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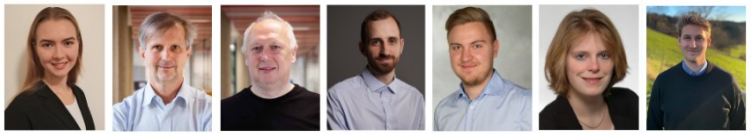
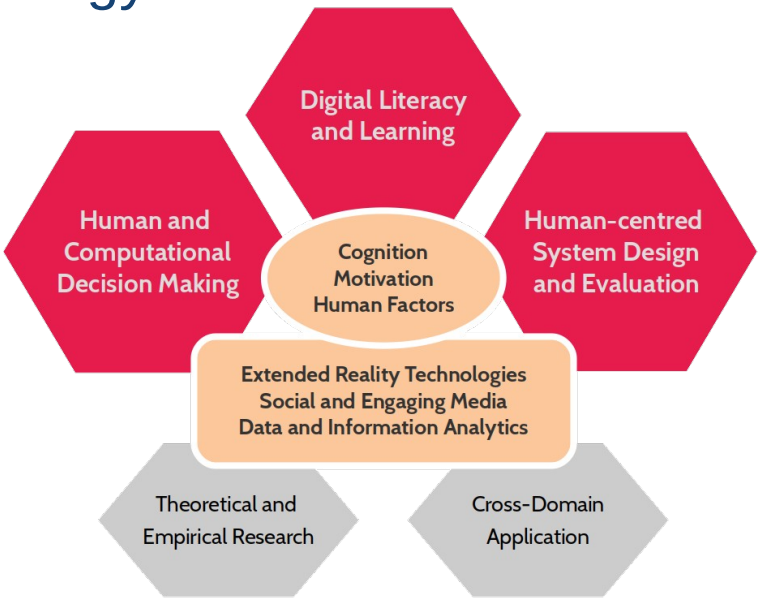
Hackathon
Introduction
Part 1
Alexander Nussbaumer, Sebastian Gürtl,
Christian Gütl
Graz, Austria
24 May 2024

Organisers

- CoDiS Lab @ ISDS, TUGraz
  - Interdisciplinary research overlapping computer science and cognitive psychology
  - 7 Staff members
  - Phd, master and bachelor students

http://isds.tugraz.at/codis/





Agenda

09:00 – 09:15	Welcome
09:15 – 09:45	**Introduction (*)**
09:45 – 10:00	Group formation and coffee
10:00 – 11:00	Working session 1: Idea generation
11:00 – 11:15	**Presentation of ideas (*)**
11:15 – 13:00	Working session 2
13:00 – 14:00	Lunch – Mensa Mercato
14:00 – 17:00	Working session 3
17:00 – 18:00	**Presentation of results, voting and prices (*)**
18:00 – 19:00	Get-together & beer; Lange Nach der Forschung

Organisation

- Communication
  - channels on Discord.com (general and one per team)
  - online broadcasting via Jitsi
- Collaboration in teams (2 – 4 people)
  - Online team: Jitsi breakout room or Discord voice channel
  - Self-organisation (e.g. GitLab)
- Information
  - Cloud folder with documents (presentations, developer guide, etc.)
  - Sub-folders for teams (project submission)

Organisation

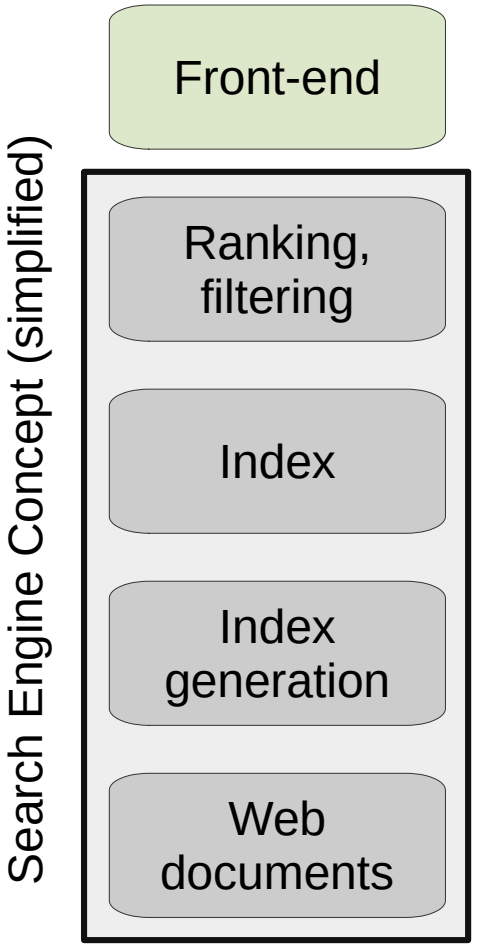
- Coffee in kitchen
- Cookies, mineral water, juice
- Lunch in Mensa Mercato
- Free beer after event
- Lange Nacht der Forschung

Hackathon Goal and Concept

- Introduction to OpenWebSearch.eu and MOSAIC
  - Presentation, manual, explanation and discussion
- Enrich or build an alternative web search solution
  - elaboration of a concept and use case
  - development or improvement of a MOSAIC component
- Result presentation
  - Discussion of results and voting

Background and Motivation

- Web search is dominated by a few big players
  - Google, Bing, Yandex, Baidu
- Few alternatives available
  - Brave, Qwant,
  - Meta search engines, e.g. Ecosia, DuckDuckGo
- Goal is the creation of an Open Web Index
  - can be used for an own search application



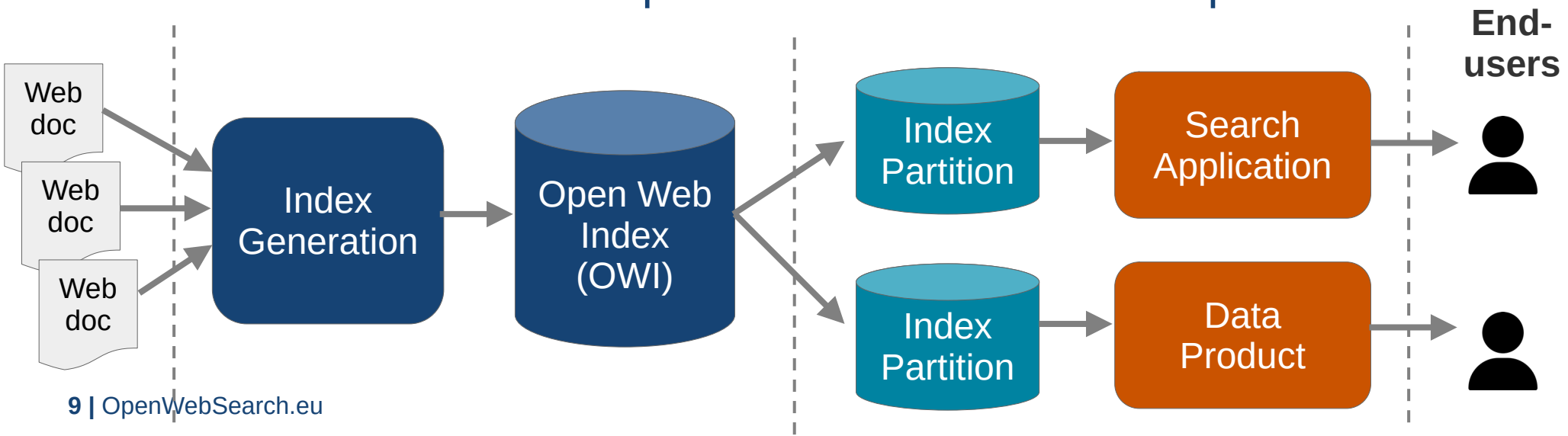
OpenWebSearch.eu

- Horizon Europe Research Project
  - 14 partners (research institutions and data centers)
- Objectives (simplified)
  - Development of an Open Web Index and related software
  - Development of relevant search engine verticals and ecosystem of vertical search engines

Open Web Index Status March 2024

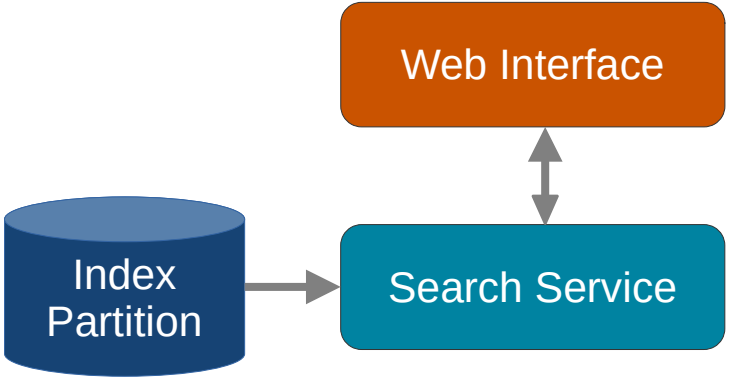
Vertical Search Engines in OWS.eu

- Vertical Search Engines serve special purposes, topics, or domains, e.g. product search
- Search applications are a key concept in OpenWebSearch.eu and are based on the Open Web Index and index partitions



MOSAIC

- **Mo**dular **S**earch **A**pplication based on **I**ndex Fra**c**tions
- Generic implementation of an OWS.eu vertical search engine
  - Demonstration of the concept of an OWS.eu vertical engine
  - Out-of-the-box search engine
  - Toolbox for an own search application



MOSAIC Front-end

Open WebSearch .eu

1 **Search term:** cern Search Index Info

2 **Geo Filter:** West: 1.8 East: 17.0 North: 55.6 South: 40.2

3 **Index:**
- ○ default / all
- ◉ Demo SimpleWiki
- ○ Demo Graz Universities
- ○ DLR Prototype

4 **Language:**
- ○ default / all
- ◉ English
- ○ German

Limit:
- ◉ default / 20
- ○ 10 items
- ○ 50 items
- ○ 1,000,000

5 **Keyword:**

6 **Search URL:** https://qnode.eu/ows/mosaic/service/search?q=cern&index=demo-simplewiki&lang=eng&west=1.8&east=17.0&north=55.6&south=40.2

7 **Wikipedia: World Wide Web**

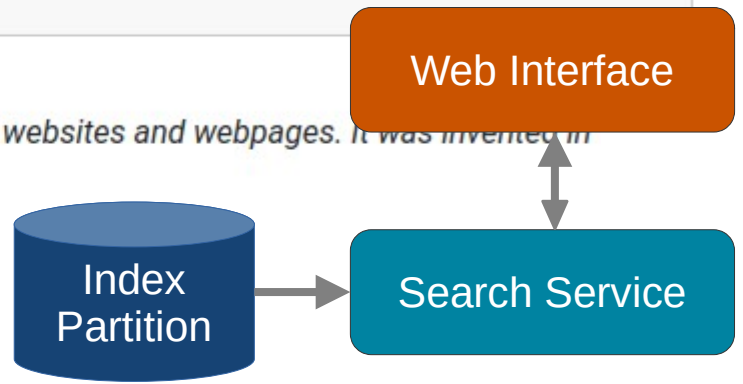
The World Wide Web ("WWW" or "The Web") is the part of the Internet that contains websites and webpages. It was invented in 1989 by Tim Berners-Lee at CERN, Geneva, Switzerland.

8 Metadata: *language:eng, word count:36, index date:NaN-NaN-NaN NaN:NaN*

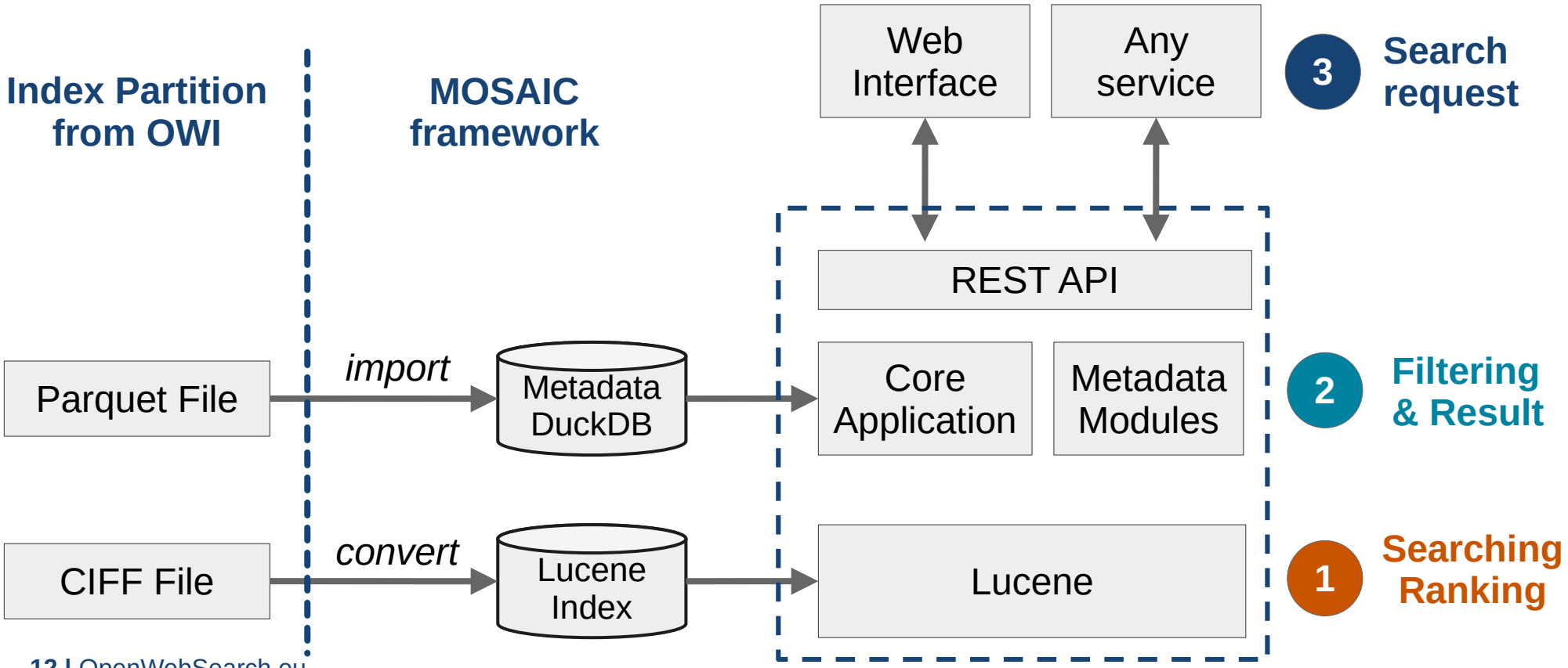
Locations: Geneva • Switzerland •

Keywords:

https://simple.wikipedia.org/wiki/World_Wide_Web



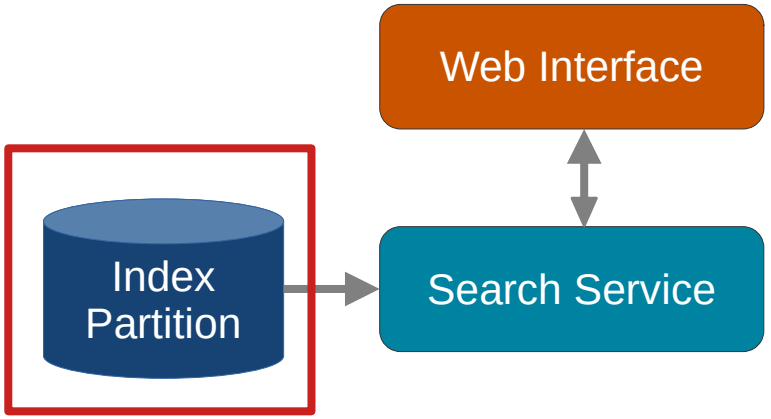
MOSAIC Concept



Development Possibilities

1) Create your own index

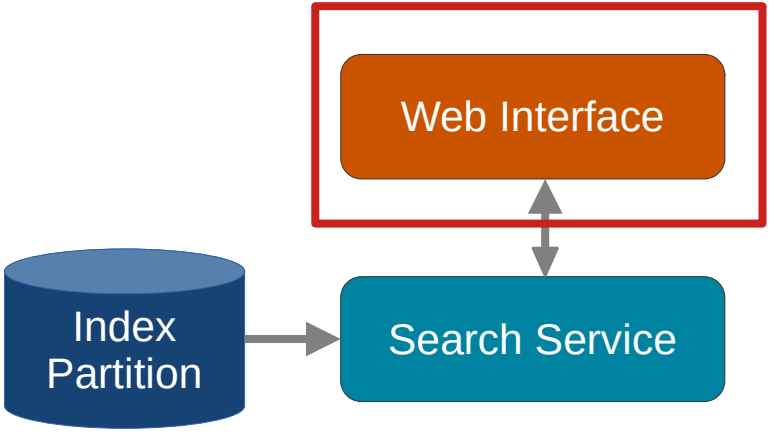
- Download an existing one
- Create an index with a list of URLs



Development Possibilities

2) Create or improve a front-end

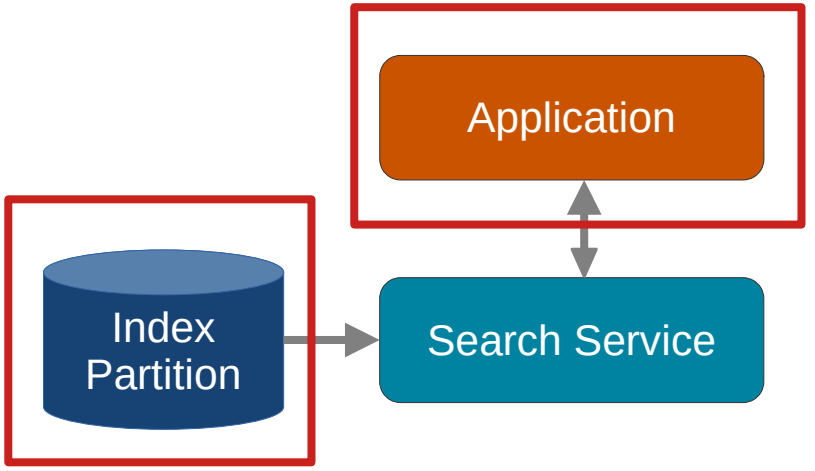
- user interface design
- selecting filter options
- display result attributes



Development Possibilities

3) Create an application that uses MOSAIC as service

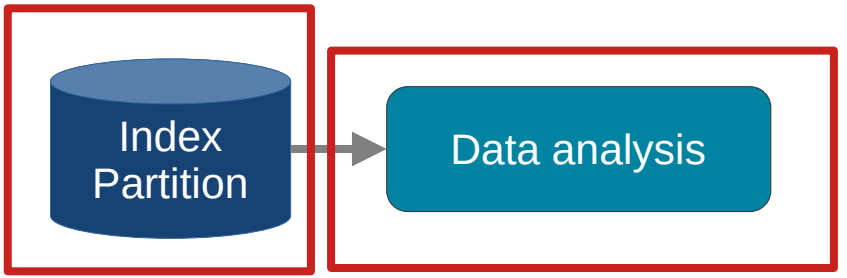
- develop a use case and application idea
- select or create an index
- use the REST API of MOSAIC
- implement the application



Development Possibilities

4) Undertake web data analysis

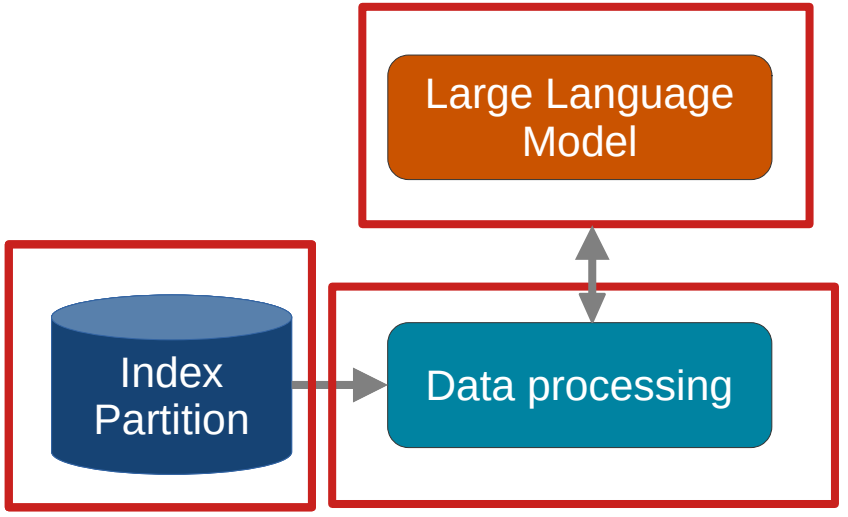
- develop a use case and analysis goal
- select or create an index
- implement an analysis procedure



Development Possibilities

5) Feed a Large Language Model

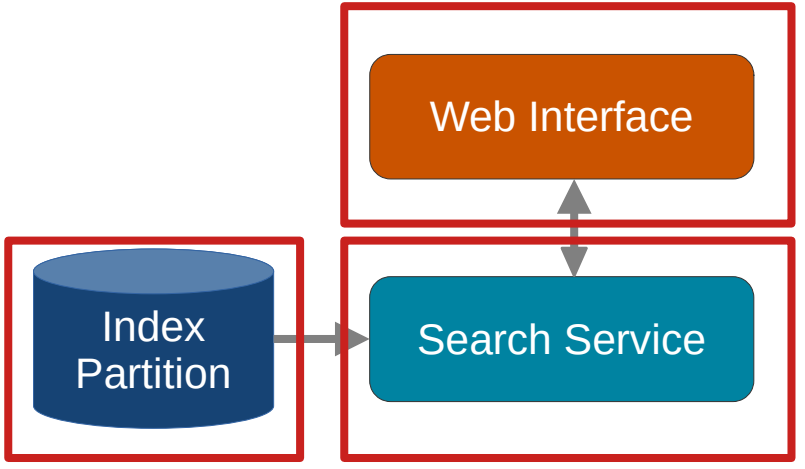
- develop a use case and analysis goal
- select or create an index
- select and feed the LLM



Development Possibilities

6) Create a new module

- use Parquet file with additional metadata columns
  or create your own additional metadata on your own
- create a module that provides filtering and returning results
- adapt the front end

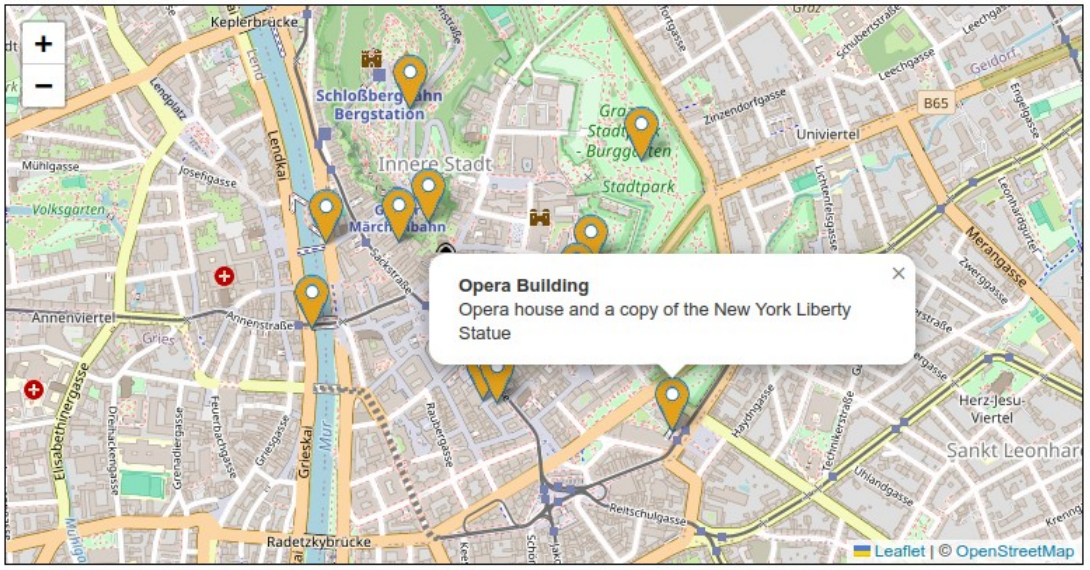


Application Example

- Sightseeing spots
- Clicking on a spots on a map triggers a search and displays result
- Sightseeing index has been created for this application

https://qnode.eu/ows-spots/

Sightseeing Graz



Search result for term: Opera Building

Best attractions in Graz

The cafe, opened in a hotel with the same name, can be called a full-fledged Austrian attraction, because it is here that they serve the real Sacher cake, cooked according to the original ancient recipe. Keep in mind that there are always a lot of vi

https://www.tripzaza.com/en/destinations/top-attractions-in-graz

Opera House Graz

Something fascinating about Graz - the interplay of modernism and tradition - is illustrated by the sculpture "light sword" next to the opera house. It was originally made for the festival "steirischer herbst" in 1992. To celebrate the 500th annivers

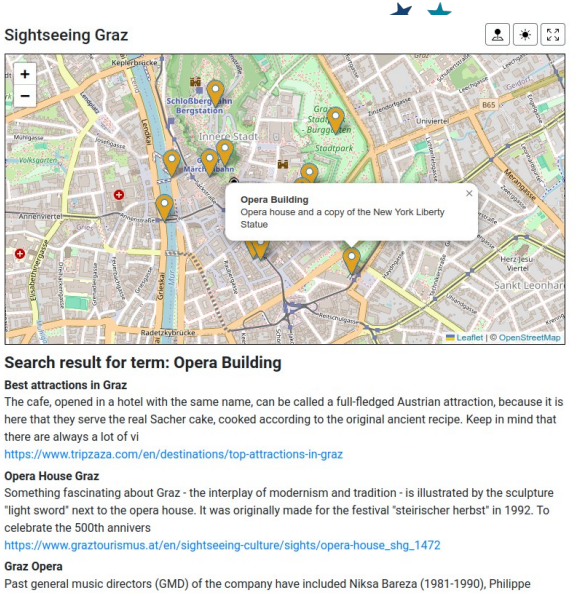
https://www.graztourismus.at/en/sightseeing-culture/sights/opera-house_shg_1472

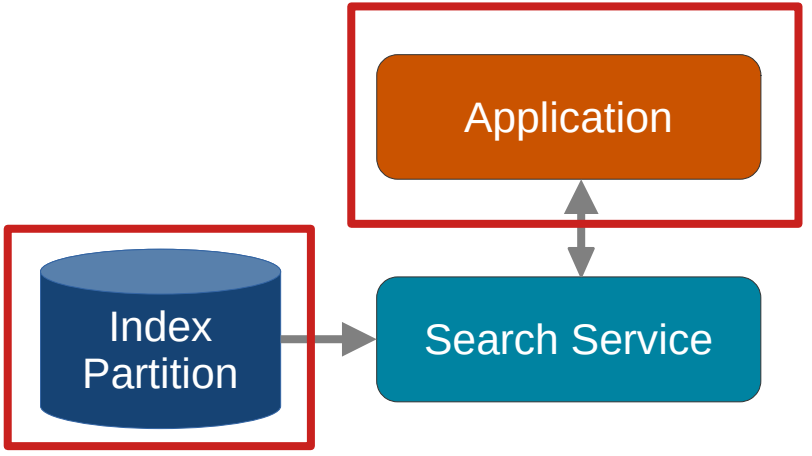
Graz Opera

Past general music directors (GMD) of the company have included Niksa Bareza (1981-1990), Philippe

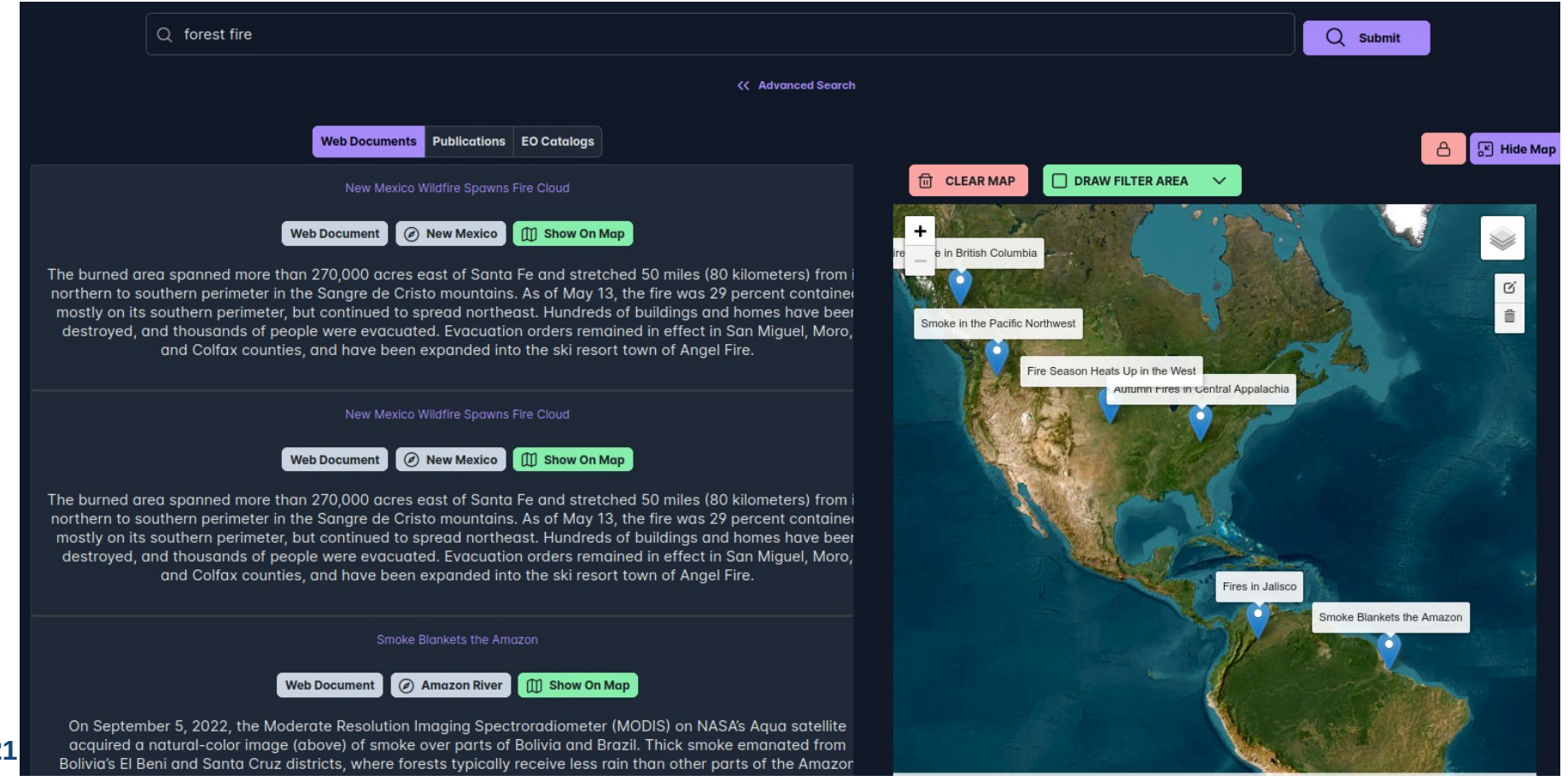
Application Example

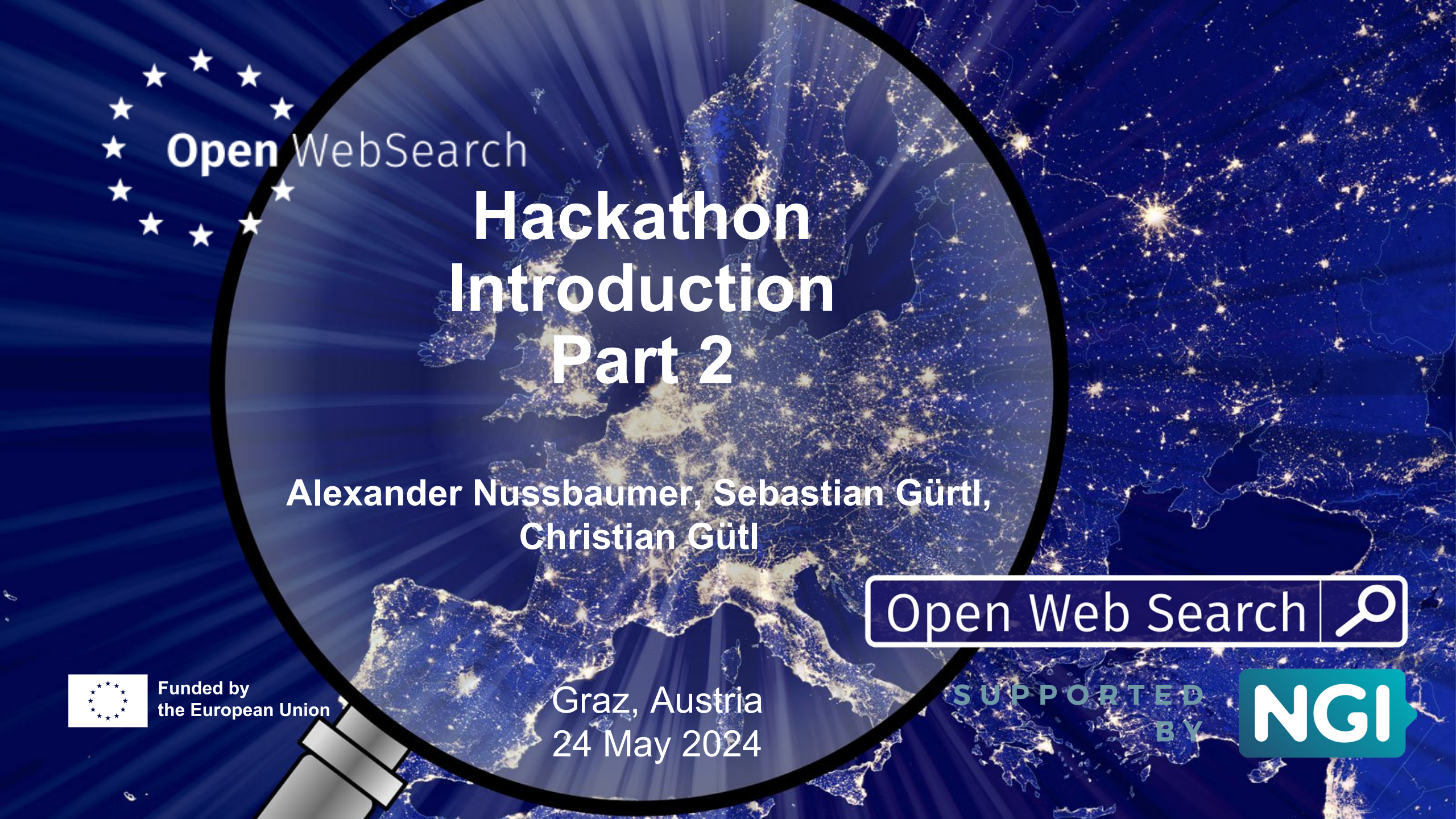
- Index:
  - generated from 50 web pages
- Search service
  - used out-of-the-box
- Web interface
  - Created with Leaflet and added search queries in click event





Application Example: Science Search




Open WebSearch
Hackathon Introduction Part 2
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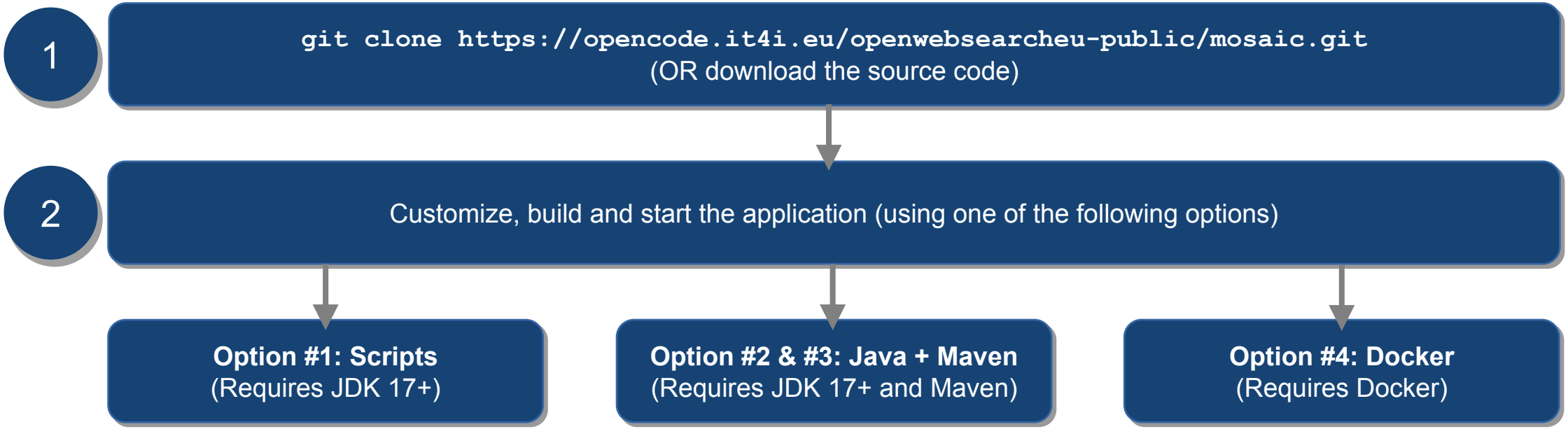
Next Steps Towards Creating Your Own Web Search Solution

➜ Find the source code of the MOSAIC on GitLab:
https://opencode.it4i.eu/openwebsearcheu-public/mosaic



MOSAIC Installation Guide
Option #1: Scripts

➜ Prerequisites: Java (JDK 17+)

```
# change the directory after cloning
cd scripts
# import indexes (optional), clean the project and create a packaged JAR
./build.sh
# run the executable
./start.sh "[OPTION]" [API_PORT]
```

➜ Example: **`./start.sh`** (both **`OPTION`** and **`API_PORT`** are optional)

➜ Batch files as alternative for Windows

MOSAIC Installation Guide
Option #2: Java + Maven

➜ Prerequisites: Java (JDK 17+) + Maven (3.8.2+)

```
# change the directory
cd search-service
# clean the project and compile the source code
mvn clean compile
# build the executable
mvn package
# run the executable
java [-Dquarkus.http.port=<API_PORT>] -jar core/target/service.jar
[OPTION]
```

➜ Example: **`java -jar core/target/service.jar`**

MOSAIC Installation Guide
Option #3: Dev Mode

➜ Prerequisites: Java (JDK 17+) + Maven (3.8.2+)

```
# change the directory
cd search-service
# run MOSAIC in dev mode
mvn quarkus:dev [-Dquarkus.http.port=<API_PORT>] [-Dquarkus:args="OPTION"]
```

➜ Example: **`mvn quarkus:dev`**

➜ Enables Quarkus Live Coding

MOSAIC Installation Guide
Option #4: Docker

➜ Prerequisites: Docker

```
# create an image
cd scripts docker build -t mosaic .
# start a container
docker run --rm -p 8008:8008 mosaic [OPTION]
```

➜ Example: `docker run --rm -p 8008:8008 mosaic`

➜ Consider port binding of Docker if you want to change the port of MOSAIC

Index Partition: CIFF/Lucene and Parquet

- ➜ CIFF: Inverted Index Exchange Format
- ➜ Lucene: Inverted Index
- ➜ Parquet: Tabular Format

CIFF/Lucene

Term	List of (Document, Frequency)
Term 1	(docID A, 1) (docID B, 3) (docID C, 1)
Term 2	(docID D,2)
Term 3	(docID E, 4) (docID F, 2)
Term 4	(docID H, 2) (docID I, 1)

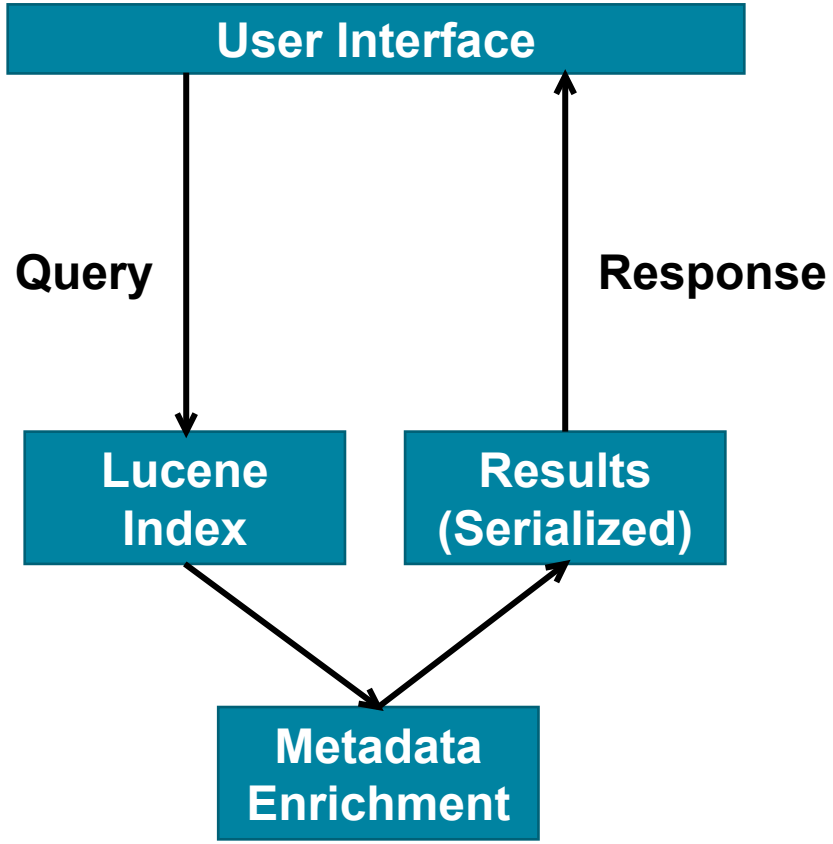
Parquet

Document	Lang	Full text	WARC date	...
docID A	eng	… text ...	2023-07-01	
docID B	deu	… text ...	2023-07-01	
docID C	deu	… text ...	2023-07-01	
docID D	eng	… text ...	2023-07-01	

Parquet File / Metadata Fields (Full List + Details)

General Metadata	URL Related Metadata
id	url
record_id	url_scheme
plain_text	url_path
title	url_params
language	url_query
domain_label	url_fragment
domain_labels	url_subdomain
warc_date	url_domain
warc_ip	url_suffix

Metadata Enrichment



Lucene DocID = Parquet DocID

General Metadata	URL Related Metadata
id	url
record_id	url_scheme
plain_text	url_path
title	url_params
language	url_query
domain_label	url_fragment
domain_labels	url_subdomain
warc_date	url_domain
warc_ip	url_suffix

REST API

End point: `host:port/search?q=...`

REST Query Parameters:

Parameter	Description
`q`	Search term(s)
`index`	Lucene index to be searched in
`lang`	Restrict searches to pages in language
`ranking`	Specify order of search result
`limit`	Set maximum number of returned results

Example:
https://qnode.eu/ows/mosaic/service/search?q=austria

Defined per module:

- ➜ **Core**: Basic search and filtering
- ➜ **Geo**: Geo-information (i.e., coordinates, location names)
- ➜ **Keywords**: Extracted keywords from full plain text
- ➜ Feel free to add your own modules

REST API

End point: `host:port/search?q=...`

Response (JSON):

```
{
  "results": [
    {
      "simplewiki": [
        {
          "id": "cfe49c84-2244-430e-83e3-fe3f30aae21e",
          "url":"https://simple.wikipedia.org/wiki/Anthem_of_Europe",
          "title": "Wikipedia: Anthem of Europe",
          "textSnippet":"https://simple.wikipedia.org/wiki/Anthem_of_Europe",
          "language": "spa",
          "warcDate": "2024-01-15T22:19:46Z",
          "wordCount": 11
        },
        ...
      ],
    },
    {
       "unis-graz": [
        { ... },
      ],
      ...
   },
   ...
  ]
}
```

REST API

End point: `host:port/searchxml?q=...`

Response (OpenSearch / XML):

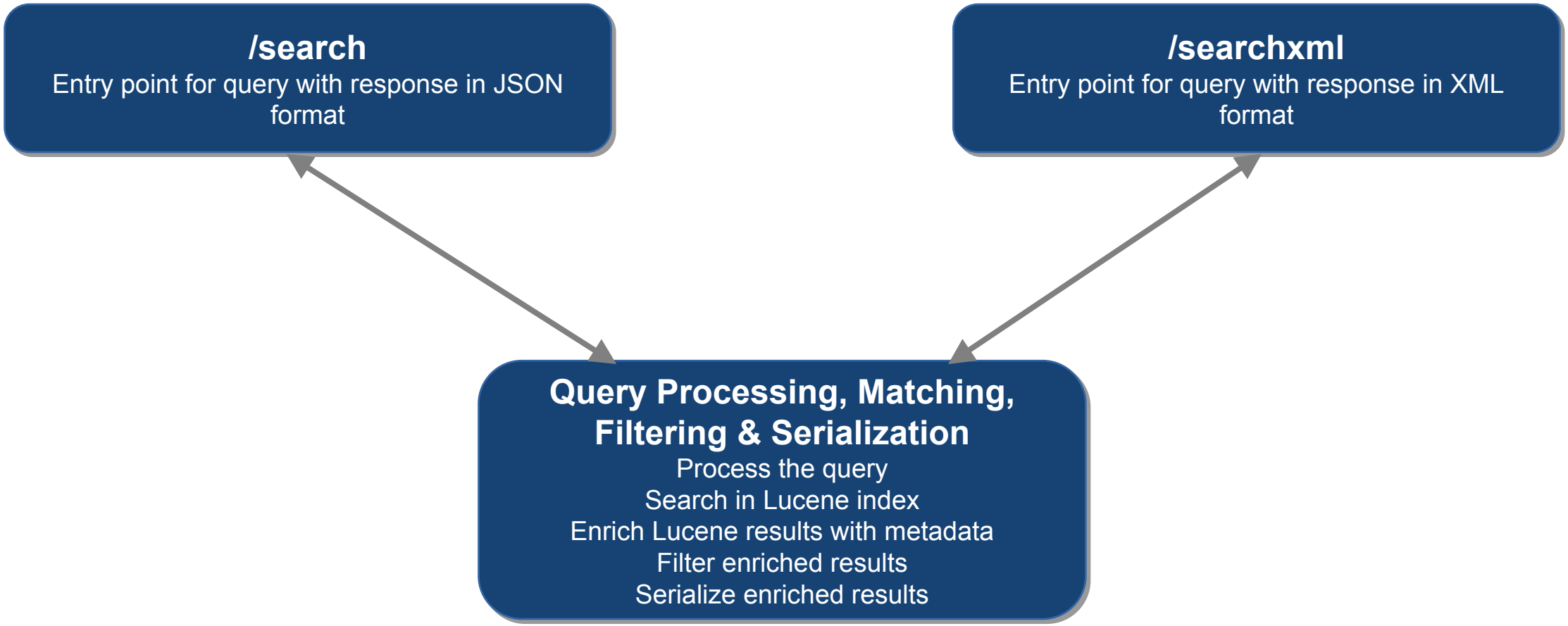
```
<feed xmlns="http://www.w3.org/2005/Atom" xmlns:opensearch="http://a9.com/-/spec/opensearch/1.1/">
  <title>MOSAIC Search: {searchTerms}</title>
  <description>Search results for "{searchTerms}" at MOSAIC Search Service</description>
  <author>
    <name>OpenWebSearch.eu</name>
  </author>
  <opensearch:totalResults>1121</opensearch:totalResults>
  <opensearch:startIndex>1</opensearch:startIndex>
  <opensearch:itemsPerPage>20</opensearch:itemsPerPage>
  <opensearch:Query role="request" searchTerms="{searchTerms}"
                                   startPage="1"/>
  <link rel="alternate" href="{baseUrl}/search?q={searchTerms}&pw=1&limit=20" type="application/json"/>
  <link rel="self" href="{baseUrl}/searchxml?q={searchTerms}&pw=1&limit=20" type="application/atom+xml"/>
  <link rel="next" href="{baseUrl}/searchxml?q={searchTerms}&pw=2&limit=20" type="application/atom+xml"/>
  <link rel="last" href="{baseUrl}/searchxml?q={searchTerms}&pw=56&limit=20" type="application/atom+xml"/>
  <link rel="search" type="application/opensearchdescription+xml" href="{baseUrl}/opensearch.xml"/>
  <item>
    ...
  </item>
  <item>
    ...
  </item>
  ...
</feed>
```

REST API

Additonal endpoints:

- ➜ **`/index-info`**: Returns a list of present indexes, including the number of documents and available languages for each index
- ➜ **`/full-text`**: Returns the full plain text of a document specified by a document ID

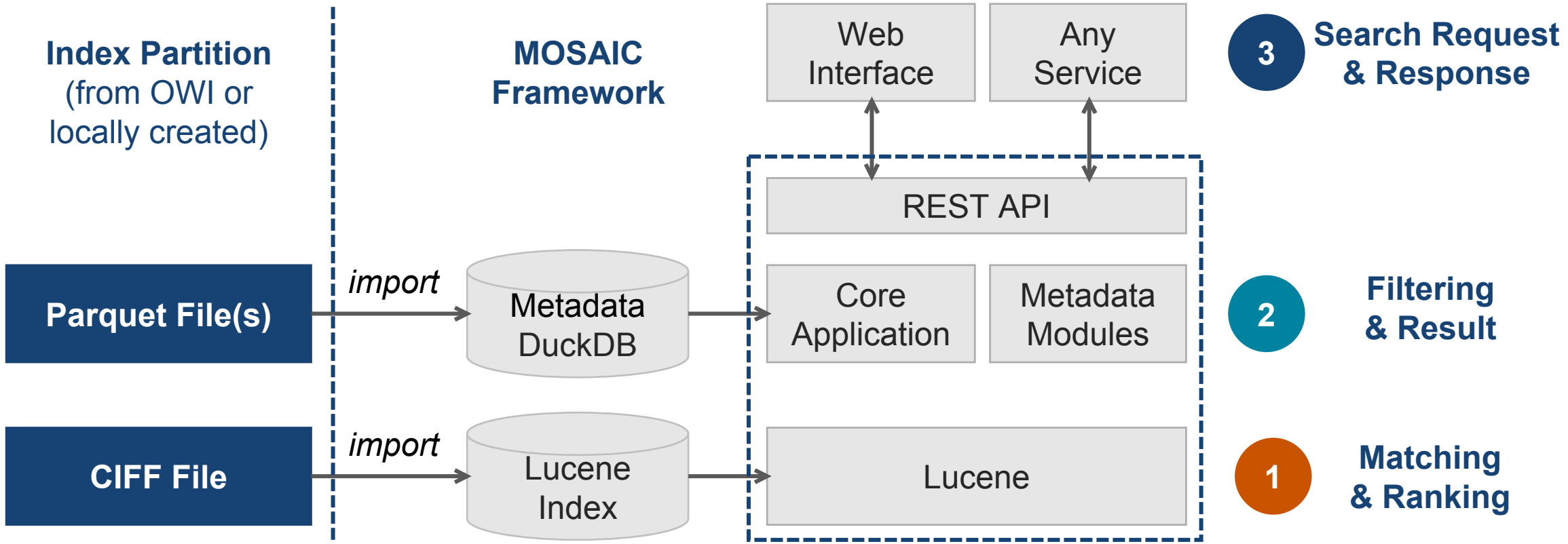
Retrieval Process of MOSAIC (simplified)



Development Possibilities

(1) Create your own index

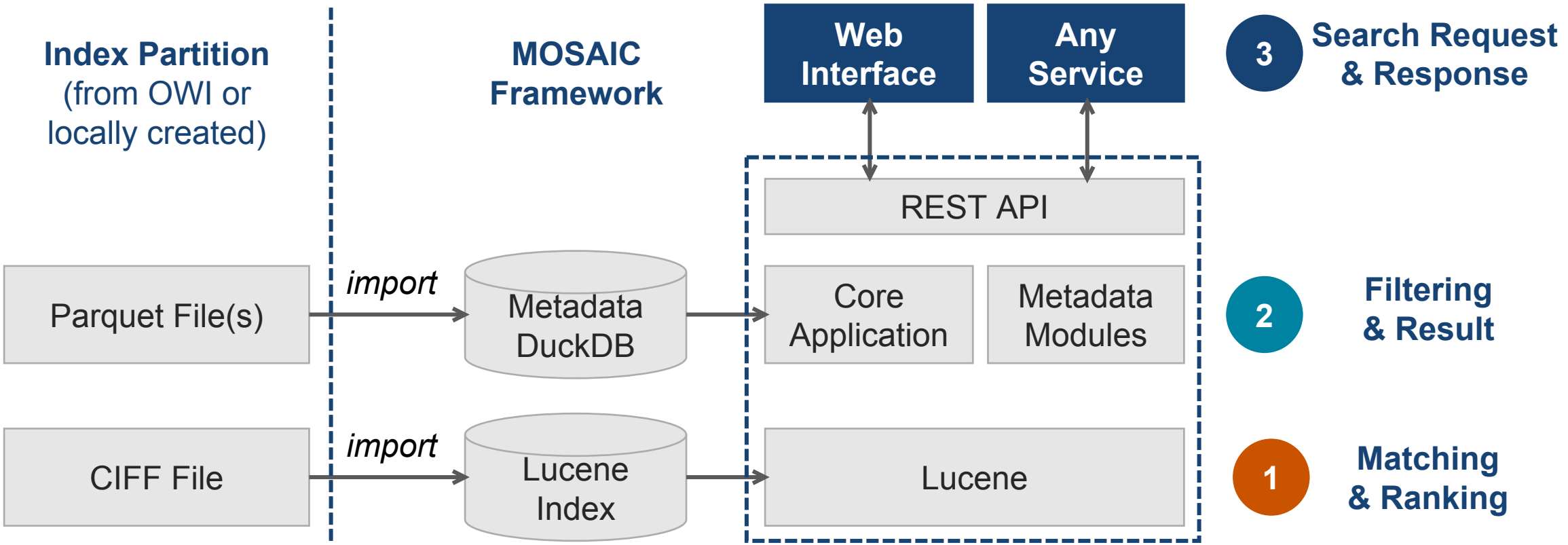
- Move/Copy CIFF and Parquet file(s) to directory `resources/<INDEX_NAME>/`
- Serve CIFF/Lucene and Parquet file(s) using CLI options



Development Possibilities

(2) Create or improve a front-end

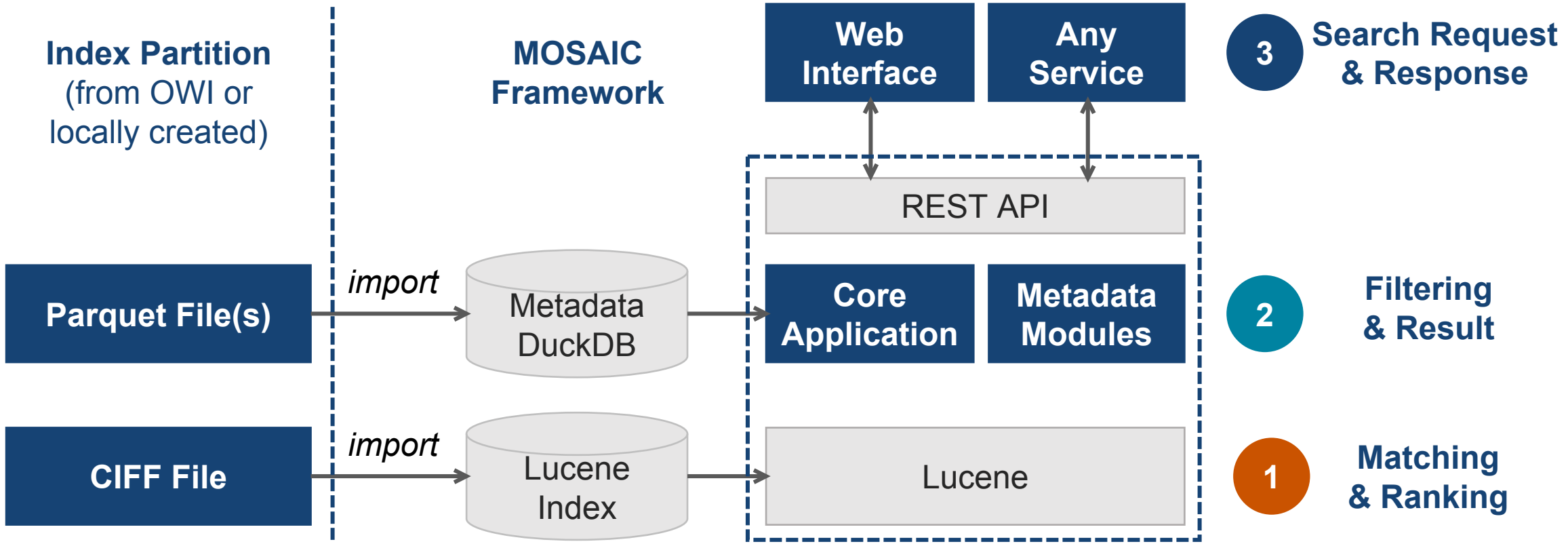
- Modify the existing front-end in the directory `front-end` of the repository
- Create a new (web) user interface utilizing the REST API



Development Possibilities

(3) Create an application that uses MOSAIC as service

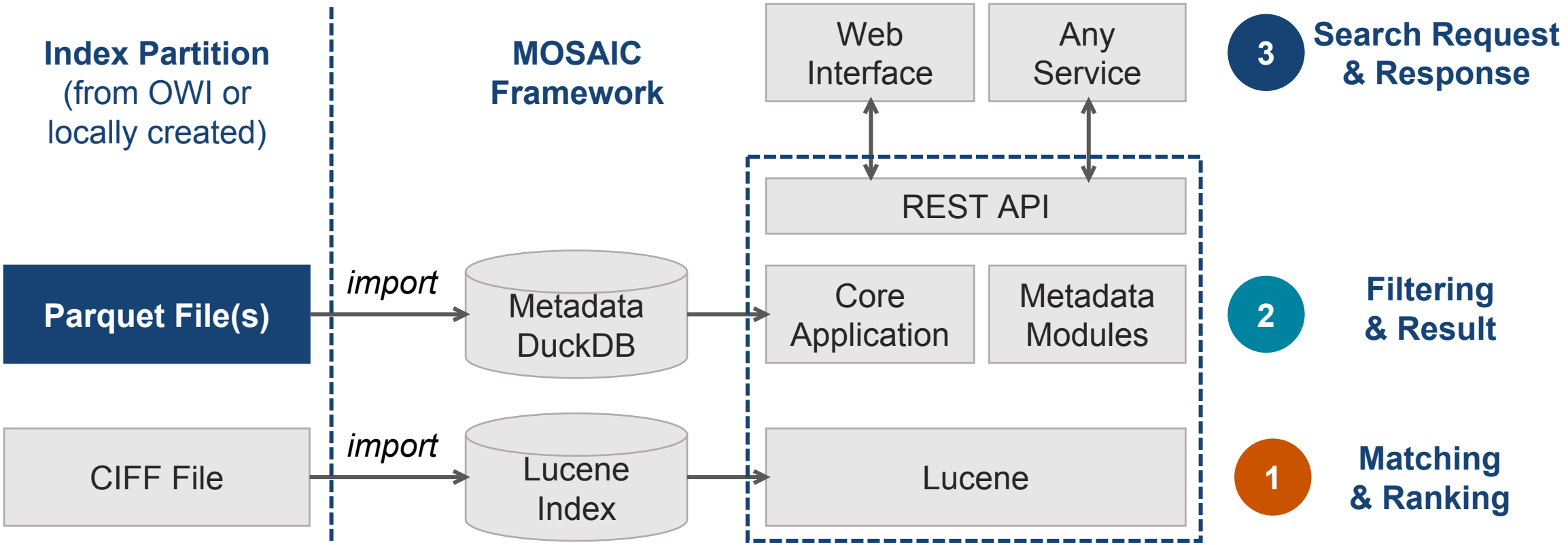
- Integrate a new index into MOSAIC (1)
- Modify or create a front-end (2)
- Access the REST API and use MOSAIC as service



Development Possibilities

(4) Undertake web data analysis

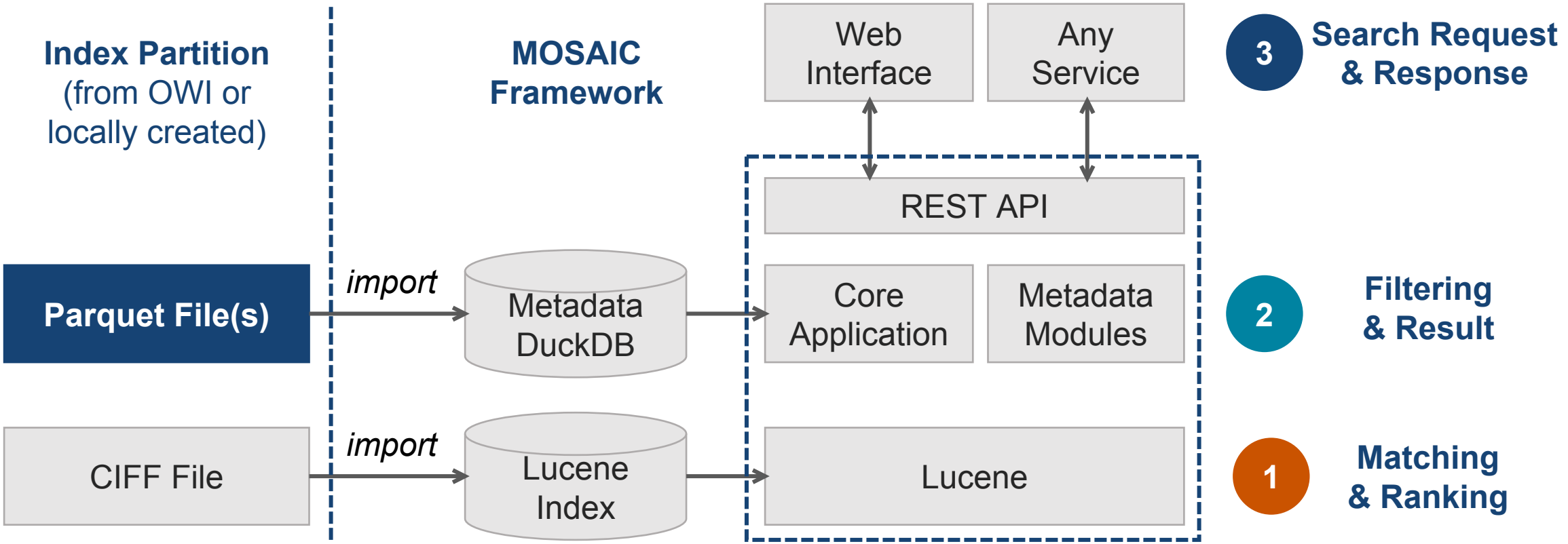
- Use existing and/or locally created indices
- Perform analysis on set of web documents
- Example: Topic Modeling, PageRank implementation, etc.



Development Possibilities

(5) Feed a Large Language Model

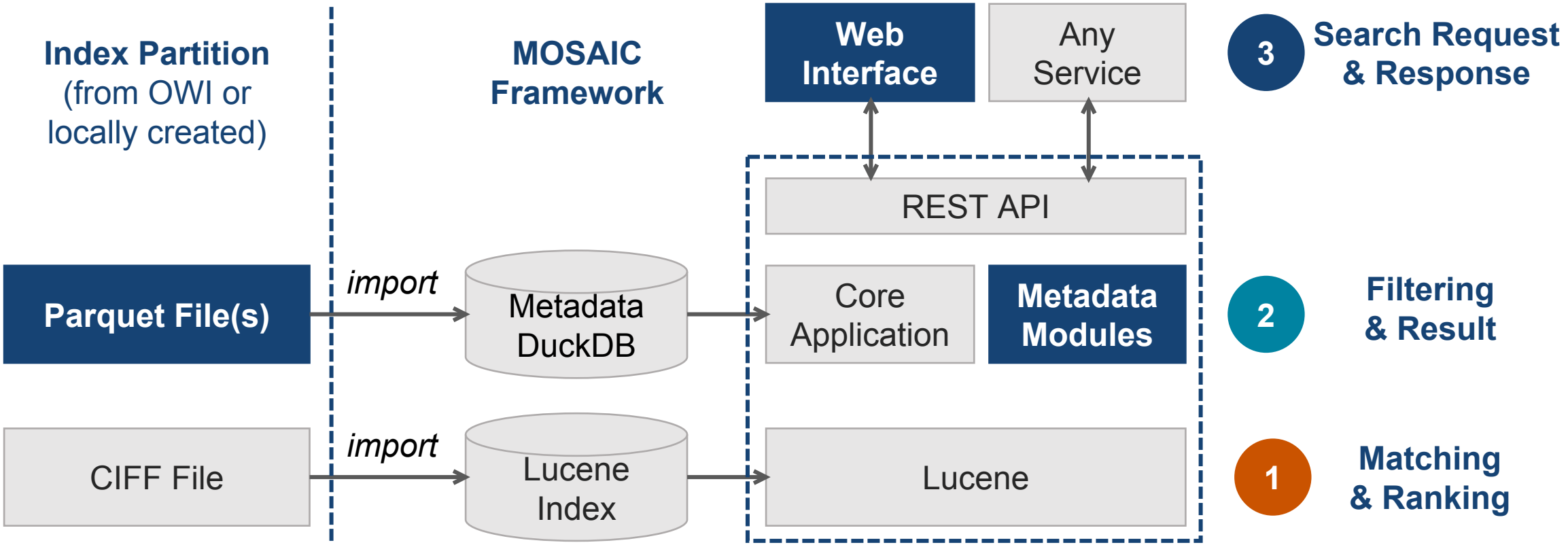
- Use existing and/or locally created indices
- Develop use case and analysis goal



Development Possibilities

(6) Create a new module

- Follow steps in Developer Guide for creating a new module
- Example: Make use of existing unused column `domain_label` in Parquet file



Concrete Ideas & Suggestions

- ➜ Create a new front-end and utilize the REST API of MOSAIC
- ➜ Create a new module using existing but unused metadata columns (e.g., `domain_label`) in the Parquet file
- ➜ Expand the existing `/index-info` endpoint byperforming an in-depth analysis of web documents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Any Questions?

Contact:

- Sebastian Gürtl <sebastian.guertl@tugraz.at>
- Alexander Nussbaumer <alexander.nussbaumer@tugraz.at>
- Graz University of Technology, Austria

Agenda

- ➜ 09:45 - 10:00: Group formation and coffee
- ➜ 10:00 - 11:00: Working session 1: Idea generation
- ➜ 11:00 - 11:15: Presentation of ideas (*)
- ➜ 11:15 - 13:00: Working session 2
- ➜ 13:00 - 14:00: Lunch
- ➜ 14:00 - 17:00: Working session 3
- ➜ 17:00 - 18:00: Presentation of results & voting (*)
- ➜ 18:00 - 19:00: Get-together and beer

* Plenary session, will be broadcasted to online participants