End of B.I.R presentation

Lowagie Célia

Université de Mons

UMONS Université de Mons

Faculté des Sciences

4 septembre 2024

Goal

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A sub-goal was to create a graph of all the interactions between the contributors.

What is NumFocus ?

An organisation that gathers and finances important open-source project related to data science.

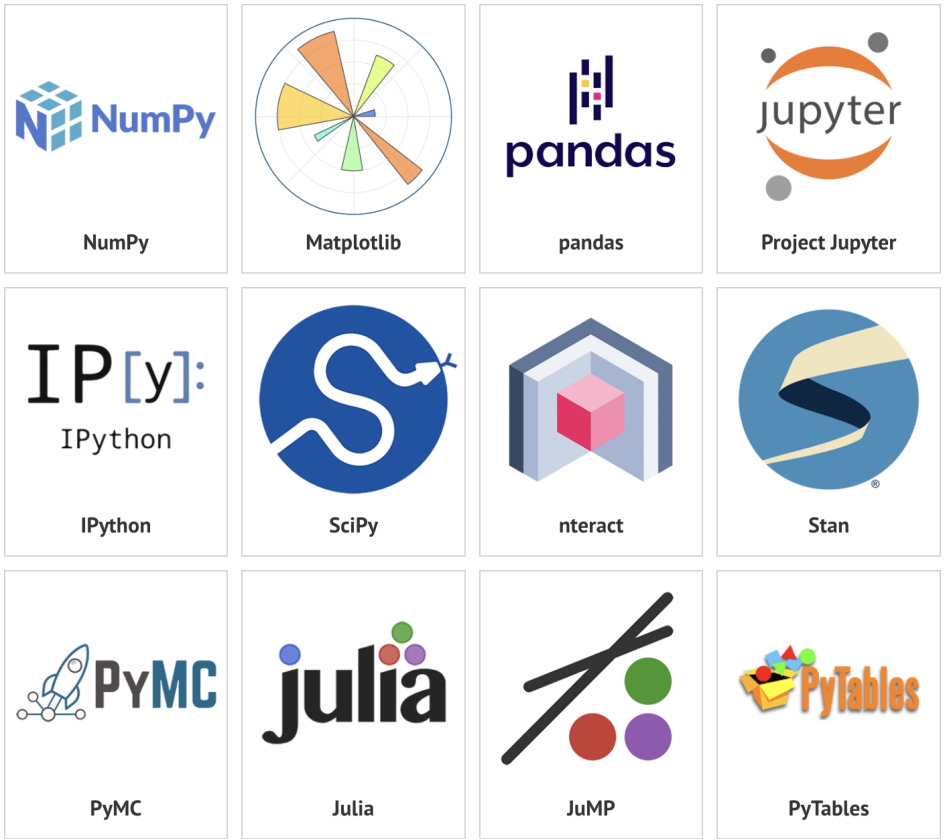

Figure – Example of projects

First approach

The first idea to simplify the graph :

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- Edge = contributed same organisation

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  2. Merging all the data extracted by Youness into a large dataframe
- Adding all the contributors from the dataframe as nodes
- For each organisation, linking the contributors of the organisation together (for each organisation saving the new file)

Results and graph

Here is the graph obtained for the data from June 2024

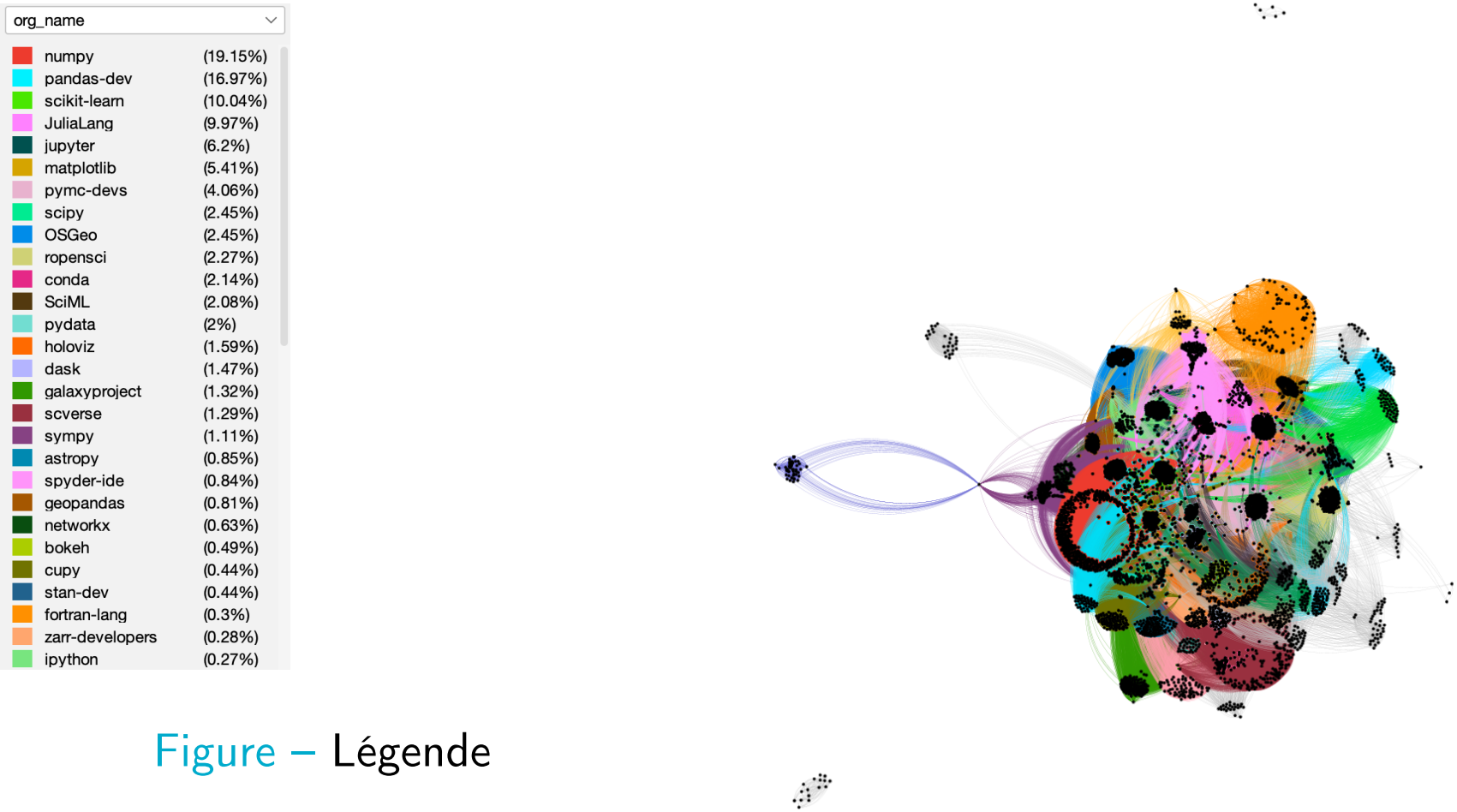

Figure – Légende

Results and issues

Observations :

- Two organisations are not connected at all to others : petsc and open-MBEE (toolkit for engineer)
- For one month of data, we reach 1 672 781 edges and the graph takes 409 MB of storage.

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Issues encountered

- Crash due to lack of memory
- Crash due to lack of storage (fixed by only saving the last to files)
- Impossible to finish the graph with all the data, I could add the edges for only 16 organisation on 58.
- Edges too general and not giving enough information about events

Second approach

To fix the generality problem and try to fix the storage/memory issue, the next approach is :

- Nodes = contributors (that have at least one edge)
- Edge = contributed in the same event

How to determine which event(s) to use as edge

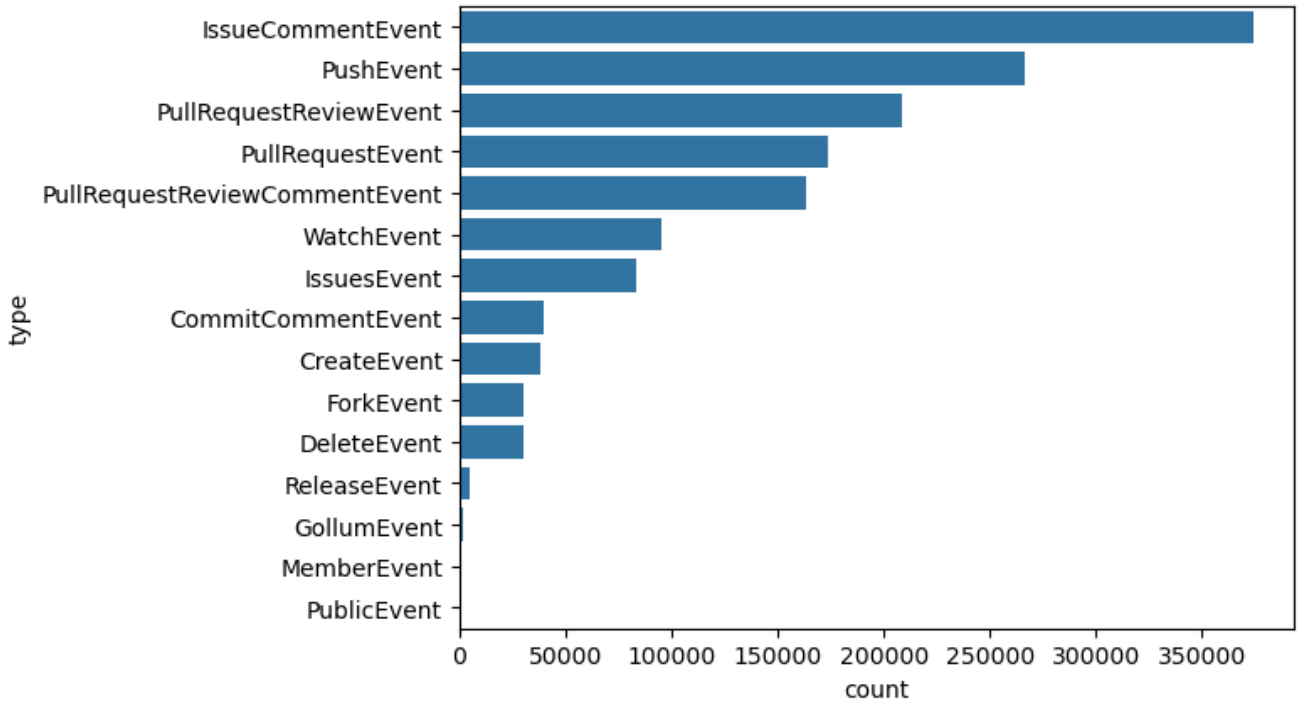

Figure – Event types in the whole dataset

To identify the relevant event types, I read the Github doc on events and explored a bit their payload

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- either not directly collaborative (e.g. WatchEvent := someone starting a repo)
- either not giving enough information to easily access the collaborators (e.g. MemberEvent := adding/deleting someone to/from a repo)

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By reading the payload, I found that issue related event had an issue_id.
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Definition

Two people collaborates on the same event if they both took part in an event that either have the same issue id or pull request id or review id

Information stored in the graph

We can either store information on the edges or on the nodes.
Nodes :

- The contributor name (actor_name)
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- The event date and time
- A weight defined by the number of directed interaction on a same event between two given contributors

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    3. We link contributors with the same event id following a specific strategy and add information on the edge

Linking strategies

We explored three different strategies to link the nodes together.

1. The naïve one : We define a directed edge as someone answering to one and only one person. So for each events, a person is linked to the directly previous one

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2. The hyper-connected one : We connect all the contributors that worked on the same event together
3. The semi-connected one : We define a directed edge as someone answering to all the previous people on a given event

Strategies example

Here is a table of people contributing on the same event. Let's see how different their graph will be depending on the strategy.

Person	A	B	C
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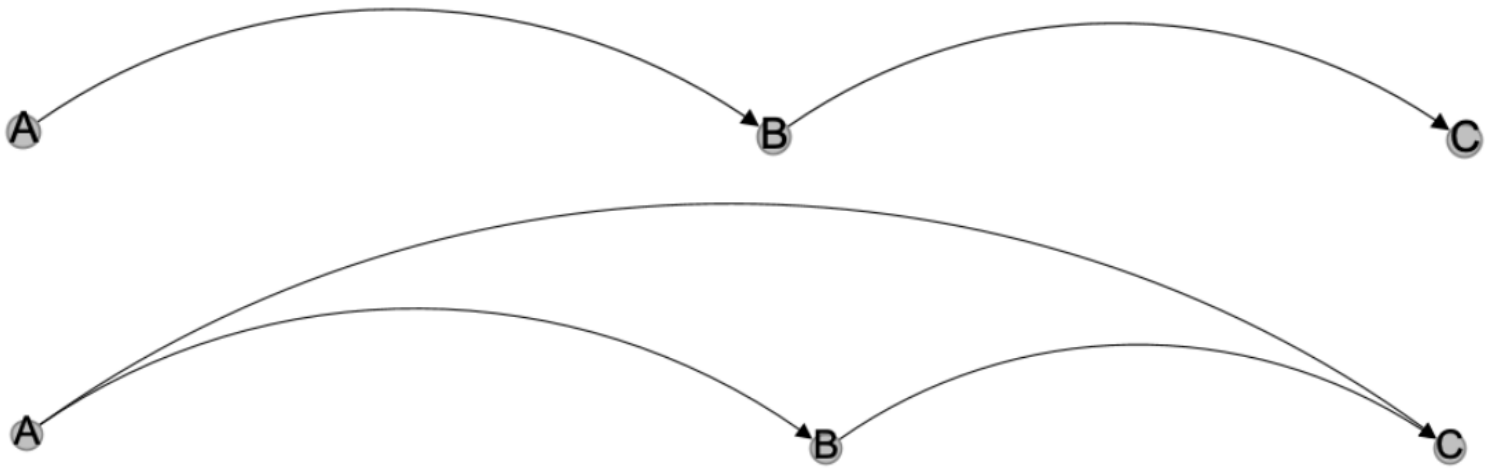

Figure – Naive and semi-connected strategy

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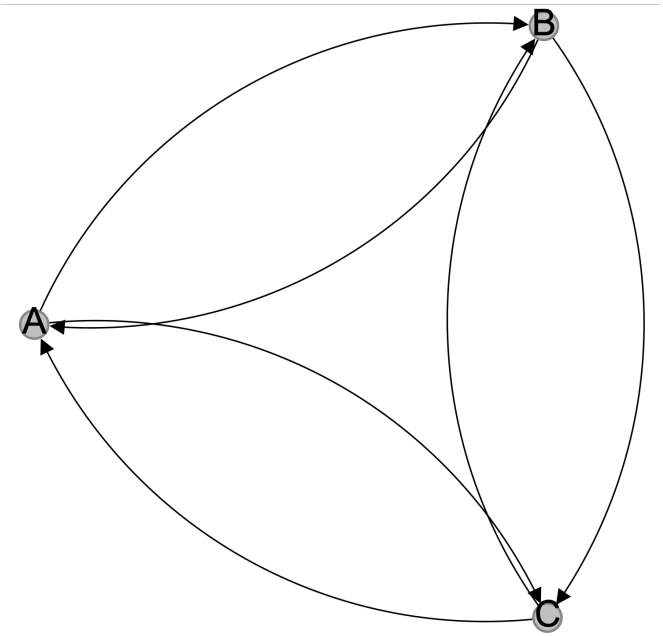


Figure – hyper-connected strategy

Questions about strategies

- Is there a strategy that is more optimal ?
- Is there a strategy that shows better the interaction between the contributors ?

Comparing the strategies

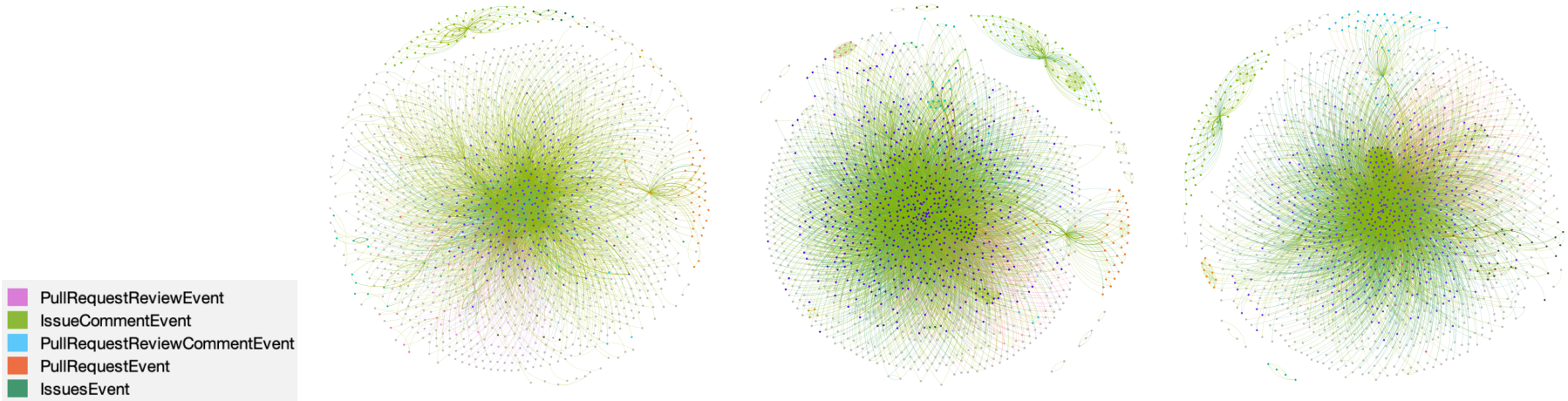
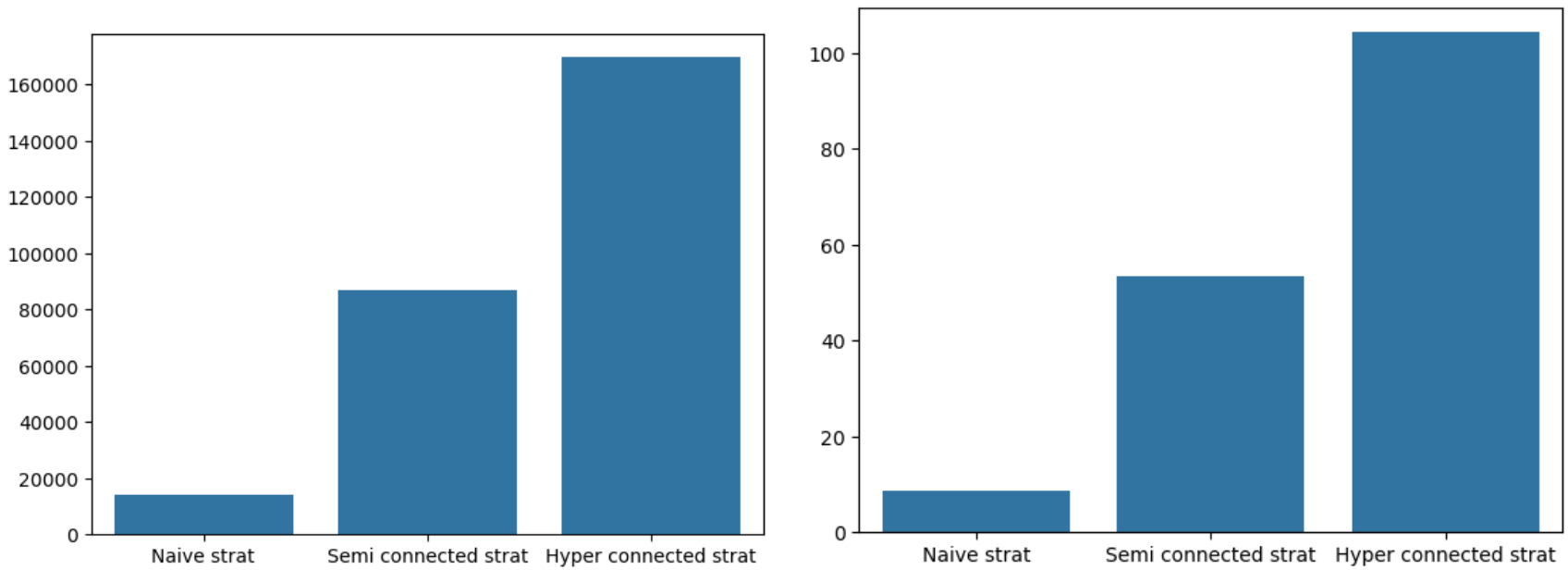


Figure – Naive, hyper-connected and semi-connected strategy

Explanation on graph density



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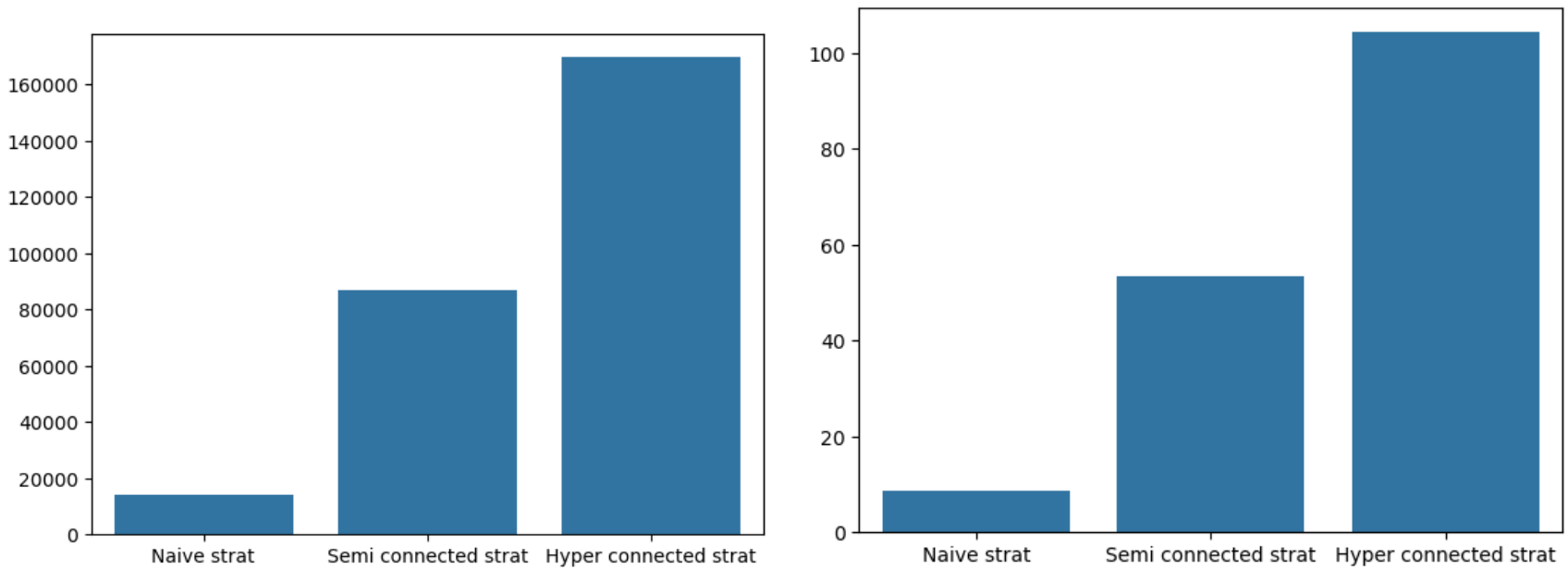

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New question : Do we gain relevant information the more edges there are ?

Comparing strategies with metrics

Now, we're going to use three nodes metrics to compare these strategies.

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Definition of shortest path

The shortest path between two nodes is the minimum number of edges used to go from one node to the other

Comparing strategies with metrics - Betweenness centrality

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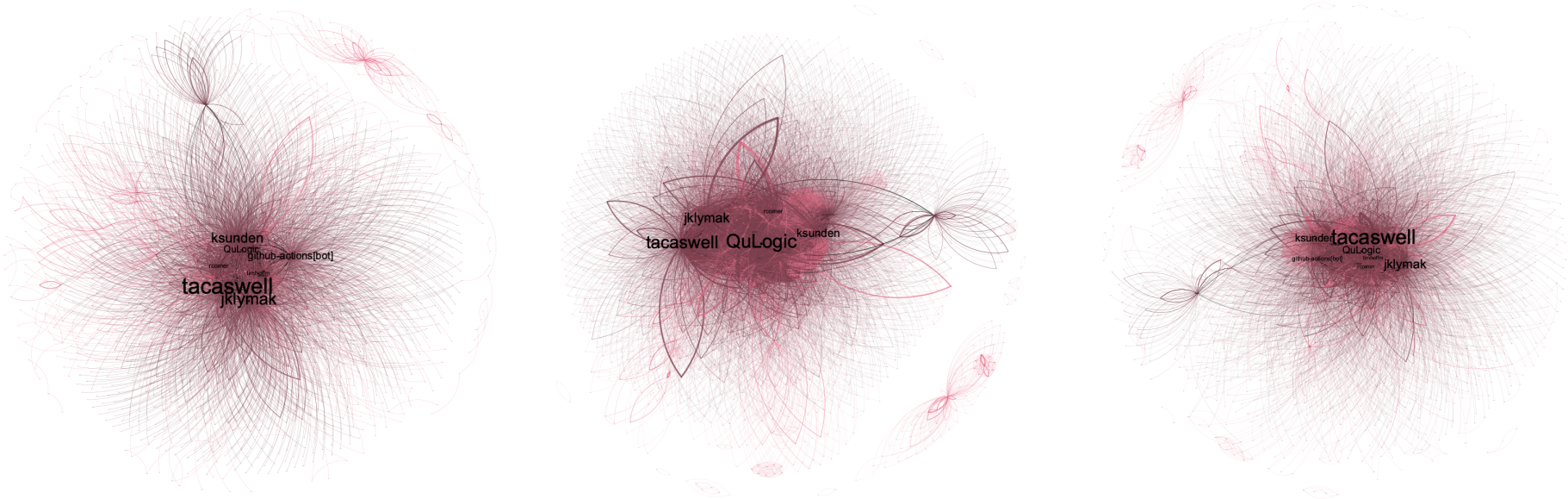

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Comparing strategies with metrics - Closeness centrality

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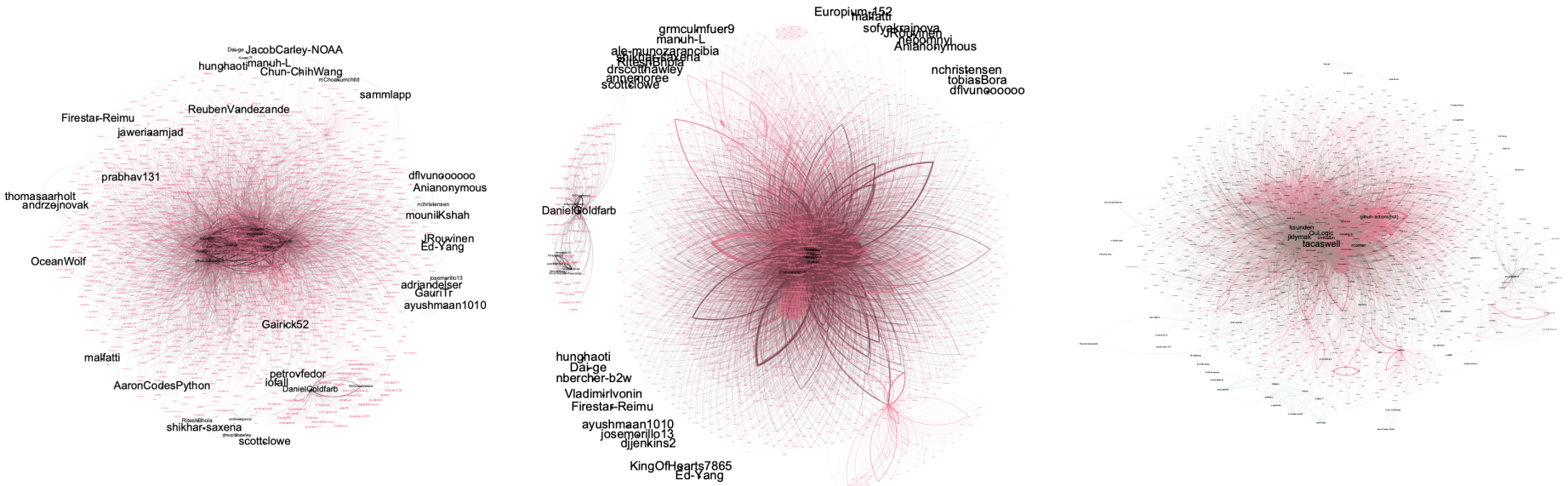

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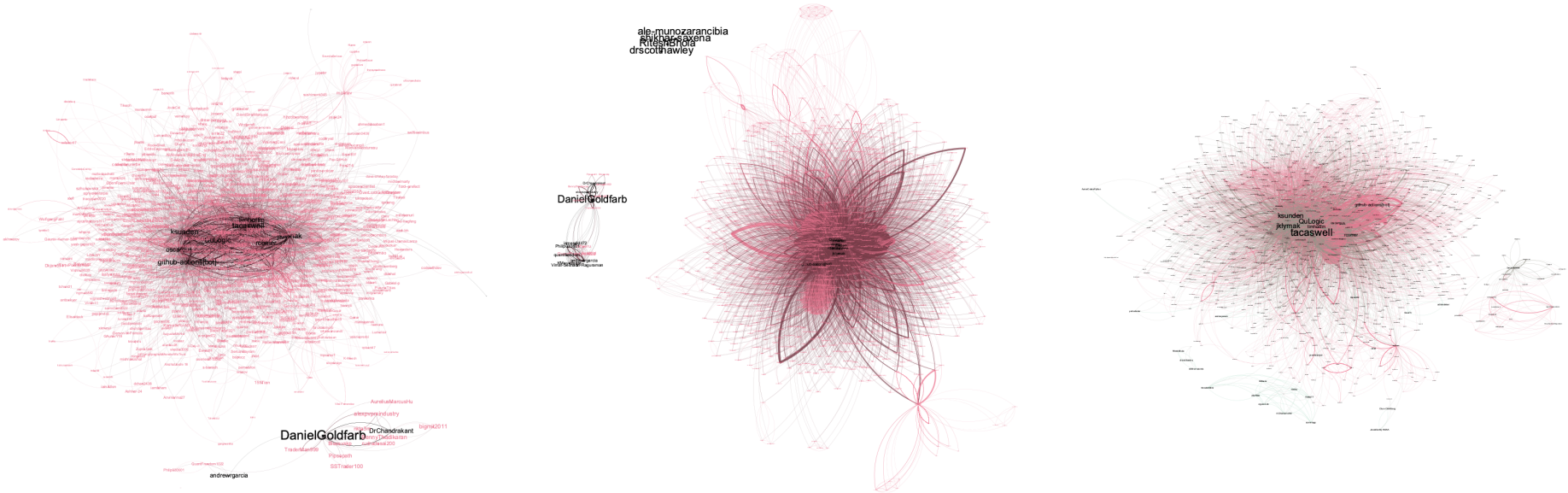

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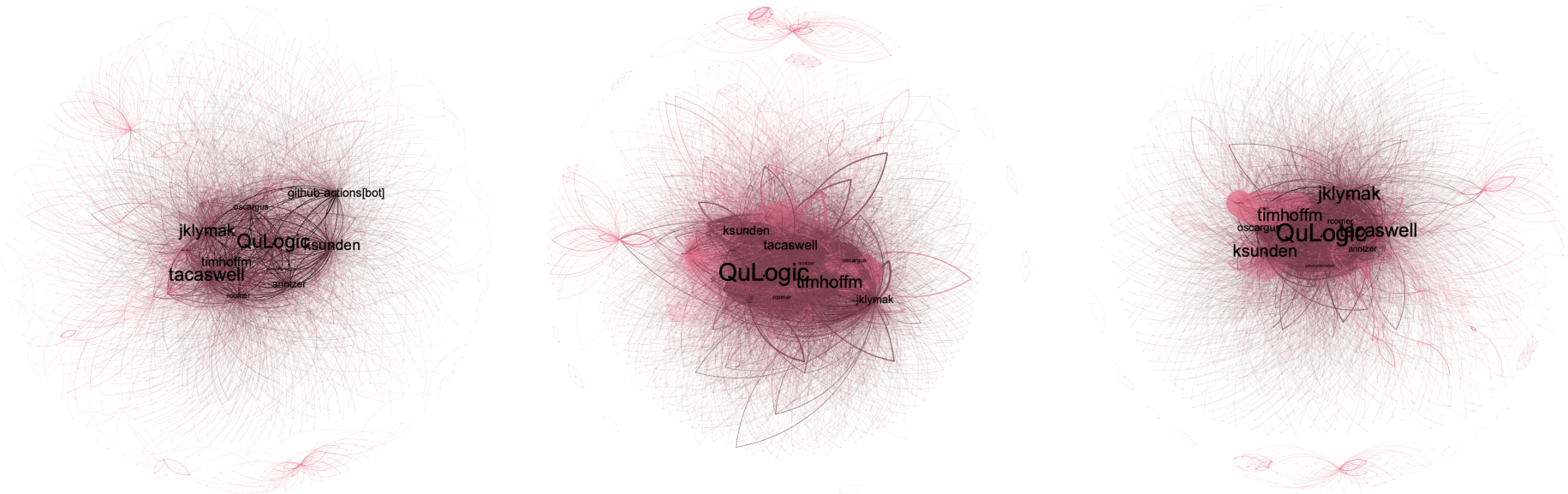

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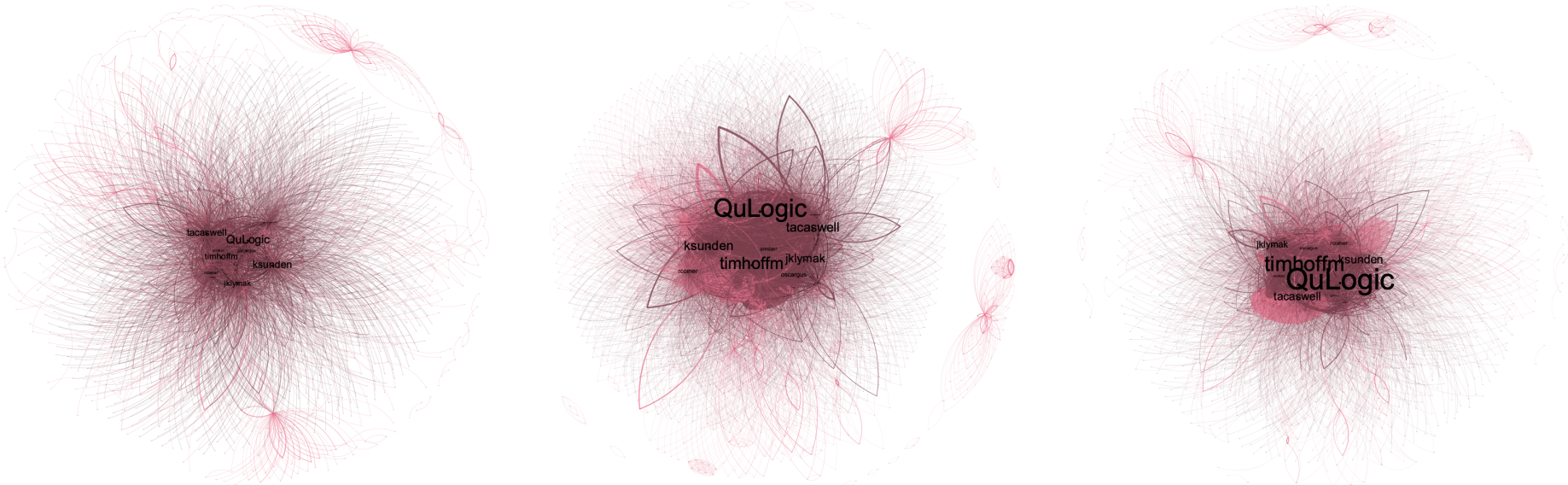

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So we're going to prefer the first strategy compared to the others.

Introduction

One of the remaining question is what does the Leiden algorithme (a community detection algorithm) mark as cluster.

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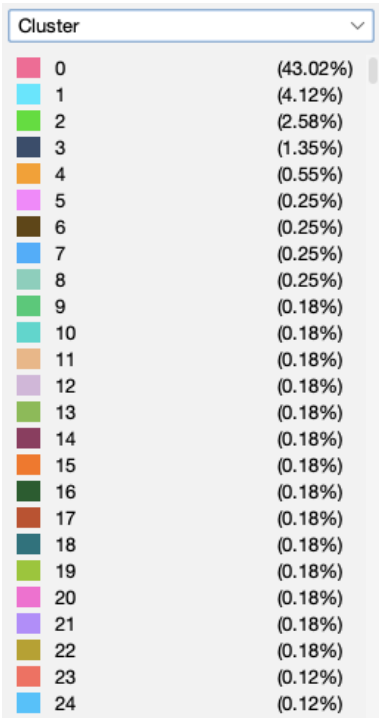
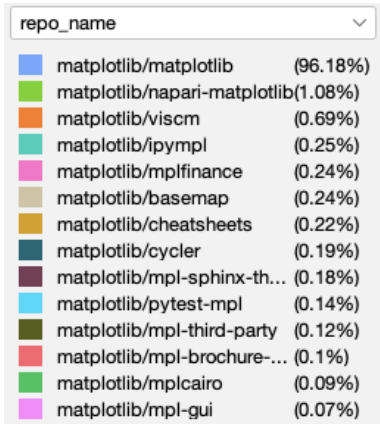
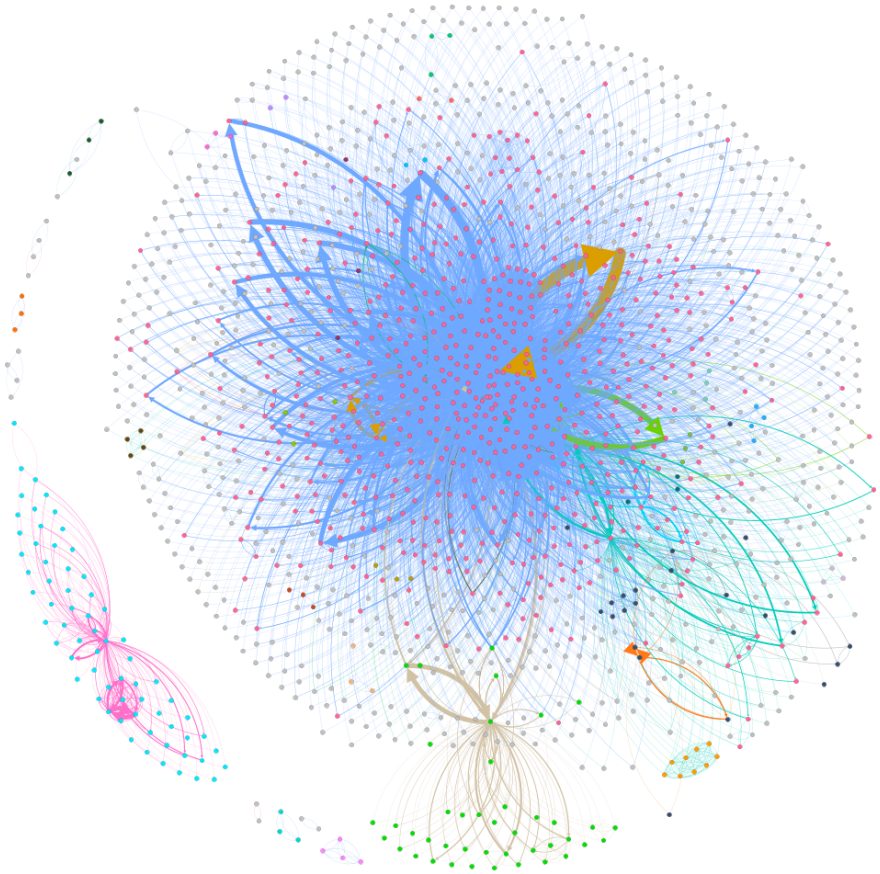
- The matplotlib hyper-connected graph
- The graph containing all the events generated with the naive strategy

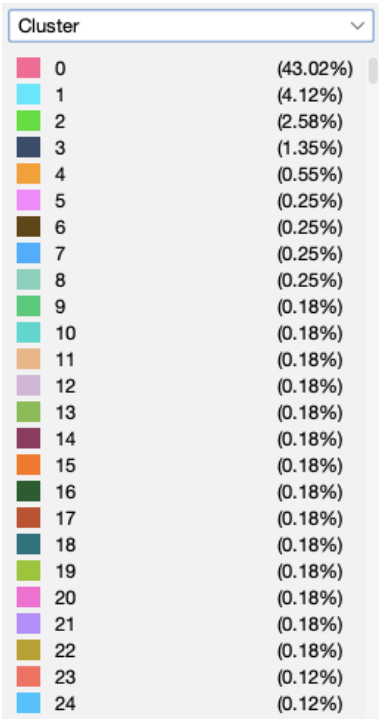
Matplotlib graph

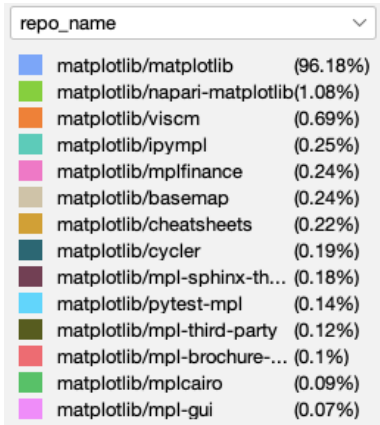


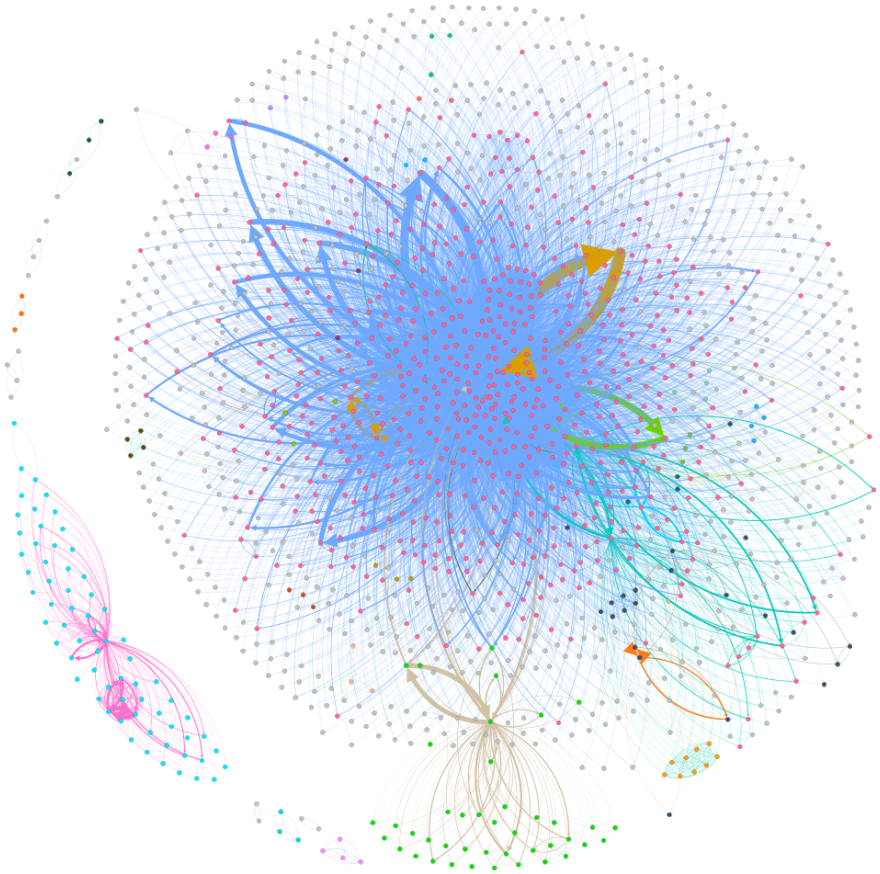




Matplotlib graph







Intuition : cluster = repository

Methodology

Methodology : generating the graph for a given cluster and a repository and side by side

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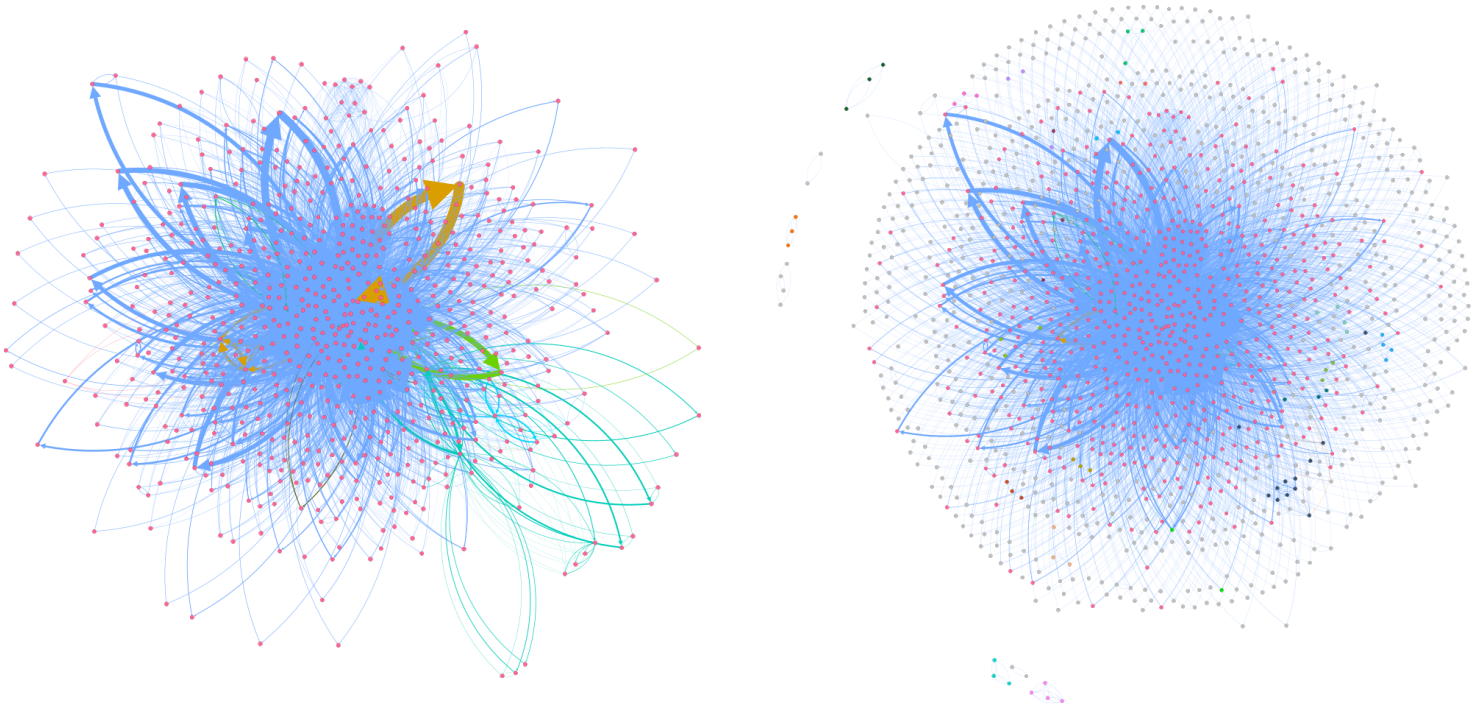

Figure – Cluster 0 and Principal repo

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Figure – Cluster 1 and matplotlib/mplfinance repo

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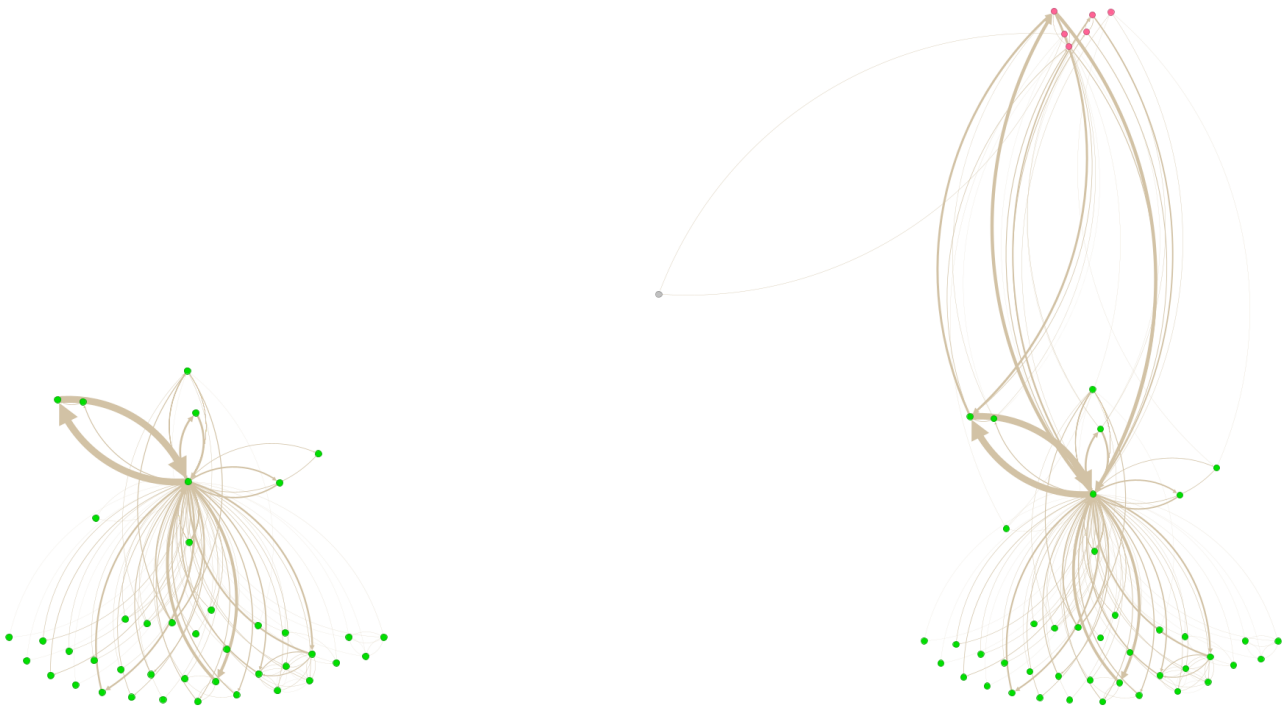

Figure – Cluster 2 and matplotlib/basemap

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Figure – Cluster 4 and matplotlib/ipympl

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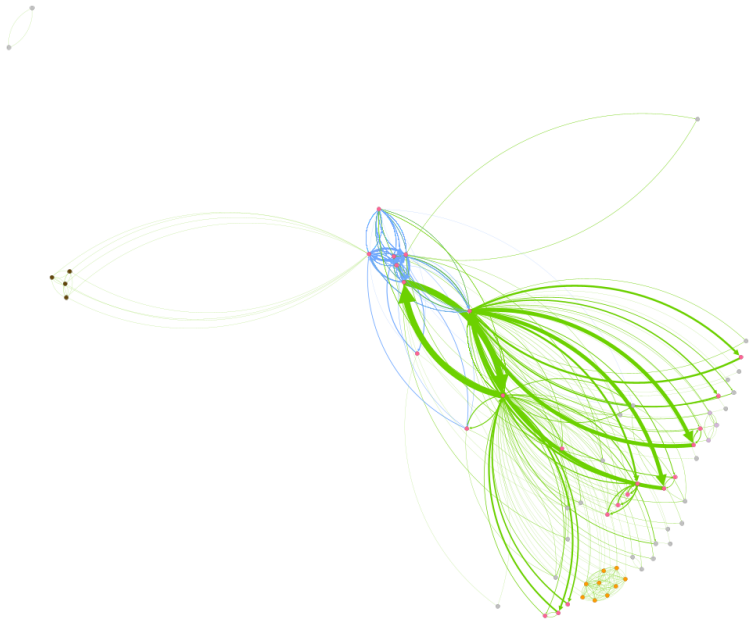
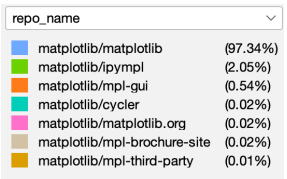
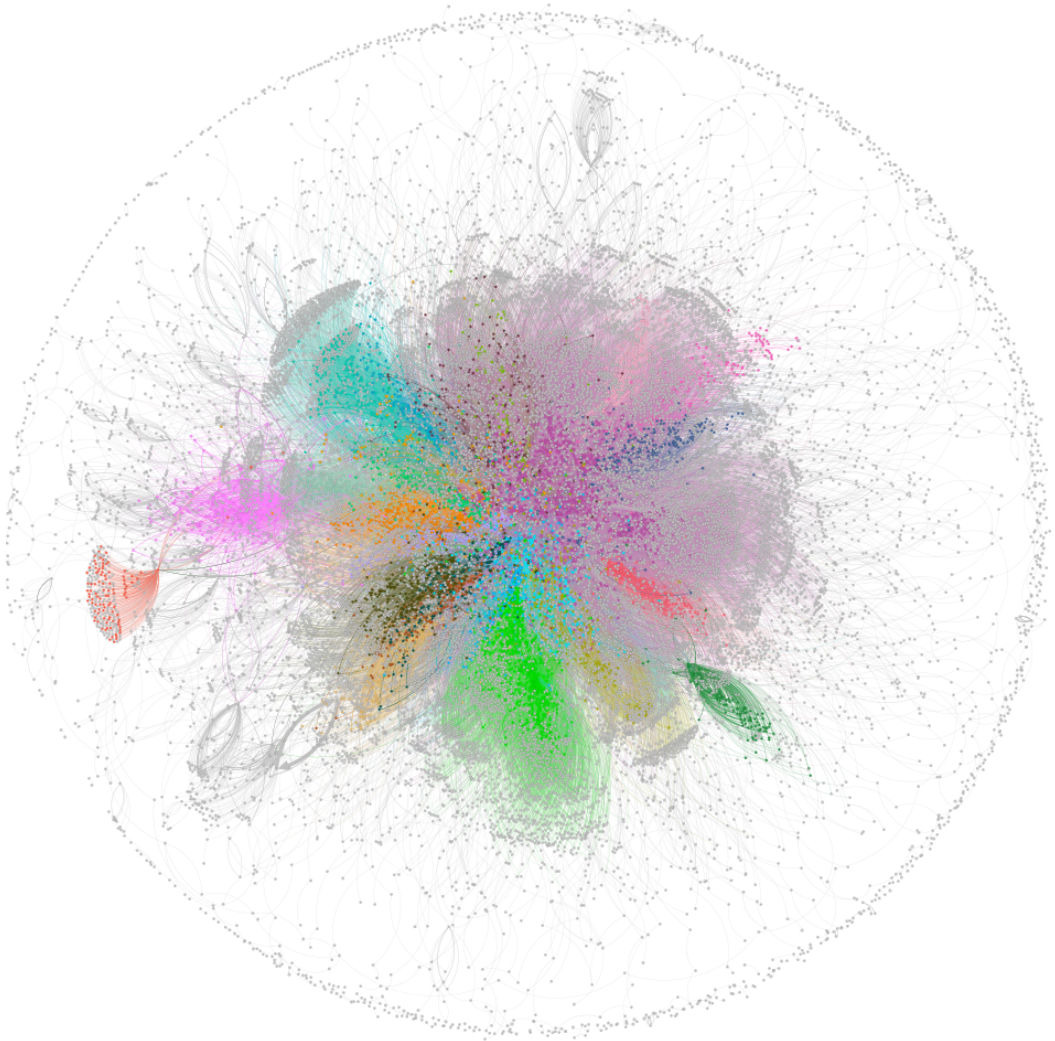
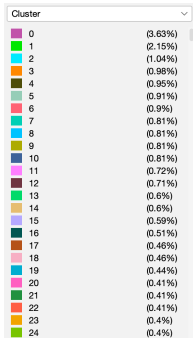




Entire graph



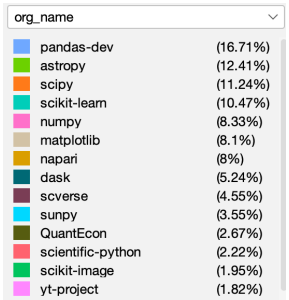


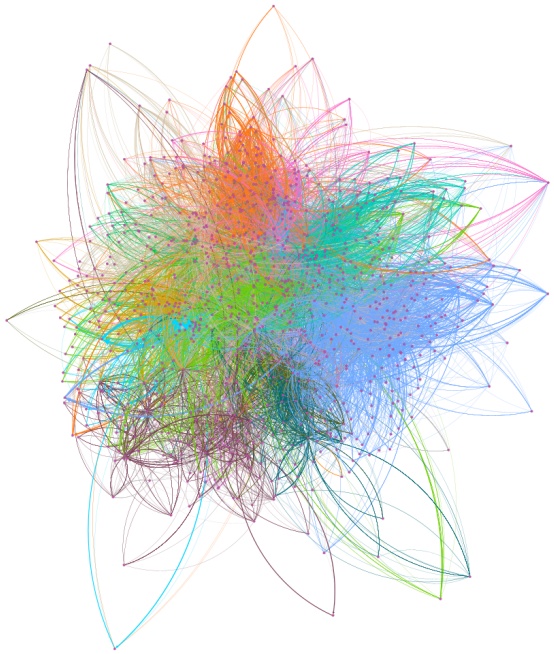
Methodology

For some cluster, to keep an ideea of the location on the entire graph, I generated two images :

- One that keeps the layout
- One where I re-run the layout to see the interactions

Results for top cluster





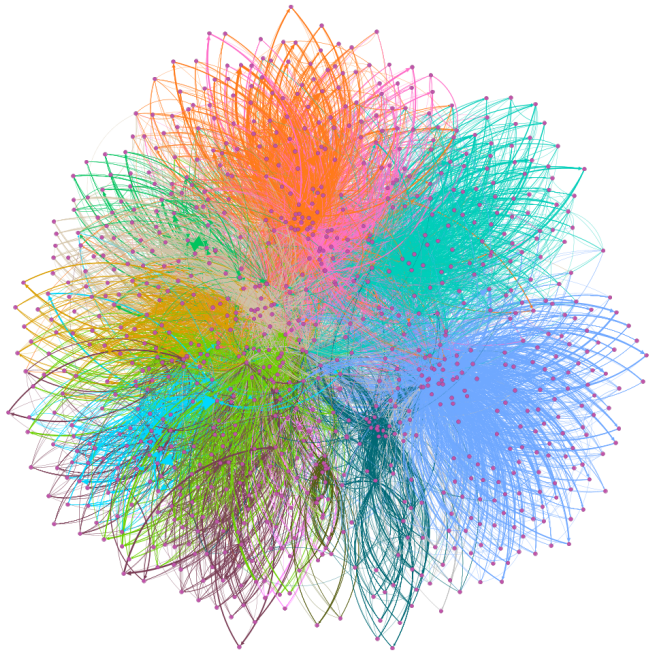


Figure – Cluster 0, original layout, re-run layout

Results for top cluster

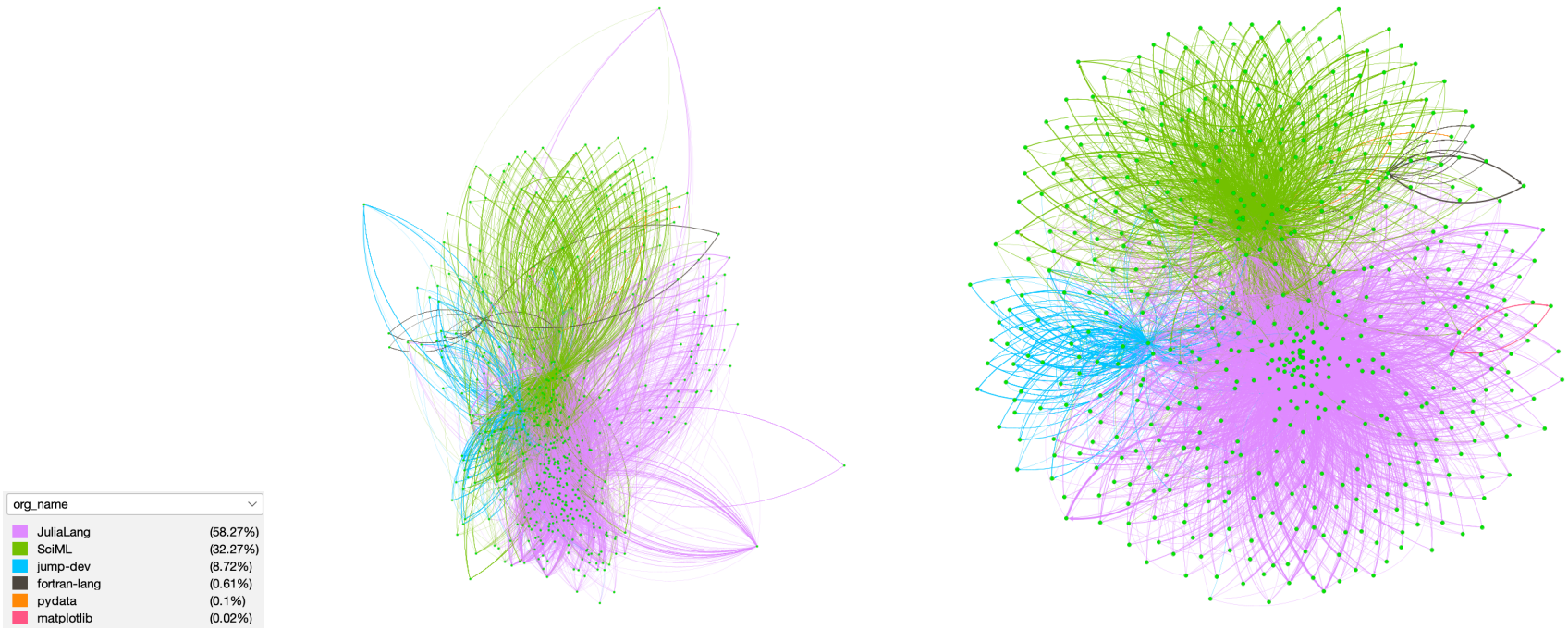


Figure – Cluster 1, original layout, re-run layout

Results for top cluster

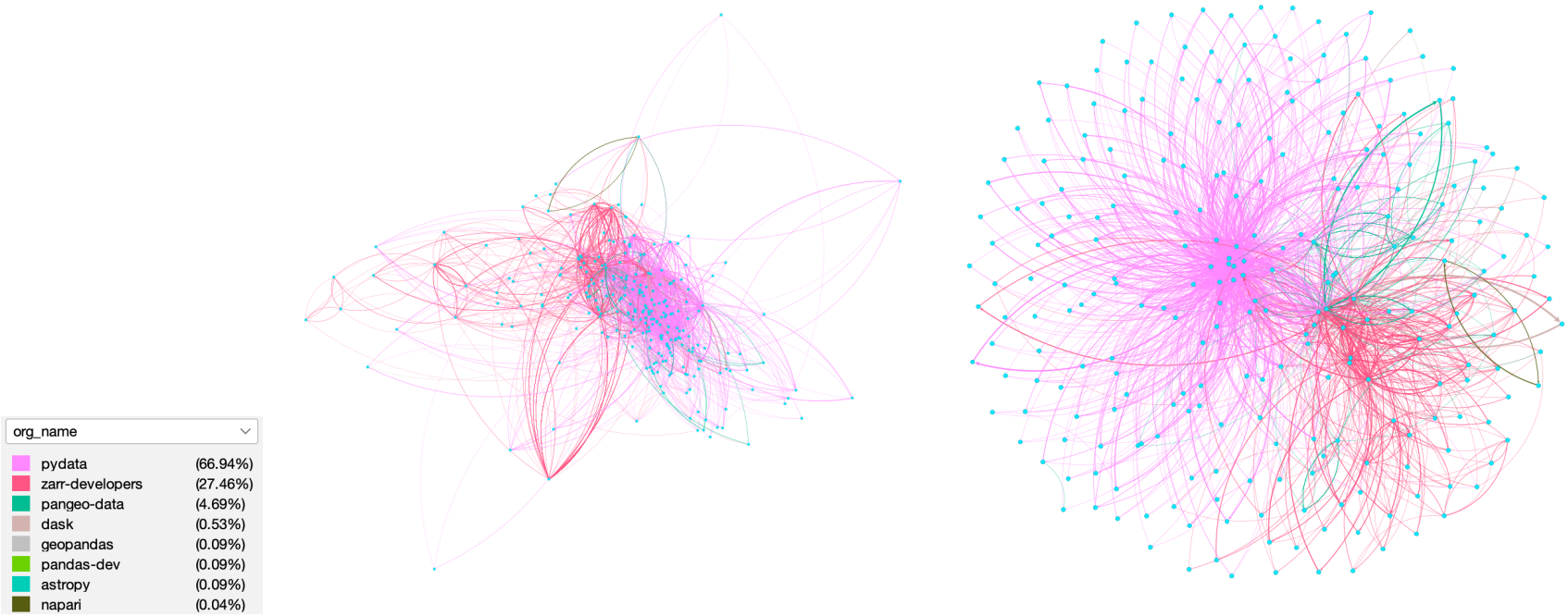


Figure – Cluster 2, original layout, re-run layout

Results for most of the clusters

As most of the other cluster only contains edges of one given organisation, we apply the previous methodology : displaying side by side a graph of the cluster and then a graph with only the organisation

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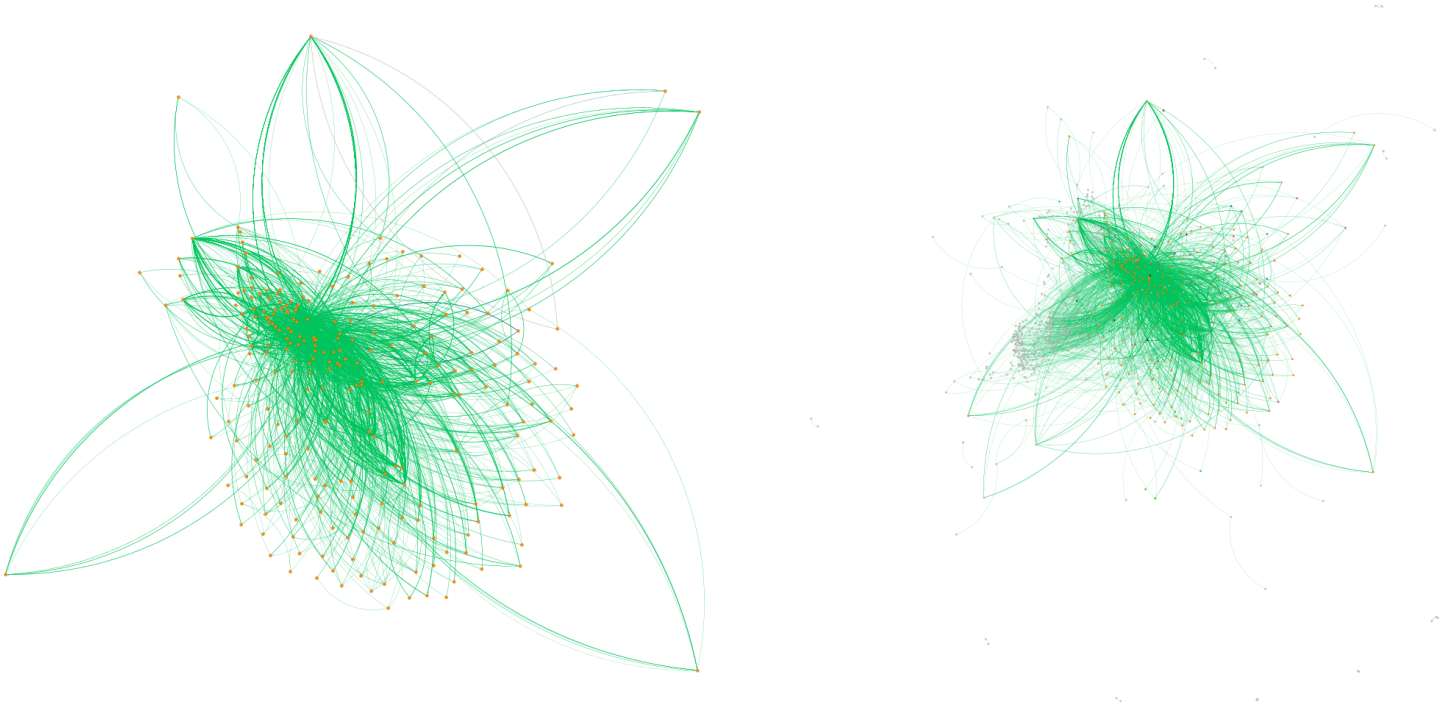

Figure – Cluster 3 and sympy

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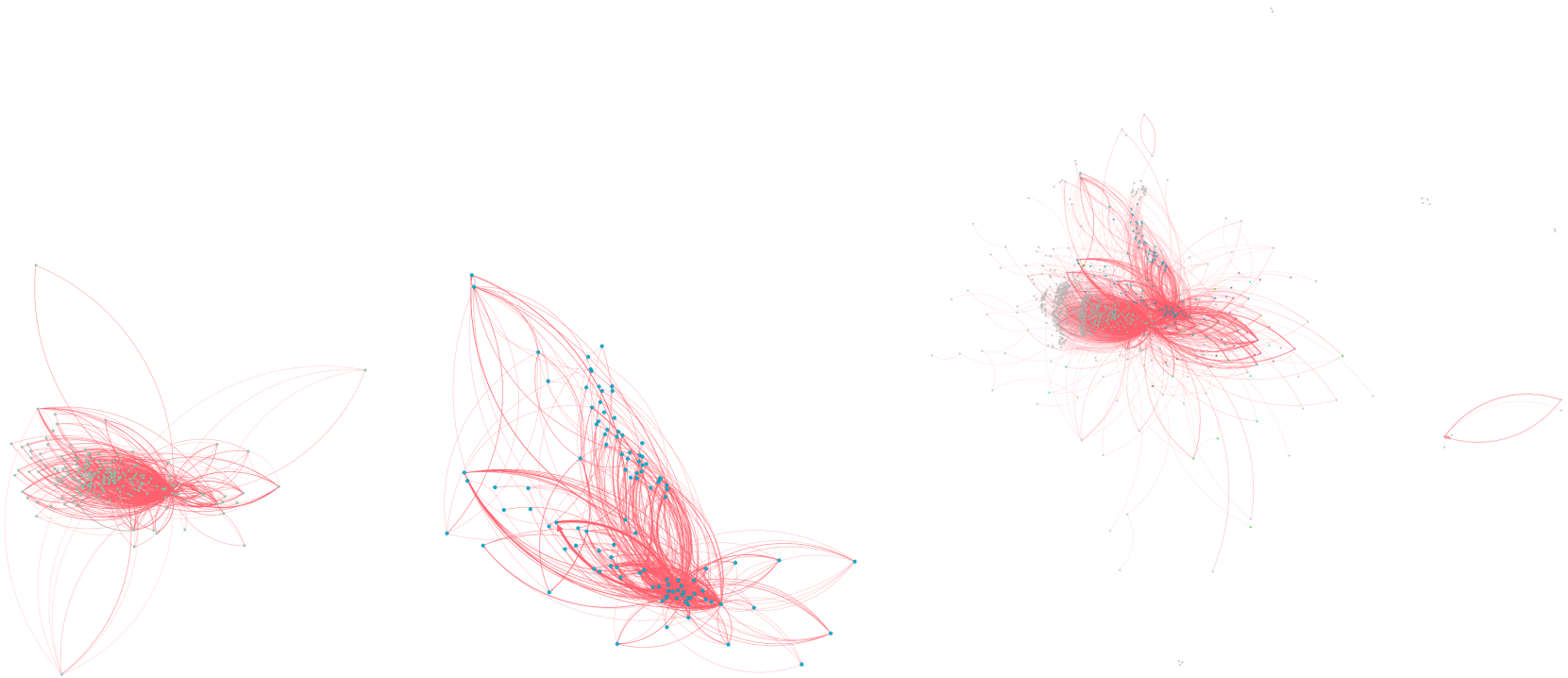

Figure – Cluster 5 and 19 and OSGeo

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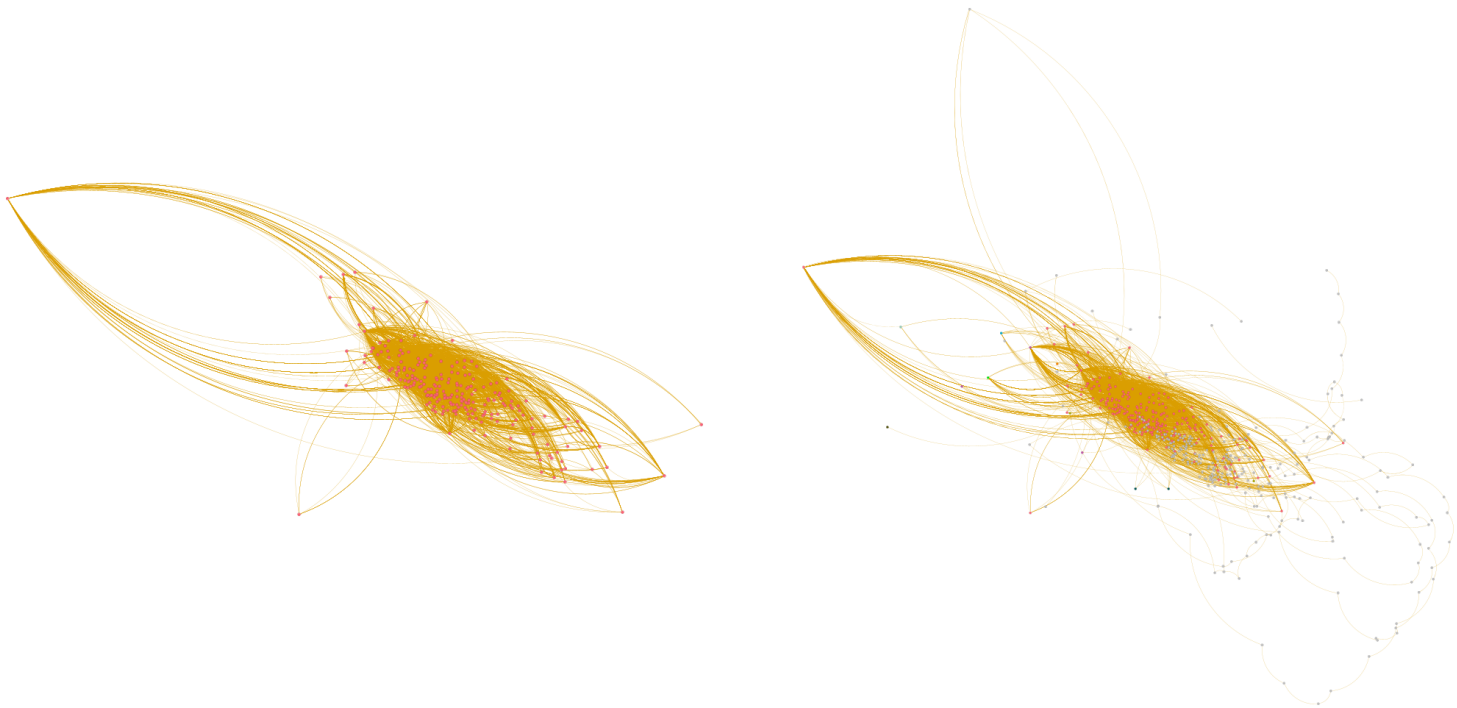

Figure – Cluster 6 and Galaxy Project

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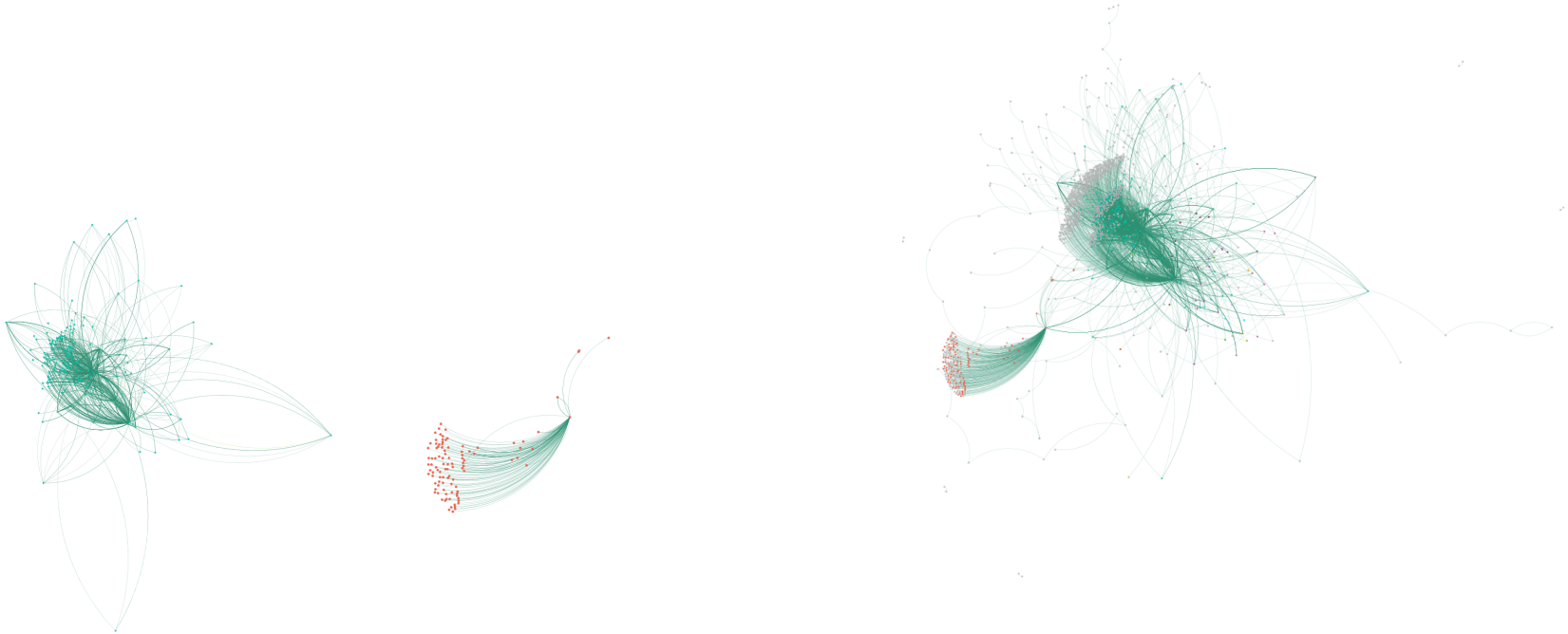

Figure – Cluster 7 and 22 and Spyder-ide

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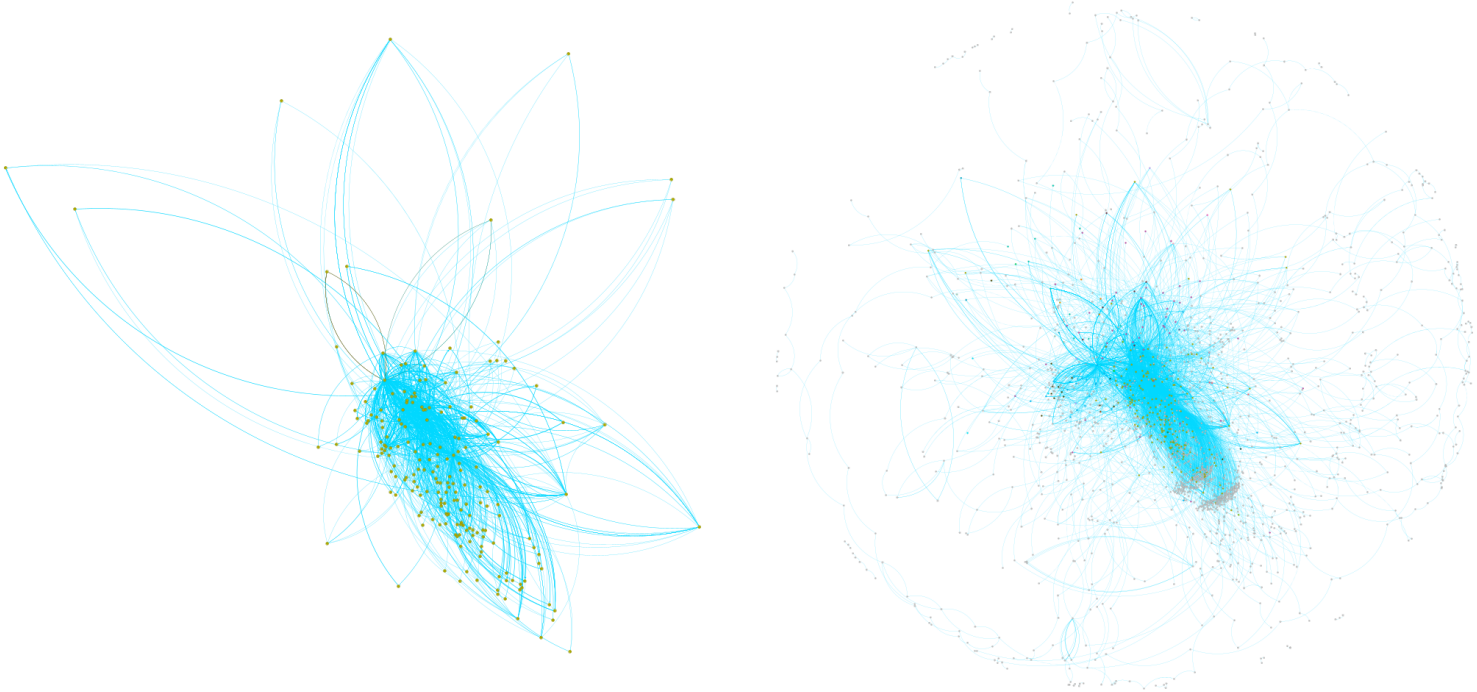

Figure – Cluster 9 and Conda

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Figure – Cluster 9 and Matplotlib

Conclusion

The analyse of cluster gave some insights :

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2. How many clusters do we need to analyse to get enough information ?
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4. Does the contributor type influence the metrics ? Can we note a difference visually or recognize a bot just by looking at the graph ?
5. If we only keep the most active repository of each organisation, will it affect the metric/graph ?

Conclusion

Thanks for listening