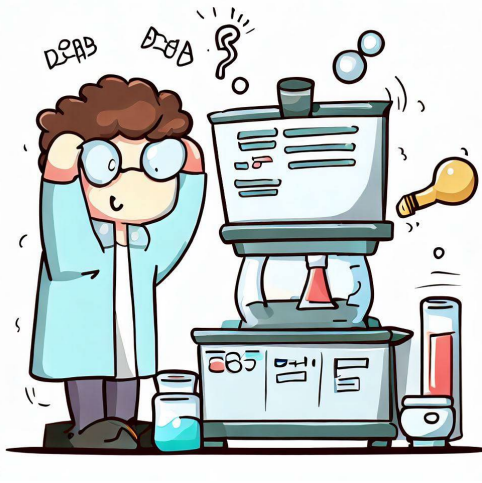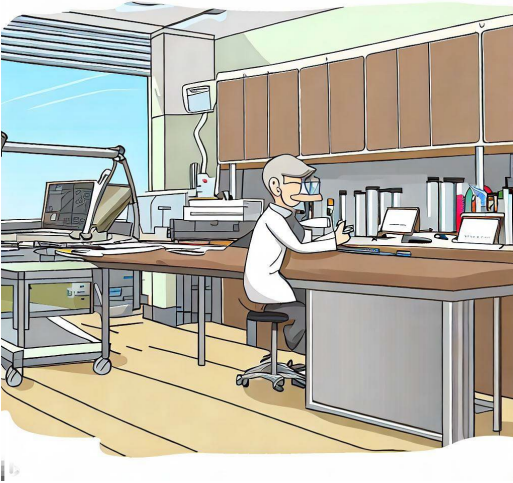# OntoTrans

Exploring Knowledge Graphs with the Exploratory Search System (ESS)

Fajar J. Ekaputra, TU Wien
Guntur B. Herwanto, TU Wien
Florina Piroi, TU Wien

An Exemplary Scenario

Rodrygo is a translator working on the *composite laminate research*

Images on this slide is generated using Microsoft Bing Image Creator: https://www.bing.com/create

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Agenda

- **What is Exploratory Search Systems (ESS)**

- Key Features

- Innovation Cases

- Architecture & Technology

- Guidelines

Traditional Search Systems

Traditional search systems heavily rely on the popular <u>query-response</u> paradigm.

=> successful for well-defined information need with precise goal in mind.

Task

What is the longest river in South America?

longest river south america 🔍

www.eniscuola.net › mediateca › 1... ▾
10 longest rivers in south America - Eniscuola
10 **longest rivers in south America**. e-learning. E-learning. To inform younger students about Energy and Environment, Science, Chemistry, English culture and ...

blogpatagonia.australis.com › long... ▾
What is the longest river in South America?
17.10.2017 — **South America** boasts no shortage of great **rivers**. · Stretching somewhere between 6,400 and 6,992 kilometres, the Amazon is **South America's** ...

en.wikipedia.org › wiki › Amazon... ▾
Amazon River - Wikipedia
The Amazon **River** in **South America** is the **largest river** by discharge volume of water in the world, and the disputed second **longest river** in the world.
Origin of the name · History · Course · Watershed

en.wikipedia.org › wiki › List_of_... ▾
List of rivers by length - Wikipedia
This is a list of the **longest rivers** on Earth. It includes **river** systems over 1,000 kilometres (620 ... **River** was rejuvenated by much of its lower course being removed, likeliest when Africa split from **South America** when Gondwanaland broke up ...
Definition of length · List of river systems... · Notes · River systems that may...

Exploratory Search Systems
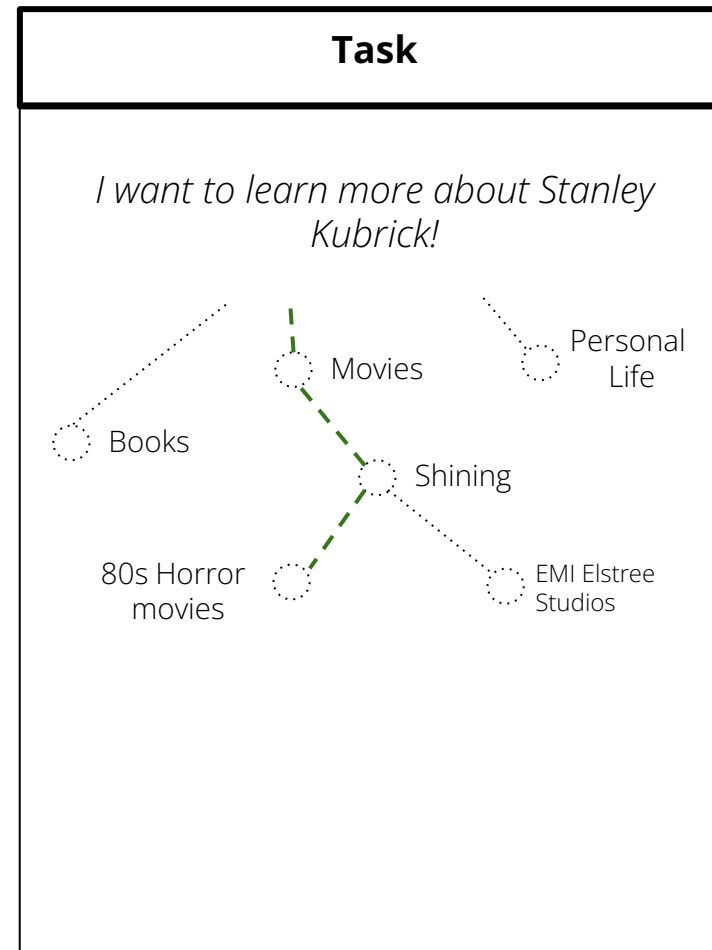
Exploratory search systems enable information seeking tasks such as <u>learning</u> and <u>investigating</u>.

=> increased level of interaction between user and search system

=> more active engagement in search process

Exploratory Search on Knowledge Graphs
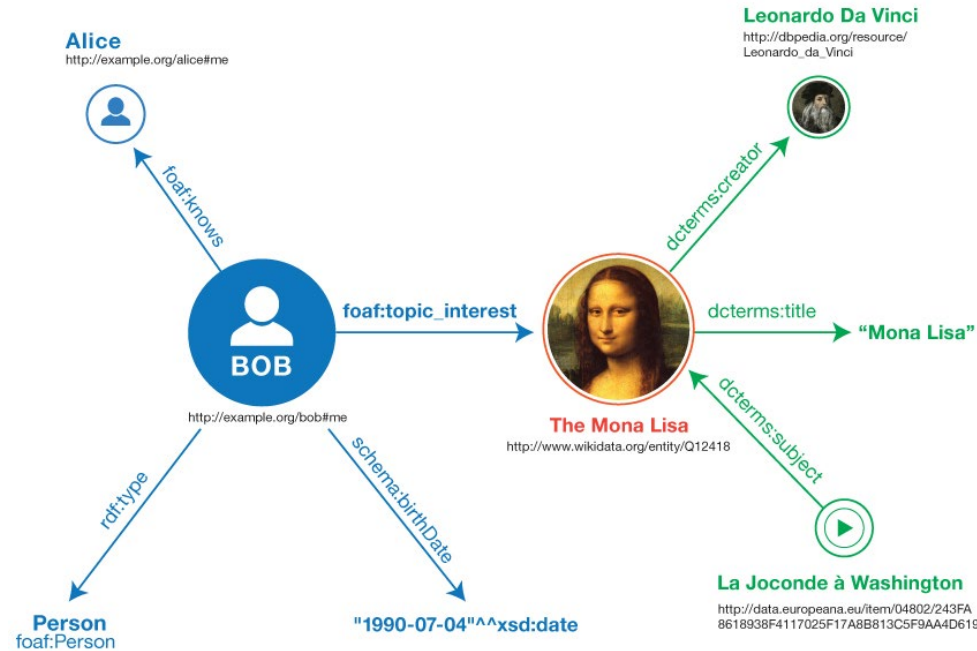
RDF Graph

Semantic Extension
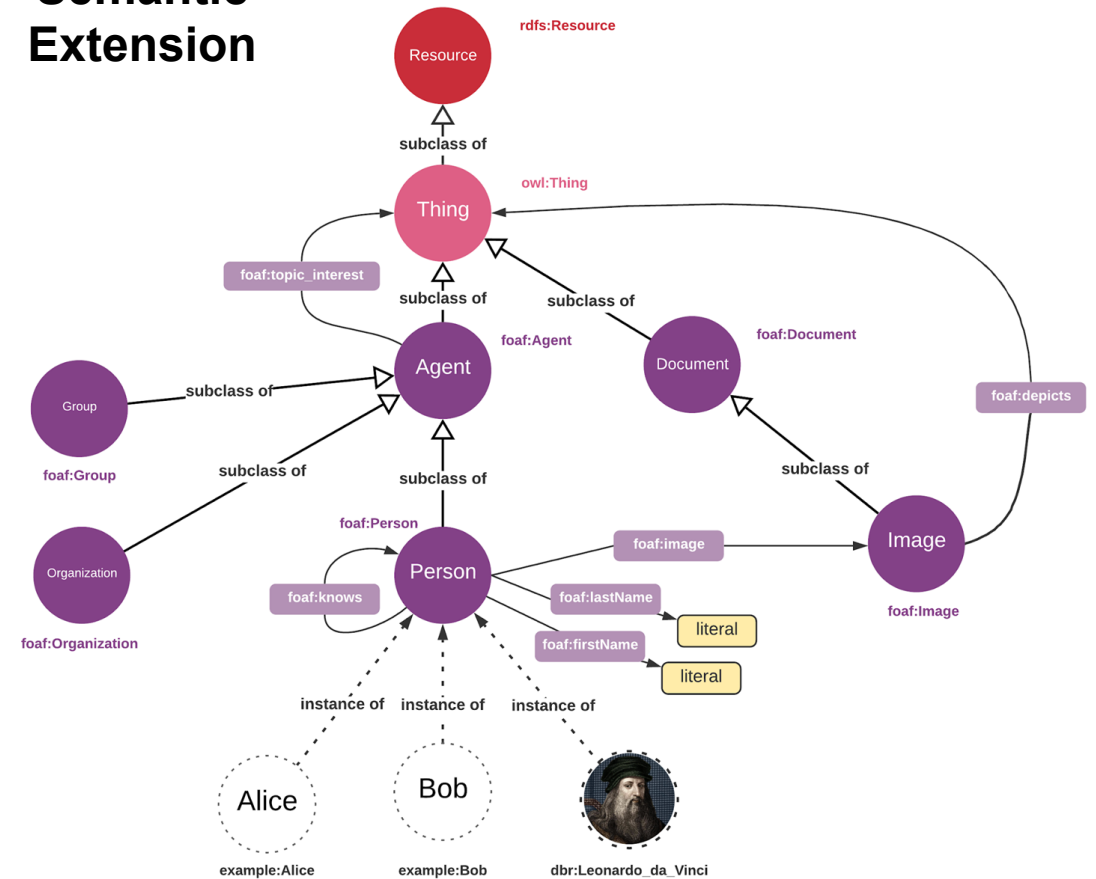
=> semantic extension can be exploited for <u>adaptive</u> and <u>interactive</u> search interfaces.

Agenda

- What is Exploratory Search Systems (ESS)

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Semantic-enriched Data Exploration

- Keyword search
  - Search results with an infobox
  - Based on semantic structure

- Links to related objects
  - Customisable algorithms

- Search result categorization

- Further: *contextualized search result visualizations*
  - Possibility to customize views with "Scopes"
  - Specialized visualization on a selection of data, e.g., class, or certain properties
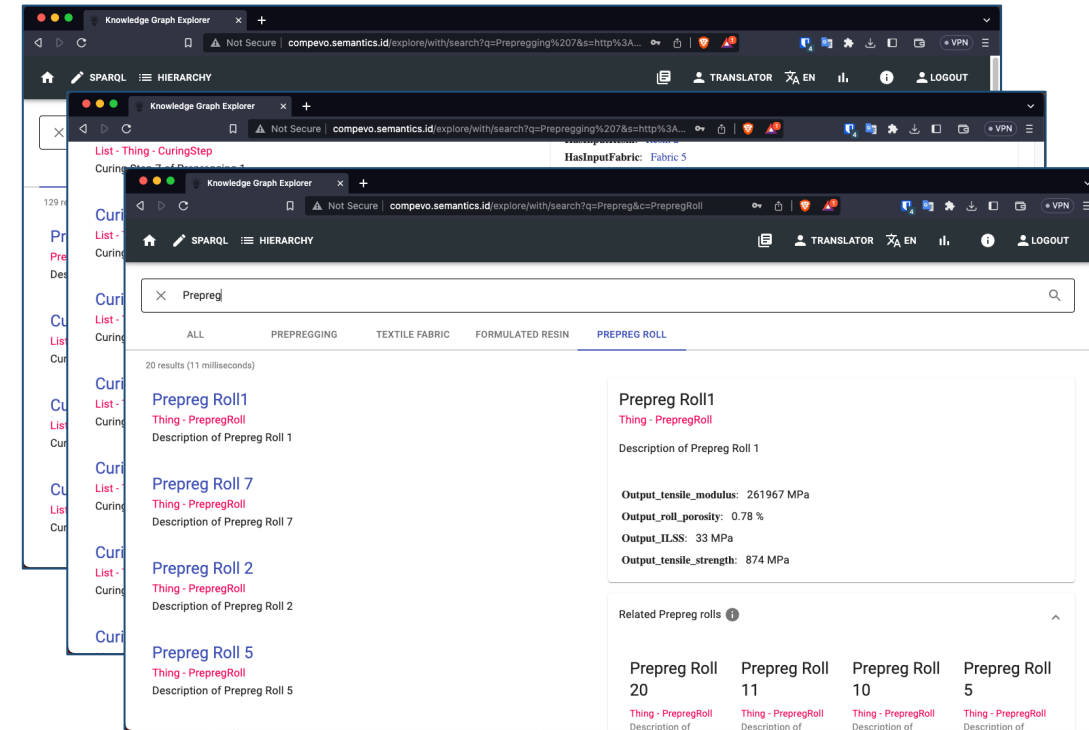
# Manufacturing-specific Paradigms

Informal interviews with stakeholders*:

- smart manufacturing researchers from industry and university

- translators to companies in OntoTrans

- simulation expert from a production plant manufacturer

=> requirements were aggregated.

- Multi-perspective exploration

- Hierarchical browsing

- Provenance visibility (not implemented yet in OTE context)

*) Haller, Kevin, Fajar J. Ekaputra, Marta Sabou, and Florina Piroi. "Enabling exploratory search on manufacturing knowledge graphs." In Proceedings of the Seventh International Workshop on the Visualization and Interaction for Ontologies and Linked Data, vol. 3253, pp. 16-28. 2022.

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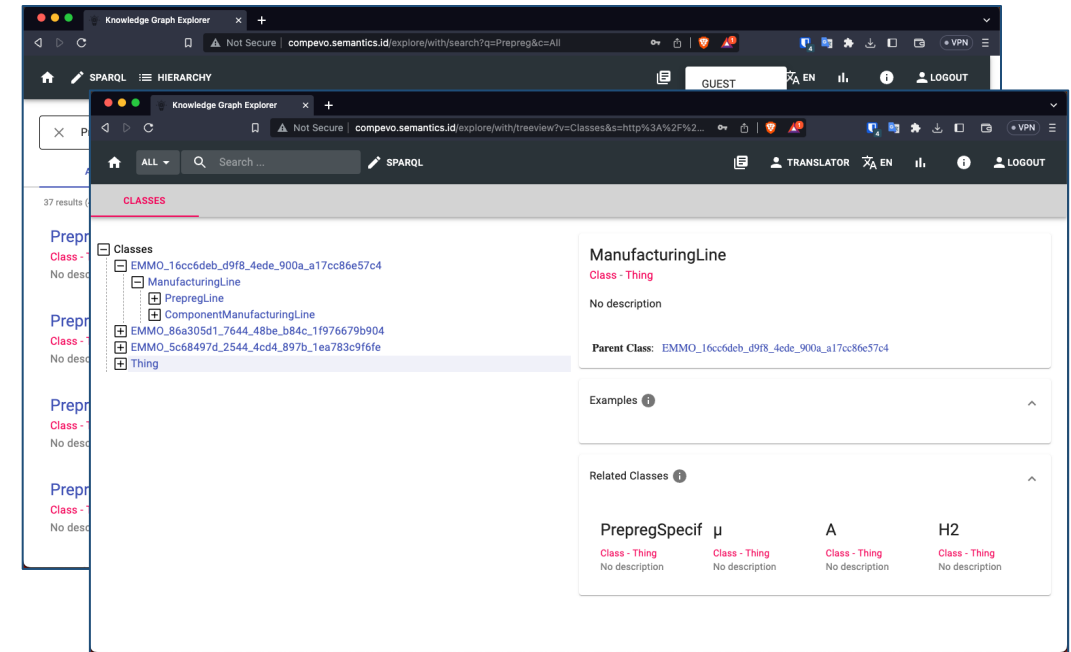
Other Features

- User Authentication
  - Keycloak implementation on (several) ESS instances
  - Control user access to ESS

- Multilingualism

- Statistical information
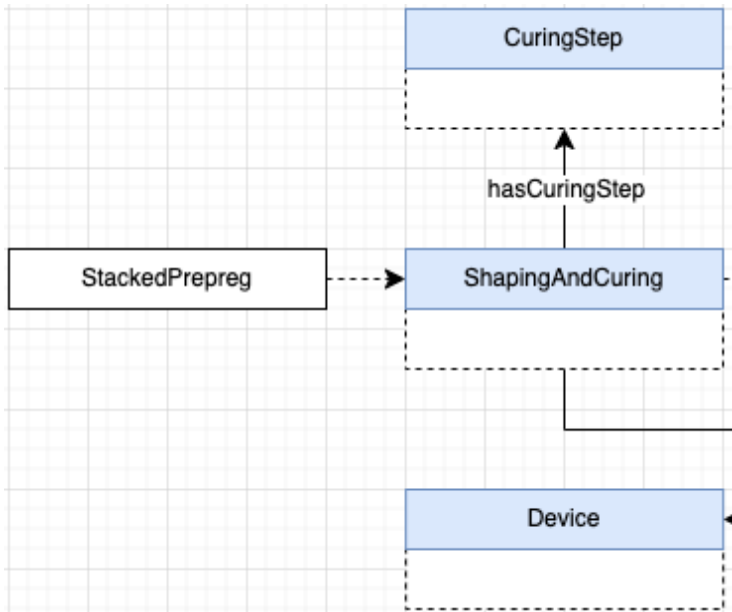
- SPARQL query for advanced analytics
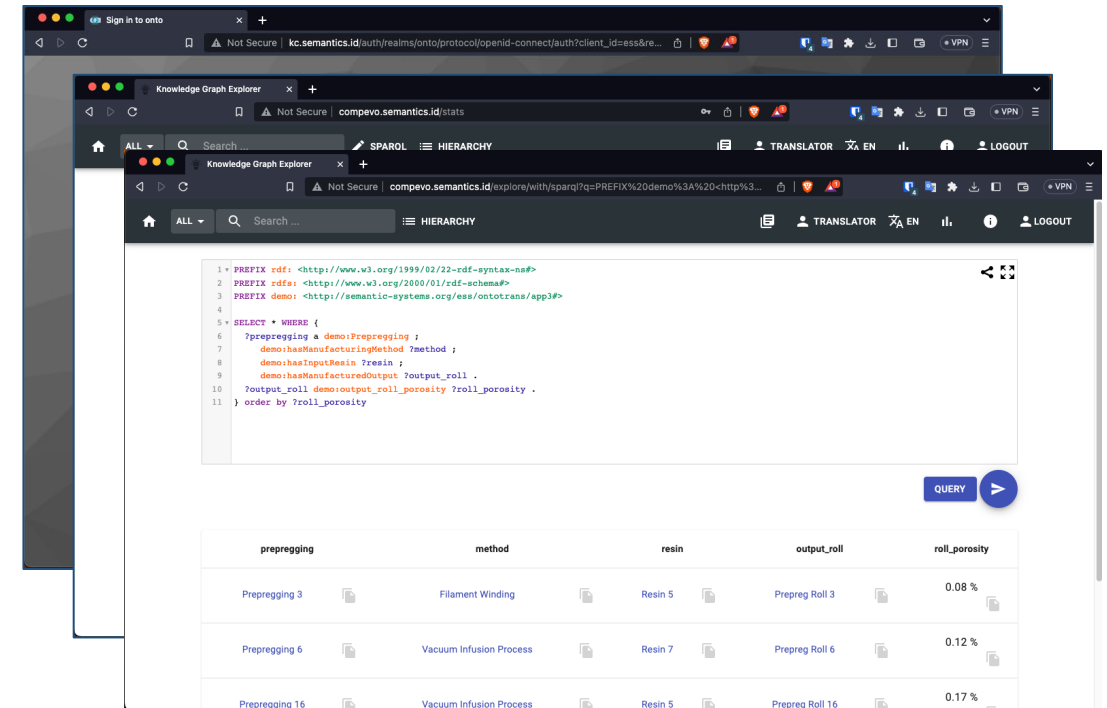
Agenda

- What is Exploratory Search Systems (ESS)

- Key Features

- **Innovation Cases**

- Architecture & Technology

- Guidelines

Innovation Cases

- Composite Laminate (http://composite.semantic-systems.cc)

- Alloy Precipitation (http://alloy.semantic-systems.cc)

- TU Wien Pilot Factory robots (http://cobot.semantics.id)

- … and several more

Helping Rodrygo with ESS

LIVE DEMO: http://composite.semantic-systems.cc

Further Case: Alloy Analysis

- … our colleagues from SINTEF will show how to use OTE-API in producing the data in the next session
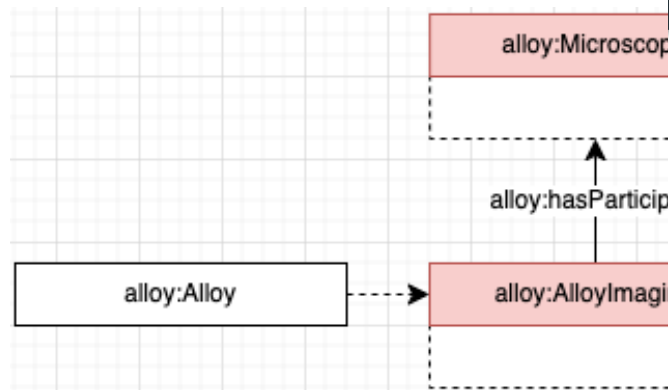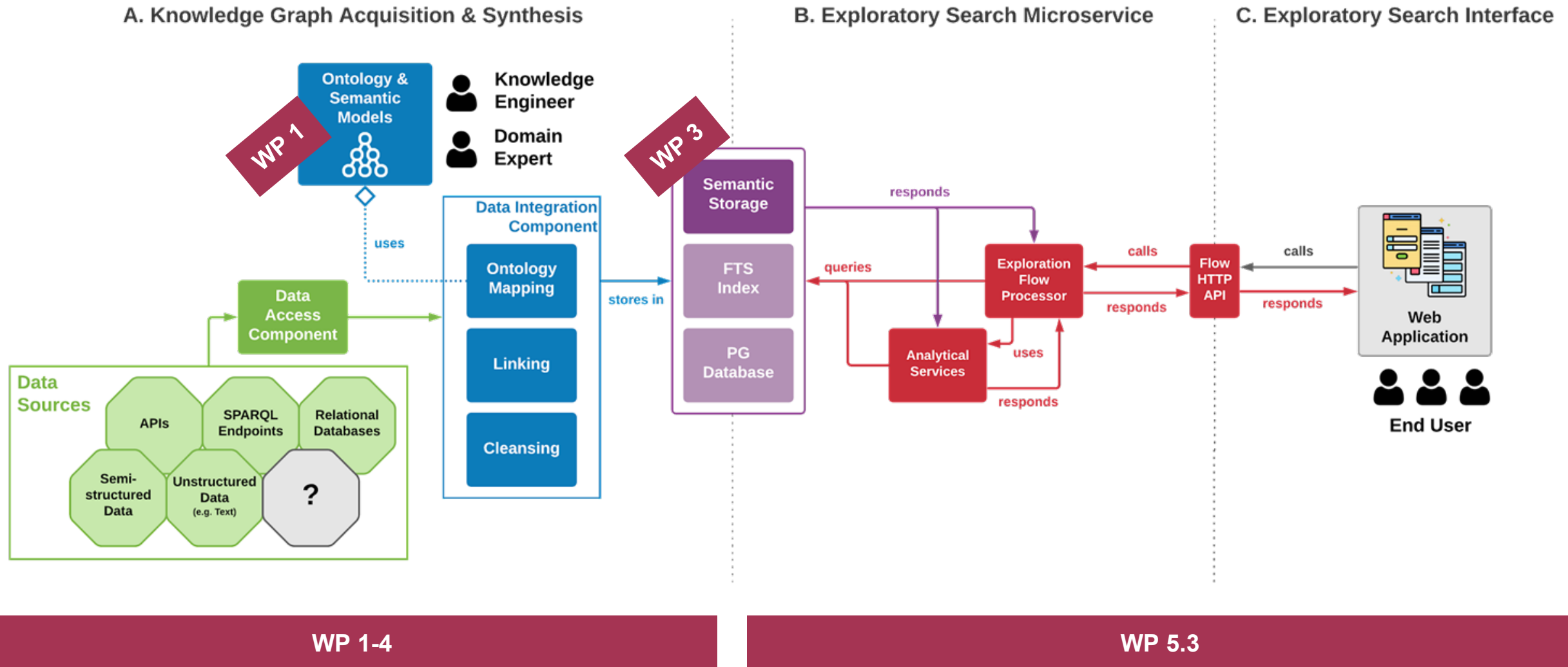

LIVE DEMO: http://alloy.semantic-systems.cc/

Agenda

- What is Exploratory Search Systems (ESS)

- Key Features

- Innovation Cases

- **Architecture & Technology**

- Guidelines

ES Platform - Architecture

A. Knowledge Graph Acquisition & Synthesis

B. Exploratory Search Microservice

C. Exploratory Search Interface

WP 1-4

WP 5.3

Technology Stack

Exploratory Search Microservice

=> Spring Boot Application
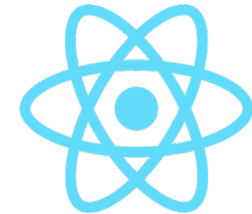
RDF Framework: RDF4J (Apache Commons RDF)

Gremlin Framework: Apache TinkerPop

Exploratory Search Interface

=> Single Page Web Application

UI Library: ReactJS

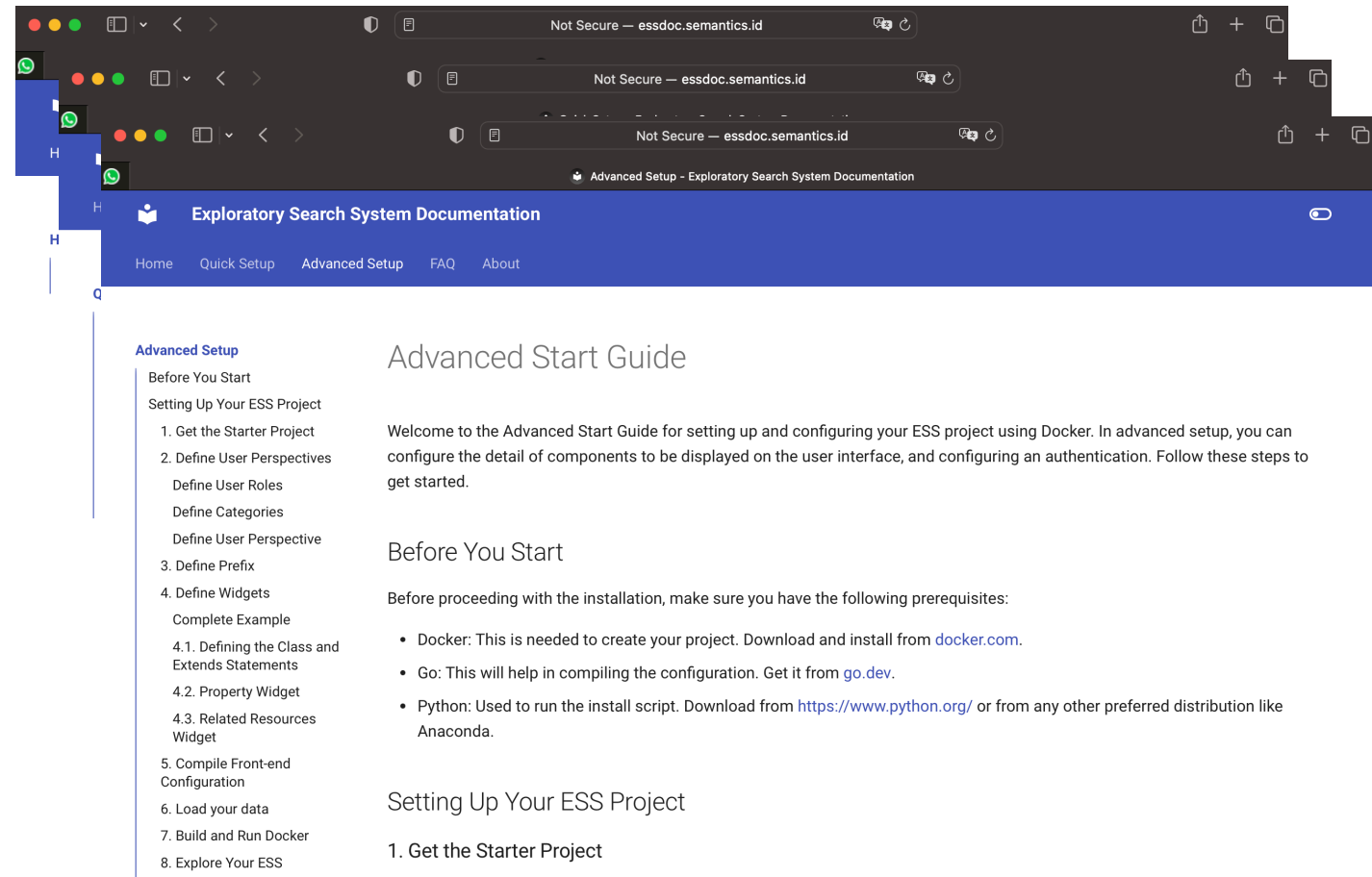State Container Library: Redux

Agenda

- What is Exploratory Search Systems (ESS)

- Key Features

- Innovation Cases

- Architecture & Technology

- **Guidelines**

ESS Documentation

- ESS Setup Guide – Basic and Advanced

  - Basic: Minimal Setup

  - Advanced: GUI Configuration
    - User perspective definition
    - Prefix definition
    - Widgets definition

URL: http://essdoc.semantics.id

Key Takeaways

- Exploratory search helps users to interact with ontologies and knowledge graphs.

- The Exploratory Search System (ESS) in OTE has been developed and applied in several innovation cases in material engineering and beyond.

- A guideline to apply ESS in *your* innovation cases is available.
  - ... and we are happy to help!

Thank you!

Backup slides

- **ESS Screenshots**

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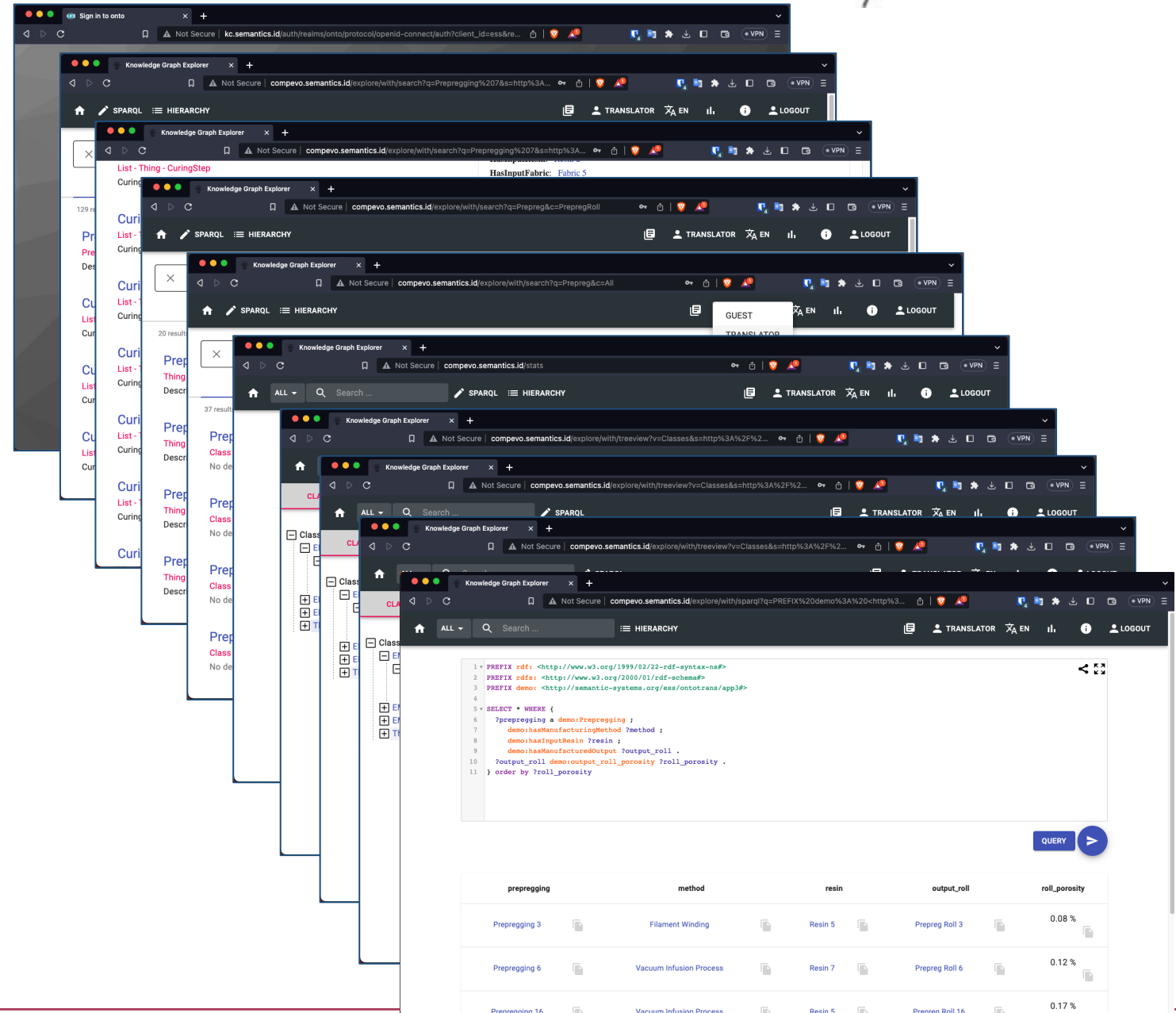
Features

- User authentication
- Search interface
  - Info-Box
  - Links to related objects

- Recommendation of related objects
- Tabs for result categories

- Role specializations and Multilingualism
- Statistical information
- Class Hierarchy
- Browsing history

- SPARQL query for advanced analytics

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Appendix

- **Deeper technical discussion**

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Semantic Storage Abstraction

Challenge:

- SPARQL not well suited for some graph algorithms
  - make use of property graphs, Gremlin query language being one option

- No standardized SPARQL feature for full-text searches

=> abstraction of storage solution with three interfaces:

1. SPARQL
2. Gremlin
3. Full-Text-Search Index
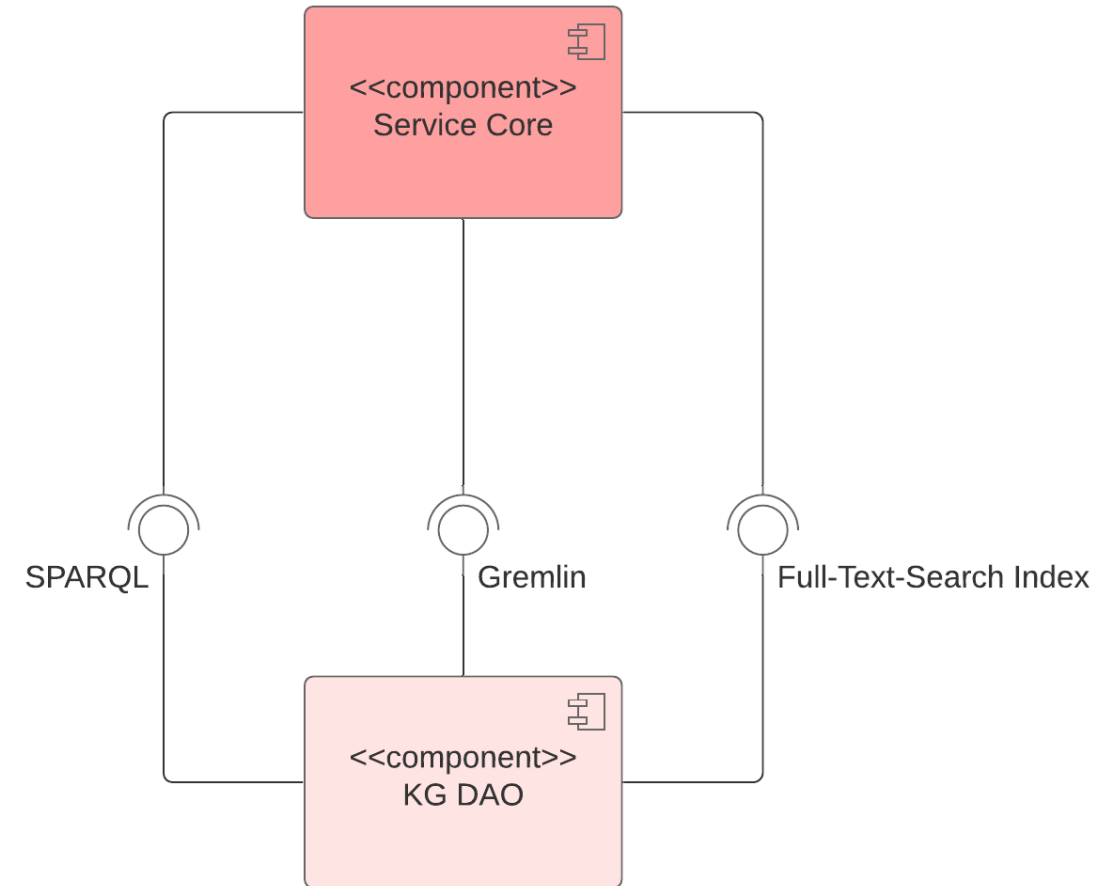
- analytical services analyze the (sematic) structure of a knowledge graph
  - can make use of:
    - i. SPARQL
    - ii. Gremlin
    - iii. Full-Text-Search Index

- new services can be registered

- processor is building a pipeline based on the specified dependencies of an analytical service

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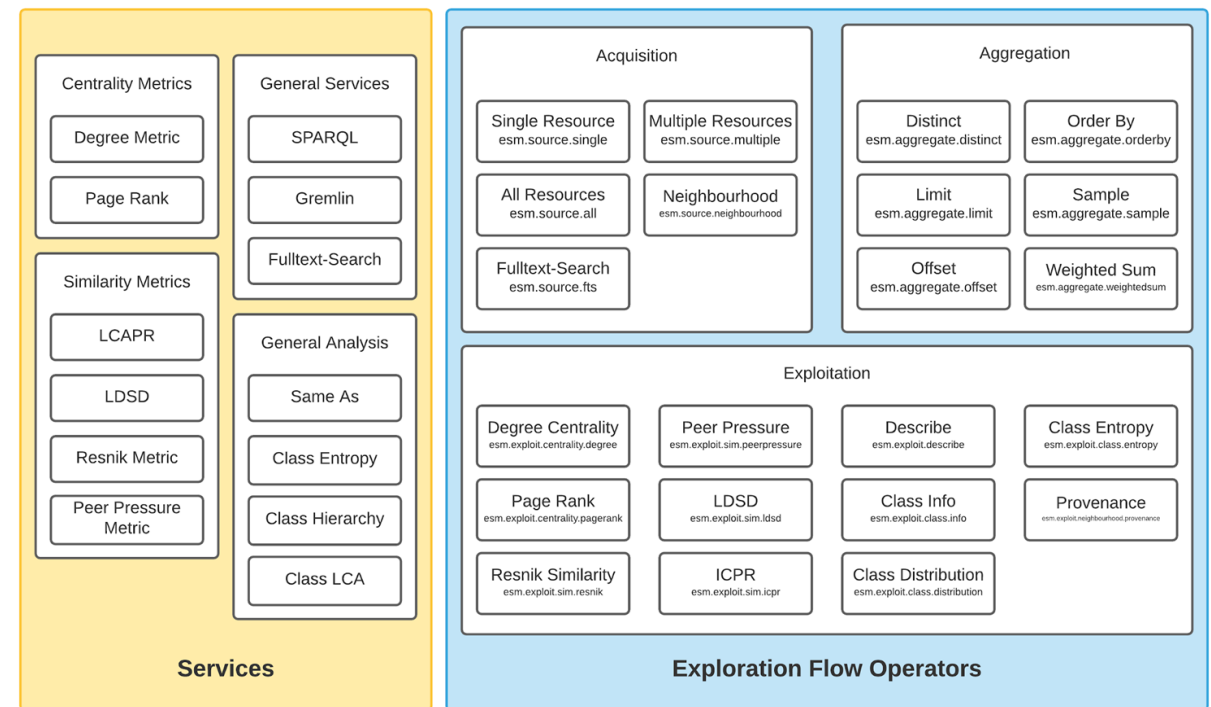
ES Microservice - Exploration Flow

- flow = a sequence of registered operators

- operator = execution of code with well-defined purpose
  - can make use of:
    i. SPARQL, Gremlin, Full-Text-Search Index
    ii. precomputed analytical services (e.g. page rank, Linked Data Semantic Distance, etc.)

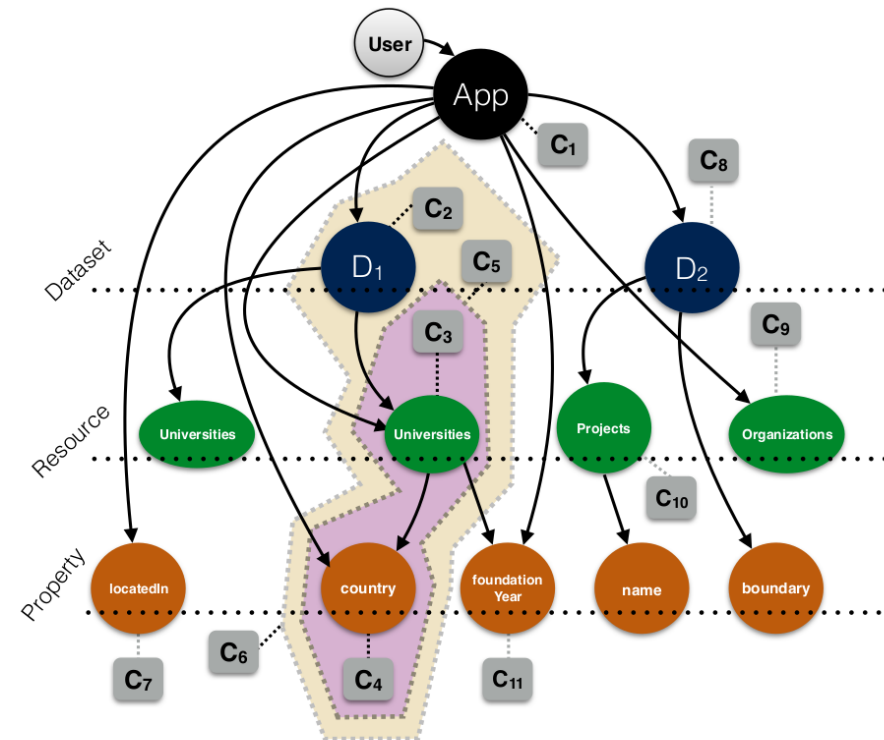*Simple flow for a keyword search:*

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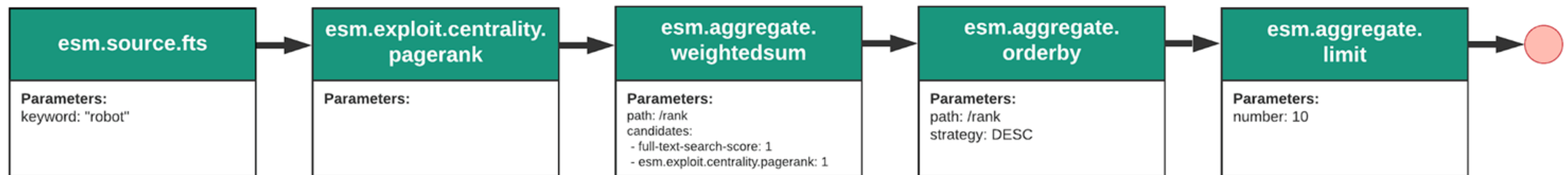
ES Web Interface

- based on the research of Linked Data Reactor

- introduces the concept of *Scopes* and *Configurations*

- algorithm selects the proper *Configuration* based on *Scope*
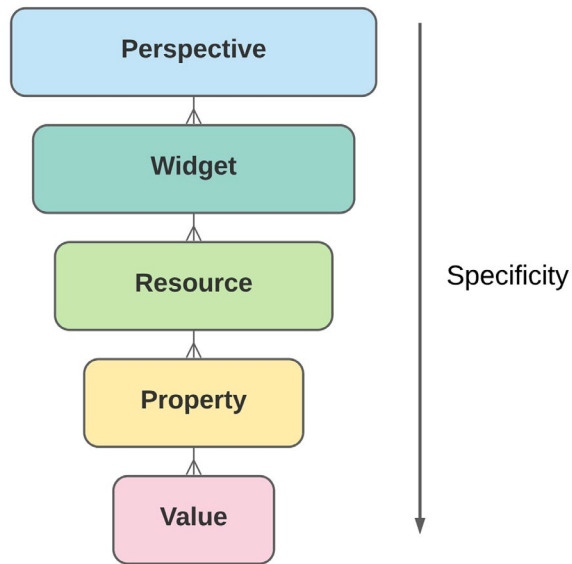
Linked Data Reactor Scopes

Linked Data Reactor Hypergraph

OntoTrans ESS Features

- Keyword search
- Customized search results categorization

- Info-box
- Ontology-based exploration
- Recommendation of related entities

- Class hierarchy
- Statistical information

- User browsing history
- User role specialization
- Multilinguality

- SPARQL query page for advanced analytics