Understanding Relevance in Maps through the use of Knowledge Graphs

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Abstract

The relation that the ontological and spatial dimensions have is not always evident. To better understand this relation, a tool called *SeMaptics* that connects the two domains was developed.

Ontological mapping allows for discrete ontologies to be projected into the spatial field. Such ontologies are regularly seen in a continuous or overlapping layered format in the spatial dimension. However, integrating both spaces results in a novel method, which adds additional perspectives when designing a map.

Relevance

The basic inner and outer human cognitive notion in constant use when we have a present matter.

Relevance is an action to **access, filter, infer rank, accept, reject and classify** information. [1]

Geographical relevance: all entities in a geographic space have a quality attribute. The quality is the relation between the **representation** of such an **entity** and the use **context**. [2]

Geographical relevance criteria:

Depth, scope, specificity, availability and sources of information, effectiveness, accuracy, validity, clarity, currency, tangibility, reliability, quality of sources, accessibility, novelty, curiosity, familiarity, variety and verification. [2][3][4]
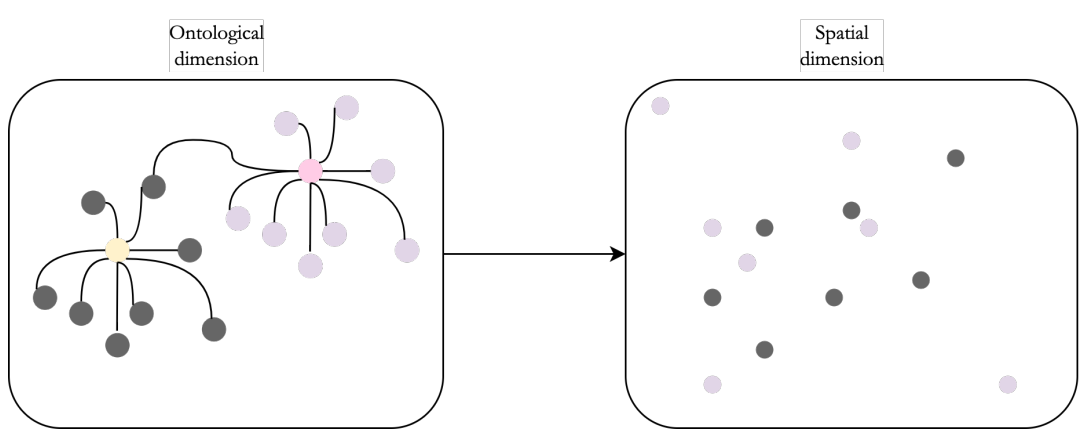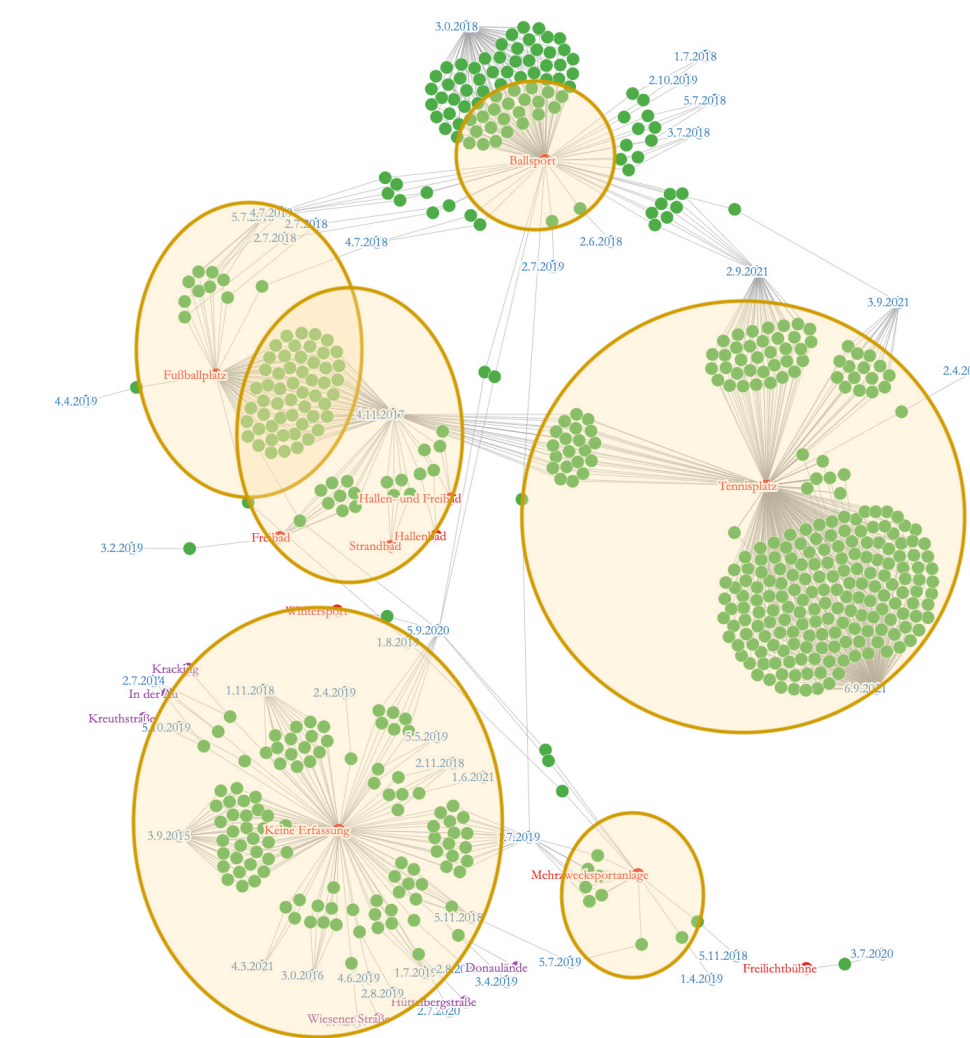

Fig.1) Ontological and Spatial Dimension mapped

Fig.2) Ontological groups

Fig.3) *SeMaptics*

Knowlede Graphs & Knowledge Networks

Ontologies are the description of concepts and relations using deterministic structures. The construction of a determined semantic space is known as a domain. [5]

Statements in context can be expressed in the form of a triplets (h,r,t), the head entity (i.e., subject), the relation (i.e., predicate), and the tail entity(i.e., object). **SPO model** [5]

Research Questions

Does a **browser-based** map tool, which contains a **linked ontological** and **spatial dimension**, enables **geographical relevance criteria to be identified** within in the ontological and spatial dimension? (Fig.1)

Which criteria from geographical relevance can be asserted from such a web-tool?

Methodology

SeMaptics design follows the 4 main steps of graph visualization. [6]

1. Data retrieval
2. Building
3. Calculations
4. Layout and rendering

Data Background

A digital landscape model from the Austrian Federal Office of Metrology and Surveying (**BEV**) was chosen. Containing points of interest of municipal, cultural, and recreational nature in Austria.

SeMaptics Architecture
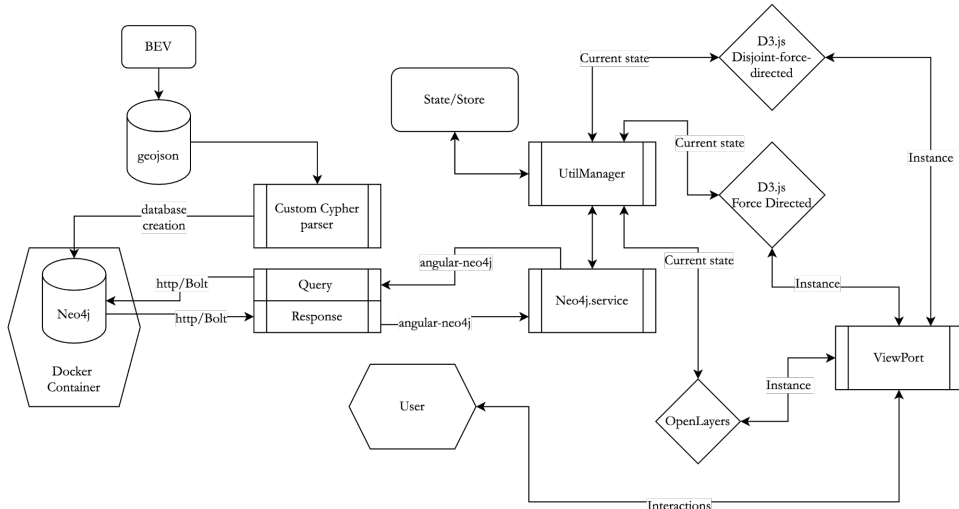
Results

A knowledge graph of 563 nodes that contains 528 **feature nodes**, 10 **categorical nodes** and 25 **date of service nodes** and 4 street name nodes.(Fig.2 & Fig.3)

SeMaptics supports **interactions**, a **flexible layout** and map projection changes. (Fig.3, Fig.4, & Fig.5)
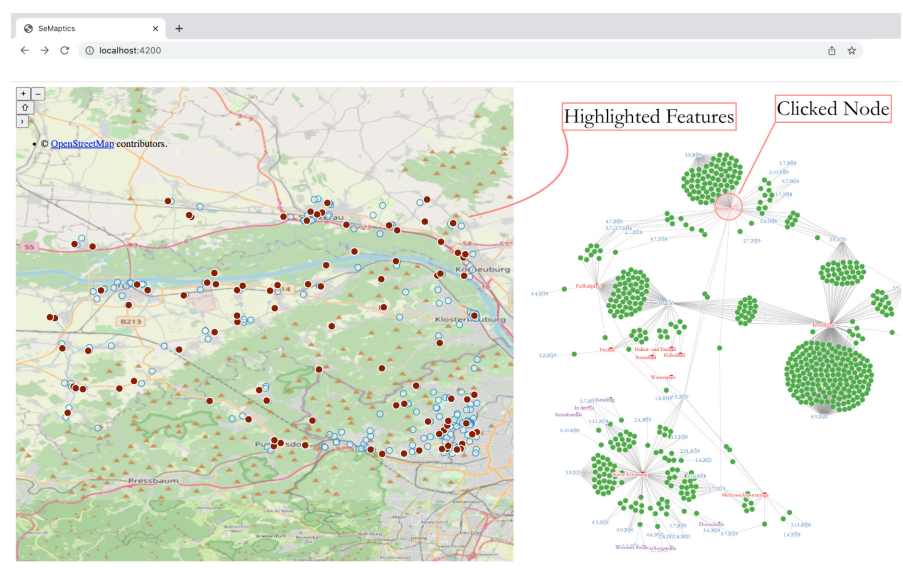

Fig.4) SeMaptics Interaction description

Conclusion & Discussion

Important characteristics such as i)**ontology definition** ii)**data harmonization**, iii)**query language selection**, iv)**graph visualization selection**, and v)**interaction design** play a role in how a user interacts and perceives the presented semantics.

The connection of both dimensions **reveals hidden patterns** and allows for efficient semantic reads. Several criteria from **geographical relevance** are met such as *depth, specificity, availability, accuracy, tangibility, accessibility, dynamism, curiosity, spatial proximity, visibility, cluster and co-location.* (Fig.2 & Fig.3)

Keywords

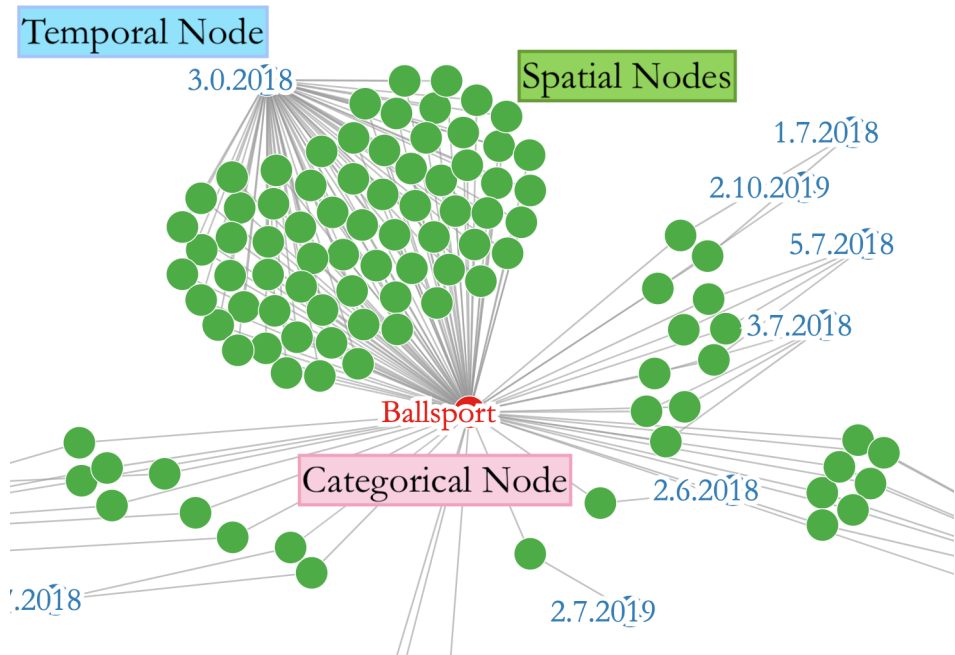knowledge graphs, geographical relevance, knowledge networks

Fig.5) SeMaptics node types

References

[1] Tefko Saracevic. Relevance reconsidered. pages 201–218. *School of Communication, Information and Library Science*, 10 1996.

[2] Tumasch Reichenbacher and Stefano De Sabbata. Geographic relevance , *Geographic Information Retrieval*, 3, 01 2011.

[3] Stefano de Sabbata and Tumasch Reichenbacher. Criteria of geographic relevance: An experimental study. International *Journal of Geographical Information Science*, 26:1495–1520, 8 2012.

[4] Carol L Barry I and Linda Schamber. Users' criteria for relevance evaluation: A cross-situational comparison. *Information Processing and Management*, 34:219–236, 1998.

[5] Gengchen Mai, Weiming Huang, Ling Cai, Rui Zhu, and Ni Lao. Narrative cartography with knowledge graphs. *Journal of Geovisualization and Spatial Analysis*, 6, 6 2022.

[6]Juan Gómez-Romero, Miguel Molina-Solana, Axel Oehmichen, and Yike Guo. Visualizing large knowledge graphs: A performance analysis. *Future Generation Computer Systems*, 89:224–238, 12 2018.