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1. Introduction

Visualization techniques are useful to explore data by enabling the discovery of meaningful patterns and causal relationships. The discovery process is often exploratory and requires multiple views to support analyzing different or complementary perspectives to the data. In this context, analytic provenance shows great potential to understand users' reasoning process through the study of their interactions on multiple view systems.

In this project, we present an approach based on the concept of chained views to support the incremental exploration of large, multidimensional datasets. Our goal is to provide visual representation of provenance information to enable users to retrace their analytical actions and to discover alternative exploratory paths without loosing information on previous analyses.

Our implementation of the approach, MGExplorer (Multidimensional Graph Explorer), allows users to explore different perspectives to a dataset by modifying the input graph topology, choosing visualization techniques, arranging the visualization space in meaningful ways to the ongoing analysis and retracing their analytical actions. MGExplorer combines multiple visualization techniques and visual querying while rep- resenting provenance information as segments connecting views, which each supports selection operations that help define subsets of the current dataset to be explored by a different view

In new version MGExplore, it includes 6 main elements to construct this application. They are interrelated and work closely together to help the application work stably. Below will be a small summary for the 6 main ingredients mentioned in the photo above:

- Dashboard (`mge-dashboard`): This is where visual chart views (`mge-view`) are stored and managed. It manages the user actions that interact between the charts (ex. close views, show views, move the hidden connection…). And of course, the data will be stored and managed in this component. It is the intermediary that distributes the link between the windows and the connection that is hidden behind each window. In addition, the Dashboard is also a place to store the history of the user's data discovery process to update the history window (`mge-history`). Dashboard includes:
  - A list of views (`mge-view`)

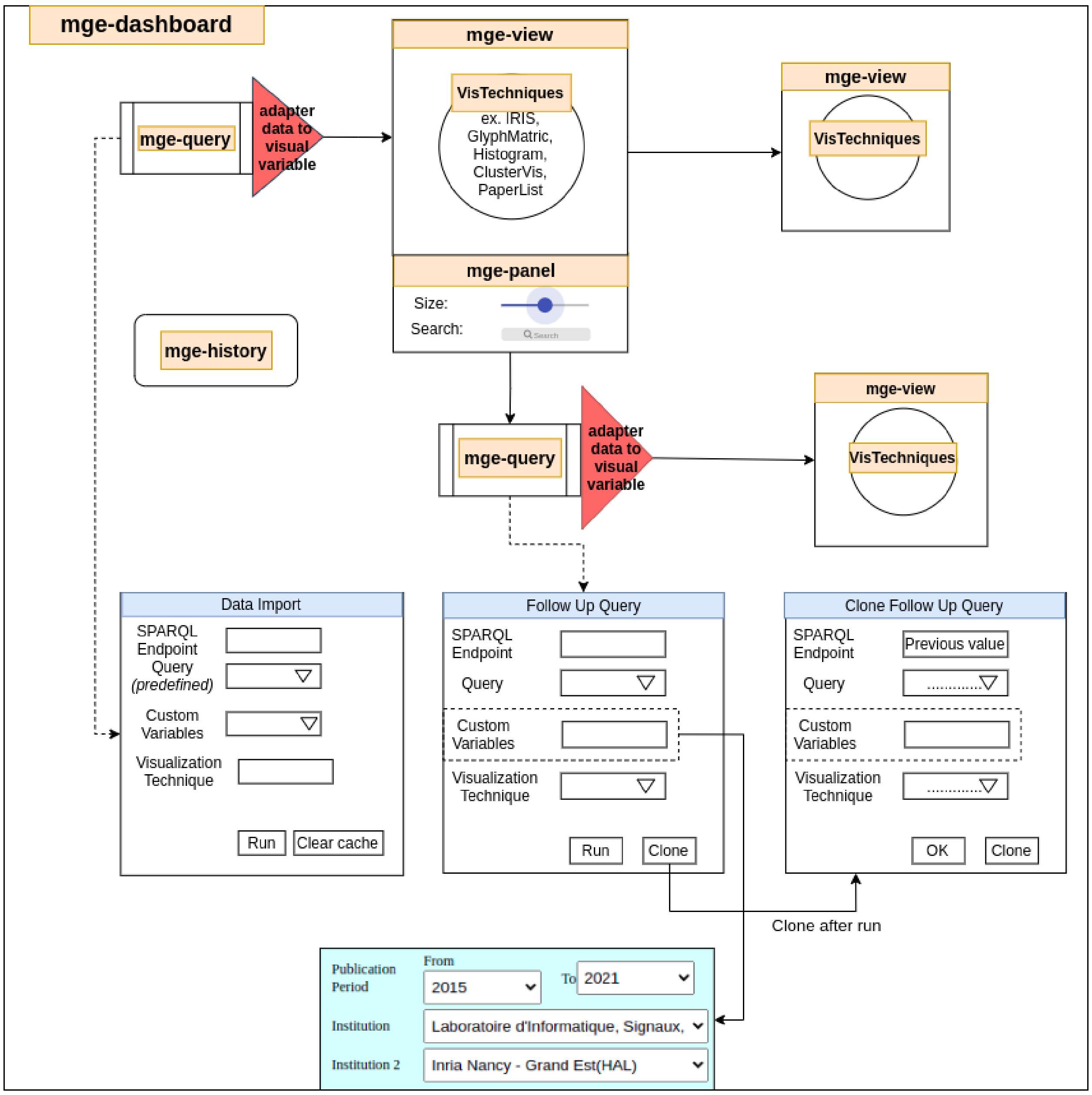


Figure 1: MGExplore application overview system

  - 1 initial query window (`mge-query`, Data import)
  - 1 history tree panel (`mge-history`)
- View (`mge-view`): This component represents a view window to show particular visualization technique (`visTechniques`). This component allows the user to move the view window, resize the view window, and create a new view from itself based on the user's mouse actions during the data discovery process. The position of the `mge-view` is inside the `mge-dashboard` and is managed by the dashboard. A view includes:
  - A header with title of the view
  - A content area contains the visualization chart
  - A Filter panel (`mge-panel`) (this component is optional that depends on the type of the visualization technique)
- Filter Panel (`mge-panel`): This component represents a panel allow users to adjust the parameter in particular visualization technique. The panel will select a pre-built template and render it as html inside the component based on the name of the visualization technique. With the panel, the user will change some properties of the visualization technique through the input data from the slider, input tag… The chart will update after the properties are changed. The location of the panel (`mge-panel`) is inside a view (`mge-view`)
- Follow-Up query (`mge-query`): This component helps the user through selecting the initial pre-defined query to invoke the query and visualize it through specific visualization techniques. The position of the `mge-query` will be inside the `mge-view` for the purpose of reusing the common functions of manipulating the window (moving, opening, closing, resizing, connecting to other windows via links and connections). There are 2 main inputs that need to be selected by the user: 1 endpoint and 1 query in the predefined query list of the selected endpoint. Depending on the intended use, it includes three types:
  - initial query: data import and will be used at the time of creating a dashboard)
  - follow-up query: Used when you want to query another pre-defined query in data discovery process)
  - clone query: Used for the purpose of copying all selected data of a submitted follow-up query)
- Visualization techniques (`visTechniques`): They represent visualization methods with different types of graphs to help users better understand the relationships in the data set they are interested in and exploring. Currently MGExplore has 6 defined visualization techniques and each visualization technique will have its own properties and methods. List of defined visualization techniques:
  - History bar chart (`mge-barchart`)
  - Clustervis chart (`mge-clustervis`)
  - Glyph matrix chart (`mge-glyph-matrix`)
  - Iris chart (`mge-iris`)
  - List of papers(`mge-listing`)
  - Node-edges chart (`mge-nodelink`)

2. Setup

Developed Dependencies

Name	Version
@stencil/store	1.4.1
@types/jest	26.0.21
@types/puppeteer	5.4.3
jest	26.6.3
jest-cli	26.6.3
rollup-plugin-node-polyfills	0.2.1

Dependencies and libraries

Name	Version
@stencil/core	2.5.2
@types/sweetalert	2.0.4
autocompleter	6.1.0
babel-plugin-transform-remove-strict-mode	0.0.2
cors	2.8.5
d3	6.0.0
d3-simple-slider	1.10.4
ejs	3.1.6
express	4.17.1
express-fileupload	1.2.1
jquery	3.6.0
jquery-ui	1.12.1
lodash	4.17.21
model-js	0.2.5
morgan	1.10.0
nodemon	2.0.12
patch-package	6.4.7
puppeteer	8.0.0
requirejs	2.3.6
sweetalert2	11.0.18
tippy.js	6.3.1
xmlhttprequest	1.8.0

To start building a new web component using Stencil, clone this repository to a new directory:

git clone via ssh

```
git clone git@github.com:Wimmics/covid-19-linkedviz.git
```

Or

git clone via htmls

```
git clone https://github.com/Wimmics/covid-19-linkedviz.git
```

Go to the project

```
cd covid-19-linkedviz
```

Change branch

```
git checkout mge-refactoring
```

and run:

```
# Install dependencies and libraries
npm install
# Build application before run server side
npm run build
# Run application via Server side
npm run start:ssr
```

To build the component for production, run:

```
npm run build
```

To run the unit tests for the components, run:

```
npm test
```

3. Components

To make it easy for the reader to understand the documentation of components inside the MGExplorer application, we need a clear presentation structure. Therefore, the following is a summary of the structure that presents the components built in the project:

- **General**: A short introduction to the component so that users understand its role, function, and working and connecting principle.
- **Properties**: A list of properties inside each implemented component class
  - Property column: The name of the property inside the component's class.
  - Attribute column: The name of the attribute of the custom component html tag after being rendered from the component class
  - Description column: The short description of the property in component class
  - Type column: The type of the property in component class
  - Default column: The default value of the property in component class
- **Methods**: A list of methods defined inside each component class. It will include both public methods and private methods
  - Public methods: The `@Method()` decorator is used to expose methods on the public API. Functions decorated with the `@Method()` decorator can be called directly from the element, ie. they are intended to be callable from the outside! Stencil's architecture is async at all levels which allows for many performance benefits and ease of use. By ensuring publicly exposed methods using the `@Method`decorator return a promise *Example*:

```
import { Method } from '@stencil/core';

export class TodoList {

  @Method()
  async showPrompt() {
    // show a prompt
  }
}
```

```
- Private methods: With private methods, It can not be callable from the outside of component class. No
```

```
class Component {
  // Since `getData` is not a public method exposed with @Method
  // it does not need to be async
  getData() {
    return this.someData;
  }
  render() {
    return (
      <div>{this.getData()}</div>
    );
  }
}
```

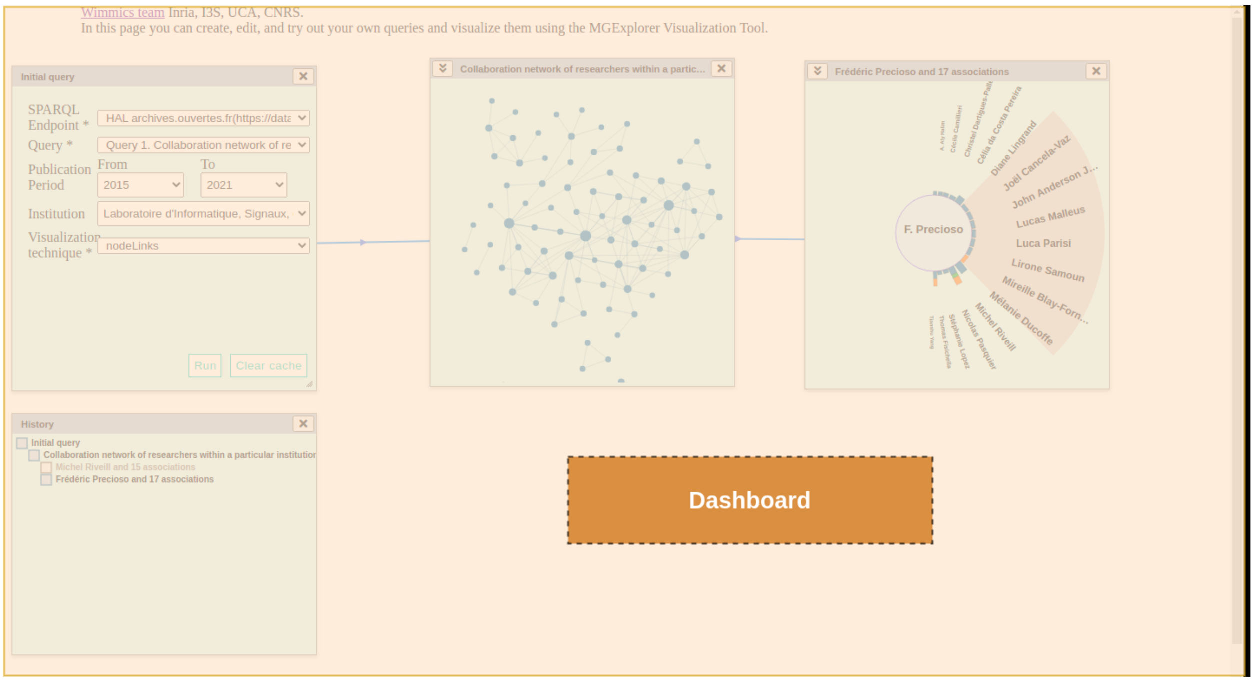
- **Data model**: This section is used to describe the data structure used for each visualization techniques. For each type of visualization technique, it will receive a different data format. Therefore, this section will help users better understand the data model being used.

3.1. Dashboard

3.1.1. mge-dashboard

General To create a dashboard element

```
<mge-dashboard init-component="mge-query" x="20" y="20" class="hydrated">
</mge-dashboard>
```


Wimmics team Inria, I3S, UCA, CNRS.
In this page you can create, edit, and try out your own queries and visualize them using the MGExplorer Visualization Tool.

Initial query

SPARQL Endpoint *: HAL archives.ouvertes.fr(https://data
Query *: Query 1. Collaboration network of re
Publication Period: From 2015 To 2021
Institution: Laboratoire d'Informatique, Signaux,
Visualization technique *: nodeLinks

History
- Initial query
  - Collaboration network of researchers within a particular institution
    - Michel Riveill and 15 associations
    - Frédéric Precioso and 17 associations

Figure 2: Dashboard position

Properties

Property	Attribute	Description	Type	Default
`_dashboardArea`	`_dashboard-area`	Area of dashboard for interacting	`any`	`undefined`
`_dragConect`	`_drag-conect`	Drag connection of views	`any`	`undefined`
`_historyChart`	`_history-chart`	Stores the graph that contains history	`any`	`null`
`_initView`	`_init-view`	First view (initial query)	`any`	`undefined`
`_treeCharts`	`_tree-charts`	Stores the tree of connections between views	`any`	`null`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`undefined`
`idTemplate`	`id-template`		`string`	`undefined`
`initComponent`	`init-component`	Type of div to create in inital point	`string`	`undefined`
`x`	`x`	x-coordinate (The horizontal value in a pair of coordinates) of the dashboard	`number`	`undefined`
`y`	`y`	y-coordinate (The vertical value in a pair of coordinates) of the dashboard	`number`	`undefined`

Methods

Public Methods

- `async _addLink(viewParent: any, viewChild: any) => Promise<{ line: any; conect: any; visible: boolean; }>`

  Description This function is to create links from parent window and the children windown It includes connection and line links

  Returns

  Type: `Promise<{ line: any; conect: any; visible: boolean; }>`

- `addChart(idParent: any, objChart: any) => Promise<void>`

  Description This function is to add a new view information to the dashboard (id, name, title, links, connection . . .). After that, it will update the status of new view on the tree history. This function will be called after create a new view.

  Returns

  Type: `Promise<void>`

- `closeView(view: any) => Promise<void>`

  Description

  This function allow to hide the target view with `CSS - display: none` and update the status of this view in the history panel (`mge-history`). This function is used when minimize window by the close button in the top right of a window

  Returns

  Type: `Promise<void>`

- `showView(view: any) => Promise<void>`

  Description This function allow to display the target view with `CSS - display: block` and update the status of this view in the history panel (`mge-history`). This function is used when click the connection in dashboard or in history panel with hidden view.

  Returns

  Type: `Promise<void>`

- `getChart(idChart: any) => Promise<any>`

  Description

  The dashboard will store all views inside itself. For good management, it provides the getChart method with the purpose of getting the data of a particular view through the id of that view.

  Returns

  Type: `Promise<any>`

- `refreshLinks() => Promise<void>`

  Description This function will refresh the status of the links and connection on the history component (`mge-history`). Updates of links and connections will be sent to the `mge-history` to display on the history window. This function is usually used after having any changes in status of views (`mge-view`)

  Returns

  Type: `Promise<void>`

  Description This function will refresh the size of the svg includes all of links and connection when we move views.

- `refreshSvg() => Promise<void>`

  Returns

  Type: `Promise<void>`

- `resetDashboard() => Promise<void>`

  Description This function is to clear all of elements in dashboard It will be run when clicking re-run for new query in initial point

  Returns

  Type: `Promise<void>`

- `setData(_: any) => Promise<void>`

  Description This function allows to store new dataset which got from `mge-query` to a global variable

  Returns

  Type: `Promise<void>`

- `setParams(globalParams: any, locals: any) => Promise<void>`

  Description Get all of params from list pre-defined query to save in global variables. Global variable in this case is a set of public variables that all components in the application can use)

  Returns

  Type: `Promise<void>`

Private Methods

- `addDashboard(_svg) => <void>`

  Description This function will init a history panel and first visualization technique component. The first visualization component is depended on your choice via attribute `init-component` .This function will be called after rendering all elements in `<Host></Host>` of `render()` function

  Returns

  Type: `<void>`

Data model

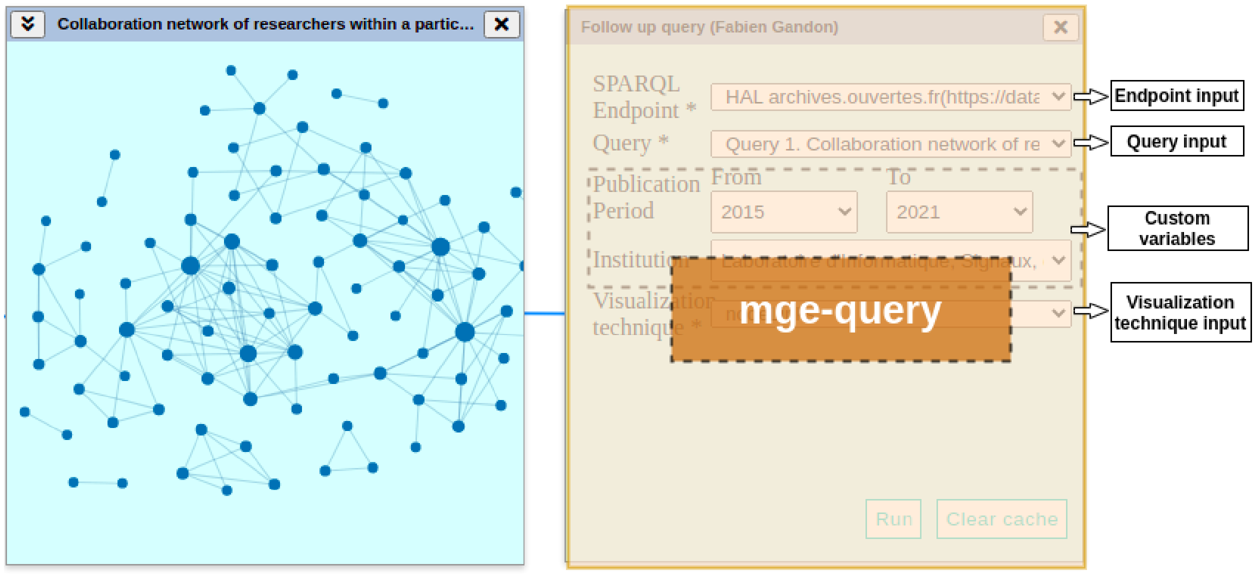
```
{
  "type": "object",
  "required": [],
  "properties": {
    "info": {
      "type": "object",
      "required": [],
      "properties": {
        "qtNodos": {
          "type": "number"
        },
        "qtArestas": {
          "type": "number"
        }
      }
    },
    "nodes": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "valueTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "imageTitle": {
          "type": "string"
        },
        "dataNodes": {
          "type": "array",
          "items": {
            "type": "object",
            "required": [],
            "properties": {
              "id": {
                "type": "string"
              },
              "idBD": {
                "type": "string"
              },
              "labels": {
                "type": "array",
                "items": {
                  "type": "string"
                }
              },
              "values": {
                "type": "array",
                "items": {
                  "type": "number"
                }
              },
              "images": {
                "type": "string"
              }
            }
          }
        }
      }
    },
    "edges": {
      "type": "object",
      "required": [],
      "properties": {
```

```
"labelTitle": {
  "type": "string"
},
"valueTitle": {
  "type": "array",
  "items": {
    "type": "string"
  }
},
"dataEdges": {
  "type": "array",
  "items": {
    "type": "object",
    "required": [],
    "properties": {
      "src": {
        "type": "string"
      },
      "tgt": {
        "type": "number"
      },
      "labels": {
        "type": "string"
      },
      "values": {
        "type": "array",
        "items": {
          "type": "number"
        }
      },
      "documents": {
        "type": "array",
        "items": {
          "type": "object",
          "required": [],
          "properties": {
            "type": {
              "type": "string"
            },
            "date": {
              "type": "string"
            },
            "title": {
              "type": "string"
            },
            "authors": {
              "type": "array",
              "items": {
                "type": "string"
              }
            },
            "link": {
              "type": "string"
            }
```

```
                  }
                }
              }
            }
          }
        }
      }
    }
  }
}
```

3.2. mge-query

General Follow-up query is a query created on-the-fly during the exploratory process to connect new datasets through visualization techniques. Follow-up queries are visual components connecting views. They feature an endpoint, predefined query, custom variables, the user choice for the outcome visualization technique. In MGExplorer, follow-up queries become part of the visual exploration process.


Collaboration network of researchers within a partic...
Follow up query (Fabien Gandon)
mge-query
Endpoint input
Query input
Custom variables
Visualization technique input
Run
Clear cache

SPARQL Endpoint * HAL archives.ouvertes.fr(https://data
Query * Query 1. Collaboration network of re
Publication Period From 2015 To 2021
Institution Laboratoire d'Informatique, Signaux,
Visualization technique *

Figure 3: Follow-up query component

Requirements for create a follow-up query: - At least a visualization technique in display - An input value selected from a visualization technique - A predefined query (currently from LDViz)

This is an example to create a follow-up query element:

```
<mge-view x="20" y="20" dataset-name="data-0" type-vis="mge-query"
title="Initial query" id-view="chart-0" class="DS-viewArea hydrated">
</mge-view>
```

Properties

Property	Attribute	Description	Type	Default
`_dashboard`	`dashboard`	represents the current dashboard	`any`	`undefined`

Property	Attribute	Description	Type	Default
`_view`	`_view`	represents the view includes this follow-up query	`any`	`undefined`
`cloneStatus`	–		`{ isClone: boolean; isFirstTime: boolean; }`	`{isClone: false, isFirstTime: false}`
`data`	–		`any[]`	`[]`
`form`	`form`		`any`	`null`
`globalParams`	`global-params`	Represents the panel associated with the graphic	`any`	`null`
`height`	`height`		`number`	`350`
`queriesList`	`queries-list`	List of predifined queries	`any`	`null`
`query`	`query`	represents the current selected query	`any`	`undefined`
`width`	`width`		`number`	`350`

Data model To create a `mge-query`, we need to provide a data model to this component. This data model will use to provide data of list pre-diefine query, available values of custom variables, available values of endpoint.

```
{
  "type": "object",
  "required": [],
  "properties": {
    "laboratories": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "name": {
            "type": "string"
          },
          "source": {
            "type": "string"
          }
        }
      }
    },
    "sparqlKeywords": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "name": {
            "type": "string"
          },
          "value": {
            "type": "string"
          }
        }
      }
```

```
},
"countries": {
  "type": "array",
  "items": {
    "type": "object",
    "required": [],
    "properties": {
      "value": {
        "type": "string"
      },
      "name": {
        "type": "string"
      }
    }
  }
},
"query_types": {
  "type": "array",
  "items": {
    "type": "object",
    "required": [],
    "properties": {
      "name": {
        "type": "string"
      },
      "value": {
        "type": "number"
      }
    }
  }
},
"endpoints": {
  "type": "array",
  "items": {
    "type": "object",
    "required": [],
    "properties": {
      "id": {
        "type": "string"
      },
      "name": {
        "type": "string"
      },
      "url": {
        "type": "string"
      }
    }
  }
},
"prefixes": {
  "type": "array",
  "items": {
    "type": "object",
    "required": [],
          "properties": {
            "id": {
              "type": "string"
            },
            "name": {
              "type": "string"
            },
            "value": {
              "type": "string"
            }
          }
        }
      }
    }
}
```

Methods

Public Methods

- `cloneQuery() => Promise<void>`

  Description Clone function will be call to create a new clone component This function will be run after click clone button

  Returns

  Type: `Promise<void>`

- `setBox(box: any) => Promise<void>`

  Description Set box size for the chart includes the content input is a object includes height and width

  Returns

  Type: `Promise<void>`

- `setClone() => Promise<void>`

  Description Set type of follow-up query to clone follow-up query It will update value in cloneStatus of element

  Returns

  Type: `Promise<void>`

- `setCloneData(query: any) => Promise<void>`

  Description With clone follow-up query, this function will be clone all of data from parent element variable isFirstTime of cloneStatus of this element will be changed to false after cloning data

  Returns

  Type: `Promise<void>`

- `setData(_: any, oldData: any) => Promise<any[]>`

  Description This function is to set the data to the selected data from parent If no arguments, It will return the value of data

  Returns

  Type: `Promise<any[]>`

- `setInitial() => Promise<void>`

  Description With initial query, this function will be set variable isInitial to true This way will help to distinguish the initial point or a follow-up query

  Returns

  Type: `Promise<void>`

Private Methods Initial functions

- `initEndpointsList() => <void>`

  Description Import list input of endpoint field by Endpoints data from defined input params. This function will be called when create mge-query component and it is only called once

  Returns

  Type: `<void>`

- `initLabList() => <void>`

  Description Import list input of laboratory fields by laboratories data from defined input params. This function will be called when create mge-query component and it is only called once

  Returns

  Type: `<void>`

- `initCountryList() => <void>`

  Description Import list input of country field by countries data from defined input params. This function will be called when create mge-query component and it is only called once

  Returns

  Type: `<void>`

- `initPeriodList() => <void>`

  Description Import list input of period field. This function will be called when create mge-query component and it is only called once

  Returns

  Type: `Promise<void>`

Eventlistener function

- `changeEndpoint(event: any, value: any) => <void>`

  Description

  Event function when change the endpoint from the endpoints list input After change endpoint, the list of predefined query will be update follow the selected endpoint

  Returns

  Type: `Promise<void>`

- `changeQuery(event: any, value: any) => <void>`

  Description Event function when change the predefined query from the predefined query list input After changing query, the information regarding predefined query will be update on the form

  Returns

  Type: `Promise<void>`

- `clearQueryCache(queryid: any) => <void>`

  Description Clear cache that stored from server. This function can be called after choosing 1 pre-defined query and click button `clear cache`

  Returns

  Type: `<void>`

- `disableButton() => <void>`

  Description This function to disable 2 buttons - Run and Clone button - after get result from server

  Returns

  Type: `<void>`

- `blockContent() => <void>`

  Description This function to disable all of input fields after clicking run button

  Returns

  Type: `<void>`

- `displayQuery(query: any) => <void>`

  Description display the form with information regarding the selected query

  Returns

  Type: `Promise<void>`

- `enableButton() => <void>`

  Description This function to enable 2 buttons - Run and Clone button

  Returns

  Type: `<void>`

Query function

- `getFormData(form: any) => <{ query: any; name: any; uri: any; params: { type: any; prefixes: any; }; }>`

  Description Get data from the form after user chose option for endpoint, query and custom variable

  Returns

  Type: `<{ query: any; name: any; uri: any; params: { type: any; prefixes: any; }; }>`

- `getQueryData(form: any) => <any>`

  Description This funtion return the data from the selected query

  Returns

  Type: `<any>`

- `getResult(text: any, values: any, followupQuery: any) => <void>`

  Description Receives the result from the query and proceed to visualization

  Returns

  Type: `<void>`

- `graphicDisplay(data: any, values: any, followupQuery: any) => <void>`

  Description Display a new visualization technique after get result from requested query After convert format of recieved data, it will create a new component include chart to represent new data New dataset will be stored to global variable

  Returns

  Type: `<void>`

- `processQuery(form: any) => <void>`

  Description Process the request query with selected query. This function will validate the data of the form. The process includes complete SPARQL query path, send request to server and process result from server

  Returns

  Type: `<void>`

- `tune(data: any) => <void>`

  Description Replace variables in SPARQL query with custom data from HTML form such as year, lab, country

  Returns

  Type: `<void>`

- `sendRequest(values: any, followupQuery?: any) => <void>`

  Description This funtion will send the request to the server to get the result with SPARQL after tune custom variables.

  Returns

  Type: `<void>`

- `updateFormMaxHeight() => <void>`

  Description Update max height of the form after selecting endpoint and predefined query

  Returns

  Type: `<void>`

- `updateQueryOptions() => <void>`

  Description update query options (lab, country, etc) according to the query type

  Returns

  Type: `<void>`

- `isURI(str: any) => <boolean>`

  Description Check the format of url from selected endpoint. This function will use REGEX of standard URI to check the format of selected endpoint url.

  Returns

  Type: `<boolean>`

CSS Custom Properties

Name	Description
`--font-size`	Size of text in this component. `14px` is the default.

3.3. mge-panel

General This is an example to create a filter panel element:

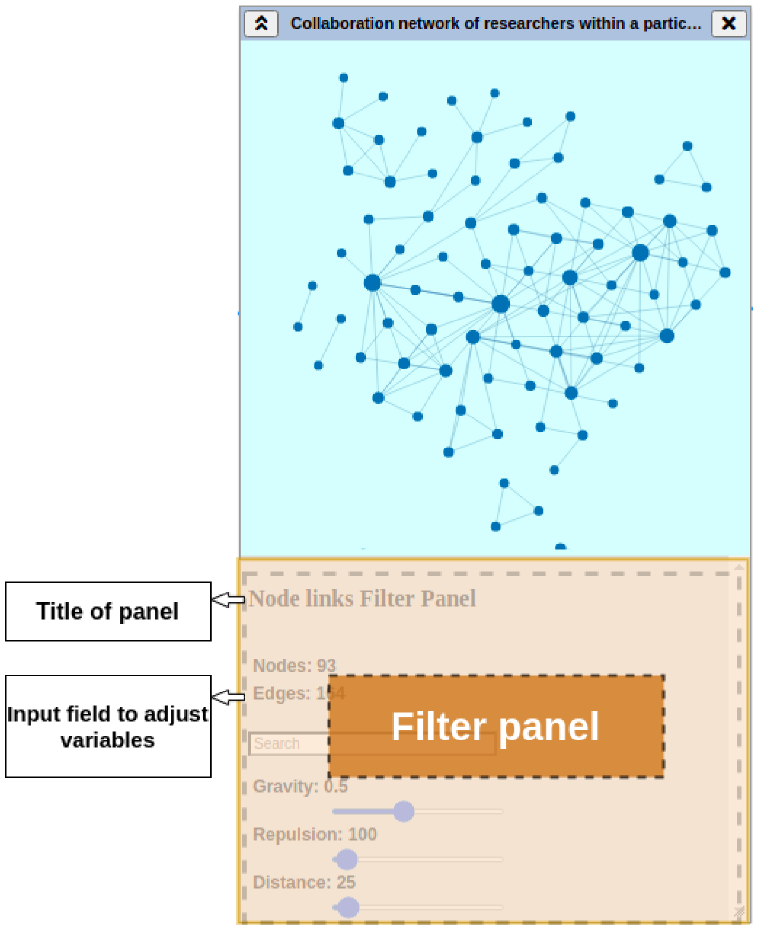


Figure 4: Filter panel component

To create a filter panel element

```
<mge-panel id="chart-1-p" type-vis="mge-nodelink" id-view="chart-1" class="hydrated" style="display: bl
</mge-panel>
```

Properties

Property	Attribute	Description	Type	Default
`_chart`	`_chart`	Represents the visualization technique which have same view with this filter panel	`any`	`undefined`
`_filter`	`_filter`	Represents the div includes cloned html from template	`any`	`undefined`
`_idPanel`	`_id-panel`	ID of the panel that generated from id of view	`any`	`undefined`
`_searchAutocomplete`	`_search-autocomplete`	Text search input (of `mge-nodelinks`)	`any`	`null`

Property	Attribute	Description	Type	Default
`_selectOrder`	`_select-order`	Represents the select input for order of Iris(`mge-iris`) filter panel and histogram(mge-barchart) filter panel	`any`	`null`
`_sliderCharge`	`_slider-charge`	Slider to adjust linkDistance (of `mge-nodelinks`)	`any`	`null`
`_sliderGravity`	`_slider-gravity`	Slider to adjust Gravity	`any`	`null`
`_sliderLinkDistance`	`_slider-link-distance`	Slider to adjust linkDistance (of `mge-nodelinks`)	`any`	`null`
`_spanCharge`	`_span-charge`	Display positive value of charge attribute (of `mge-nodelinks`)	`any`	`null`
`_spanEdges`	`_span-edges`	Text span to show number of edges (of `mge-nodelinks`)	`any`	`null`
`_spanGravity`	`_span-gravity`	Display the value of the attribute gravity (of `mge-nodelinks`)	`any`	`null`
`_spanLinkDistance`	`_span-link-distance`	Displays the value of the linkDistance attribute (of `mge-nodelinks`)	`any`	`null`
`_spanNodes`	`_span-nodes`	Text span to show number of nodes (of `mge-nodelinks`)	`any`	`null`
`filterTemplate`	`filter-template`	Represents the selection of the pre-defined template based on class name of template	`any`	`undefined`
`idView`	`id-view`	id of view includes the panel	`any`	`undefined`
`typeVis`	`type-vis`	type of visualization technique that is displayed in the same view as the filter panel	`any`	`undefined`

Methods

Public Methods

- `updateNodePanel() => Promise<void>`

  Description This function allows to update all of input value in node-edges filter panel from displaying visualization technique

  Returns

  Type: `Promise<void>`

- `setChart(_: any) => Promise<void>`

  Description This function allows to set the chart by displaying visualization technique. With this function, users can call all public methods from added chart.

  Returns

  Type: `Promise<void>`

Private Methods

Iris panel and histogram panel - `_addItemsSelectOrder() => <void>`

```
**Description**
This function allows to set the chart by displaying visualization technique. With this function, users 

**Returns**

Type: `<void>`
```

Node-edges panel

- `_addSliderGravity(idDivPanel: any) => <void>`

  Description This function will add a slider input to the panel. This slider is used to adjust the gravity value of node-edges chart.

  Returns

Type: `<void>`

- `_addSliderCharge(idDivPanel: any) => <void>`

  Description This function will add a slider input to the panel. This slider is used to adjust the charge value of node-edges chart.

  Returns

  Type: `<void>`

- `_addSliderLinkDistance(idDivPanel: any) => <void>`

  Description This function will add a slider input to the panel. This slider is used to adjust the distance value of links in node-edges chart.

  Returns

  Type: `<void>`

- `_addAutocomplete(idDivPanel: any) => <void>`

  Description This function will add a text input to the panel. This slider is used to search node data in node-edges chart.

  Returns

  Type: `<void>`

- `upStatistics() => <void>`

  Description This function will update value for 2 `<span>` tags for displaying number of nodes and edges of `mge-nodelinks`.

  Returns

  Type: `<void>`

- `upSliderGravity() => <void>`

  Description This function will update chart with value from gravity slider when it's updated.

  Returns

  Type: `<void>`

- `upSliderCharge() => <void>`

  Description This function will update chart with value from charge slider when it's updated.

  Returns

  Type: `<void>`

- `upSliderLinkDistance() => <void>`

  Description This function will update chart with value from link distance slider when it's updated.

  Returns

  Type: `<void>`

- `atualizaAutocomplete() => <void>`

  Description This function will set auto complete text in search input.

  Returns

  Type: `<void>`

- `createFilter() => <void>`

  Description This function will add all functions to filter panel bases on the type of visualization technique.

  Returns

  Type: `<void>`

3.4. mge-view

General Each view is a self-contained element, which includes a visualization technique and supports subsetting operations to allow further exploration of subsets of data through different views. The views can be dragged, allowing the user to rearrange the visualization space in meaningful ways to the ongoing analysis. They are connected via line segments, which reveal their dependencies and enable tracing back the exploration path, thus preserving provenance information.

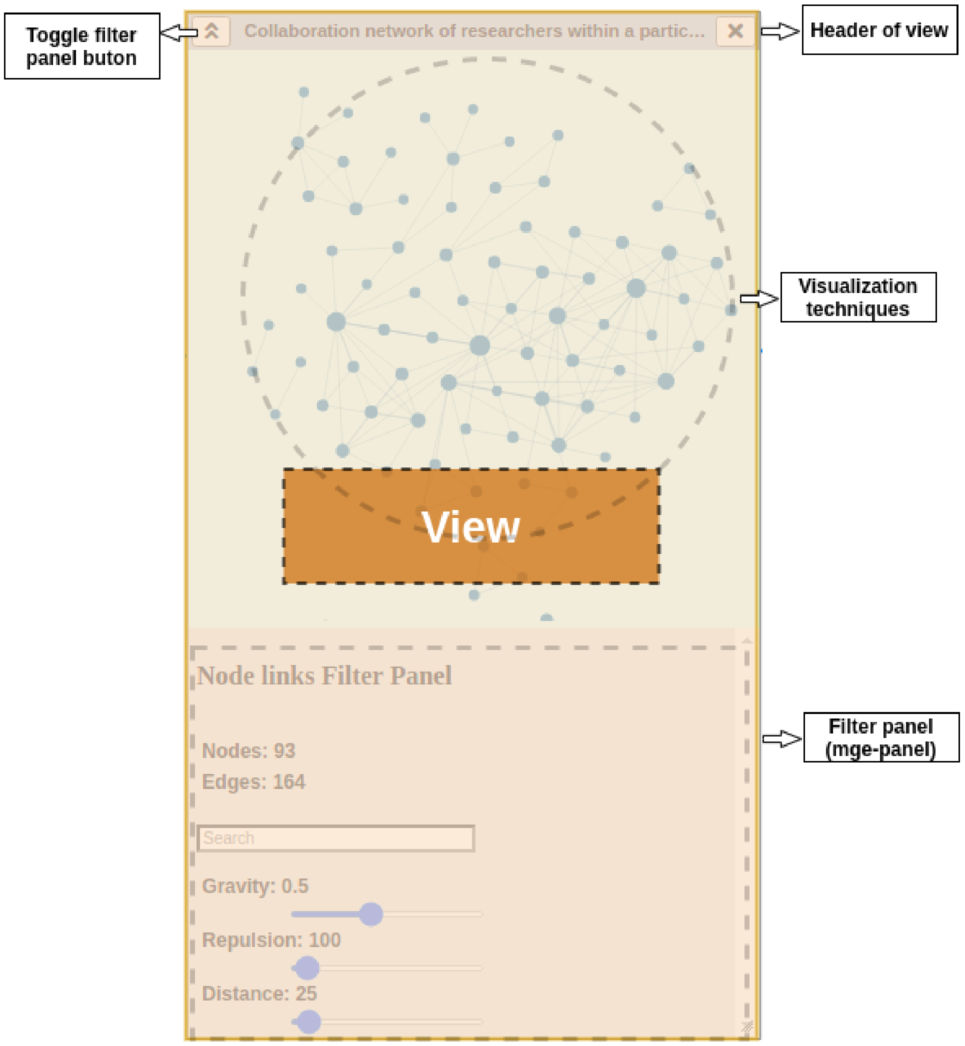


Figure 5: View component

This is an example to create a view element:

```
<mge-view x="50" y="50" data="data-1" type-vis="mge-nodelink" id-view="chart-1" class="DS-viewArea hydra
title="Collaboration network of researchers within a particular institution (HAL)">
```

```
</mge-view>
```

Properties

Property	Attribute	Description	Type	Default
`_barTitleHeight`	`bar-title-height`	Title bar height	`number`	`15`
`_center`	–	View center point	`{ cx: number; cy: number; }`	`{ cx: 0, cy: 0 }`
`_chart`	`_chart`	Chart associated with view	`any`	`undefined`
`_content`	`_content`	Div that represents the content includes chart of a view	`any`	`undefined`
`_dimView`	–	View dimensions	`{ width: number; height: number; }`	`{ width: 10, height: 10 }`
`_filter`	`_filter`	Div that represents the filter panel of a view	`any`	`undefined`
`_position`	–	View current position	`{ x: number; y: number; }`	`{ x: 0, y: 0}`
`_top`	`_top`	Div that represents the header part of a view	`any`	`undefined`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the view displayed by the window	`number`	`400`
`idDash`	`id-dash`		`string`	`undefined`
`idView`	`id-view`	represents ID of the view	`string`	`undefined`
`title`	`title`	The title of the view	`string`	`"[]"`
`typeVis`	`type-vis`	represents type of visualization technique displayed via content of the view	`string`	`undefined`
`viewDiv`	`view-div`	Div that represents the view included	`any`	`undefined`
`width`	`width`	represents the width of the view displayed by the window	`number`	`400`
`x`	`x`	x-coordinate (The horizontal value in a pair of coordinates) of view's position	`number`	`0`
`y`	`y`	y-coordinate (The vertical value in a pair of coordinates) of view's position	`number`	`0`

Methods

Public methods

- `_refreshBarTitle() => Promise<void>`

  Description Refresh bar title width when we resize the windown

  Returns

  Type: `Promise<void>`

- `_showChart(node: any, parentId: any, typeChart: any, isFromEdge?: boolean, secondNode?: any, isFromCluster?: boolean, isFromHC?: boolean, newQuery?: any) => Promise<any>`

  Description This function allows to create a new view from current view. After create a new view , it will be added to the dashboard with a generated title

  Returns

Type: `Promise<any>`

- `generateTitle(node: any, data: any, _typeChart: any, parentId: any, isFromEdge: boolean, secondNode: any, isFromCluster: boolean, isFromHC: boolean) => Promise<any>`

  Description This funtion is to generate the title of the view window it depends on the type chart to generate

  Returns

  Type: `Promise<any>`

- `getCenter() => Promise<{ cx: number; cy: number; }>`

  Description Get current center position of the view

  Returns

  Type: `Promise<{ cx: number; cy: number; }>`

- `getChart() => Promise<any>`

  Description

  Get the selection of the visualization technique element which containing in this view

  Returns

  Type: `Promise<any>`

- `getPosition() => Promise<{ x: number; y: number; }>`

  Description Get current position of the view

  Returns

  Type: `Promise<{ x: number; y: number; }>`

- `idChart() => Promise<string>`

  Description Get ID of the view

  Returns

  Type: `Promise<string>`

- `refresh() => Promise<void>`

  Description this function allows to Refresh position of the view

  Returns

  Type: `Promise<void>`

- `setCenter(x: any, y: any) => Promise<void>`

  Description Set new center point for the view Inputs are coordinates (x and y) of new center position

  Returns

  Type: `Promise<void>`

- `setPosition(x: any, y: any) => Promise<void>`

  Description Set new position for the view Inputs are coordinates : x and y

  Returns

  Type: `Promise<void>`

- `setTitle(_: any) => Promise<void>`

  Description This function allows to set new title for the view

  Returns

  Type: `Promise<void>`

- `setVisible(status: any) => Promise<void>`

  Description Set visible for all contents in view if input status is true, the content wil be visible if input status is false, the content will be hidden

  Returns

  Type: `Promise<void>`

Private methods *Initial functions*

- `setResizable() => <void>`

  Description This function allows to set resizable to the view. The view can be resized vertically and horizontally with the mouse. It consists of defining 3 functions at three event times (initialization, execution and stopping).

  Returns

  Type: `<void>`

- `_initAction() => <void>`

  Description This function allows to set resizable to the view. The view can be resized vertically and horizontally with the mouse. It consists of defining 3 functions at three event times (initialization, execution and stopping).

  Returns

  Type: `<void>`

- `buildChart(div:any) => Promise<void>`

  Description This function allows to create all content in the view. In this function, it will call 3 another functions to create a header content bar, a particular visualization tecnique and a filter panel (`mge-panel`).

  Returns

  Type: `Promise<void>`

- `addTopContent() => Promise<void>`

  Description This function allows to create a header bar.

  Returns

  Type: `<void>`

- `addFilterContent(div:any) => Promise<void>`

  Description This function allows to create a filter panel. It will create a `mge-panel` and add it to the view to manage it.

  Returns

  Type: `<void>`

- `addChartContent(div:any) => <void>`

  Description This function allows to create a particular visualization technique. After that, it will be added to the view to manage. **Returns**

  Type: `<void>`

Eventlistener functions

- `_onContextMenu(event:event) => <void>`

  Description This function allows to create a context menu. This function will be called when click right mouse. A list of visualization techniques will be shown after clicking. The content inside this list will depend on the element you right click on **Returns**

  Type: `<void>`

- `_dblClickAction(event:event) => <void>`

  Description This function is call when user double click on some particular elements **Returns**

  Type: `<void>`

- `_onMouseOverContent(event:event, d:any) => <void>`

  Description This function is call when user move mouse over some particular elements. The tooltip will appear. **Returns**

  Type: `<void>`

- `_onMouseOutContent(event:event, d:any) => <void>`

  Description This function is call when user move mouse out some particular elements. The tooltip will disappear. **Returns**

  Type: `<void>`

- `_findParentDiv(clickedElem:any) => <selection>`

  Description This function allow to find a parent hydrated div of clicked element. **Returns**

  Type: `<selection>`

3.5. mge-history

General History panel displays the exploration path in a hierarchical format to indicate the dependencies between views and supports quick recovery of the multiple analytical paths that emerge from a particular view

To create a history panel element

```
<mge-history id="chart-history" class="hydrated" height="250" width="350">
</mge-history>
```

Properties

Property	Attribute	Description	Type	Default
`_dashboard`	`_dashboard`	The parent dashboard	`any`	`undefined`
`_grpHistory`	`_grp-history`	Group representing history tree	`any`	`null`
`_grpNodes`	`_grp-nodes`	Group representing nodes in the tree	`any`	`null`
`_leftText`	`_left-text`	Distance from the text to the left coordinate of the node	`number`	`18`
`_nodeMargin`	`_node-margin`	Margin css of the node	`number`	`1`

Property	Attribute	Description	Type	Default
`_nodoHeight`	`_nodo-height`	Space height for each node without the margins	`number`	`14`
`_rectHeight`	`_rect-height`	The height symbol	`number`	`this._nodoHeight - this._nodeMargin*2`
`_treeLayout`	`_tree-layout`	The tree layout to stored tree data	`any`	`tree().size([0, this._nodoHeight ])`
`_vNodes`	–	Vector with objects of all nodes	`any[]`	`[]`
`height`	`height`	represents the height of the history panel	`number`	`250`
`historyTreePanel`	`history-tree-panel`	Represents the panel associated with the graphic	`any`	`null`
`width`	`width`	represents the width of the history panel	`number`	`350`

Methods

Public methods

- `addHistoryTreeChart(idDiv: any, divTag: any) => Promise<void>`

  Description The initial function to create all of elements in the history treechart In this function, it will set Geometric attributes of the graph create actions on graph and manage all of the interaction on the graph

  Returns

  Type: `Promise<void>`

- `setBox(_: any) => Promise<any>`

  Description Set box size for the chart includes the content input is a object includes height and width If no arguments, It will return the value of box

  Returns

  Type: `Promise<any>`

- `setData(_: any) => Promise<any>`

  Description This function is to set the data to the chart If no arguments, It will return the value of data The data model will be display bellow section

  Returns

  Type: `Promise<any>`

- `setTree(newTree: any) => Promise<void>`

  Description This function is to set the data to the tree history data

  Returns

  Type: `Promise<void>`

Private methods

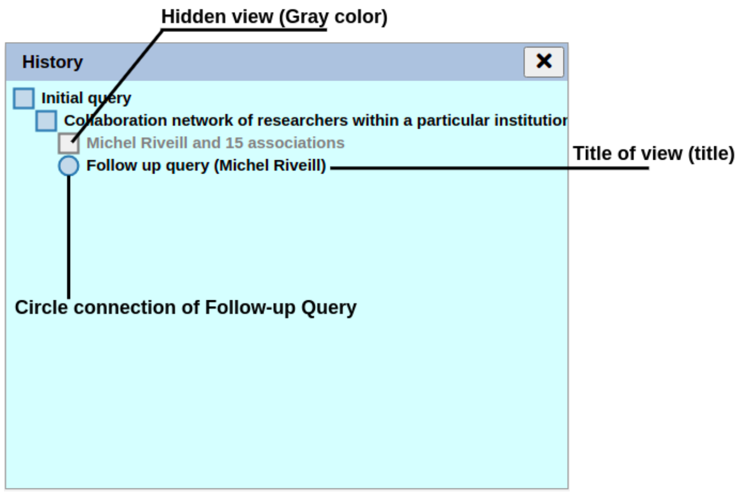

Hidden view (Gray color)
History
Initial query
Collaboration network of researchers within a particular institutior
Michel Riveill and 15 associations
Follow up query (Michel Riveill)
Title of view (title)
Circle connection of Follow-up Query

Figure 6: History panel component

Data model

```
{
  "type": "object",
  "required": [],
  "properties": {
    "id": {
      "type": "string",
      "description": "Unique destination of views in the dashboard"

    },
    "title": {
      "type": "string",
      "description": "Text title of views in the dashboard"
    },
    "hidden": {
      "type": "string",
      "description": "To show whether the visibility of the view is hidden or visible"

    },
    "x": {
      "type": "number",
      "description": "To show horizontal coordinate of position of the view"

    },
    "y": {
      "type": "number",
      "description": "To show vertical coordinate of position of the view"
    },
    "view": {
      "type": "object",
      "required": [],
      "description": "To store instance of the view component"
      }
    },
    "parentNode": {
      "type": "Node ",
      "description": "Node instance containing the current view"
    },
    "isLeaf": {
      "type": "string",
      "description": "return true if the view is leaf and return false if it's not a leaf"
    },
    "link": {
      "type": "string",
      "description": "To show all links and connections of this view to another views"

    },
    "children": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "id": {
              "type": "string",
              "description": "Unique destination of children view"

            },
            "title": {
              "type": "string",
              "description": "Text title of children view"
            },
            "hidden": {
              "type": "string",
              "description": "To show whether the visibility of the children view is hidden or visible"

            },
            "x": {
              "type": "number",
              "description": "To show horizontal coordinate of position of the children view"

            },
            "y": {
              "type": "number",
              "description": "To show vertical coordinate of position of the children view"
            },
            "view": {
              "type": "object",
              "required": [],
              "description": "To store instance of the children view component"
              }
            },
            "parentNode": {
              "type": "Node ",
              "description": "Node instance containing the children view"
            },
            "isLeaf": {
              "type": "string",
              "description": "return true if the children view is leaf and return false if it's not a le
            },
          "link": {
            "type": "object",
            "required": [],
            "properties": {
              "line": {
                "type": "object",
                "required": [],
              },
              "conect": {
                "type": "object",
                "required": [],
              },
              "visible": {
                "type": "boolean",
                "description": "return true if the view is visible and return false if it's hidden"
              }
            }
          }
        }
      }
    }
  }
}
```

4. Implementing visualization techniques (extending mge-view)

General Visualization techniques are useful to explore data by enabling the discovery of meaningful patterns and causal relationships. The discovery process is often exploratory and requires multiple views to support analyzing different or complementary perspectives to the data.

In MGExplore, we have 6 pre-defined visualization technique to explore data:

```
- History bar chart (`mge-barchart`)
- Clustervis chart (`mge-clustervis`)
- Glyph matrix chart (`mge-glyph-matrix`)
- Iris chart (`mge-iris`)
- List of papers(`mge-listing`)
- Node-edges chart (`mge-nodelink`)
```

Every visualization technique components will have a set of common methods. This is a list of common methods:

Common methods

- `setBox(_: any) => Promise<any>`

  Description Set box size for the chart includes the content input is a object includes height and width If no arguments, It will return the value of box

  Returns

  Type: `Promise<any>`

- `setData(_: any) => Promise<any>`

  Description This function is to set the data to the chart If no arguments, It will return the value of data The data model will be display bellow section

Returns

Type: `Promise<any>`

- `setPanel(_: any) => Promise<any>`

  Description This function is required in all techniques It is called internally to add connection between chart and filter panel If no arguments, It will return the filter panel which has same view with chart.

  Returns

  Type: `Promise<any>`

4.1. mge-barchart

General The Bar Chart technique shows the distribution of data attributes' value for an item or set of items. In our case study, the x-axis encodes temporal information, while the y-axis encodes the counting of co-publications. The data is displayed as a single bar per time period or multiple colored bars to represent categorical information of attributes

To create a histogram bar chart element

```
<mge-barchart dataset-name="data-1" id="chart-3" class="hydrated">
</mge-barchart>
```

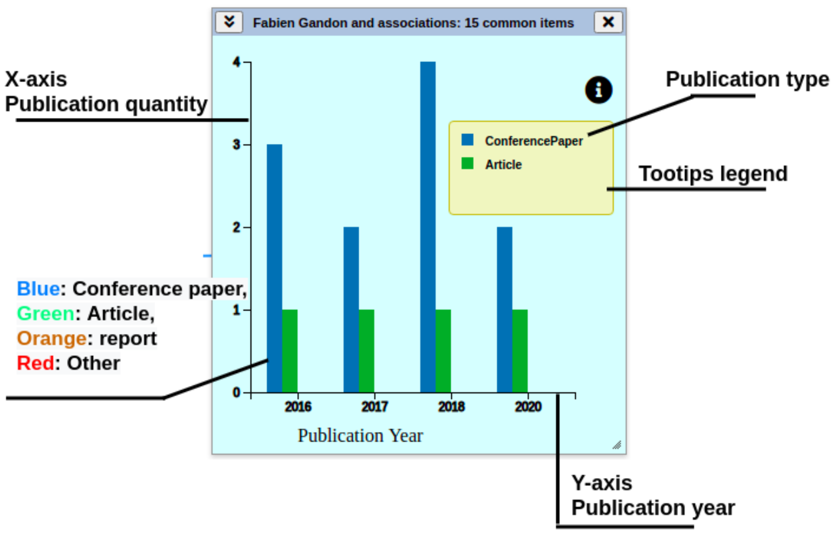


Figure 7: Histogram chart component

Properties

Property	Attribute	Description	Type	Default
`_cfgIndexAttr`	`cfg-index-attr`	Contains the indexes of the attributes that can be configured in the graph	`any`	`undefined`
`_colorsBars`	`_colors-bars`	colors for the different attributes	`any`	`undefined`
`_documentTypes`	`document-types`	keeps data on the different types of documents (attributes)	`any`	`undefined`
`_grpHistogram`	`grp-histogram`	Group representing Histogram	`any`	`undefined`
`_histogramData`	`histogram-data`	keeps the count of documents per year and type	`any`	`undefined`
`_innerRadius`	`_inner-radius`	(calculated) radius of the circle where the centroid is inserted	`any`	`undefined`

Property	Attribute	Description	Type	Default
`_irisPanel`	`_iris-panel`	represents the panel associated with the graph	`any`	`undefined`
`_maxHeightBar`	`_max-height-bar`	(calculated) distance occupied by the bars	`any`	`undefined`
`_nbOfTypesDoc`	`_nb-of-types-doc`	Number of types of documents in the base	`any`	`undefined`
`_outerRadius`	`_outer-radius`	(calculated) Outernal circle radius where the graph is drawn	`any`	`undefined`
`_vOrder`	`_v-order`	Indirect ordering vector	`any`	`undefined`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the Histogram chart	`number`	`350`
`width`	`width`	represents the width of the Histogram chart	`number`	`350`

Data model

```json
{
  "type": "object",
  "required": [],
  "properties": {
    "root": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "valueTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "imageTitle": {
          "type": "string"
        },
        "data": {
          "type": "object",
          "required": [],
          "properties": {
            "id": {
              "type": "number"
            },
            "idOrig": {
              "type": "number"
            },
            "labels": {
              "type": "array",
              "items": {
                "type": "string"
              }
            },
            "values": {
```

```
          "type": "array",
          "items": {
            "type": "number"
          }
        },
        "images": {
          "type": "string"
        },
        "documents": {
          "type": "array",
          "items": {
            "type": "object",
            "required": [],
            "properties": {
              "type": {
                "type": "object",
                "required": [],
                "properties": {
                  "label": {
                    "type": "string"
                  },
                  "index": {
                    "type": "string"
                  }
                }
              },
              "title": {
                "type": "string"
              },
              "link": {
                "type": "string"
              },
              "date": {
                "type": "string"
              },
              "authors": {
                "type": "array",
                "items": {
                  "type": "number"
                }
              }
            }
          }
        }
      }
    }
  }
},
"children": {
  "type": "object",
  "required": [],
  "properties": {
    "labelTitle": {
      "type": "array",
      "items": {
        "type": "string"
      }
    },
    "valueTitle": {
      "type": "array",
      "items": {
        "type": "string"
      }
    },
    "imageTitle": {
      "type": "string"
    },
    "cluster": {
      "type": "string"
    },
    "data": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "id": {
            "type": "number"
          },
          "idOrig": {
            "type": "number"
          },
          "labels": {
            "type": "array",
            "items": {
              "type": "string"
            }
          },
          "values": {
            "type": "array",
            "items": {
              "type": "number"
            }
          },
          "images": {
            "type": "string"
          }
        }
      }
    },
    "others": {
      "type": "array",
      "items": {
        "type": "string"
      }
    }
  }
}
```

```
  }
}
```

Methods

Public Methods

- `_closeToolTip() => Promise<void>`

  Description

  Returns

Type: `Promise<void>`

- `_openToolTip() => Promise<void>`

  Description

  Returns

Type: `Promise<void>`

- `acSortExecAttribute() => Promise<void>`

  Description

  Returns

Type: `Promise<void>`

- `acSortExecText() => Promise<void>`

  Description

  Returns

Type: `Promise<void>`

- `dataVisToNode(index: any) => Promise<any>`

  Description This function will return the children data from children list in data model. The iput is index of children data.

  Returns

  Type: `Promise<any>`

- `getSourceObject() => Promise<any>`

  Description This function will return the root object data

  Returns

  Type: `Promise<any>`

- `getVOrder() => Promise<any>`

  Description This function will return the indirect ordering vector

  Returns

  Type: `Promise<any>`

- `setConfigCentroid(titulo: any, tituloGrau: any, textoBarra: any) => Promise<void>`

  Description Configure the data that will be printed in the centroid and the text of the bar (Label only)

Returns

Type: `Promise<void>`

- `setIndexAttrBar(_: any) => Promise<any>`

Description This function will set value of index of the attribute that will be plotted in the toolbar

Returns

Type: `Promise<any>`

- `setpInnerRadius(_: any) => Promise<any>`

  Description Set value of Percentage relative to graph width for `_innerRadius` calculation If no arguments, It will return the value of pInnerRadius

  Returns

  Type: `Promise<any>`

- `setpMaxHeightBar(_: any) => Promise<any>`

  Description This function will set maximum value for height of bars

  Returns

  Type: `Promise<any>`

- `setpOuterRadius(_: any) => Promise<any>`

  Description Set value of Percentage relative to graph width for `_OuterRadius` calculation If no arguments, It will return the value of pOuterRadius

  Returns

  Type: `Promise<any>`

Private methods

- `addHistogramChart(idDiv: any, divTag: any) => <void>`

  Description The initial function to create all of elements in the histogram chart In this function, it will set Geometric attributes of the graph create actions on graph and manage all of the interaction on the graph

  Returns

  Type: `<void>`

4.2. mge-clustervis

General The ClusterVis technique depicts clusters according to some relationship among data items. It has a multi-ring layout, where the innermost ring is formed by the data items (represented by circles), and the remaining rings display the data

To create a clusterVis chart element

```
<mge-clustervis dataset-name="data-1" id="chart-4" class="hydrated" height="350" width="350">
</mge-clustervis>
```

Properties

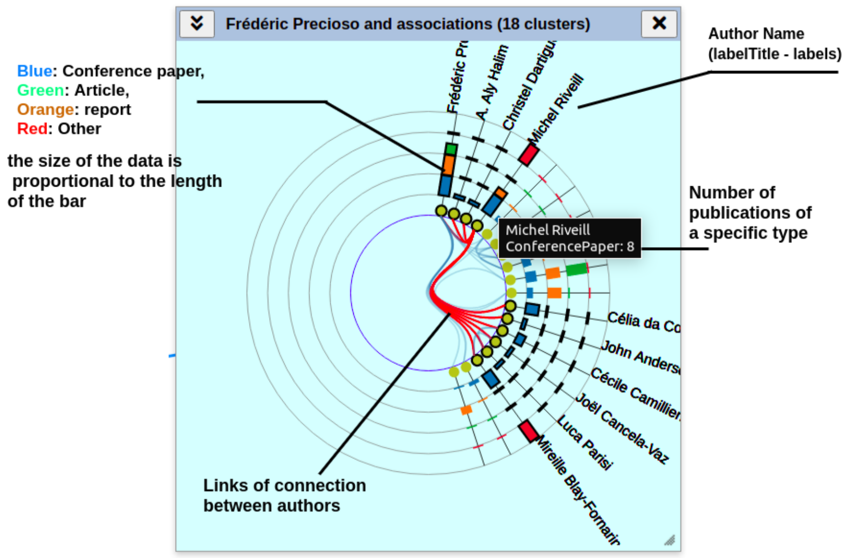


Figure 8: ClusterVis chart component

Property	Attribute	Description	Type	Default
`_clusterVisPanel`	`_cluster-vis-panel`	Represents the panel associated with the graphic	`any`	`null`
`_drawLine`	`_draw-line`	Generator of splines that makes up the edges	`any`	`undefined`
`_grpBars`	`_grp-bars`	Selection that contains all groups that store the bars	`any`	`null`
`_grpCluster`	`_grp-cluster`	Group representing ClusterVis	`any`	`null`
`_grpLinks`	`_grp-links`	Selection that contains all groups that store the links	`any`	`null`
`_grpRings`	`_grp-rings`	Selection that contains all groups that store the rings	`any`	`null`
`_innerRadius`	`_inner-radius`	(calculated) Internal circle radius where the graph is drawn	`number`	`0`
`_links`	`_links`	Selection that contains the links	`any`	`null`
`_outerRadius`	`_outer-radius`	(calculated) Outernal circle radius where the graph is drawn	`number`	`0`
`_sameScale`	`_same-scale`	Indicates that the same scale should be used for all bars	`boolean`	`false`
`_xClusterCenter`	`_x-cluster-center`	Coordinate x of the center of the cluster	`number`	`0`
`_yClusterCenter`	`_y-cluster-center`	Coordinate y of the center of the cluster	`number`	`0`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the Cluster chart	`number`	`350`
`width`	`width`	represents the width of the Cluster chart	`number`	`350`

Data model

```
{
  "type": "object",
  "required": [],
  "properties": {
    "nodes": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "array",
          "items": {
            "type": "string"
            "required": [],
            "properties": {
              "id": {
                "type": "string"
              },
              "idBD": {
                "type": "string"
              },
              "labels": {
                "type": "array",
                "items": {
                  "type": "string"
                }
              },
              "values": {
                "type": "array",
                "items": {
                  "type": "number"
                }
              },
              "images": {
                "type": "string"
              },
              "idOrig": {
                "type": "string"
              },
              "idCluster": {
                "type": "number"
              },
              "qtNodes": {
                "type": "number"
              },
              "visible": {
                "type": "boolean"
              },
              "cluster": {
                "type": "array"
              }
            }
          }
        },
      }
    },
    "edges": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "string"
        },
        "valueTitle": {
          "type": "array",
          "items": {
            "type": "string"
```

```
          }
        },
        "dataEdges": {
          "type": "array",
          "items": {
            "type": "object",
            "required": [],
            "properties": {
              "src": {
                "type": "string"
              },
              "tgt": {
                "type": "number"
              },
              "labels": {
                "type": "string"
              },
              "values": {
                "type": "array",
                "items": {
                  "type": "number"
                }
              },
            }
          }
        },
      }
    },
}
```

Methods

Public methods

`acAlteraAnel(indexAnel: any, indexAttr: any) => Promise<void>` Returns

Type: `Promise<void>`

`acSameScale(checked: any) => Promise<void>` Returns

Type: `Promise<void>`

`acSortExec(_: any) => Promise<void>` Returns

Type: `Promise<void>`

`addAttribute(_indexAttr: any, _typeAttr: any) => Promise<void>` Returns

Type: `Promise<void>`

`addClusterChart(idDiv: any, divTag: any) => Promise<void>` The initial function to create all of elements in the cluster chart In this function, it will set Geometric attributes of the graph create actions on graph and manage all of the interaction on the graph

Returns

Type: `Promise<void>`

`alteraAttribute(_indexAnel: any, _indexAttr: any, _typeAttr: any) => Promise<void>` Returns

Type: `Promise<void>`

`obtemRings() => Promise<any[]>` Returns

Type: `Promise<any[]>`

`removeAnelExterno() => Promise<void>` Returns

Type: `Promise<void>`

`setIndexAttrSort(_: any) => Promise<number>` Returns

Type: `Promise<number>`

`setpInnerRadius(_: any) => Promise<any>` Set value of Percentage relative to graph width for `_innerRadius` calculation If no arguments, It will return the value of pInnerRadius

Returns

Type: `Promise<any>`

`setpOuterRadius(_: any) => Promise<any>` Set value of Percentage relative to graph width for `_OuterRadius` calculation If no arguments, It will return the value of pOuterRadius

Returns

Type: `Promise<any>`

Private methods

`_angleToWidth(angle: any, radius: any) => Promise<number>` Calculates the sector width from the angle and a radius E: width, radius S: angle in degrees

Returns

Type: `Promise<number>`

`_calcCoordinates(dataNodes: any) => Promise<void>` Calculates the coordinates of the leaf nodes

Returns

Type: `Promise<void>`

`_calcGeometry(data: any) => Promise<void>` Calculates all geometric parameters for ClusterVis display

Returns

Type: `Promise<void>`

`_getEdges(dados: any, nodes: any) => Promise<any[]>` Generates a vector with the list of edges in the format: [{source:Object, target: Object},. . .]

Returns

Type: `Promise<any[]>`

`_getTree(heightTree: any, dados: any, degree: any, vOrder: any) => Promise<any>` Generates a tree in the format { id:. . . , chidren[] }

Returns

Type: `Promise<any>`

`_updateMaxRings() => Promise<void>` Returns

Type: `Promise<void>`

`_widthToAngle(width: any, radius: any) => Promise<number>` Calculates the angle of the occupied sector by a width E: width, radius S: angle in degrees

Returns

Type: `Promise<number>`

4.3. mge-glyph-matrix

General The GlyphMatrix technique is based on a matrix where rows and columns represent data items in a cluster, and the cells contain glyphs encoding attributes that describe a pairwise relationship. The default glyph is a star-plot-like shape, with a variable number of axes used to encode values of selected data attributes. By pointing a glyph in the matrix, it is possible.

To create a Glyph matrix chart element

```
<mge-glyph-matrix dataset-name="data-1" id="chart-5" class="hydrated" height="350" width="350">
</mge-glyph-matrix>
```

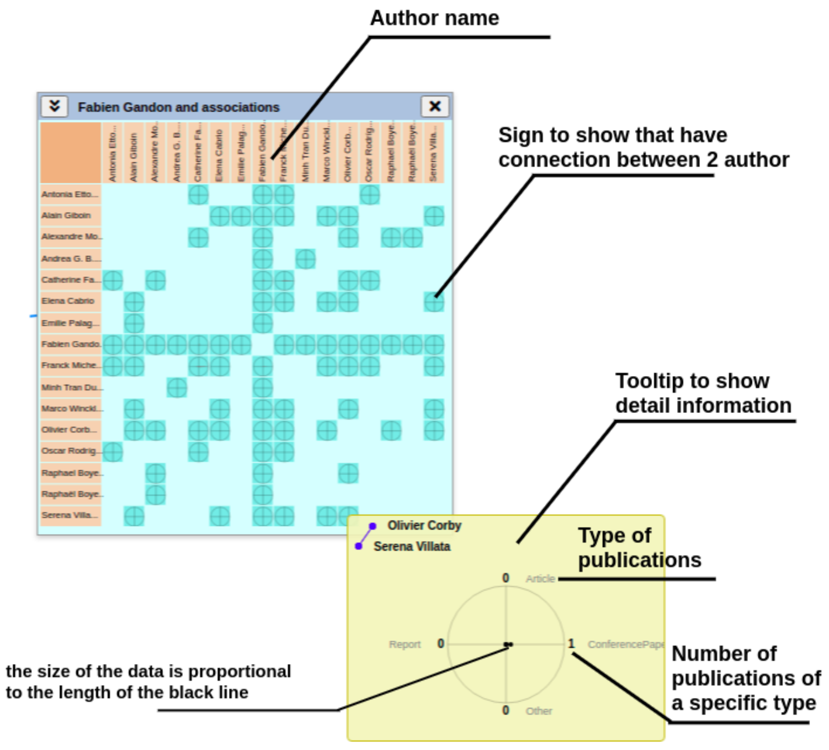

Author name
Fabien Gandon and associations
Sign to show that have connection between 2 author
Tooltip to show detail information
Olivier Corby
Serena Villata
Type of publications
Article
Report
ConferencePape
Other
Number of publications of a specific type
the size of the data is proportional to the length of the black line

Figure 9: Glyph matrix chart component

Properties

Property	Attribute	Description	Type	Default
`_cellCoordScale`	`_cell-coord-scale`	Scale is used to determine the coordinates of cells and legend elements	`any`	`scaleBand()`
`_cellGlyph`	`_cell-glyph`	keeps data on the different types of documents (attributes)	`any`	`NumericGlyph(0)`
`_dragListenerL`	`_drag-listener-l`	Listener of legends	`any`	`null`
`_dragListenerM`	`_drag-listener-m`	Listener of Matrix	`any`	`null`
`_grpBarsLL`	`_grp-bars-l-l`	Select with all groups from left side legend bar	`any`	`null`
`_grpBarsTL`	`_grp-bars-t-l`	Select with all groups from top side legend bar	`any`	`null`
`_grpLeftLegend`	`_grp-left-legend`	Select with left side legend bar	`any`	`null`
`_grpLines`	`_grp-lines`	Contains lines with cells in each line	`any`	`null`
`_grpMatrix`	`_grp-matrix`	Select with matrix chart	`any`	`null`
`_grpMatrixGlyph`	`_grp-matrix-glyph`	keeps data on the different types of documents (attributes)	`any`	`null`
`_grpOverview`	`_grp-overview`	The group represents the matrix overview	`any`	`null`
`_grpTopLegend`	`_grp-top-legend`	Select with top side legend bar	`any`	`null`
`_idClipLeft`	`_id-clip-left`	Left legend clipping area id	`any`	`undefined`
`_idClipMatrix`	`_id-clip-matrix`	Matrix clipping area id	`any`	`undefined`
`_idClipTop`	`_id-clip-top`	Top legend clipping area id	`any`	`undefined`
`_indexAttrLegend`	`_index-attr-legend`	The index of the attribute will be printed in the legend (node)	`number`	`0`
`_indexAttrSort`	`_index-attr-sort`	Attribute index used for sorting	`number`	`0`
`_matrixGlyphPanel`	`_matrix-glyph-panel`	Group represents the entire chart	`any`	`null`
`_matrixHeight`	`_matrix-height`	Matrix area height (calculated)	`number`	`0`
`_matrixWidth`	`_matrix-width`	Matrix area width (calculated)	`number`	`0`
`_overviewScale`	`_overview-scale`	Scale is used to set the coordinates of the overview cursor	`any`	`scaleLinear()`
`_vOrder`	`_v-order`	Indirect ordering vector	`any`	`null`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the matrix chart	`number`	`350`
`width`	`width`	represents the width of the matrix chart	`number`	`350`

Data model

```json
{
  "type": "object",
  "required": [],
  "properties": {
    "nodes": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "valueTitle": {
          "type": "array",
          "items": {
```

```
        "type": "string"
      }
    },
    "imageTitle": {
      "type": "string"
    },
    "dataNodes": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "id": {
            "type": "string"
          },
          "idOrig": {
            "type": "number"
          },
          "labels": {
            "type": "array",
            "items": {
              "type": "string"
            }
          },
          "values": {
            "type": "array",
            "items": {
              "type": "number"
            }
          },
          "images": {
            "type": "string"
          }
        }
      }
    }
  }
},
"edges": {
  "type": "array",
  "items": {
    "type": "string"
  }
},
"matrix": {
  "type": "array",
  "items": {
    "type": "array",
    "items": {
      "type": "object",
      "required": [],
      "properties": {
        "x": {
          "type": "number"
```

```
            },
            "y": {
              "type": "string"
            },
            "exist": {
              "type": "boolean"
            },
            "labels": {
              "type": "string"
            },
            "values": {
              "type": "array",
              "items": {
                "type": "number"
              }
            }
          }
        }
      }
    }
  }
}
```

Methods

`_adjustLengthText(stText: any, limit: any) => Promise<any>` Adjusts the size of the text that will be printed in the centroid title

Returns

Type: `Promise<any>`

`_calcHeightCell() => Promise<any>` Calculate cell height/width. So is the comment bar

Returns

Type: `Promise<any>`

`_calcVisibleLines() => Promise<void>` Determines limits for visible lines

Returns

Type: `Promise<void>`

`_limCoord(coord: any) => Promise<any>` Limit the coordinate value

Returns

Type: `Promise<any>`

`_onMouseEnterNode(event: any, d: any) => Promise<void>` Returns

Type: `Promise<void>`

`_onMouseLeaveNode(event: any, d: any) => Promise<void>` Returns

Type: `Promise<void>`

`acChangeAttrLegend(_: any) => Promise<void>` Returns

Type: `Promise<void>`

`acChangeVisibleLines(qtLines: any) => Promise<void>` Returns

Type: `Promise<void>`

`acSortExec(_: any) => Promise<void>` Returns

Type: `Promise<void>`

`addMatrixGlyph(idDiv: any, divTag: any) => Promise<void>` The initial function to create all of elements in the Matrix Glyph chart In this function, it will set Geometric attributes of the graph create actions on graph and manage all of the interaction on the graph

Returns

Type: `Promise<void>`

`cellColorsMap(colors: any) => Promise<void>` Returns

Type: `Promise<void>`

`debug() => Promise<void>` Returns

Type: `Promise<void>`

`getMaxVisibleLines() => Promise<number>` Returns

Type: `Promise<number>`

`getMinVisibleLines() => Promise<number>` Returns

Type: `Promise<number>`

`getVisibleLines() => Promise<number>` Returns

Type: `Promise<number>`

`glyph(_: any) => Promise<any>` Returns

Type: `Promise<any>`

`indexAttrCellColor(_: any) => Promise<number>` Returns

Type: `Promise<number>`

`indexAttrLegend(_: any) => Promise<number>` Returns

Type: `Promise<number>`

`indexAttrSort(_: any) => Promise<number>` Returns

Type: `Promise<number>`

`pFontHeight(_: any) => Promise<any>` Returns

Type: `Promise<any>`

pLegendWidth(_: any) => Promise<any> Returns

Type: `Promise<any>`

setTTMatrixCell(_: any) => Promise<void> Returns

Type: `Promise<void>`

4.4. mge-iris

General The IRIS technique allows isolating a data item of interest (at the center) and showing all other data items with which it has a specific relationship in a circular view [25]. The data attributes of such pairwise relationships are encoded by the height and color of a bar placed between the item of interest and each related item. The user can place any item in the field of view

To create a Iris chart element

```
<mge-iris dataset-name="data-1" id="chart-2" class="hydrated" height="350" width="350">
</mge-iris>
```

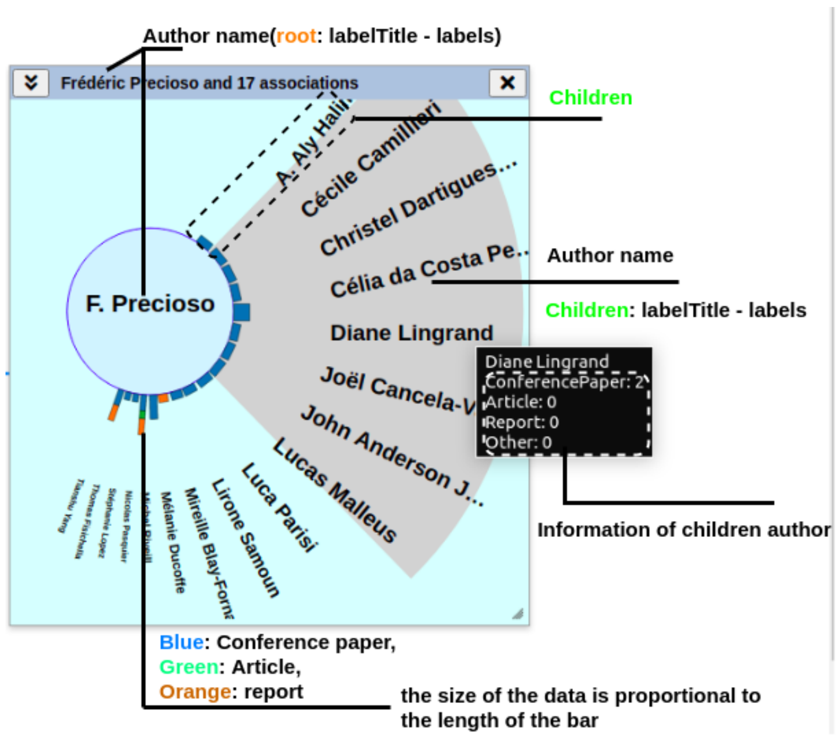


Figure 10: Iris chart component

Properties

Property	Attribute	Description	Type	Default
`_cfgIndexAttr`	`cfg-index-attr`	Contains the indexes of the attributes that can be configured in the graph	`any`	`undefined`
`_colorsBars`	`_colors-bars`	colors for the different types	`any`	`undefined`
`_dataVis`	`_data-vis`	Vector of visible data. Points to the elements of model.data	`any`	`undefined`
`_fishEyeArea`	`_fish-eye-area`	Contains the attribute of the fish eye area	`any`	`undefined`

Property	Attribute	Description	Type	Default
`_focusArea`	`_focus-area`	Contains the attribute of the focused area	`any`	`undefined`
`_grpBars`	`_grp-bars`	Selection that contains all groups of bars	`any`	`undefined`
`_grpIris`	`_grp-iris`	Group representing IRIS	`any`	`undefined`
`_hiddenArea`	`_hidden-area`	Contains the attribute of the hidden area	`any`	`undefined`
`_indexFirstData`	`_index-first-data`	Index in the “dataVis” vector where the first element of the data vector is located	`any`	`undefined`
`_innerRadius`	`_inner-radius`	(calculated) radius of the circle where the centroid is inserted	`any`	`undefined`
`_irisPanel`	`_iris-panel`	The dataset name being used	`any`	`undefined`
`_maxHeightBar`	`_max-height-bar`	(calculated) distance occupied by the bars	`any`	`undefined`
`_minArea`	`_min-area`	Contains the attribute of the minimum area	`any`	`undefined`
`_nbOfTypesDoc`	`_nb-of-types-doc`	number of types of documents in the base	`any`	`undefined`
`_numMaxBars`	`_num-max-bars`	Maximum number of the bars	`any`	`undefined`
`_numTotalBars`	`_num-total-bars`	Total number of the bars	`any`	`undefined`
`_orders`	`_orders`	The orders of typesDocs	`any`	`undefined`
`_outerRadius`	`_outer-radius`	(calculated) Outernal circle radius where the graph is drawn	`any`	`undefined`
`_pDesloc`	`_p-desloc`	Percentage of center displacement	`any`	`undefined`
`_vOrder`	`_v-order`	Indirect ordering vector	`any`	`undefined`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the Iris chart	`number`	`350`
`width`	`width`	represents the width of the Iris chart	`number`	`350`

Data model

```
{
  "type": "object",
  "required": [],
  "properties": {
    "root": {
      "type": "object",
      "required": [],
      "properties": {
        "labelTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "valueTitle": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "imageTitle": {
          "type": "string"
        },
        "data": {
          "type": "object",
          "required": [],
          "properties": {
```

```
        "id": {
          "type": "number"
        },
        "idOrig": {
          "type": "number"
        },
        "labels": {
          "type": "array",
          "items": {
            "type": "string"
          }
        },
        "values": {
          "type": "array",
          "items": {
            "type": "number"
          }
        },
        "images": {
          "type": "string"
        }
      }
    }
  }
},
"children": {
  "type": "object",
  "required": [],
  "properties": {
    "labelTitle": {
      "type": "array",
      "items": {
        "type": "string"
      }
    },
    "valueTitle": {
      "type": "array",
      "items": {
        "type": "string"
      }
    },
    "imageTitle": {
      "type": "string"
    },
    "data": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "id": {
            "type": "number"
          },
          "idOrig": {
            "type": "number"
          },
          "labels": {
            "type": "array",
            "items": {
              "type": "string"
            }
          },
          "values": {
            "type": "array",
            "items": {
              "type": "number"
            }
          },
          "images": {
            "type": "string"
          },
          "edge": {
            "type": "object",
            "required": [],
            "properties": {
              "src": {
                "type": "number"
              },
              "tgt": {
                "type": "number"
              },
              "labels": {
                "type": "string"
              },
              "values": {
                "type": "array",
                "items": {
                  "type": "number"
                }
              }
            }
          }
        }
      }
    }
  }
},
"edges": {
  "type": "object",
  "required": [],
  "properties": {
    "labelTitle": {
      "type": "string"
    },
    "valueTitle": {
      "type": "array",
      "items": {
        "type": "string"
        }
      },
      "data": {
        "type": "array",
        "items": {
          "type": "string"
        }
      }
    }
  }
}
}
```

Methods

Public methods

- `_getTheRightOrder(i: any) => Promise<any>`

  Description Returns the order in which we need to display the types of documents

  Returns

  Type: `Promise<any>`

- `acSortExecAttribute() => Promise<void>`

  Description Returns

  Type: `Promise<void>`

- `acSortExecText() => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `addIrisChart(idDiv: any, divTag: any) => Promise<void>`

  Description Returns

  Type: `Promise<void>`

- `dataVisToNode(index: any) => Promise<any>`

  Description This function will return the children data from children list in data model. The iput is index of children data.

  Returns

  Type: `Promise<any>`

- `getBox() => Promise<any>`

  Description Get box size value Output is a object includes height and width

  Returns

  Type: `Promise<any>`

- `getSourceObject() => Promise<any>`

  Description Returns

Type: `Promise<any>`

- `getVOrder() => Promise<any>`

  Description This function will return the indirect ordering vector

  Returns

  Type: `Promise<any>`

- `putBarsOnIris() => Promise<void>`

  Description Returns

  Type: `Promise<void>`

- `setConfigCentroid(titulo: any, tituloGrau: any, textoBarra: any) => Promise<void>`

  Description Configure the data that will be printed in the centroid and the text of the bar (Label only)

  Returns

  Type: `Promise<void>`

- `setIndexAttrBar(_: any) => Promise<any>`

  Description Returns

  Type: `Promise<any>`

- `setpInnerRadius(_: any) => Promise<any>`

  Description Set value of Percentage relative to graph width for `_innerRadius` calculation If no arguments, It will return the value of pInnerRadius

  Returns

  Type: `Promise<any>`

- `setpMaxHeightBar(_: any) => Promise<any>`

  Description Returns

  Type: `Promise<any>`

- `setpOuterRadius(_: any) => Promise<any>`

  Description Set value of Percentage relative to graph width for `_OuterRadius` calculation If no arguments, It will return the value of pOuterRadius

  Returns

  Type: `Promise<any>`

- `updateTextSize() => Promise<void>`

  Description Returns

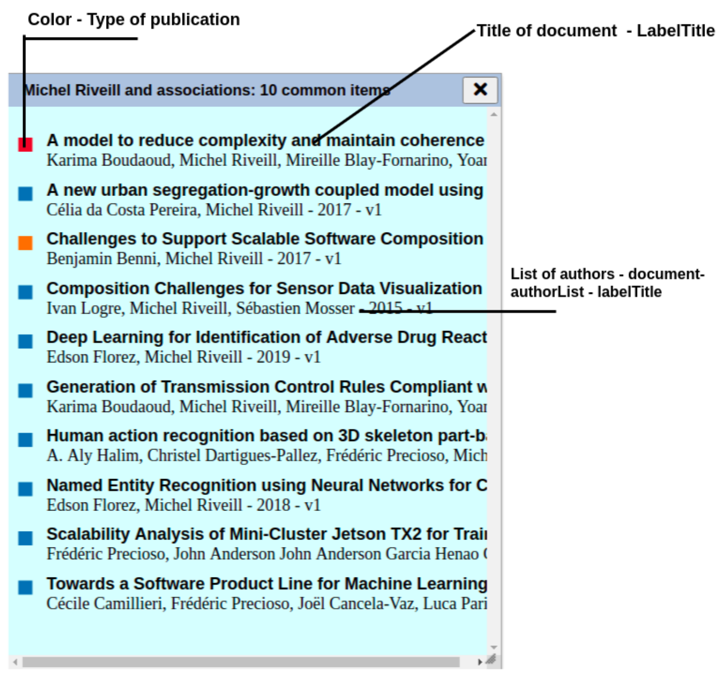
  Type: `Promise<void>`

4.5. mge-listing

General The list of papers technique allows listing all the information related to the selected data. Listing all related items will help users have all the necessary information in the data discovery process

To create a listing papers chart element

```
<mge-listing dataset-name="data-1" id="chart-6" class="hydrated" height="400" width="350">
</mge-listing>
```


Color - Type of publication
Title of document - LabelTitle
List of authors - document-authorList - labelTitle

Michel Riveill and associations: 10 common items

A model to reduce complexity and maintain coherence
Karima Boudaoud, Michel Riveill, Mireille Blay-Fornarino, Yoa

A new urban segregation-growth coupled model using
Célia da Costa Pereira, Michel Riveill - 2017 - v1

Challenges to Support Scalable Software Composition
Benjamin Benni, Michel Riveill - 2017 - v1

Composition Challenges for Sensor Data Visualization
Ivan Logre, Michel Riveill, Sébastien Mosser - 2015 - v1

Deep Learning for Identification of Adverse Drug React
Edson Florez, Michel Riveill - 2019 - v1

Generation of Transmission Control Rules Compliant w
Karima Boudaoud, Michel Riveill, Mireille Blay-Fornarino, Yoa

Human action recognition based on 3D skeleton part-b
A. Aly Halim, Christel Dartigues-Pallez, Frédéric Precioso, Mich

Named Entity Recognition using Neural Networks for C
Edson Florez, Michel Riveill - 2018 - v1

Scalability Analysis of Mini-Cluster Jetson TX2 for Trai
Frédéric Precioso, John Anderson John Anderson Garcia Henao

Towards a Software Product Line for Machine Learning
Cécile Camillieri, Frédéric Precioso, Joël Cancela-Vaz, Luca Pari

Figure 11: Listing papers chart component

Properties

Property	Attribute	Description	Type	Default
`_colorsRect`	–	Colors for the different types	`string[]`	`["#1f77b4", "#2ca02c", "#d62728", "#ff7d0e"]`
`_data`	`_data`	List of items in the data	`any`	`null`
`_grpPapers`	`_grp-papers`	Selection that contains all groups of bars	`any`	`null`
`_grpPapersList`	`_grp-papers-list`	Group representing IRIS	`any`	`null`
`_maxLenghtTitleIndex`	`_max-lenght-title-index`	Maximum length of title	`number`	`7.8`
`_maxNamesLenght`	`_max-names-lenght`	Maximum length of names	`number`	`87`
`_names`	`_names`	Selection that contains the names of the members of a cluster	`any`	`null`
`_papersListPanel`	`_papers-list-panel`	represents the panel associated with the graph	`any`	`null`
`datasetName`	`dataset-name`	The dataset name being used	`string`	`"[]"`
`height`	`height`	represents the height of the paper's list chart	`number`	`400`
`width`	`width`	represents the width of the paper's list chart	`number`	`350`

Methods

Public methods

`addPaperListChart(idDiv: any, divTag: any) => Promise<void>` Returns

Type: `Promise<void>`

- `dataVisToNode(index: any) => Promise<any>`

  Description This function will return the children data from children list in data model. The iput is index of children data.

  Returns

  Type: `Promise<any>`

Private method

- `_findAuthorById(id: any) => Promise<any>`

  Description Returns the author depending on ID

  Returns

  Type: `Promise<any>`

- `_getTheIndex(type: any) => Promise<1 | 0 | 2 | 3>`

  Description Returns the index for the color

  Returns

  Type: `Promise<1 | 0 | 2 | 3>`

4.6. mge-nodelink

General The NodeEdge diagram shows nodes as items and edges between them as relationships. The NodeEdge is used to provide an overview of any network defined within the dataset according to some criteria (e.g., keywords, co-publications, etc.).

To create a node-links chart element

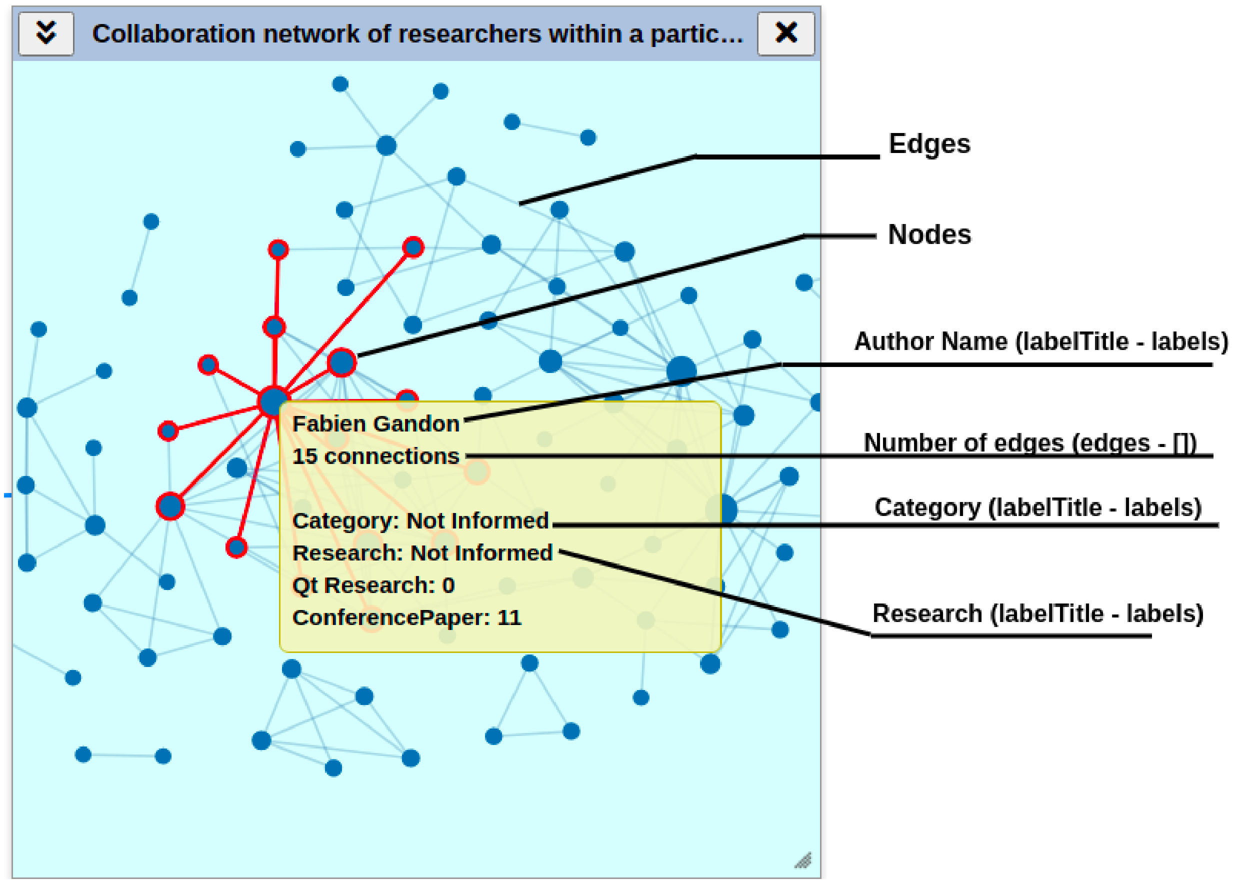
```
<mge-nodelink dataset-name="data-1" id="chart-1" class="hydrated" height="350" width="350">
</mge-nodelink>
```

Properties

Property	Attribute	Description	Type	Default
`data`	`data`		`string`	`"[]"`
`height`	`height`		`number`	`350`
`width`	`width`		`number`	`350`

Data Model

```
{
  "type": "object",
  "required": [],
  "properties": {
    "info": {
      "type": "object",
      "required": [],
      "properties": {
        "qtNodos": {
          "type": "number",
```


Collaboration network of researchers within a partic…
Edges
Nodes
Author Name (labelTitle - labels)
Number of edges (edges - [])
Category (labelTitle - labels)
Research (labelTitle - labels)

Fabien Gandon
15 connections

Category: Not Informed
Research: Not Informed
Qt Research: 0
ConferencePaper: 11

Figure 12: Node-links chart component

```
        "description": "Total number of nodes"
      },
      "qtArestas": {
        "type": "number",
        "description": "Number of links between nodes"
      }
    }
  },
  "nodes": {
    "type": "object",
    "required": [],
    "properties": {
      "labelTitle": {
        "type": "array",
        "items": {
          "type": "string",
          "description": "array of character string. An element at position X will put a meaning on ar
        }
      },
      "valueTitle": {
        "type": "array",
        "items": {
          "type": "string",
          "description": "array of character string. An element at position X will put a meaning on ar
        }
      },
      "imageTitle": {
        "type": "string",
      "description": "."
      },
      "dataNodes": {
        "type": "array",
        "items": {
          "type": "object",
          "required": [],
          "properties": {
            "id": {
              "type": "string",
              "description": "Unique identifier of the node"
            },
            "idBD": {
              "type": "string",
              "description": "Unique identifier of the node (similar to id)"
            },
            "labels": {
              "type": "array",
              "items": {
                "type": "string",
                "description": "To know the meaning of an element at position x, we must look at the v
              }
            },
            "values": {
              "type": "array",
              "items": {
```

```
              "type": "number",
              "description": "To know the meaning of an element at position x, you have to look at t
            }
          },
          "images": {
            "type": "string",
            "description": "."
          }
        }
      }
    }
  }
},
"edges": {
  "type": "object",
  "required": [],
  "properties": {
    "labelTitle": {
      "type": "string",
      "description": "Array of character strings. An element at position X will put a meaning on an
    },
    "valueTitle": {
      "type": "array",
      "items": {
        "type": "string",
        "description": "Array of character strings. An element at position X will put a meaning on a
      }
    },
    "dataEdges": {
      "type": "array",
      "items": {
        "type": "object",
        "required": [],
        "properties": {
          "src": {
            "type": "string",
            "description": "Integer referring to a unique identifier of a node corresponding to the
          },
          "tgt": {
            "type": "number",
            "description": "Integer referring to a unique identifier of a node corresponding to the
          },
          "labels": {
            "type": "string",
            "description": "To know the meaning of an element at position x, we must look at the val
          },
          "values": {
            "type": "array",
            "items": {
              "type": "number",
              "description": "To know the meaning of an element at position x, you have to look at t
            }
          },
          "documents": {
                "type": "array",
                "items": {
                  "type": "object",
                  "required": [],
                  "properties": {
                    "type": {
                      "type": "string",
                      "description": "Type of the published document"
                    },
                    "date": {
                      "type": "string",
                  "description": "Date the document was published"
                    },
                    "title": {
                      "type": "string",
                  "description": "Document title"
                    },
                    "authors": {
                      "type": "array",
                      "items": {
                        "type": "string",
                  "description": "An element refers to a unique identifier of a node"
                      }
                    },
                    "link": {
                      "type": "string",
                  "description": "Link to the online document."
                    }
                  }
                }
              }
            }
          }
        }
      }
    }
  }
}
```

Methods

- `acChangeAttrSize(atributo: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `acChangeCharge(value: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `acChangeGravity(value: any) => Promise<void>`

Description

Returns

Type: `Promise<void>`

- `acChangeLinkDistance(value: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `acSelectByName(nome: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `acSelectByNameCluster(nomeCluster: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `addNodeLinkChart(idDiv: any, divTag: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `getCharge() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getColorBreaks() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getColorScale() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getGravity() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getLinkDistance() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getQtEdges() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `getQtNodes() => Promise<any>`

  Description

  Returns

  Type: `Promise<any>`

- `indexAttrSize(_: any) => Promise<number>`

  Description

  Returns

  Type: `Promise<number>`

- `resetHighSearch() => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `setItensContextMenu(itens: any) => Promise<void>`

  Description

  Returns

  Type: `Promise<void>`

- `setLegend(_: any) => Promise<any>`

  Description Returns

  Type: `Promise<any>`