université de Paris, on leave at Inria
- Free/Open Source Software activist (20+ years)
- Debian Developer & Former 3x Debian Project Leader
- Former Open Source Initiative (OSI) director
- Software Heritage co-founder & CTO

Outline

1. Open Compliance
2. Software Heritage
3. swh-scanner
4. Outlook

Open Compliance

My own take on a comprehensive definition of our shared interests:

Definition (Open Compliance)

The pursuit of compliance with *license obligations* and other *best practices* for the management of open source software components using only open technology, such as: open source software, open data information, and open access documentation.

Why

- Reduced lock-in risks
- Lower total cost of ownership (TCO)
- Allow to crowdsource expensive compliance steps (e.g., scanning, curation)
- Aligned with the ethos of free/open source software (FOSS) communities

Long-discussed in FOSS compliance circles. Many well-established collaboration initiatives: Open Source Tooling Group, Open Compliance Program, Double Open, ...

Reuse is the new rule . . . . . . KYSW is coming!

Reuse is the new rule

80% to 90% of a new application is . . . just reuse! (Sonatype survey, 2017)

Where does reused software come from?

Sourceforge
Debian
CPAN
Gitorious
Maven
Inria
Bitbucket
GitHub
BerliOs
CTAN
Gitlab
CRAN
GoogleCode
Adullact

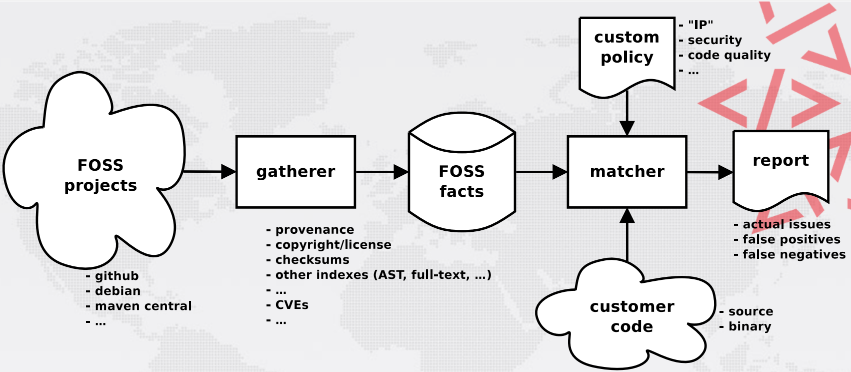
Do *you* know where it comes from?

- the software you ship
- the software you use
- the software you acquire
- the software that
  - has that bug
  - has that vulnerability

KYSW: Know Your SoftWare

Like KYC in banking, KYSW is now essential all over IT

Anatomy of a KYSW toolchain



custom policy

- "IP"
- security
- code quality
- ...

FOSS projects

- github
- debian
- maven central
- ...

gatherer

- provenance
- copyright/license
- checksums
- other indexes (AST, full-text, ...)
- ...
- CVEs
- ...

FOSS facts

matcher

report

- actual issues
- false positives
- false negatives

customer code

- source
- binary

source: *A Community Take on the License Compliance Industry*, Stefano Zacchiroli, FOSDEM 2016, Legal and Policy Issues devroom,

`https://upsilon.cc/~zack/talks/2016/2016-01-31-fosdem-compliance.pdf`

A code scanner is the key ingredient of all KYSW toolchains: it scans a local source code base and compares it to a FOSS knowledge base, summarizing findings. (We will ignore other features for the purpose of this talk.)

An Open Compliance Source Code Scanner — Requirements

Be Open Compliance-…compliant

- front-end: open source client, running locally on your code base
- back-end: open data knowledge base, remote or self-hosted

Practical needs

- known/unknown information (has this been published before?)
- license information
- provenance information
- scanning granularity: both file-level and snippet-level
- knowledge-base coverage: cover all of FOSS

Claim: we still lack a source code scanning tool that is compliant with Open Compliance principles and addresses industry practical needs.

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Software Heritage, in a nutshell

Software Heritage

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

Debian
Sourceforge
CPAN
Gitorious
Maven
Inria
Bitbucket
GitHub
BerliOS
CTAN
GitLab
CRAN
GoogleCode
Adullact

find and reference all software source code

Universal archive

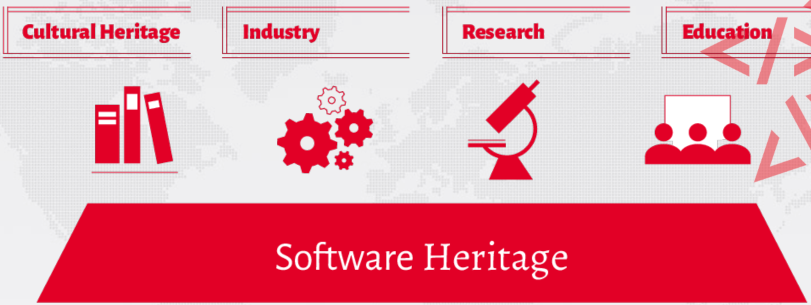
damage
storage
disaster
reference
deletion
media
malicious
obsolete
dangling
wear
corruption
encryption
format
aging
tear
attack
dependencies

preserve all software source code

Research infrastructure

enable analysis of all software source code

A principled infrastructure http://bit.ly/swhpaper



Cultural Heritage

Industry

Research

Education

Software Heritage

Technology

- transparency and FOSS
- replicas all the way down

Content

- intrinsic identifiers
- facts and provenance

Organization

- non-profit
- mirror network

An international, non profit initiative built for the long term

Sharing the vision

UNESCO

United Nations
Educational, Scientific and
Cultural Organization

IEEE Software · GitLab · ENGINEERING · eclipse · OW2 · fsfe · nlnet FOUNDATION · SIGSOFT · Liberté • Égalité • Fraternité RÉPUBLIQUE FRANÇAISE · INAPI · THE LINUX FOUNDATION · ADULLACT · INFORMATICS EUROPE · Computer History Museum · software freedom conservancy · Software Freedom Law Center · AdaCore The GNAT Pro Company · gandi.net · TDF · FREE SOFTWARE FOUNDATION · creative commons · SIF Société Informatique de France · open source initiative · openinventionnetwork

And many more ...
www.softwareheritage.org/support/testimonials

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INVENTEURS DU MONDE NUMÉRIQUE

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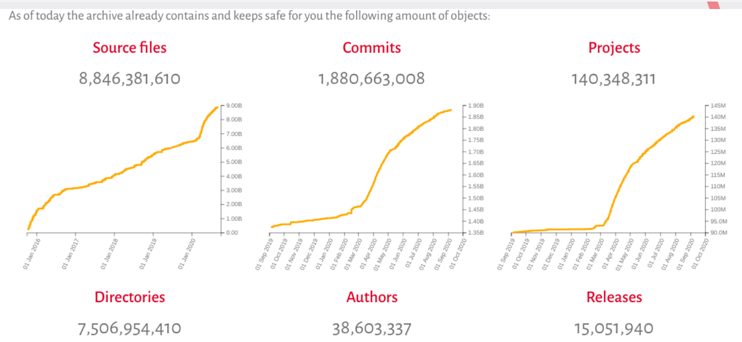
Bronze sponsors

DANS Data Archiving and Networked Services · FOSSID · Alma Mater Studiorum

The largest free/open source software archive



As of today the archive already contains and keeps safe for you the following amount of objects:

Source files	Commits	Projects
8,846,381,610	1,880,663,008	140,348,311

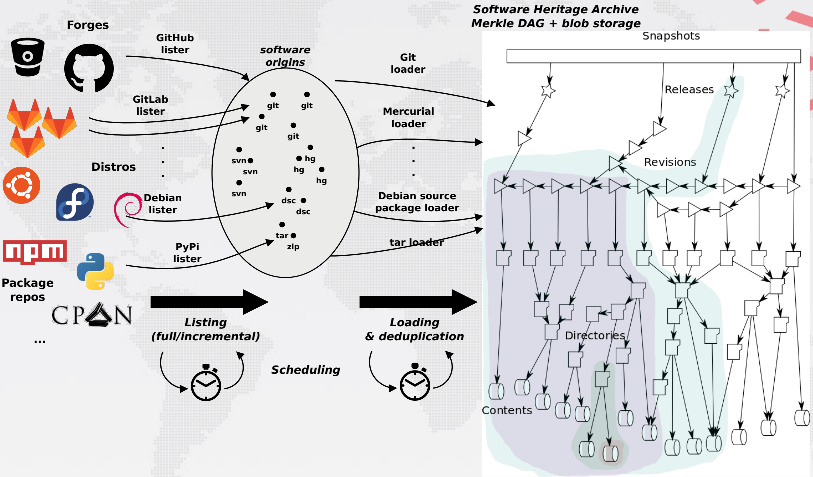
Directories	Authors	Releases
7,506,954,410	38,603,337	15,051,940

GitHub GitLab Bitbucket Google code GITORIOUS Framagit

HAL archives-ouvertes.fr debian npm R GNU Inria inventeurs du monde numérique python Package Index

- ~400 TB (uncompressed) blobs, ~20 B nodes, ~300 B edges

Automation, and storage



Forges

GitHub lister

GitLab lister

Distros

Debian lister

Package repos

PyPi lister

...

software origins

Listing (full/incremental)

Scheduling

Git loader

Mercurial loader

Debian source package loader

tar loader

Loading & deduplication

Software Heritage Archive
Merkle DAG + blob storage

Snapshots

Releases

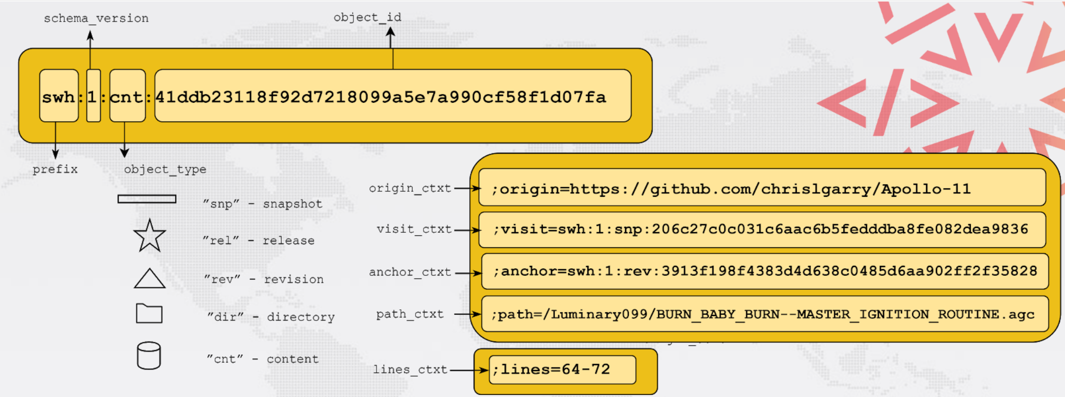
Revisions

Directories

Contents

Full development history permanently archived in a uniform data model.

Meet the Software Heritage Identifiers (SWHIDs) (full spec)



schema_version

object_id

swh:1:cnt:41ddb23118f92d7218099a5e7a990cf58f1d07fa

prefix

object_type

"snp" - snapshot

"rel" - release

"rev" - revision

"dir" - directory

"cnt" - content

origin_ctxt → ;origin=https://github.com/chrislgarry/Apollo-11

visit_ctxt → ;visit=swh:1:snp:206c27c0c031c6aac6b5fedddba8fe082dea9836

anchor_ctxt → ;anchor=swh:1:rev:3913f198f4383d4d638c0485d6aa902ff2f35828

path_ctxt → ;path=/Luminary099/BURN_BABY_BURN--MASTER_IGNITION_ROUTINE.agc

lines_ctxt → ;lines=64-72

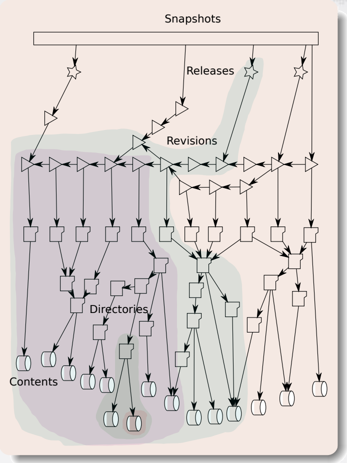
An emerging standard

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

Examples

- Apollo 11 AGC excerpt
- Quake III rsqrt

"It's ~~Turtles~~ SWHIDs all the way down"



Reference *any* source code artifact that has ever been shared—source code file, tree, commit, release, repository state—using the same, standard identifier.

Try it out:

```
$ pip install swh.model
$ swh identify /srv/src/linux/kernel/
swh:1:dir:b770a2aed8db52df737f88f18ca6bf39a1582240
```

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Tech preview: swh-scanner

Vision

swh-scanner is an open source and open data code scanner for open compliance workflows, backed by the largest archive of free/open source software source code.

Design

- query the Software Heritage archive as source of truth about public code
- leverages the Merkle DAG model and SWHIDs for maximum scanning efficiency
  - e.g., no need to query the back-end for files contained in a known directory
- file-level granularity
- output: source tree partition into known (= published before) v. unknown

swh-scanner — Demo

```
$ pip install swh.scanner

$ swh scanner scan -f json /srv/src/linux/kernel
{
  [...]
  "/srv/src/linux/kernel/auditsc.c": {
      "known": true,
      "swhid": "swh:1:cnt:814406a35db163080bbf937524d63690861ff750" },
  "/srv/src/linux/kernel/backtracetest.c": {
      "known": true,
      "swhid": "swh:1:cnt:a2a97fa3071b1c7ee6595d61a172f7ccc73ea40b" },
  "/srv/src/linux/kernel/bounds.c": {
      "known": true,
      "swhid": "swh:1:cnt:9795d75b09b2323306ad6a058a6350a87a251443" },
  "/srv/src/linux/kernel/bpf": {
      "known": true,
      "swhid": "swh:1:dir:fcd9987804d26274fee1eb6711fac38036ccaee7" },
  "/srv/src/linux/kernel/capability.c": {
      "known": true,
      "swhid": "swh:1:cnt:1444f3954d750ba685b9423e94522e0243175f90" },
  [...]
}
0,53s user 0,61s system 145% cpu 1,867 total
$
```

swh-scanner — Demo (cont.)

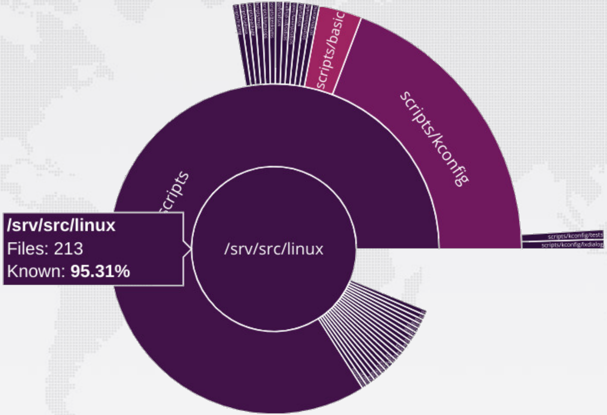
```
$ du -sh --exclude=.git /srv/src/linux
1,1G /srv/src/linux

$ time swh scanner scan -f json -x *.git /srv/src/linux
{
  [...]
  "/srv/src/linux/arch": {
      "known": true,
      "swhid": "swh:1:dir:590c329d3548b7d552fc913a51965353f01c9e2f" },
  [...]
  "/srv/src/linux/scripts/kallsyms.c": {
      "known": true,
      "swhid": "swh:1:cnt:0096cd9653327584fe62ce56ba158c68875c5067" },
  "/srv/src/linux/scripts/kconfig": {
      "known": false,
      "swhid": "swh:1:dir:548afc93bd01d2fba0dfcc0fd8c69f4b082ab8c6" },
  "/srv/src/linux/scripts/kconfig/.conf.o.cmd": {
      "known": false,
      "swhid": "swh:1:cnt:0d8be19e430c082ece6a3803923ad6ecb9e7d413" },
  [...]
}
20,84s user 1,52s system 103% cpu 21,540 total
$
```

swh-scanner — Demo (cont.)

Interactive mode to drill-down and inspect unknown files:

```
$ swh scanner scan -f sunburst -x *.git /srv/src/linux
```



/srv/src/linux
Files: 213
Known: **95.31%**

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swh-scanner — Checklist

Open Compliance

- ✓ front-end: open source client, running locally on your code base
- ✓ back-end: open data knowledge base, remote or self-hosted

Practical needs

- ✓ known/unknown information (has this been published before?)
- ✗ license information
- ✗ provenance information
- ✓ file-level granularity
- ✗ snippet-level granularity
- ✓ knowledge-base coverage: all of ~~FOSS~~ Software Heritage

swh-scanner — Going further

swh-scanner shows that *it is possible* to create a source code scanner that is both open source and backed by the most comprehensive open data FOSS archive.

Roadmap

swh-scanner is *not a production-ready scanner*. The following features are still missing:

- license information → in-house scanning + ClearlyDefined
- provenance information → Software Heritage crawling info
- increase granularity to snippet/SLOC

Some of these are low-hanging fruits, some require substantial R&D investments.

Feedback welcome

- feel free to play with swh-scanner, feedback is very welcome!
- caveat: intensive use will result in hitting the API rate-limit

Wrapping up

Software Heritage
THE GREAT LIBRARY OF SOURCE CODE

www.softwareheritage.org @swheritage

- open compliance is about FOSS management using *only* open technology
- we still lack a fully open—open source, backed by an open data knowledge base—source code scanner for open compliance toolchains
- swh-scanner is a *prototype scanner* showing that it is possible, today, to develop such a scanner, building on Software Heritage as an extensive knowledge base
- swh-scanner is not an industry-ready scanner, but might become one; its architecture and components can be reused elsewhere

Contacts

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Complete Corresponding Source (CCS) hosting

Complete Corresponding Source (CCS) requirement

> *For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable.* — GPLv2

CCS management in the real world

- CCS tarballs published at release time; URLs included in user manuals
- IT reorganizations → link rot (e.g., 404 on CCS URLs) → out of compliance

A better approach (Intel+SWH prototype)

Delegate CCS hosting to an archive:

1. prepare CCS tarball
2. deposit it to Software Heritage
3. include SWHID in user manuals

Is it compliant?

- TL;DR: yes! (with agreement with hoster)
- Cf. GPL FAQ *Can I put the binaries on my Internet server and put the source on a different Internet site?*

Depositing source code to Software Heritage

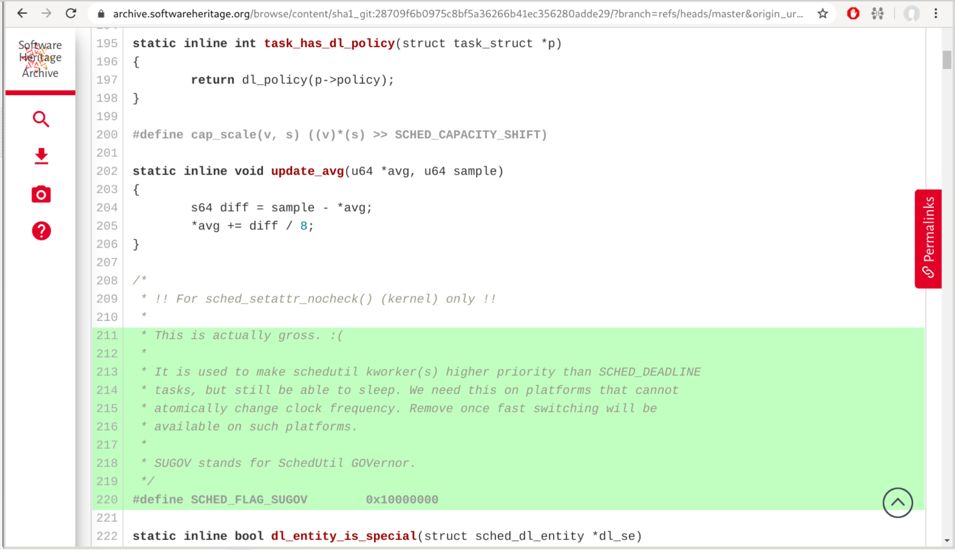
Deposit service

- complement regular (pull) crawling of forges and distributions
- restricted access (i.e., not a warez dumpster!)
- deposit.softwareheritage.org

Tech bits

- SWORD 2.0 compliant server, for digital repositories interoperability
- RESTful API for deposit and monitoring, with CLI wrapper

Web UI — Browse the Great Library of Source Code


archive.softwareheritage.org/browse/content/sha1_git:28709f6b0975c8bf5a36266b41ec356280adde29/?branch=refs/heads/master&origin_ur...
Software Heritage Archive
Permalinks

```
static inline int task_has_dl_policy(struct task_struct *p)
{
        return dl_policy(p->policy);
}

#define cap_scale(v, s) ((v)*(s) >> SCHED_CAPACITY_SHIFT)

static inline void update_avg(u64 *avg, u64 sample)
{
        s64 diff = sample - *avg;
        *avg += diff / 8;
}

/*
 * !! For sched_setattr_nocheck() (kernel) only !!
 *
 * This is actually gross. :(
 *
 * It is used to make schedutil kworker(s) higher priority than SCHED_DEADLINE
 * tasks, but still be able to sleep. We need this on platforms that cannot
 * atomically change clock frequency. Remove once fast switching will be
 * available on such platforms.
 *
 * SUGOV stands for SchedUtil GOVernor.
 */
#define SCHED_FLAG_SUGOV        0x10000000

static inline bool dl_entity_is_special(struct sched_dl_entity *dl_se)
```

https://archive.softwareheritage.org/<SWHID>

Web API — Integrate your tools with the Software Heritage archive

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/