



INTERACTIVE DATA VISUALIZATION WITH TULIP 2010

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|| Tulip 2010 – version 3.4.0

Tulip is an information visualization framework dedicated to the analysis and visualization of relational data. Tulip aims to provide the developer with a complete library, supporting the design of interactive information visualization applications for relational data that can be tailored to the problems he or she is addressing.

Graph, Measure, Clustering

Views and Interaction

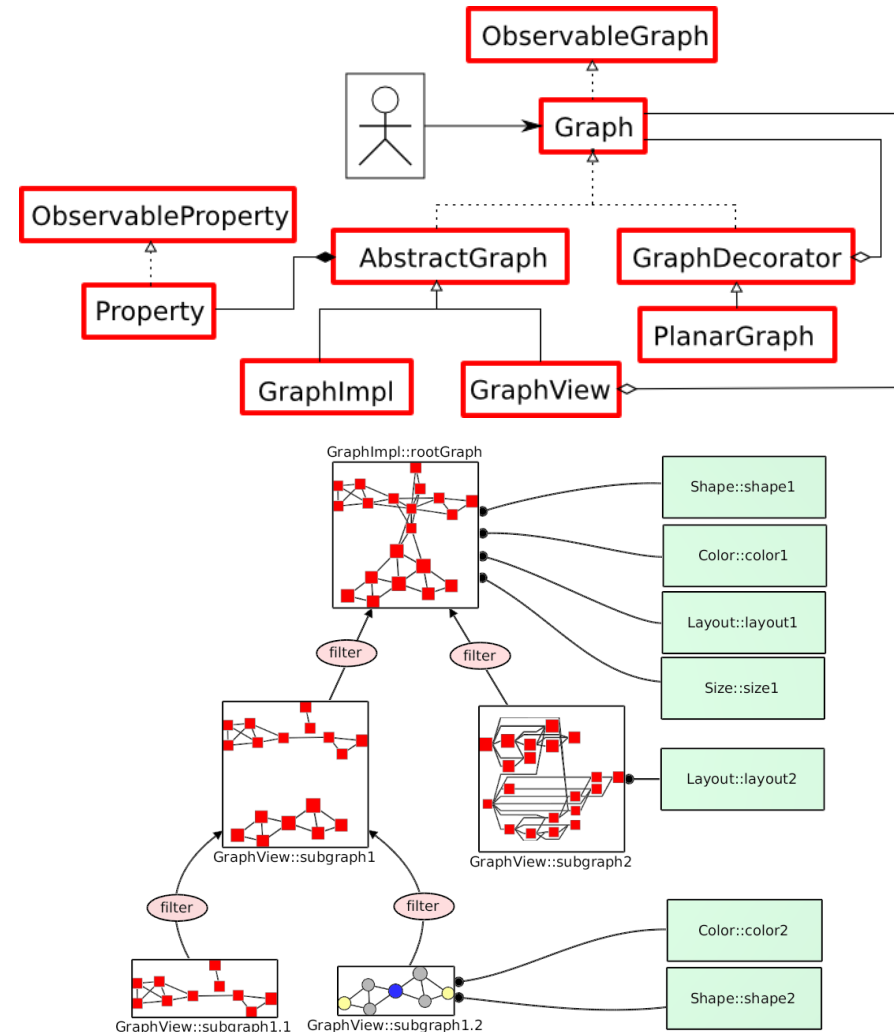
Middleware framework



GRAPH, MEASURE, LAYOUT AND CLUSTERING

Graph

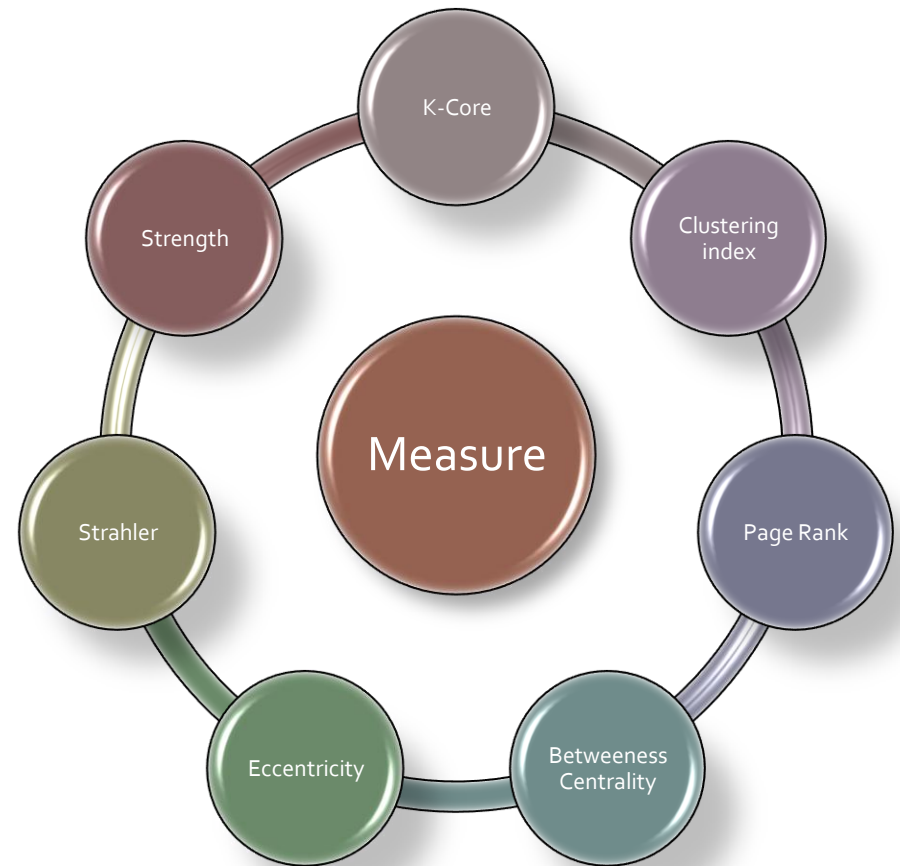
- Provide an efficient data structure for management Weighted Graphs, Weighted Maps and Hierarchical Weighted Graphs.
- To support exploration of huge datasets Tulip also managed multi level aggregation.
- The entire data structure is fine tuned to enable tracking of all modifications.
- Efficient management of data structure state to enable to reverse/redo all modification operations.



Measures

To enable graph analysis, Tulip provide a set of plug-ins for computing measure on elements. Well-known social network analysis measure are available as well as specific measure for trees, dag and component identification.

- Through the Tulip Measure plug-in technology one can easily add new measure.
- Tulip enable to store an unbounded number of computed or user define measure.





Layout – Graph Drawing

Tulip provides one of the largest set of Graph Drawing Algorithm. Including, hierarchical drawing, force directed layout, planar drawing, edge bundling and soon Euler diagram representation.

Organic :

- GEM, FM₃, GRIP

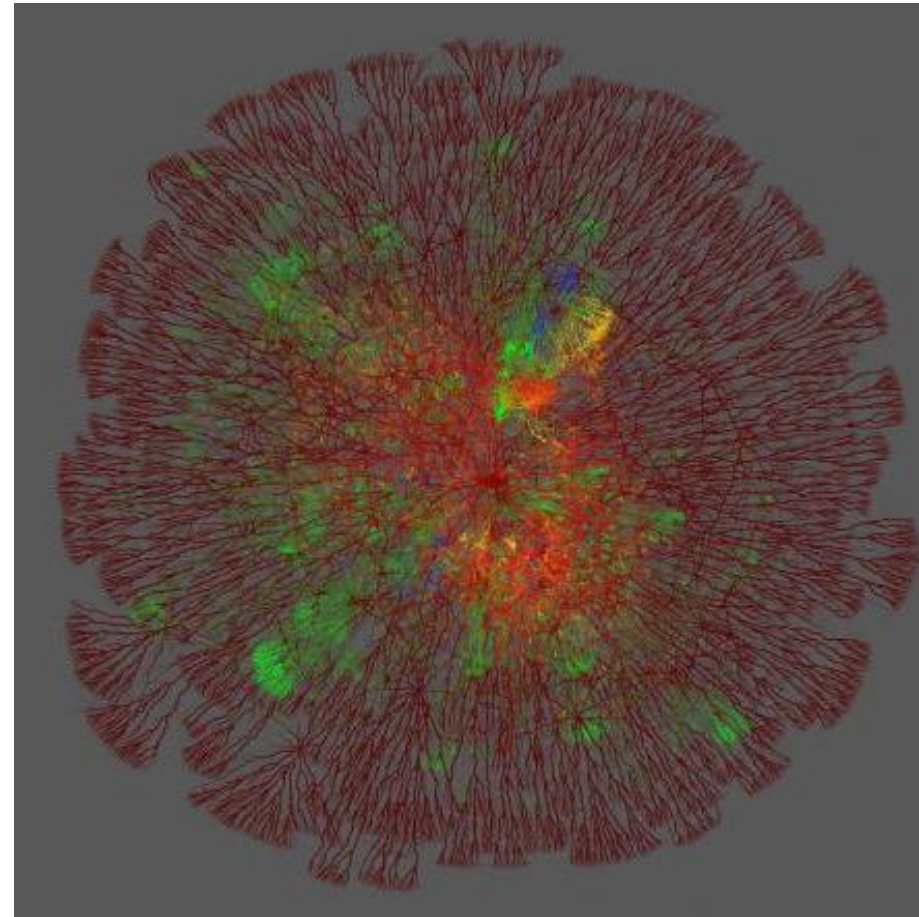
Hierarchical

- Walker, Radial, Bubble
- Treemaps

Planar:

- Mixed Model, FPP

Through the Tulip Layout plug-in technology one can easily add new Layout.



A FM₃ bundled layout of the first 100.000 wikipedia pages (obtained with the Tulip Web Crawler) connected to the graph drawing topic

Clustering

Through its hierarchical graph data structure Tulip enables any attribute based clustering. Furthermore it also provides graph based clustering algorithm.

Q-Measure :

- Agglomerative, divisive

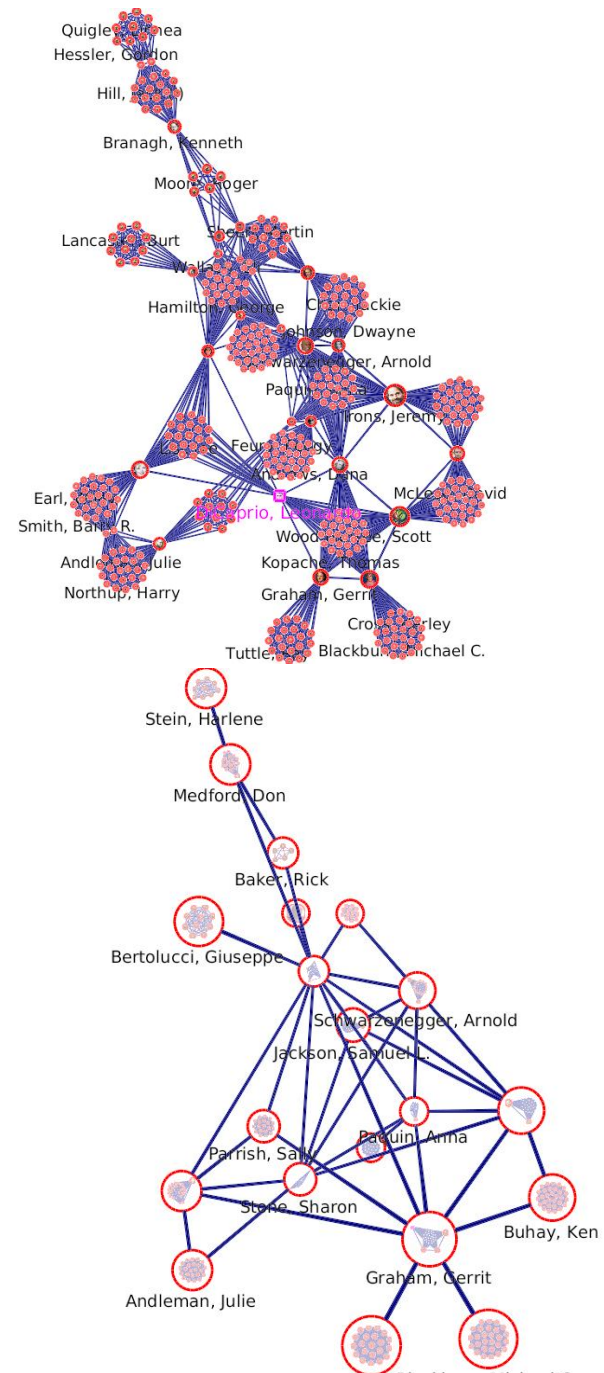
MQ-Measure

- Strength, Agglomerative

Strahler:

- Convolution based clustering

Through the Tulip Clustering plug-in technology one can easily add new Clustering method.





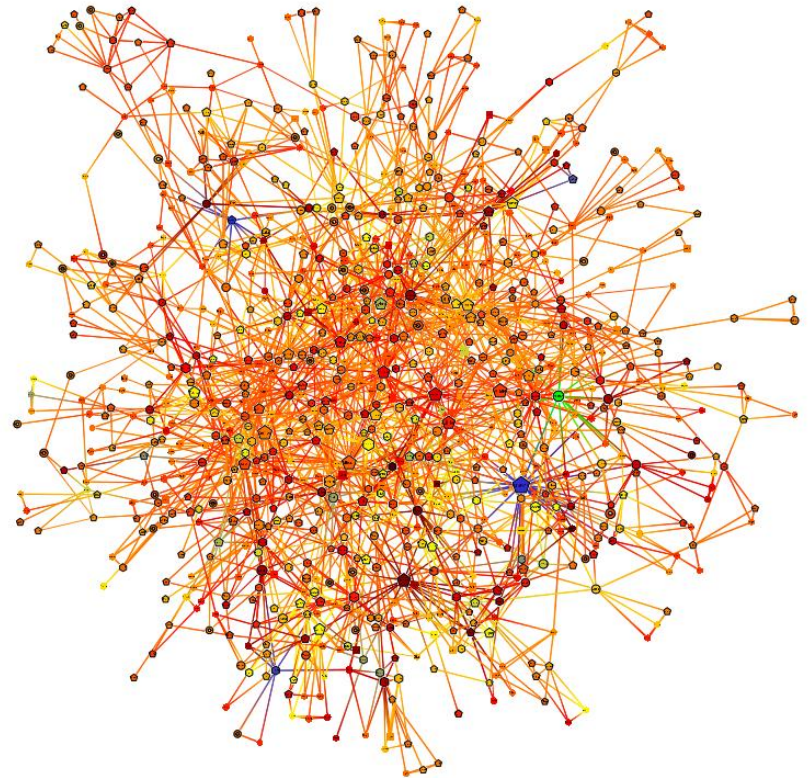
VIEWS

Node Link Diagram

The node-link diagram view renders glyphs for nodes and curves for edges. The view provides navigation such as zoom and pan, bring and go, fish eyes views, and a magnifying glass.

Direct editing of the graph elements and data, such as adding or removing nodes and edges or translating rotating or scaling elements, are also supported.

Other operations on this view include graph splatting, meta-node/graph hierarchy exploration, path-finder and texture-based animation.

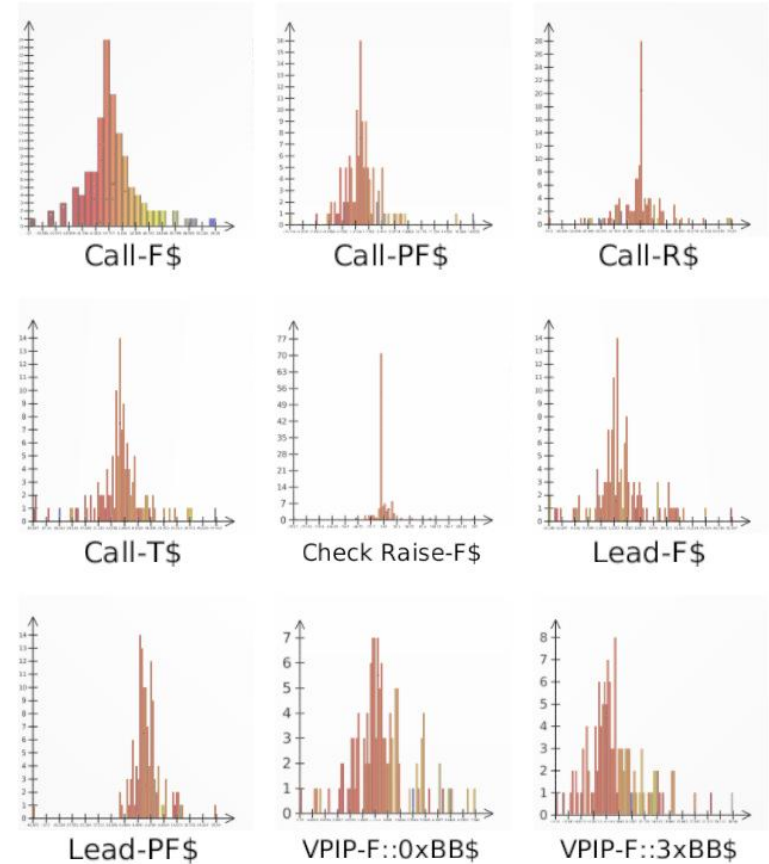


Histogram

The Histogram view provides a view of element frequency. A matrix of histograms allows for the visual comparison of several statistical properties of a set of dimensions.

This view has a standard set of navigation and statistical interactors.

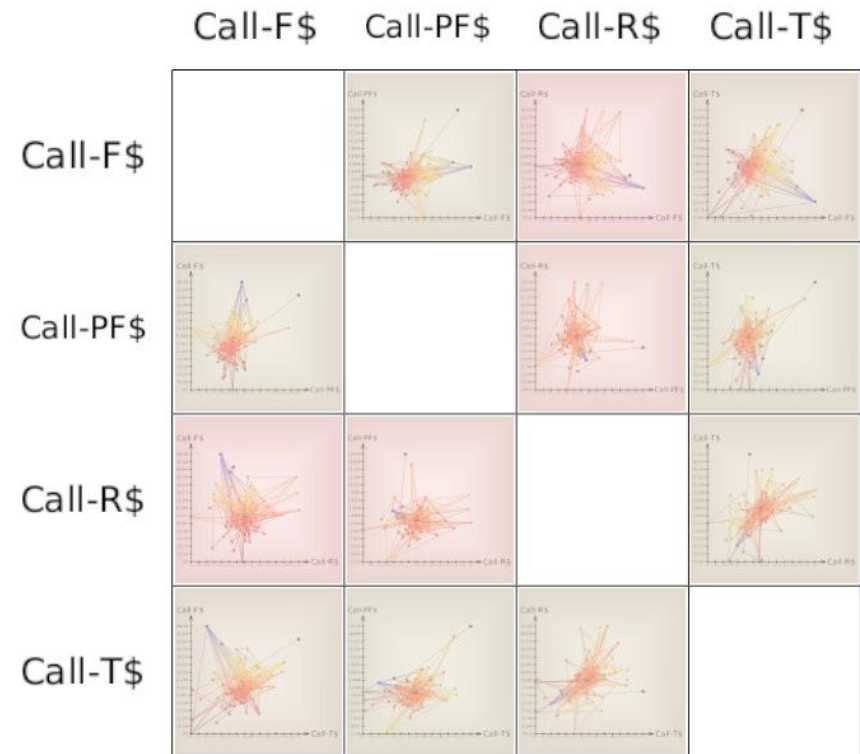
Additionally, an interactor enables the user to build non-linear mapping functions to any of the graph attributes such as size, colors, glyphs, etc..



Scatter Plot

The Scatter plot 2D view renders attribute values to depict possible correlations between properties and the matrix allows efficient navigation between dimensions.

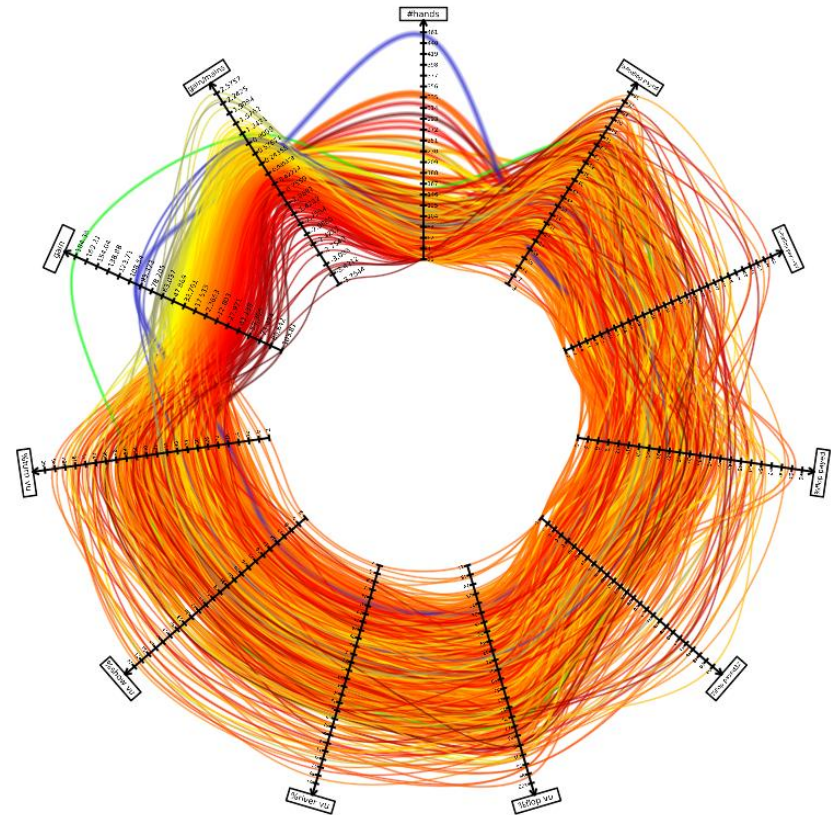
The view provides similar interaction to the node link view and implements an interactor to search for correlation in an interactively defined subsets of elements. Splatting is also available in this view.



Parallel Coordinates

The Parallel Coordinates view depicts multivariate data, using the traditional parallel coordinates representation as well as a circular representation.

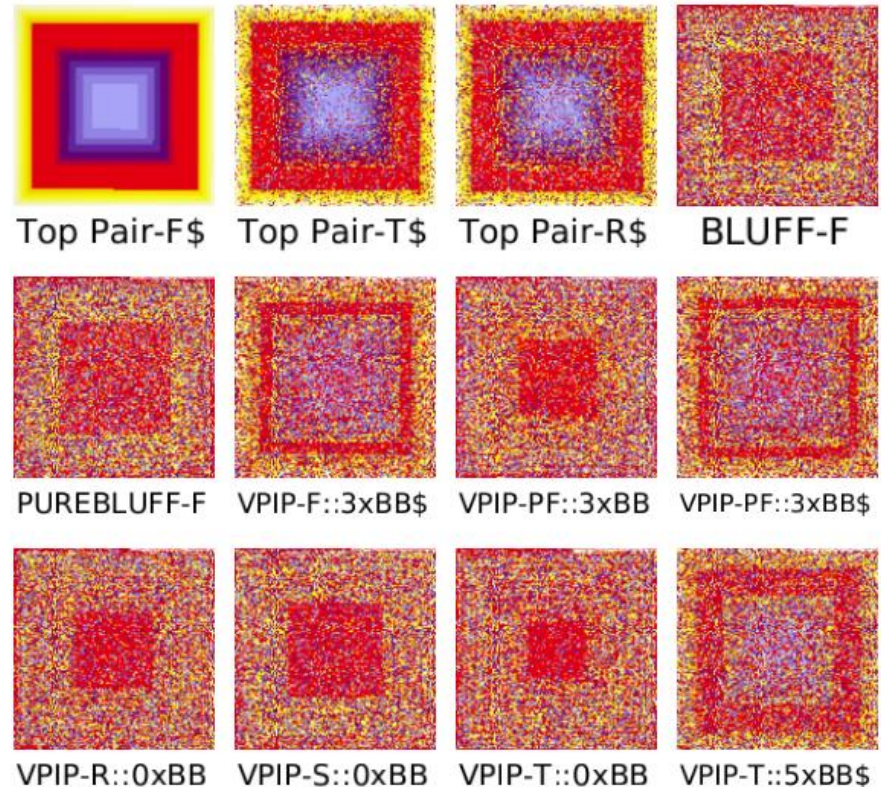
In both views, lines can be rendered with smooth Bézier curves. Interaction with the view is supported through zoom and pan, axis edition/permutation/shifting, and multi-criteria/statistical selection.



Pixel Oriented View

The Pixel Oriented view uses space filling curves to display large number of entities and relations on a screen. This view supports Hilbert curves, Z-order curves, and spiral curves.

The Pixel Oriented view supports zoom and pan/selection interaction as well as focus+context techniques.

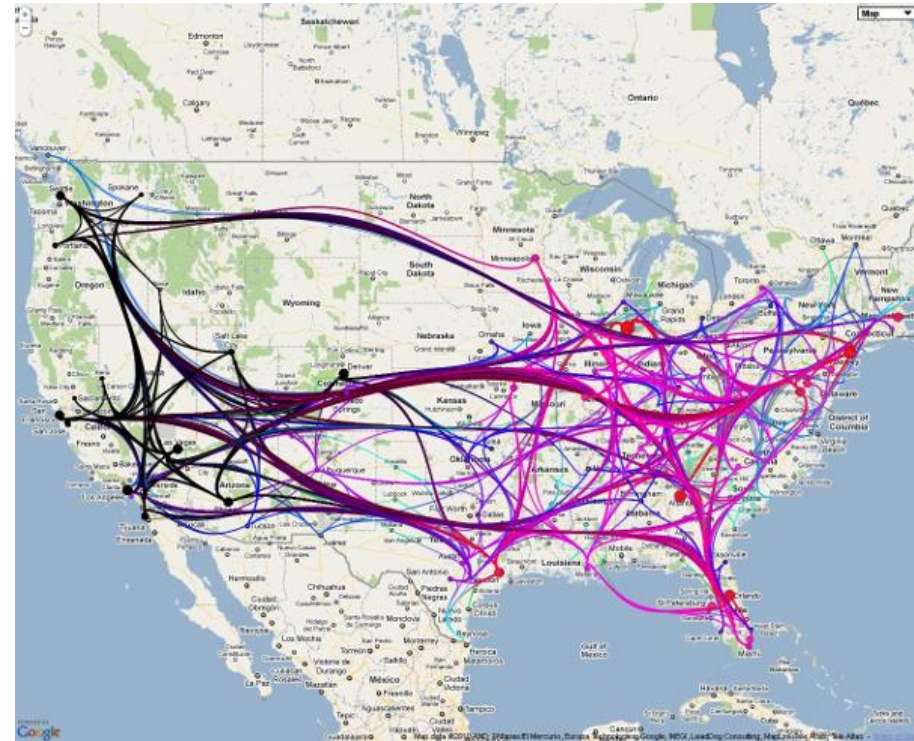


Google Map View

The Google Map view implements a mash-up of the Google map API. With this API, geospatial positions for the layout of graph elements can be specified.

When working with data in geography, graphs can be displayed on top of the map.

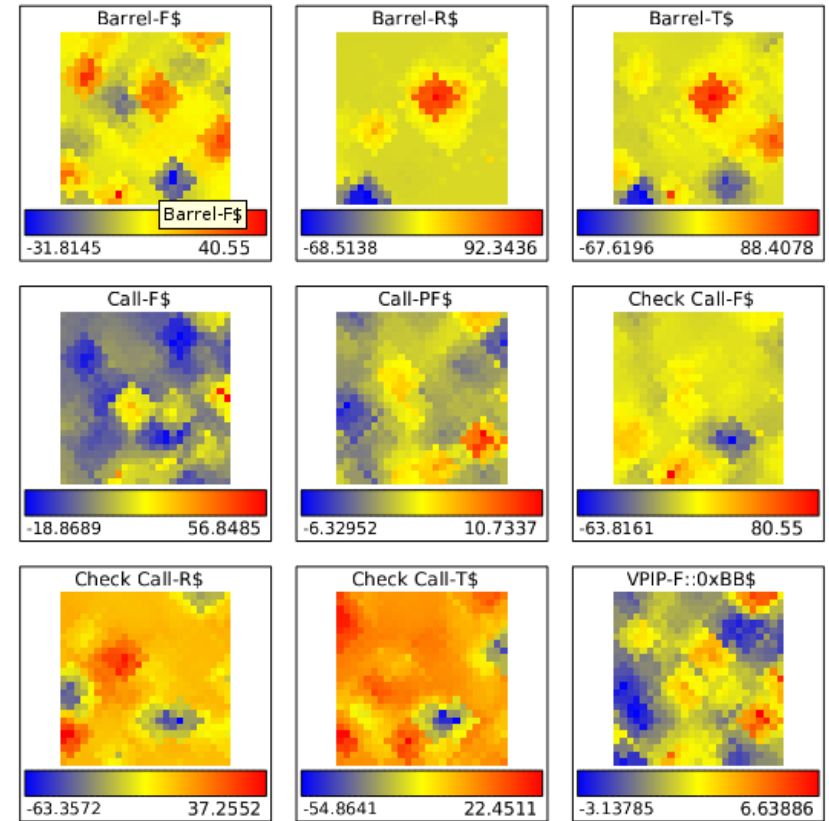
This view supports standard zoom and pan as well as the selection of elements.



Self Organizing Maps

The Self Organizing View implements Kohonen self-organizing maps. Several kinds topology/connectivity for the generated maps are supported, Grid, torus, 4connectivity, 8 connectivity.

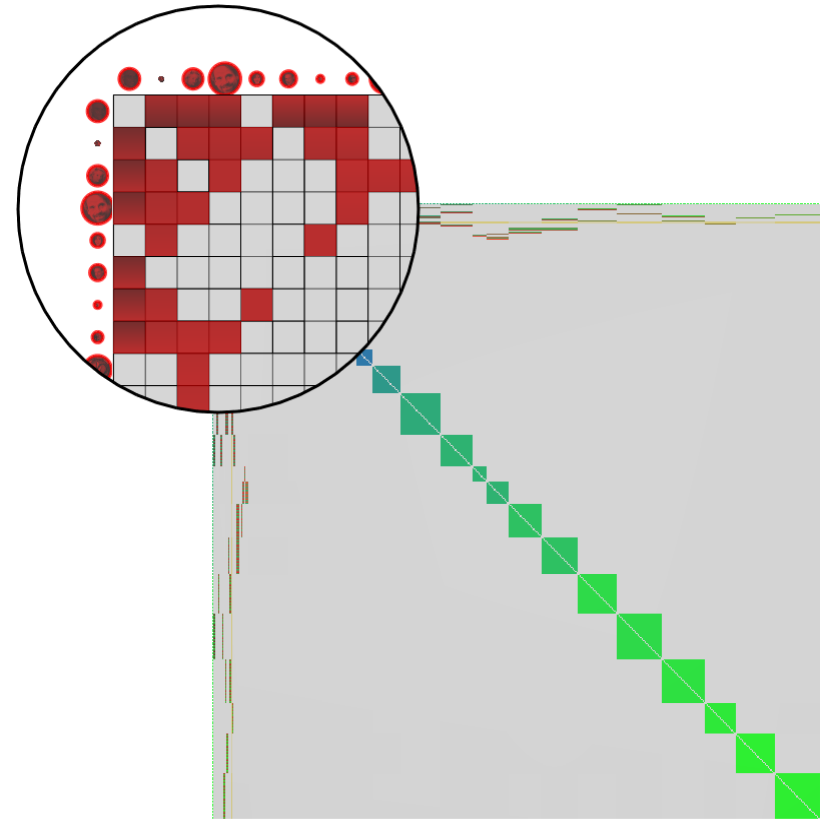
Zooming and selection interactors are available for this view.



Matrix

The Matrix view implements a matrix view of the graph. This view has been built to support graphs with a large number of nodes and edges.

Zooming and selection interactors are available for this view





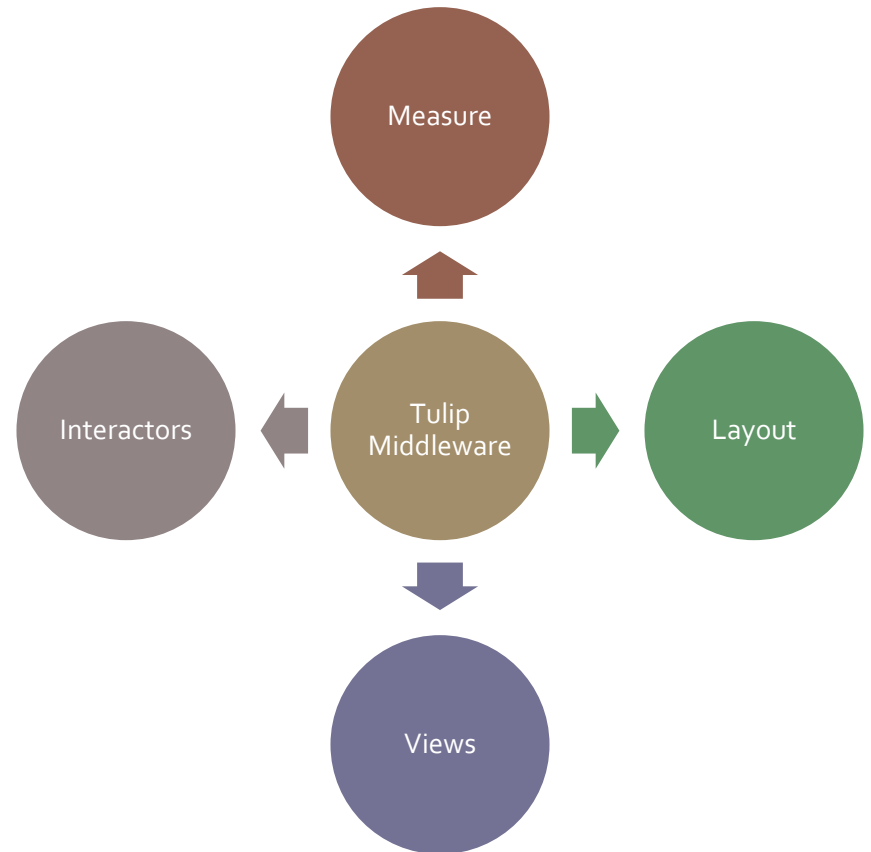
TULIP MIDDLEWARE

Tulip Middle Ware

On top of its unified data structure, Tulip provides an application that enables to integrate all the Tulip plug-ins:

- Clustering, layout, measure
- Glyph
- Views
- Interactors

The MiddleWare manages the consistency as well as automatic updates/addition/removal of plug-ins through the Tulip plug-ins web service.



Middleware perspective

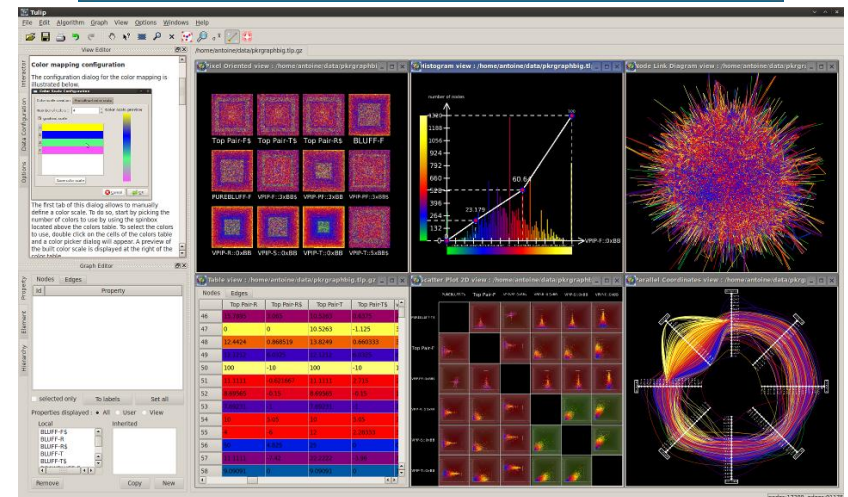
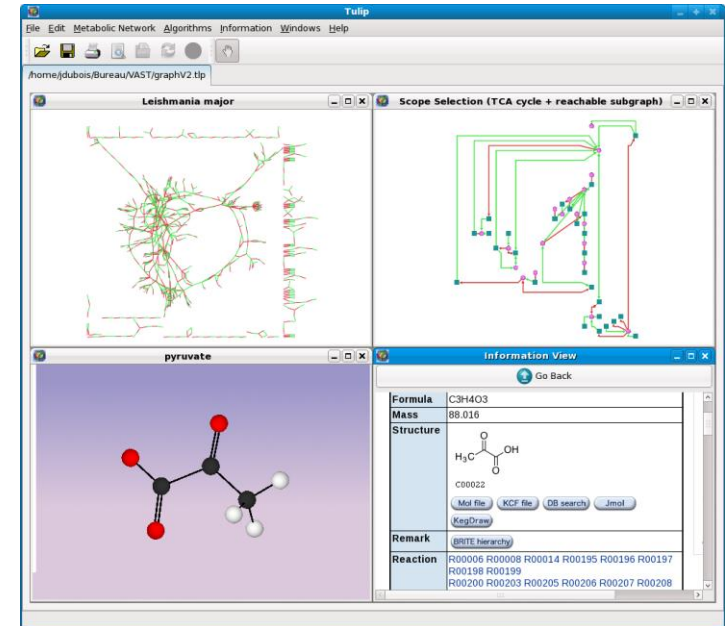
The Tulip middleware includes a specific kind of plug-in called perspective.

A perspective enable to indicate which views/interactors/Algorithm should be available and how they interact together.

It also enable to add specific widget.

Perspective are used to implement working layer.

By changing its perspective the user can change the user interface according to its task.



Tulip ON THE WEB

|| Tulip on the web

Several projects involving Tulip Software urge the need for online solutions.

Among them, we are setting up an *out-of-core visualization system* based on Client-server model

- Server : used for computation
- Client : a data visualizer embedded in a web browser



Client

Visualization & Interaction

Server

*Computation
(Measures, clustering, algorithms,...)*