

# Chapter 39

## LinkedVis an Information Visualisation Toolkit for RDF Data

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### ABSTRACT

*LinkedVis implements a JavaScript and SVG data visualisation toolkit that can be used to generate a wide range of interactive information visualisations from RDF graphs using a grammar of graphics style syntax extended with operations for structural transformation of the RDF data graph. Additionally, LinkedVis visualisations make it possible to embed meta-data about the visualisation and the way different graphic components from the visualisation are related to the original RDF data. Insertion of meta-data transforms the visualisation into a self-describing piece of information that can be processed by an automatic agent to perform different tasks, like extracting data associated to a visual component, following the associated linked URIs or translate the visualisation to an entirely different underlying graphics system other than SVG.*

### INTRODUCTION

Transforming raw data into a graphical representation of that data suitable for being presented to final users is an important task when building applications consuming RDF data. These graphical representations can range from simple data charts to complex interactive visualisations. In order to build these data representations, raw RDF data must be pre-processed to extract the

subset of information that will be rendered with the help of a graphics library or visualisation toolkit. Preparing RDF to be processed can be a complex process. The graph structure of the RDF data must be transformed into a more convenient data structure for the underlying graphical library and values must be transformed into the measurement units of the display system.

LinkedVis <sup>1</sup> tries to make the process of building interactive and expressive data visualisations

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from RDF graphs easier. The library is not a replacement for general data visualisation toolkits like D3 or Protovis but tries to offer a better alternative for developers familiar with Semantic Web technologies and working with Linked Data. The library is built around a declarative model in the style of Wilkinson's "Grammar of Graphics" (Wilkinson, 2005) that has been extended to include syntactical extensions capable of extracting and transforming the underlying RDF graph into the data that will be visualised. The library transforms these operations into SPARQL (Prud'hommeaux, 2008) queries that will be used to select RDF resources that can be inserted into the proper data structure (list, tree, graph) using operators from the grammar, and finally bound to a graphical mark. The library is implemented using the JavaScript programming language and generates by default SVG documents. It can be used inside the browser to build interactive data visualisations or as utility library in a JavaScript platform like Node.js <sup>2</sup>.

The main contributions of this library can be summarised in the following points:

- Implements a "grammar of graphics" style visualisation toolkit for RDF data, providing an expressive yet effective way of describing declaratively visualisations for semantic data.
- Extends the grammar of graphics syntax with data transformation operations over the normalized data layer provided by RDF. Ad hoc transformations of the incoming data are no longer required before the visualisation can be encoded and rendered.
- Describes a generalised version of a *join* operation capable of linking RDF resources to high level visual marks instead of the usual join on data items in an arbitrary collection with DOM nodes used in *jQuery* <sup>3</sup> style libraries.
- Proposes the use of meta-information embedded into the visual representation link-

ing the semantic data to be visualised to the visual representation of that semantic data. In this way, visualisations become self-contained piece of information that can be interpreted by human users and automatically processed by software applications.

- Describes a way of transforming graph transformations in the declarative syntax into SPARQL queries to select and transform parts of the visualisation inside the browser in the same way CSS selectors can be used to select and transform DOM nodes in a document using a *jQuery* style library.

LinkedVis makes it possible to embed meta-data about the original data and the graphical representation of these data within the final visualisation document. RDF resources mapped to graphical marks and the RDF properties mapped to some dimension of these marks are stored in the final SVG output of the visualisation in a RDF graph called the "data-graph." Information about which marks and which visual properties are bound to which RDF resources and properties is stored in a different RDF graph called the "meta-graph." These RDF graphs use a small ontology that models the main graphical components generated by the graphics grammar to describe the visualisation components. The addition of this meta-data layer to the final visualisation output opens the door for the automatic processing of the visualisation by a software agent capable of dealing with the HTTP protocol, XML and RDF processing. The meta-graph, for example, can be used to reconstruct the visualisation using a different graphics system.

Visualisation meta-data is also used by the library to provide better tools for user interaction. A mechanism to select graphical components is included in the library. It can accept SPARQL queries to select graphical marks based on information in the meta-graph or data-graph. Transformations can then be applied in a declarative way to the selected components.

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