# Recommender Metrics Framework

## Measuring the success of a Recommender System

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National Infrastructures for Research and Technology (GRNET)

FOSS COMM 23
FREE & OPEN SOURCE SOFTWARE COMMUNITIES MEETING

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

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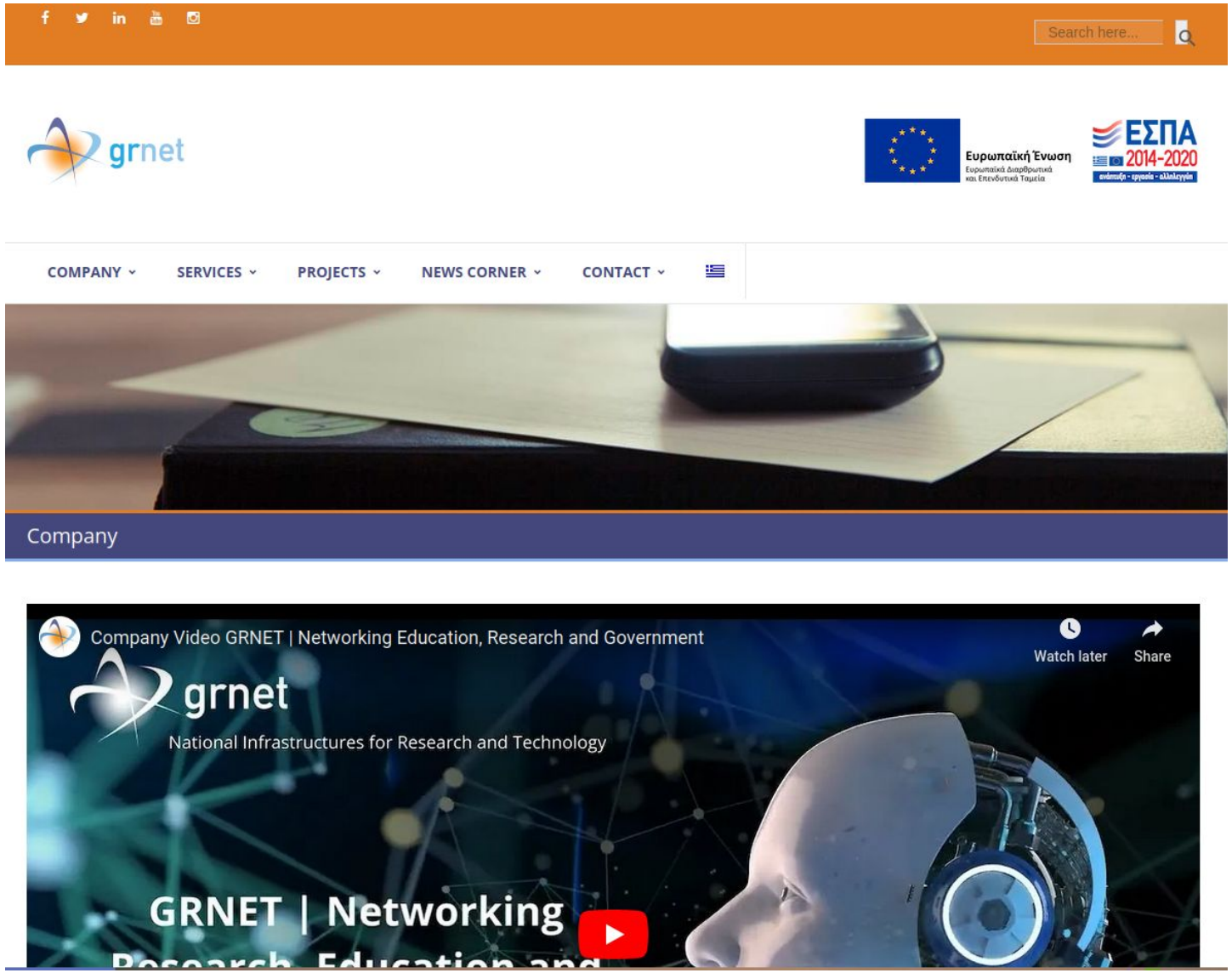
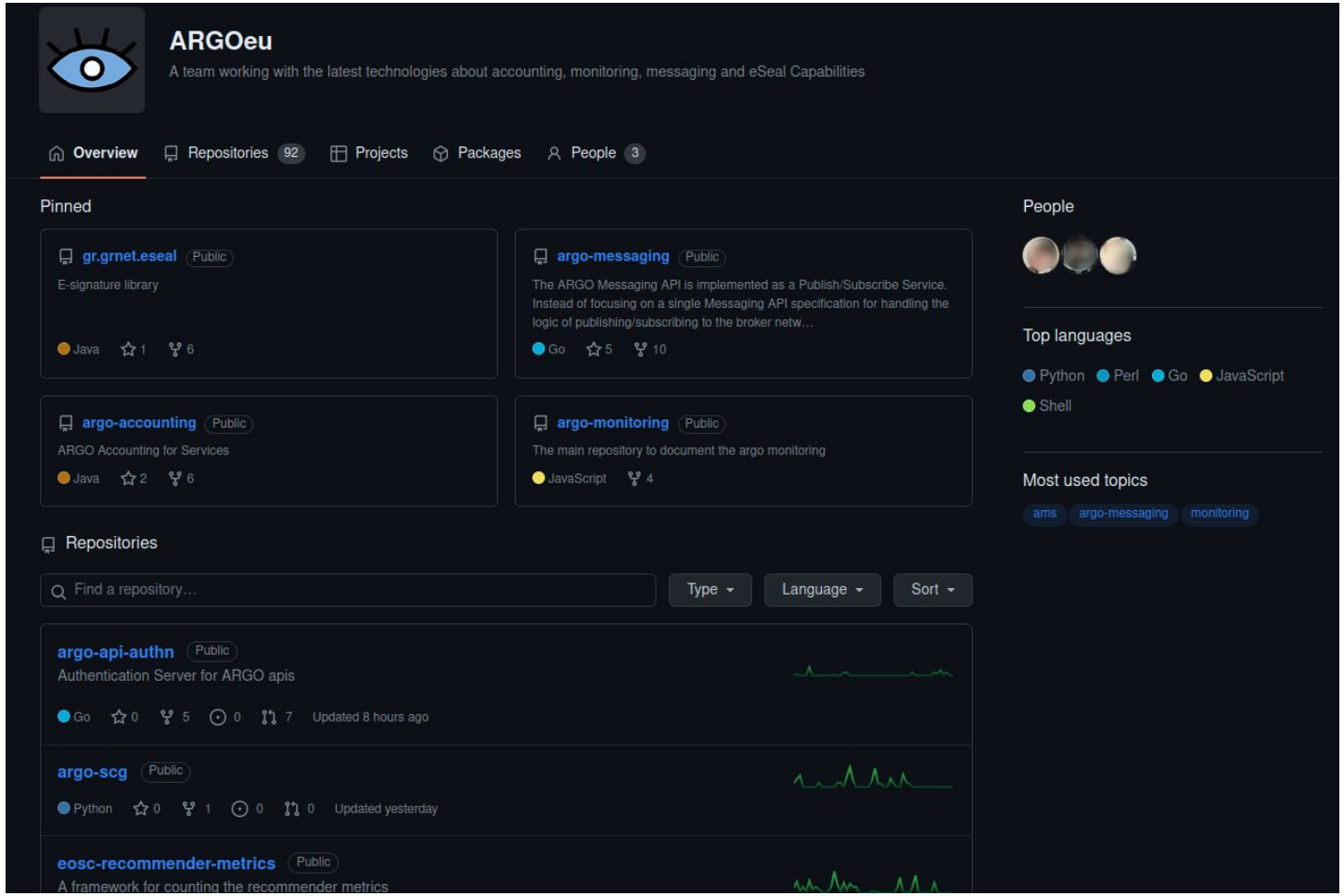
# Who we are?

- GRNET S.A. – National Infrastructures for Research and Technology, is one of the largest public sector technology companies in Greece.
- It provides networking, cloud computing, HPC, data management services and e-Infrastructures and services to academic and research institutions, to educational bodies at all levels, and to all agencies of the public sector.
- https://grnet.gr



# Who we are?

- The European Infrastructures and Projects Directorate.
- Among others, it develops software solutions in various research projects across EU and Greece.
- One of the subteams of the Directorate that lies in GitHub Organizations: https://github.com/ARGOeu
- Recommender Metrics Framework (RMF) is developed by GRNET and used as an open-source solution in the EOSC-Future project.



# What are we going to talk about?

A Recommender System's Metrics Framework that can produce measurable results for a Recommender System's evaluation.

# Where is it used?

Will explain in a few minutes

To monitor and report diagnostic metrics for the EOSC Marketplace Recommender Service.

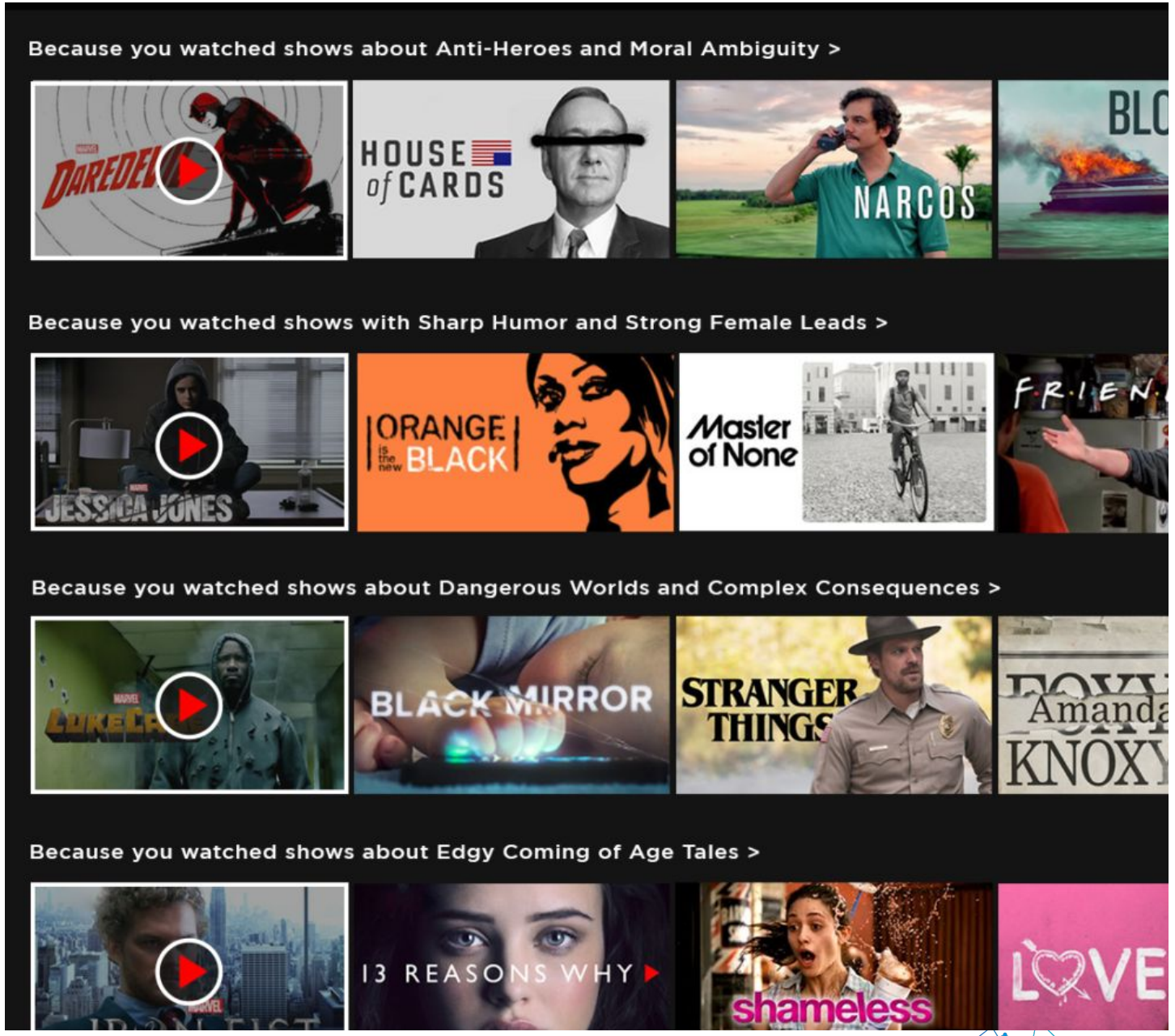
**Recommender Service**

- **Owners**
- **Developers**
- **Engineers**

**Service using the RS Marketing Team**

# What is a Recommender System (RS)?

- Offers personalized suggestions to users.
- Recommendations are based on user preferences, behaviors, patterns.
- Recommendations can include products, content, services, or connections.
- Aims to enhance user experience.
- Applications include e-commerce, content streaming, and social media.
- Addresses the information overload problem in the digital age.



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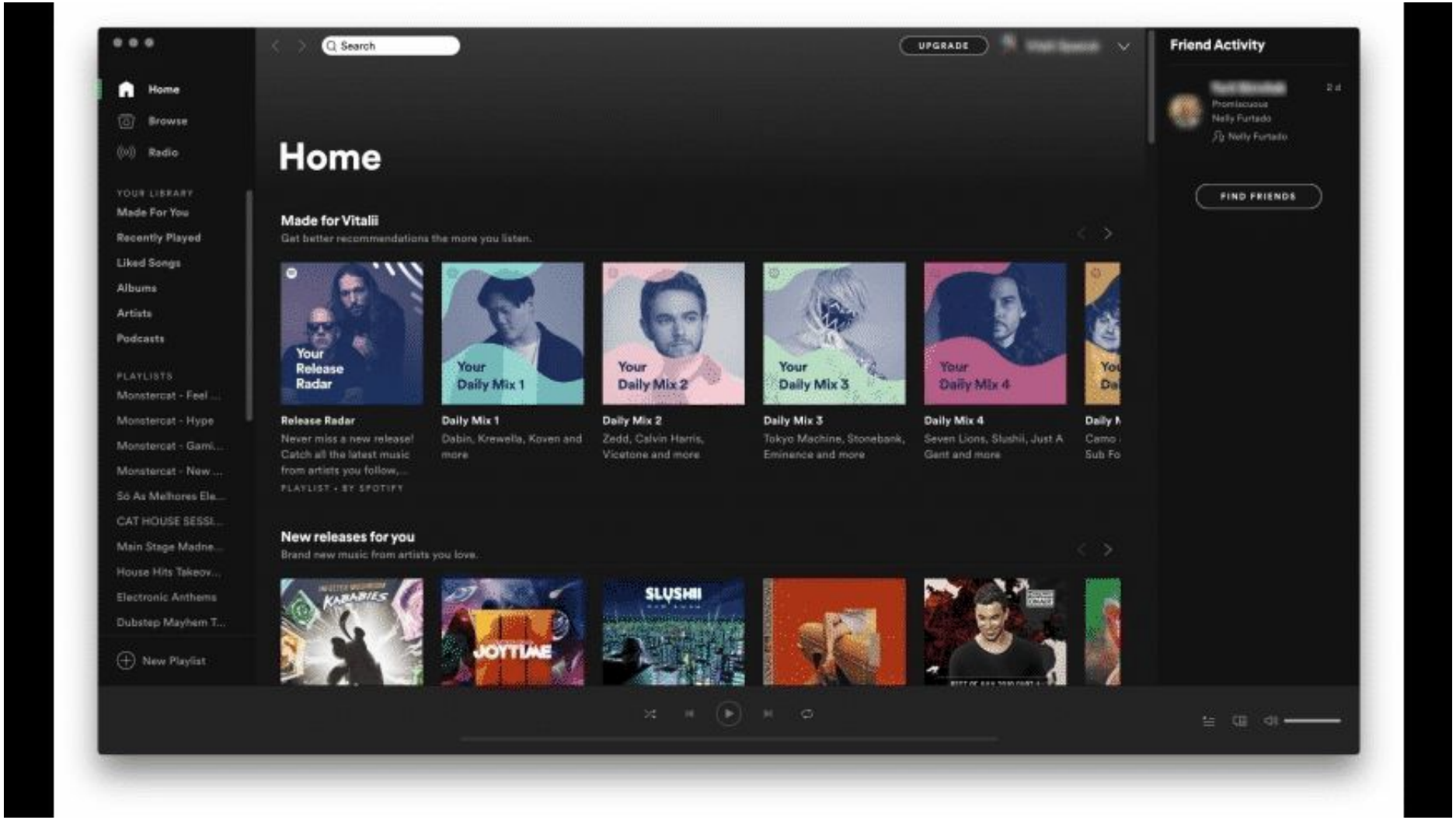
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Tokyo Machine, Stonebank, Eminence and more
Your Daily Mix 4
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Seven Lions, Slushii, Just A Gent and more
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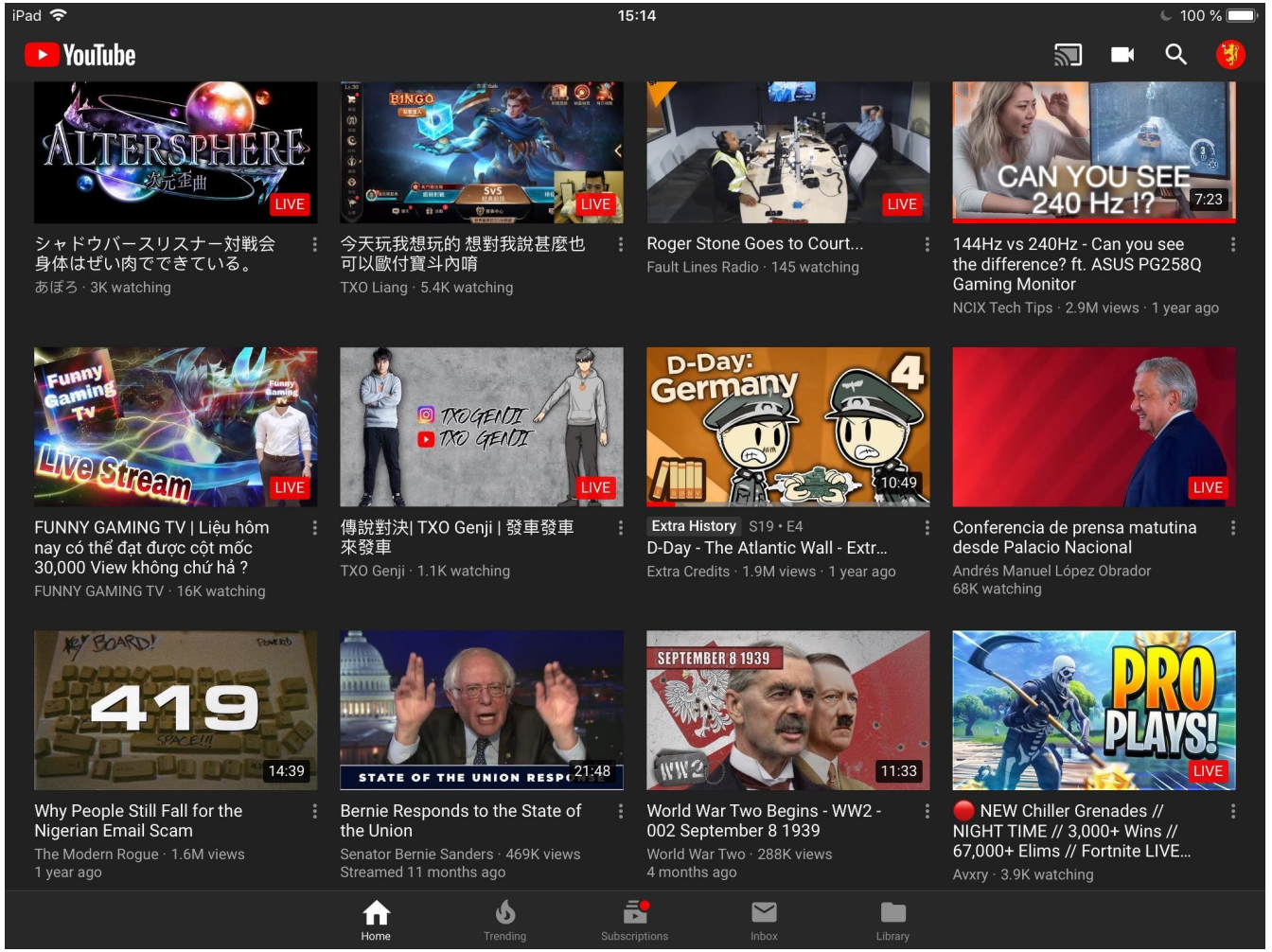
KABABIES
JOYTIME
SLUSHII
Friend Activity
FIND FRIENDS

# More...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# More...

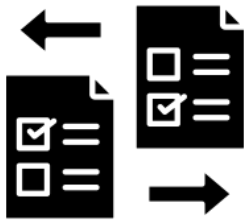
# But…

- How “good” recommendations are?

- What is “good”?

# Why do we need RS metrics?

**Evaluation:** They assess RS performance and effectiveness.



**Comparison:** They help compare different systems or variations.

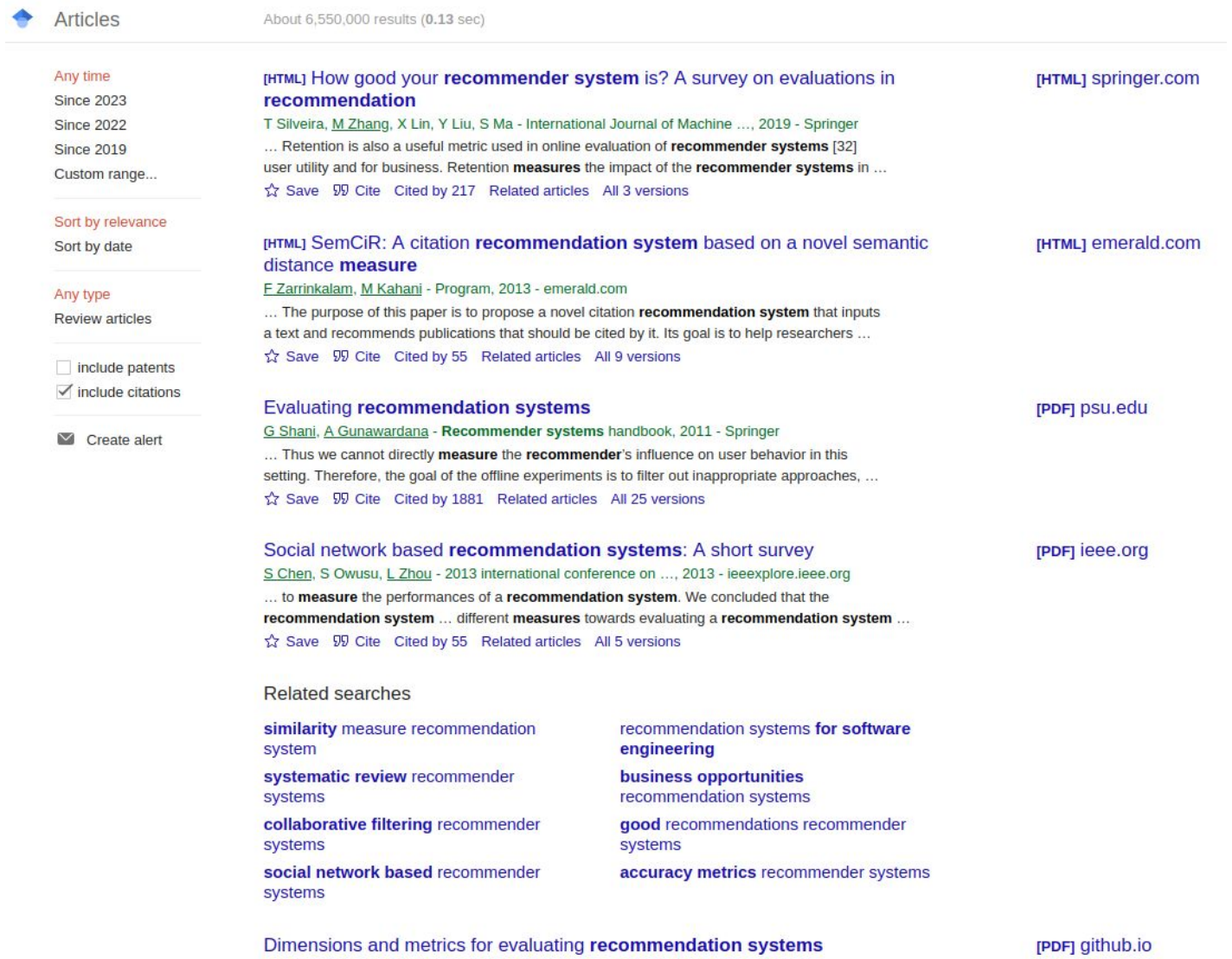
**User Satisfaction:** They measure user engagement and they can help in building user trust.

**Fairness**: They can be used to mitigate biases in recommendations, promoting fairness and inclusivity.

**Optimization**: They guide improvements and fine-tuning in algorithms and parameters, whereas they support continuous system improvement.

**Business Impact:** They can be tied to financial outcomes (KPIs).

# Science in the background...



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# How to measure success?

**Statistics:** quantifies the occurrences of various data entities, such as user interactions, item popularity, or recommendation relevance scores.

**Metrics**: goes beyond simple **counts** and offer sophisticated characterizations of Recommender System's performance.

**KPIs**: Key Performance Indicators (KPIs) focused on business-oriented metrics, which are aligned with the overarching goals of the organization.

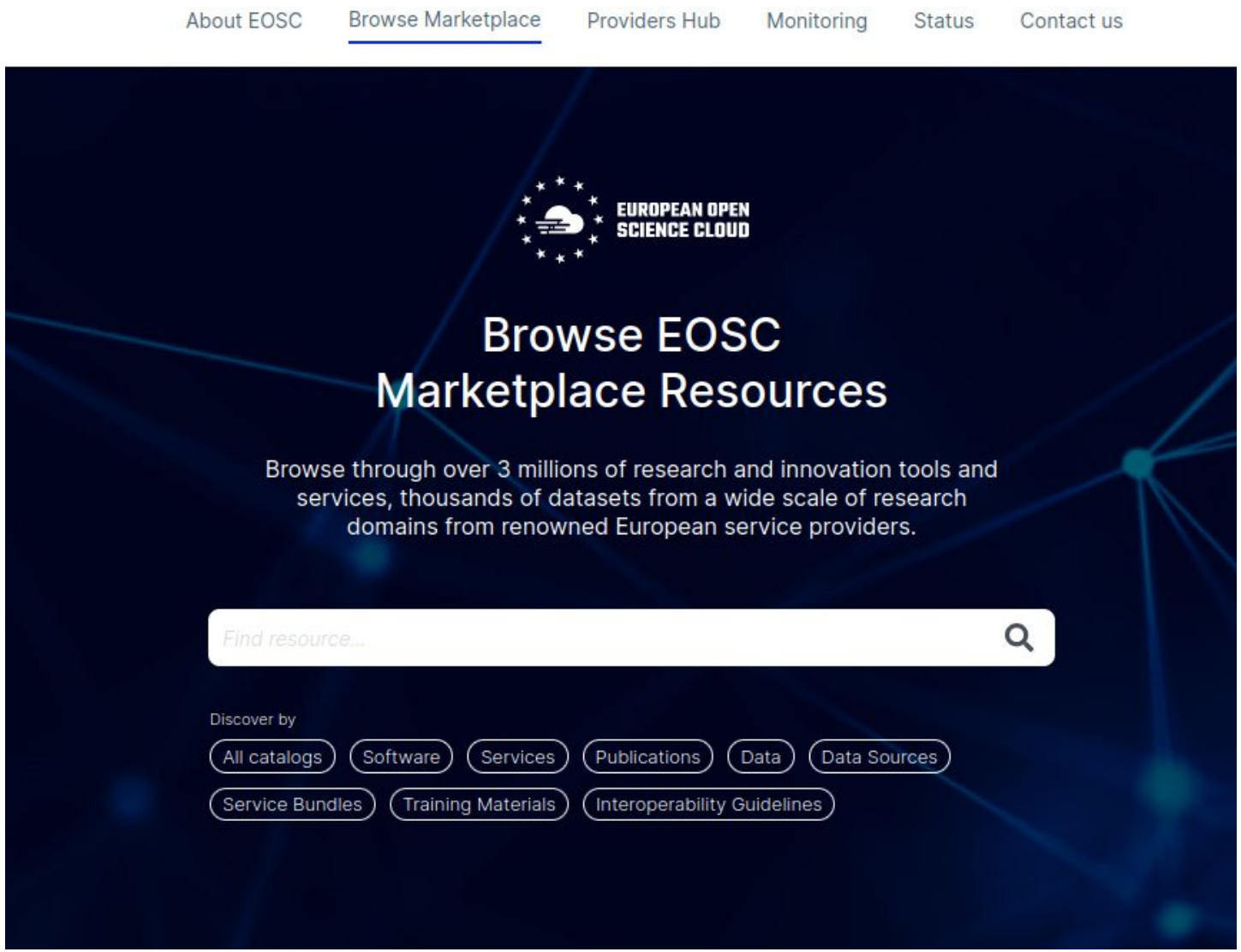
**Graphs**: visualizations of statistics/metrics across time helping in tracking trends, and identifying seasonality.

# What is EOSC?

- EOSC stands for the "European Open Science Cloud".
- It is a European initiative aimed at creating a unified, open environment for researchers and scientists.
- Its objectives include enabling access, sharing, and reuse of data, as well as providing access to research services and resources.
- EOSC promotes open science principles, fostering transparency and accessibility in research.
- Collaboration among researchers from various disciplines and institutions is a central goal of EOSC.

# What is EOSC Marketplace?

- The EOSC Marketplace is an online platform and ecosystem within EOSC: https://marketplace.eosc-portal.eu/
- It is designed to facilitate access to a wide range of digital resources, services, and data.
- It serves as a centralized hub for researchers and scientists in the EU research community.
- Researchers can use the marketplace to discover, access, and use resources that support their research activities.
- Resources available through the marketplace include data repositories, software applications, computing and storage facilities, trainings, and various research services.



# What is Recommender Metrics Framework (RMF)?

- A Python open-source software that monitors, analyzes, and evaluates recommendation mechanisms.
- Measures the effectiveness of the EOSC Marketplace RS to enhance the user experience and improve AI algorithms.
- Incorporates diagnostic statistics, metrics and visualizations for deeper insights into model performance.
- Presents reports as a web service and visualizes statistics, metrics, and Key Performance Indicators (KPIs) through a RESTful API and UI dashboard.
- Quantitative evaluation is taking into account EOSC Marketplace resources, user actions, and recommendations.
- Supports real-time and offline data ingestion, multiple resource types, and various recommendation engines as sources.
- Evolves over time, adding features and utilities to promote the development of more reliable and high-quality RS designs.

# Use Cases

IS CURRENTLY USED

## Monitoring the EOSC Marketplace RS

- Monitors and reports diagnostic metrics for the EOSC Marketplace RS.
- Analyses user actions and recommendations.
- Provides Statistics, Metrics, KPIs, Graphs in a REST API and dashboard UI.
- Delivers comprehensive documentation.

CAN BE USED

## Evaluate a third-party RS

- An analysis tool of the recommendation engine.
- Data preparation with the necessary input information.
- Tasks involve retrieving data from multiple sources, removing irrelevant data, correlating information, and generating **statistical insights**.

# What it offers?

## Statistics

- Number of Users
- Number of Resources
- Number of Recommended items
- Number of User Actions by
  - Registered or
  - Anonymous users
- Total Views

# What it offers?

User Actions

## Statistics

- Number of Users
- Number of Resources
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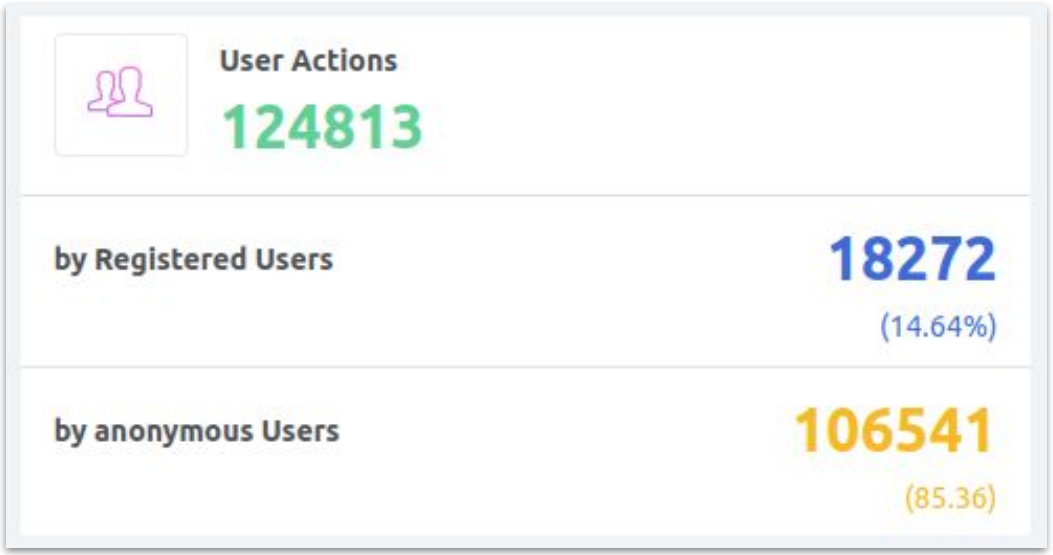

# What it offers?

## Metrics

- Accuracy
- Catalog Coverage
- Diversity Gini Index
- Diversity Shannon Entropy
- Novelty
- User Coverage

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## Metrics

- **Accuracy**
- Catalog Coverage
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- Diversity Shannon Entropy
- Novelty
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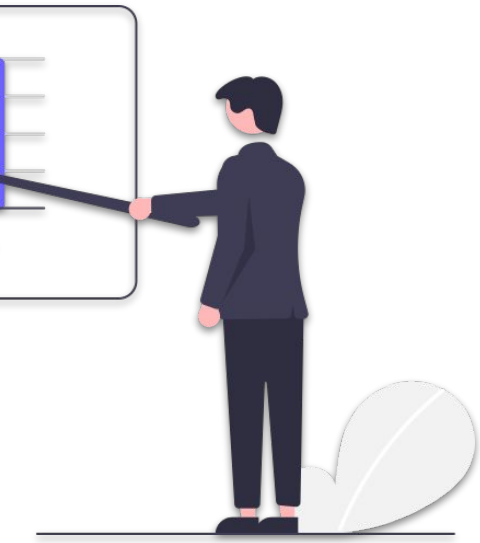
Measures Recommendations' accuracy based on users' access to the services. A value of 1, indicates that the RS model got all the predictions right, and a value of 0 indicates that the RS model did not make a single correct prediction.

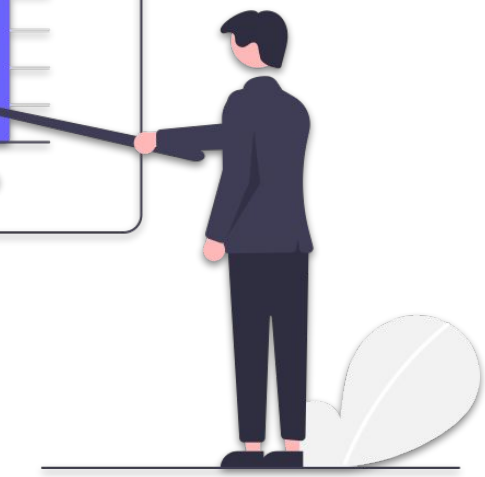


# What it offers?

## Metrics

- Accuracy
- **Catalog Coverage**
- Diversity Gini Index
- Diversity Shannon Entropy
- Novelty
- User Coverage

The percentage (%) of the division of the unique services found in recommendations to the total number of published services.

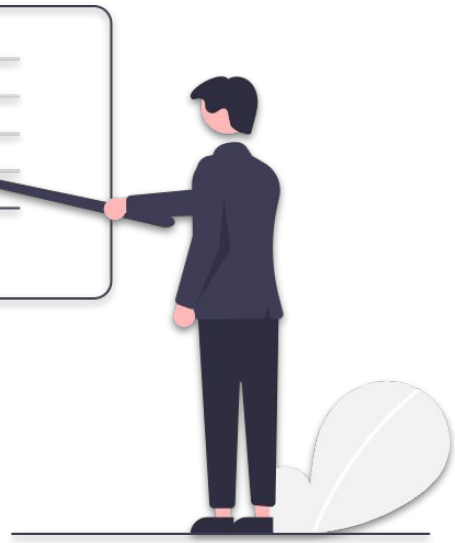


# What it offers?

## Metrics

- Accuracy
- Catalog Coverage
- **Diversity Gini Index**
- Diversity Shannon Entropy
- Novelty
- User Coverage

Measures Recommendations' diversity. The index is 0 when all items are chosen equally often, and 1 when a single item is always chosen.



# What it offers?

## Metrics

- Accuracy
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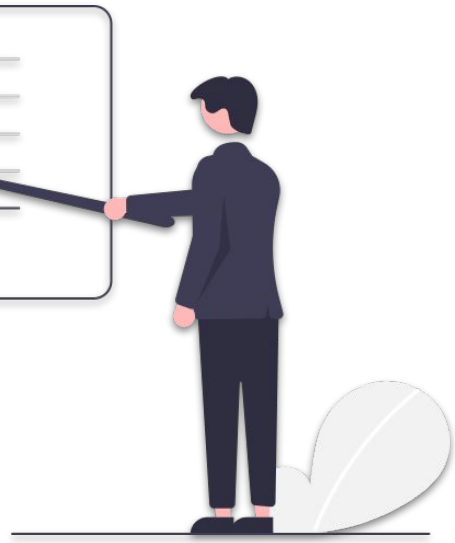
- Diversity Gini Index
- **Diversity Shannon Entropy**
- Novelty
- User Coverage

Measures Recommendations' diversity. The entropy is o when a single item is always chosen or recommended, and log n when n items are chosen or recommended equally often.

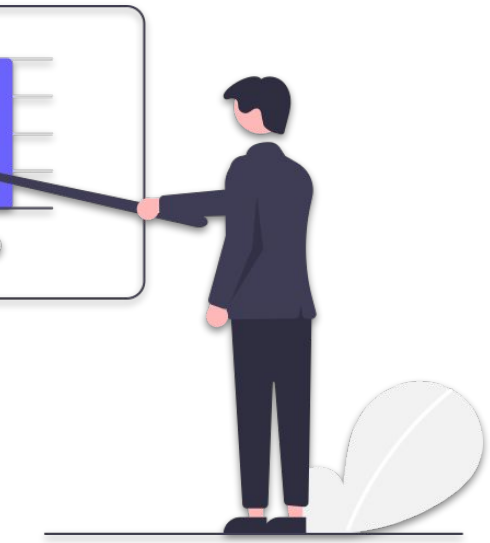


# What it offers?

## Metrics

- Accuracy
- Catalog Coverage
- Diversity Gini Index
- Diversity Shannon Entropy
- **Novelty**
- User Coverage

The novelty metric expresses the ability of the system to recommend items not generally seen before by the population of users.



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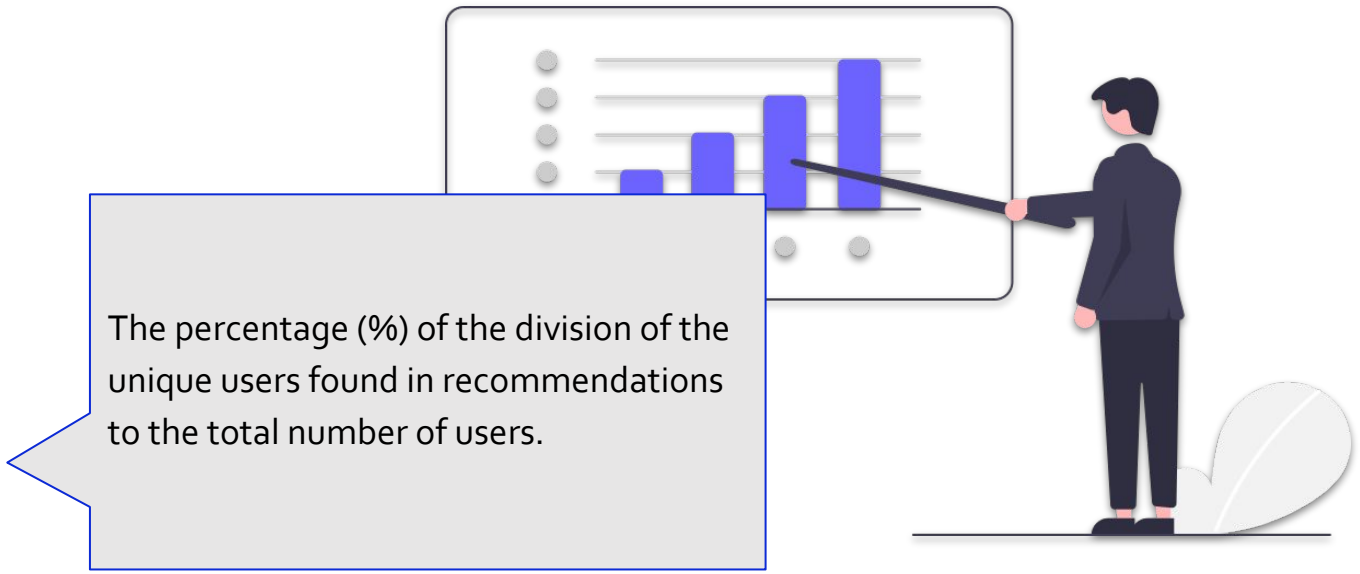
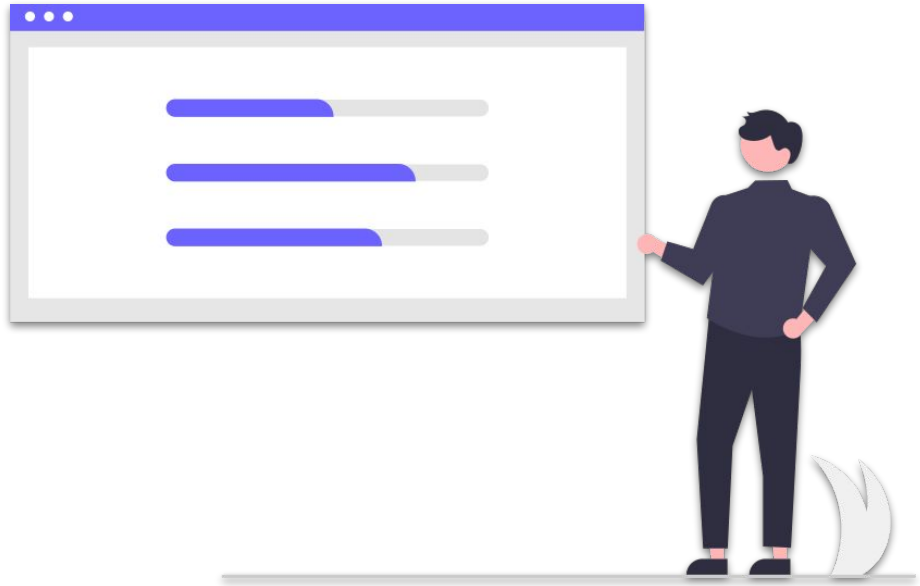


# What it offers?

## KPIs

- Click-Through Rate
- Hit-Rate
- Top 5 viewed Items
- Top 5 recommended Items
- Top 5 viewed categories
- Top 5 recommended categories
- Top 5 viewed scientific domains
- Top 5 recommended scientific domains



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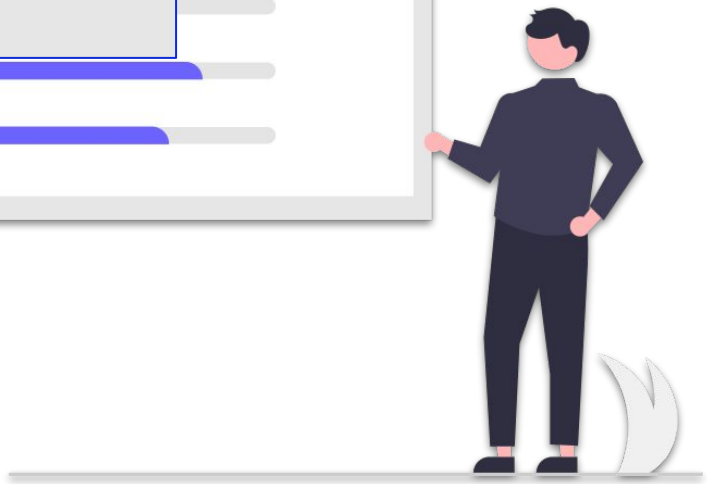
The number of user clicks through recommendations panels divided by the total times recommendation panels were presented to users.



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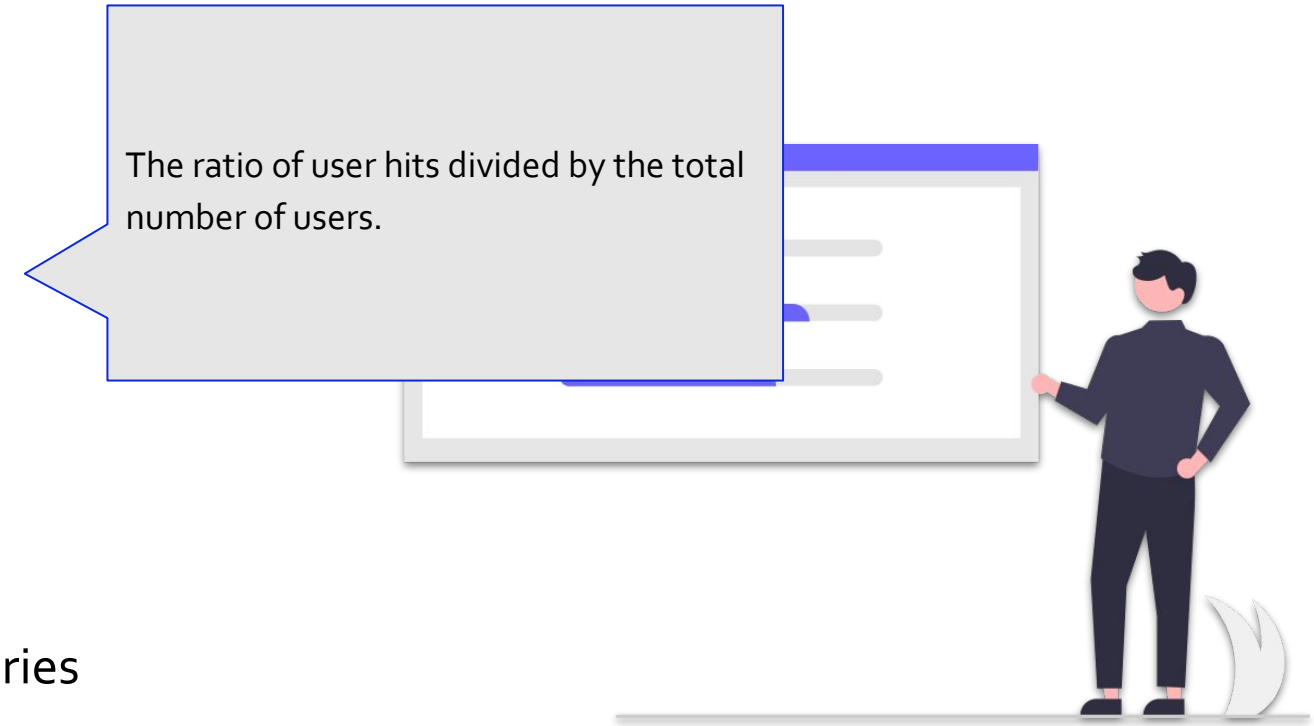

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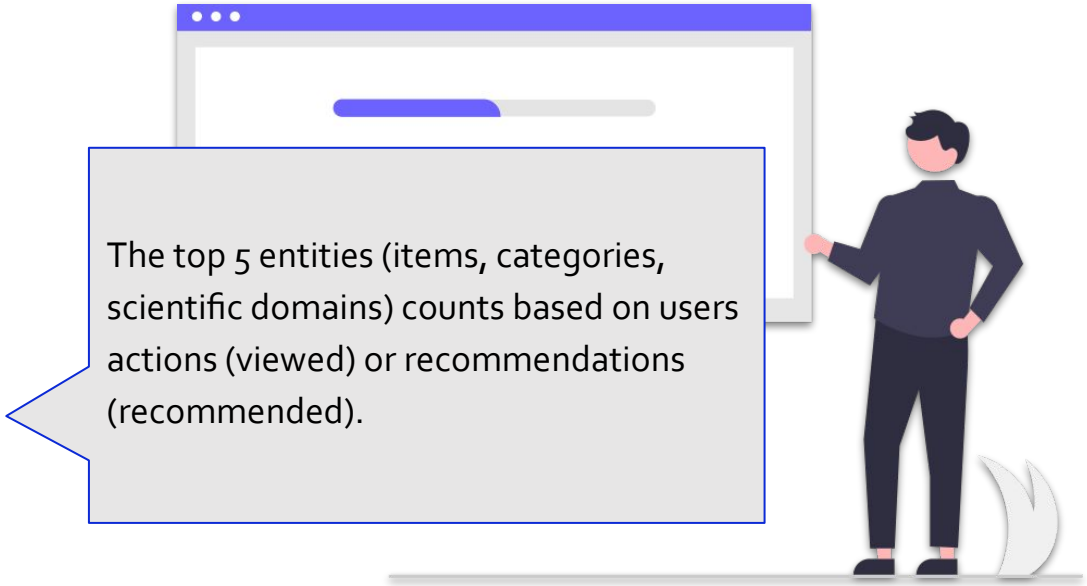
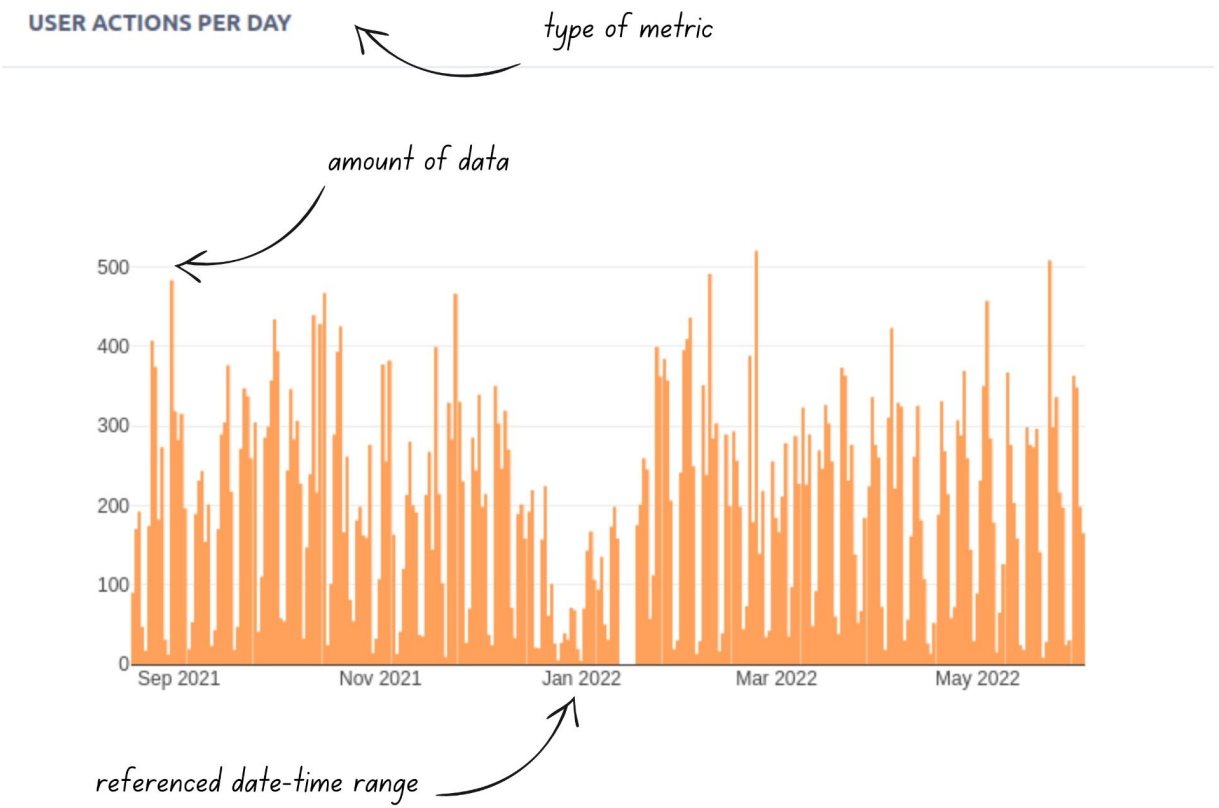


# What it offers?

## Graphs

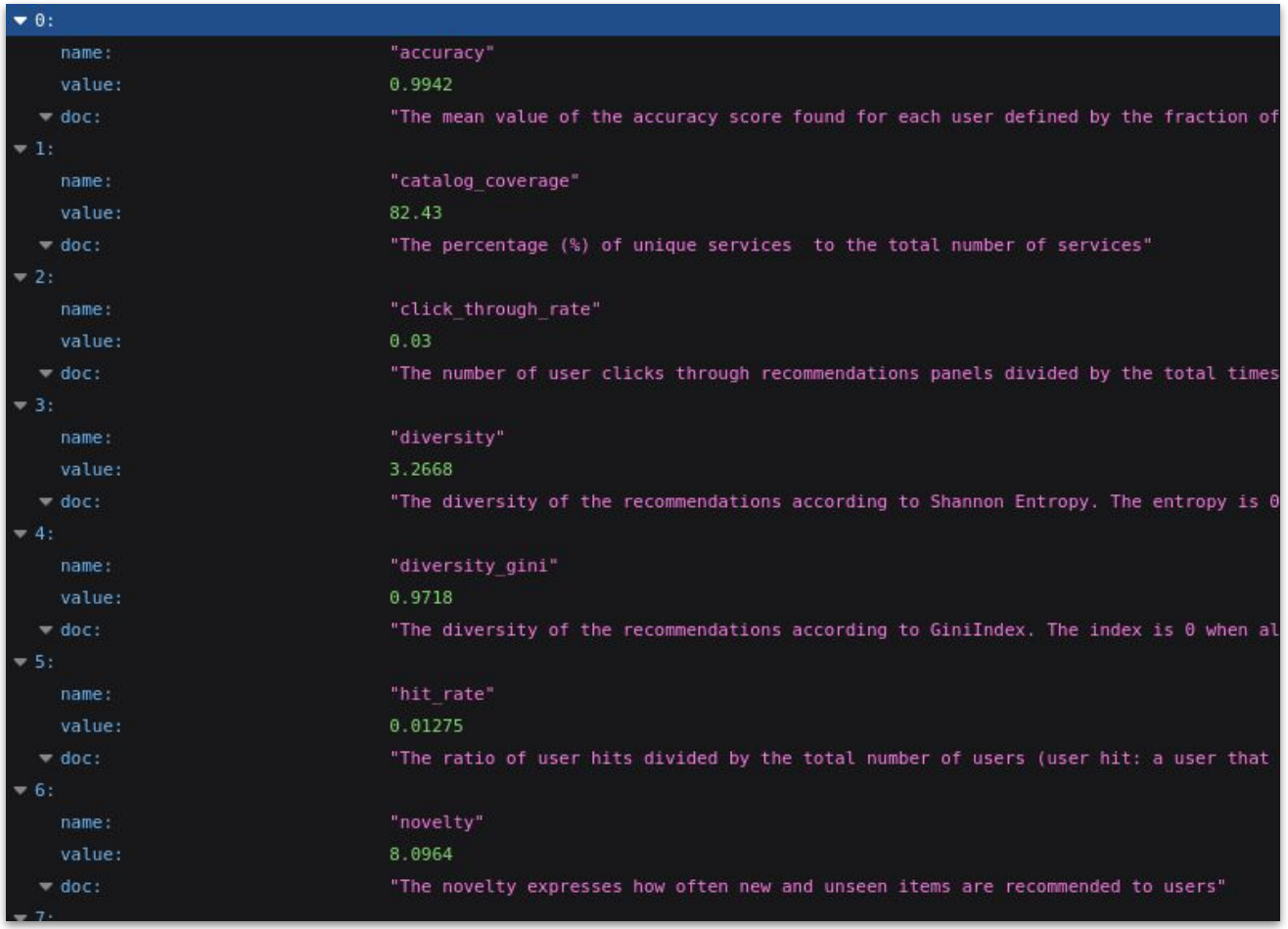
- User Actions per day
- Recommended Items per day
- User Actions per month
- Recommended Items per month



# What it offers?

## Rest API

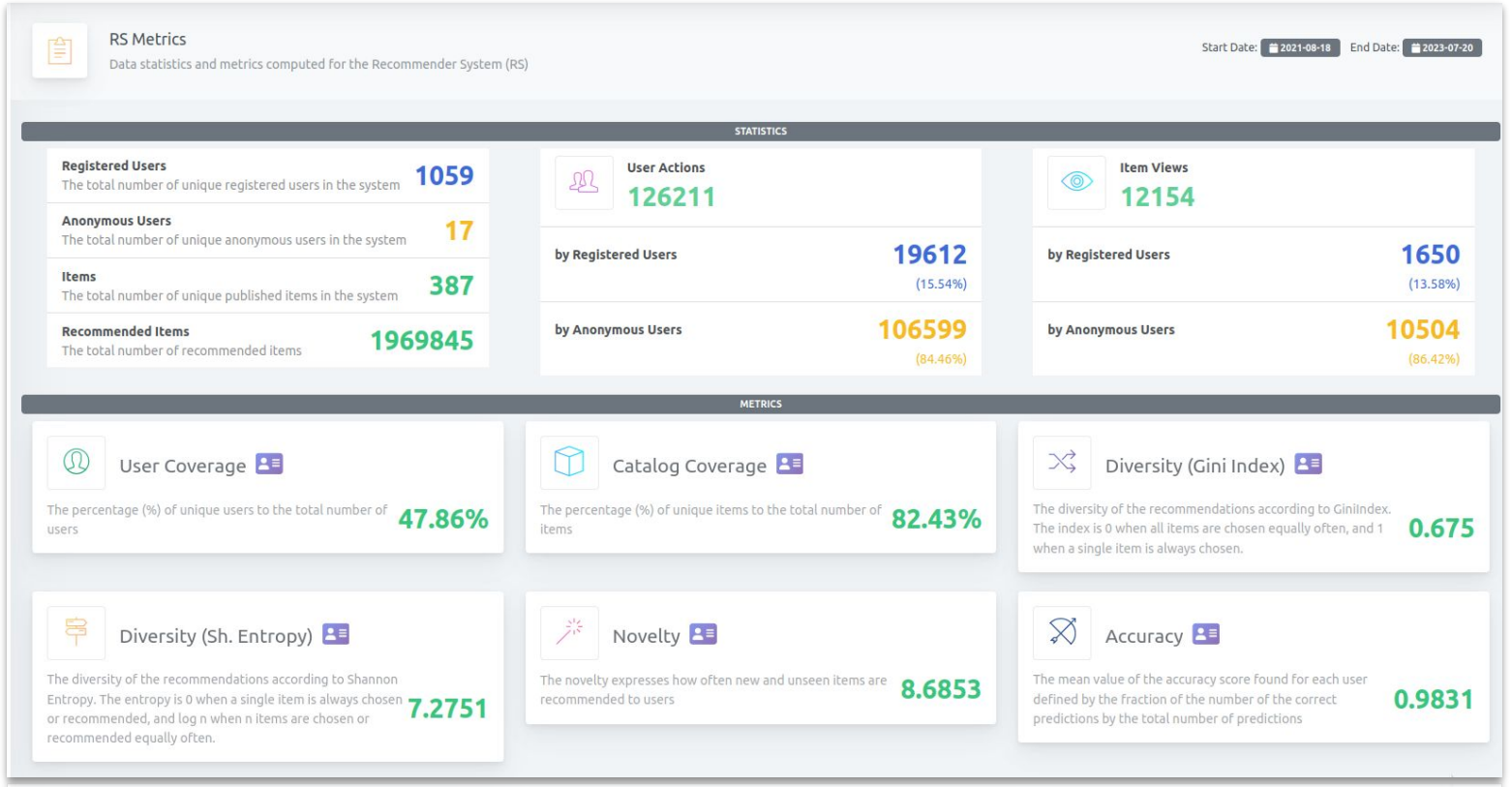
- Statistics
- Metrics
- KPIs
- Graphs' Data



# What it offers?

## UI Dashboard

- Statistics
- Metrics
- KPIs
- Graphs



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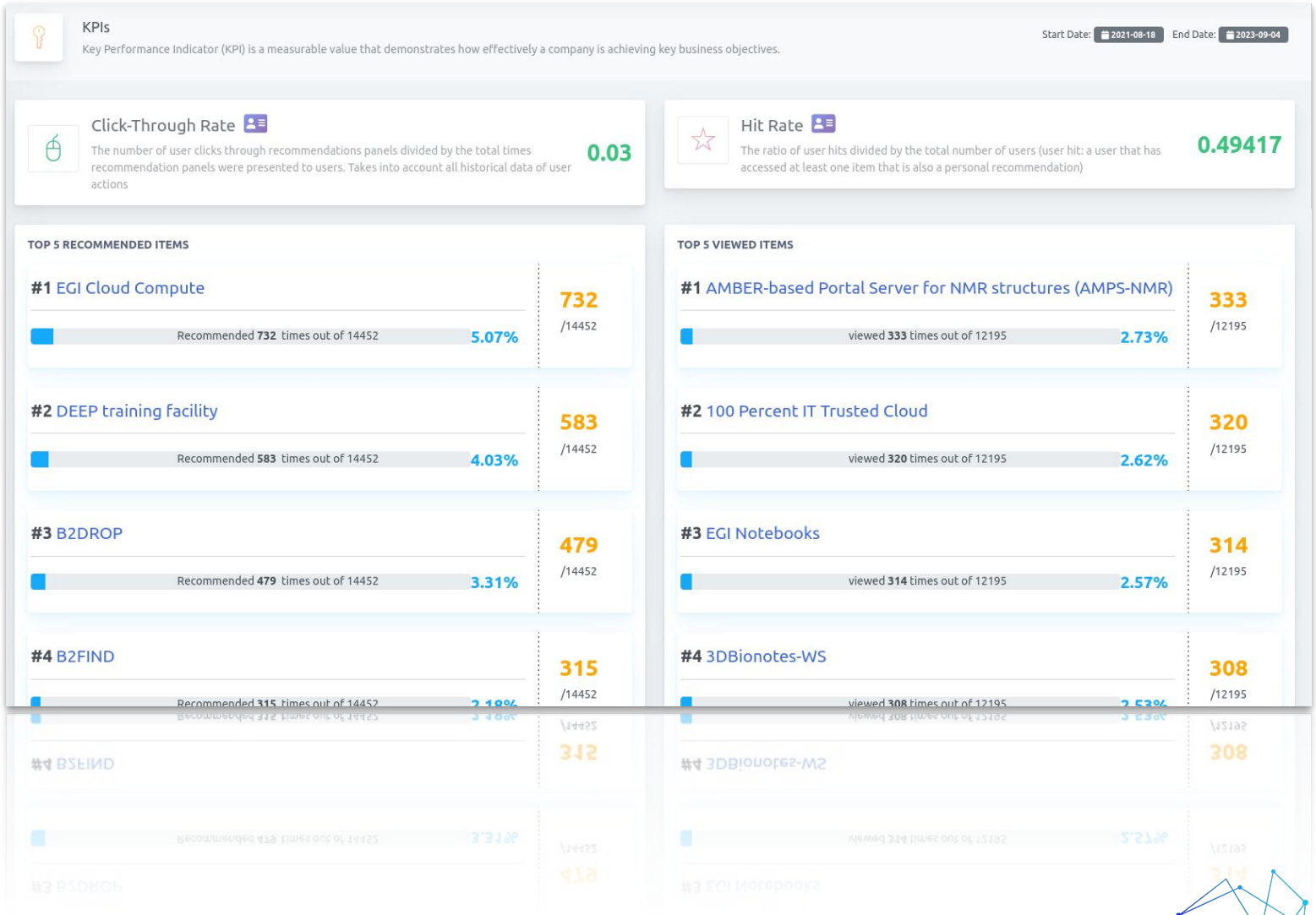

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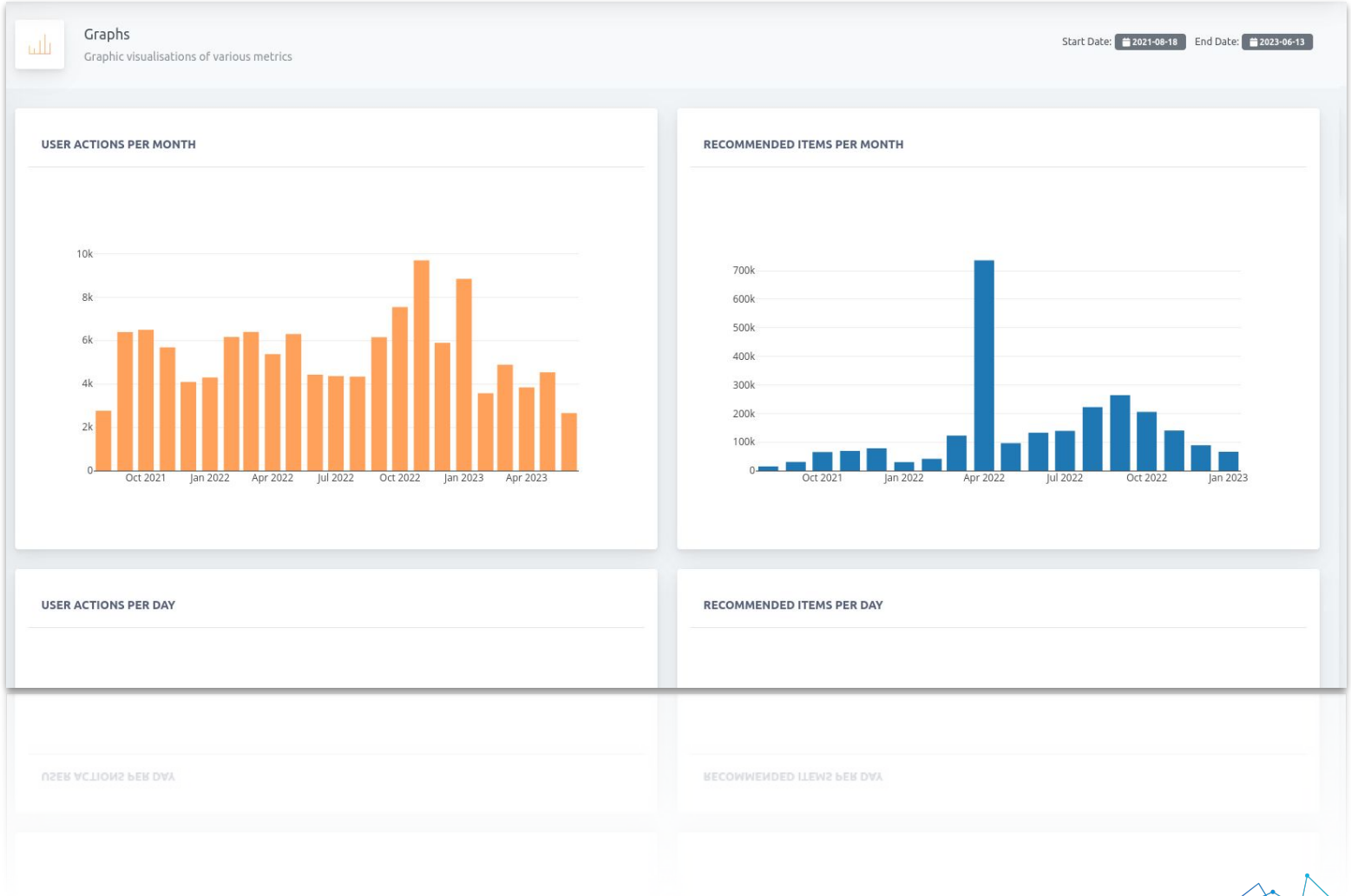
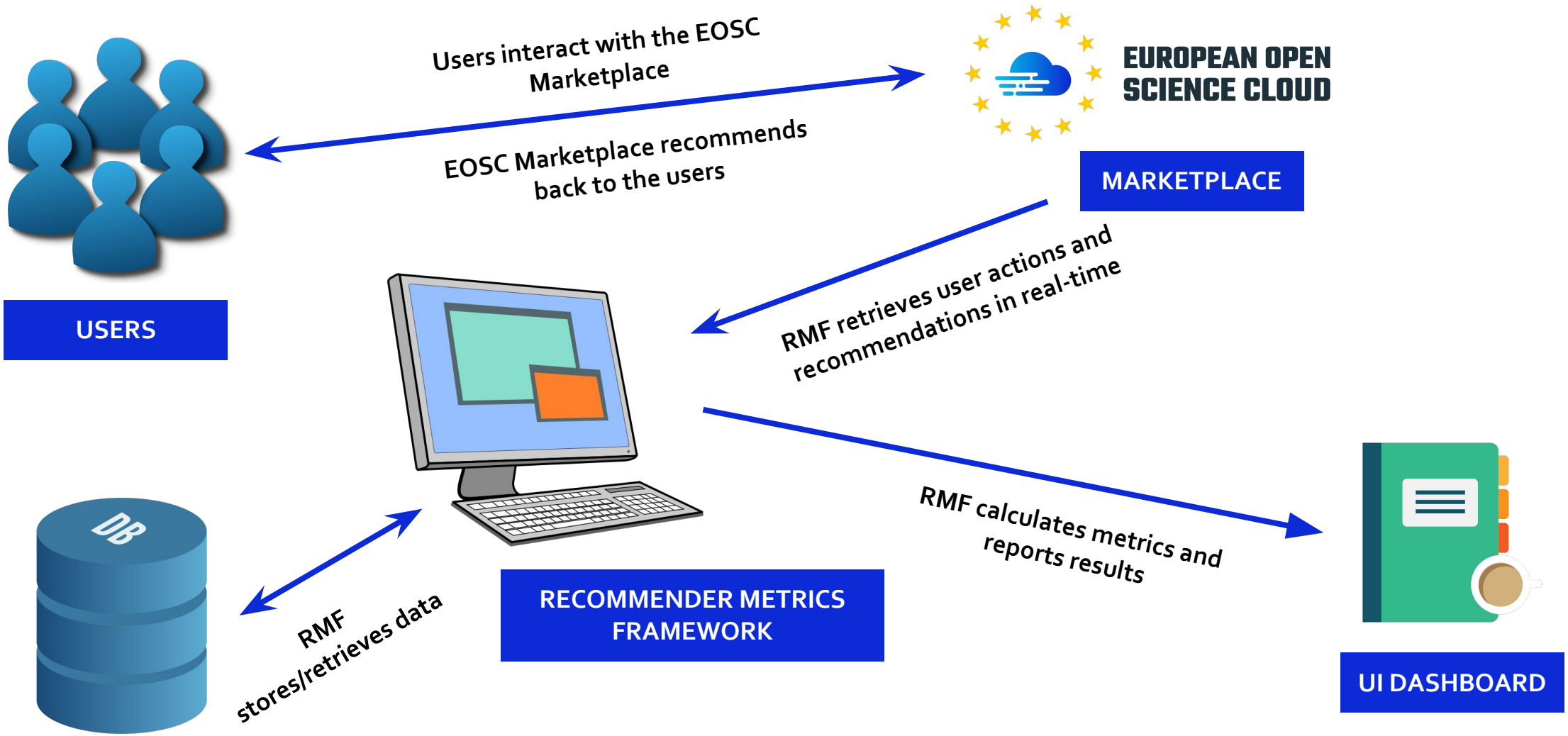


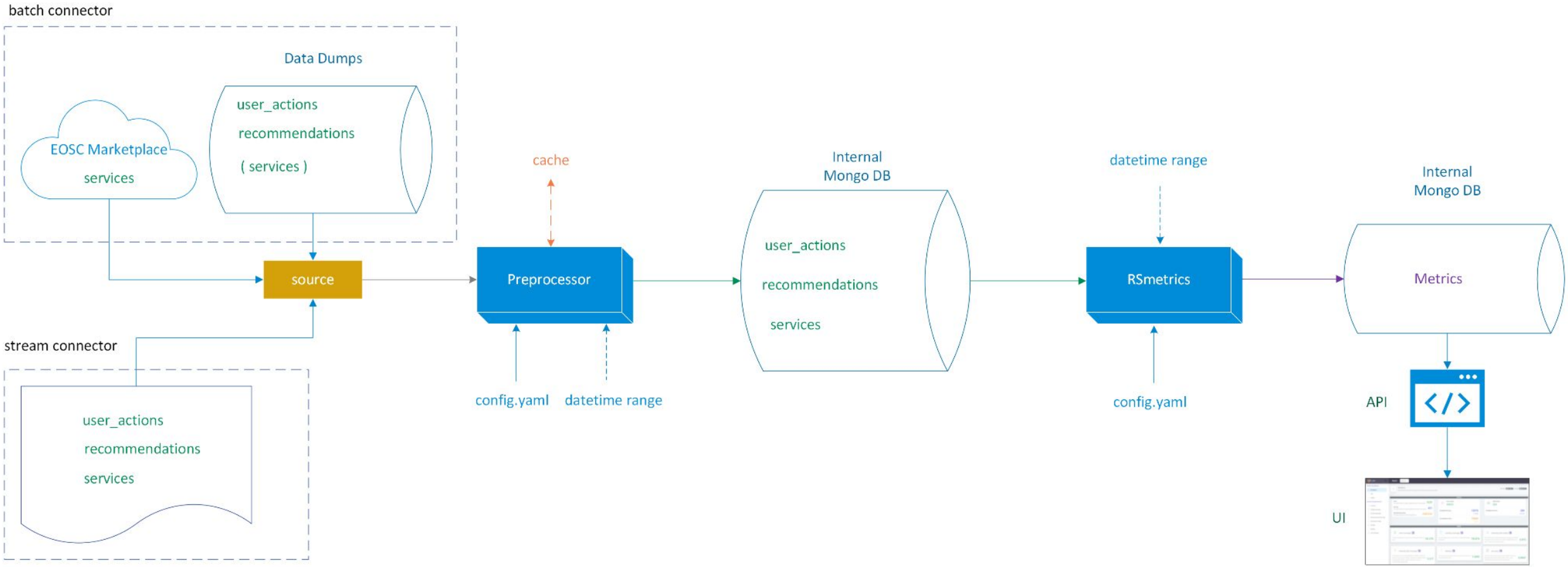
# Process Flow



# RMF Components

All Units

# Framework's components



# RMF Components

Preprocessor Unit

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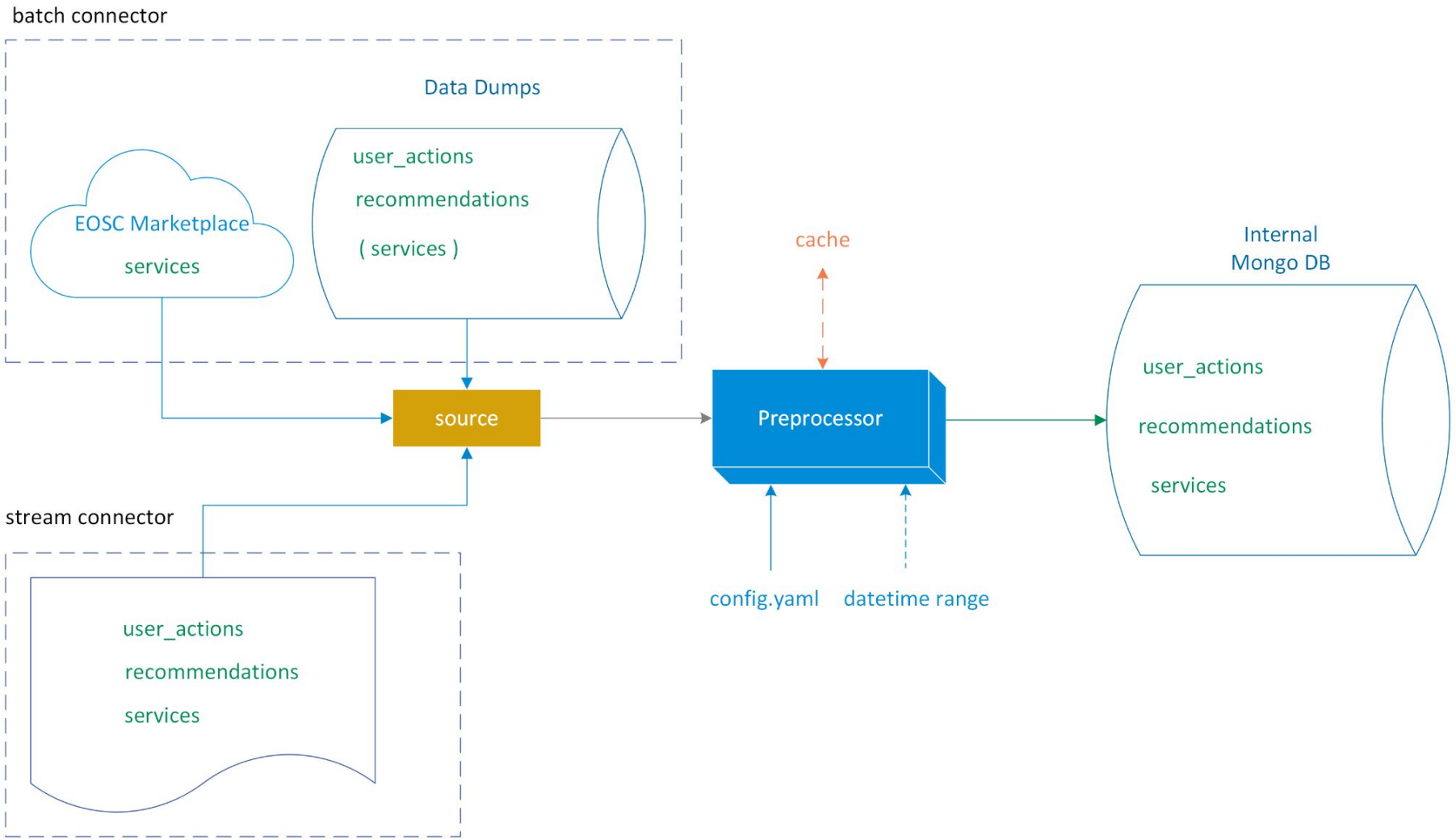
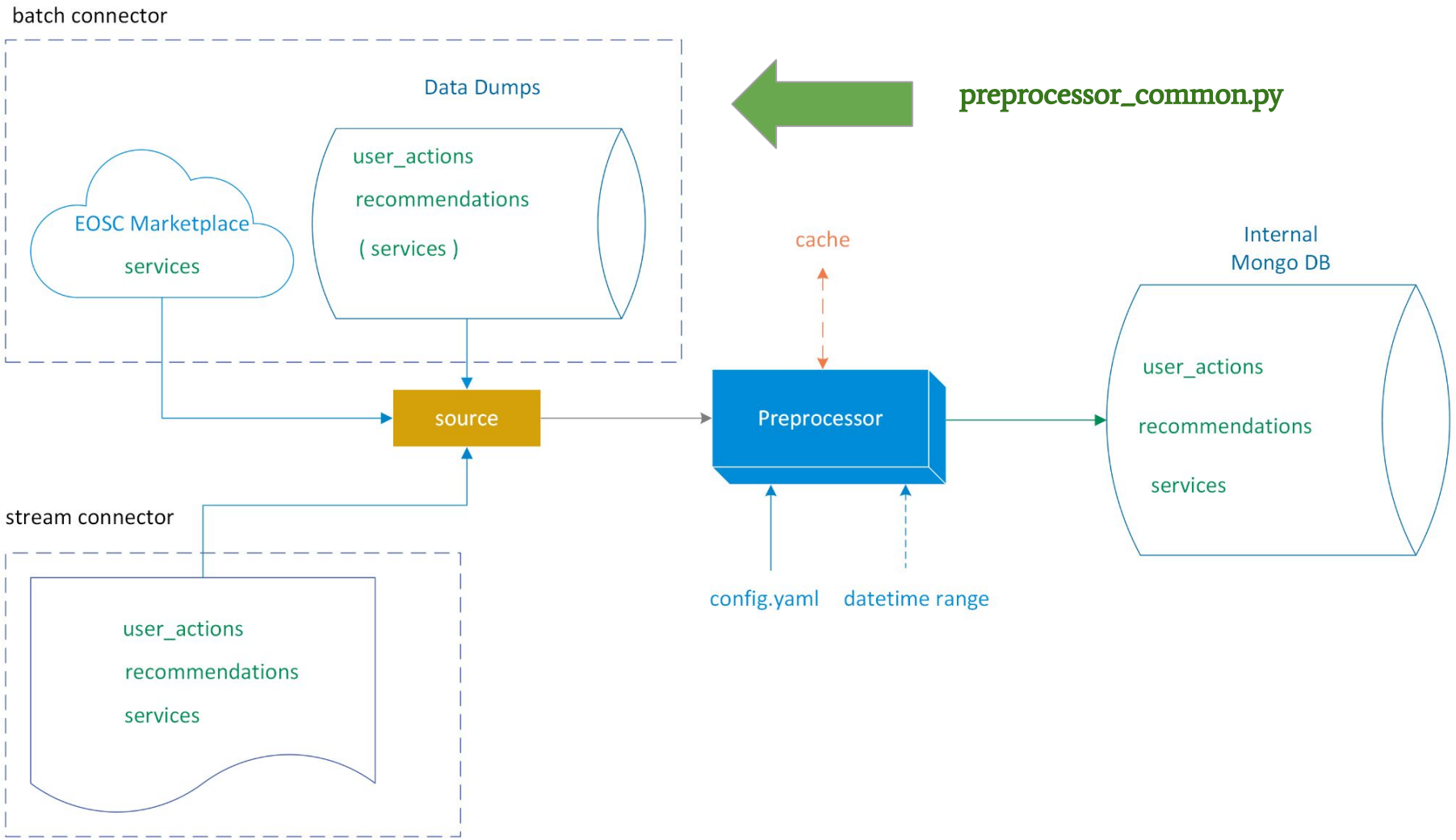
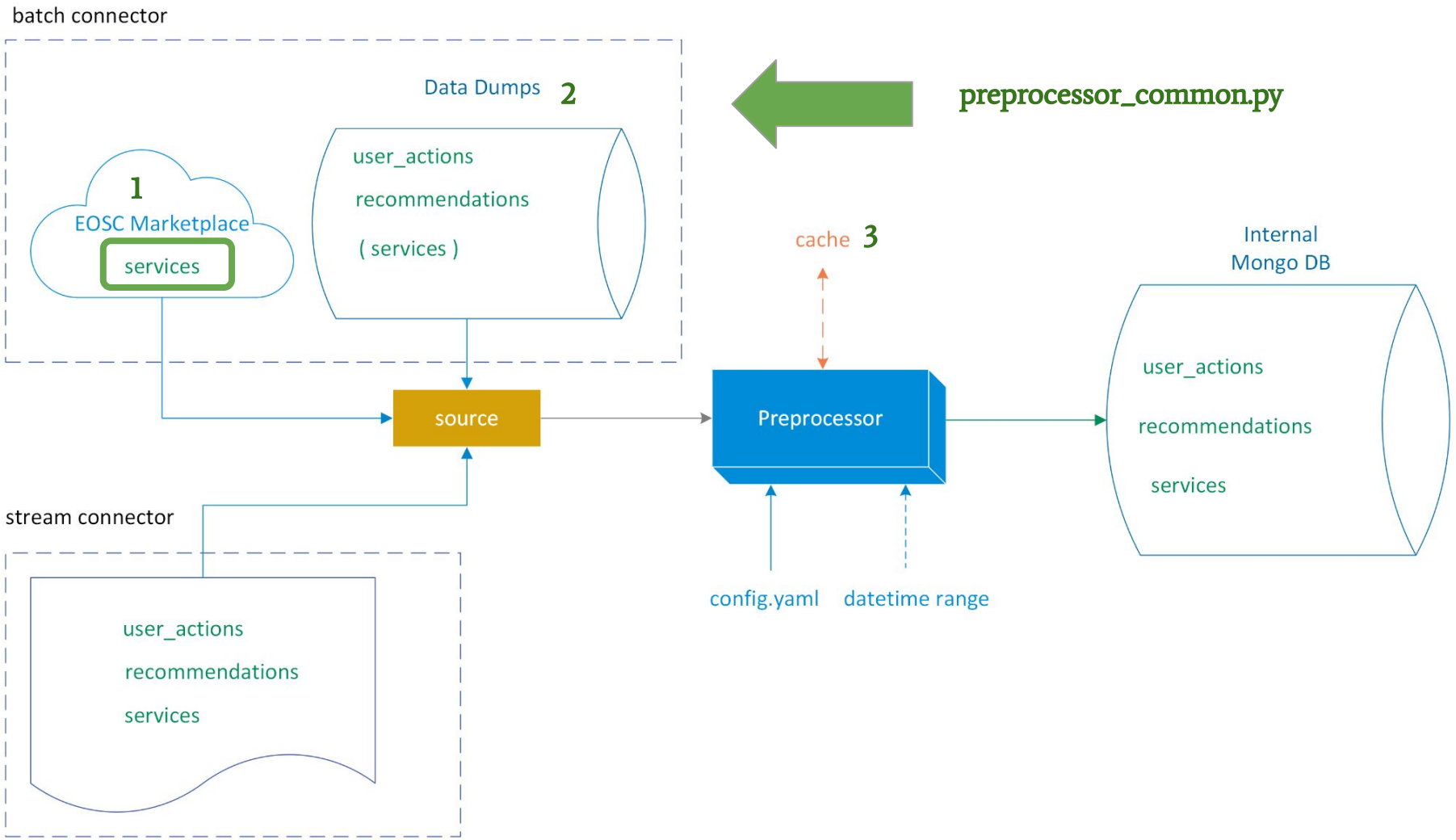


# Preprocessor Unit



# Preprocessor Unit



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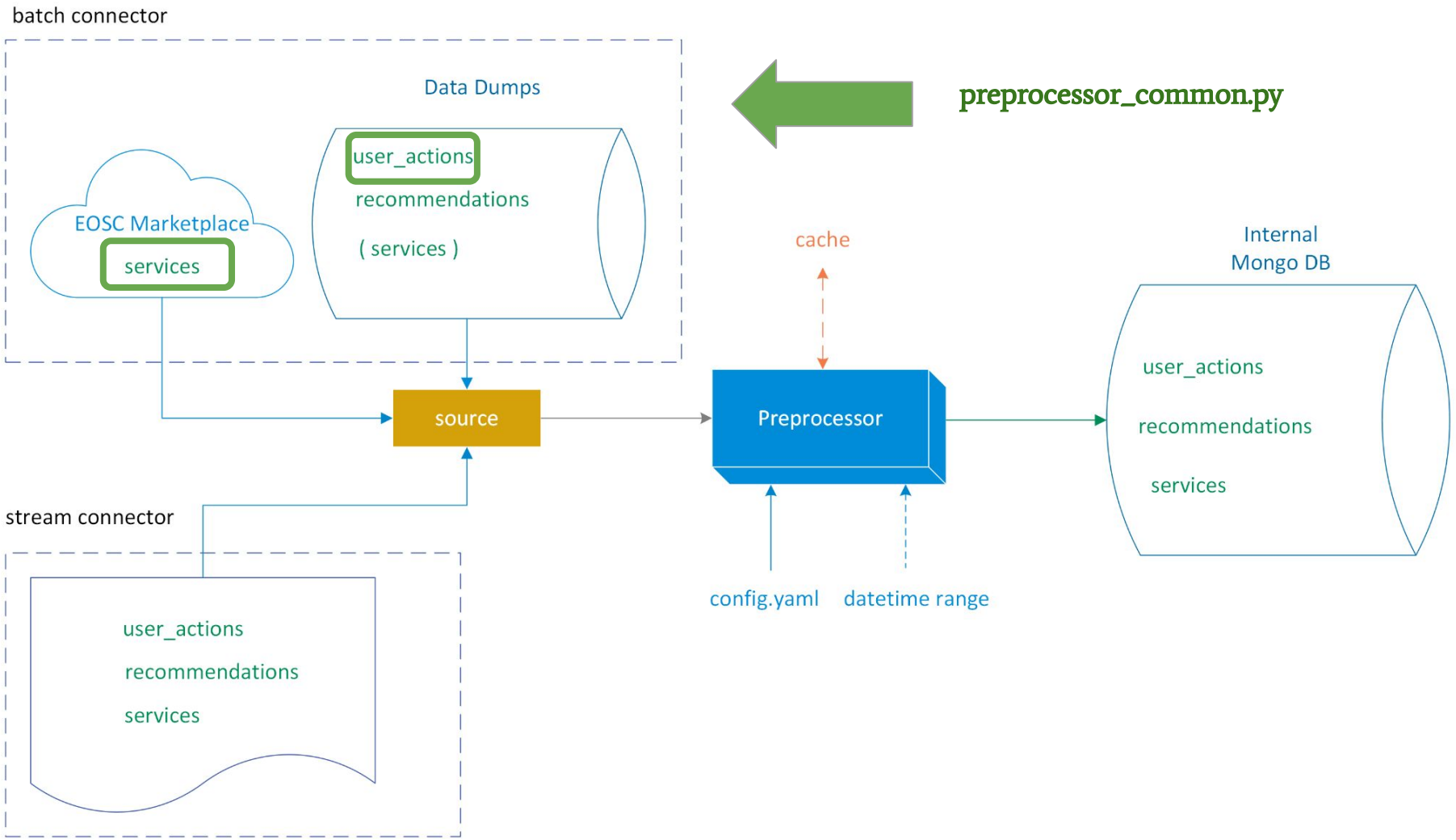

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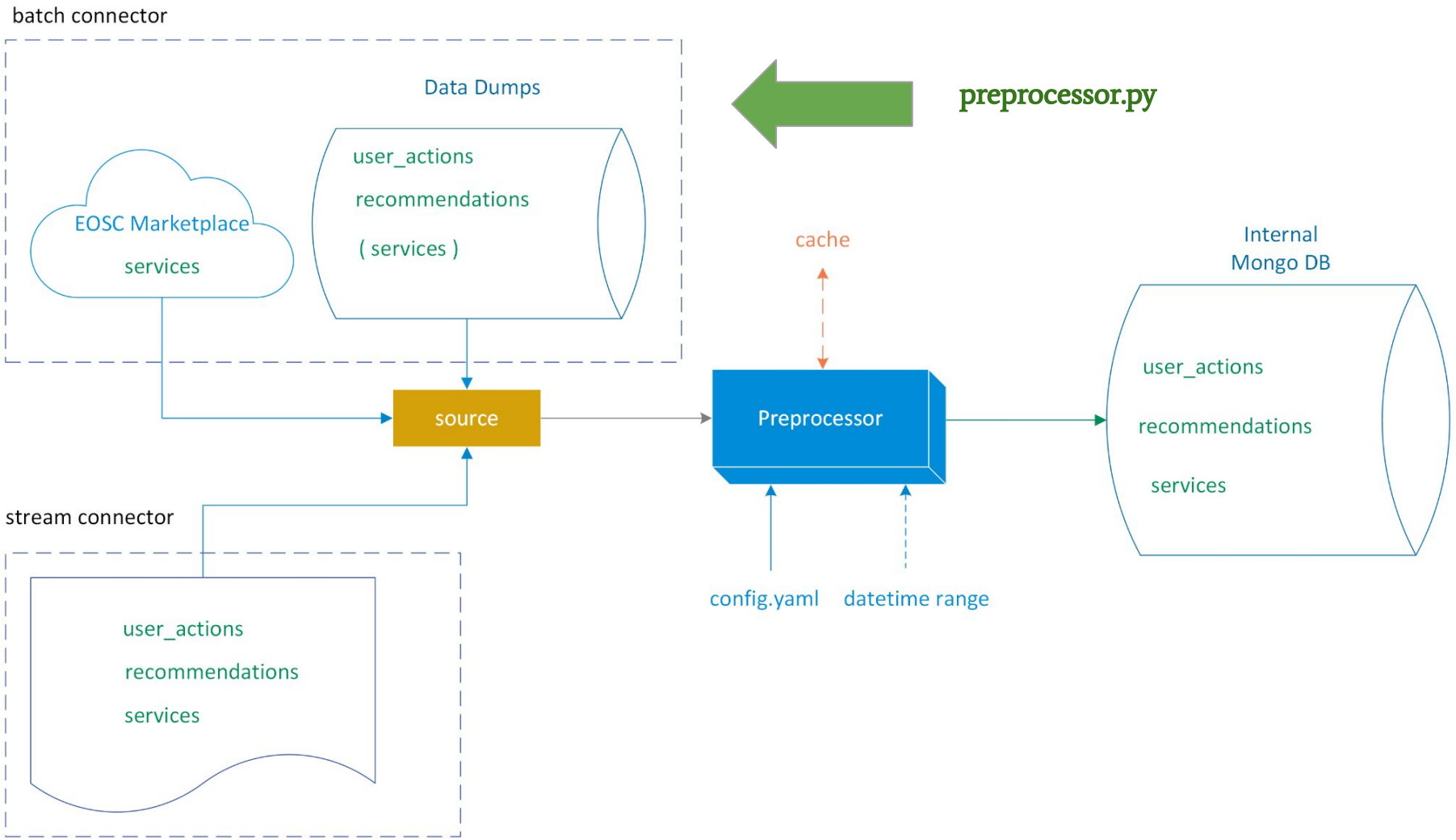

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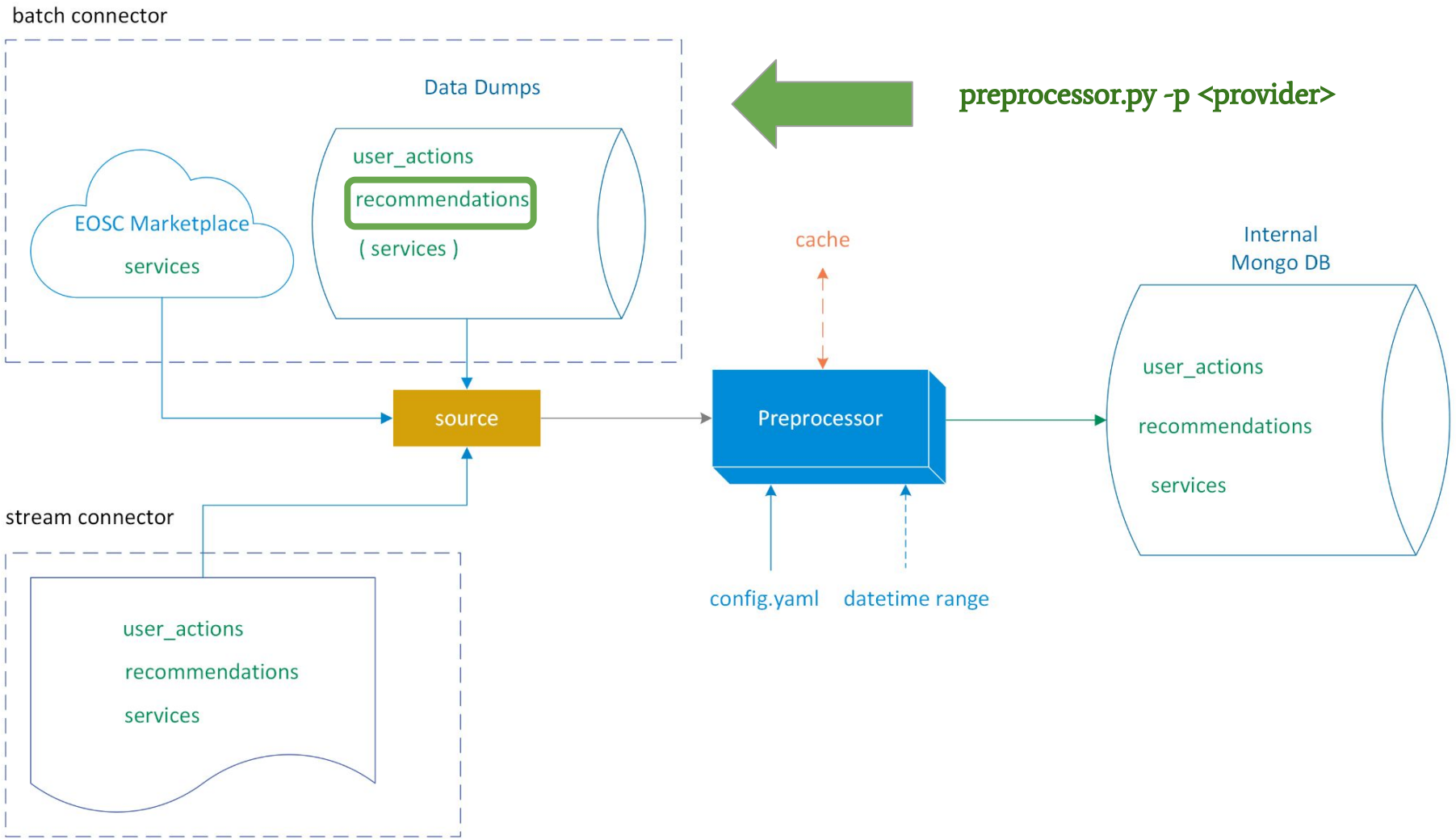
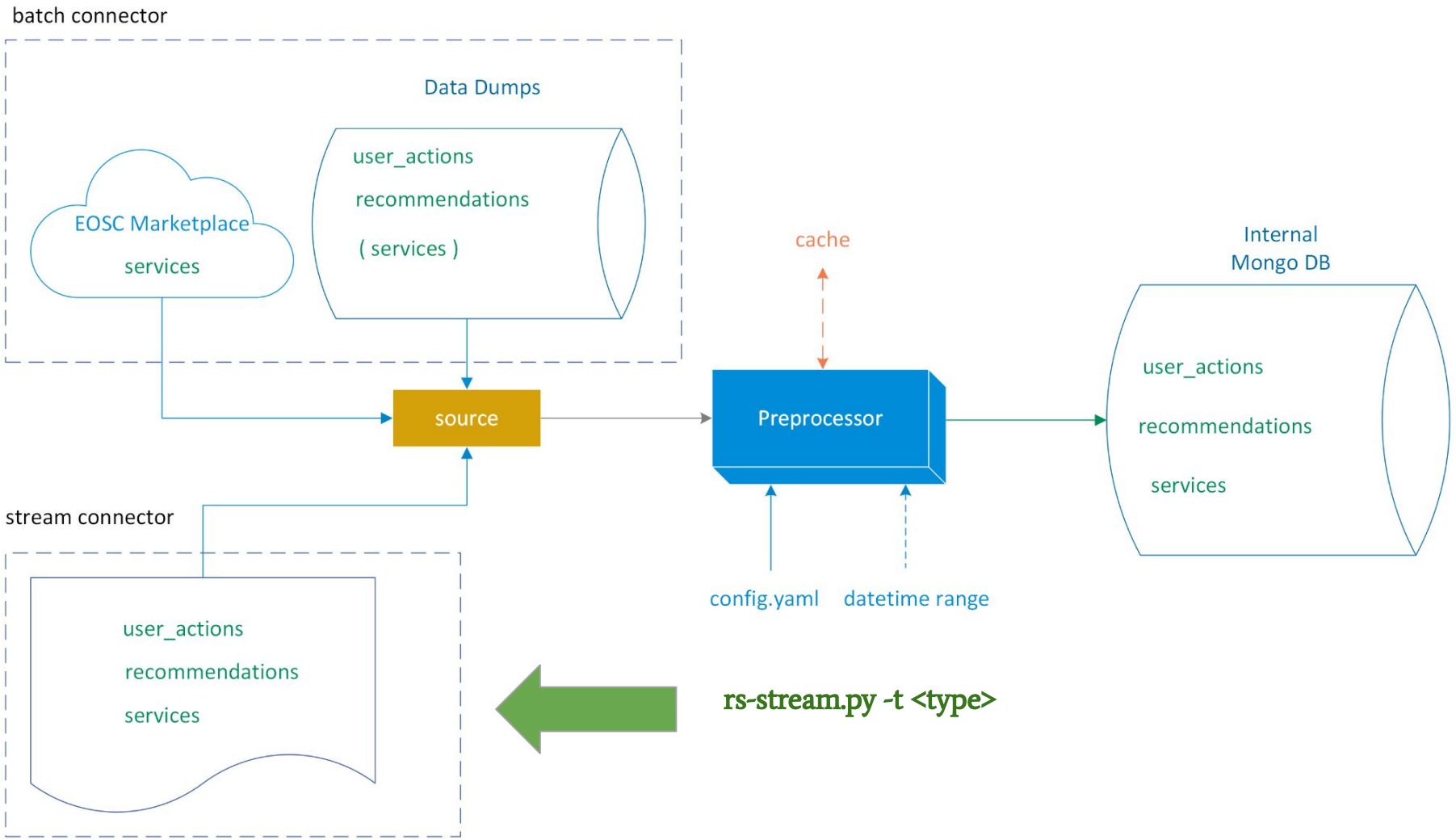


# Preprocessor Unit



# RMF Components

RS Metrics Unit

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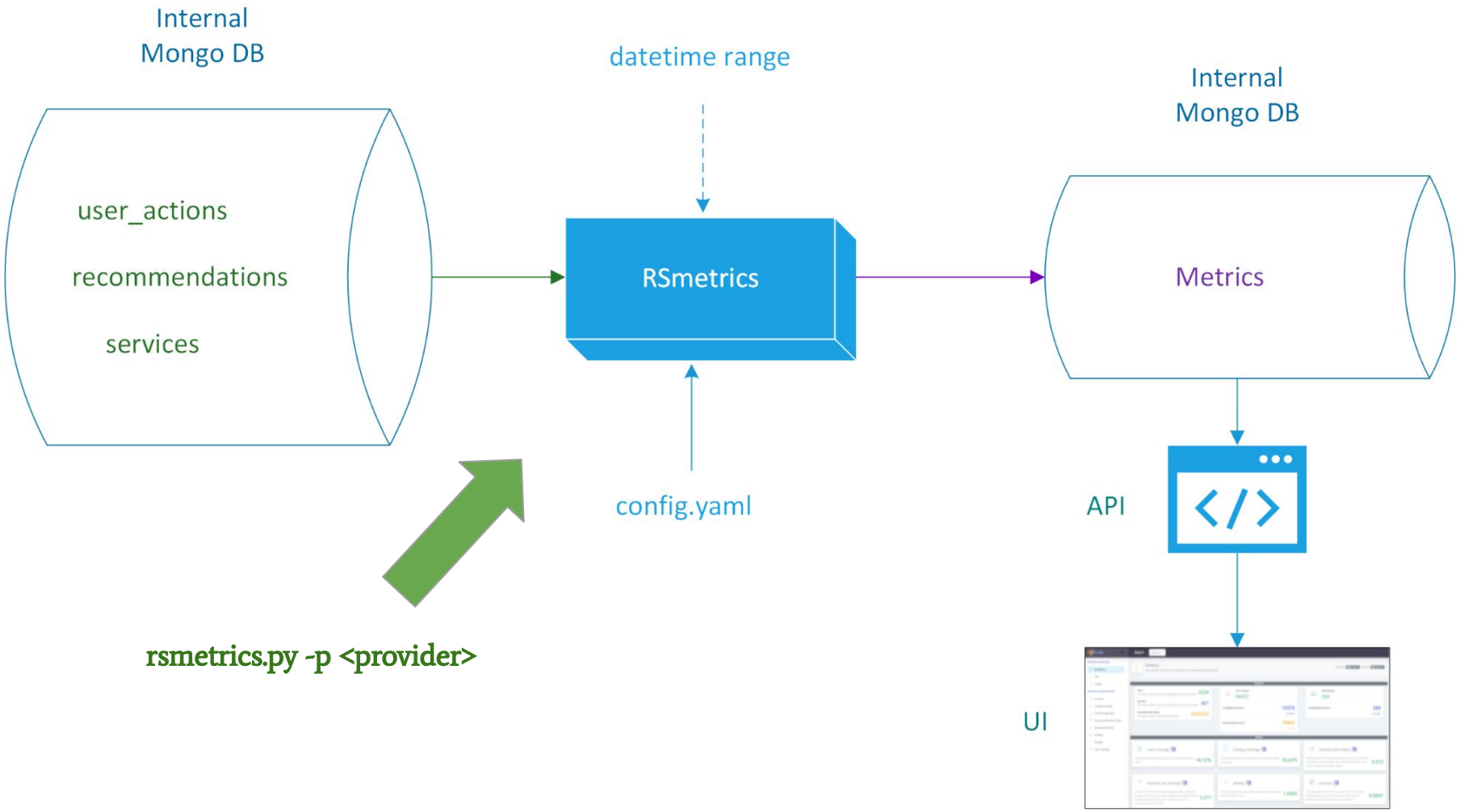
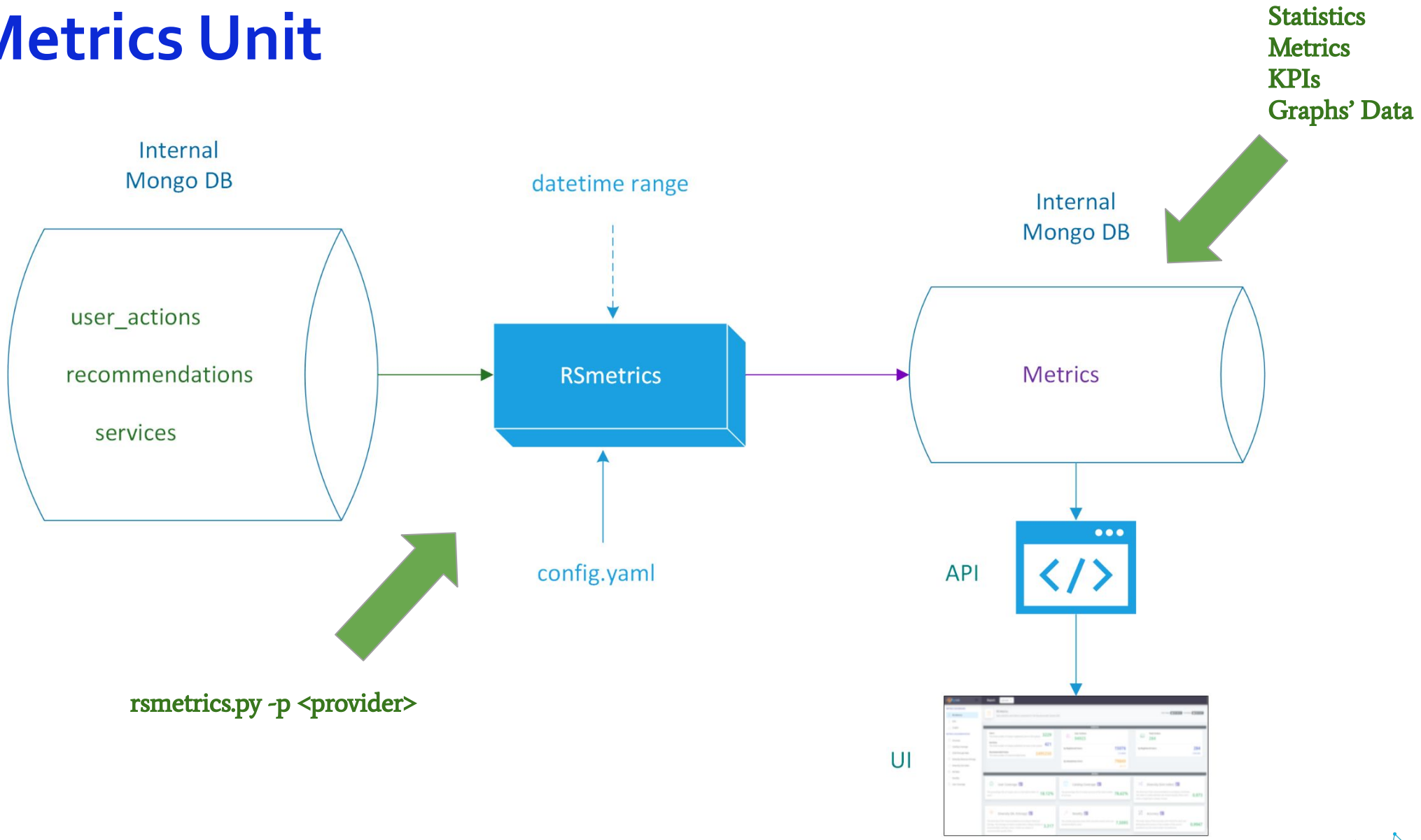


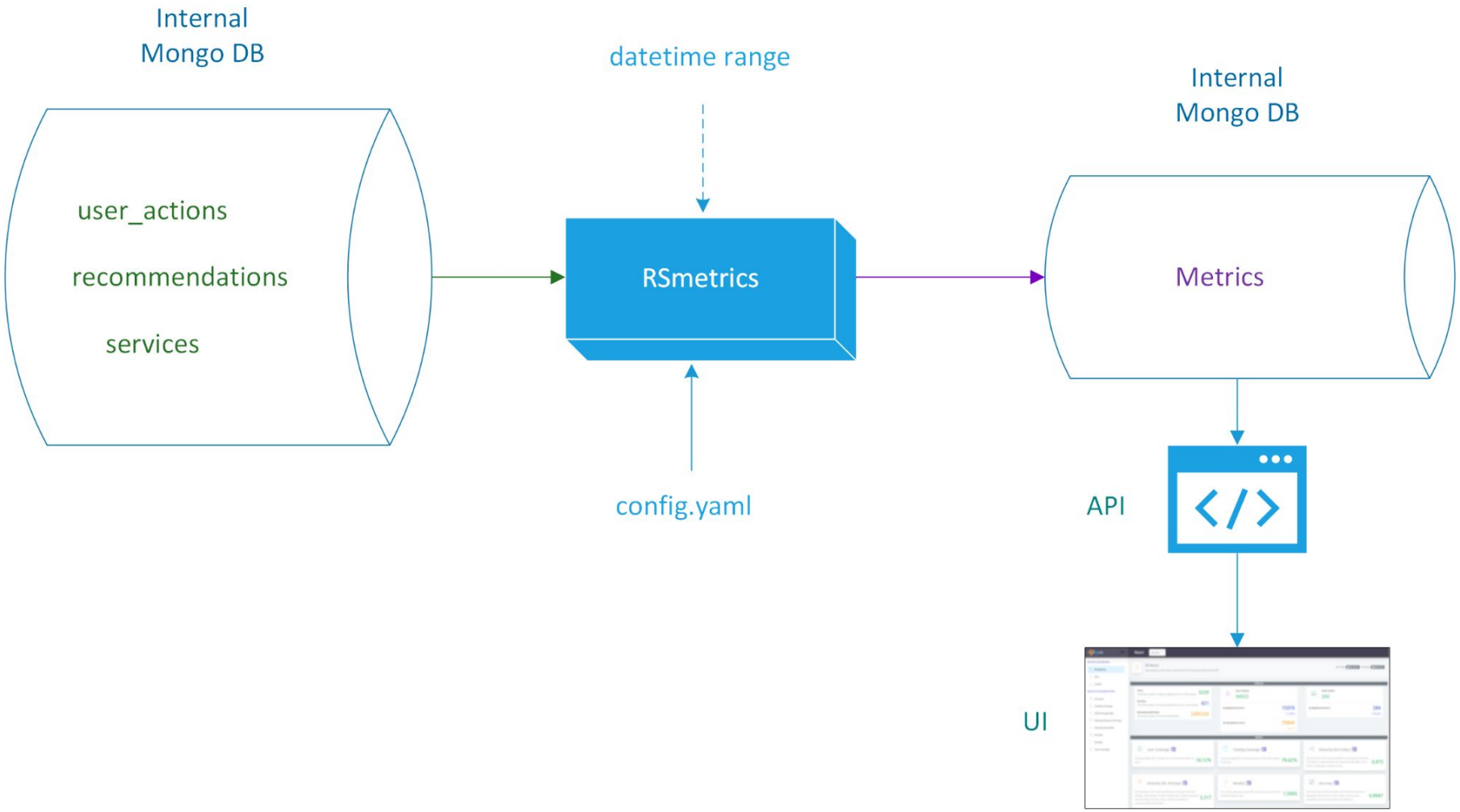
# RS Metrics Unit



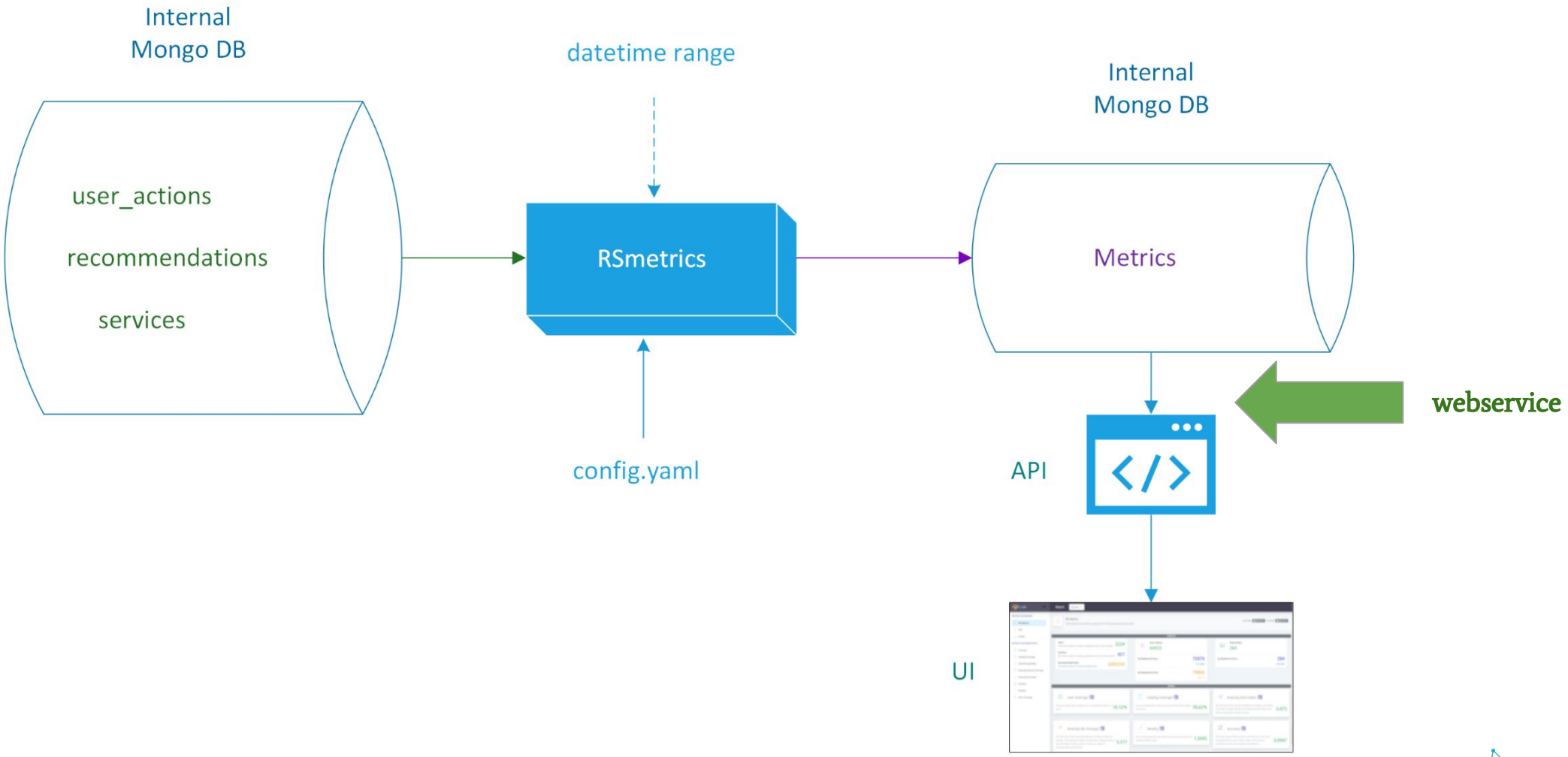
# RMF Components

Rest API/ UI Dashboard Unit

# REST API/UI Dashboard Unit



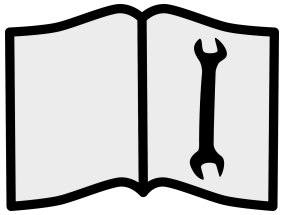
# REST API/UI Dashboard Unit



# More to see ...

overview

https://github.com/ARGOeu/eosc-recommender-metrics



https://argoeu.github.io/eosc-recommender-metrics/docs

# Ready to answer your questions!

# Thank you for your attention

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536