



SLA 2021
ANNUAL CONFERENCE
DESTINATION EVERYWHERE



Using Semantic Resources to Enrich Content Services

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Agenda

- Introductions
- Value of Semantic Resources
- Types of Semantic Resources (KOS)
- Knowledge Graph Use Cases
- JPL's Knowledge Graph Use Cases
- Knowledge Graph Implementation Examples



Types of Semantic Resources

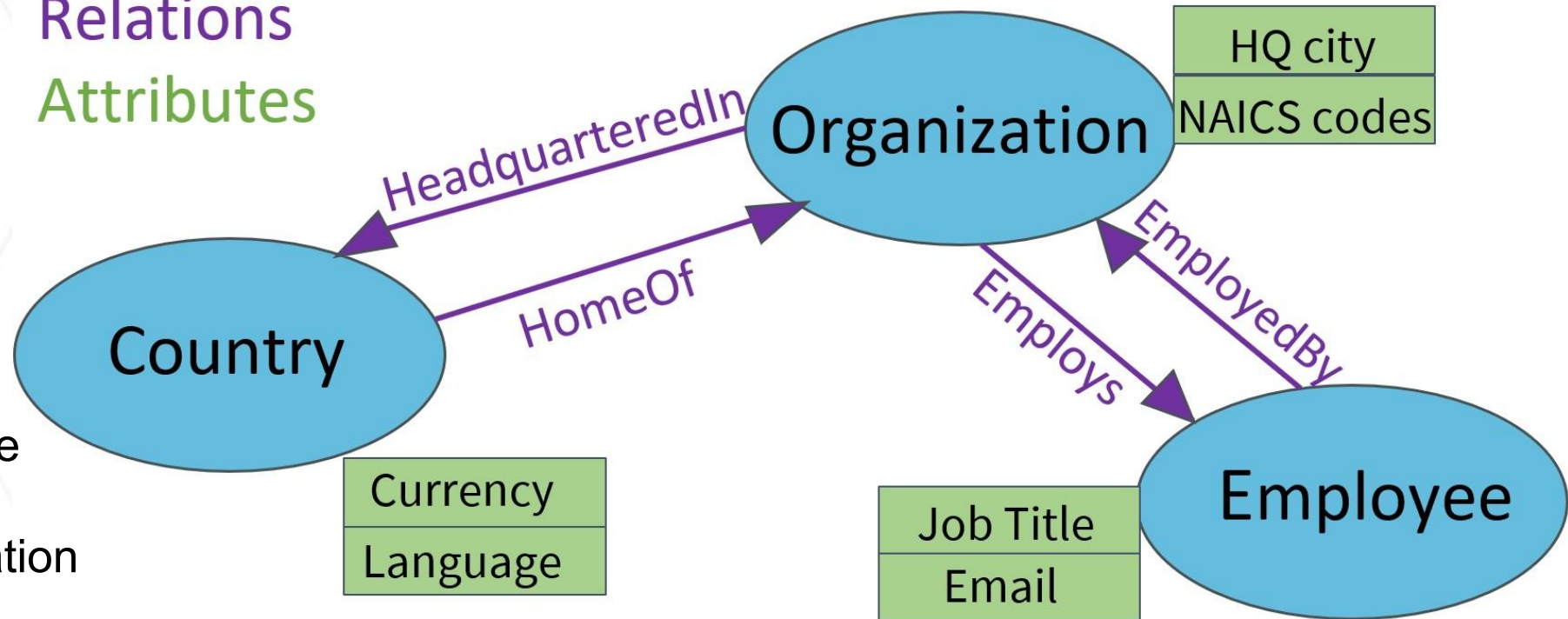


Ontology

Classes

Relations

Attributes

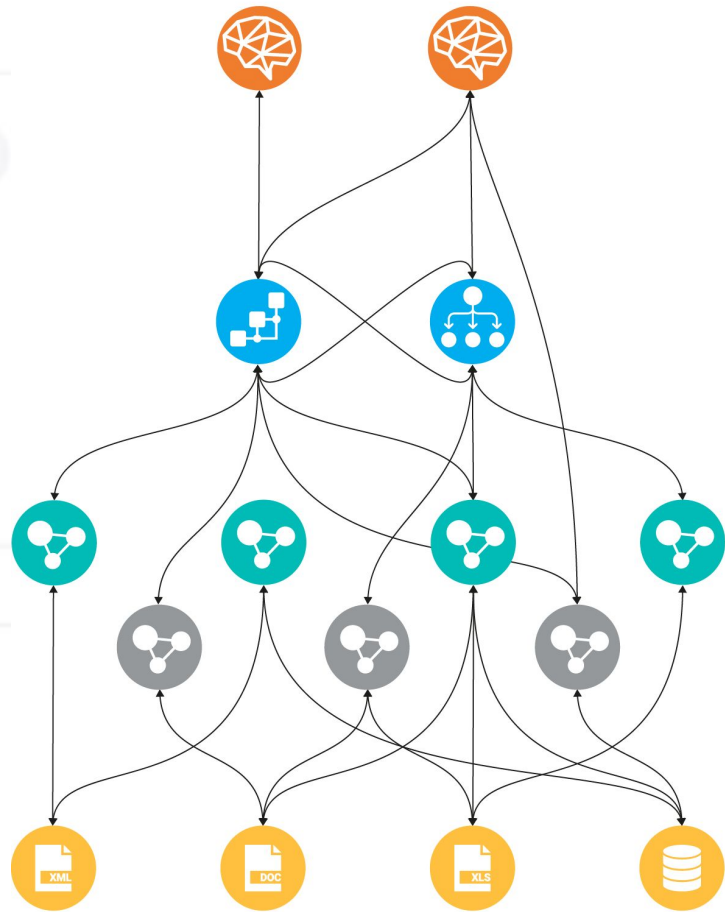


Classes: Employee
Country
Organization

Relations: HeadquarteredIn < > HomeOf
EmployedBy < > Employs

Attributes: Email address, Job title, HQ city, NAICS codes, Currency, Language

What is an Enterprise Knowledge Graph (EKG)?



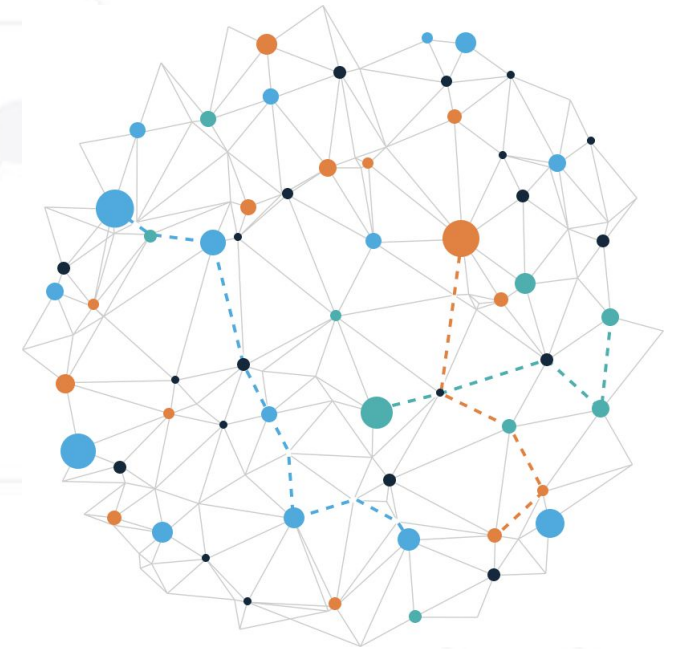
SEMANTIC AI APPLICATION

CONCEPTUAL AND LINGUISTIC MODEL

(VIRTUAL) DATA GRAPH

CONTENT & DATA LAYER

ENTERPRISE KNOWLEDGE GRAPH



An Enterprise Knowledge Graph (EKG) contains business objects and topics that are closely linked, classified, semantically enriched, and connected to existing data and documents.

Knowledge Graph Implementation Examples



Knowledge Graph Implementations

Systems that provide information without standard search for non-expert users:



Recommendation Systems

- Users don't know how best to look for information that would benefit them
- Users don't know that the information is there or how to find it
- Use cases for suggesting content: cross-selling, networking, learning

Question Answering Systems

- Natural language interface over enterprise data
- Concise and comprehensible answers to user questions
- Fast access to enterprise data for non-technical users
- It is already everywhere (Alexa, Siri, Google Assistant, etc.)

Knowledge Graph Implementations

Advantages of *knowledge graph*-based systems over other methods:

For recommendation systems:

- Based on explicit knowledge of content stored in database
- Does not require prior interactions, large numbers of users, or trained data, as in content filtering or collaborative filtering systems
- Does not have cold start problem due to insufficient data

For question answering systems:

- Requires little or no training data
- Robust in handling user mistakes
- Efficient and scales with the increasing size of the knowledge graph
- Can include explanations for how the question was interpreted
- Can deal with questions and answers in different languages



Knowledge Graph Implementations

Example solutions:

Recommendation system:

HR Recommender

Prototype application developed by Semantic Web Company with knowledge graph built in PoolParty software and user interface in Drupal

<https://hr-recommender.poolparty.biz>



Question answering system:

QAnswer

Developed in a strategic partnership between QA Company and Semantic Web Company with knowledge graph built in PoolParty.

<https://qanswer.poolparty.biz>



Recommendation System Example

The screenshot displays the 'HR Recommender' web application. At the top left is the 'poolparty' logo. The main header contains the title 'HR Recommender' and a 'GET IN TOUCH' button. A navigation bar below the header lists 'OVERVIEW', 'EMPLOYEES', 'PROJECTS', 'OPEN POSITIONS', 'ABOUT', 'MY ACCOUNT', and 'LOG OUT'. A central blue box contains the text 'Demo HR Recommender front end' and the URL <https://hr-recommender.poolparty.biz/>. The main content area features a network diagram with a central node for 'Beverly Neal' and several surrounding nodes for roles like 'Data Engineer', 'Software Developer', and 'Frontend Developer', along with icons for 'Evaluation of version...' and 'Helpdesk Chatbot'. On the right, a 'Footprint status' section shows a 75% progress indicator and a 'IMPROVE YOUR FOOTPRINT' button. Below that, a 'Recommender - Overview' section provides a description of the tool and a 'READ MORE' button.

poolparty

HR Recommender

GET IN TOUCH

OVERVIEW EMPLOYEES PROJECTS OPEN POSITIONS ABOUT MY ACCOUNT LOG OUT

Demo

HR Recommender front end

<https://hr-recommender.poolparty.biz/>

Matthew Walker

Florian Bernard

Beverly Neal

Evaluation of version...

Helpdesk Chatbot

Data Engineer ...

Software Developer...

Junior Developer...

Data Engineer

Frontend Developer

Footprint status

75%

IMPROVE YOUR FOOTPRINT

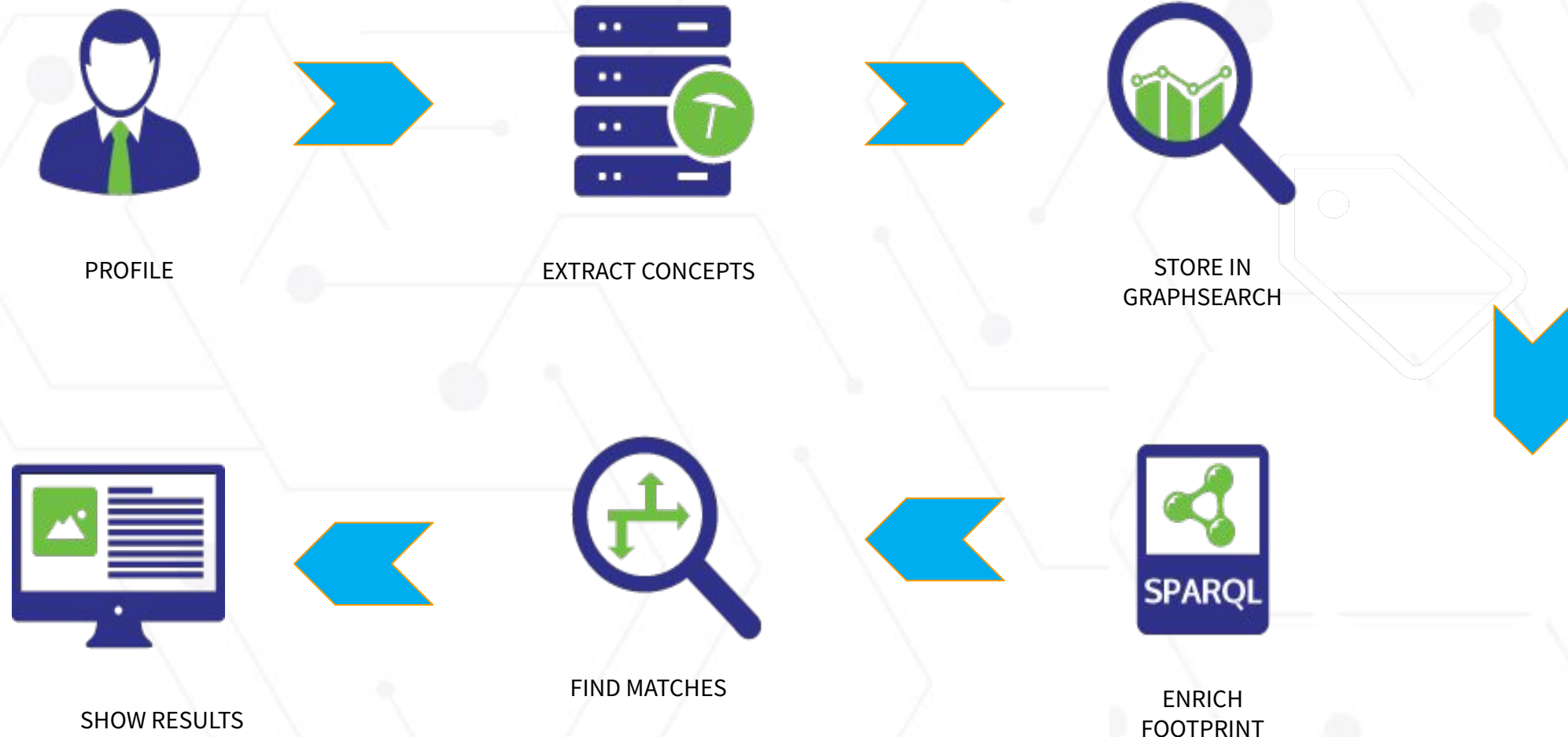
Recommender - Overview

The HR Recommender is a semantic matchmaking tool. Based on your profile information it connects you with other employees, shows you interesting projects and suggests open positions within your organization. The most relevant matches are displayed in the visualisation. Click on any icon to show details about this match.

Improve your matches by clicking on the button above.

READ MORE

Recommendation System Example: HR Recommender



Recommendation System Example: HR Recommender

HR Recommender Components

Semantic resources

- Taxonomies containing concepts and labels
- Ontology of semantic relations

Content that is text-mined

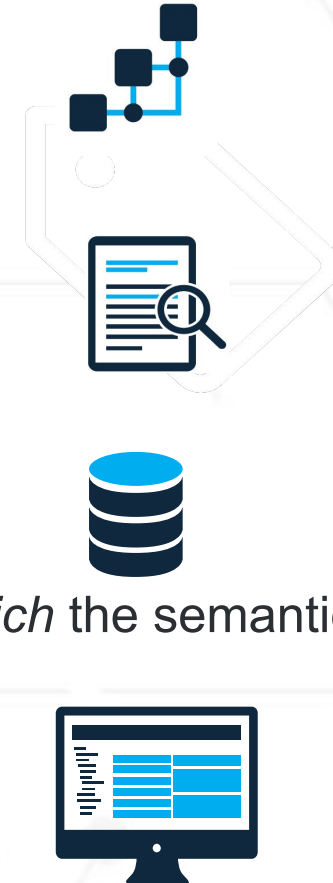
- CVs, personal profiles, job descriptions, project descriptions

Stored data

- Knowledge graph and a search index (Solr)

Recommender application

- Algorithms for calculating similarities and recommendations to *enrich* the semantic footprint
- Web application user interface on top of an API



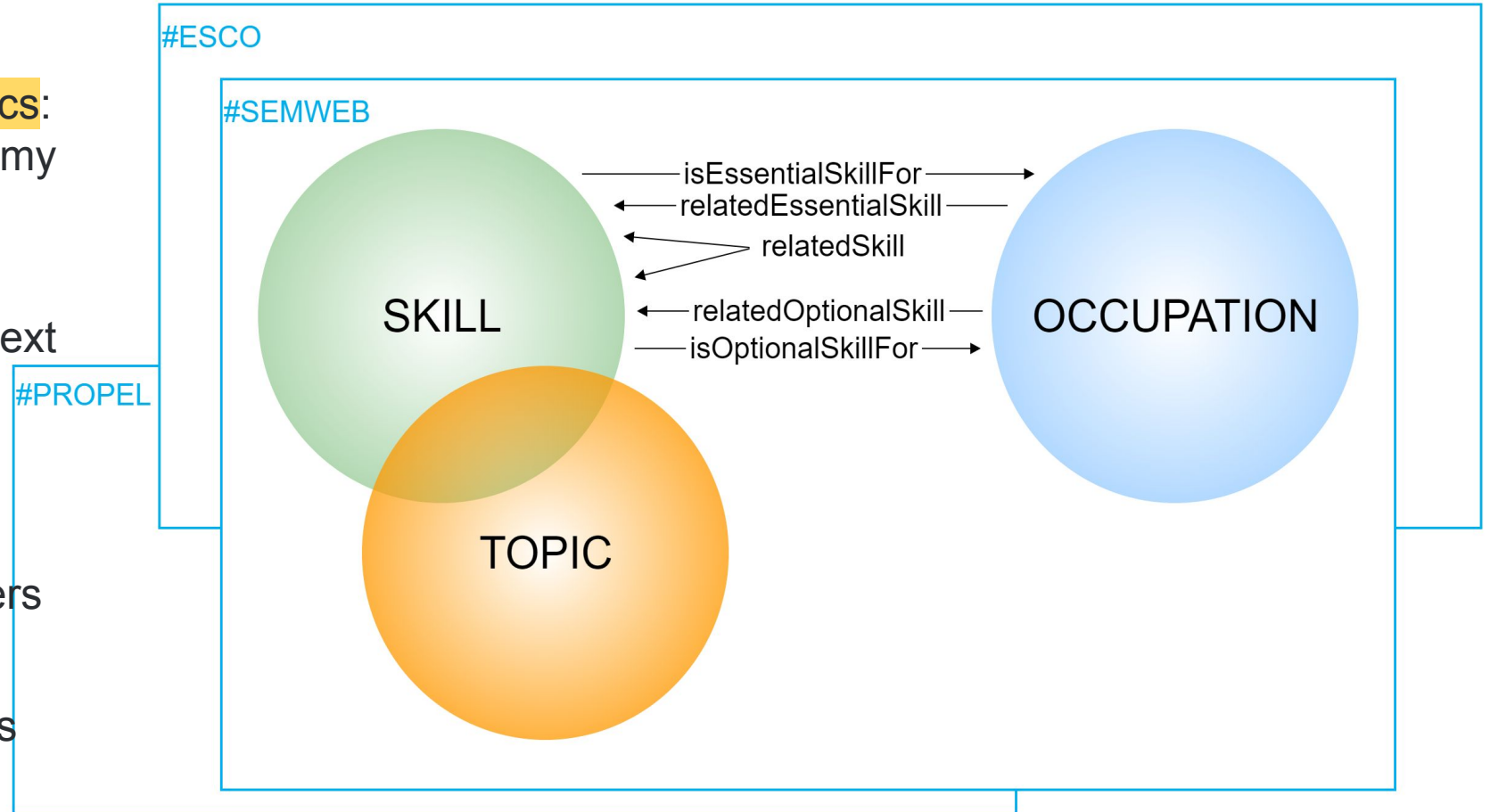
Recommendation System Example: HR Recommender

Taxonomy sources:

- Skills & Occupations Topics: **SEMWEB** custom taxonomy
- Skills & Occupations: **ESCO** Classification
- Taxonomy enriched with text mining (entity extraction) of Topics: **Propel** corpus of industry conference content: submitted papers, speakers

Ontology layer:

Adds semantic relationships





advise on career (0)

advise on curriculum development (0)

advise on environmental alterations (0)

advise on fertiliser and herbicide (0)

advise on government policy compliance (0)

advise on grape quality improvement (0)

advise on healthy lifestyles (0)

advise on licencing procedures (1)

advise on nitrate pollution (0)

advise on plant mineral nutrition (0)

advise on preparation of diet food (1)

advise on risk management (3)

advise on social responsibility and sustainability matters (0)

advise on social security benefits (0)

advise on soil and water protection (0)

advise on tanning treatments (0)

advise on tax policy (0)

advocate for healthcare users' needs (0)

advocate for others (0)

advocate health (0)

aeronomy (0)

aerospace engineering (1)

aerospace engineering

+ Add to Collection - Add to Blacklist - Add to ExactMatch x Delete Concept

<http://data.europa.eu/esco/skill/5dd96c59-5955-474b-8cf5-e986a5b50f1a>

Skill

Details Notes Documents Linked Data Triples Visualization Quality Management History

SKOS ESCO-scheme +

Broader Concepts



Narrower Concepts

[aerodynamics](#)



Related Concepts



Top Concept of Concept Schemes

x [ESCO member-skills](#)

x [ESCO skills](#)



Preferred Label

[aerospace engineering](#) en

Alternative Labels

[aeronautical engineering](#) en

[aircraft engineering](#)

[astronautical engineering](#)

[spacecraft engineering](#)



Hidden Labels



Scope Notes



Definitions





advise on career (0)

advise on curriculum development (0)

advise on environmental alterations (0)

advise on fertiliser and herbicide (0)

advise on government policy compliance (0)

advise on grape quality improvement (0)

advise on healthy lifestyles (0)

advise on licencing procedures (1)

advise on nitrate pollution (0)

advise on plant mineral nutrition (0)

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advocate for others (0)

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aeronomy (0)

aerospace engineering (1)

aerospace engineering

+ Add to Collection ⊘ Add to Blacklist ⊘ Add to ExactMatch ⊗ Delete Concept

<http://data.europa.eu/esco/skill/5dd96c59-5955-474b-8cf5-e986a5b50f1a>

Skill

Details Notes Documents Linked Data Triples Visualization Quality Management History

SKOS **ESCO-scheme** +

isEssentialSkillFor

- ⊗ [aerospace engineer](#)
- ⊗ [cosmologist](#)
- ⊗ [satellite engineer](#)
- ⊗ [space science lecturer](#)

isOptionalSkillFor

- ⊗ [flight test engineer](#)
- ⊗ [industrial engineer](#)
- ⊗ [teach space science](#)

relatedEssentialSkill

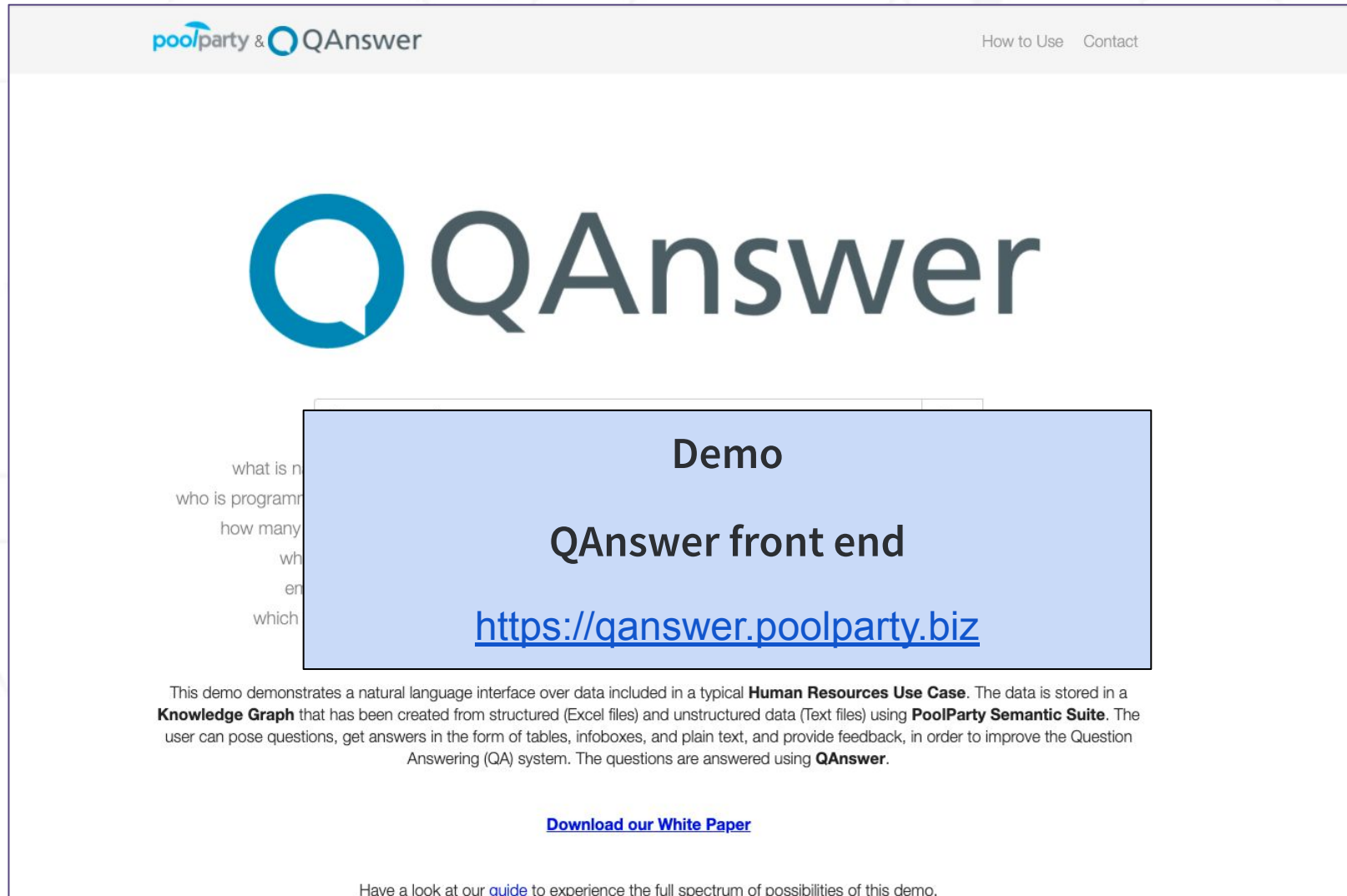


relatedOptionalSkill



No attributes defined yet.

Question Answer System Example



The screenshot shows the top of the QAnswer website. The header includes the logo "poolparty & QAnswer" on the left and "How to Use" and "Contact" on the right. The main content area features a large "QAnswer" logo. Below it, a blue box highlights a "Demo" section for the "QAnswer front end" with the URL <https://qanswer.poolparty.biz>. To the left of this box, a list of sample questions is partially visible: "what is n", "who is program", "how many", "wh", "en", and "which". Below the demo box, a paragraph explains that the demo uses a natural language interface over data from a Human Resources Use Case, stored in a Knowledge Graph created from structured and unstructured data using PoolParty Semantic Suite. It notes that users can pose questions and receive answers in various formats, and provide feedback to improve the system. At the bottom, there is a link to "Download our White Paper" and a footer note: "Have a look at our [guide](#) to experience the full spectrum of possibilities of this demo."

poolparty & QAnswer

How to Use Contact

QAnswer

what is n
who is program
how many
wh
en
which

Demo

QAnswer front end

<https://qanswer.poolparty.biz>

This demo demonstrates a natural language interface over data included in a typical **Human Resources Use Case**. The data is stored in a **Knowledge Graph** that has been created from structured (Excel files) and unstructured data (Text files) using **PoolParty Semantic Suite**. The user can pose questions, get answers in the form of tables, infoboxes, and plain text, and provide feedback, in order to improve the Question Answering (QA) system. The questions are answered using **QAnswer**.

[Download our White Paper](#)

Have a look at our [guide](#) to experience the full spectrum of possibilities of this demo.

QAnswer System Example

QAnswer System Components

Semantic resources

- Taxonomies containing concepts and labels
- Ontology of semantic relations

Data sources

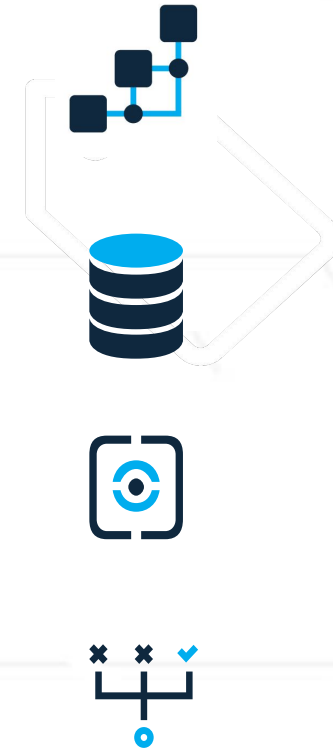
- Databases, spreadsheets, document repositories

Pipelines

- To automatically extract and semantify the data

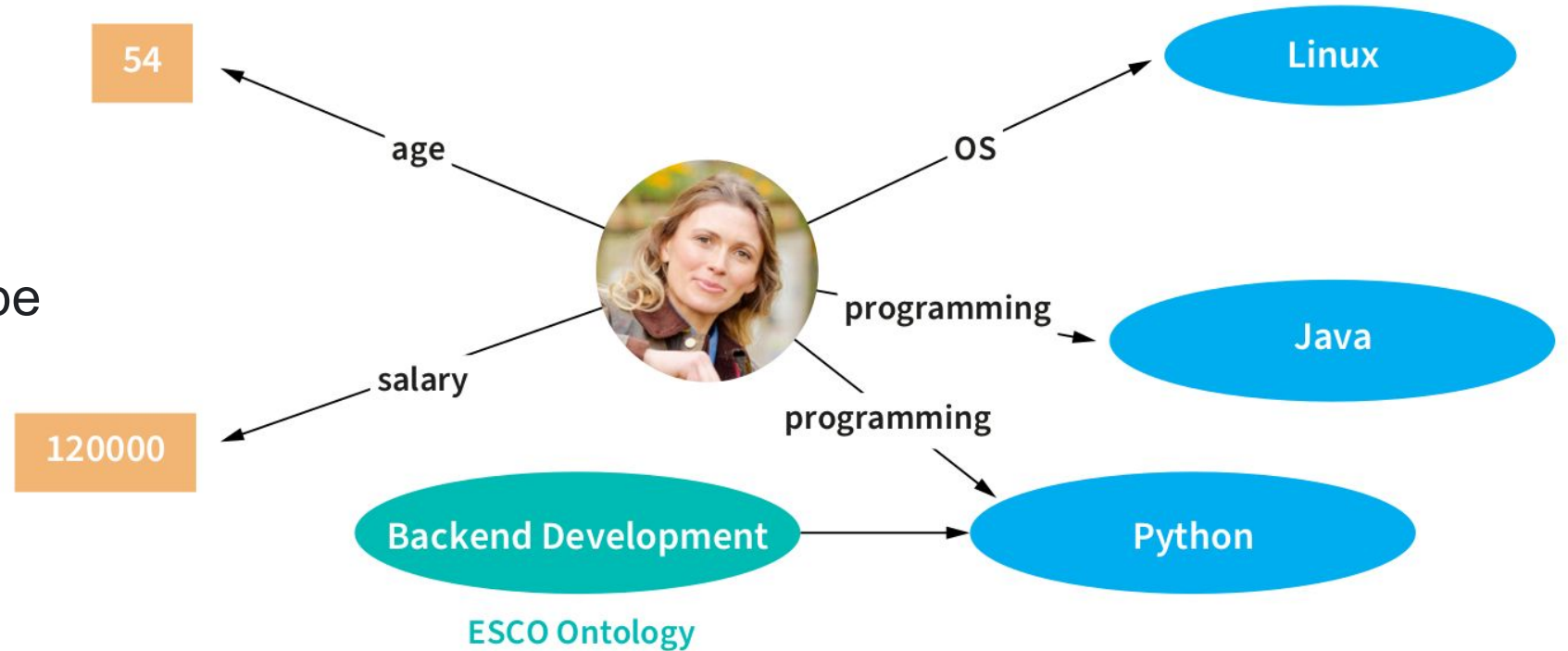
Machine learning models

- Pre-trained machine learning models
- New machine learning models generated and trained



QAnswer System Example

- Create a semantic model using taxonomies and ontologies to describe the domain.
- Establish new relationships using logical inferences, graph analysis or link discovery.



QAnswer System Example

[/ Technology domains / Artificial Intelligence](#)
[/ type / Employee](#)

TABLE

LIST

IMAGES

Pre-trained machine learning models

New ML models are generated automatically based on the training data provided

Technology domains

description

Education

type

age

gross salary

image

[Dani Van Dinteren](#)

- [Artificial Intelligence](#)
- [Database](#)

I hold a Artificial Intelligence degree from University of Texas at Dallas. I currently work as a Sc ...

[Intelligent Systems](#)

[Employee](#)

[Hugo Saez](#)

- [Data Mining](#)
- [Artificial Intelligence](#)

I studied Artificial Intelligence at University of Amsterdam. I am employed as a Data Specialist at

[Intelligent Systems](#)

[Employee](#)

Details

TRAIN

DOWNLOAD TRAIN

REMOVE

REMOVEALL

CHECK SELECTION

<input type="checkbox"/>	ID	Question	Lang	Validated	Ranking	Confidence	Ok
<input type="checkbox"/>	3228178	who speaks english and can use dos	en	T	0	0.1	T
<input type="checkbox"/>	3228182	os	en	T	1	0.08	F
<input type="checkbox"/>	3228188	who is using mac os	en	T	0	0.69	F
<input type="checkbox"/>	3228202	who is using windows	en	T	0	0.72	F
<input type="checkbox"/>	3228212	who is using linux	en	T	0	0.73	F
<input type="checkbox"/>	3228222	who can use sql	en	T	0	0.11	F
<input type="checkbox"/>	3228231	employees that can program in java	en	T	1	0.33	F
<input type="checkbox"/>	3228275	who can program in java and speak spanish	en	T	0	0.12	T
<input type="checkbox"/>	3228279	who can program in c++ and speak english	en	T	0	0.08	F

Contact



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