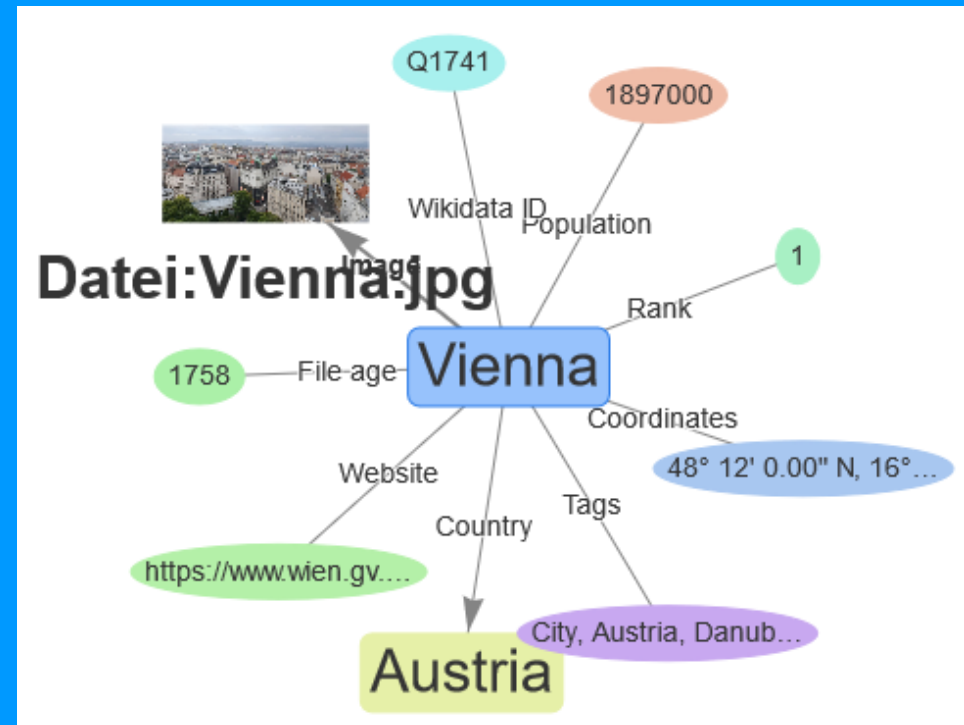


# KnowledgeGraph Extension

Bernhard Krabina, KM-A



# Introduction



Managing partner at KM-A Knowledge Management Associates

- KM consulting
- KM training
- KM research



Active member of the Semantic MediaWiki community ~ 15 years



- open-source SMW stack
- professional hosting



Knowledge Graph researcher at WU Vienna



Knowledge Management lecturer at university of applied sciences

# Agenda



1

What is a Knowledge Graph?

2

KnowledgeGraph Extension

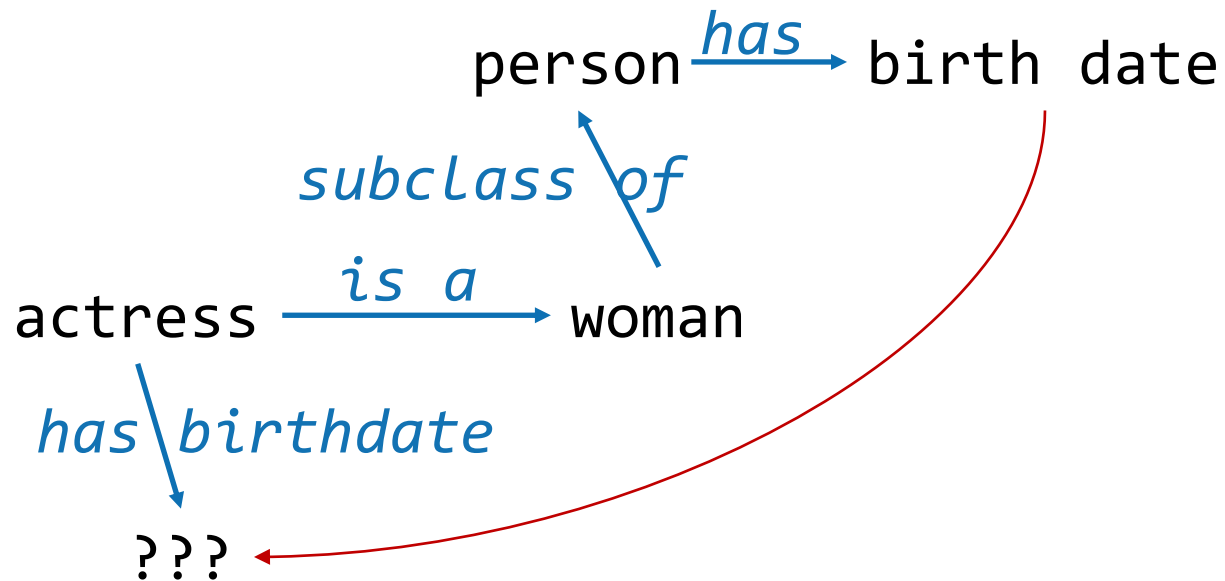
3

Outlook

# Knowledge Graph (trivial definition)



- Term was made popular by Google  
„Introducing the Knowledge Graph: things, not strings”
- Trivial definition: Ontology + Instances



+

Hedy Lamarr  
Romy Schneider  
Christiane Hörbiger  
Paula Wessely

[https://en.wikipedia.org/wiki/Category:Actresses\\_from\\_Vienna](https://en.wikipedia.org/wiki/Category:Actresses_from_Vienna)

# A scientific definition (Paulheim 2016)



## A knowledge graph

- mainly describes real world entities and their interrelations, organized in a graph,
- defines possible classes and relations of entities in a schema,
- allows for potentially interrelating arbitrary entities,
- covers various topical domains.

## in MediaWiki

- real world entities = wiki pages
- classes = categories and **relations of entities = properties**,
- interrelating entities = linking
- wiki topic

# Database vs. Knowledge Model vs. Language Model

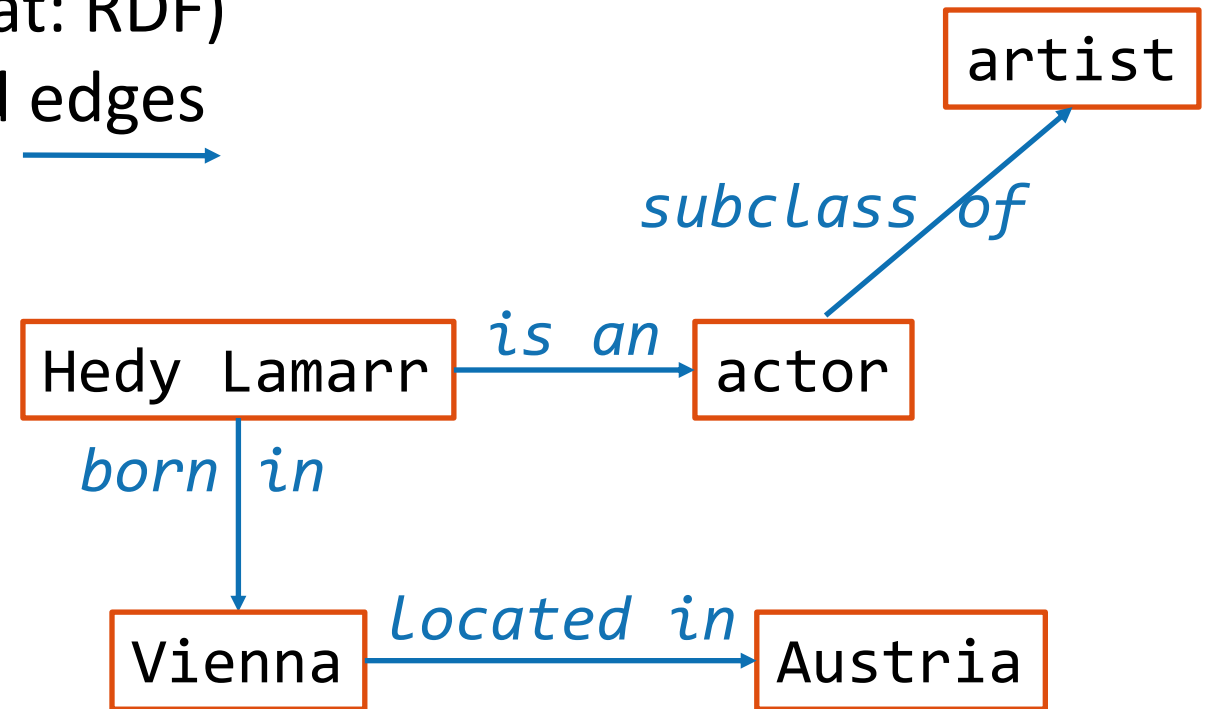


- Every KG is a kind knowledge base - a database of facts
- Regular databases connect entities with weak semantic relationships emulated by primary and foreign keys
- In KGs, relationships can be used to query and traverse links for knowledge discovery.
- Unlike ontologies, KGs often contain large volumes of factual information with less formal semantics (which is key on ontologies)
- A knowledge base (KB) is fact-oriented but ontology is schema-oriented.
  
- Large Language Models are quite similar regarding their graph structure (vector databases)
- They use statistical probabilities rather than semantics
- The combination is the future!

# The power of Knowledge Graphs



- A knowledge graph represents knowledge in form of triples: subject – predicate – object (format: RDF)  
This forms a network of **nodes** and edges



- Query for Austrian artists can retrieve Hedy Lamarr even when this is not tagged on her page!

# Options

In MediaWiki:

- only Namespaces
- Subpages
- Categories (& subcategories)

Wikidata, DBPedia

## Manual:Managing data in MediaWiki

Manual Discussion

Read Edit View history Tools

Translate this page

Languages: Bahasa Indonesia Deutsch Dusun Bundu-liwan English Nederlands français italiano polski portuguese čeština русский українська 中文 日本語

MediaWiki was designed to manage mostly textual information and it does this very well. However, the only way of structuring content is by Namespaces, Subpages or Categories.

If you want to manage structured data in MediaWiki, e.g. a date or a number, several different approaches exist, handled by dedicated extensions.



The extensions in the following table stores data in MediaWiki database which may be queried by users. See below for extensions using external data or storing data without query feature.

The differences and similarities of the most common ones are shown in the following table:

Feature	 Semantic MediaWiki	 Wikibase	 Cargo	VisualData
Main usecase	Managing data within a MediaWiki installation, based on Semantic Web standards.	Powering Wikidata.	Managing data within a MediaWiki installation.	Managing data within a MediaWiki installation based on JSON-schema.
Approach	Data (properties) are annotated within regular wikitext or by templates. With the datatype "reference", properties can be used to describe items using statements. <sup>[1]</sup>	Properties are defined and used to describe Items using statements.	Data is stored in database tables, with each table corresponding to a template.	Data are stored in a dedicated slot with JSON content model



# Knowledge Graph?



Storage of data	MW database, ElasticSearch, TripleStores (incl. Blazegraph)	MW database, Blazegraph	MW database	MW database
Properties	flexible	defined before usage, unchangeable	no properties, but table fields	defined through JSON-schema
Queries	parser function, API, TripleStore (SPARQL)	API, TripeStore (SPARQL)	parser function, API	parser function, API
Linking Data	RDF, importing ontologies	RDF, reusing Wikidata ontology	-	-
Knowledge Graph	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> would need RDF or JSON-LD	<input checked="" type="checkbox"/> would need RDF or JSON-LD

# Semantic MediaWiki or Wikibase?

[https://www.mediawiki.org/wiki/Manual:Managing\\_data\\_in\\_MediaWiki](https://www.mediawiki.org/wiki/Manual:Managing_data_in_MediaWiki)



Semantic MediaWiki	Wikibase
flexible data model	data model of Wikidata
properties can be pre-defined or declared by annotating	properties need to be pre-defined
properties (and datatypes) can be changed any time	properties cannot be changed!
requires extensions for form-based input	comes with a fixed, built-in edit interface
SPARQL only with external triplestore	
internal query language (easier than SPARQL)	no built-in querying of data

# What is Semantic MediaWiki (SMW)?



WIKIPEDIA  
The Free Encyclopedia

- open source project:
  - [www.semantic-mediawiki.org](http://www.semantic-mediawiki.org)
  - <https://github.com/SemanticMediaWiki>
- the „swiss army knife“ for data and semantics
- built on the MediaWiki ecosystem:  
the wiki engine that powers Wikipedia

can be used for much more than just wikis...

# Building your Knowledge Base



- page Vienna can have properties
  - number of inhabitants, located in, coordinates, WikidataID, ...
- properties can have various data types
  - page, text, number, date, URL, ...
  - external identifier links to external resources
- re-use external vocabularies
  - “Coordinates” imported from schema:geo
- a page should be put into a category
  - Also category pages should re-use vocabularies:  
**{{#set:Imported from=schema:City}}**

## Vienna

Capital of Austria

### INFO

<b>Country</b>	<a href="#">Austria</a>
<b>Size</b>	414.78 km <sup>2</sup>
<b>Population</b>	1897000
<b>Coordinates</b>	48° 12' 0.00" N, 16° 22' 0.00" E
<b>Wikidata</b>	<a href="#">Q1741</a>
<b>Rank</b>	1

# Using External Vocabularies



## Editing MediaWiki:Smw import schema

**Warning:** You are editing a page that is used to provide interface text for the interface for other users on this wiki.

```

B I    > Advanced > Special characters > Help
https://schema.org/ | [https://schema.org/docs/full.html Schema.org]
Person|Category
Project|Category
geo|Type:Geographic coordinates
location|Type:Text
streetAddress|Type:Text
addressCountry|Type:Text
familyName|Type:Text
description|Type:Monolingual text

```

1. Add/edit a page

### MediaWiki:Smw import schema

Add (or remove) vocabulary terms any time...



2. Instead of local datatype declarations, use `{{#set:Imported from=schema:geo}}` on the property page (e. g. **Property:Coordinates**) instead of `{{#set:Has type=Geographic coordinates}}`

# Linking to external identifiers



- Define a property
- Assign datatype „External identifier“
  - Links to external ids

```
{{#set:Has type=External identifier  
|External formatter uri=  
http://www.wikidata.org/entity/$1}}
```

- Look for other identifiers
  - ORCID <https://orcid.org/>
  - GND
  - .....

Even better, use Schema.org:

```
{{#set:Imported from::schema:sameAs}}
```

## Property:WikidataID

- Type: [External identifier](#)
- URI: [http://www.wikidata.org/entity/\\$1](http://www.wikidata.org/entity/$1)
- *Has preferred property label*
- *Has property description*
  - Wikidata ID (en)
  - ID von Wikidata (de)

Usage 252

previous 20 20 50 100 250 500 next 20

Showing 20 pages using this property.

	Pope Paul III +	Q133001 +
A	Joseph Addison +	Q206384 +
	Michael Gottlieb Agnethler +	Q830730 +
	Georgius Agricola +	Q76570 +



## Outline

Highlights

Abstract

Keywords

1. Introduction

2. Background and related work

3. Building a knowledge graph

4. Analysis

5. Discussion

6. Conclusions and future work

CRediT authorship contribution statement

Declaration of Competing Interest

Acknowledgments

Data availability

References

Show full outline

Cited by (3)

Figures (17)



Journal of Web Semantics

Volume 76, April 2023, 100771



## Building a Knowledge Graph for the History of Vienna with Semantic MediaWiki

Bernhard Krabina

Show more

+ Add to Mendeley Share Cite

<https://doi.org/10.1016/j.websem.2022.100771>

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### Highlights

- Semantic MediaWiki (SMW) is a tool for setting up and maintaining knowledge bases.
- The Vienna History Wiki is a large publicly available knowledge base.
- It is operated by a government institution in collaboration with citizens.
- Unique identifiers have been established and exchanged with Wikidata.
- Schema.org vocabulary was used to improve the RDF representation.
- A user survey, access statistics and a knowledge graph analysis are provided.

Part of special issue

Community-based Knowledge Bases and Knowledge Graphs

Edited by Tim Finin, Sebastian Hellmann, David Martin, Elena Simperl

View special issue

Recommended articles

Answering Count Questions with Structured Answers from Text

Journal of Web Semantics, Volume 76, 2023, Article 10...  
Shrestha Ghosh, ..., Gerhard Weikum

Semantic Web of Musical Things: Achieving interoperability in the Internet of Musical...

Journal of Web Semantics, Volume 75, 2023, Article 10...  
Luca Turchet, Francesco Antoniazzi

A parametric similarity method: Comparative experiments based on...

Journal of Web Semantics, Volume 76, 2023, Article 10...  
Antonio De Nicola, ..., Francesco Tagliano

Show 3 more articles

Article Metrics

Citations

FEEDBACK

# Agenda



What is a Knowledge Graph?



KnowledgeGraph Extension



Outlook



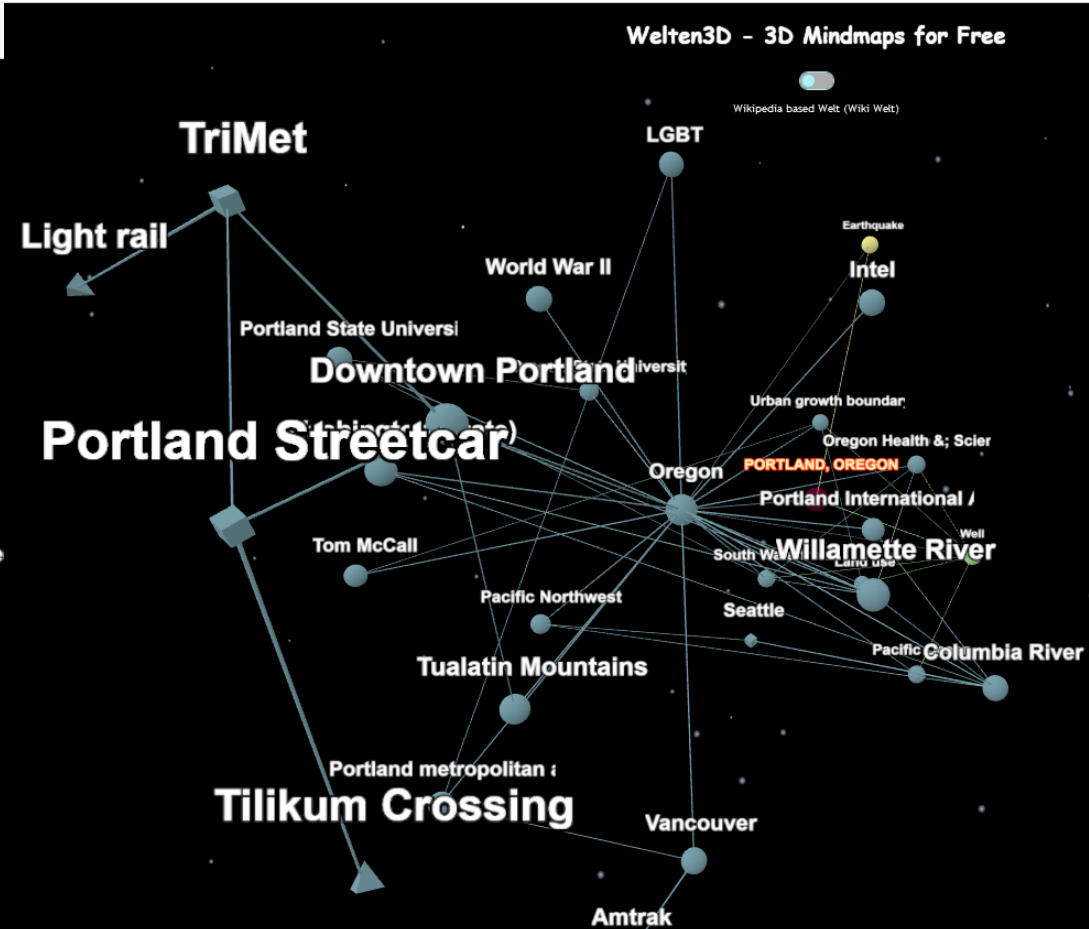
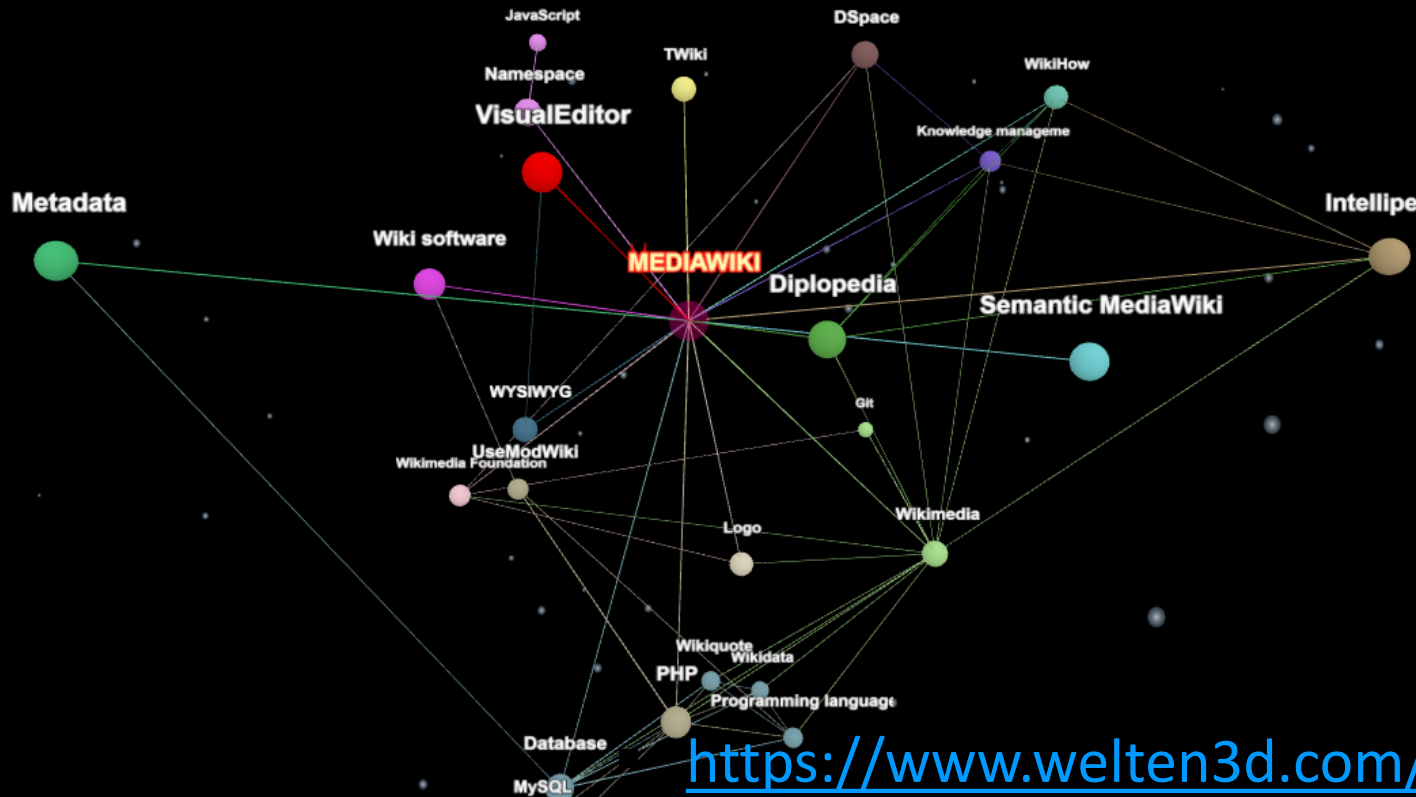
# Visualize a Knowledge Graph



https://www.welten3d.com/hlindex.html?key=qwiweMediaWiki

Welten3D - 3D Mindmaps for Free

Wikipedia based Welt (Wiki Welt)



<https://www.welten3d.com/hlindex.html?key=qwiweMediaWiki>

# Extension: SemanticGraph

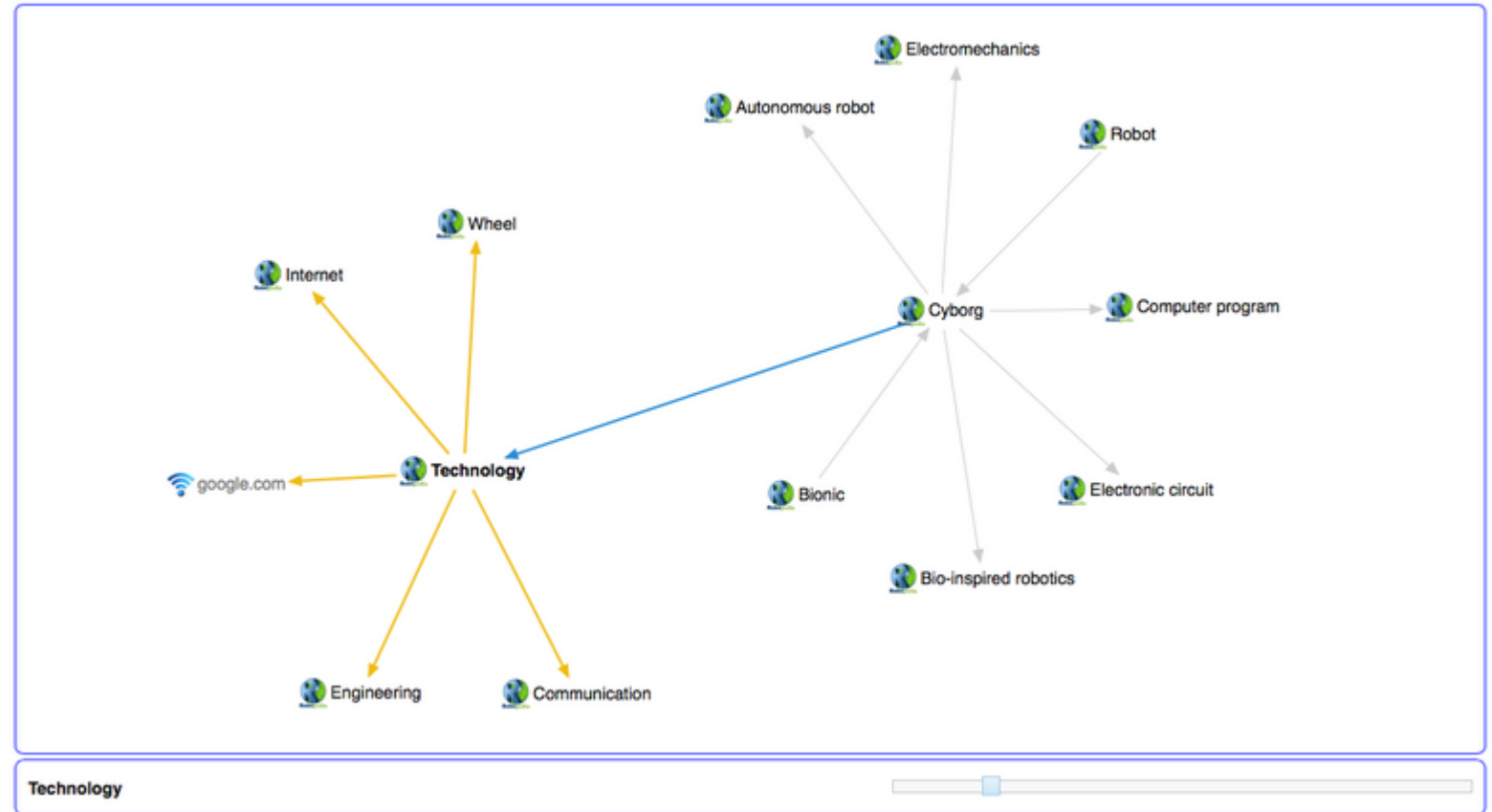


- unmaintained since 2011
- requires SMW

# Extension: VIKI



- unmaintained since 2017
- requires SMW
- can use Titleicons



# Extension: SemanticMediaWikiGraph



## Semantic MediaWiki Graph

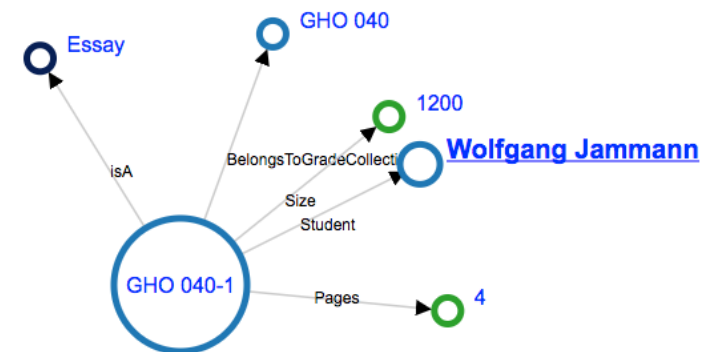
- unmaintained since 2017
- requires SMW
- special page, no parser function

Wiki Article\*

Submit

### Color Keys for Data Types...

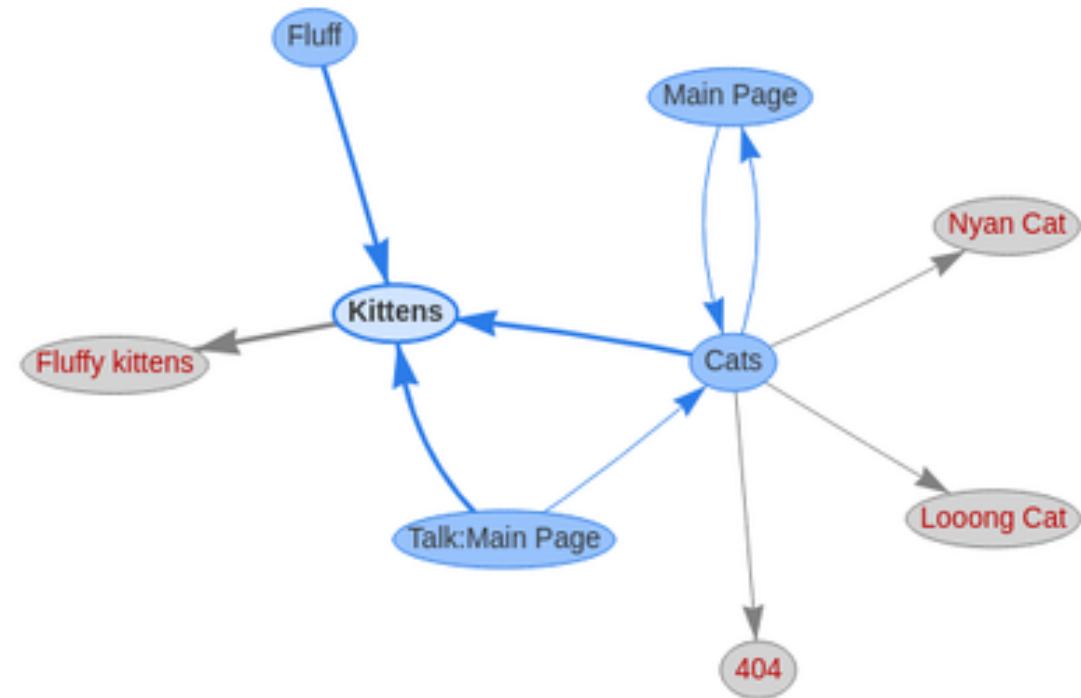
- Category
- Internal Link
- Number
- Text



# Extension:Network



- maintained!
- not semantic
- shows links between pages

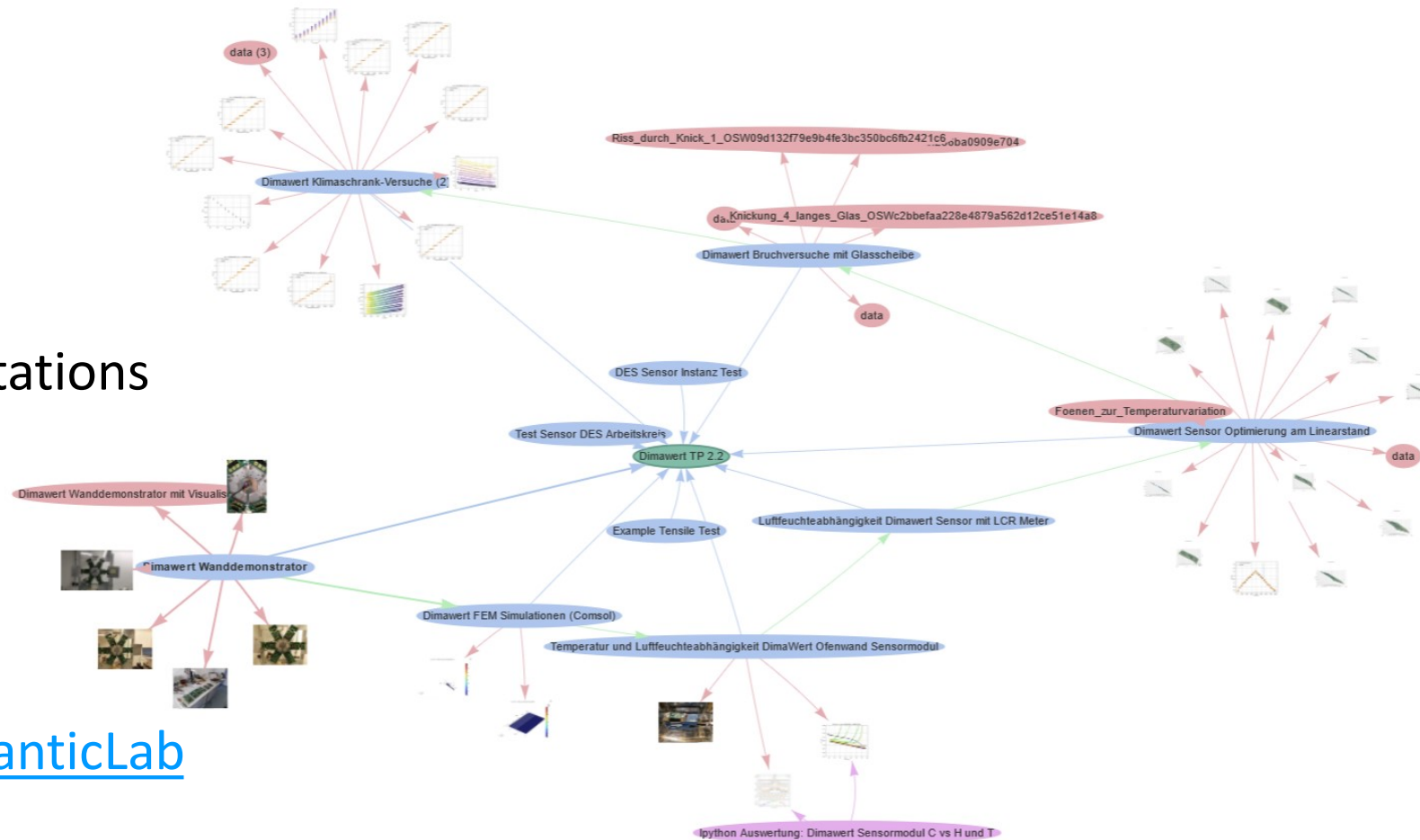


<https://www.mediawiki.org/wiki/Special:MyLanguage/Extension:Network>

# Extension: Interactive Semantic Graph



- experimental
- no ready-to use extension
- requires SMW
- part of „OpenSemanticLab“
- check out SMWCon presentations



<https://github.com/OpenSemanticLab>

# Extension: KnowledgeGraph



- maintained
- requires SMW
- special page and parser function
- highly configurable
- created by Thomas (Topway IT) for KM-A
- inspired by InteractiveSemanticGraph (and others), thank you, Simon!
- <https://www.mediawiki.org/w/index.php?title=Extension:KnowledgeGraph>

# Special: KnowledgeGraphDesigner



https://test.knowledge.wiki/Spezial:KnowledgeGraphDesigner

Test

Search Test

Admin

THIS IS ONLY A TESTWIKI! LH, MW 1.39.5, PHP 8, SMW 4.1.2

## KnowledgeGraph Designer

Help

More

Info

Wien Geschichte Wiki

- Main page
- Themenschwerpunkte
- Recherche
- Random page
- Über das Projekt
- English Information

Switch to old look

Inhalte

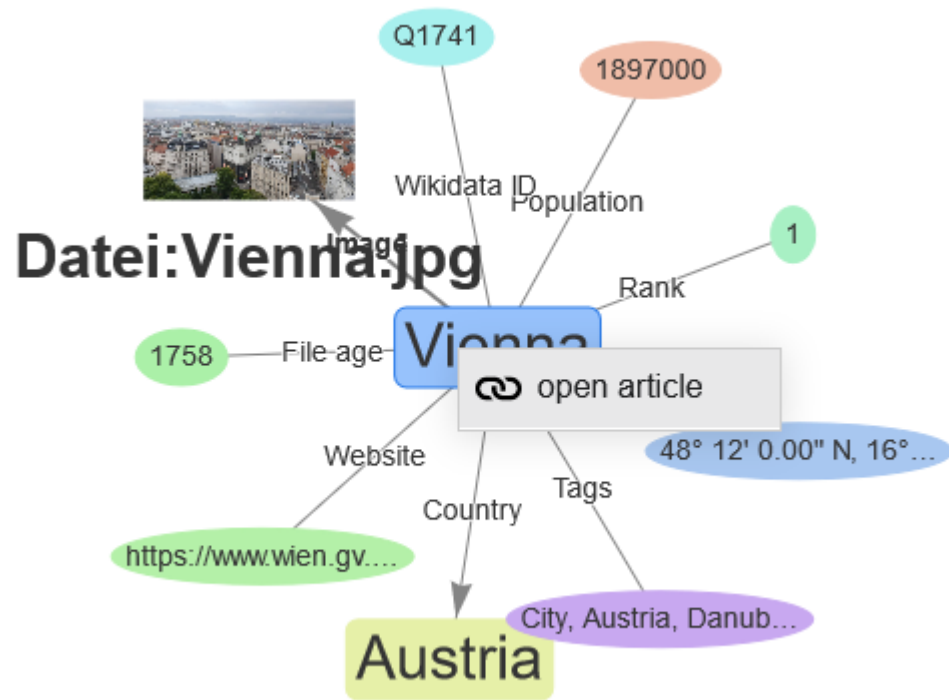
- Personen
- Topografische Objekte
- Bauwerke
- Organisationen
- Ereignisse
- Erinnern
- Karten
- Begriffe
- Sonstiges

Mitmachen

- Leitfaden
- Beiträge verbessern
- Beitrag erstellen
- Zitierregeln

Tools

- Upload file
- Special pages
- Printable version
- KnowledgeGraph Designer





# Special: KnowledgeGraphDesigner



https://test.knowledge.wiki/Spezial:KnowledgeGraphD

+ add node    ⚙ toggle config    ↻ reset    👁 export graph

Test

Search Test

Wien Geschichte Wiki

- Main page
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- Über das Projekt
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Switch to old look

Inhalte

- Personen
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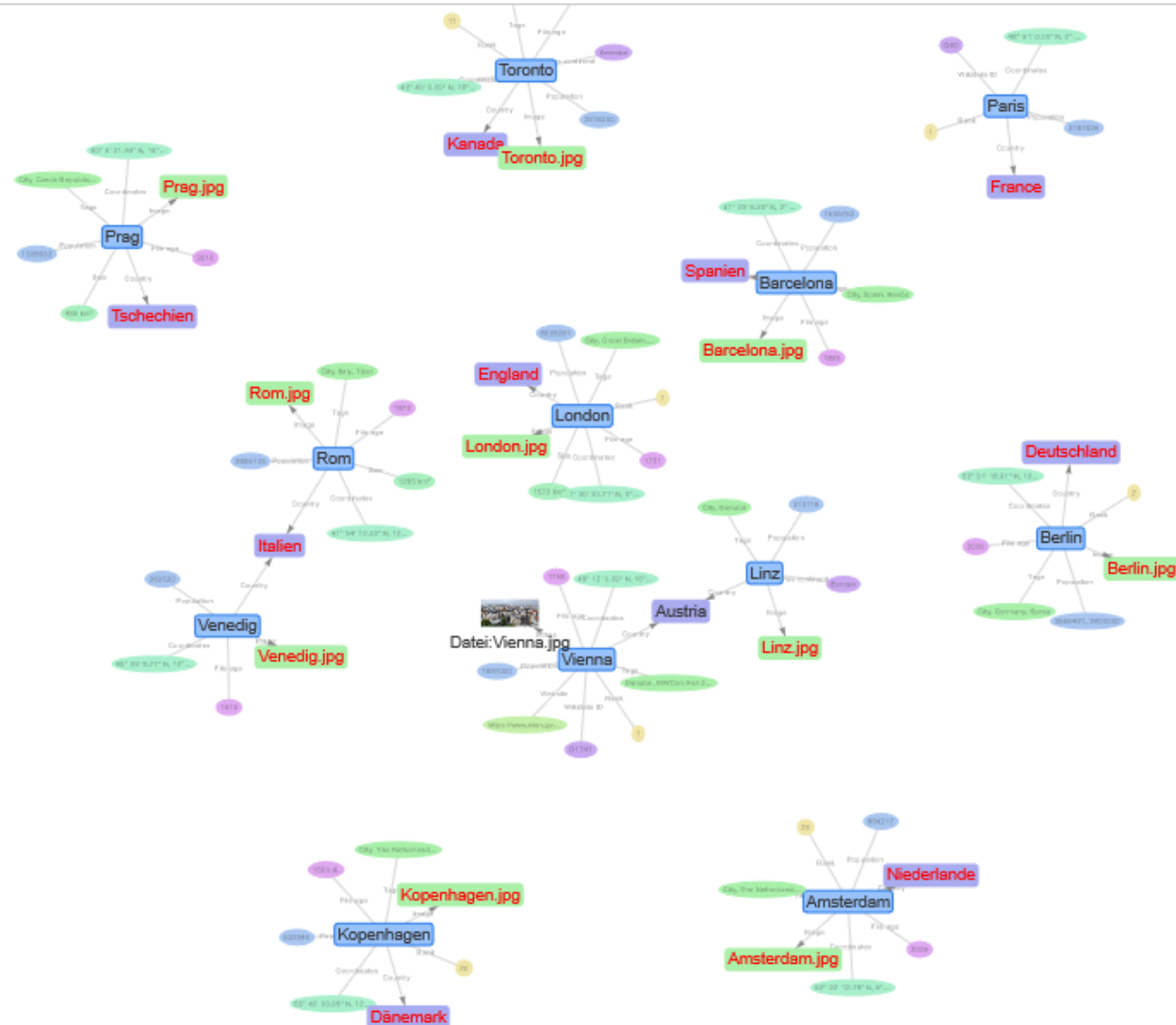
Tools

- Upload file
- Special pages
- Printable version
- KnowledgeGraph Designer

## Knowledge

+ add nod

add

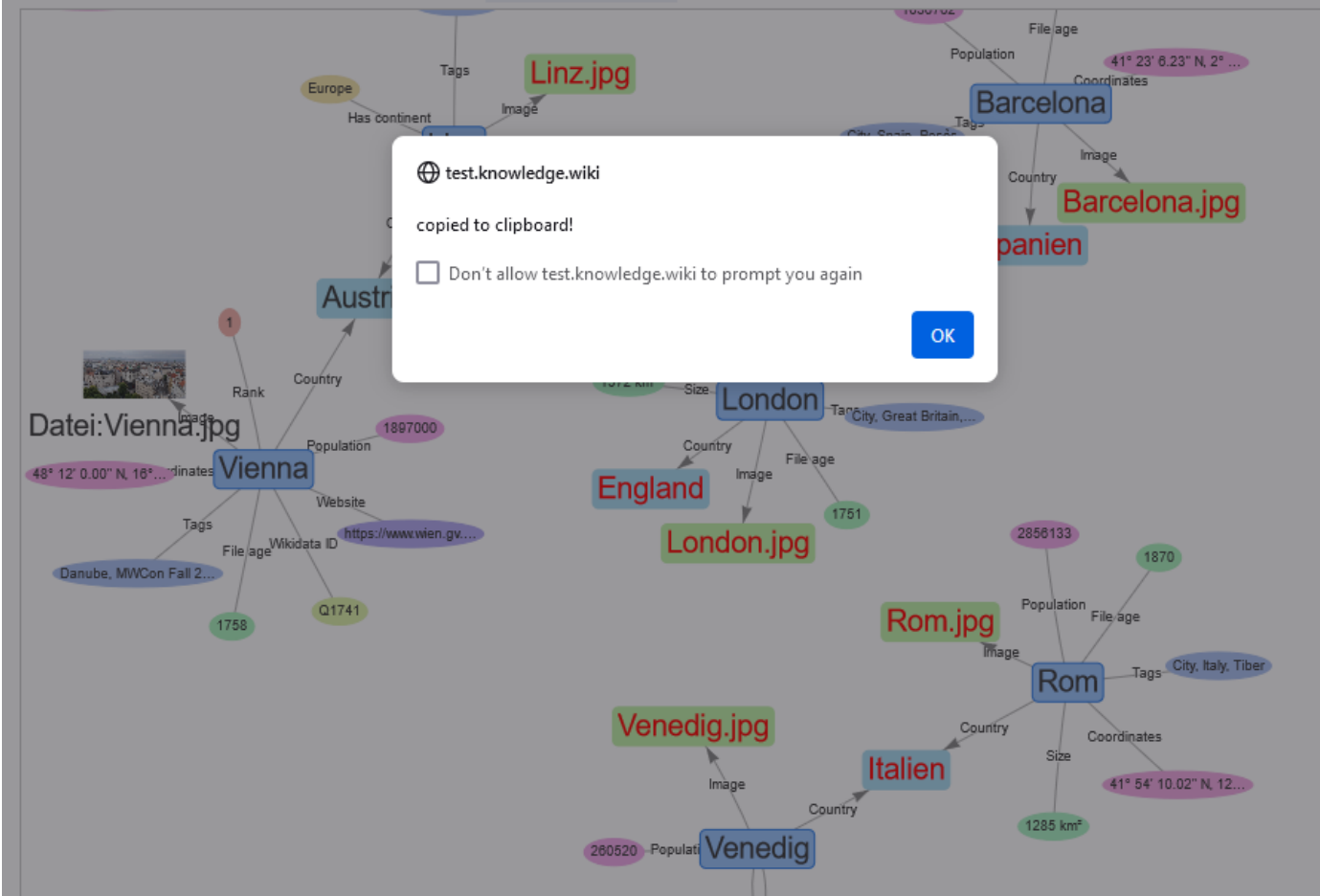


# Special: Knowledge Graph Designer



KnowledgeGraph Designer Help

+ add node toggle config reset export graph



```
{#knowledgegraph:nodes=Rom, Vienna, Austria, Datei:Vienna.jpg, Barcelona, Berlin, Kopenhagen, London, Prag, Toronto, Venedig, Amsterdam, Paris, Linz | properties=Coordinates, Country, File age, Image, Population, Schlagworte, Size, Rank, Website, Wikidata ID, Has continent | depth=0 | graph-options= | property-options?Coordinates= | property-options?Country= | property-options?File age= | property-options?Image= | property-options?Population= | property-options?Schlagworte= | property-options?Size= | property-options?Rank= | property-options?Website= | property-options?Wikidata ID= | property-options?Has continent= | show-property-type=true | width=400px | height=400px | properties-panel=false | categories-panel=false}}
```

# {{#knowledgegraph:}}



```
{{#knowledgegraph:
|nodes= Fdfd, Test d
|properties=A,B, Prop a, Prop_b
|depth=0
|show-property-type=false
|graph-options=MediaWiki:KnowledgeGraphOptions
|property-options?Organization logo=KnowledgeGraphOptionsImage
|width=100%
|height=400px
|properties-panel=true
}}
```

## Configuration parameters [\[ edit \]](#)

variable	description	default
<code>nodes</code>	articles to be shown on the graph	false
<code>properties</code>	limit to the specified set of properties	false
<code>depth</code>	maximum depth when a property is a page	false
<code>show-property-type</code>	show property type besides the property names	false
<code>graph-options</code>	configuration options for the entire graph (see next section)	false
<code>property-options?[property label]</code>	configuration options for a specific property or node (see next section)	false
<code>width</code>	set width of the graph	400px
<code>height</code>	set height of the graph	400px
<code>properties-panel</code>	show/hide properties panel	false

# Agenda



1

What is a Knowledge Graph?

2

KnowledgeGraph Extension

3

Outlook

# Interested? Want to try it on Friday?



Write me:

- [bernhard.krabina@km-a.net](mailto:bernhard.krabina@km-a.net) or
- [https://www.mediawiki.org/wiki/User\\_talk:Krabina](https://www.mediawiki.org/wiki/User_talk:Krabina)

Help us with testing, documentation, i18n, programming

Release of the extension?

- [https://www.mediawiki.org/wiki/Wikimedia\\_Hackathon\\_2024](https://www.mediawiki.org/wiki/Wikimedia_Hackathon_2024)
- #MWCon Fall 2024



**WIKIMEDIA**  
HACKATHON

3 – 5 May 2024 | Tallinn, Estonia



## Bernhard Krabina

- Knowledge Management
- Wiki consulting, Semantic MediaWiki
- Open Government, Open Data

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