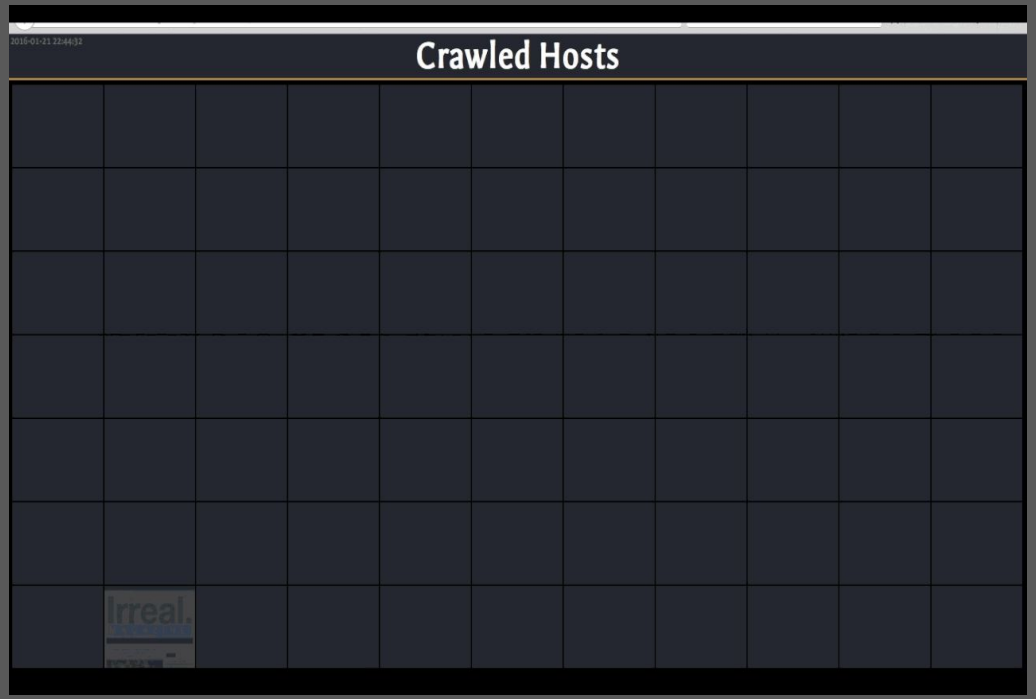
Perpetual Access Machines:
Archiving Web-published Scholarship at Scale



≠

Jefferson Bailey, Director, Web Archiving & Data Services, Internet Archive
Bryan Newbold, Open Data Engineer, Web Archiving & Data Services, Internet Archive
FORCE11 2019 | EDI | [jefferson], [bnewbold] @archive.org

The Internet Archive

Non-Profit Digital Library

Founded in 1996

HQ IN SF (come visit!)

Universal Access to All Knowledge

Total Digital Items

200,000	Software Titles
3,000,000	Moving Images
3,500,000	Books
4,500,000	Audio Recordings
20,000,000	Texts*
1,000,000	Users/day
800+	Institutional Partners
800,000,000,000+	URLs
50	PB (unique)

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Collection / Preservation Stats

Total Archiving

~8PB Total collected/year

~30TB Total collected/day

~50% Web data

Web & Data Services

~2.x+PB Per year via paid services

600 & $6M Orgs & Rev

~3.xTB Per year per org average

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Outline

1. **At Risk Scholarship**
2. Goals & Methods
3. Technical Approaches
4. What It Looks Like
5. Partnerships, Roadmap, Services

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Perpetual Access Archiving Challenges

- Print >>> Digital = custodial challenges
- Traditional curation doesn't scale
- Traditional deposit/services obsolete
- First-world preservation non-problems
- Long Tail: not English, STEM, or US/EU
- 94 problems... for web/born-digital OA

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Perpetual Access Access Challenges

- Wayback Machine = known URLs
  - But has ~600M PDFs (~5% scholarly)
- Web archives not (yet) in most search
- Scholarly outputs all over the dang web
- No QA/QC mechanisms or edit tools
- (Prior) no targeted, integrated harvesting

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goal

goal

- IA open infrastructure for public good/access
- Instead of specialized archiving services…
  - **Add “open scholarship” automation to the existing automation/scale of web harvesting**
- Instead of specialized curation and ingest…
  - **Develop tools to identify scholarly objects in existing harvests/archives, ID/correct incompleteness, augment with metadata**

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Methods / Approaches

Top-Down Approach

Harvest/archive PIDs, registries, metadata, manifests, etc to find web-published scholarly outputs to archive, extract/augment with metadata, etc

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Methods / Approaches

Bottom-Up Approach

Use machine learning tools to identify scholarly objects in TB/PB scale web archives, assess completeness, and match with versions, metadata, etc

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Methods / Approaches

Forever Approach

- Partnerships, services
- Open APIs, code, infrastructure
- Add to discovery services
- Add to data services
- Re-distribution & bulk access

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Tech Constraints

- **Bots and humans working together**
  - Augmentation
- **Open to public contributions**
  - don’t be a bottleneck
- **Build little new IA infrastructure**
  - efficient, risk reduction, perpetual-ish

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NEW!

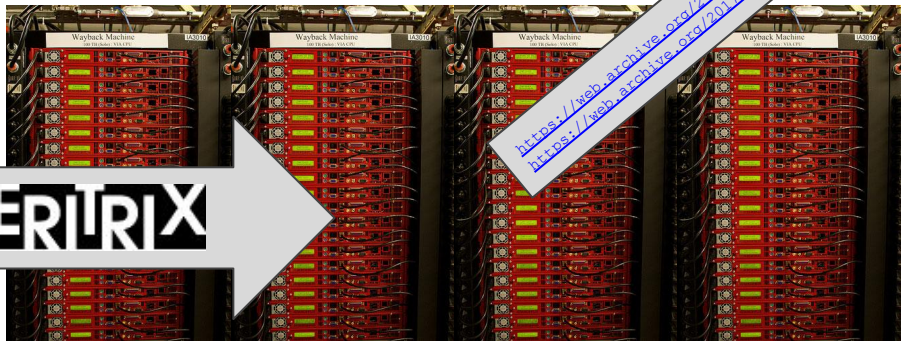
"fatcat"

NEW!

"sandcrawler"

WaybackMachine

https://web.archive.org/20190102O3/http://plos.org/...
https://web.archive.org/20170102O3/http://elife.org/...



https://fatcat.wiki/

https://github.com/internetarchive/fatcat

Ingest: Crawl Existing Indices

- **Usual suspect (registrars, indices)**
- **Transform metadata into CSL-like schema, import**
- **Bulk URL seedlist crawling, import “hits”**
- **Work with peer aggregators hosting fulltext**
  - OAI-PMH / IRs

CiteSeerX

Bulk Bibliographic Metadata

Internet Archive Web Group

This collection contains both external ("upstream") metadata dumps and Internet Archive generated databases and reports on our holdings of papers, books, and other documents.

Share
Favorite
RSS
Edit
History
Play All

ABOUT COLLECTION

https://archive.org/details/ia_biblio_metadata

82 RESULTS

SORT BY VIEWS · TITLE · DATE

Search this Collection

- Metadata
- Text contents

PART OF

The Internet Archive

Media Type

- data 81
- texts 1

Year

- 2019 17
- 2018 22
- 2017 11
- 2016 3
- 2015 1
- 2014 1

More

Topics & Subjects

- 2
- 1
- 1
- 1
- 1
- 1

Crossref DOI Dump (2018-01)
459 1 0

Crossref DOI Dump (2018-09)
259 0 0

Microsoft Academic Graph (2016-02-05 snapshot)
by Microsoft Academic Search
233 0 0

oaDOI DOI/URL Dataset
226 0 0

Sci-Hub DOI List
by Sci-Hub
225 0 0

Internet Archive Paper Manifest (2017-09-19)
151 0 0

Internet Archive Paper Manifest (2018-01-25)
136 0 0

CiteSeerX Database Dump (2017-03-31)
by CiteSeerX Group at PSU
128 0 0

Open Academic Graph (aminer.org)
by aminer.org
121 0 0

ORCID Public Data File (2017)
by ORCID, Inc
84 0 0

ROAD/ISSN Directory (2018)
by ROAD: Directory of Open Access Scholarly Resources
84 0 0

DOAJ Journal and Article Metadata (2018)
by Directory of Open Access Journals
71 0 0

CORE Open Access Paper Metadata (2017-11-
68 0 0

Internet Archive Paper Manifest (2017-10-06)
65 0 0

Journal ISSN Metadata Exploration (2018-04-05)
by Internet Archive Web Group

Ingest: Index Web Archives

1. **Petabytes of unsorted web resources**
   - HTML, PDF, Datasets, everything
2. **Filter down to likely research pubs**
3. **Try matching against existing catalog**
4. **Else, create new catalog records**

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PDF Tooling

pdf_classify

grobid

```
<?xml version="1.0"?>
<quiz>
 <qanda seq="1">
  <question>
   Who was the forty-second
   president of the U.S.A.?
  </question>
  <answer>
   William Jefferson Clinton
  </answer>
 </qanda>
 <!-- Note: We need to add
  more questions later.-->
</quiz>
```

XML

biblio-glutton

```
PS3557
.R5355          Grisham, John
F57 1991

        The firm / John Grisham. 1st. ed.
        New York : Doubleday, c1991.
        421p. ; 24 cm.

          1. Government investigators--Fiction.
          2. Organized crime--Fiction.
```

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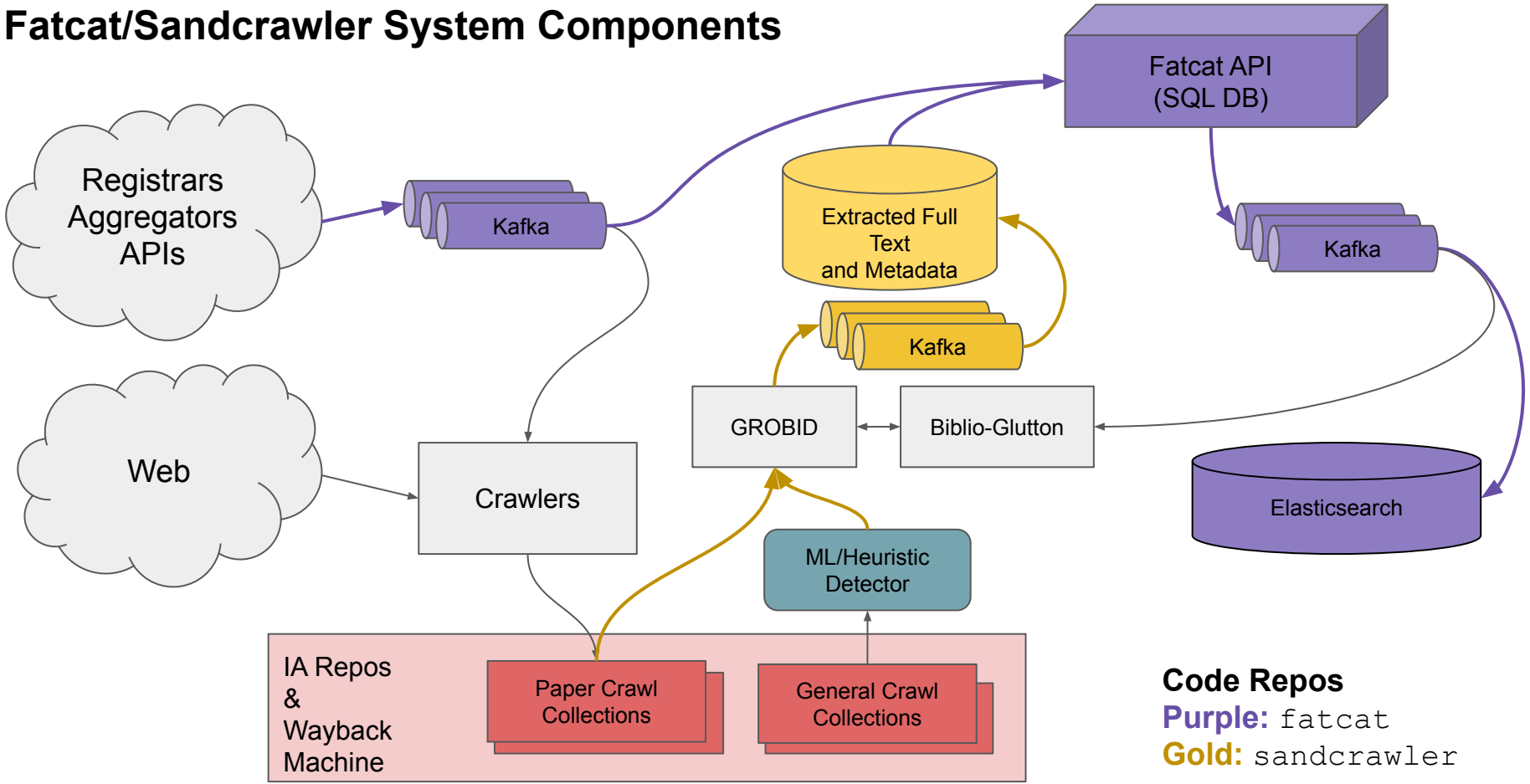
Fatcat/Sandcrawler System Components



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fatcat! About Guide Changelog Search Papers... Login/Signup

https://fatcat.wiki/

Perpetual Access to Millions of Open Research Publications From Around The World

by title, authors, identifiers... Search

96,947,165	18,117,429	140,085
Papers	Fulltext	Journals

Fatcat is a versioned, user-editable catalog of research publications including journal articles, conference proceedings, and datasets

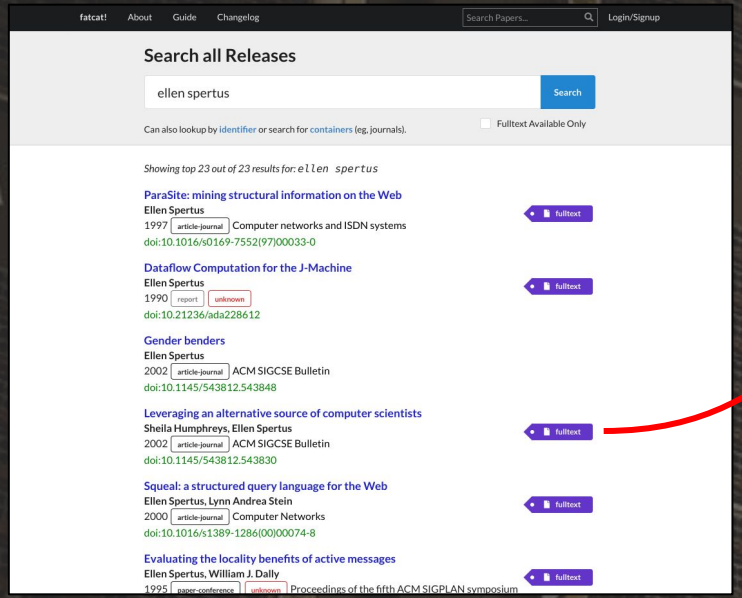
Features include archival file-level metadata (verified digests and long-term copies), an open, documented API, and work/release indexing (eg, distinguishing between and linking pre-prints, manuscripts, and version-of-record). Read more...

This service is hosted at The Internet Archive, a US non-profit dedicated to providing Universal Access to All Knowledge. Donations welcome!

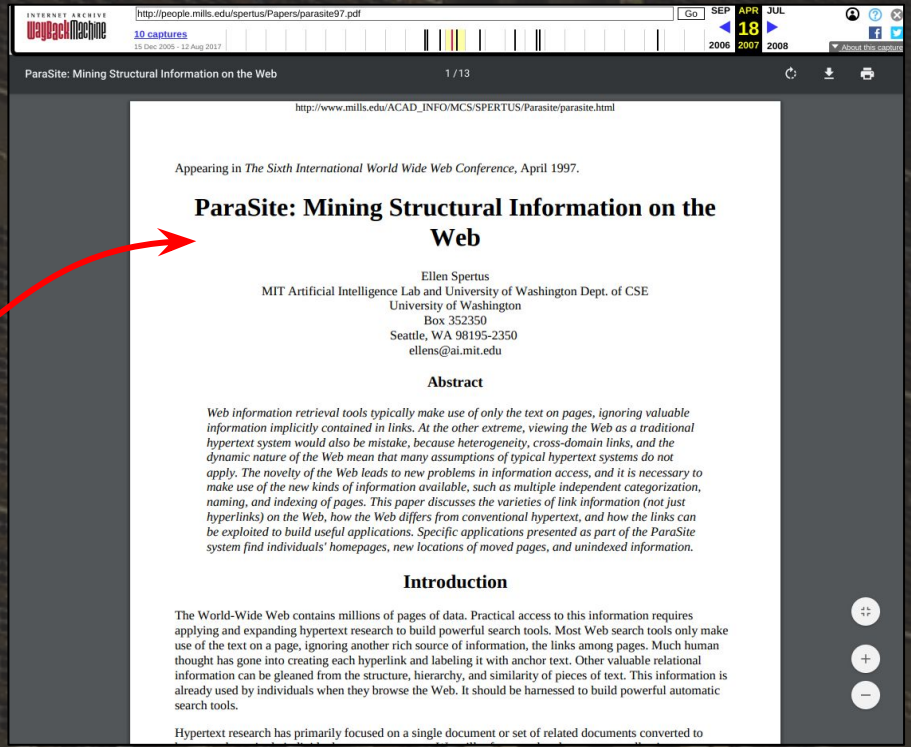
Development funding comes from The Andrew Mellon Foundation to improve preservation and access to "long-tail" open access works on the public web which might otherwise be lost.

INTERNET ARCHIVE

Basic Reader Access



Search



Wayback Replay

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Publication Status

PIDs Galore

Journal Metadata

Alt. Versions

API Helpers

Wiki Sauce

Fulltext Mirror Locations

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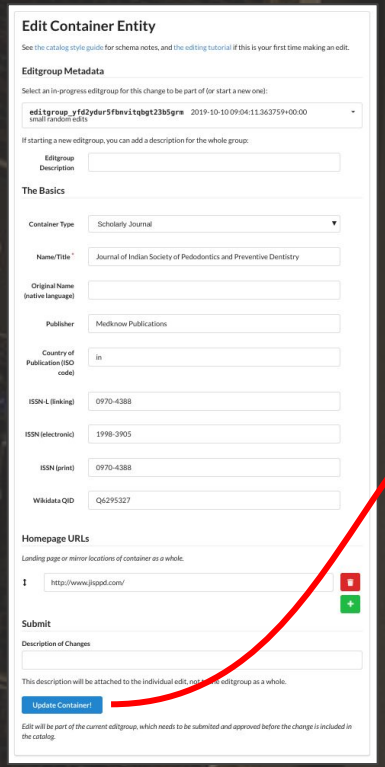
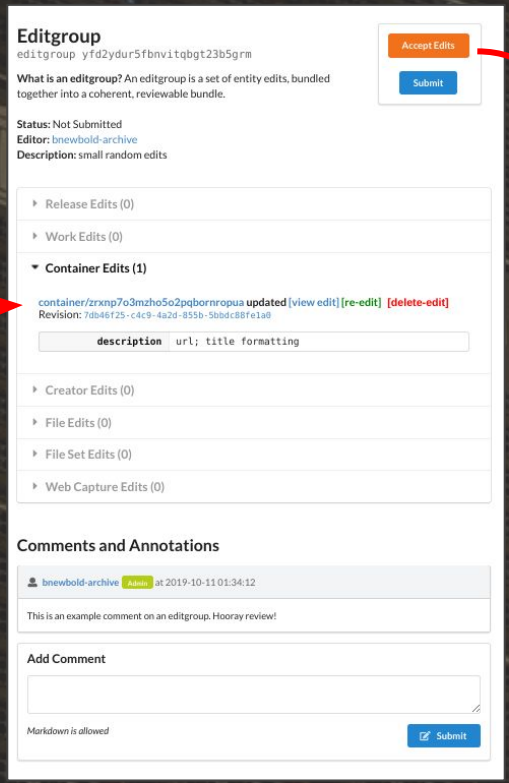
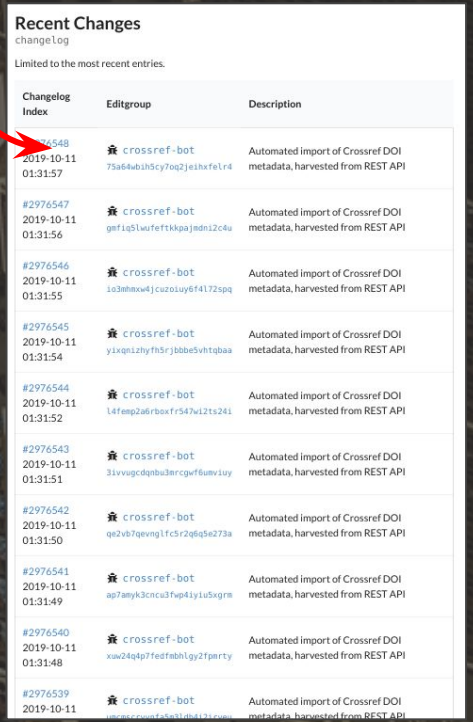
Editing Metadata



Edit



Collaborative Review



Changelog

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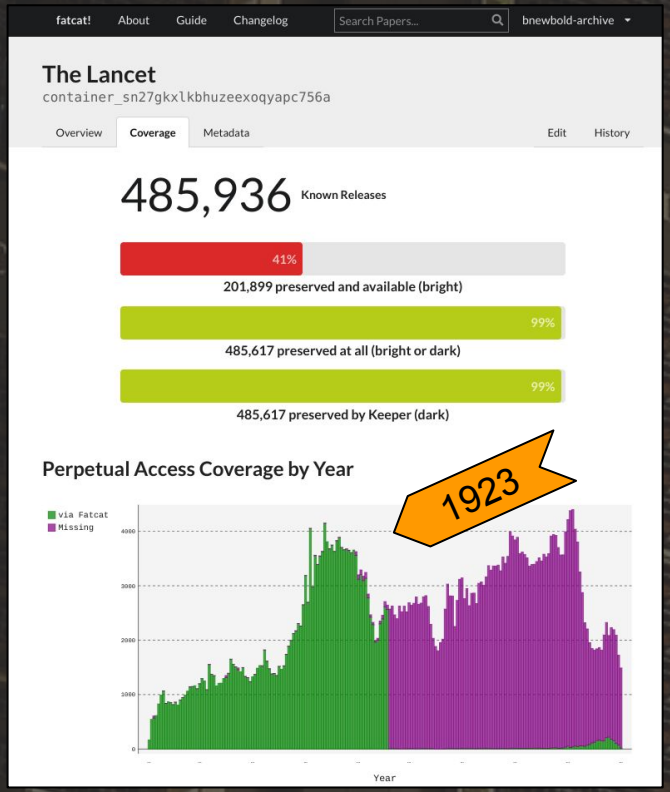
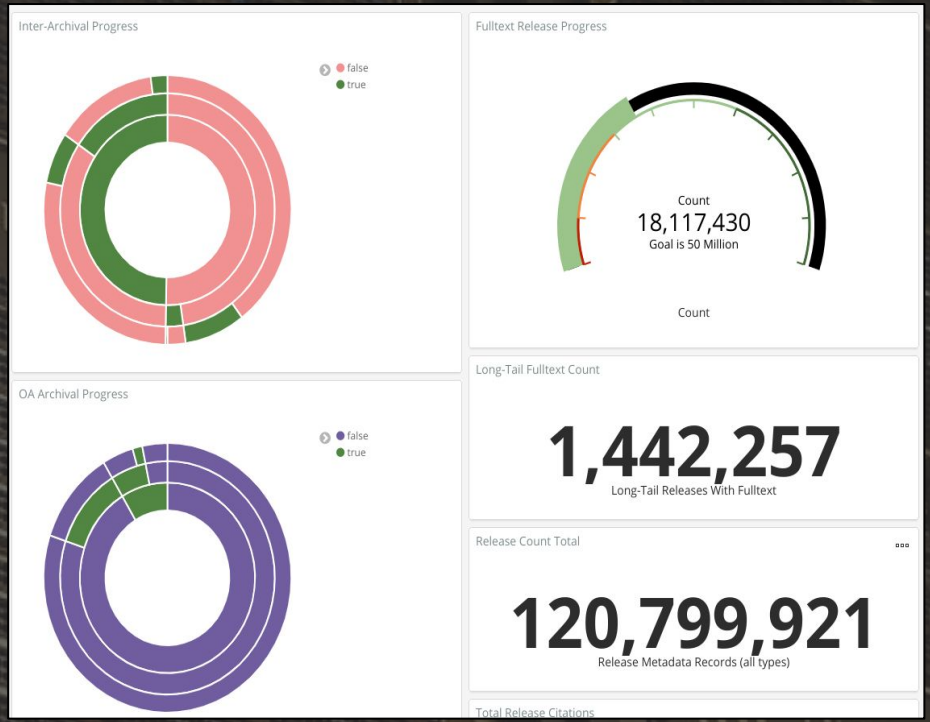
Coverage Dashboards





Journal Level

Collection Level

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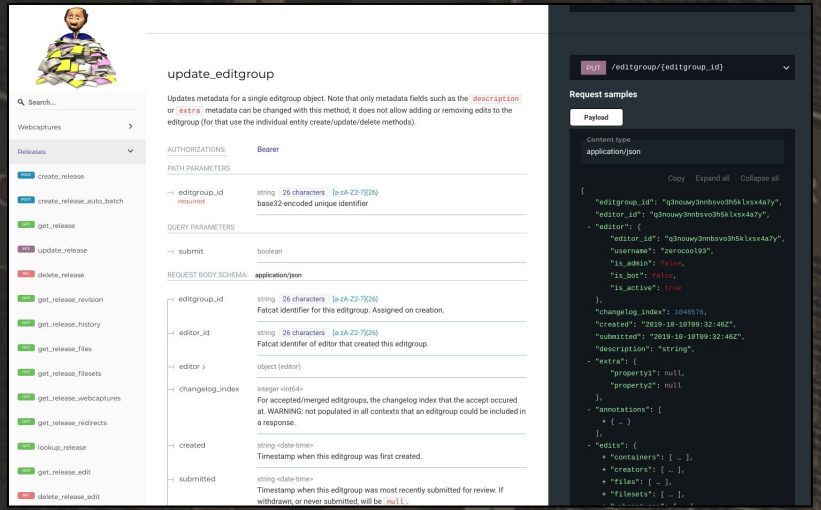
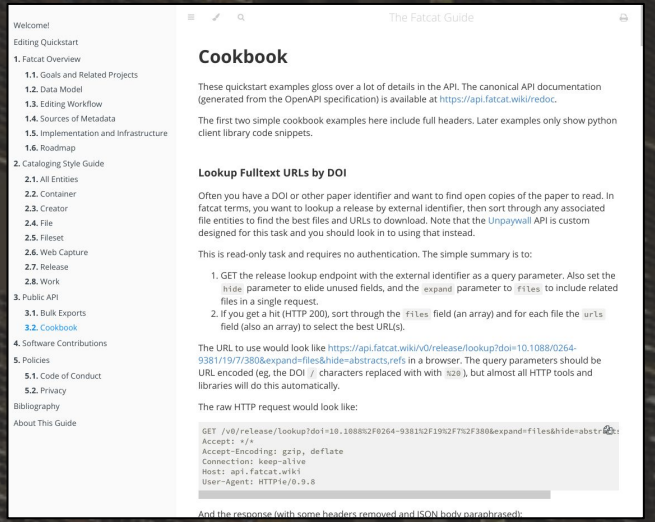
#DeveloperThings





API Specification and Docs

https://api.fatcat.wiki

“The Guide”

https://guide.fatcat.wiki

Also: dumps, feed, code, client libraries, sandbox, etc

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PARTNER

- Center for Open Science - open data archiving
- PID+, preservation, & discovery services
- Unpaywall/OR: data/access sharing
- CDL/Dat: datasets in dweb
- Partial funding: Mellon, IMLS

THE ANDREW W. MELLON FOUNDATION

Semantic Scholar

COS CENTER FOR OPEN SCIENCE

our research

University of California CDL California Digital Library

LOCKSS

INSTITUTE of Museum and Library SERVICES

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dat://

ISSN

DOAJ DIRECTORY OF OPEN ACCESS JOURNALS

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Current Work & Roadmap

- Beyond PDF: html, data, code, etc
- Secondaries & platforms
- “Save Paper Now”
- Full-text search for everything
- Citation integrity & indexing
- Bulk Data Sharing

Entities		
"Papers"	Total	98,142,998
	Fulltext on web	18,117,430
	"Gold" Open Access	9,700,221
	In a Keepers/KBART archive	59,742,897
	On web, not in Keepers	8,203,985
Releases	Total	121,015,771
	References (raw, unlinked)	780,160,922
Containers	Total	140,931

https://fatcat.wiki/stats

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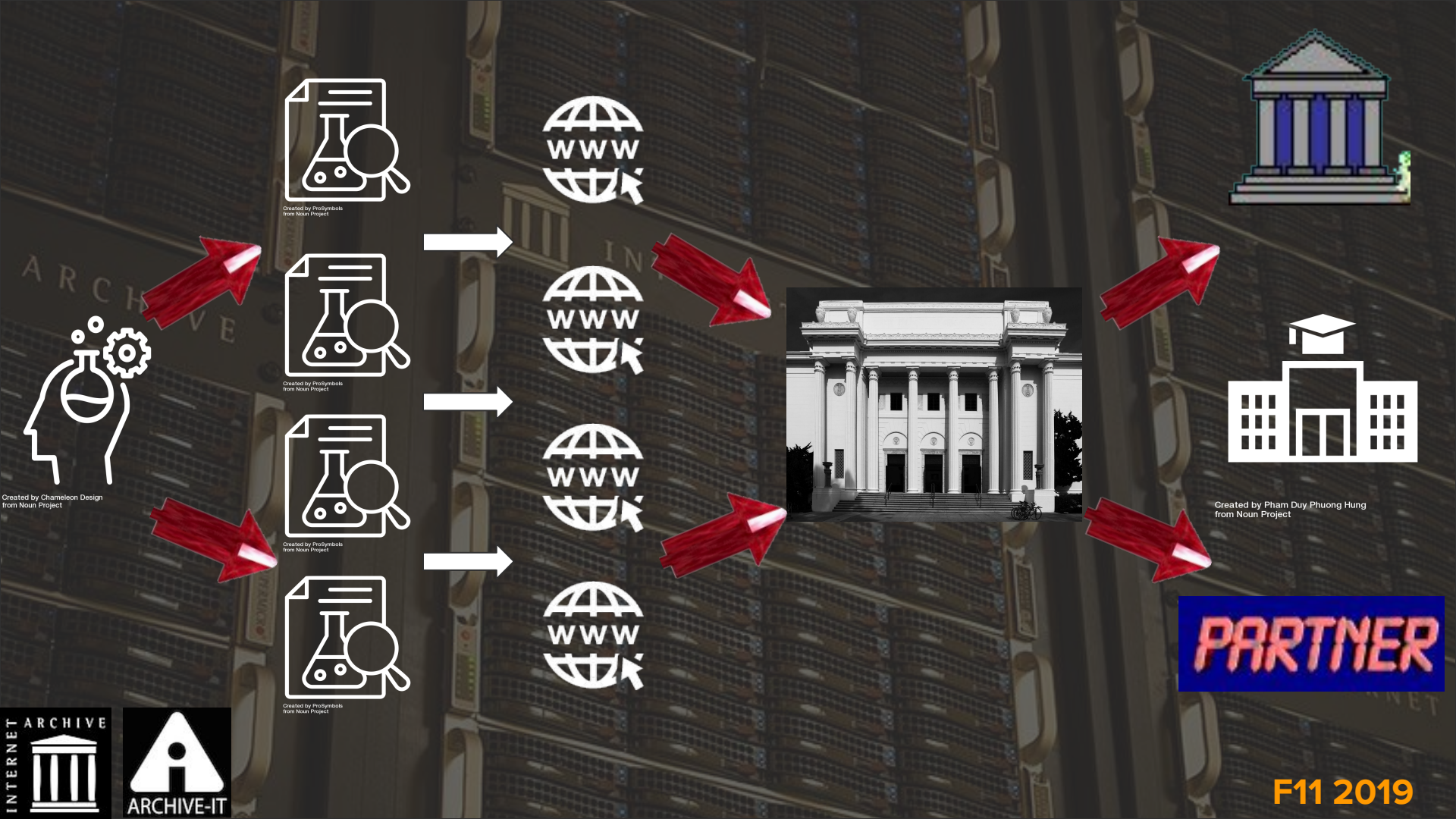
Created by ProSymbols from Noun Project
Created by ProSymbols from Noun Project
Created by ProSymbols from Noun Project
Created by ProSymbols from Noun Project
Created by Chameleon Design from Noun Project
Created by Pham Duy Phuong Hung from Noun Project
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Service Developments

- Build on existing service relationships with 600+ research & knowledge orgs
- Embed in existing services, Archive-It
- Content Deposit Services
- Data/Digital Preservation Services
- Computational Research Data Services
- PIDtegrations
- We'll do any pilots, collaborations, R&D!

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THANKS! CONTACT US!

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Bryan Newbold, Open Data Engineer
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Special Thanks!!
Volunteers: David Rosenthal, Vicky Reich, Ellen Spertus
Funders: Mellon Foundation, IMLS

Internet Archive, https://archive.org
Fatcat beta, https://fatcat.wiki/

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