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Editorial

Special Issue of the Journal of Web Semantics on Geospatial Semantics

Geospatial reasoning has grown larger scope in the semantic web. Increasingly more information is geolocated, more mobile devices produce geocoded records, and more web mashups are created to convey geospatial information. Semantics can support the integration of geospatial information, track the provenance and quality of the data shown to an end user, and improve visualizations and querying of geospatial data. This special issue highlights recent trends in research and practice in geospatial semantics.

The availability of geospatial data in semantic web formats is constantly increasing. Examples include geonames.org, with geographical information of all countries in many languages, linkedgeodata.org, which offers OpenStreetMap data in RDF queried through SPARQL, data.ordnancesurvey.co.uk, which publishes all kinds of products from the UK's mapping agency, and geo.linkeddata.es, which contains data from Spain in RDF.

A diversity of standards have emerged in this area, including GeoSPARQL, GeoJSON, GML, and KML to name a few, in addition to other popular ISO standards that are used in Geographic Information Systems (GIS). Their merits and level of adoption vary, as the community puts them to the test in a wide range of application types and scales.

The research community in this area is very diverse and well beyond semantic web researchers. Within computer science, it includes researchers in spatio-temporal databases, computational geometry, machine learning, and crowdsourcing of spatial information. Beyond computer science, it includes geographers, cartographers, and social scientists. There is strong interest in the commercial world and from governments, as well as in scientific research and social applications of geospatial data. This paints a very heterogeneous landscape of requirements and priorities, all centered around space and, inevitably, time.

This special issue includes four papers with contributions in both research and practice in the area of geospatial semantics.

Harbelot, Arenas, and Cruz present a model to track the evolution of geospatial entities over time, and apply it to track changes in land use and land cover in a region. They introduce the LC3 model, which uses GeoSPARQL and a model of time based on Allen's classic temporal calculus. Here, semantic web technologies enable the system to reason about the geospatial information for two purposes. One purpose is to check the consistency of the observations and validate the geospatial information coming into the system. A second purpose is to make inferences to generate new knowledge from those observations. Their approach is used with satellite images of the European landscape, and identify for example when an area evolves from a coniferous forest to become urban fabric and eventually industrial units. A taxonomy of land use and land cover types enables the detection of temporal patterns from the data. This enables policy makers to understand the impacts of constructing a highway or an industrial complex. One of the open research challenges is handling negligible changes and uncertainty.

Keßler and Farmer build on Hägerstrand's time geography framework, developed by to analyze human activities that span time and space. In particular, they take the idea of space–time paths (an individual's location change over time) and space–time prisms (an individual's potential path area over time) to capture how individual constraints (home and work locations or speed of travel) affect the extent of those prisms. They create an ontology design pattern to describe a space–time prism, using Hobbs and Pan's Time Ontology and Janowicz's Points of Interest ontology design pattern. They use semantics to answer queries that require making inferences about the spatio-temporal dimensions of prisms. They use this approach in two different applications. One is gathering data from cars, such as fuel consumption and CO_2 emissions, to generate environmental information. Looking at the space–time prisms of increased emissions, the small ones indicate spatial effects, where emissions may be due to steep terrain, and larger ones indicate other effects such as speeding or driving style. The second application uses cultural heritage data, in particular to identify photos about a specific historical event and how the effects spread from a specific location to a geographic area of a certain diameter. A promising area of future work is extending this framework with other concepts from time geography.

Nikolau, Dogani, Bereta, Garbis, Karpathiotakis, Kyzirakos, and Koubarakis present an approach to visualize the evolution of spatial information in linked data. Their implemented system, called Sextant, generates such visualizations and allows collaborative editing to enrich the information and create special-purpose maps. Sextant incorporates several standards and translators, so spatial information can be specified in KML or GeoJSON, and temporal information can be specified in several formats. It includes a map ontology that is used to describe map products that are integrated and queryable under the framework. Sextant includes a variety of mapping products and geospatial datasets, which are available as linked data, and has been used in a variety of scenarios, including emergency response and monitoring of environmental data.

Patroumpas, Georgomanolis, Stratiotis, Alexakis, and Athanasiou take the INSPIRE directive in the European Union to make geospatial data available in a common format, and proposes an approach to make INSPIRE data available in semantic web format. The approach is to extend existing INSPIRE infrastructure to expose data as linked data and support queries through GeoSPARQL. The paper describes best practices for mapping metadata and data

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to RDF and for assigning unique identifiers, and discusses performance and scalability issues in this enterprise.

Several recent workshops have emphasized the key role of semantics in the geospatial arena. Of particular note are workshops organized by the World Wide Web Consortium (W3C) and the Open Geospatial Consortium (OGC) focused on standardization efforts in geospatial semantics, leading to a joint W3C/OGC Working Group to identify best practices and establish standards where desirable. This would propel this research area by making more open geospatial data available in common formats, enabling easily reusable geospatial infrastructure and tools, and motivating new approaches to geospatial data integration and exploitation.

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