



ÉCOLE POLYTECHNIQUE FÉDÉRALE DE  
LAUSANNE

# LOG RETURNS

## MILESTONE 2

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## VISUALISATION GOAL

Correlation between stock prices gives powerful insights into the evolution of financial systems in interesting periods: during a financial crisis, political instability, or significant economic development of a country. Correlation tells us a lot about how stocks are linked, such as how industries are dependent on or independent of crisis or development in specific economic sectors. The notion of stock independence has numerous applications: an instrumental one is portfolio differentiation for risk minimization.

The goal of this visualization is to **represent the evolution in time of correlation, hierarchies and clustering of various financial stocks**. Visualization is done through graphs and basic graph theory principles, focusing on per-sector analysis. In our visualization, we **represent stocks as nodes of a graph and their corresponding correlation as the weight of the edges connecting them**.

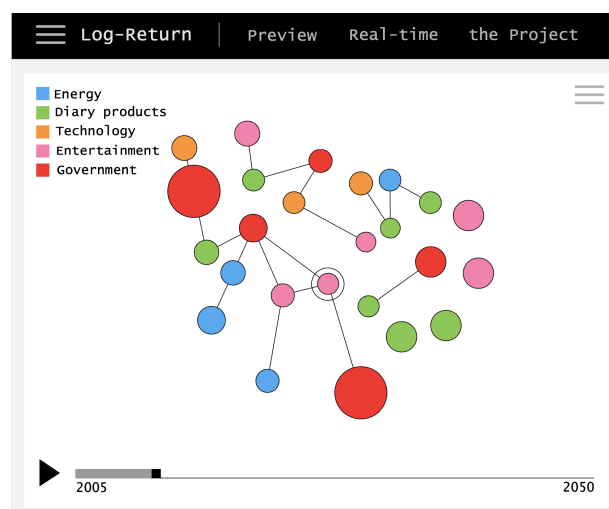
## VISUALISATION, TOOLS AND DOCUMENTATION

Implementing this visualisation requires documentation and various tools that enable us to build every component of our website. For the purpose and goal of this visualisation, we found two layouts proposed in lecture 10 (*Graph Visualisation*) very insightful: the physic-based node-link diagram (slide 28) and a multi-level interpretation of the circle layout (slide 35), namely a concentric layout.

The tool used for both visualisations is the Cytoscape graph & network library for analysis. Our focus is centred on the **cola layout** and the **concentric layout**: the former for the minimum spanning tree visualisation, the latter for the fully-connected graph visualisation.

## COLA LAYOUT - INSIGHTS

The cola layout is fed with data produced by a minimum spanning tree algorithm on the fully connected graph. As mentioned in *Milestone 1*, correlation is converted into distance, which is the value of the edges between two nodes. The MST will thus pick the edges with lower distances and display the graph as a physics-based animation that evolves over time.



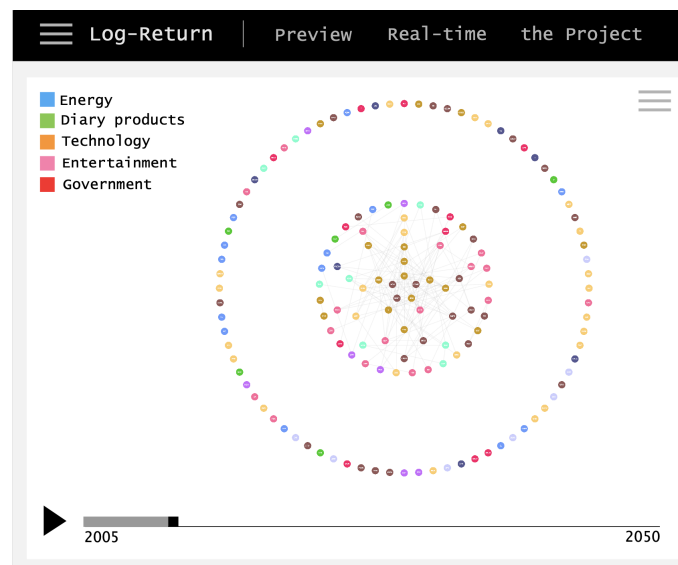
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Since nodes are represented in different colours according to their sector (ex. Finance, Technology, Basic Materials, Industry, Energy, etc.) and are visualised over an evolving timeline from 2007 to the current days, our visualisation offers an **intuitive evolution** in time of correlation, hierarchies and clustering of selected financial stocks.

## CONCENTRIC LAYOUT - INSIGHTS

The concentric layout data is **not** the result of a minimum spanning tree on the graph. Instead, edges are selected according to their correlation (or distance). Edges with low distance have high correlation and are kept in the data, while edges with a high distance are discarded at each computation of the data window. This layout model assigns each node to a circular level around the centre according to its degree. High-degree nodes are positioned in the middle, while low degree nodes are positioned in the outer circles. Namely, the number of edges attached to a node determines where the node is positioned. When loading data for a given time window, all edges with low correlation are discarded, the threshold with which these edges are discarded can be selected with preferential buttons on the web interface in terms of maximum distance.

Thus in the **periods where the stock market is generally highly correlated, all nodes tend to concentrate in the inner circles**. In contrast, when the market is generally less correlated, nodes are mainly positioned in the outer circles of the concentric layout.



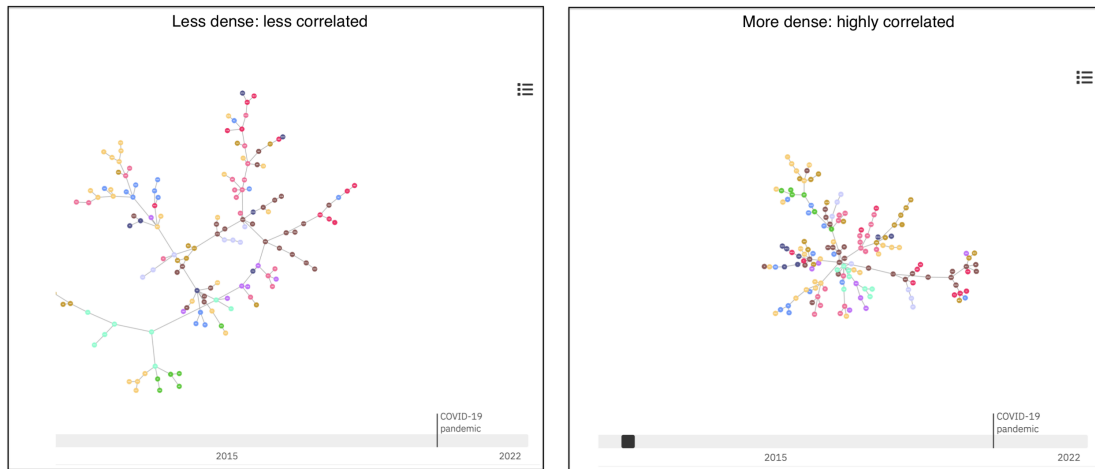
## GENERAL MARKET OVERVIEW INSIGHT

Both the layouts proposed in the LogReturns application have specific insights as explained above: **cola** gives the perception of evolution in time and sector-clustering, while **concentric** focuses on a more narrowed but precise visualisation of the correlation metric on a level-based representation. However, both layouts give a clear and perceptive view of how the stock market is **generally correlated** by means of the density of nodes in the visualisation.

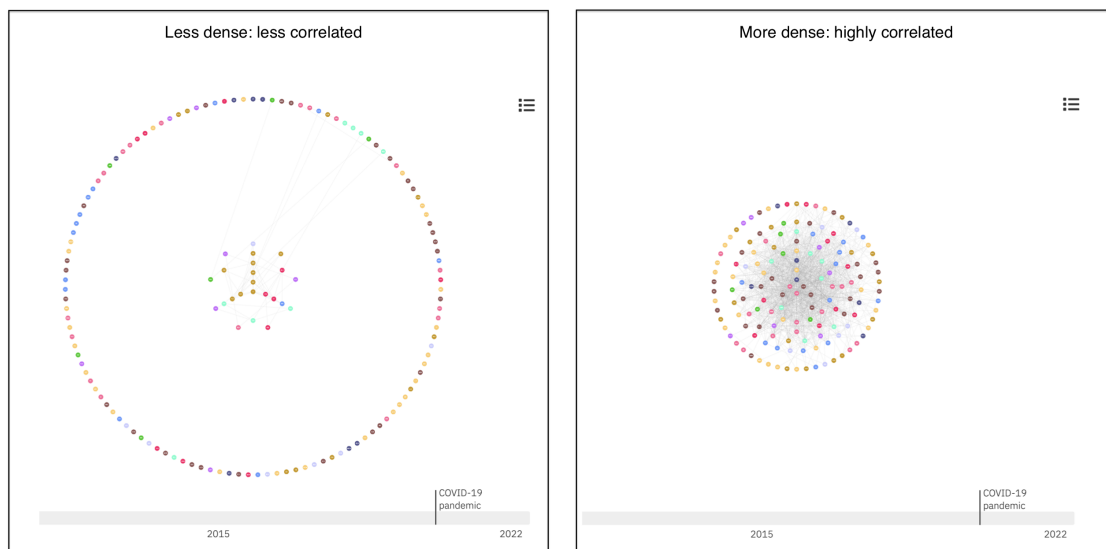
Here below are reported scenarios of a slightly correlated and a highly correlated market (ex. in financial crisis periods) for both layouts:

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## COLA



## CONCENTRIC



## VISUALISATION OF STOCK INFORMATION

Other than the general visualisation of the graph, **each stock (node) has a variety of specific information** which are interesting to view while looking at the evolving animation. For example: sector, industry, number of full-time employees, correlation value of selected stock with adjacent ones and neighbouring nodes sector-distribution.

Our visualisation enables the user to gain all of these insights by simply clicking on the desired node on the graph. An informative sidebar will pop-up showing all of the above-mentioned details as shown in the figures below.



## PROJECT ROADMAP

The implementation of our visualisation requires various steps. As the main javascript library for our website we are using React js. The road map would be the following:

- Set up the React environment for web applications.
- Implement a python3 jupyter notebook for data cleaning and the creation of JSON files containing the data corresponding to the needs of both graph layouts proposed on the application.
- Implement all components and their related functionalities on the React application. The main component will be the graph (*GraphApp*).
- Add explanations and insights for proposed layouts and instructions to use the graph on the web interface.
- Add a page for the project description and a page for the description of the team.
- Set up a python-based docker and server files for data-driven interaction between the javascript application and the server. The server will be used in the **real time monitor** option (explained below).

## FURTHER ENHANCING OUR VISUALISATION

We are currently working on a prerecorded dataset of financial asset returns. In order to make our dashboard a more interesting and exciting instrument, it would be useful also to **use a real-time flow of the assets' state**. This way, the project would become a real-time interactive tool to monitor the contractions of the financial market.

## OUR WEBSITE

Click [here](https://log-returns.vercel.app/) or visit the website <https://log-returns.vercel.app/> to see the current state of our visualisation (best to use Google Chrome). The link is also retrievable from our github [repository](#).