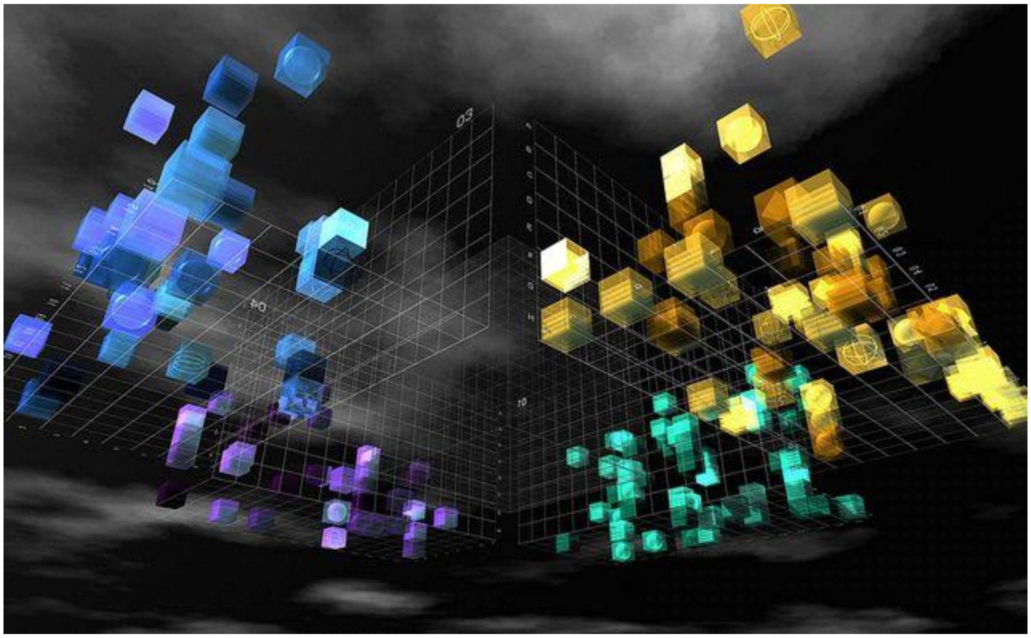
The impact of 3D data visualization on our human brain



Data Visualization has entered a new era, that of the exploratory approach of BIG DATA. Indeed, having databases is no longer the main problem since for the last ten years companies have developed the necessary means to collect raw data with larger volumes of data than ever before.

The challenge today is to explore/exploit this data to find new key indicators - those that are still hidden until now. But how does our brain manage to assimilate so much information, and how can we simplify its task?

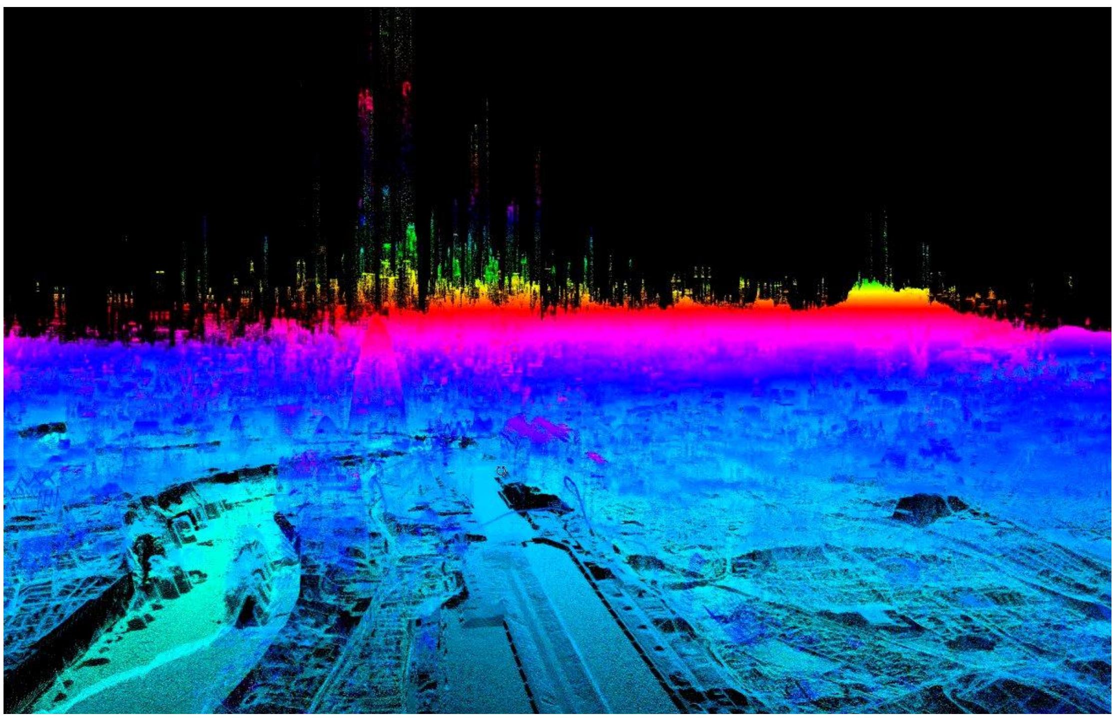
In the old days - some 20 years ago - when people had questions, they tried to answer them by applying a method. First, they had to identify the raw data that could provide them with answers, then they had to find a way to collect that data, and finally they had to set up a method of analysis to make the best use of the data they had managed to collect.

Thus, because of the non-availability of data, each new question they asked themselves meant inventing a new method to answer it.

Today, in an era of data profusion, the analytical challenge around data remains but is driven by new constraints: the problem is no longer to be able to collect the right data, it is to manage to explore/exploit larger volumes of data than ever before in order to visually represent the knowledge of a market.

If conducting a market study still makes sense to know the perception of prices, there is also a huge volume of data on the Web, immediately available, which also reflects this perception. The problem is: how do you exploit this mountain of data to extract useful information? The answer is not only linked to analytical tools, but above all to the analytical capacities of our brain to establish a visualization zone.

Data Visualization is more efficient than symbolic representation

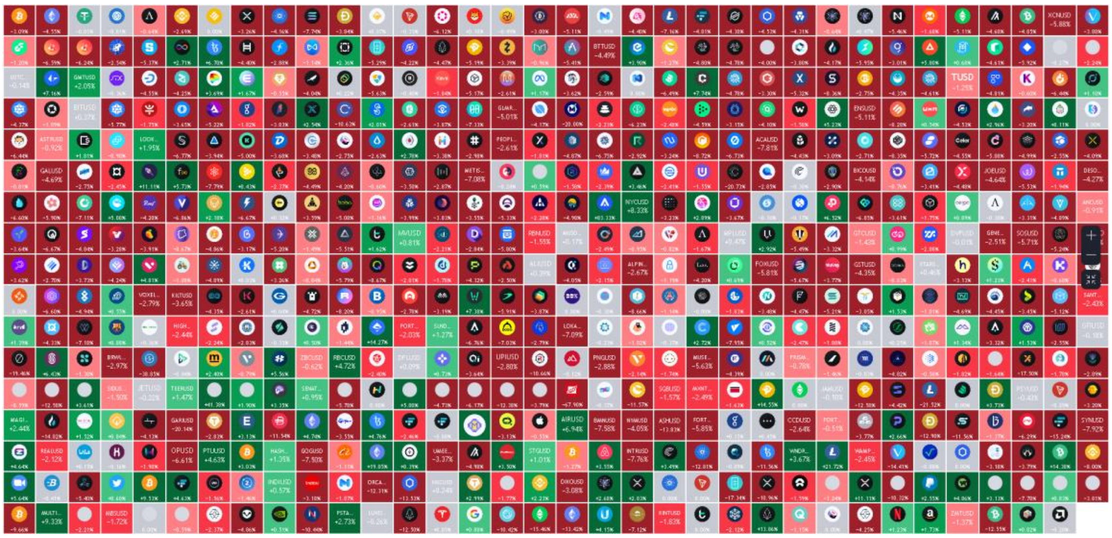


When our brain has to explore a large volume of data, visual representations (infographics, graphs, interactive maps, charts, curves...) - or Data Visualizations - are much more efficient than symbolic representations - or data tables.

Indeed, when faced with a table of numerical data, the time required by our brain to isolate the answer to a question is proportional to the number of entries in the table. Thus, the more complex a table is, the less intuitive its interpretation is.

On the other hand, the graphical visualization of data allows us to more quickly identify remarkable elements and the correlations that link them. Thus, the visual representation of data allows not only to answer questions more quickly but also to ask new questions based on correlations that were not initially considered but which nevertheless "jump out at you".

Graphic representation: 1, symbolic representation: 0.



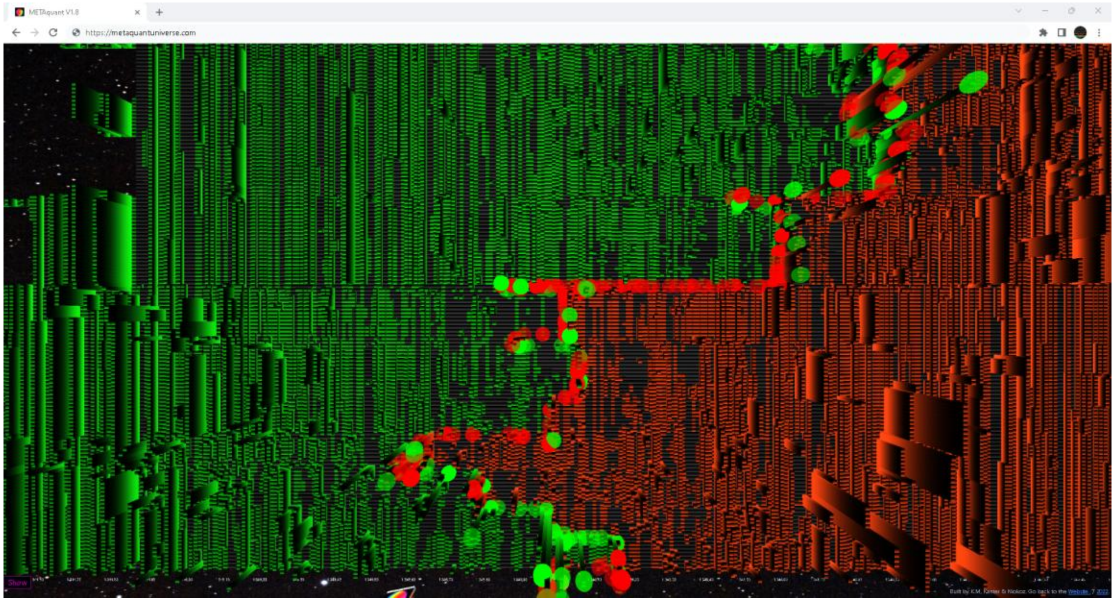
Why does visual representation seem so effective? The explanation is in fact cognitive. The American psychologist Anne Treisman discovered in 1985 that when faced with a graphic representation, the human perceptual system is capable of instantaneous and effortless processing. Better still, whatever the number of elements presented in the graph, the brain can answer questions related to usable information in a very reliable way, even if the graph is only displayed for a fraction of a second.

Anne Treisman explains this feat by the pre-attentive perception capacity of our brain which allows us to identify a large number of visual characteristics instantaneously (color, orientation, lines, ...). Conversely, and always because of this pre-attentive perception, if we are not exposed to an adequate visual representation, the processing time required by the brain to "understand" what it "sees" becomes proportional to the number of objects to be studied. Therefore, it will always take longer to understand data dashboards than a data visualization allowing to fluidify decision support processes.

Graphical representation: 2, symbolic representation: 0.

Top scorer: pre-attentive perception.

Data Visualization: the visual variables model



The choice of visual variables is therefore crucial to use representations that will release the full potential of our brain. Fortunately, research in cognitive psychology has widely explored the relevance of different visual variables according to the nature of the characteristics to be visualized. Jacques Bertin, in particular, has presented a model of visual variables defined according to multiple criteria in order to constitute effective "graphic primitives":

position,

the length,

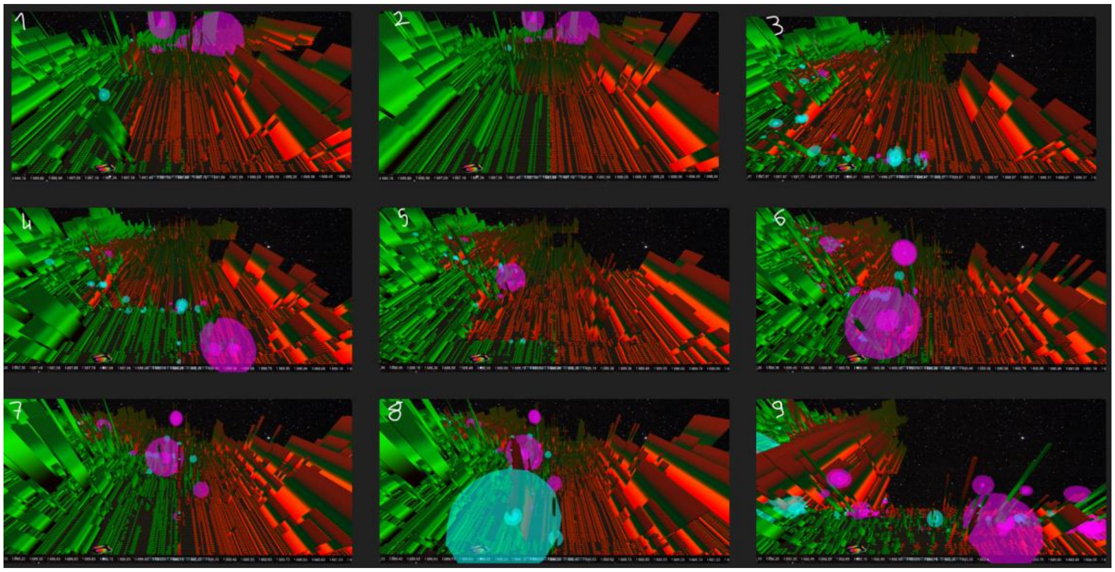
the angle,

the slope,

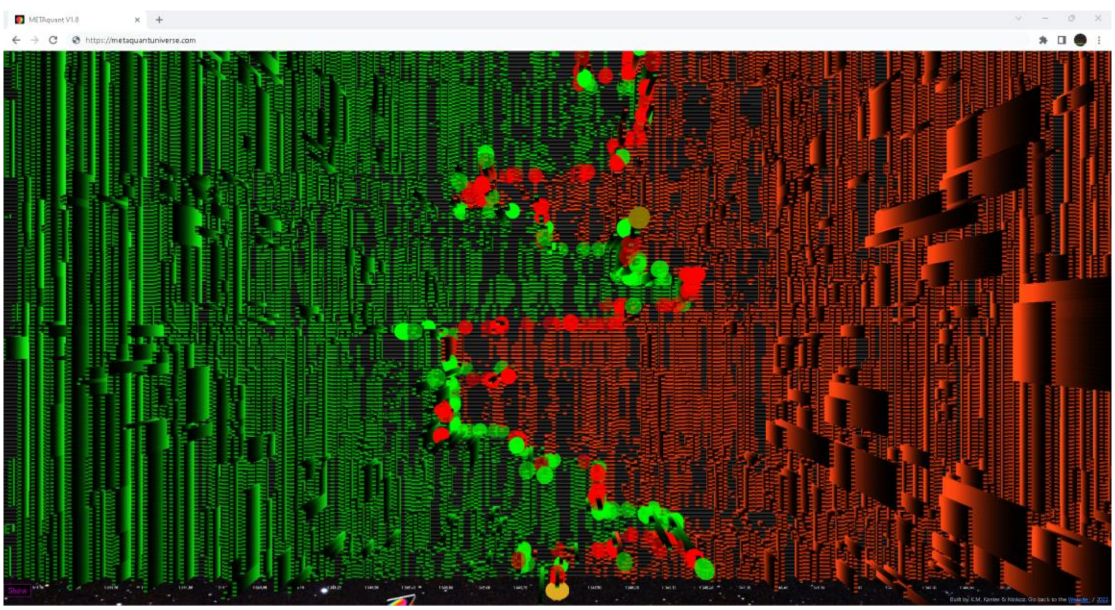
the surface,

shape

and color (itself divided into intensity, saturation and hue)

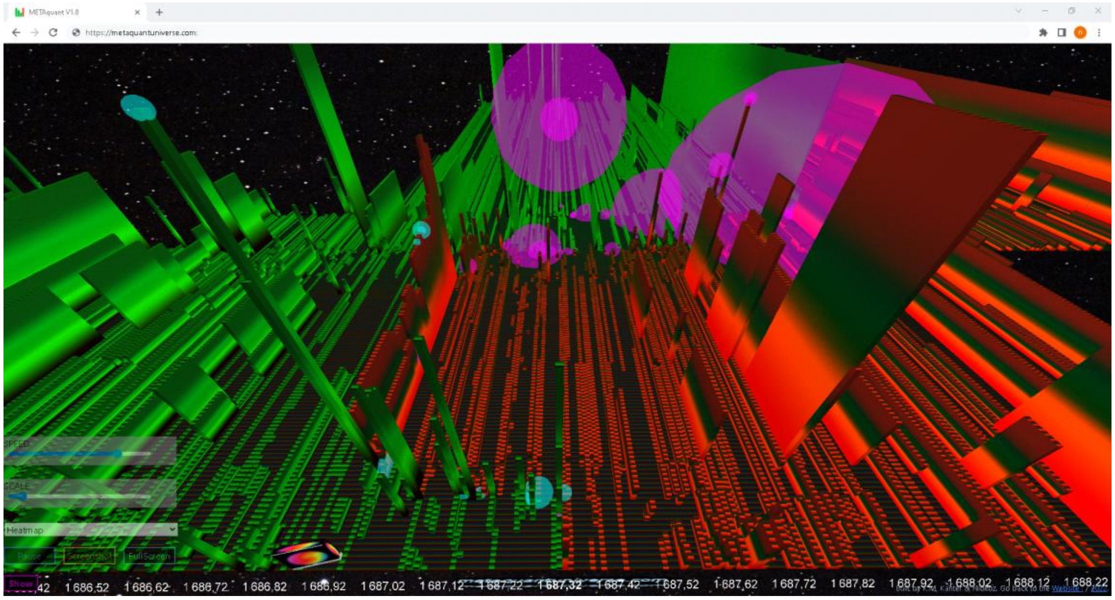


Let's imagine a data table with two inputs: a thousand product references associated with their sales over the year and the average margin rate per product. According to Bertin's system, the most efficient visual representation will be to deal with the quantitative aspect by using the position, thus positioning each product along two axes - the sales and the margin rate of each.



If we want to add a third dimension, such as the most profitable products, we will use an ordinal dimension, such as a color intensity to distinguish products with a high margin from those with an average margin and those with a below average margin.

Let's go further. We might also want to introduce a fourth dimension: product families or categories. Still using Bertin's system, we would then apply different colors to this nominal dimension, with a specific color for each major product family.



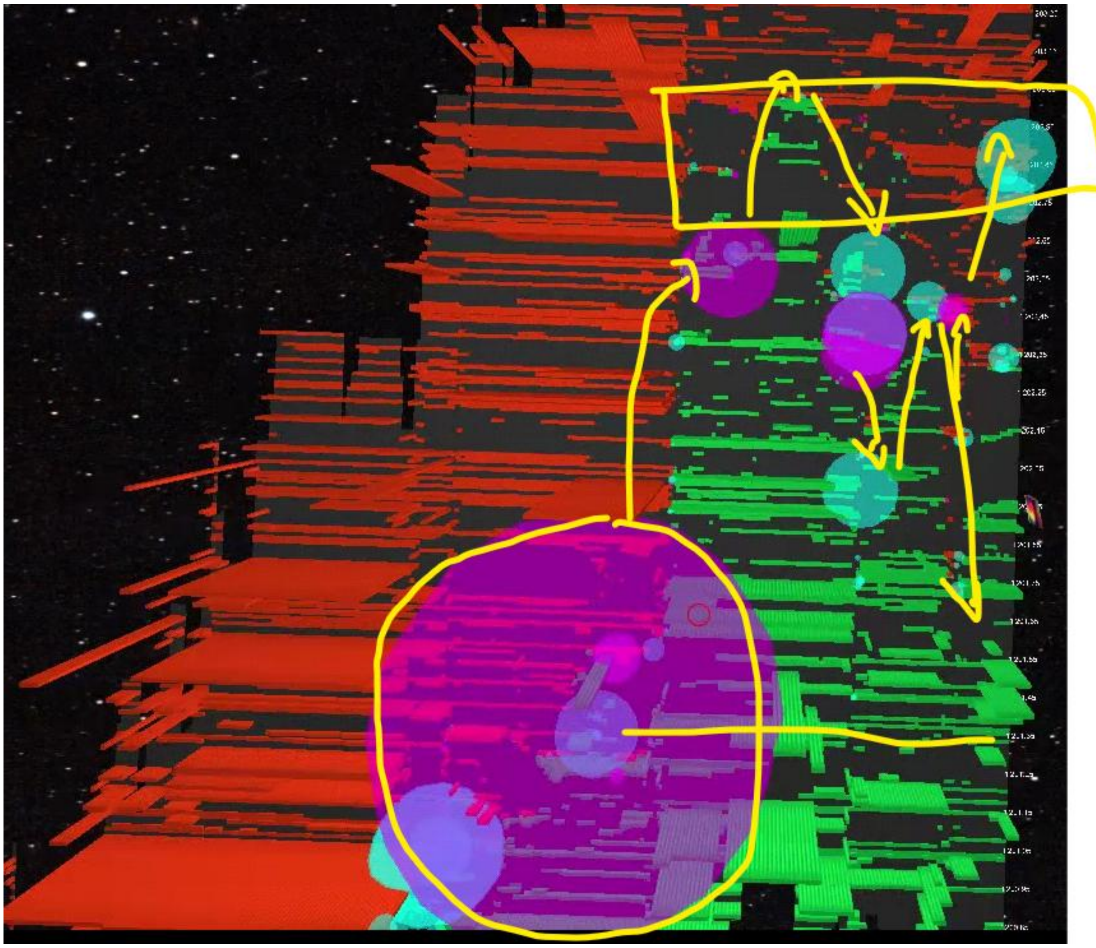
Jacques Bertin's system of visual variables thus makes it possible to introduce several levels of information to graphic representations that are limited to two dimensions.

Graphic representation: 3, symbolic representation: 0.

Best tactician: Jacques Bertin

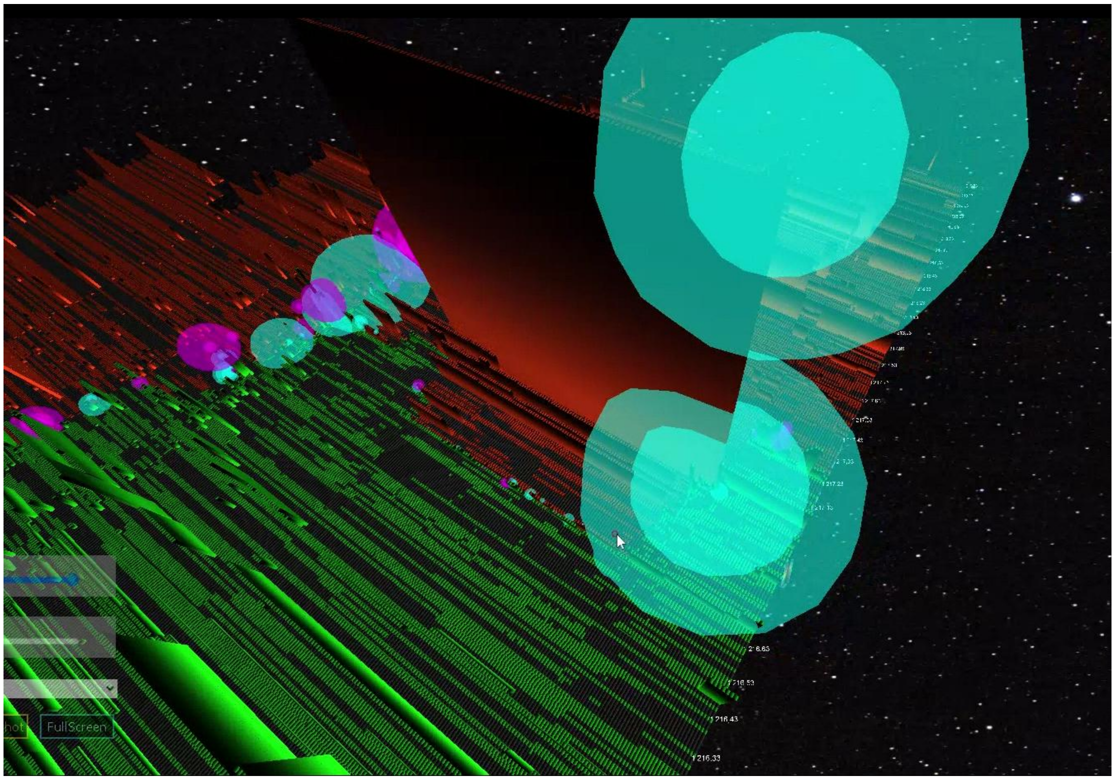
<u>Data Visualization: the need for interaction</u>

The graphical representation of data allows us to understand this data more quickly and efficiently, to draw actionable conclusions and to act accordingly. In this respect, James J. Gibson concluded in 1950 that we must perceive in order to act and act in order to perceive, thus introducing the importance of interaction with graphic information.

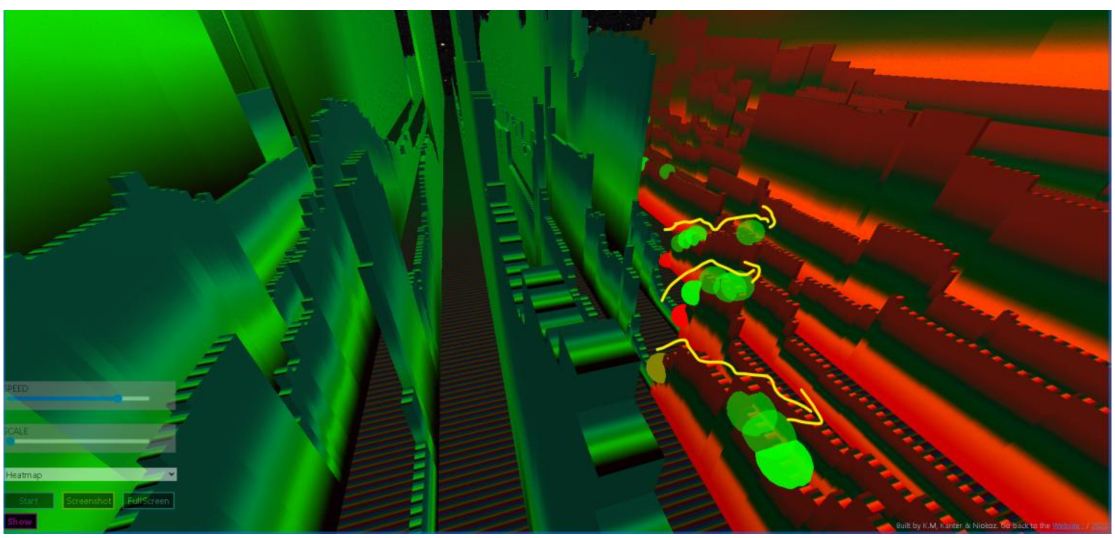


It is physiological: to perceive an object, we move our head around it and if the object is too small we move the object directly. The human brain needs to "see" an object from several angles in order to better understand it. In this logic, if we associate interactions with graphic representations we simply increase the volume of useful information that our brain gets from them. On the other hand, if the eye remains motionless, the retinal image disappears and the volume of information from the image stops.

Interaction with visual representations is all the more necessary because our short-term memory is actually a very limited tool. Humans have several types of memory, including working memory - short-term memory - which we use when we think.



In 1956 George A. Miller established that we can only memorize seven items. When we think, we make a plan of the answers we expect, each answer mobilizing an item. This plan is stored in our working memory and the multiplication of items redefines the plan we have made. Seen from this angle, "being lost" when faced with a complex subject takes on a literal meaning since we are indeed lost in the plan we have built: each new expected answer adds an item to our working memory, which can only contain seven, thus redefining our plan to the point where we no longer know where we are or how we got there.

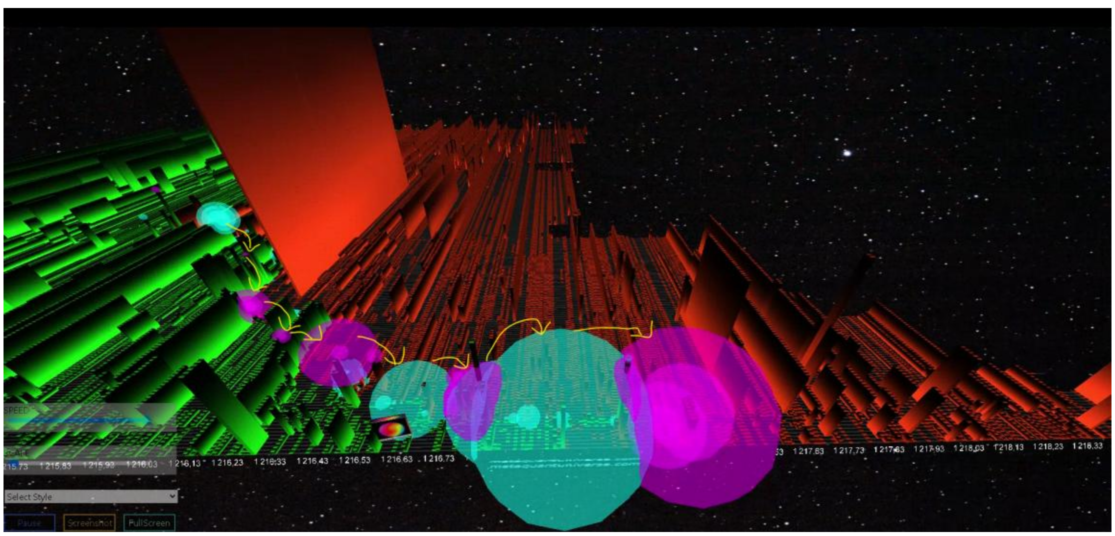


On the other hand, interaction with a graphical data representation does not mobilize an item. We can then build much more complex plans and explore many more alternatives. Coupled with our pre-attentive abilities, interactions then allow us to modify reflection parameters while reading the results at high speed without saturating our short-term memory. This is called a feedback loop, and it is a formidable analytical weapon.

Indeed, these iterative loop sequences allow us to visualize information quickly over very large data spaces to find - sometimes incidentally - information that we were not looking for but that turns out to be useful. In other words, the interaction tamdem + pre-attentive capacity allows us to reveal hidden information.

Graphical representation: 4, symbolic representation: 0

Best attacker: the feedback loop.



What does this insight into how our brain works when exposed to complex data bring us?

First of all, it allows us to understand that graphical representation increases our potential in data processing tenfold.

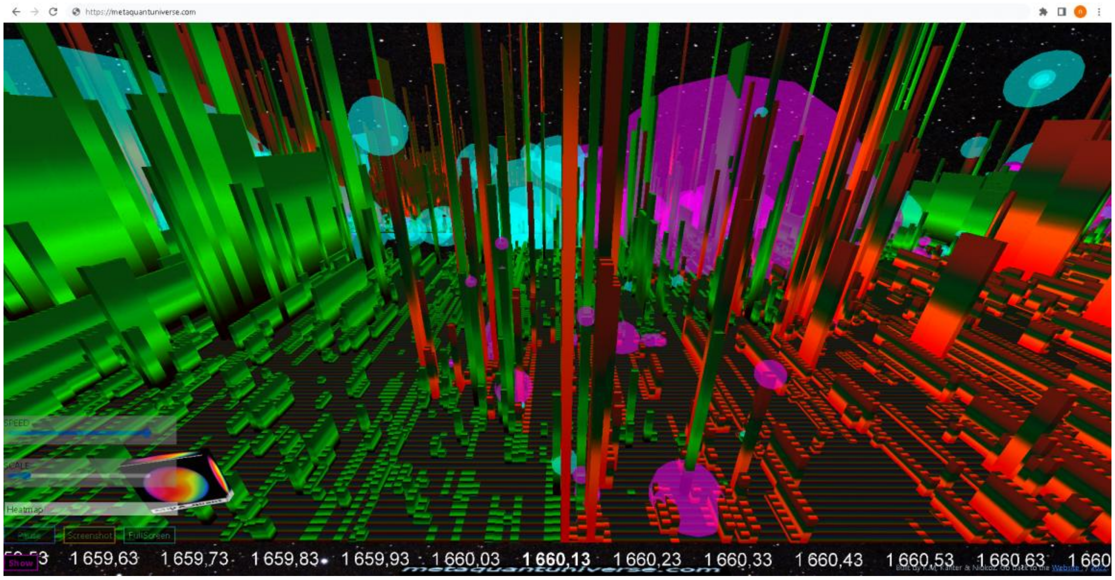
Framed by efficient visual variables, visual representations deliver a more massive and expressive volume of information.

However, our brain remains limited by the capacity of our working memory. Interaction with the graphical representation allows us to overcome this limit by preserving the capacities of our short-term memory while initiating feedback loops that allow us to intuitively reveal hidden information.

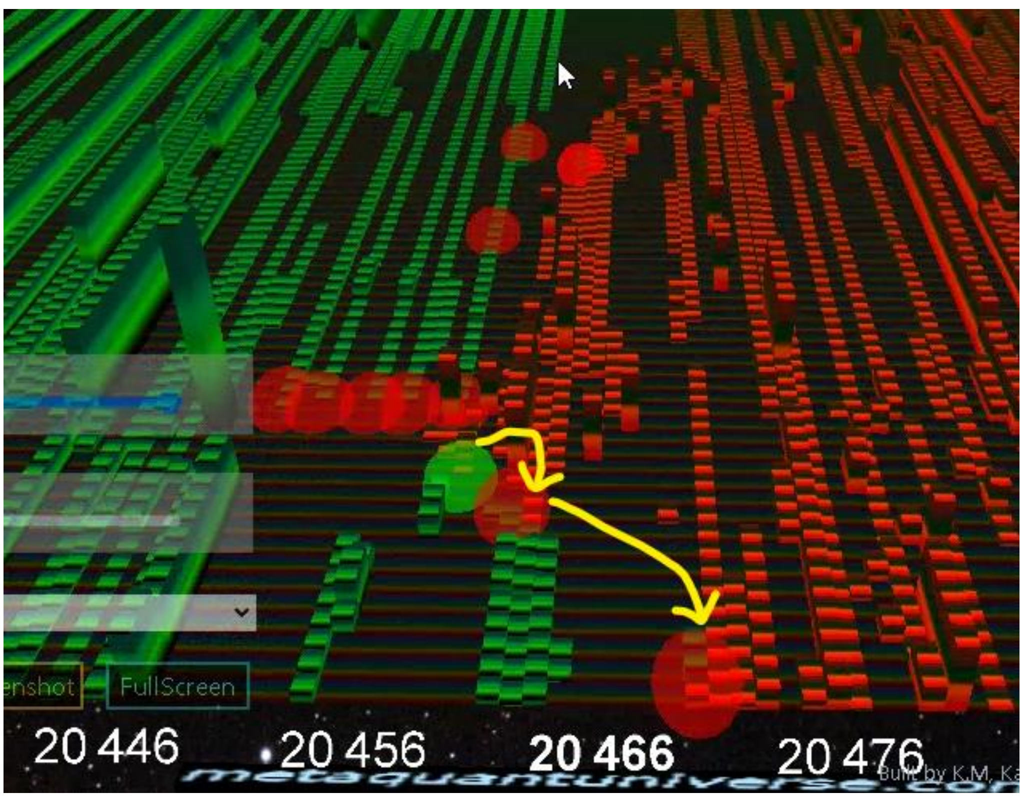
The META_quant, as a solution!

In the century of digital transformation, companies are faced with large volumes of data that obscure the performance indicators that allow organizations to make better decisions for business monitoring.

In this ocean of data, companies must redouble their efforts to analyze the relevant data in their multi-source and multi-format ecosystems. However, these steps are complex and require a lot of data preparation work in order to be able to extract "signals" that will guide your strategic and tactical decisions.



META_quant is a fully automated data visualization solution that accompanies you through all the stages of your trade taking in order to make data exploitation more fluid by grouping together key market indicators in a centralized as well as decentralized universe, to make the visualization and sharing of these signals to all your collaborators and partners more fluid.



In this sense, META_quant is a solution for visualizing market data and order book microstructure, which allows you to optimize your trading decisions in a purely interactive way by navigating inside an order book and a 3D tape that is completely personalized and customizable! The visualization interface is simple, interactive and collaborative and will allow you to optimize your results related to your trading activities!

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