

# Knowledge Graphs

Linking Data to Knowledge



Thomas N. Burg

[poolparty.biz](http://poolparty.biz)

[thomas.burg@semantic-web.com](mailto:thomas.burg@semantic-web.com)

Business Solution Architect  
Semantic Web Company



About 19.700.000 results (0,59 seconds)

The **Iran nuclear deal** framework was a preliminary framework **agreement** reached in 2015 between the Islamic Republic of **Iran** and a group of world powers: the P5+1 (the permanent members of the United Nations Security Council—the United States, the United Kingdom, Russia, France, and China—plus Germany) and the European ...

[Iran nuclear deal framework - Wikipedia](https://en.wikipedia.org/wiki/Iran_nuclear_deal_framework)  
[https://en.wikipedia.org/wiki/Iran\\_nuclear\\_deal\\_framework](https://en.wikipedia.org/wiki/Iran_nuclear_deal_framework)

About this result Feedback

Top stories



Britain, France and Germany fear Iran nuclear deal collapse as tensions r...  
Sky News  
17 hours ago



Trump axed Iran deal to spite Obama, says newly leaked U.K. diplomati...  
CBC.ca  
23 hours ago



EU holds crisis talks on Iran nuclear deal  
Yahoo News  
1 hour ago

More for iran nuclear treaty



Joint Comprehensive Plan of Action

The Joint Comprehensive Plan of Action, known commonly as the Iran nuclear deal or Iran deal, is an agreement on the Iranian nuclear program reached in Vienna on July 14, 2015, between Iran, the P5+1, and the European Union. [Wikipedia](#)

**Date effective:** : 18 October 2015 (Adoption); 16 January 2016 (Implementation);

**Purpose:** Nuclear non-proliferation

**Location:** Vienna, Austria

**Created:** 14 July 2015

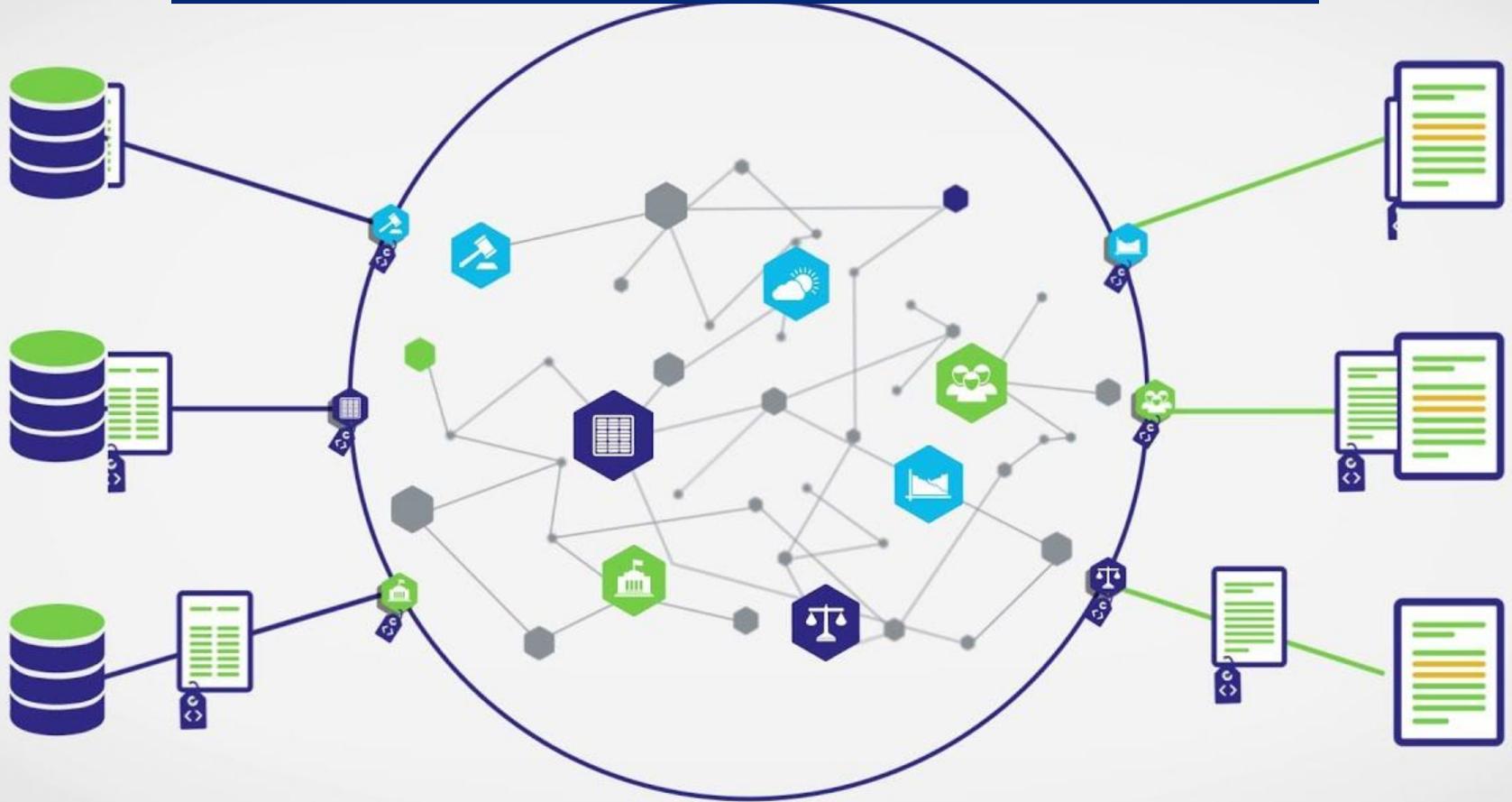
Feedback

See results about

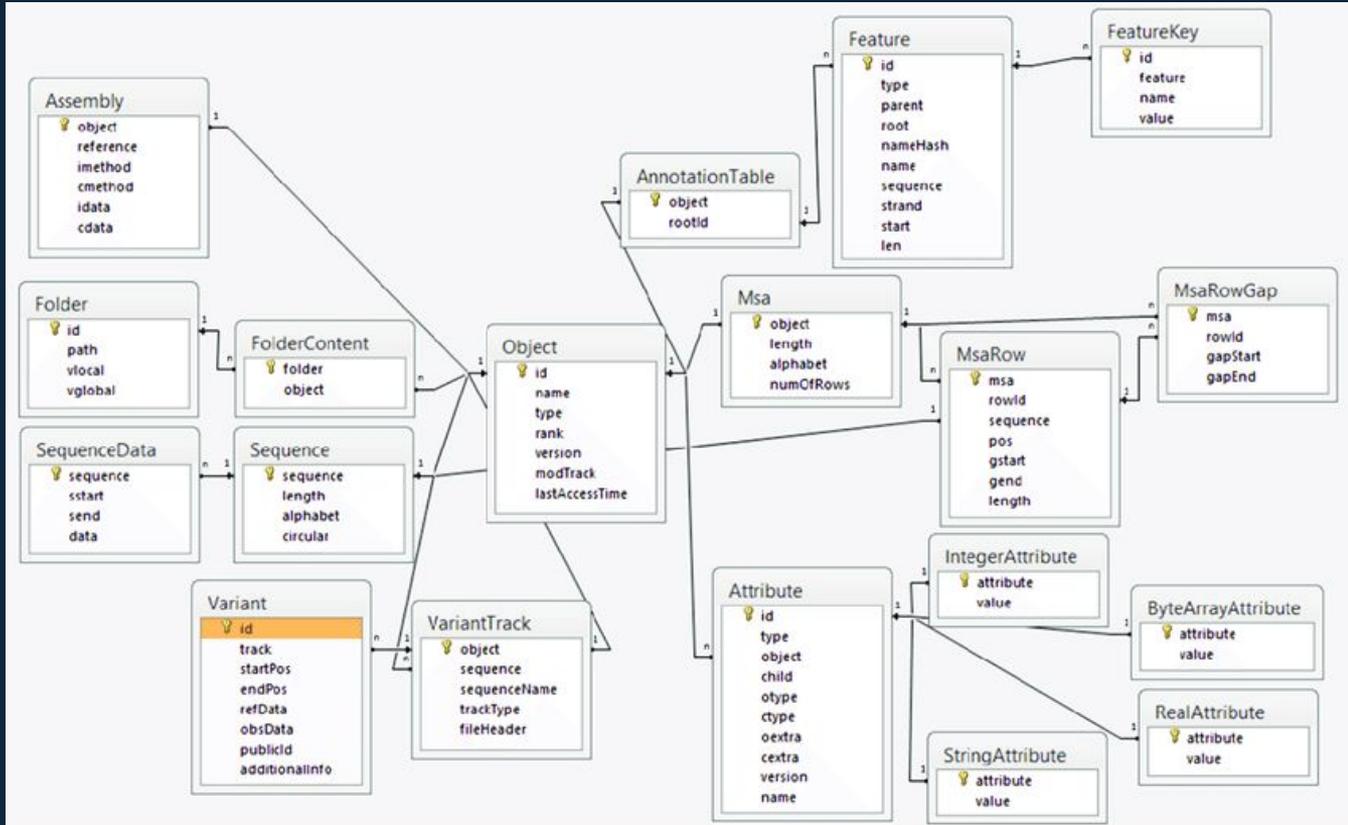
[Iran nuclear deal framework](#)  
The Iran nuclear deal framework was a preliminary framework agreement reached in 2015 between ...



# Entity-Centricity over Document-Centricity



# After 5k yrs RDBMS can't cope with agile contexts

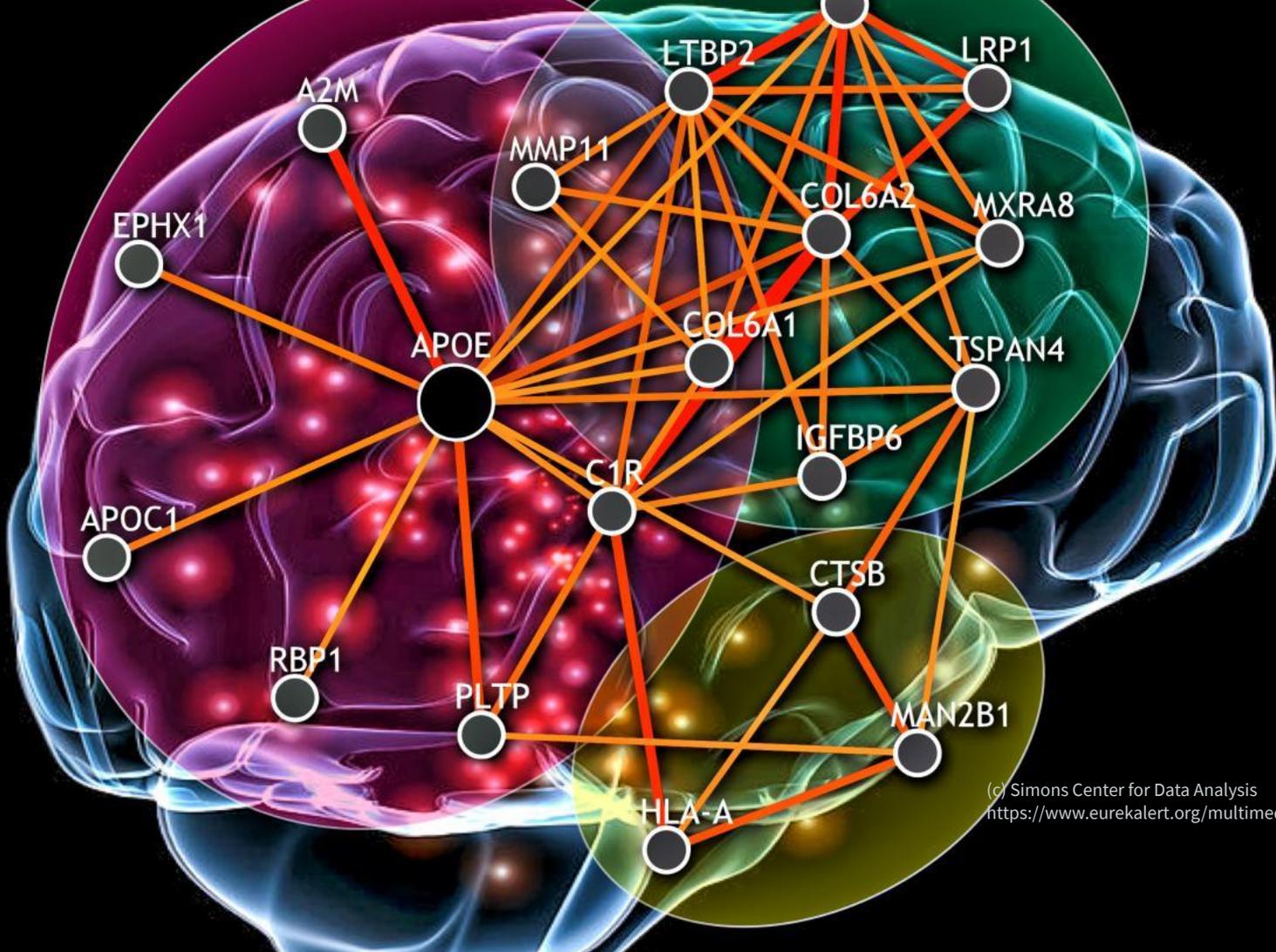


---

**Do all business problems fit well  
into tables?**

**What's better, more inline w/  
how humans make sense of the  
world.**

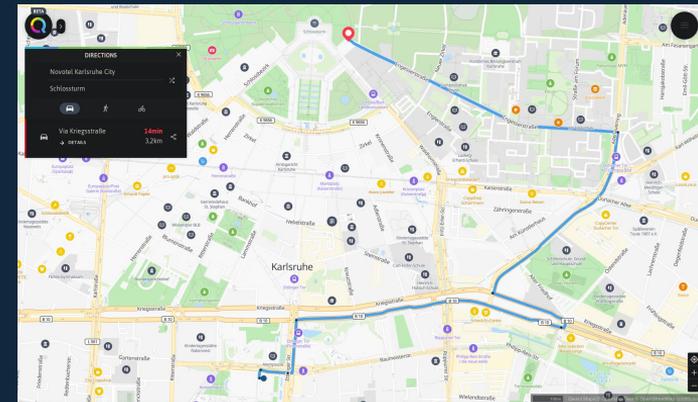
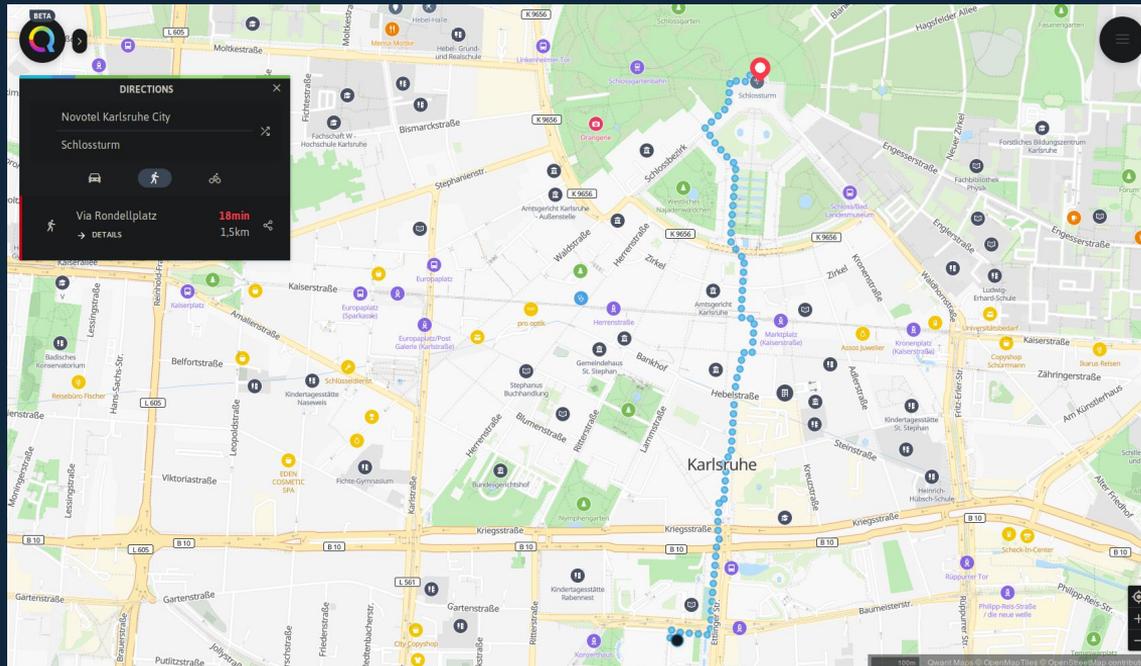
**For  
more  
than  
100k  
years**



# More is better

## How Graphs are changing our relationship with Data.

»Not understanding this level of complexity leaves businesses not modeling data and relationships correctly.« – Denise Gosnell



# What is a Knowledge Graph?

## From a Knowledge Engineer's perspective

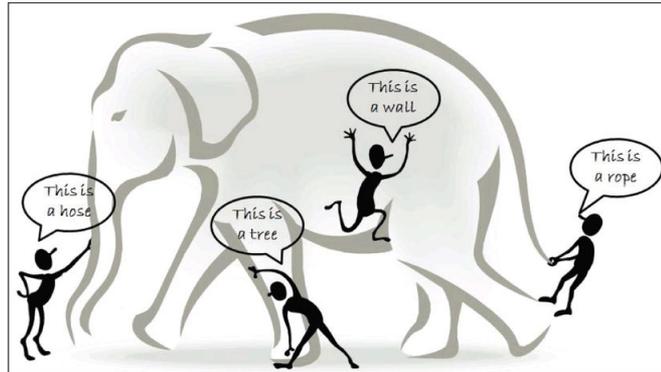
A Knowledge Graph is a **model of a knowledge domain** created by subject-matter experts with the help of intelligent machine learning algorithms.

## From a Data Architect's perspective

Structured as an additional **virtual data layer**, the Knowledge Graph lies on top of your existing databases or data sets to **link all your data together at scale** – be it structured or unstructured.

## From a Data Engineer's perspective

It provides a **structure and common interface** for all of your data and enables the creation of smart multilateral relations throughout your databases.



# KGs in use by largest companies

	Company name	Location	Industry	Change in market cap 2009-2018 (\$bn)	Market cap 2018 (\$bn)	
Known knowledge graph builders	1	Apple	United States	Technology	757	851
	2	Amazon.Com	United States	Consumer Services	670	701
	3	Alphabet	United States	Technology	609	719
	4	Microsoft Corp	United States	Technology	540	703
	5	Tencent Holdings	China	Technology	483	496
	6	Facebook	United States	Technology	383(1)	464
Operator of Taobao and KG builder	7	Berkshire Hathaway	United States	Financial	358	492
Known KG builders	8	Alibaba	China	Consumer Services	302(1)	470
	9	JPMorgan Chase	United States	Financials	275	375
	10	Bank of America	United States	Financials	263	307

From: [Alan Morrison - Collapsing the IT Stack: Clearing a path for AI adoption](#)

Graphs are a 2019 TREND and “*Graph DBMSs will grow at **100 percent annually** through 2022*”...

...because we “*need to ask **complex** questions across complex data*”

Source: [Gartner.com](https://www.gartner.com)

# Taxonomies, Ontologies, Knowledge Graphs

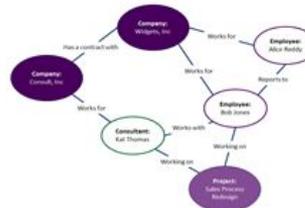
**Content & Data Sources**

Drupal  
SharePoint  
salesforce  
Excel  
MediaBeacon  
twitter  
Microsoft Dynamics  
WebDAM

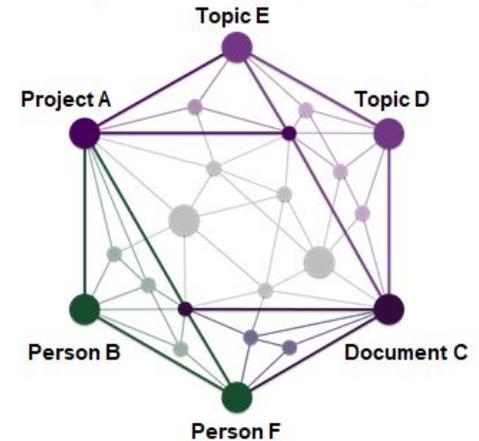
## Business Taxonomy



## Business Ontology



## Enterprise Knowledge Graph



Subject	Predicate	Object
Person B	isPMOn	Project A
Document C	isAbout	Topic D
Document C	isAbout	Topic F
Person B	IsExpertIn	Topic D

## Triple Store

# Generic Use Cases for Knowledge Graphs

- ▶ **Loosely connected data**
- ▶ **Too simplistic, disconnected data models**
- ▶ **Data models don't keep pace with market dynamics**
- ▶ **Too abstract data models**



Add Context to Data



Make Decisions with Confidence



Strengthen AI Strategy



Gain Augmented Analytics



Connect Data Silos



Scale Data Governance

# Knowledge Graphs

---

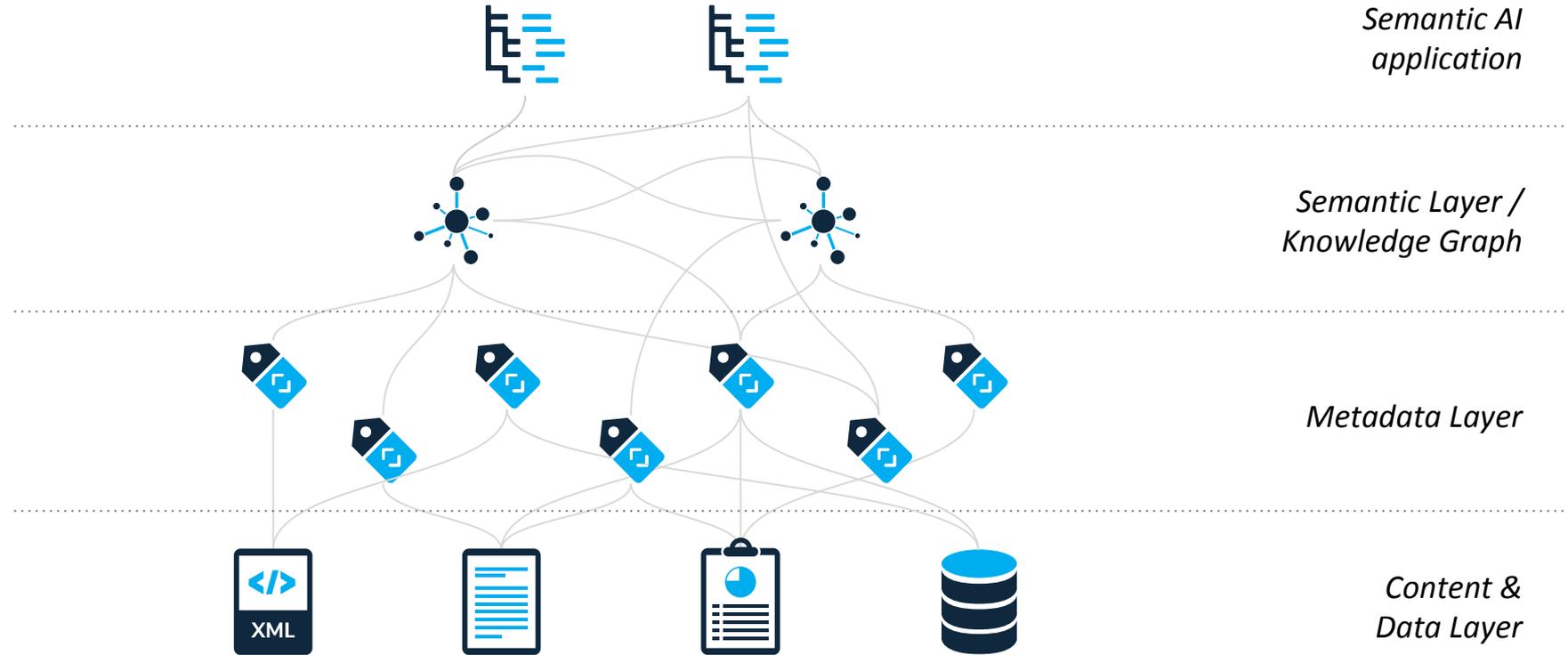


---

# Governed by Knowledge

Where does Semantics sit in your information architecture?

# Four-layered Information Architecture



---

# Things, Not Strings

What is it and why should you care?

*From keywords to entities.*

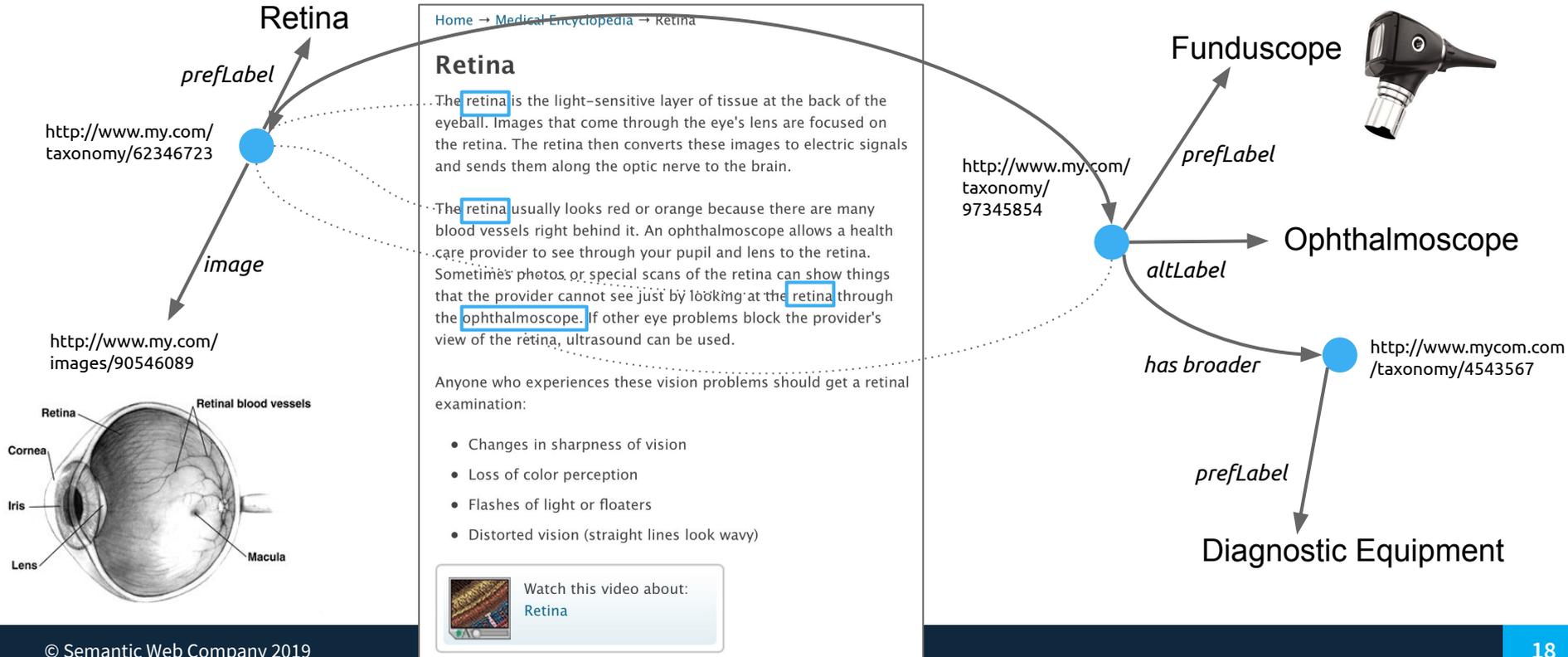
*From the words that are used to describe things to the things being described.*

*It changes [web pages | data repos] from isolated islands, to islands joined by billions of bridges.*

Aaron Bradley, EA - <http://www.seoskeptic.com/semantic-seo-making-shift-strings-things/>

# 'Things' but not Strings:

## Using a 'Semantic Knowledge Graph'



# The standards compliant THING

TheCheese2WineHarmoniser

- Cheese (2)
- Flavours and characteristics (2)
- Wine (5)
  - Fortified wine (1)
  - Red wine (5)
  - Sweet wine (1)
  - White wine (12)
    - Chardonnay (1)
      - Uibel Chardonnay Reserve 2013 (0)
    - Field blend (1)
    - Grüner Veltliner (8)
    - Neuburger (1)
    - Pinot blanc (2)
    - Pinot gris (1)
    - Riesling (3)
    - Roter Veltliner (1)
    - Rotgipfler (2)
    - Sauvignon blanc (2)
    - Traminer (2)
    - Zierfandler (2)
  - Wine by country (1)
- Lists
- Collections
- GraphEditors

## Chardonnay

<http://vocabulary.semantic-web.at/cheese-wine/66c3875d-76b9-4292-b1ad-93299ce3d966>

Wine

Details Notes Documents Linked Data Triples Visualization Quality Management History

SKOS Harmonizer-Schema Varieties definitions +

**Broader Concepts**

- [White wine](#)

**Narrower Concepts**

- [Uibel Chardonnay Reserve 2013](#)

**Related Concepts**

- [Medium acidity](#)

**Top Concept of Concept Schemes**

- 

**Exact Matching Concepts**

- <http://dbpedia.org/resource/Chardonnay> LOD Source: EnDBPedia

**Preferred Label**

- Chardonnay

**Alternative Labels**

- Arboisier
- Armaison
- Armaison Blanc
- Armoison
- Aubain
- Auvergnat Blanc
- Auvernas
- Auvernas Blanc
- Auvermat Blanc
- Auvermat blanc
- Auxeras
- Auxerras Blanc
- Auxois Blanc
- Bargeois
- Bargeois Blanc

[Link to LOD](#) [Link to PP](#)

# The standards compliant THING

## Chardonnay



<http://vocabulary.semantic-web.at/cheese-wine/66c3875d-76b9-4292-b1ad-93299ce3d966>



Wine

Subject (resource, entity, thing)

Predicate

Object

<http://www.w3.org/2004/02/skos/core#exactMatch>

<http://dbpedia.org/resource/Chardonnay>

<http://www.w3.org/2004/02/skos/core#narrower>

<http://vocabulary.semantic-web.at/cheese-wine/912c97a4-ce16-40db-b85c-e751b8b1f7cd>

<http://www.w3.org/2004/02/skos/core#prefLabel>

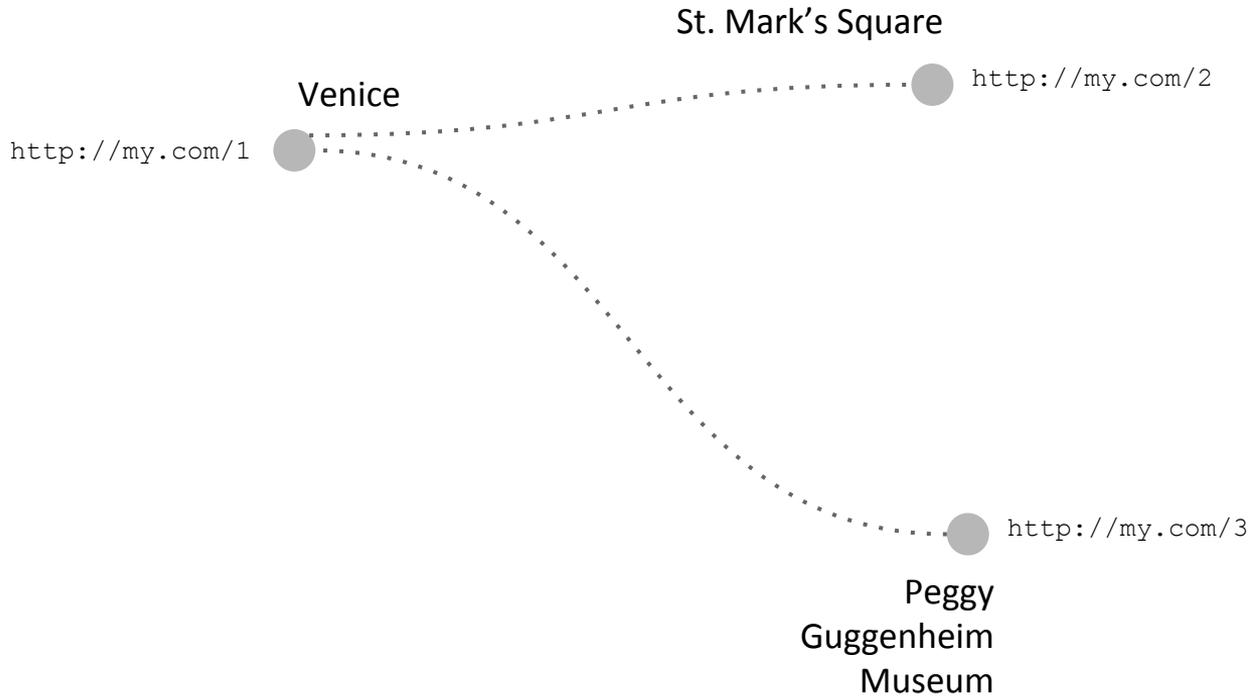
Chardonnay en

# Standards-based KNOWLEDGE GRAPHS

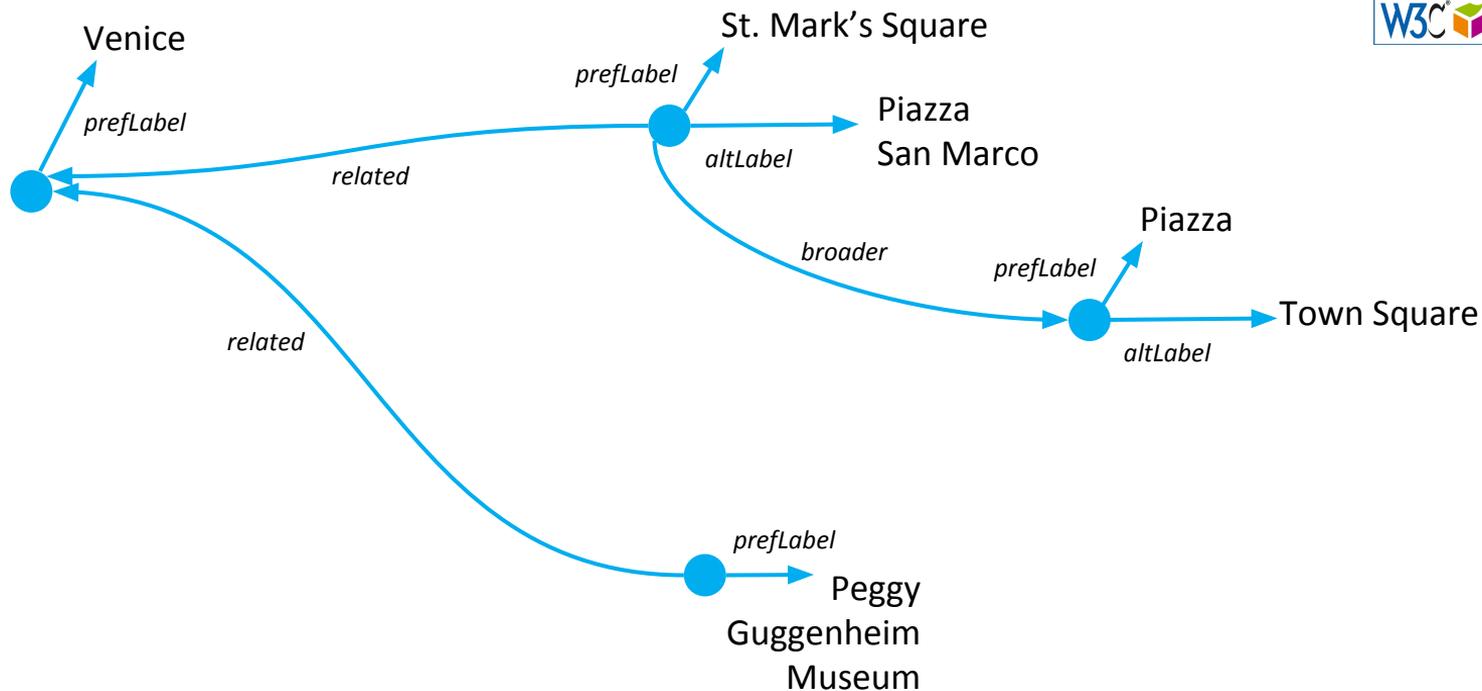
Building Blocks

# Things and URIs

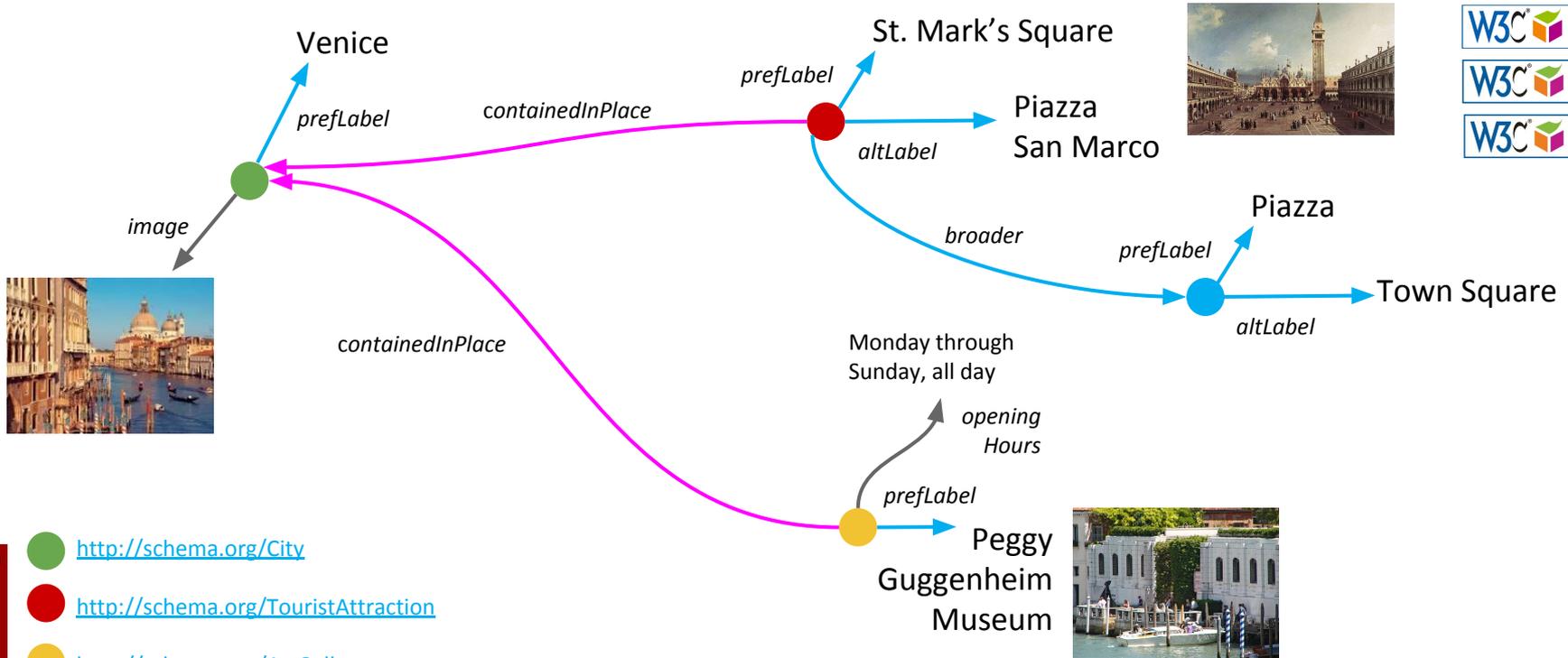
---



# Labels and basic relations



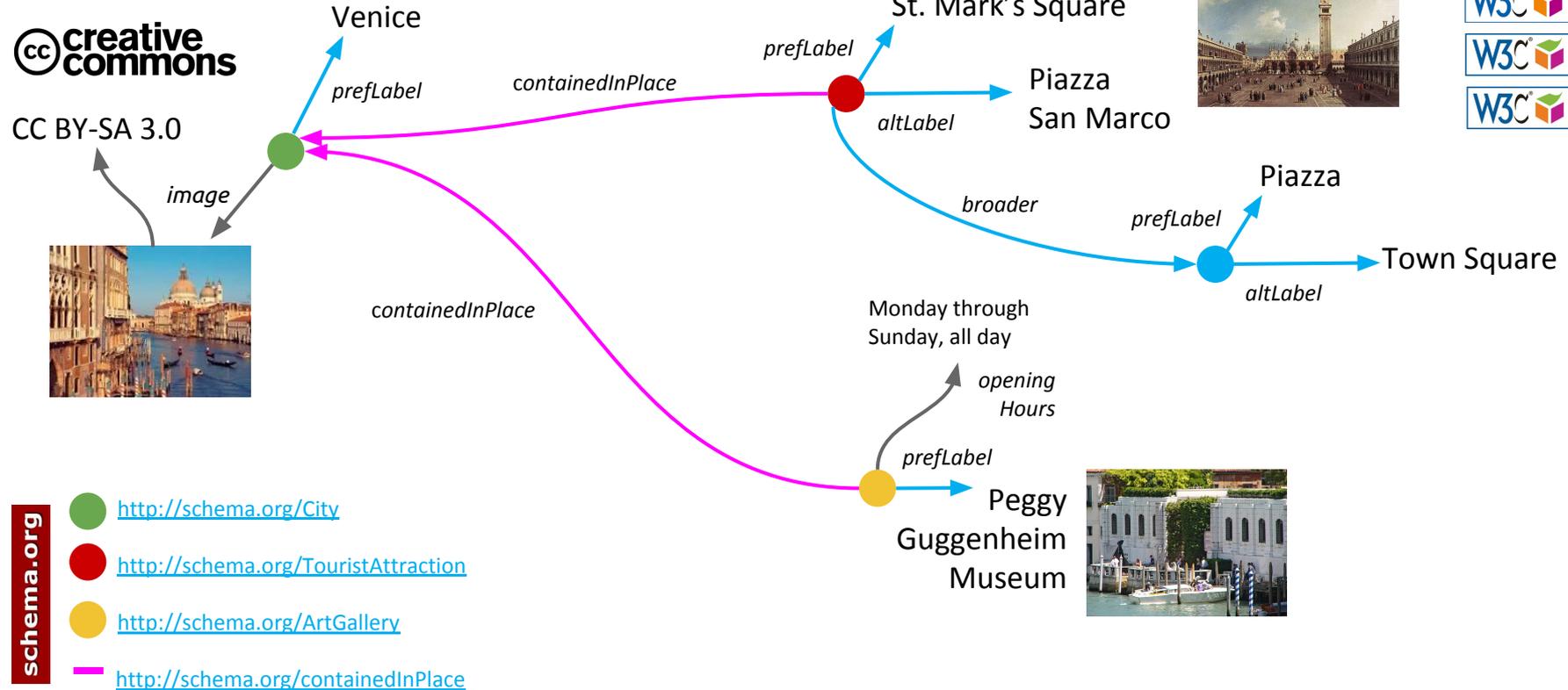
# Classes, specific relations, restrictions



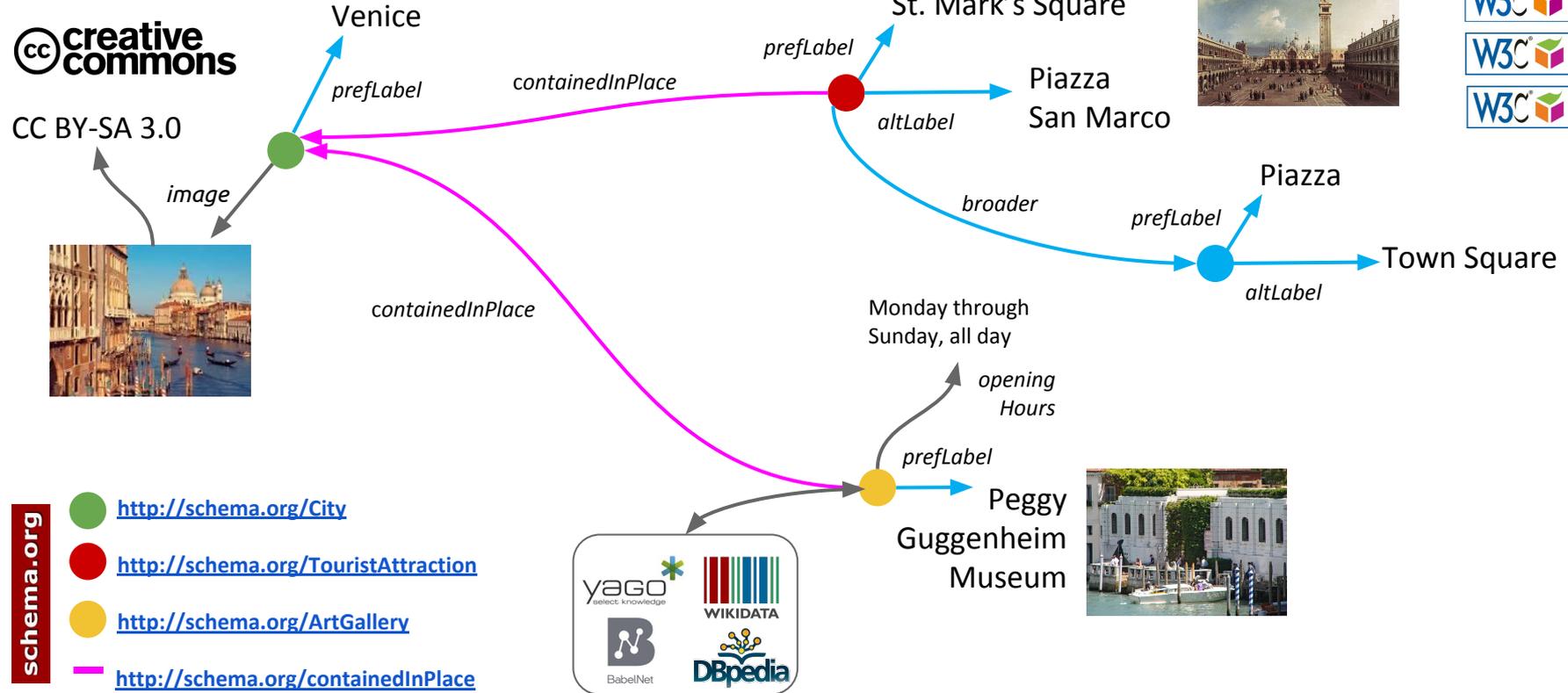
schema.org

- <http://schema.org/City>
- <http://schema.org/TouristAttraction>
- <http://schema.org/ArtGallery>
- <http://schema.org/containedInPlace>

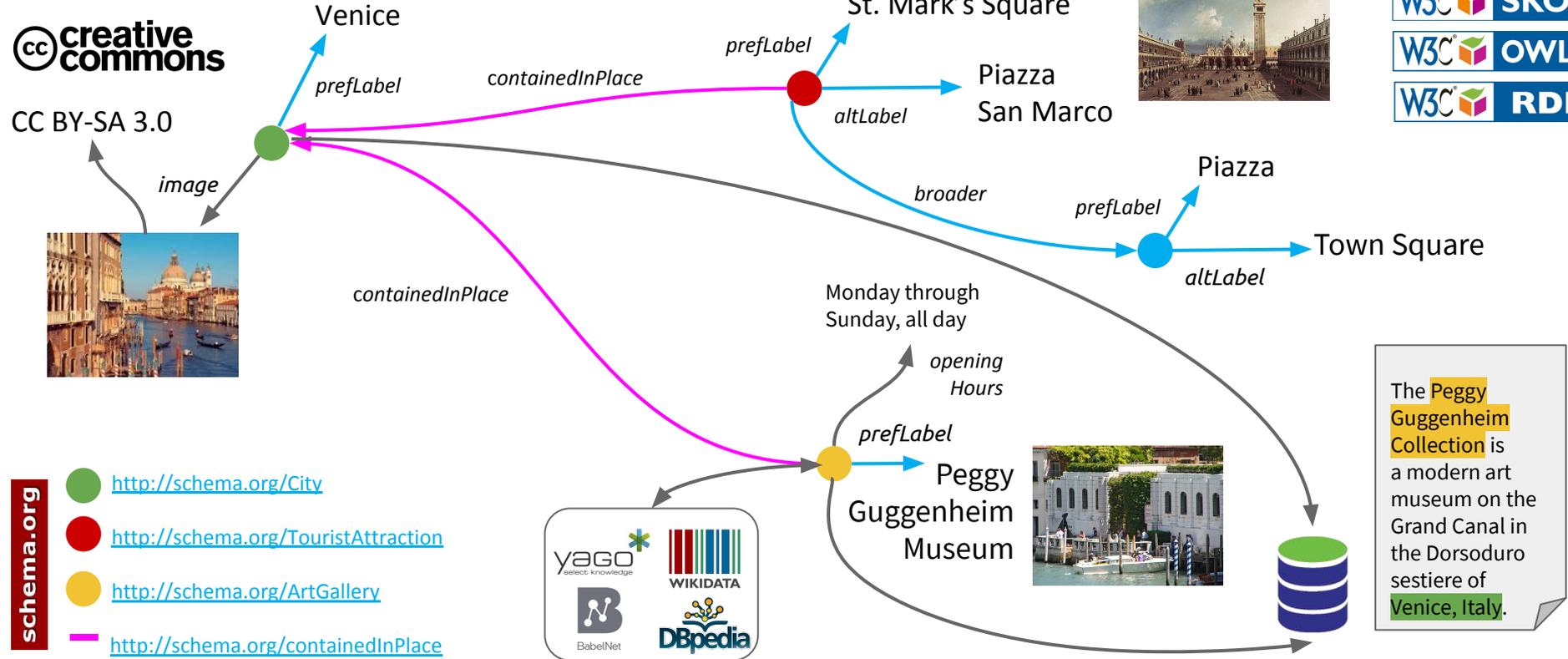
# Metadata and Graph annotations



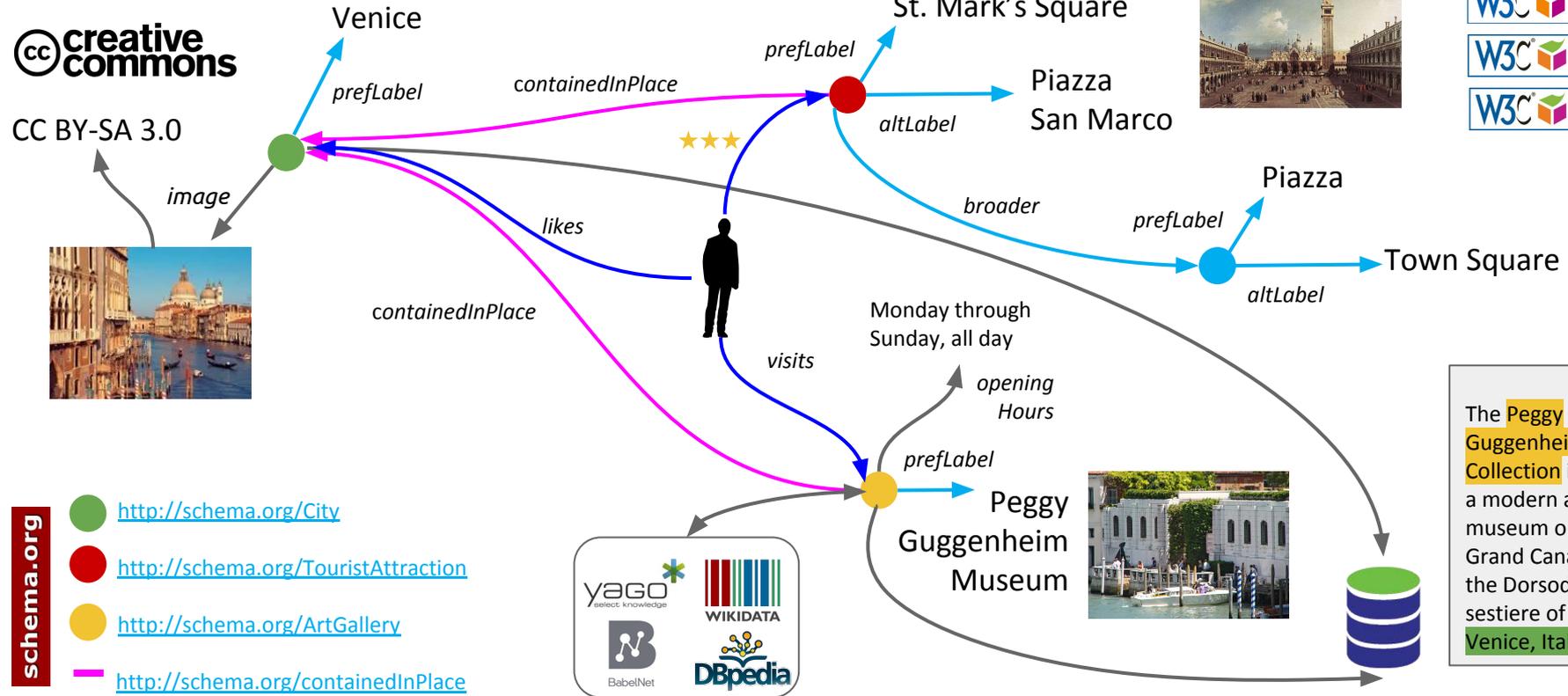
# Entity linking and schema mappings



# Linking to data and document stores



# Putting the user into the graph



The **Peggy Guggenheim Collection** is a modern art museum on the Grand Canal in the Dorsoduro sestiere of **Venice, Italy**.

---

# Establishing the KNOWLEDGE GRAPH

As an HR manager, for upcoming training programmes, I want to identify employees who:

- have a certain skill set
- have a specific degree
- have skills that are increasingly important on the labour market
- fall into a specific salary range



Employee database



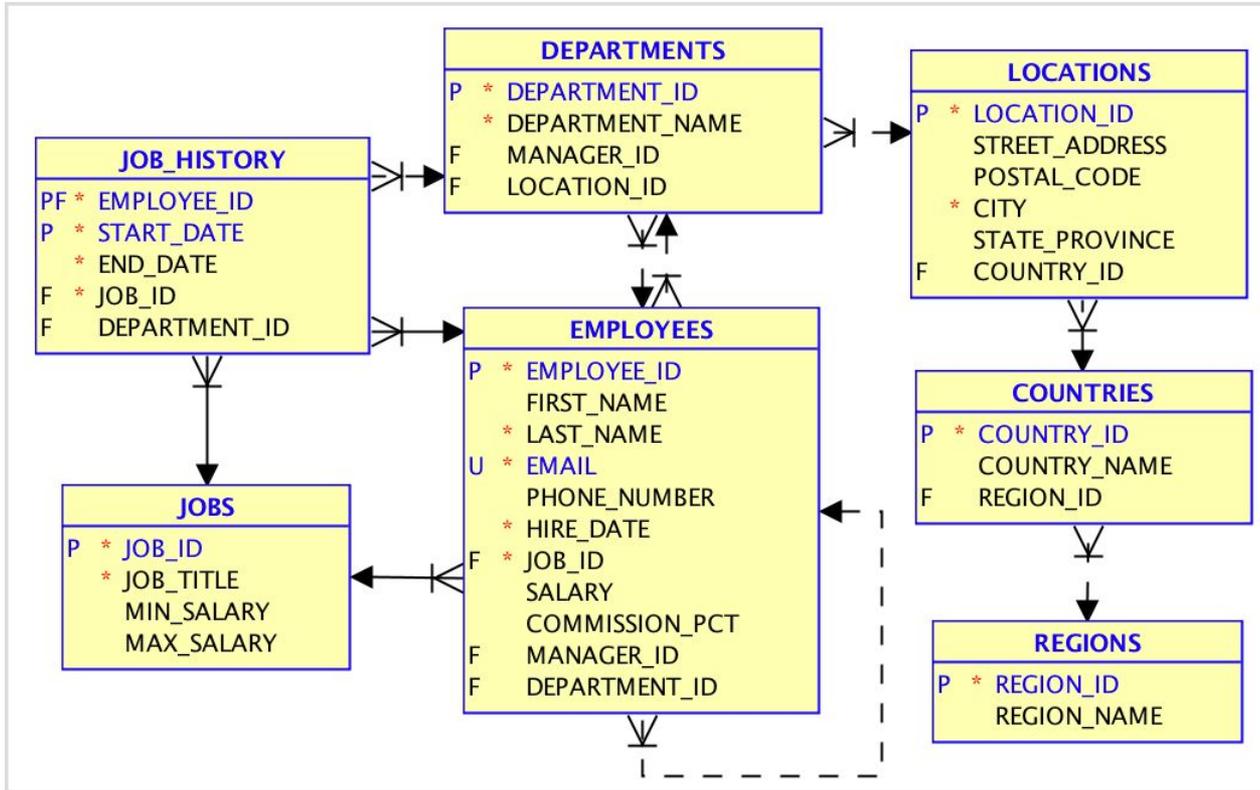
Resumes



Labour market statistics

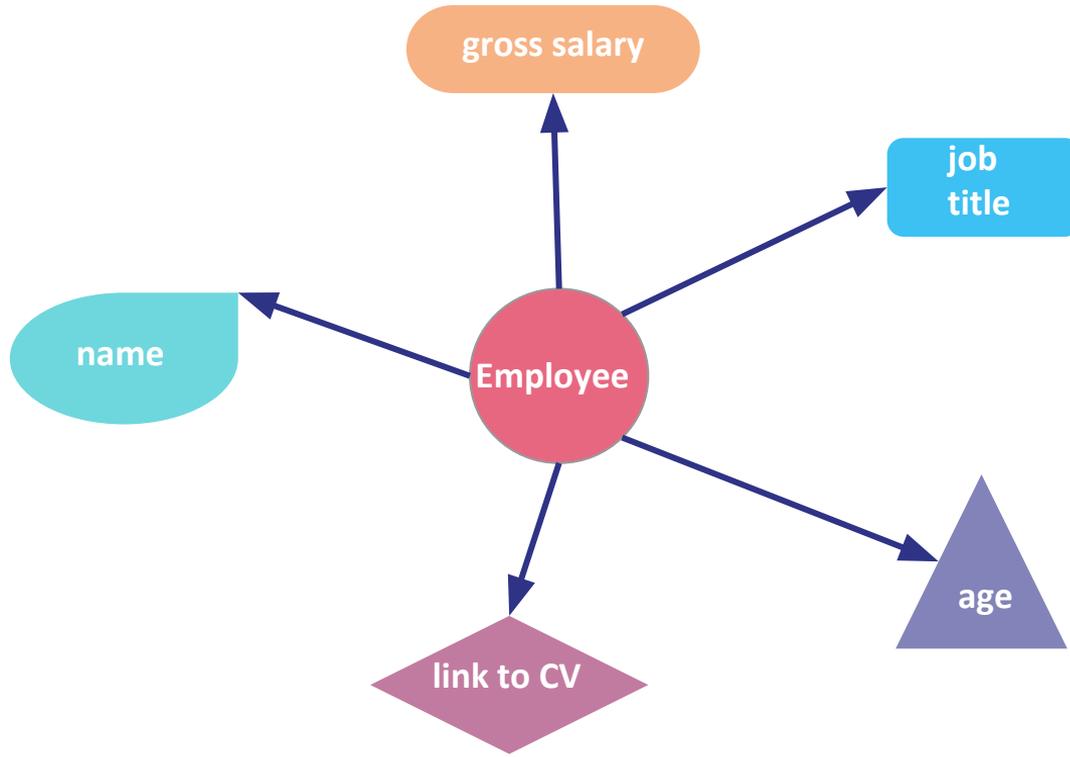


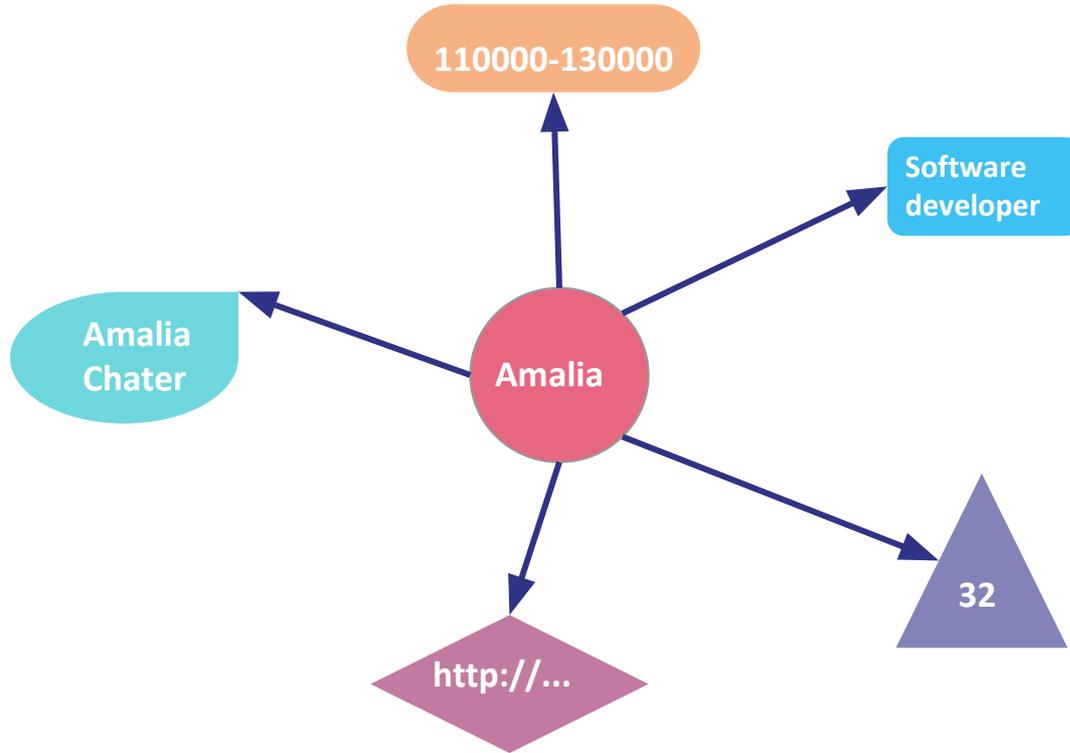
# HR Analytics - relational data model



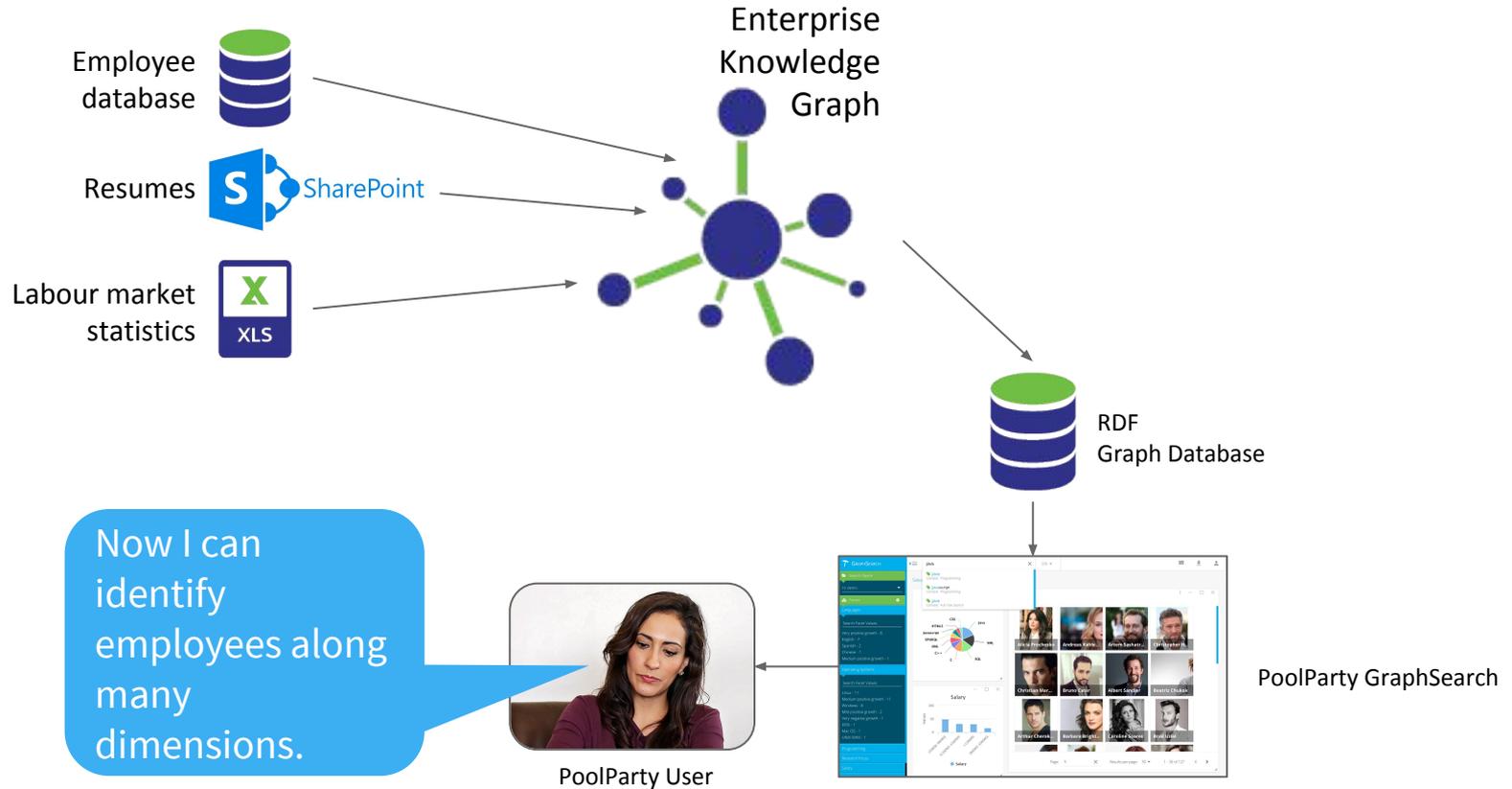
# HR Analytics - graph data model

---





# HR Analytics



# What do you need? And who's in charge?

---

- ▶ Taxonomy
  - ▷ Domain Expert
- ▶ Ontology
  - ▷ Domain Expert
- ▶ Data Orchestration {transforming, mapping}
  - ▷ Knowledge engineer
- ▶ Data
  - ▷ Organization / IT
- ▶ Settings for the front end
  - ▷ Domain Expert

- Company Type (5)
- Employees (1)
- Job Roles (6)
  - IT (7)
  - Knowledge Engineering Experts (3)
  - Management (6)
  - Research (3)
  - Teaching (2)
  - Writing (2)
- Location (3)
- Skills (6)
  - Languages (4)
    - Chinese (0)
    - English (0)
    - Japanese (0)
    - Spanish (0)
  - Operating Systems (6)
    - DOS (0)
    - Linux (0)
    - Mac OS (0)
    - Solaris (0)
    - UNIX SVR4 (0)
    - Windows (0)
  - Programming (17)
  - Research Focus (13)
  - Technology Domains (19)
  - Tools (15)
- Studies (3)
- Lists
- Collections
- GraphEditors

# Job Roles

<http://vocabulary.semantic-web.at/jobs-skills/15>

Metadata Skills Facets Triples **Visualization** History





- Freebase
- GEO
- Geo
- H2020 Project
- Harmonizer
- Informa Custom Ontology
- Jobs-Skills**
  - Classes
    - Employee
  - Relations
    - Languages
    - Operating Systems
    - Programming
    - Research focus
    - Salary
    - Technology domains
    - Tools
  - Attributes
    - age
    - empID
    - gross salary
    - job title
    - link to cv
    - name

## Jobs-Skills

<http://schema.semantic-web.at/jobs-skills>

[Export](#) [Delete](#)

**Title**

- Jobs-Skills
- 

**Languages**

- English
- No Language
- 

**Description**

- 
- 

**User Groups**

- Stardog
- SWC
- 

**Statistics**

- Classes - 1
- Relations - 7
- Attributes - 6

**Usages**

- <http://schema.semantic-web.at/Skills-Facets>
- <http://schema.semantic-web.at/Employees-Details>

**URI Generation**

`http://schema.semantic-web.at/jobs-skills/{element}`

Pipeline: 'HR demo' ↓

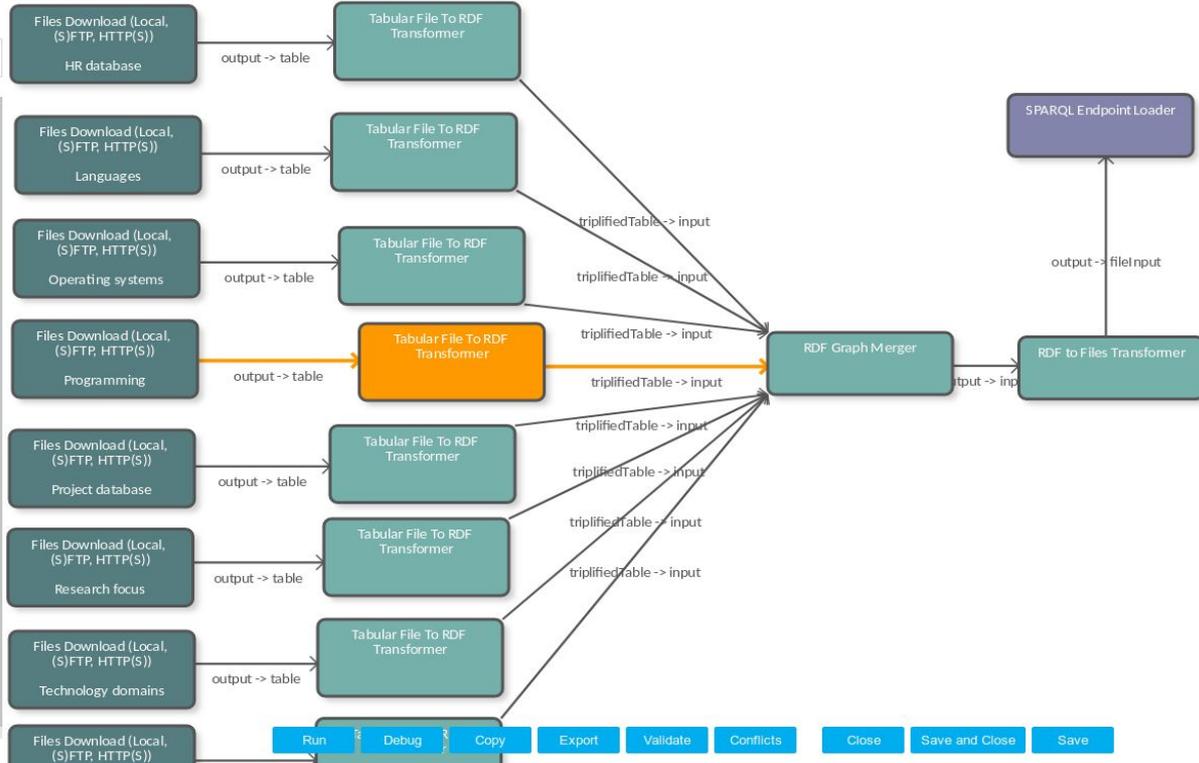
Pipeline Designer

List of Available DPUs ↑

Only Private DPU Templates

Type to Filter Tree

- Extractors
  - Confluence Attachments Extractor
  - Copy Of e-Confluence-Attachments
  - Files Download
  - HTTP API Request
  - Relational Database
  - Shell Script
  - Silk RDF Link Discovery
  - SPARQL Endpoint
- Loaders
  - Files Upload
  - Relational Database
  - SPARQL Endpoint
  - Virtuoso Specific (Files)
  - Virtuoso Specific (RDF)
- Quality
  - SPARQL Ask Validator
- Transformers
  - Excel to CSV
  - File Filter
  - File Merger
  - File Renamer
  - Files to RDF
  - GZIP File Compressor
  - GZIP File Decompressor
  - JSON to XML
  - Open Calais Entity Extractor
  - PoolParty Concept Extractor
  - PoolParty GraphSearch Index Constructor



### Tabular File To RDF Transformer Detail

**Name:** Tabular File To RDF Transformer

**Parent:** Tabular File To RDF Transformer

**Description:**

Use Custom Description
  Use Template Configuration

Full column mapping
  Ignore blank cells
  Use static row counter
  Advanced key column
  Generate row column

Generate subject for table
  Auto type as string
  Generate table/row class
  Generate labels
  Remove trailing spaces

Ignore missing columns

**Mapping**

Simple mapping
  Advanced mapping with templates
  XLS mapping

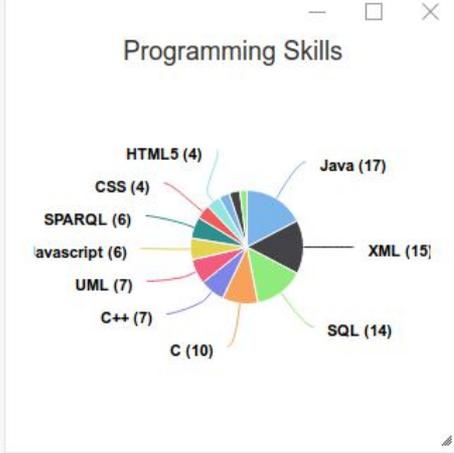
Column name	Output type	Language	Use Dbf types	Property URI
Skill	Auto		<input type="checkbox"/>	https://sharepoint-demo/hr/skill-name
2015 Annual average gross demand	Auto		<input type="checkbox"/>	https://sharepoint-demo/hr/2015-annual-avg-gross-demand
2016 Annual average gross demand	Auto		<input type="checkbox"/>	https://sharepoint-demo/hr/2016-annual-avg-gross-demand
Growth Rate	Auto		<input type="checkbox"/>	https://sharepoint-demo/hr/growth-rate
Category	Auto		<input type="checkbox"/>	https://sharepoint-demo/hr/category

[Add mapping](#)

[Copy From DPU Template](#)
[Save as new DPU template.](#)
[Cancel](#)
[Save](#)

- Search Space
- HR Demo
- Facets
- Entity types
- Languages
- Operating Systems
- Programming
- Research focus
- Salary
- Technology domains
- Tools

Selected facet values: empty



128 results

 <b>Brad Uziel</b>	 <b>Bob Todler</b>	 <b>Amber Smith</b>	 <b>Anika Ferrero</b>
 <b>Albert Sandler</b>	 <b>Arthur Cherkov...</b>	 <b>Alina Dawson</b>	 <b>Amy Willson</b>
 <b>Belyse Karan</b>	 <b>Artem Sashatr...</b>	 <b>Beatriz Chukok</b>	 <b>Bruno Cater</b>
			

Page: 1 Results per page: 20 1 - 20 of 128

Search Space

HR Demo

Facets

Entity types

Languages

Operating Systems

Search Facet Values

Windows - 2

Mild positive growth - 1

Medium positive growth - 1

Linux - 1

Mac OS - 1

Programming

Research focus

Search Facet Values

Data Mining - 2

Mild positive growth - 2

Machine Learning - 1

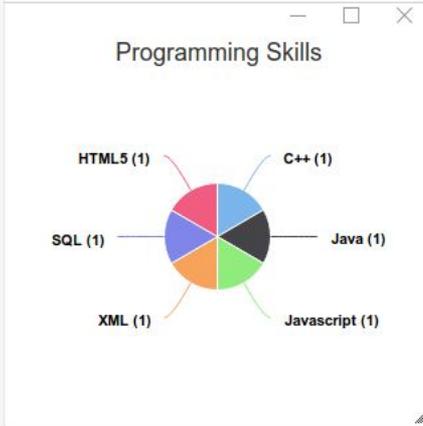
Medium positive growth - 1

Information retrieval - 1

Image Processing - 1

Salary

Selected facet values: Windows (Operating Systems) X Data Mining (Research focus) X Clear all X



2 results



**Chen Yuang**



**Nail Pateli**

Page: 1 Results per page: 20 1 - 2 of 2

# Chen Yuang

← → Chen Yuang



## LANGUAGES

## OPERATING SYSTEMS

- Mild positive growth
- Medium positive growth
- Linux
- Windows
- Mac OS

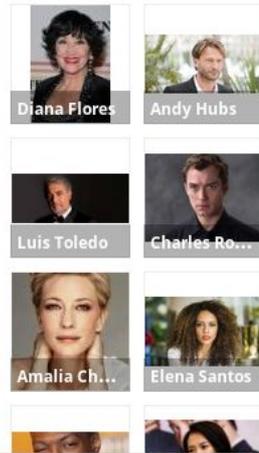
## PROGRAMMING

## RESEARCH FOCUS

- Data Mining
- Mild positive growth
- Machine Learning
- Medium positive growth
- Information retrieval
- Image Processing

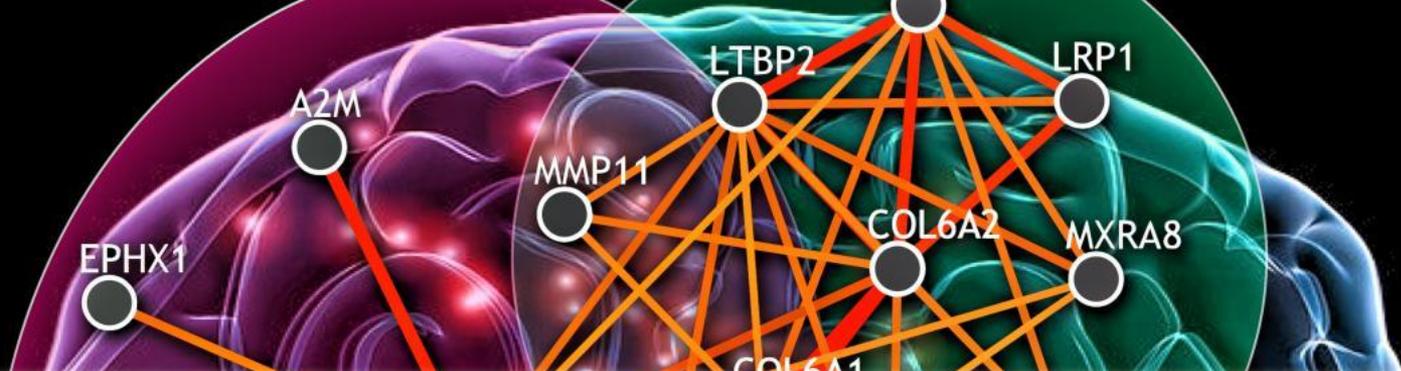
## See Also

Graph Similarity



Similarities: 10

CLOSE



# Thank You T

Email: [thomas.burg@semantic-web.com](mailto:thomas.burg@semantic-web.com)

Website: [poolparty.biz](http://poolparty.biz)

