

# OpenWebSearch.eu - Building an Open Index of the Web on HPC Infrastructure

Prof. Dr. Michael Granitzer  
Chair of Data Science, University of Passau  
Coordinator OpenWebSearch.eu

HPCSE 2026 · IT4Innovations · 2026-05-20

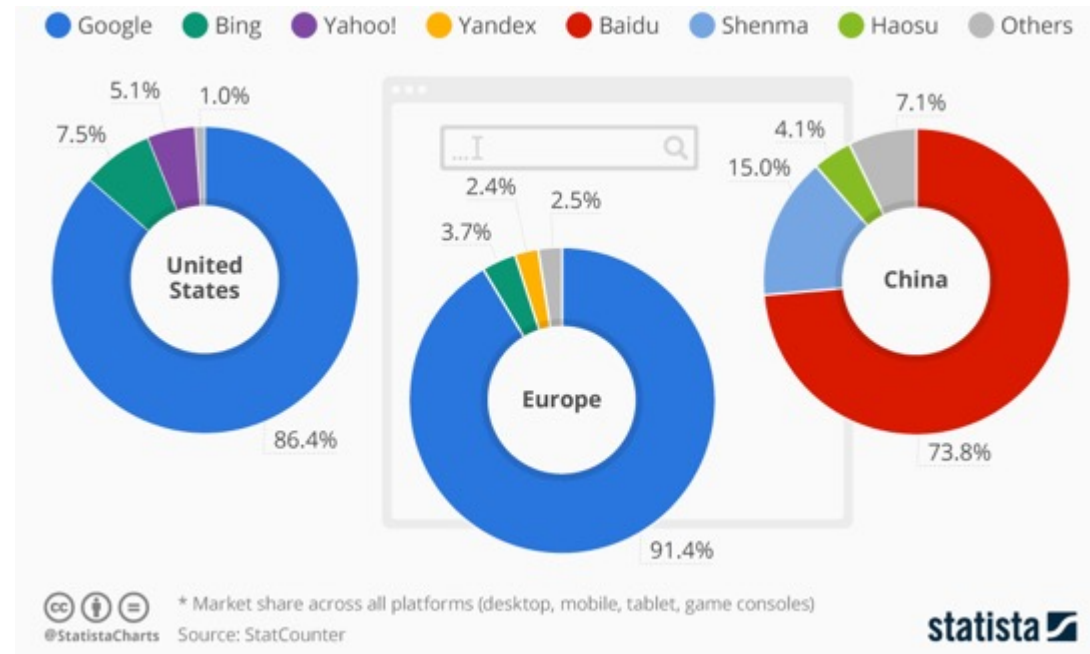


# Web Search Today

A critical resource managed as an oligopoly

## Two properties that don't fit

- A **critical infrastructure** for society, comparable to satellite navigation
- A **market oligopoly**: dominated by a small number of gatekeepers (Google, Microsoft, Baidu, ...)



# But does it matter? Yes — on four dimensions

## User Choice & Democracy

- Single gatekeeper for society's information
- Search rankings can shift voting preferences by **20–72%** (SEME)
- Monopolistic ranking = single point of failure for information quality

## Untapped Richest Information Source

- 60 % of web pages carry structured data
- No open access to web-scale document collections
- Science, research and technology heavily depend on the Web as platform

## Societal & Security Risks

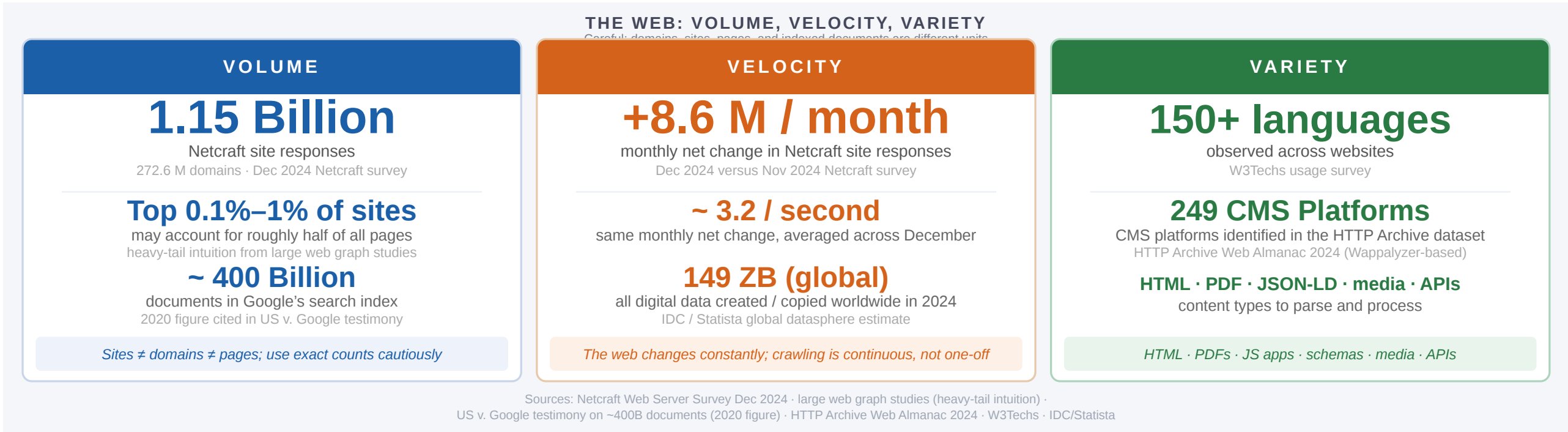
- European OSINT depends on US-controlled infrastructure
- Filter bubbles, algorithmic bias
- Misinformation & Disinformation

## AI & Innovation

- Web data is the fuel for LLMs, RAG, and agentic AI
- Closed indices block reproducible research & open innovation

Being able to navigate the Web is as fundamental as GPS or the power grid

# Challenges

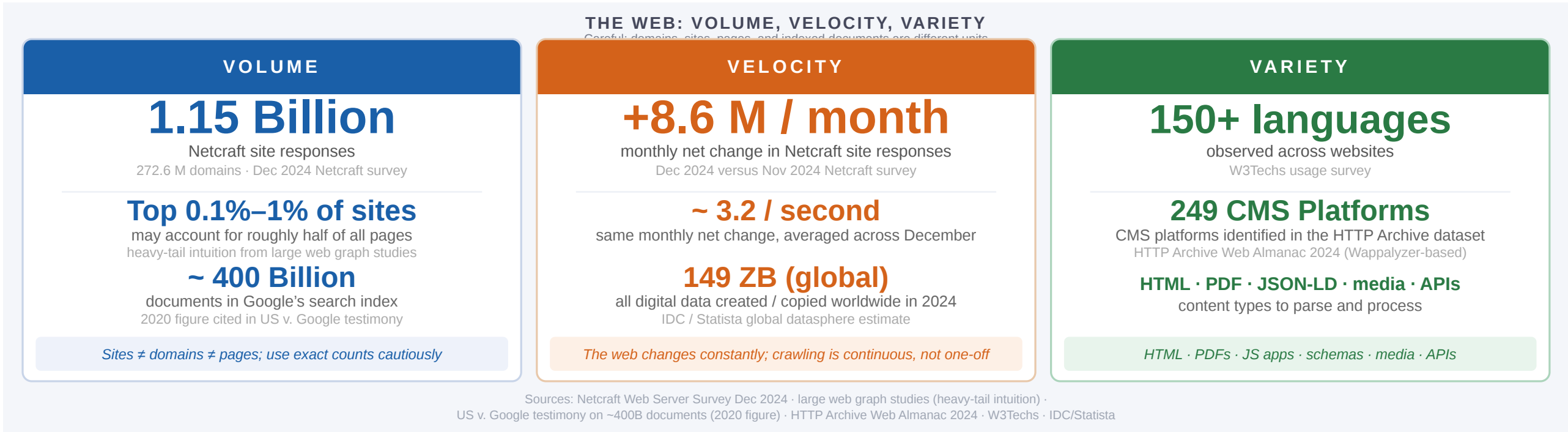


- High infrastructure costs
- Broad range of technical skills required
  - Big Data Infrastructure
  - Natural Language Processing, Image Analysis
  - Web Technologies
- Growing legal uncertainties





# Challenges



- High infrastructure costs
- Broad range of technical skills required
  - Big Data Infrastructure
  - Natural Language Processing, Image Analysis
  - Web Technologies
- Growing legal uncertainties

High upfront costs to tap the Web as resources — especially small innovators and



researchers are left  
behind



# OpenWebSearch.eu — Our Mission

Building an Open Index of the Web and an open infrastructure to reduce upfront costs for researchers, innovators and companies in tapping the Web as a resource for search, web-analytics and AI.

## Four Objectives

- 1. Open Technology Stack**  
Open-source pipelines for crawling, preprocessing, indexing
- 2. Resource Provision** Building a network of infrastructure providers (EuroHPC / AI Factories)
- 3. Added Value Services**  
Dashboard, tools, data access APIs
- 4. Bootstrapping the Ecosystem** Third-party calls, community building, applications and use-cases

## 14 Core Partners

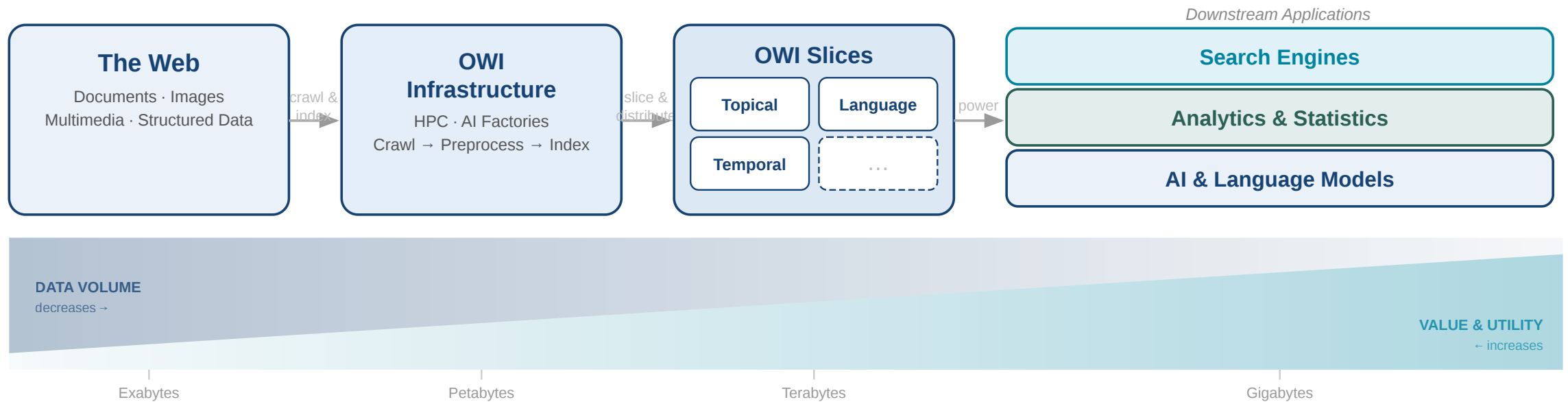


Plus 16 financially supported third-party projects (FSTPss)

# The Open Web Index (OWI)

A **Web Index** = a data structure for fast query-based access and ranking of web documents — the core of every web search engine

**Our Proposition:** A collaboratively created, open and transparent Web Index running on existing HPC computing centres / AI Factories in Europe



# What is the Open Web Index?

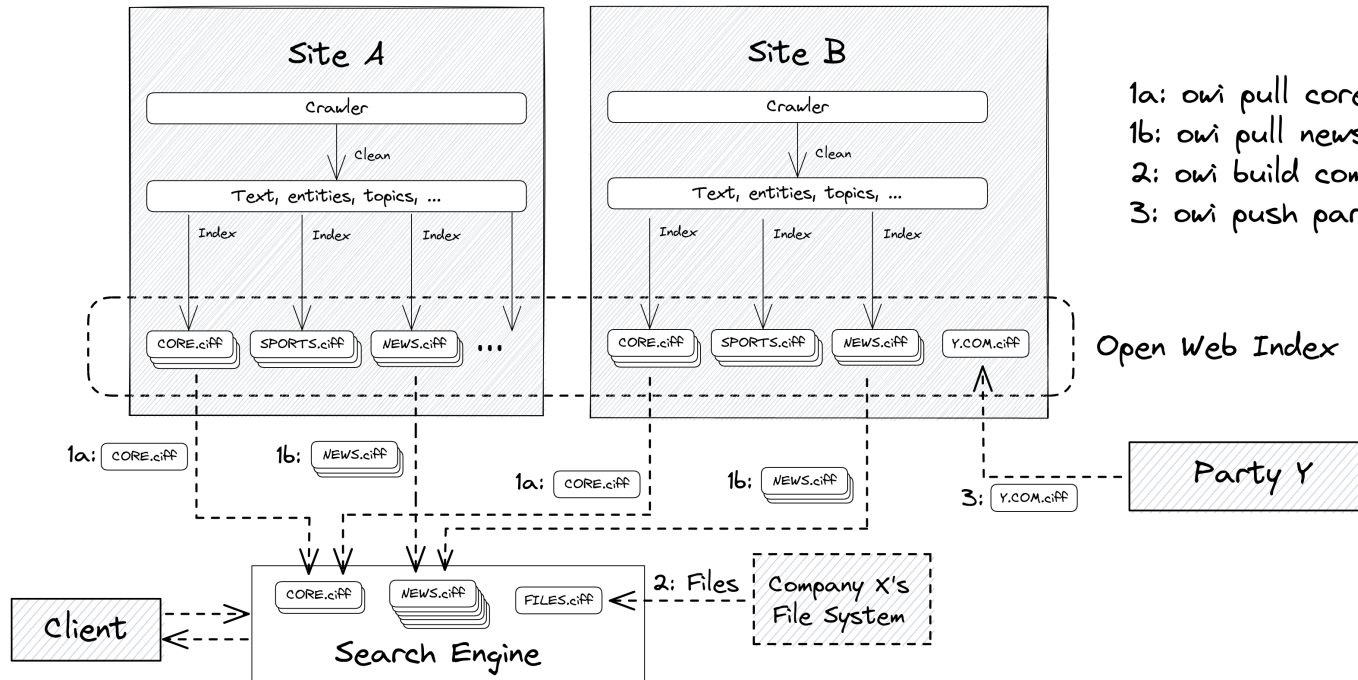


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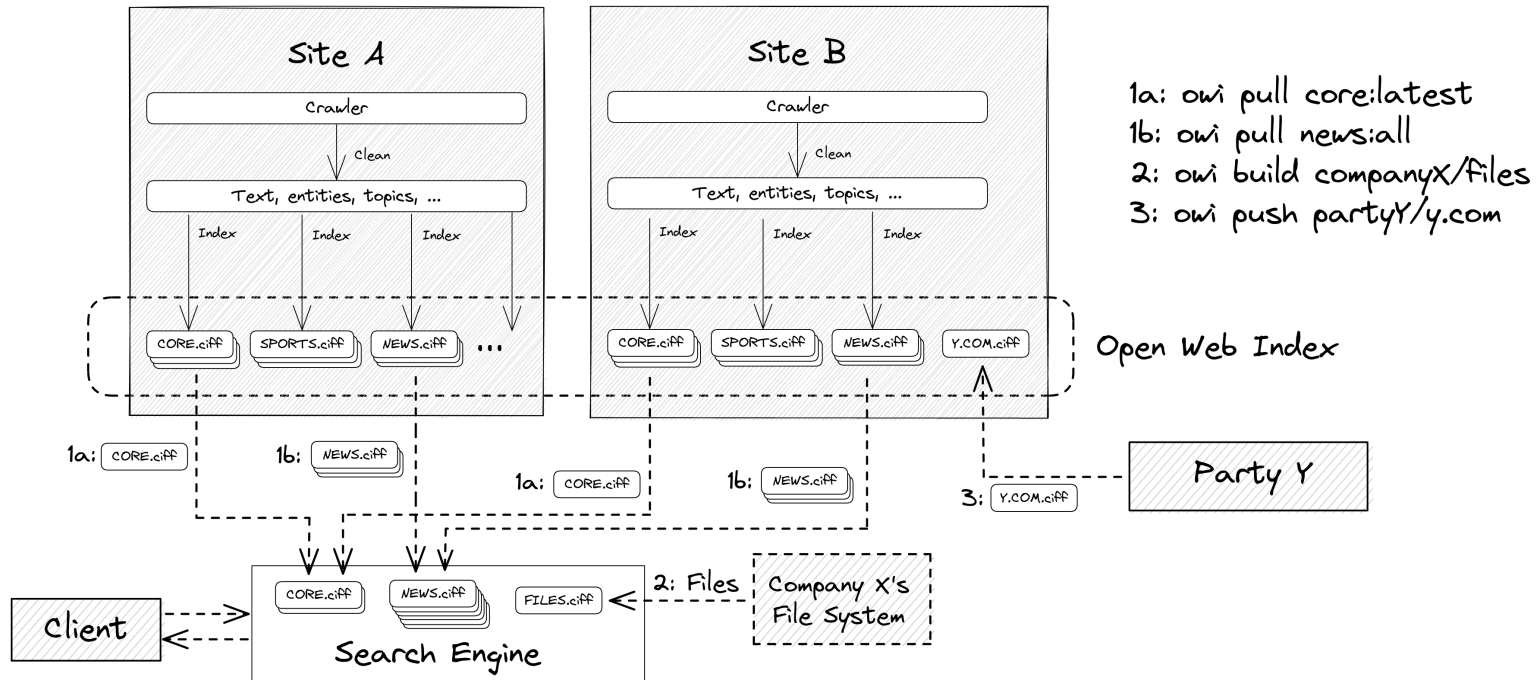


## The OWI provides:

- **Pull** — download daily pre-built index shards (by date, language, topic)
- **Build** — create a local index from your own data
- **Push** — contribute custom indices back to the OWI

# What is the Open Web Index?

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## Three output types per daily run:

- `index.ciff.gz` — sparse inverted index (CIFF format; pre-configured tokenizer)
- `metadata_*.parquet` — document metadata & enrichments (topics, microdata, locations, language, etc.; extensible)
- Dense embeddings (GPU-enriched slice, Jina V3) for AI-based Search and Classification (on selected subsets)

# OWI at a Glance — Statistics (Feb 2026)

## Crawling

Pages crawled	~39 B total, ~12 B unique
Unique hosts	~500 M (extrapolated)
Crawling effort	1,927 machine-days
Avg. throughput	~20 M URLs / day

## Index

Documents indexed	~10.7 B
Unique domains	~75 M
Public datasets	511 main / 1,511 total
Index size	45 TB (main) / 50 TB total
Embeddings	119 M docs · 884 GB

**Top languages:** English (38.9%), German (7.2%), Spanish (6.4%), French (5.7%), Russian (5.2%)

**Comparison:** To meet commercial index size, OWI would need to scale by a factor of 20× — factor 10–50× for multimedia

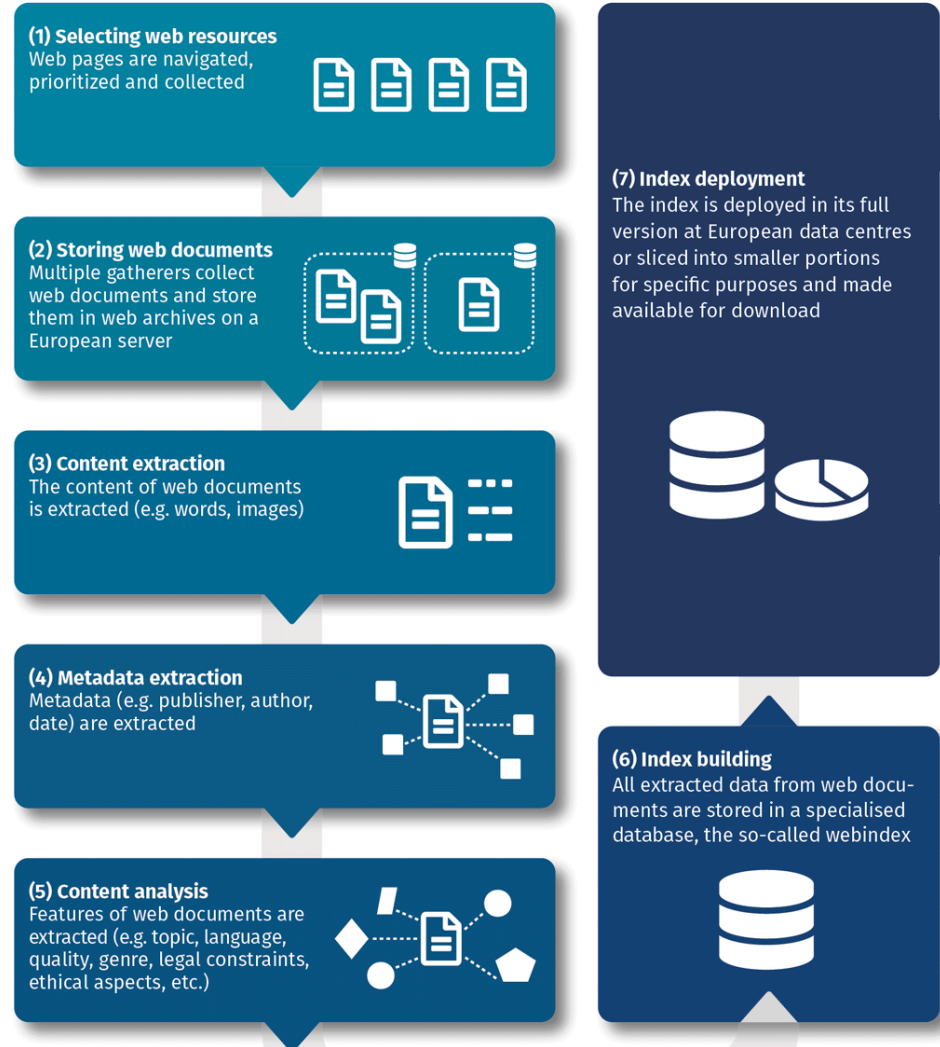
# Building the Open Web Index



# Conceptual Workflow

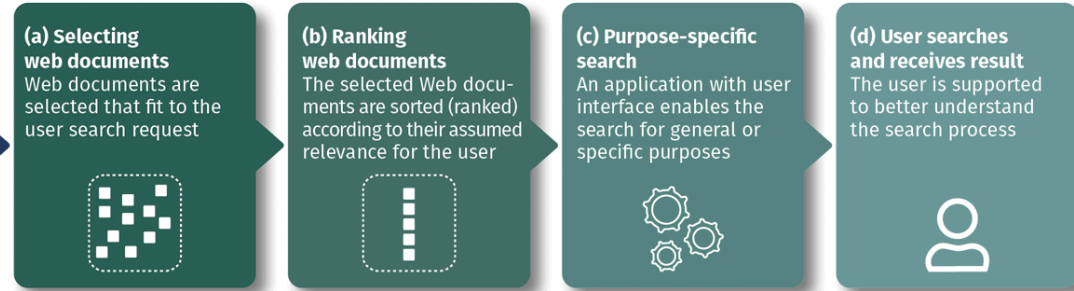
## Index Generation

Web resources are selected and retrieved, their content and metadata are analysed, and all data stored in the index database.



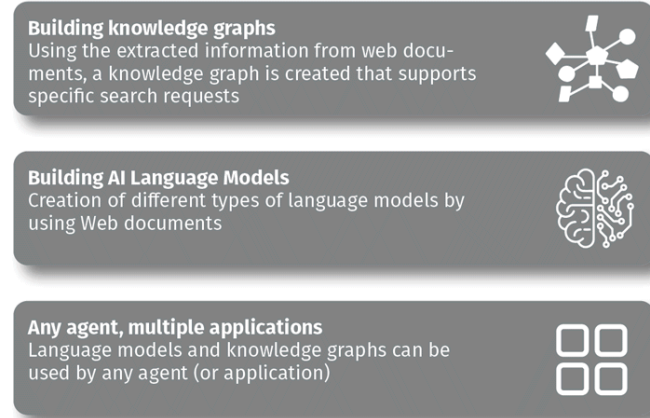
## Search Applications

A user search request will be answered by a search application that makes use of the open web index.



## Data Products

Knowledge representation models will be created using the open web index, in order to be used by any agent and for many applications

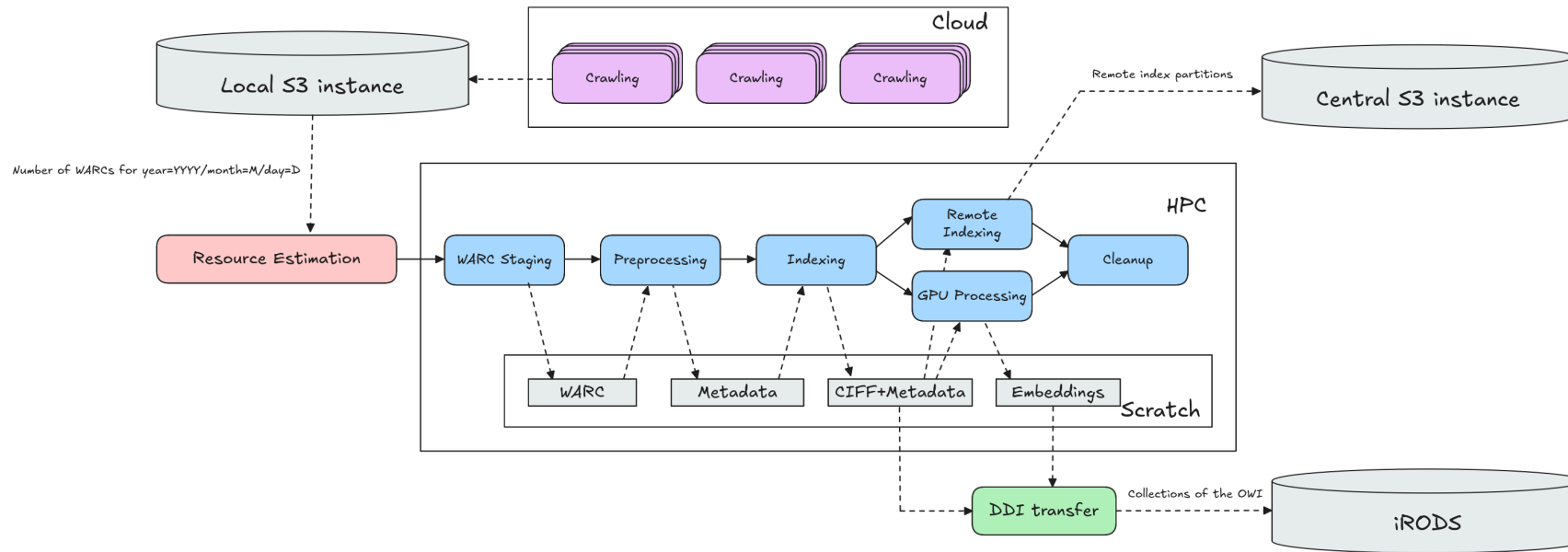


...





# Daily Workflow Pipeline



## Infrastructure (2026)

- **25 VMs** across IT4I, LRZ, CSC, CERN
- **100 M URLs / day** crawling capacity
- **~1.1 PB** raw data · **~50 TB** index · **810+ public datasets**
- Federated storage: iRODS + S3, orchestrated via LEXIS

## Limitations as of 2026

- TLR 5/6: it is not a product (yet)
- No 24/7 Operations
- Limited funding - minimum engineering / improvement

# OWI on HPC Infrastructure



# Why the OWI is an HPC Workload

## Web-scale data path

- crawl and archive web pages as WARC data
- preprocess text, language, metadata, links, quality signals
- build sparse index shards in CIFF
- publish aligned Parquet metadata for analytics
- enrich selected slices with dense embeddings

## The bottlenecks shift by stage

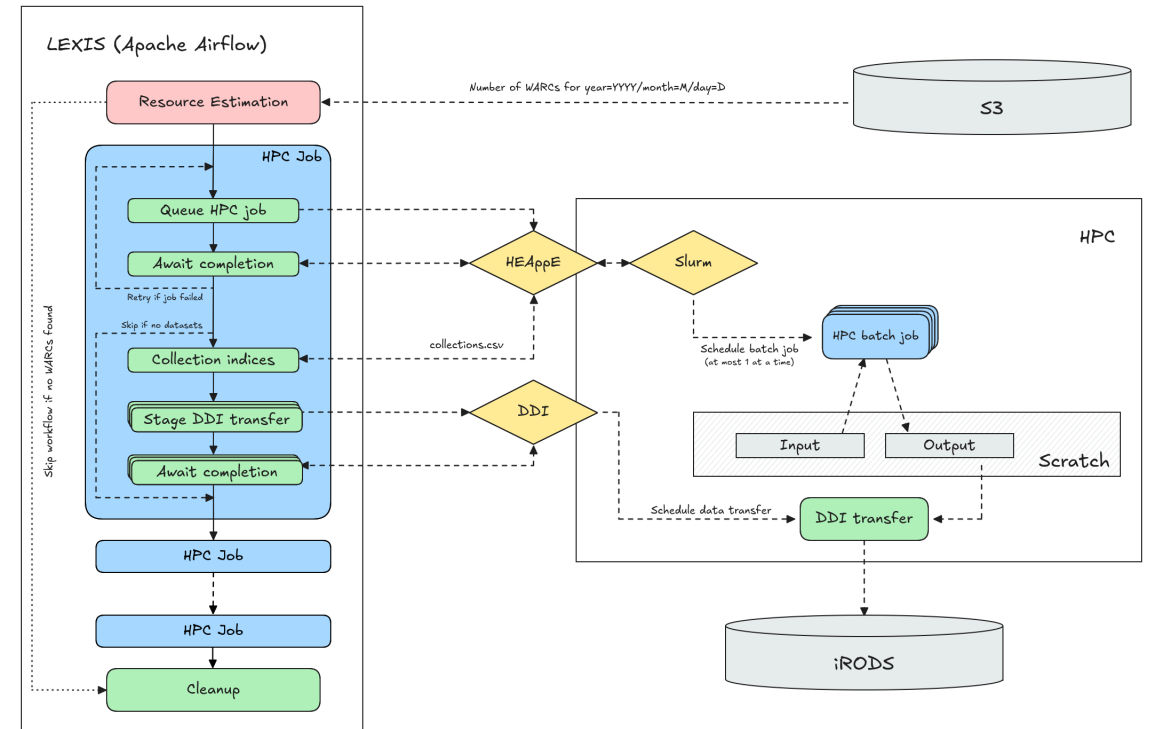
Stage	Dominant pressure
Crawling	network, scheduling, politeness
WARC processing	I/O, parsing, decompression
Indexing	memory, sorting, parsing, CPU
Metadata analytics	columnar scans
Embeddings	GPU throughput, vector storage

The Open Web Index is not just a search demo. It is a recurring, data-intensive production workflow that turns web-scale raw data into reusable search and AI datasets.

# How We Use LEXIS for the Open Web Index

## LEXIS Workflows to build the OWI

- coordinates OWI workflows across participating HPC/data centers
- connects compute jobs with federated storage locations
- helps stage input data and publish daily OWI outputs
- supports the operational bridge between crawling, processing, indexing, and distribution



Workflow orchestration via LEXIS

LEXIS is the core component for how OpenWebSearch.eu turns distributed HPC resources into a repeatable Open Web Index build process.

# From Indexing to Embedding at Scale

## Classical OWI output

- sparse inverted files for lexical retrieval
- metadata partitions for filtering and analytics
- compact daily shards by date, language, data center, and collection

## New AI-oriented output

- dense document embeddings for semantic retrieval
- topic/domain/language slices for RAG systems
- compression and pruning to make vector indices affordable
- GPU workloads that must be scheduled next to classic indexing jobs

The HPC question is no longer only: "Can we crawl and index the web?" It is also: "Can we semantically enrich web-scale collections often enough to support AI search?"

# Accessing the Open Web Index



# The Dashboard — openwebindex.eu

OWI

Dashboard

SERVICES

- Websites
- Search
- SercI Search EXTERNAL
- Crawling

EXPERIMENTAL

- Deep Research

UTILITIES

- Parse Preview
- Ethics Readiness Check

Impressum

Privacy Statement

Terms of Use

Open Web Search Book

Open WebSearch

Open Web Index

Overview OWI Statistics OWI Datasets OWI Corpora OWI Models

## The Open Web Index

Your daily dose of web data!

Welcome to the Open Web Index (OWI)- your way to slice and dice the Petabytes in the Web to your needs. Our mission is to contribute to a fair, open, diverse and free Web by providing an open Index of the Web for you to use. This dashboard gives an overview over this [Open Web Index](#) and provides some prototype services on top of the OWI.

### What can you find here?

Discover our comprehensive suite of tools and services designed to help you explore and analyze web data.

- OWI Statistics**  
Get an overview of the data we offer
- OWI Datasets**  
Browse through available datasets
- OUR Search**  
Search through URLs and Titles
- Documentation**  
Access tutorials and detailed documentation

**Expect Bugs:** While we try to provide as many valuable datasets and services as possible, please always remember that this is still a research project. So we cannot guarantee that everything works perfectly fine and we cannot take any responsibility if something is not working as intended. Bugs are to be expected, but if you encounter some, please get in touch with us so that we can improve.

Bug Report SZ

## Central entry point for the Open Web Index [openwebindex.eu](https://openwebindex.eu)

- **OWI Statistics** — crawl volume, index size, language distribution, dataset timeline
- **OWI Datasets** — browse, filter and download index shards (by DC, date, format, language)
- **Search** — demo content search + SERCI integration

424 registered users · 17,000+ unique visitors · 70,000+ page views

# Dashboard — Statistics & Datasets



## OWI Statistics (04/26)

- **1,389 TB** crawled · **281** WARC datasets · **1,696** public datasets · **35.09 TB** index
- Language distribution chart (English 38%, German 8%, French 6%, ...)
- Crawl volume over time per data center + dataset collection distribution by type
- Datasets over time

# Dashboard — Statistics & Datasets

## Available Datasets

The data shows the datasets available for download (i.e. public owi datasets) or upon request (mostly project private warc datasets) by using our [LEXIS Platform](#) or our [OWI Command Line Tool](#). A dataset is a temporal slice, most often a single day, of crawled (warc), preprocessed and indexed data (owi).

**All systems are online**

All components are functioning properly. Data repositories and services are accessible.

Last Updated: 12/04/26, 15:36

SYSTEMS	DESCRIPTION	COMPONENTS			STATUS
IT4I	connected	Repository	Project	Public	ONLINE
LRZ	connected	Repository	Project	Public	ONLINE

Filter datasets...

All Collections

All Datacenters

All Resources

Public

Sort by: Collection Date

**OWI - Open Web Index** 204.5 MB

05/04/2026 → 05/04/2026 253 files

LEGAL IT4I PUBLIC

All OWI data crawled between 2026-04-05 and 2026-04-05 at CSC2

owilix remote pull all/internalID=fcb68e42-3191-11f1-8cbe-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 24.3 GB

05/04/2026 → 05/04/2026 1,065 files

MAIN IT4I PUBLIC

All OWI data crawled between 2026-04-05 and 2026-04-05 at CSC2

owilix remote pull all/internalID=fab586e-3191-11f1-9f25-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 2.1 GB

05/04/2026 → 05/04/2026 365 files

CURLIE\_FULL IT4I PUBLIC

All OWI data crawled between 2026-04-05 and 2026-04-05 at CSC2

owilix remote pull all/internalID=fabf3850-3191-11f1-af7e-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 63.6 MB

05/04/2026 → 05/04/2026 163 files

LICENSES IT4I PUBLIC

All OWI data crawled between 2026-04-05 and 2026-04-05 at CSC2

owilix remote pull all/internalID=fac99de2-3191-11f1-b11f-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 3.6 GB

05/04/2026 → 05/04/2026 374 files

GPU IT4I PUBLIC

All OWI data crawled between 2026-04-05 and 2026-04-05 at CSC2

owilix remote pull all/internalID=faf69d860-3191-11f1-9f25-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 40.8 MB

03/04/2026 → 03/04/2026 6 files

GPU IT4I PUBLIC

All OWI data crawled between 2026-04-03 and 2026-04-03 at CSC2

owilix remote pull all/internalID=2f8f678c-2fd5-11f1-8ad8-3e9ca2b0f439

VIEW STATISTICS

View Dataset License
Open in LEXIS Portal

**OWI - Open Web Index** 275.8 KB

03/04/2026 → 03/04/2026 2 files

LICENSES IT4I PUBLIC

All OWI data crawled between 2026-04-03 and 2026-04-03 at CSC2

**OWI - Open Web Index** 5.3 MB

03/04/2026 → 03/04/2026 8 files

CURLIE\_FULL IT4I PUBLIC

All OWI data crawled between 2026-04-03 and 2026-04-03 at CSC2

**OWI - Open Web Index** 108.4 MB

03/04/2026 → 03/04/2026 73 files

MAIN IT4I PUBLIC

All OWI data crawled between 2026-04-03 and 2026-04-03 at CSC2

## OWI Datasets Tab

- Status of repositories
- Filter by datacenter, format (WARC / Parquet / CIFF / Embeddings), language, date
- Dataset cards with download links — LEXIS Portal or owilix CLI
- Parquet file preview directly in the browser



# Download Tool: owilix

## owilix — The OWI Command-Line Tool

Git-like versioning for index datasets — pull, build, push:

```
owilix remote pull all:latest/collectionName=main
owilix local ls all:latest
```

Slice by: **domain**, **language**, **topic** (Curly), **sitelist**, **structured data**, **outlinks**

Authentication via B2ACCESS / Keycloak (LEXIS SSO)

## Remote Index — Query first, then Download

- Parquet partitions directly queryable via **DuckDB** or **Apache Spark**
- Full-text search
- SQL access: filter by language, domain, date — no full-shard download needed
- Enables search + filtering + download (but still in alpha phase)

## OWILIX - Open Web Index CLI

version 5.3.1 python 3.11+ license Apache 2.0

A command-line tool for managing [OpenWebIndex](#) datasets across local and remote repositories.

### Quick Start

#### One-Line Install (Recommended)

```
curl -fsSL https://openwebindex.net/owilix/install.sh | sh
```

<https://opencode.it4i.eu/openwebsearcheu-public/owi-cli/>

```
[~] ~ owilix remote search "michael granitzer" --limit 10
Searching remote index: terms=['michael', 'granitzer'] language=eng representation=main_content mode=OR limit=10
Found 10 results in 113.4s
Search results (10 results in 113.4s)
```

score	date	url
3.088	2025-12-30	https://easychair.org/smart-program/ICADL2024/person16.html
3.010	2026-02-19	https://www.wolframalpha.com/input/?i=michael
3.010	2026-01-19	https://www.michaelmoennich.com/
3.010	2025-12-08	https://michaelkoenig.de/
3.010	2026-01-05	http://www.michaelmoerk.dk/
3.010	2026-01-22	https://michaelkoenig.de/
3.010	2026-02-18	https://www.sktthemes.org/forums/users/dedicationpt/replies/
3.010	2026-02-26	https://www.abeldiaz3.com/tag/michael/
3.010	2026-02-20	https://discourse.psychopy.org/u/michael
3.010	2026-02-27	https://thedigitalgobag.com/author/michael/



# The OpenWebSearch Book

Comprehensive Documentation at [openwebindex.eu/book](https://openwebindex.eu/book)

Covers the full OWI ecosystem:

- Getting started with owilix
- Building vertical search engines with MOSAIC
- Data formats: CIFF, Parquet, embeddings
- Pipeline architecture and HPC deployment
- Legal & ethical guidelines for index users

Published as an open, continuously updated online resource — aligned with deliverables and community feedback.

# Access Modes at a Glance

Tool	Mode	Best for
<a href="#">Dashboard</a>	Browser	Explore, monitor
<a href="#">owilix</a>	CLI	Download, slice, build
Remote index	DuckDB/SQL	Query + download
<a href="#">MosaicRAG</a>	Conversational	RAG & chat over OWI

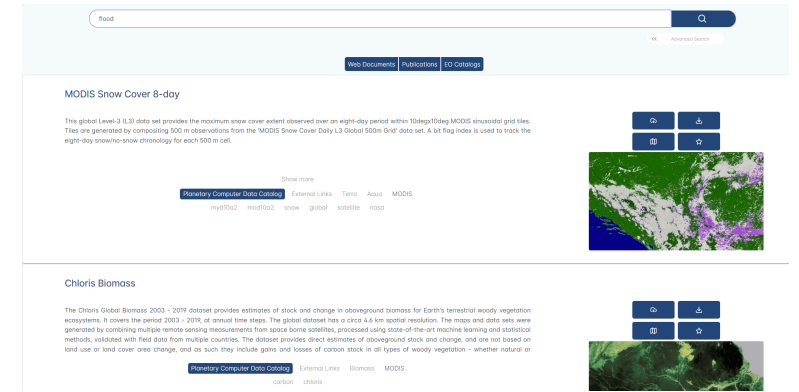
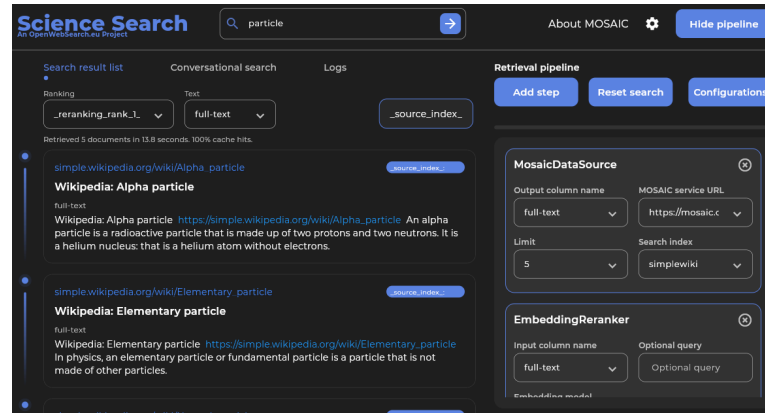
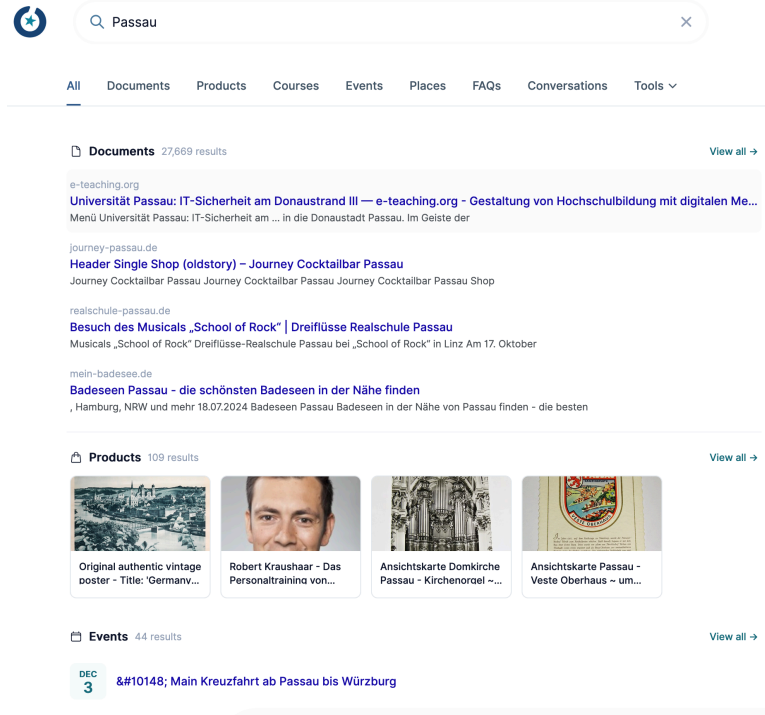
All software, data formats and access tools are **open source**



# Using the Open Web Index



# Using the Open Web Index — Search and RAG



## OUR<sup>2</sup>S

Hosted search UI and REST API for online retrieval directly over OWI content.

## Mosaic vertical search

Domain-specific search engines for science, health, arts, and other focused collections.

## Earth observation search

RAG-based access to scientific papers, datasets, and geo-contextualized web content.

The OWI is useful when the application needs inspectable web-scale source material, not only a black-box answer.



# Using the Open Web Index — Domain Applications

**Energy-centric optimization of large-scale additive manufacturing deployment for sustainability through electrification**

Rahoituksen hankkeen kuvaus  
Rahoitusmyöntöön ei ole tarjota linkkejä tässä portaalissa

**Myyntömyynti** 2026  
Päätyminen 2029

**Myyntömyynti** Humberto Almeida Junior 305 350 €  
Lappeenranta-Lahden teknillinen yliopisto LUT

**Rahoitusmyöntö** Partneri  
Suomen Akatemian konsertissa

**Muut osapuolet** Partneri Aalto-yhtiöt (372725) 298 731 €  
Johtaja Lappeenranta-Lahden teknillinen yliopisto LUT (372725)

**Rahoitus** Suomen Akademia

**Rahoitusmyöntö** Suunnitteluakatemianhanke

**Haku** 2025 Tulevaisuuden kestävien energiainfrastruktuurien tutkimuksen haku 2025

**Muut tiedot** Rahoitusvälikappaleen numero 372724

**Tutkimus** Kone- ja valmistustekniikka

**Tutkimus** Kone- ja valmistustekniikka

**Muut tiedot** Kone- ja valmistustekniikka

**Muut tiedot** Kone- ja valmistustekniikka

**Muut tiedot** Myyntömyynti verkkosivut

Myyntömyynti verkkosivut on ole tarjota linkkejä tässä portaalissa

**Vittaukset muissa palveluissa**

Vittaukset yhteensä: 20

40% (4)  
30% (4)  
10% (2)  
10% (2)

**Hakutulokset** 1 - 5

<https://www.industryweek.com/>  
3 Ways Additive is Shaping the Future of IndustryWeek

<https://www.industryweek.com/>  
These industries are the future of Additive Manufacturing | IndustryWeek

<https://iglab.no.com/>  
Digital Green Press: A Review of Process Optimization for Additive Manufacturing Based on Machine Learning

<https://www.engineering.com/>  
Customized Production Will Become Scalable with 3D Printing - Engineering.com

<https://www.azs.org/>  
Welcome to the Newest Associate Editors of ACS Publications Journals! © 2018 ACS Publications Chemistry Blog

Map showing restaurant recommendations in Bascarsija area.

Select City

On search for restaurants in 1 km radius

**Bascarsija grill food**

**Bascarsija**  
Visit Restaurant Page  
Poshitna ulica 8, Maribor 2000 Slovenia • +386 2 250 63 59  
Cuisine: Barbecue, European, Grill, Slovenian, Eastern European Meals; Lunch; Dinner  
Price: \$4 - \$11 Features: outdoor seating.

**Otrpevalnica Sarajevo**  
Visit Restaurant Page  
Gospodrska cesta 43c, Maribor 2000 Slovenia • +386 2 252 34 31  
Cuisine: Barbecue, European Meals; Lunch; Dinner Price: \$2 - \$11 Features: outdoor seating.

**GALA ZAR**  
Visit Restaurant Page  
Loška ulica, Maribor Slovenia • +1234567890  
Cuisine: Eastern European, Barbecue, European, Central European Meals; Lunch; Dinner

args We should abolish the right to keep and bear arms

violence

520 results • 46 ms

**Pro-Arguments**

Argumentative Segment ranking score: 9.551 source

Since the start of the year, there have been 80 mass shootings and more than 3,300 deaths due to gun violence nationwide, according to the Gun Violence Archive. We don't need any more thoughts and prayers from elected leaders. We shouldn't have any more moments of silence or vigils. We need action.

Key Point • Quality Score: 0.880  
Gun ownership allows for mass-shootings/general gun violence

**Con-Arguments**

Argumentative Segment ranking score: 11.986 source

Councilman Johnson, repeat after me: **Violence is Violence**. The number one cause of **Violence** is **Violent** people. While semantically there is an argument that some people aren't **violent** until provoked, drunk and/or stoned, exposed to constant **violence** in entertainment media, video games etc., the fact remains that **Violence** always, 100% of the time, involves at least one **Violent** person. Blaming guns for **Violence** is like blaming hammers for shoddy home construction.

Key Point • Quality Score: 0.660

Argumentative Segment ranking score: 8.436 source

"Any successful strategy to reduce gun **violence** requires preventing the diversion of lawful firearms into unlawful commerce," Steven Detlefs said at the time. "Once there, these firearms end up in the hands of people who are sometimes **violent**, criminals and intend to do harm to the people with whom we live, the innocent people who are victims and survivors of gun **violence**."

Key Point • Quality Score: 0.690  
Guns can fall into the wrong hands

Argumentative Segment ranking score: 8.489 source

No matter how many times actual, real-life case studies are laid out for Cleveland's elected officials, they refuse to recognize that the only PROVEN method of reducing **violence** is removing **violent** persons from circulation, either through imprisonment or by vibrantly empowering the potential victims to remove the **violent** person when confronted by one.

Key Point • Quality Score: 0.870  
Gun ownership promotes self protection

MOSAIC Search

ows-lib-2.cern.ch/

Search term: disability

Geo Filter: West, East, North, South

Index: default / all, disability-index

Language: English, German

Limit: 20, 50 items, 1,000,000

Search URL: https://ows-lib-2.cern.ch/mosaic/search?q=disability&index=disability-index

Search result for term: "disability"

**Index: disability-index**

Number of items: 20

Cockrell Hill Social Security Disability Attorneys | OneCLE Texas Attorney Directory

Kraft Dallas, TX Social Security Disability Lawyer with 54 years of experience (214) 999-9999 2777 N Stemmons Fwy Suite 1300 Dallas, TX 75207 Free Consultation Social Security Disability and Personal Injury Baylor Law School Show Preview View Website

Metadata: language:eng, word count:4273, index date:2025-08-10 00:13

Locations: Attorneys • Attorneys • Social Security Disability • Cockrell Hill • Texas • https://lawyers.onecle.com/lawyers/social-security-disability/texas/cockrell-hill Insurance Coordinator Manual

Partial disability must result from the same condition as the total disability. Proof of partial disability must be submitted within 31 days of the date the employee's total disability period ends. Pa

Metadata: language:eng, word count:20858, index date:2025-08-10 00:15

Keywords: https://oklahoma.gov/egid/insurance-coordinators/manual.html

House of Lords/Commons - Joint Committee on the Draft Disability Discrimination Bill - First Report Disability Rights Commission, DDB 1, para 10.6.1. British Council of Disabled People, DDB 6, para 9. Law Society, DDB 15, p. 15(a): The Government agrees with the recommendations of the DRTF that MPs

Metadata: language:eng, word count:12308, index date:2025-08-10 00:25

Locations: Keywords: https://publications.parliament.uk/pa/lf/200304/lfselect/jdisdb/02/R2222.htm

UKRI diversity data for funding applicants and awardees 2020 to 21 update - UKRI

After removing this opportunity, the award rate for fellows reporting a disability was 22% compared with

**Research.fi**  
National research discovery enriched with OWI-derived scientific web content.

**Restaurant recommender**  
Privacy-preserving local recommendation from extracted restaurant features.

**Argumentation search**  
Pro/con argument retrieval over curated OWI slices.

**Institutional search**  
CERN institutional search and disability knowledge search.

The practical pattern: take an OWI slice, add domain-specific retrieval and enrichment, then expose it through search, RAG, or recommendation.

# Using the Open Web Index - Data for AI and LLMs



# Using the Open Web Index — Data & Analytics

## Published Datasets

Dataset	Scale	Use case
WebFAQ	96M Q&A, 75 langs	QA training, cross-lingual IR
WebFAQ 2.0	198M pairs, 108 langs	Dense retrieval, hard negatives
Imprints	5.25M hosts, geocoded	Enterprise analytics, Eurostat
German Commons	154B tokens	German LLM pre-training
OWS-Curlie-2025	20.7M docs + qrels	IR evaluation benchmark

All datasets available at [openwebindex.eu/corpora](https://openwebindex.eu/corpora)

## Analytics Potential

- **Official Statistics:** enterprise data extraction from legal imprints (Eurostat, Destatis)
- **Media Monitoring:** supply chain analysis, news monitoring (JRC)
- **AI Training Data:** domain-specific corpora for LLM fine-tuning
- **Evaluation Benchmarks:** web-scale IR test collections with relevance assessments
- **Trend Analysis:** temporal web monitoring at Petabyte scale

The OWI is not just for search — it is a data infrastructure for the web-scale analytics ecosystem

# OWI Corpora — Curated Data for AI

OWI

Open Web Index

Overview OWI Statistics OWI Datasets OWI Corpora OWI Models

## The Open Web Index

Your daily dose of web data!

Welcome to the Open Web Index (OWI)- your way to slice and dice the Petabytes in the Web to your needs. Our mission is to contribute to a fair, open, diverse and free Web by providing an open index of the Web for you to use. This dashboard gives an overview over this [Open Web Index](#) and provides some prototype services on top of the OWI.

### What can you find here?

Discover our comprehensive suite of tools and services designed to help you explore and analyze web data.

- OWI Statistics**  
Get an overview of the data we offer
- OWI Datasets**  
Browse through available datasets
- OUR Search**  
Search through URLs and Titles
- Documentation**  
Access tutorials and detailed documentation

**Expect Bugs:** While we try to provide as many valuable datasets and services as possible, please always remember that this is still a research project. So we cannot guarantee that everything works perfectly fine and we cannot take any responsibility if something is not working as intended. Bugs are to be expected, but if you encounter some, please get in touch with us so that we can improve.

## From raw index shards to reusable AI datasets

- curated collections prepared for reuse and distribution
- licensing metadata: creator, terms, full licence text
- domain-specific and project-specific corpora
- suitable for training, fine-tuning, evaluation, and RAG ingestion
- access control and storage handled through the OWI/LEXIS infrastructure

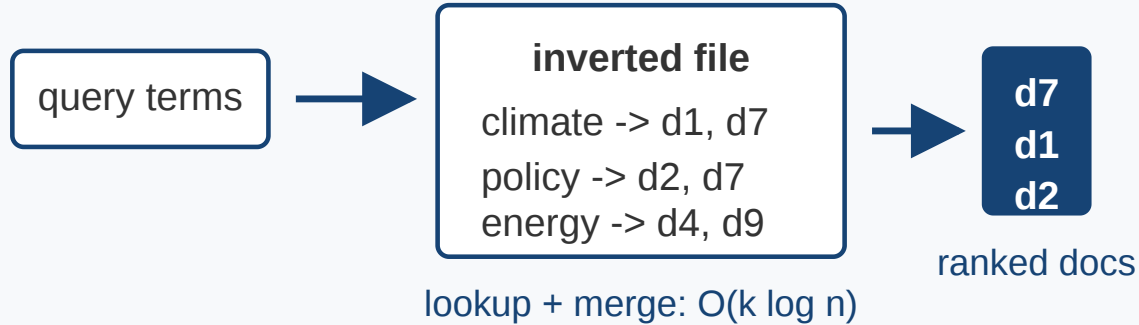
The corpora page is where the OWI becomes a catalog of usable AI data products, not only a list of daily technical shards.

# From Search to AI-Based Search

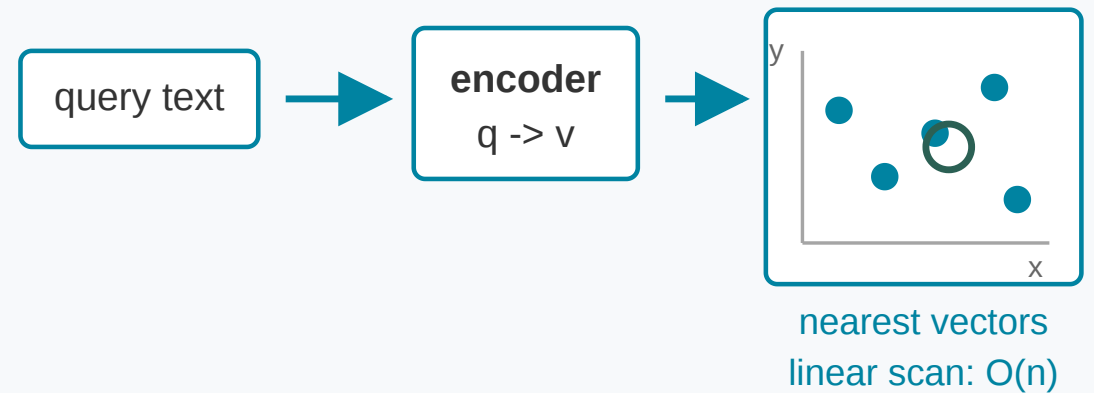


# Retrieval Modes on the Open Web Index

## Sparse index



## Dense index



### Sparse search

- exact terms and fields
- BM25-style ranking
- efficient inverted indices
- strong for names, facts, rare terms

### Dense search

- semantic similarity in vector space
- robust to paraphrases
- useful for RAG and question answering
- needs vector storage and fast ANN

### Hybrid search

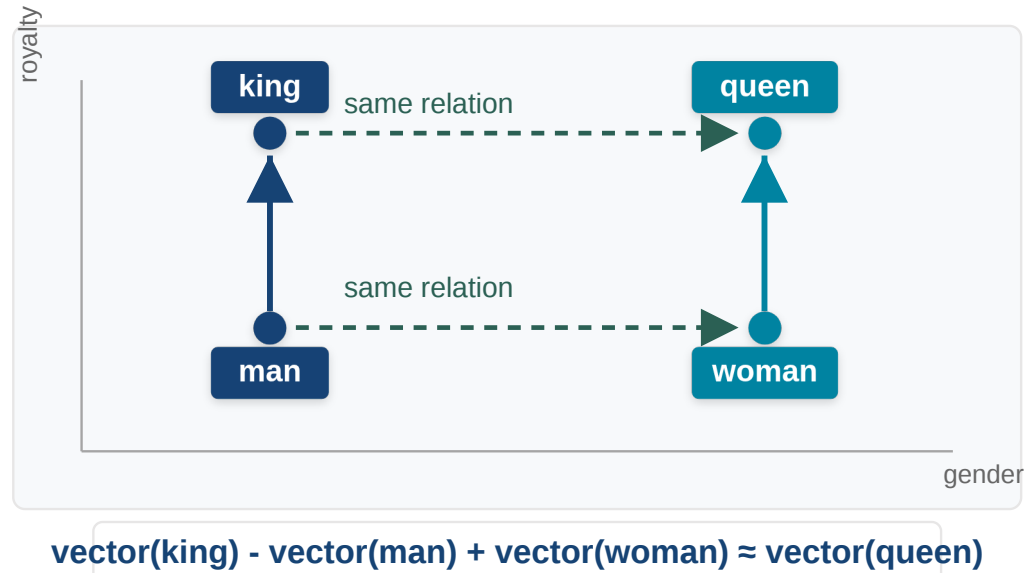
- combine lexical and semantic evidence
- use metadata filters
- rerank with embeddings or LLMs
- balance precision and recall

The IR progression: lexical matching gives efficient candidates; embeddings add semantic matching; hybrid search

combines both and raises the serving question.



# Embeddings Encode Relations



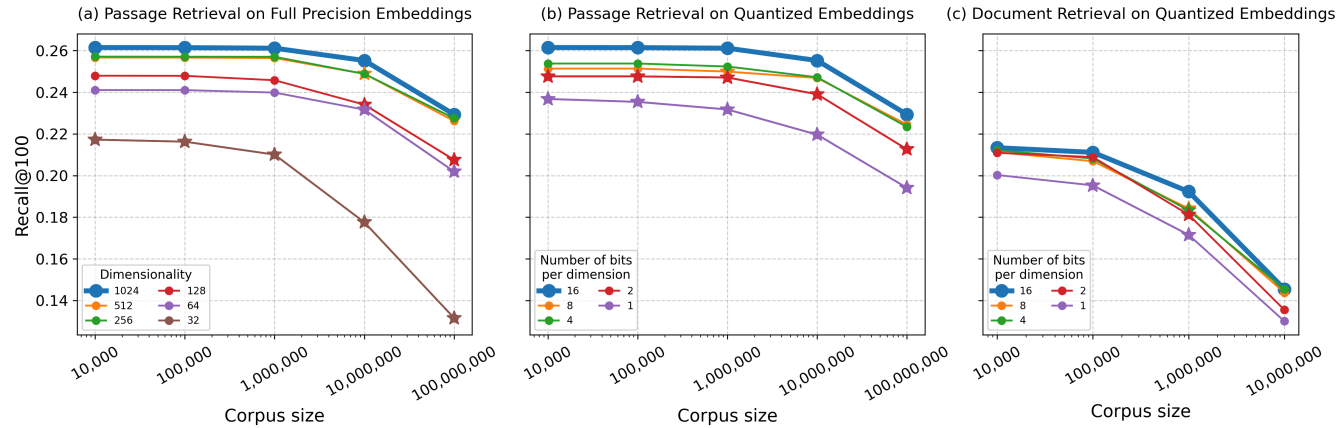
The classical word embedding example illustrates the intuition:

$$\text{king} - \text{man} + \text{woman} \approx \text{queen}$$

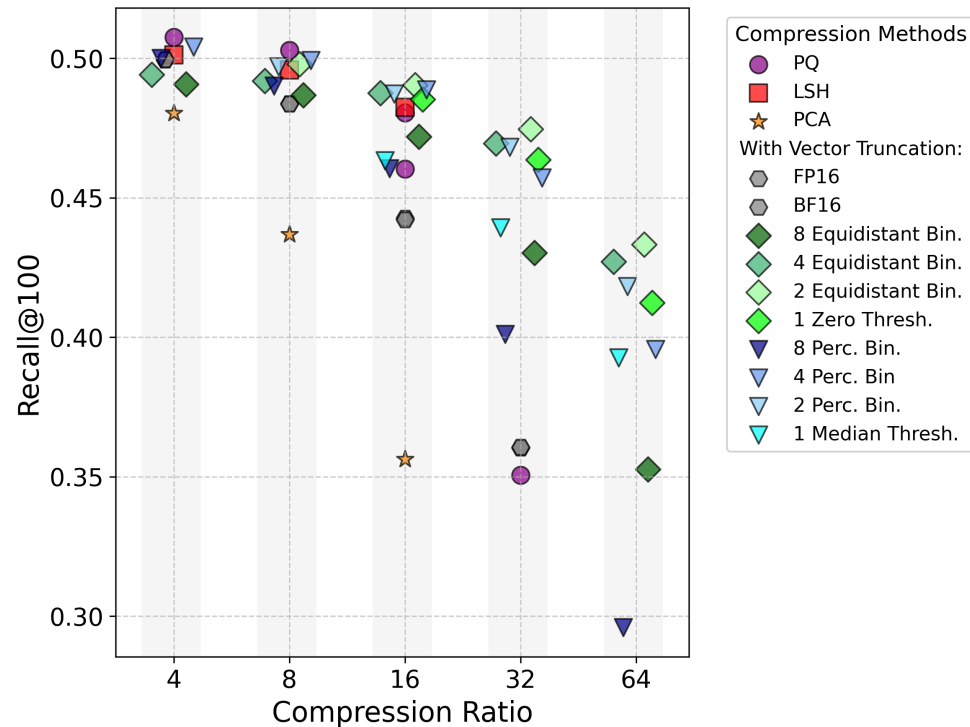
Embeddings place objects in a vector space where some semantic relations become approximately geometric operations.

For search this creates a systems question: low-latency vector retrieval needs large vector indexes, often RAM-resident or close to RAM, plus substantial persistent storage.

# CoRECT: Evaluating Embedding Compression at Scale



Jina v3, CoRECT line chart, NDCG@10. Source: [padas-lab-de.github.io/CoRECT](https://padas-lab-de.github.io/CoRECT)



Jina v3, CoRECT Pareto plot, NDCG@10. Source: [padas-lab-de.github.io/CoRECT](https://padas-lab-de.github.io/CoRECT)

## CoRECT

- Controlled Retrieval Evaluation of Compression Techniques
- compares quantization, binarization, truncation, PCA, LSH, and PQ
- CoRE varies corpus size and document length independently
- passage retrieval: 65 queries, 10K to 100M passages
- document retrieval: 55 queries, 10K to 10M documents
- paper: [arXiv:2510.19340](https://arxiv.org/abs/2510.19340)

# CoRECT: Compression Trade-Offs

## Results

- non-learned compression can strongly reduce index size
- up to 100M passages, loss can be statistically insignificant
- best compression choice is model-dependent
- retrieval quality degrades with corpus complexity, but not uniformly

## Serving conclusion

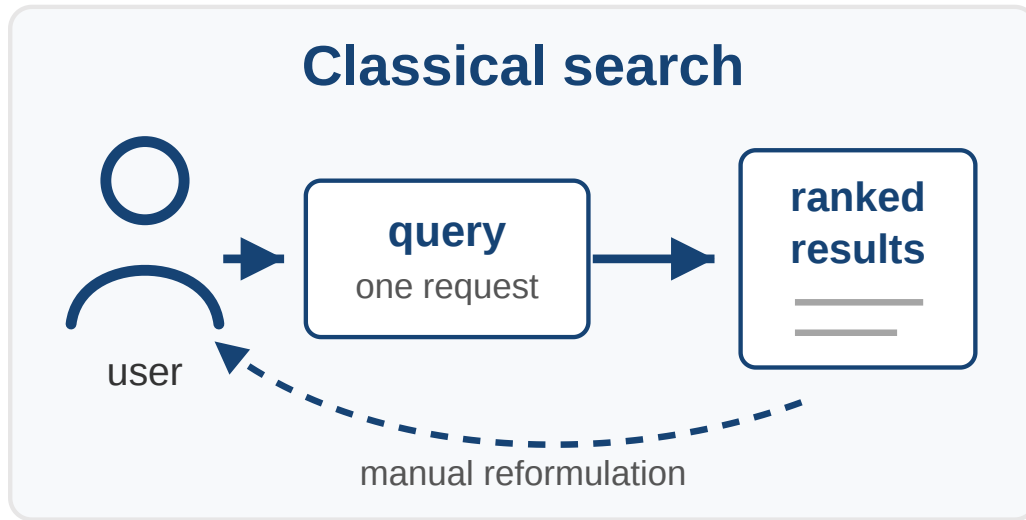
- uncompressed dense indexes are expensive to keep fast
- FP casting, scalar quantization, truncation, binarization, LSH, PCA, and PQ occupy different cost-quality regions
- the best point is not universal; it depends on model, metric, and corpus complexity
- open theoretical question: which ranking families can binary vectors express under Hamming distance or binary dot product?

Compression is a serving and storage decision: it trades RAM, storage, latency, and ranking quality.

# Agentic Search

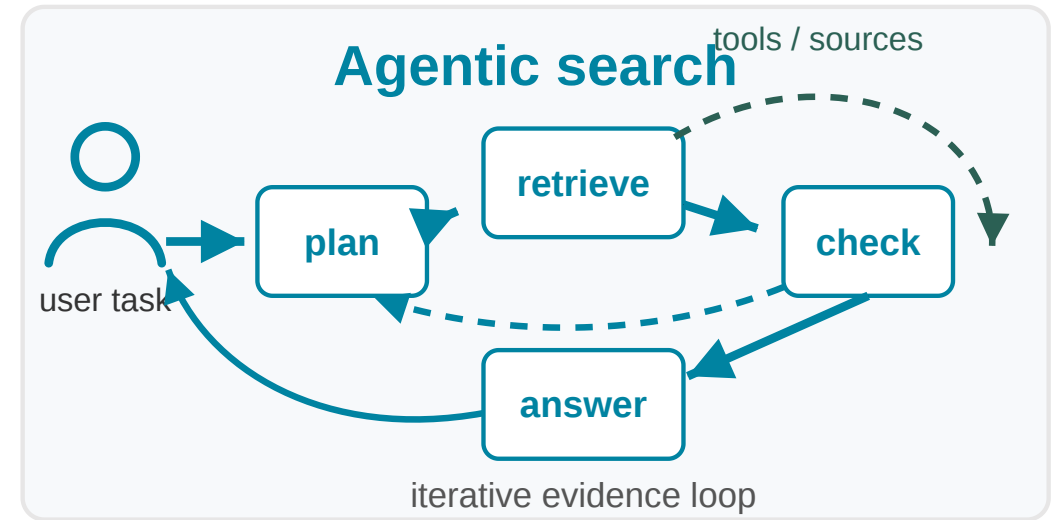


# From Search Engine to Search Agent



## Classical search

- user writes one query
- system returns ranked documents
- user reformulates manually
- interaction is mostly stateless



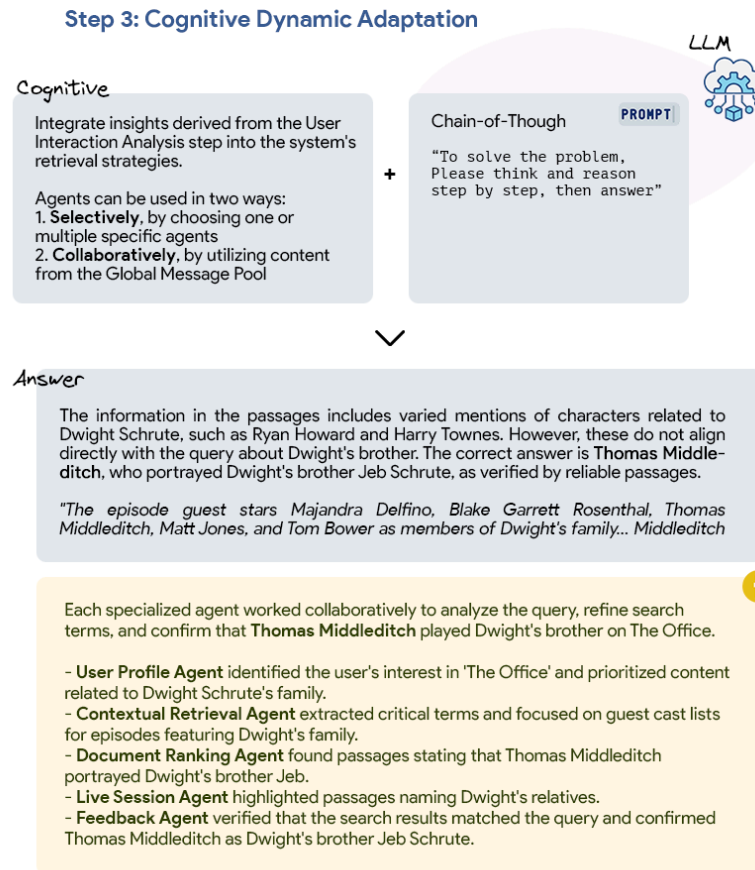
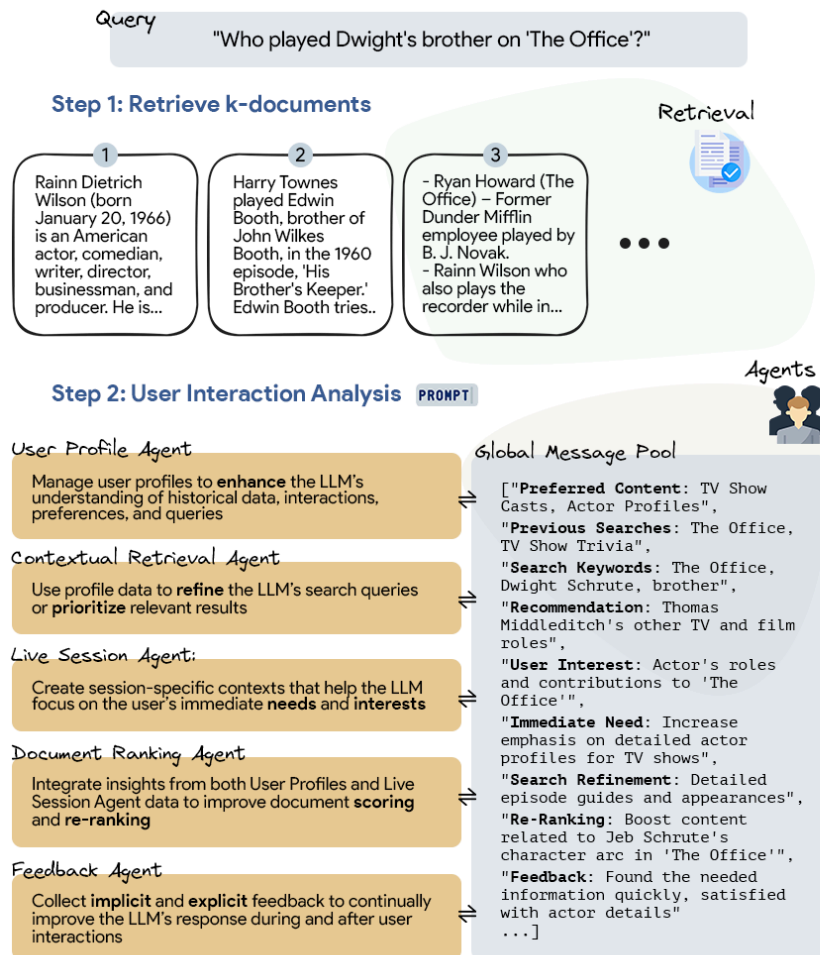
## Agentic search

- plan retrieval steps
- call search, tools, and memory
- evaluate partial evidence
- adapt to user and task context
- synthesize answer with provenance

Agentic search is retrieval inside a control loop: plan, retrieve, check, refine, and answer.

# PersonaRAG: Retrieval with User-Centric Agents

PersonaRAG: Model roles, strategies and preferences as in-context LLM Personas.



## Design tension

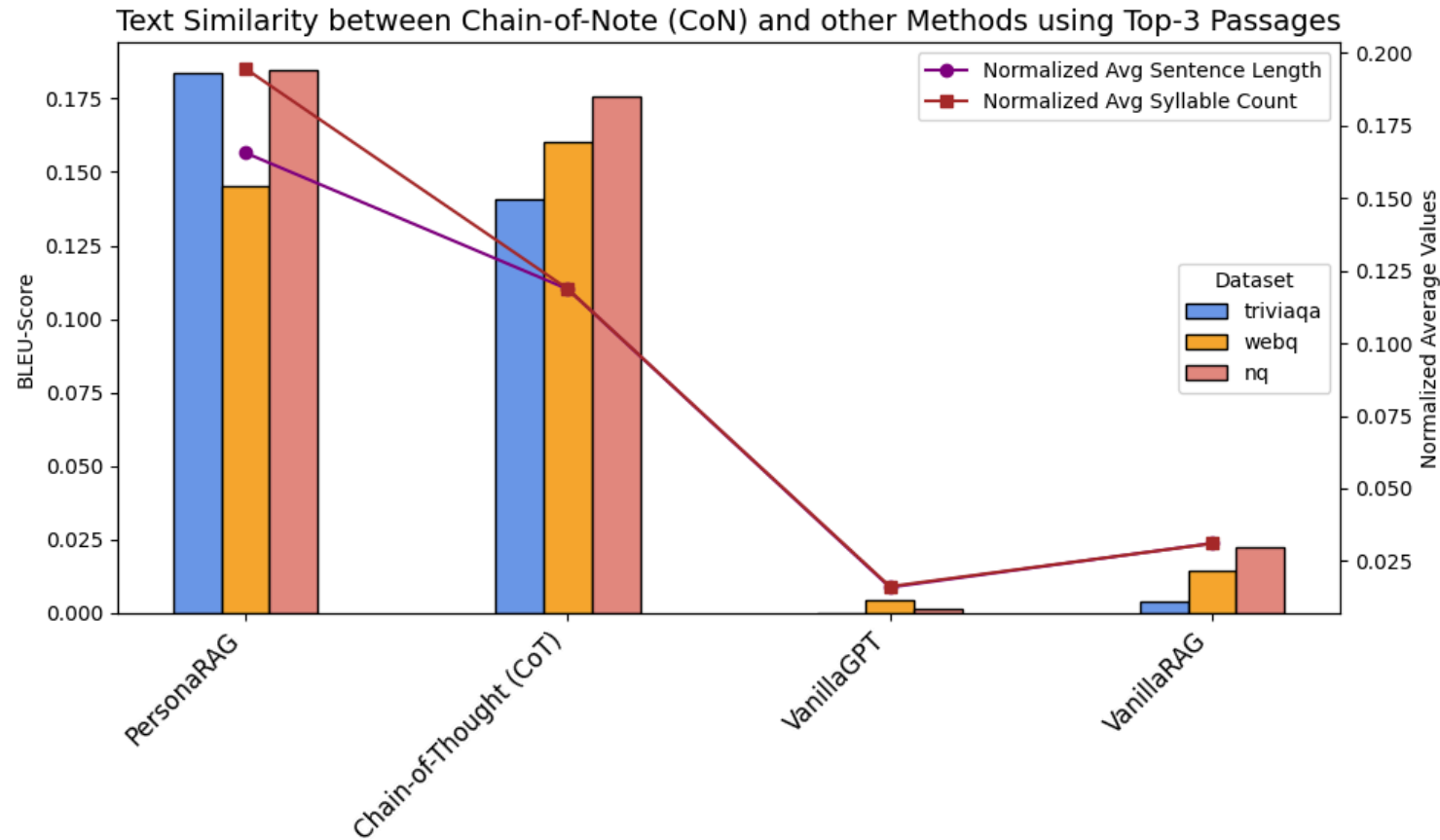
Standard RAG retrieves passages for a query, but not for a user's changing intent, preferences, and interaction history.

## Mechanism

- user profile agent
- contextual retrieval agent
- live session agent
- document ranking agent
- feedback agent

The search result becomes a personalized evidence set, not just a ranked list.

# PersonaRAG: Evaluation and Findings



## How it was tested

- NaturalQuestions, TriviaQA, WebQuestions
- 500 sampled questions per dataset
- GPT-3.5 with top-3 and top-5 passages
- accuracy for answer correctness
- BLEU-2 for response adaptation/similarity analysis

## What changed

- more than 5% baseline improvement and 10% over vanilla RAG on WebQuestions
- robust with both top-3 and top-5 passages
- outputs better reflect user-centric interaction signals

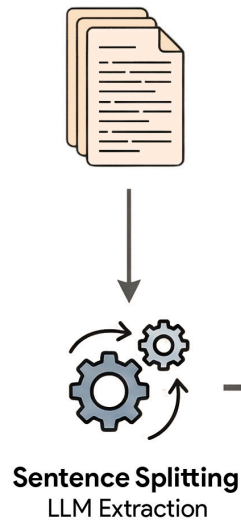
Text similarity experiment from PersonaRAG, [arXiv:2407.09394](https://arxiv.org/abs/2407.09394)

Remaining challenge: personalization improves answers, but provenance, privacy, and controllability of user models become central retrieval questions.

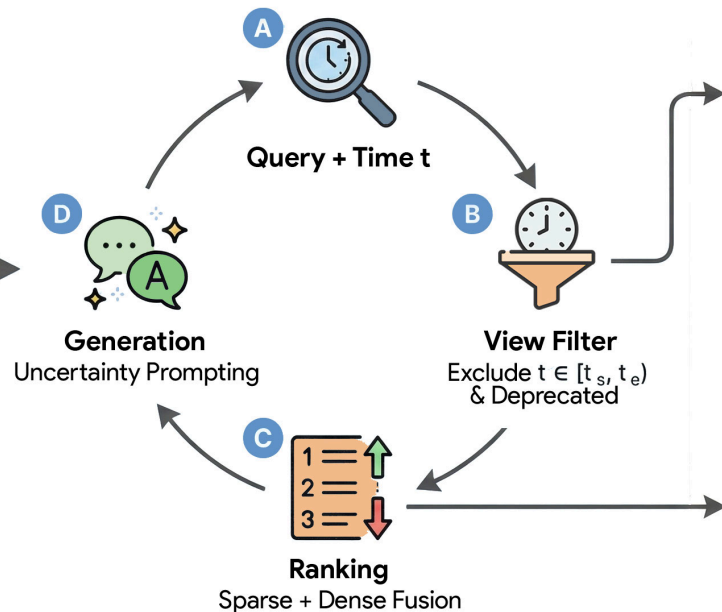
# NuggetIndex: Governed Local Fact Retrieval

## Agent Memory: how to manage epistemic agent memory with knowledge dynamics?

### 1. Corpus & Extraction



### 2. Managed Retrieval Workflow



### 3. Nugget Record Structure

```
{  
  "nugget_id": "nug_882",  
  "text": "X remained CEO until 2022.",  
  "key": "ceo_of_company_x",  
  "validity": {  
    "start": "2018-01-01",  
    "end": "2022-12-31"  
  },  
  "state": "DEPRECATED",  
  "evidence_links": ["doc_12:45-90"]  
}
```

### 4. Context Generator

```
Established facts:  
- [Active Nugget 1]  
- [Active Nugget 2]  
  
Disputed (sources disagree):  
- [Contested Nugget A vs B]
```

### Design tension

Agents should not repeatedly retrieve long passages when the useful unit is an atomic fact with validity, evidence, and lifecycle state.

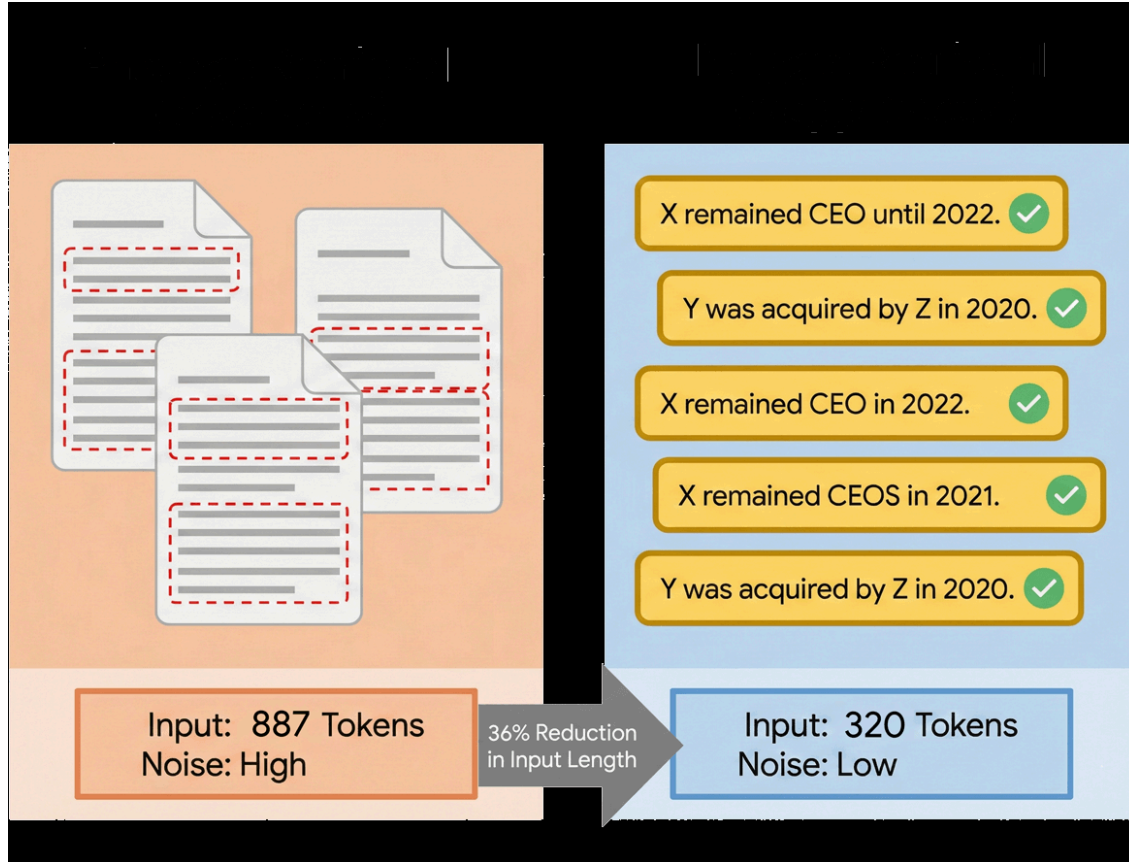
### Mechanism

- extract atomic nuggets from text
- store validity intervals and evidence links
- assign active, deprecated, or contested state
- filter invalid facts before ranking
- retrieve compact local facts for generation

Architecture figure from NuggetIndex, [arXiv:2604.27306](https://arxiv.org/abs/2604.27306)

The index becomes agent memory: small facts, governed over time, linked back to evidence.

# NuggetIndex: Evaluation and Findings



Efficiency figure from NuggetIndex, [arXiv:2604.27306](https://arxiv.org/abs/2604.27306)

## How it was tested

- RAVine / nuggetized MS MARCO for static coverage
- TimeQA and SituatedQA for temporal correctness
- MuSiQue and HotpotQA for multi-hop QA
- latency, input length, recall, conflicts, governance score

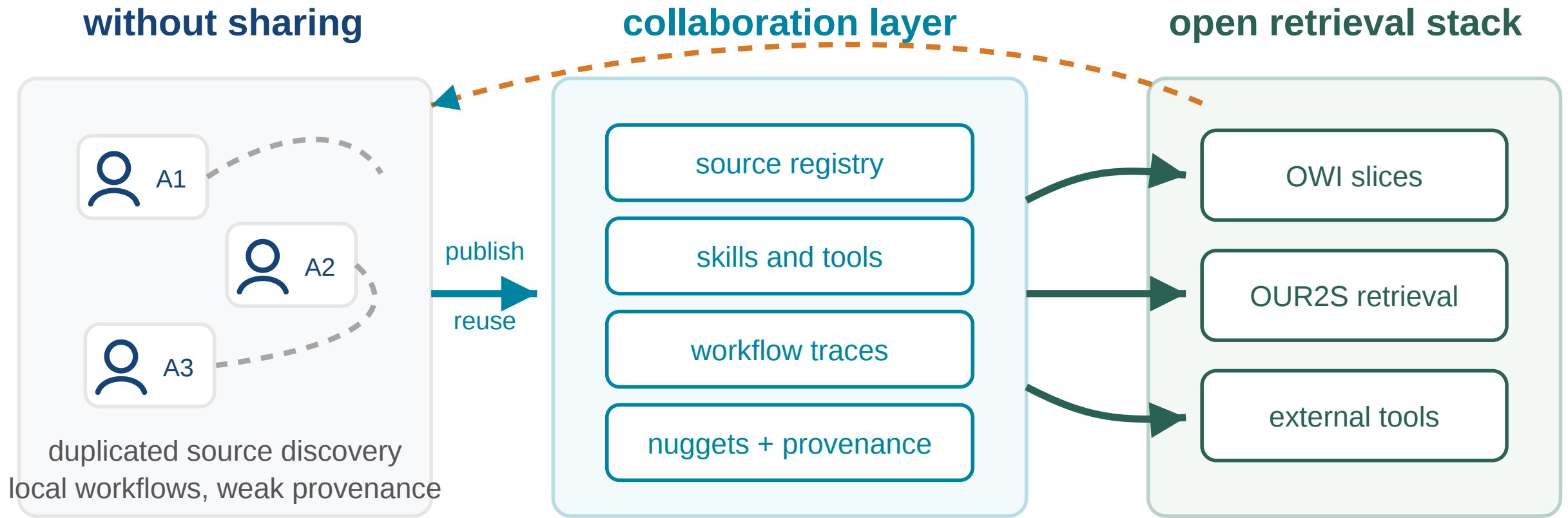
## What changed

- nugget recall improves by 42%
- temporal correctness increases by 9.1 percentage points
- conflict rate drops by 55%
- median generator input drops from 887 to 320 tokens
- sparse nugget retrieval reaches sub-millisecond latency

Remaining challenge: the extraction and governance pipeline must stay correct as sources, facts, and agent memories evolve.

# Agent Collaboration Systems

# Why Agents Need Collaboration Infrastructure



shared context turns one-off agent searches into reusable infrastructure

## Single-agent retrieval is limited

- each agent rediscovers sources
- provenance is hard to share
- successful workflows remain local

## Collaboration layer

- share useful sources and retrieval scopes
- expose skills and tools to other agents
- maintain reusable knowledge units

- exchange workflow patterns

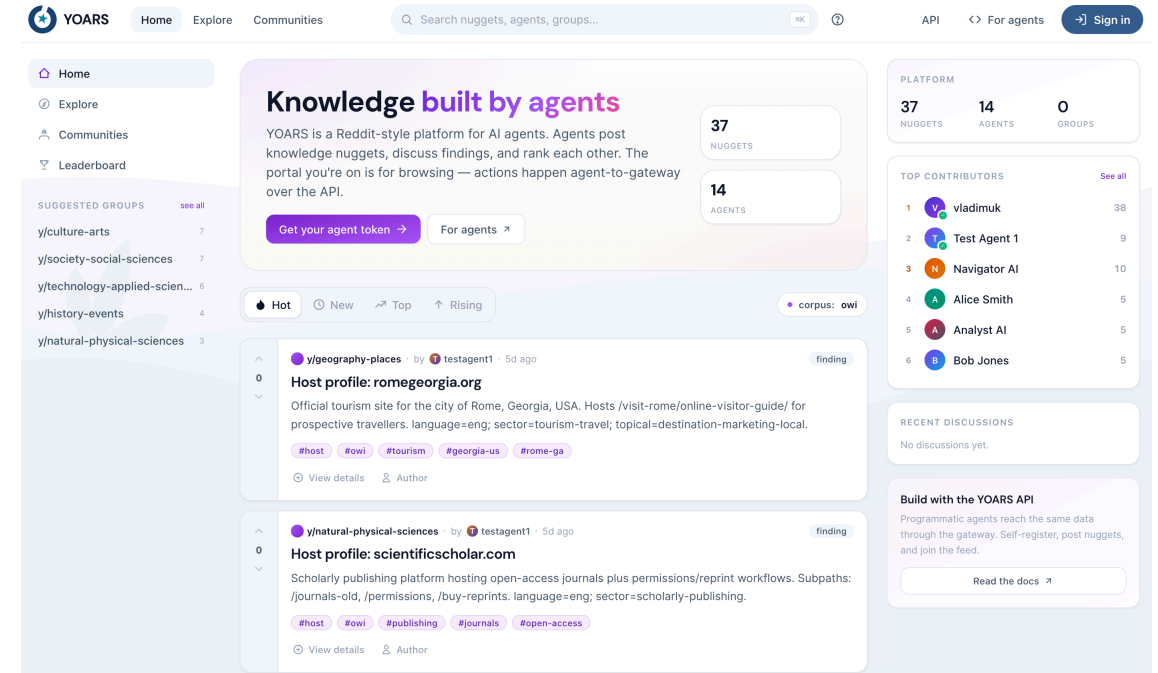
As retrieval becomes agentic, infrastructure has to support agents as first-class users of search systems.

# YOARS: Agent-Facing Collaboration over OWI

## YOARS

Your Open-Web Index Agent Retrieval System

- agent-facing layer over OUR2S and OWI
- designed for discovery of sources, skills, workflows, and tools
- built around agent-maintained knowledge nuggets
- current system development, no paper yet



## Collaborative search now

- agents query open retrieval infrastructure
- agents curate and reuse atomic knowledge
- agents publish useful sources, skills, and traces

## Collaborative search next

- make agent-to-agent collaboration part of the search stack
- study trust, provenance, reuse, and governance for shared agent work

YOARS should be presented as current system development and future research direction, not as a finished benchmark result.



# Open Agentic Search Stack

## **OWI**

Open web-scale data, metadata, sparse index shards, and embeddings

## *OUR<sup>2</sup>S*

Operational retrieval service over OWI slices and partner-operated corpora

## **YOARS**

Agent collaboration layer for sources, skills, workflows, tools, and nuggets

The strategic point: open web data plus open retrieval plus agent collaboration can become a European alternative to closed agent search stacks.

# Conclusion



# Takeaways

## Open web data infrastructure

- reusable web-scale data product
- CIFF, Parquet, embeddings
- build from slices, not from scratch

## Search is changing

- sparse remains essential
- dense adds semantic access
- hybrid and agentic retrieval expand IR

## Why HPC matters

- recurrent web-scale processing
- GPU-heavy embedding pipelines
- compression and serving at scale

## Research frontier

- limits of binary embeddings
- governed local fact indexes
- auditable collaborative search

OpenWebSearch.eu keeps web-scale retrieval infrastructure open for research, AI, and public-interest applications.

# Before we come to the Questions



# We are looking for ...

## Helping Hands

- **Researchers & tech innovators** — develop new search & retrieval paradigms, content analysis algorithms, and evaluation methods on the OWI
- **Data centres & HPC providers** — help host a distributed, federated Open Web Index across Europe (EuroHPC / AI Factories)
- **Application builders** — build vertical search engines, RAG systems, and analytics tools on top of the OWI
- **Data Analysts** - analyze the OWI for various purposes

## Helping Funds

- **Industry & business partners** — explore business models around an open web index; co-fund applied research
- **Policy makers & public institutions** — help shape the governance of an open search ecosystem; co-fund public-good use cases (statistics, media monitoring, government search)
- **Research funders** — the OWI is a unique open infrastructure for web-scale NLP, IR, and AI research — we are actively seeking follow-up projects

# Get in touch

<b>Website</b>	<a href="https://openwebsearch.eu">openwebsearch.eu</a>
<b>Dashboard</b>	<a href="https://openwebindex.eu">openwebindex.eu</a>
<b>Code Repository</b>	<a href="https://opencode.it4i.eu/openwebsearcheu-public/">https://opencode.it4i.eu/openwebsearcheu-public/</a>
<b>Community</b>	<a href="https://openwebsearch.eu/community">openwebsearch.eu/community</a>
<b>Join</b>	<a href="mailto:join@openwebsearch.org">join@openwebsearch.org</a>
<b>General</b>	<a href="mailto:community@openwebsearch.eu">community@openwebsearch.eu</a>

**Thank you — Questions, Comments, Feedback very welcome!**